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THE DESIGN AND REALIZATION OF A CONTROL SCHEME FOR A TRANSPORT SYSTEM WITH TRAILERS USED IN THE FOOD INDUSTRY

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ABSTRACT

Given the diversity of products that need to be transported into the food processing industry, transporting with trailers on narrow rail can be used successfully in case of granular solid materials, or in the form of units (in cold or hot state), and also for the unit tasks.

Transporting with trailers on the narrow track takes the advantage of a security operation, with minimum costs, higher travel speeds (6...8 km/h), as well as of a high reliability. Transport of materials also can be run over longer distances (compared with conveyors or roller) and on combined paths (rectilinear and curvilinear).

Trail transport and can travel also on a system of single rail guides (the trail being designed with a central shaft), thus allowing installation of guides on the nearest wall and eliminating the necessary support systems in the production hall. Downloading the material of conveyance can be done through a funnel located at the bottom of trail transport (with the help of two valves operated by a hydraulic cylinder, or by means of a rotating system).

INTRODUCTION

Having in view that in most cases the trail movement is done manually, by pushing, this paper proposes the implementation of a control scheme used for movement of system of transport in both directions, as well as stopping it in the points indicated. The control scheme has been designed for a system of transport which using a cable.

For electric drive of the system transport can be use an electric motor which operate to a drum that wrap the cable that pulls the transport trail (Banu C., and collab., 2002; Iordache G., 2004).

Calculation the electric power of driving motor is determined based on the daily traffic (T_d) of materials to be transported. This can be determined using the relation:

$$T_d = G \cdot L \cdot T \cdot m \cdot k \text{ (t/km)} \tag{1}$$

where:

G is the carrying capacity of the train of the transport system, in tonnes;
L - length of the route in km;
T - the number of hours of work per day;
m - the number of cycles per hour;
k - parking coefficient.

The number of cycles per hour can be determined with relation:

$$m = \frac{3600}{t_i + t_d + t_s + t_0} \tag{2}$$

where: ti is the loading time of trail transport, in s;
t_d - download time of of trail transport, in s;
t_s - travel time of loaded trails, in s;
t_0 - travel time of the downloaded trails, in s;

The power of the electric corresponds to a operation regiemen with maximum load. If the transport of materials is carried out in several occasions, with varying loads and carrying various materials, then it is necessary to take into account the following: the efforts of the respective displacement, the stopping times for loading and unloading of trolleys. In this case the calculation of the power of the engine is made considering the intermittent regiemen operation.

MATERIAL AND METHODS

Control scheme for moving the train of railroad cars in either direction is indicated in figure 1. This scheme works as follows: the actuators reversible engine acting D drum on which is wrapping the cable that pulls the trolley T, in one sense or another, depending on the sense of rotation of the motor.

Engine startup command is done using two buttons: FB for forward rotation and BB for backward rotation.

- ***moving the trolley in the forward sense***

To do this it is necessary topress the power button FB. In this case, if the switch K_m is closed it will closed the coil circuit of contactor for moving forward, thus: from S-phase, through the stop button SB through startup button FB (which is clicked), through normally closed contact of the contactor for backward rotation B, through the limiter for forward rotation LRF, through coil contactor I, through contacts of thermal protection relays RO, the T-phase (Bianchi C. and collab., 1976).

Being supplied, the coil of contactor F will close its contacts from the statoric circuit of the electric engine and this will begin to rotate in the forward sense. Thus, the engine start to rotate involving drum D, and so moving the trolley in adequate direction. When the trolley has reached the end of its route, he will push the stroke limiter race LRF and the contact will open. This opens the circuit of coil contactor F and the engine will be disconnected from the electric network (the trolley will stop) (Popescu Lizeta, 2008, Vlad C. and collab., 2009).

If in this case press the FB button again, the motor can not start because the stroke limiter stays down (his contact being open, it is not possible to supply the coil contactor F) (Vlad C. and collab., 2009).

- ***moving the trolley in the back sense***

For movement the trolley in the opposite direction it is necessary to press power button BB. In this way it closes the circuit of coil contactor N, the engine will be connected to the electric network with two phases of stator reversed (so will rotate in the opposite direction).

Stopping the trolley at the end of the line can be made through the stroke limiter race LRB, (which operates in the same manner as a stroke limiter LRF). Trolley stop in an intermediate point between the two ends of the line can be done by clicking the stop button SB (regardless of the sense of displacement of the engine and therefore of the trolley) (Fink D., Wayne Beaty, 2006; Popescu Lizeta, 2008).

