The Use of Intelligent Relays for the Sewer Cleaning Vehicle Control and Automation

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***Abstract*—The paper presents the way in which the electrical control and automation system of the 5 mc combined sewer and gully cleaning vehicle equipped by a local company was designed, using the intelligent relay of the easy 700 type of Moeller (Eaton) company. The control of all the equipments is performed locally from the control panel and some of them can also by remote controlled by means of the radio waves. The program required by the intelligent relay was created, tested and implemented with the help of the dedicated software easy-soft 6, developed by the manufacturing company.**

I. INTRODUCTION

Nowadays, the use of intelligent relays and of programmable devices in industry is a more and more important requirement, given the advantages they bring about. Here are some of the most remarkable: increased operating safety, reduced costs and less space required for the equipment used for the control and automation of certain a industrial process, increased flexibility and, last but not least, an easier maintenance.

In the auto field, the use of intelligent relays and/or of the programmable logic controllers (PLC) is required for the equipment of the trucks meant to perform special activities, especially because of the limitations regarding the space dedicated to different equipments.

The electrical installation has been designed in order to control and automate the operation of the equipments that are going to be used on a truck shell that will be in fact a gully emptier. This is the reason for which the nominal voltage of all the equipments involved, which do not have their own power supply, is 24V cc.

The electrical installation that is described in the present paper only refers to the specific part that provides the power supply of the intelligent relay EASY719-DC-RC and of its extension EASY618-DC-RC, to the connections input/output and to the connections of the receiver to the radio waves remote control.

The program that has to be uploaded in the memory of the intelligent relay in order to ensure the proper operation of the equipment is also depicted.

The devices that are to be electrically-controlled are the following:

- the controlling electrovalve of the circuit that operates the vacuum/pressure pump;
- the absorption/delivery switching electrovalve;
- the controlling electrovalve of the operation of the high pressure pump(HPP);
- the controlling electrovalve of the operation of the compressor;
-the electrovalve of the mud compartment closing-opening
-the electrovalve operating the 1" valve;
-the electrovalve operating the ½" valve;
-pressure regulating electrovalve (PN3);
-absorption arm (Jurop I) electrovalves;
- washing arm (Jurop II) electrovalves;
-motor driving the ventilator for cooling the water of the auxiliary tank;
-the motor driving the auxiliary tank water circulation pump;

II. THE INSTALATION DESIGN AND THE CREATION OF THE PROGRAM

A. The Control and Automation Logic

The first pump that creates vacuum or pressure, has to be controlled (switched on and off) from the control panel placed in the rear part of the gully emptier. If the general emergency button is pressed, the pump will also be switched off. The creation of vacuum and pressure, respectively, is achieved by operating an electrovalve that switches the pump from absorption (vacuum is thus created) to delivery (pressure is created). The operation of the electrovalve is also performed from the control panel.

When the pump produces vacuum, if the pressure of the system decreases under a minimum level, a visual signal will alert it.

As the water in the vacuum pump tank must not exceed a maximum temperature, once the vacuum pump starts working another pump must start working, that will recirculate the tank water through a cooling radiator, as well as the ventilator that ensures the radiator cooling.

In order to operate the vacuum pump, it is compulsory that the air pressure in the compressed air system of the truck, should be higher than a minimum value, otherwise a visual signal on the control panel will indicate that this condition is not met.

The absorption compartment shuts automatically at the level of the absorption arm, by operating an electrovalve.

The mud compartment is washed automatically by a washing head that is supplied with water from a high pressure pump. The washing command is given to an electro valve operating a ½" valve and is conditioned by the high pressure pump operation at the moment when the command is given.

The hose connected to the washing circuit is hydraulically separated by means of a 1" valve, also operated by the control of another electro valve.

The 1" valve must always be closed, in order to let open the ½" valve, a temporization of the latter being also necessary. The 1" valve opening is delayed until the 1" valve shuts.

The high pressure pump is used for the inner tank self-washing, and the pressure can be set (increase/decrease) by means of a regulator (PN3) controlled by a bistable two solenoid - electrovalve. The pressure regulator control is possible both from the control panel and the remote control.

The high pressure pump control is performed by a monostable, normally closed electro valve, from the control panel and the pump can also be turned off by means of the remote control.

The water from the pump tank must be heated during winter time and the control for heating is performed manually from the control panel. The warm water circulation in the washing installation is performed by a pump (called heating pump) that is electrically supplied at 24V c.c and manually controlled from the control panel.

For deep absorption situations a compressor is used and it is controlled by means of an electrovalve operated from the control panel.

