THE DESIGN AND REALIZATION OF A CONTROL SCHEME OF A THREE-SECTION CONVEYOR BELTS USED IN THE FOOD INDUSTRY

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ABSTRACT

In the food industry, tape conveyors are used in grain silos for cereal products transport. Roller conveyors with strips are used for continuous transport of materials. Belt conveyors are used for horizontal or sloping direction towards the horizontal direction with an angle of 5-25°, both of the tasks and the tasks discharged into pieces. In most cases the path which works the transport can be combined, being composed of horizontal areas, sloping areas, joined with curved areas.

Having in view the resistance of bands, the maximum length of the conveyor belt was limited at 250-300 m. If the task needs to be transported on greater distances, it is important to use a transport system consisting of multiple conveyors. These conveyors are powered in series. In the case of inclined conveyors, the rake angle of the strip depending on the properties of tasks, on the friction angle of the material transported by tape, and also on the value of the speed and power of the load.

INTRODUCTION

Power conveyors is made with three-phase induction motors, calculated to work under.

Driving motor power depends on the conveyer productivity, for its construction, lifting height (in the case of bucket conveyors), the distance to be transported, the material and the type of material being transported (Banu C., and collab., 2002; Iordache G., 2004).

Engine power calculation of belt conveyors can be done with the relationship:

$$P = \frac{Q \cdot H}{367} + \sqrt{Q} \cdot 0{,}13(1{,}3 + m) + 0{,}001\sqrt[3]{Q \cdot L} \quad \text{(kW)} \qquad (1)$$

where: Q is the productivity of the conveyor, in t/h;
H – lifting height of the material, in m;
m – number of roller guide of the conveyor;
L - conveyer length, in m.

MATERIAL AND METHODS

When transport are carried at large distances, transports with strips are achieved with 2-3 or more sections, each section being driven by a separate electric motor (Banu C., and collab., 2002)

The command to start of these engines can be made from a centralized point, or at various places.

Whatever the mode of command of electric motors it is necessary that the command scheme to be achieved the control scheme in such a way that the start of different sections to be made from the first to the last section.

This way of working is chosen in order to avoid crowding of material transported in some points and hence its loss on tape.

It is obvious that if start begin from the penultimate section to the last, there would be the possibility that if one of the sections would not start for any reason, the material

from the previous section (which will fall to the anterior portion of the section which did not start) tends of agglomeration to falling on the tape.

To avoid this inconvenience has been designed and realized the corresponding command schemes of electric motors actuators.

Figure 1 shows a command scheme of the conveyor consists of three sections, each section being driven by an electric motor. The command to start of the engines shall be carried out with the help of three homepage buttons P1, P2, P3.

Through the operation of these buttons are closed circuits of coils of electric contactors (L1, L2, L3), which ensuring the coupling of electric motors in the power grid.

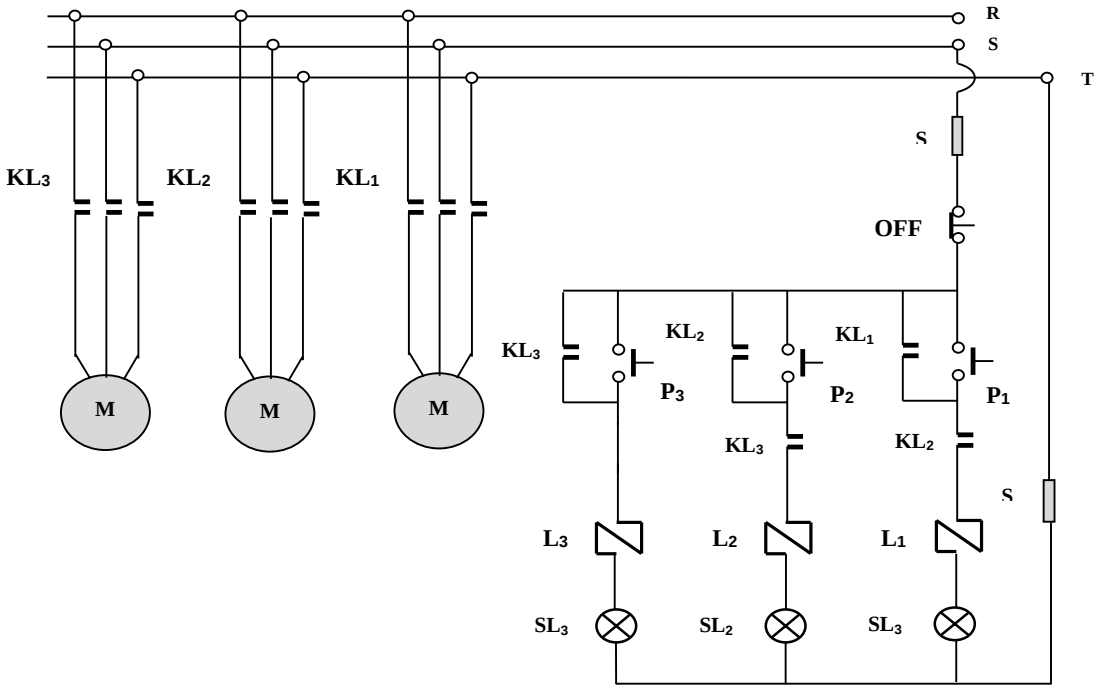

Fig.1. Command scheme of the conveyor consists of three sections.