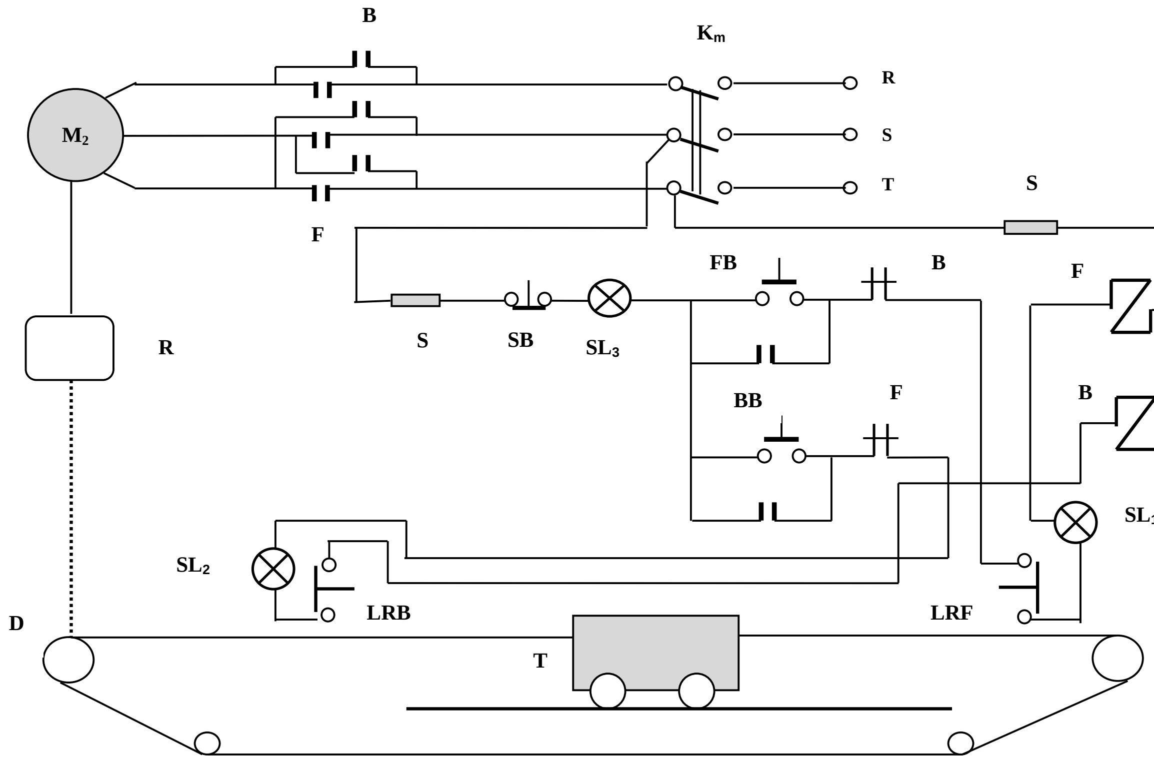

Fig.1. Command scheme of a transporting system with trailers on narrow rail.

RESULTS AND DISCUSIONS

To verify the correct operation of the command scheme (in order to ensure the movement of the trolley in both directions) there were mounted signal lamps SL1, SL2, SL3. The lamps SL1 and SL2 were mounted on the circuit of the stroke limiter race LRF and LRB. Signal lamp SL3 is mounted on the circuit of stopping button SB.

The way of installation of the signalling lamps must confirm the movement of trolley in both directions (signalling lamps will flash as long as the trolley are moving, their extinction, indicating that the trolley has reached the end of the race).

Trolley stop checking in an intermediate point of the line was made using the signaling lamp SL3. Its extinction indicates trolley stop in an intermediate point of the line.

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

Table 1

Results of the tests concerning the operation of the control system

Start button position (SB)	Signalling lamps status			Engine startup command buttons	
	SL1	SL2	SL3	FB (forward sense)	BB (back sense)
moving the trolley in the forward sense					
switched on	ON	OFF	ON	ON	OFF
	End of the race				
	OFF	OFF	ON	ON	OFF
moving the trolley in the back sense					
switched on	OFF	ON	ON	OFF	ON
	End of the race				
	OFF	OFF	ON	OFF	ON
stopping in a intermediate point of the line					
switched off	OFF	OFF	OFF	OFF	OFF

CONCLUSIONS

- Given the diversity of products that need to be transported into the food processing industry and the advanteges ensured by this type of transport systems (security operation, minimum costs, higher travel speeds - 6...8 km/h, high reliability) transporting with trailers on narrow rail can be used successfully in case of granular solid materials, or in the form of units (in cold or hot state), and also for the unit tasks.
- Having in view that in most cases the trail movement is done manually (by pushing), it is necessary to design and implementation of a control scheme used for movement of system of transport in both directions, as well as stopping it in the points indicated. The control scheme has been designed for a system of transport which using a cable.
- Checking the work process of the command scheme has indicated the following:
  - it is ensured the starting of electric engine for the movement in both directions;
  - The stopping of the trolley is achieved in good conditions in the indicated points;
  - The command scheme ensure trolley stop in an intermediate point of the line.

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