The absorption hose is supported by an arm (Jurop I) that requires certain controls in order to be able to perform the following operations: the hose unwrapping/wrapping on the drum, extension and retraction of the telescopic arm as well as its right/left rotation. All these controls are available both on the control panel and the remote control.

The arm supporting the washing hose (Jurop II) is similar to the above mentioned arm, excepting the lack of the extension/retraction movements. Likewise, the controls are available both on the control panel and the remote control.

The programming of the remote control buttons is as follows:

The mushroom button – remote control activation (when it is released) and emergency shut down (when it is pressed);

The buttons: K1 – Drum hose wrapping; K2 – Drum hose unwrapping; K3 – Absoption hose arm retraction; K4 – Absorption hose arm advance; K5 – Absorption hose right movement; K6 – Absorption hose left movement; K10 – High Pressure Pump Stop; K17 – Left movement washing hose arm; K21 – Right movement washing hose arm; K19 – HPP pressure decrease (it is performed by left rotation of the switch); K20 – HPP pressure inecrease (it is performed by right rotation of the switch); K23 – Drum washing hose wrapping; K24 – Drum washing hose unwrapping.

The other available remote control buttons that are not mentioned, have not been assigned any role.

B. The input/output connections of the easy relays and of the receiver

The electrical diagram of the EASY719-DC-RC relay input connections and of its extension is displayed in fig.2, the figure 3 displays their output and they are both shown in Table 1.