According to the scheme of the electrical principle, it can be seen that the starting of electric motor M1 (by pressing the power button P1) it is not possible until the closing lock contact KL2 (from the circuit of coil of electric contactor L1). Also contact KL2 cannot be closed unless it is closed contact KL3 (from the circuit of electric contactor L2) (Vlad C. and collab., 2009; Popescu Lizeta, 2008).

In conclusion, the command scheme requires the following sequence of commands:

- pressing power button P3, for the entry into service of the contactor L3 (in preparation for the contactor L2);
- pressing power button P2, for the entry into service of the contactor L2 (in preparation for the contactor L1);
- pressing power button P1, for the entry into service of the contactor L1;

This way of working ensures starting engines in order of M3-M2-M1, any other startinng order can not be possible. Stopping actuation conveyors shall be carried out with the help of a stop button OFF (Bianchi C. and collab., 1976; Fink D., Wayne Beaty, 2006).

Another scheme (used for the same purpose), which uses a single starting button (St) and a stop button (OFF) is shown in figure 2. Operation of the control scheme is similar to the previous one. In this case, the start button P must be kept pressed until the motor M1 is starting (controlled by L1 contactor).

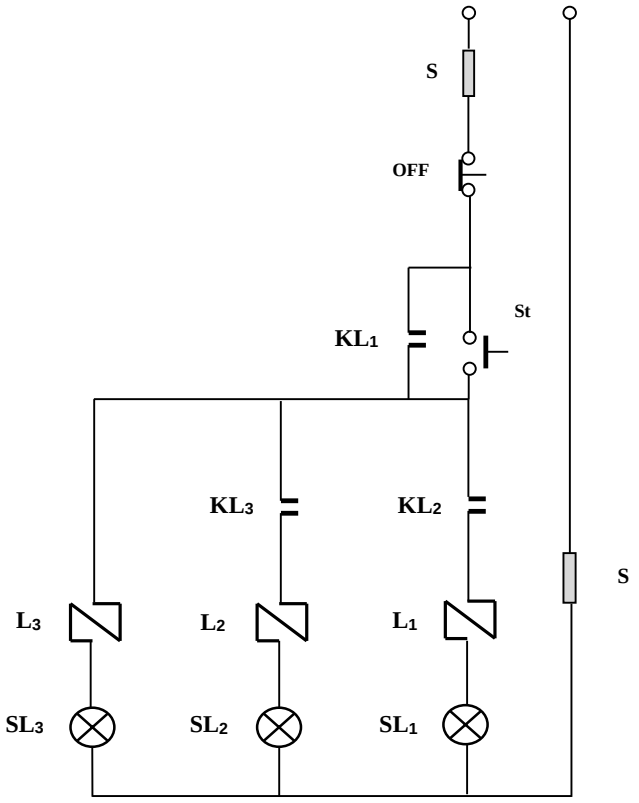

Fig.2. Command scheme used for the same purpose, which uses a single starting button and a stop button.

RESULTS AND DISCUSIONS

To verify the correct operation of the command scheme (to ensure the startup of electric motors in order of M3-M2-M1) there were mounted signal lamps SL1, SL2, SL3. These lamps were mounted on coils circuit of switching contactors from run-down (L1, L2 and L3), to flag closing of the circuit and the power supply to the electric motor controlled by this circuit.

The results of the tests concerning the operation of the control system are shown in table 1.

Also can be designed and achieved command schemes with three buttons, which ensure the stopping of the engines in reverse order of startup (M1-M2-M3). The advantage of stopping electric motors in reverse order of startup consists of the evacuation of all material that is on the tape.

Table 1

Results of the tests concerning the operation of the control system

Stages	Start button position		Signalling lamps status		Status of electric motor	
I	P1	switched off	SL1	OFF	M1	STOP
	P2	switched off	SL2	OFF	M2	STOP
	P3	switched on	SL3	**ON**	M3	**START**
II	P1	switched off	SL1	OFF	M1	STOP
	P2	switched on	SL2	**ON**	M2	**START**
	P3	switched on	SL3	**ON**	M3	**START**
III	P1	switched on	SL1	**ON**	M1	**START**
	P2	switched on	SL2	**ON**	M2	**START**
	P3	switched on	SL3	**ON**	M3	**START**
Startup order M3 –M2 – M1						

CONCLUSIONS

- Having view the fact that in many cases, transport of materials must be done on long distance transport and taking into account the resistance of the tape it is necessary that the transports with strips to be composed of 2-3 or more sections, each section being driven by a separate electric motor;
- in order to avoid crowding of transported material in some points and hence its loss on tape it is necessary that the start of different sections be made from the last to the first section;
- This requirement imposed to design and implementation of a control scheme, to ensure the startup of different sections from last to the first section;
- Checking the work process of the command scheme has indicated that it ensured the starting of electric engines according to established order (M3 –M2 – M1).

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