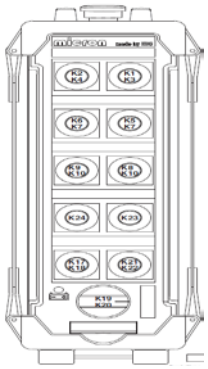

Figure 1. Radio wave remote control

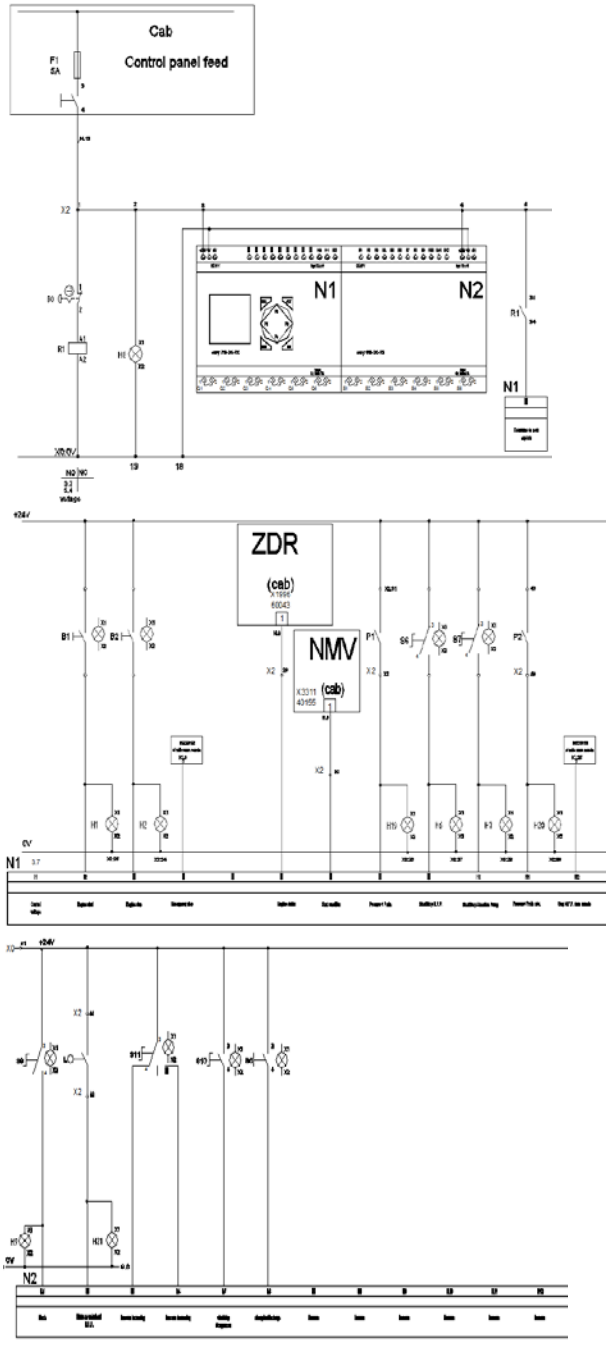

Figure 2. Input connections of Easy relays

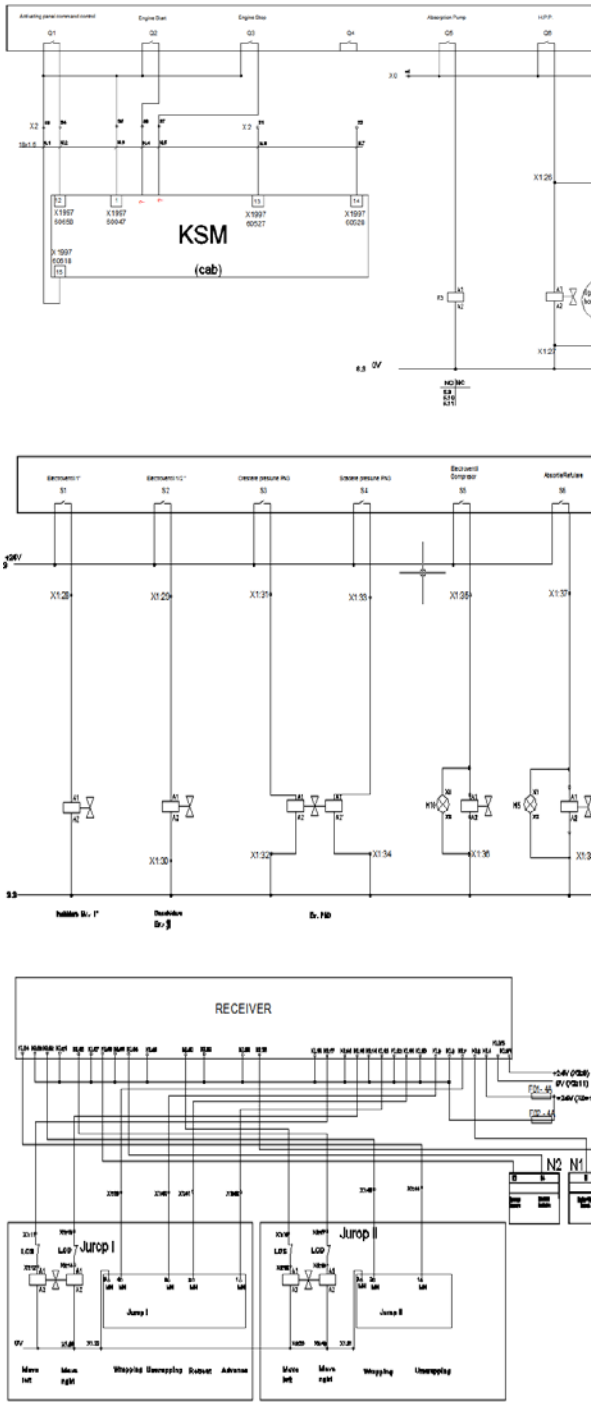

Figure 3. Output connections of relays and receiver

C. Easy relay program

The program required by the intelligent relay has been created and tested by means of the easy soft 6 software.

For security reasons, the program has been conceived as to allow automatic stopping of a device, if necessary (even if there is no stop instruction);

When the event that has caused the stopping is eliminated the device will remain in stand-by mode until a new start command is given.

The code of this program is shown in Figure 4.

Table 1 Ties inputs/outputs of easy relays

Nr. crt.	Input	Outpu	PLC den./simb	DESTINATION
1	I1		EASY 719-DC-RC / N1	Voltage command
2	I2			Engine start
3	I3			Engine stop
4	I4			Emergency Stop from remote
5	I5			
6	I6			D+ (Engine status)
7	I7			Start condition (NMV-cab)
8	I8			Pressure sensor (P<Pmin command)
9	I9			Start/Stop H.P.P.
10	I10			Start/Stop absorption pump
11	I11			Pressure sensor (P< Pmin absorption)
12	I12			Stop H.P.P. from remote
13	R1		EASY 618-DC-RE/ N2	Start/Stop washing
14	R2			Minimum water level sensor (H.P.P.)
15	R3			Pressure increasing H.P.P.
16	R4			Pressure decreasing H.P.P.
17	R5			Start / stop Compressor
18	R6			Absorption/Discharge
19	R7			rezerva
20	R8			rezerva
21	R9			rezerva
22	R10			rezerva
23	R11			rezerva
24	R12			rezerva
25		Q1	EASY 719-DC-RC / N	Activating panel command control
26		Q2		Engine start (KSM)
27		Q3		Engine stop (KSM)
28		Q4		
29		Q5		Absorption pump relay
30		Q6		Start/Stop H.P.P.
31		S1	EASY 618-DC-RE/ N	close Ev. 1"
32		S2		Close Ev.1/2"
33		S3		Pressure increasing H.P.P.
34		S4		Pressure decreasing H.P.P.
35		S5		Start/Stop Compressor
36		S6		Absorption/Discharge

III. CONCLUSIONS

It is worth mentioning that the automations that involve a great number of contactors, sensors as well as multiple controls require the use of intelligent relays or PLC's.

Beside the advantages mentioned in Chapter I, it is also important to emphasize the possibility of testing, in the design stage, of the programming and functioning logic, of using some incorporated facilities such as timers, counters etc. , as well as the possibility of reprogramming when necessary.

Other useful features are the possibility of using a large number of functions (contactor, current impulse, set, reset, negated contactor etc.) and contact types (N.O, N.C), which are all very helpful for creating complex programs according to special requirements.

Moreover, it is to be noticed that meeting increased requirements does not imply increased costs for the equipment and at the same time the operation safety is higher, given the reduced necessary space and resulting in much more compact structures.

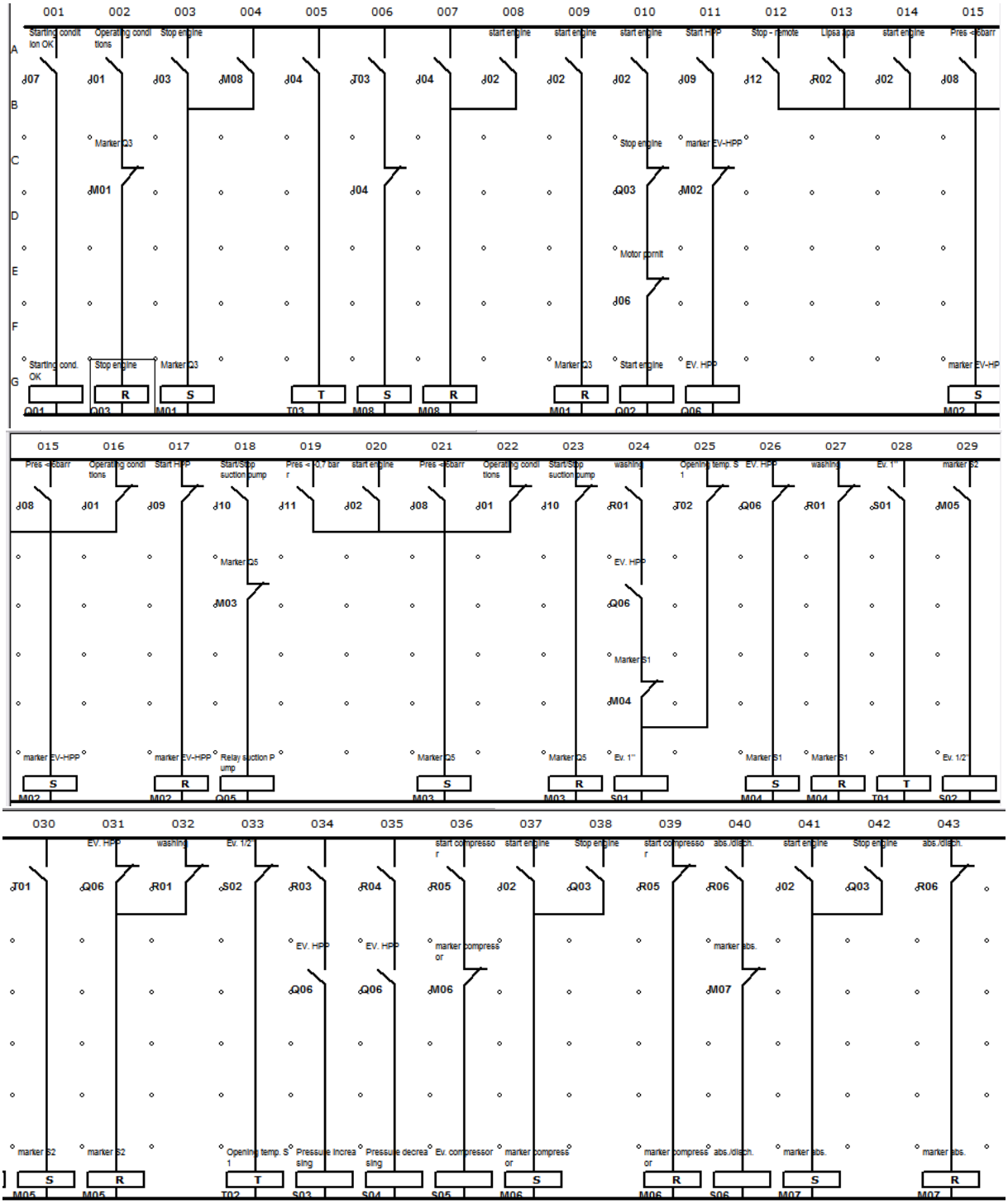

Figure 4. Program code

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