SIMPLIFIED SIGNAL LIGHT CIRCUIT - THE BLUE WAY

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Rezumat. *Aplicaţia practică doreşte să simplifice sistemul de semnalizare al autovehiculelor rutiere şi în special al remorcilor ataşate acestora. Se urmăreşte descongestionarea firelor de sub bordul autovehiculelor şi suprimarea curenţilor mari din sistemul de semnalizare, astfel evitându-se pericolul de incendiu prin scurt-circuit electric. Pentru funcţionarea sistemului se folosesc doar trei fire de legătură, polul pozitiv, negativ (masă) şi un fir foarte subţire de comandă şi răspuns. Acest sistem este unic până în acest moment din punct de vedere conceptual şi nu este încă implementat pe nici un autovehicul.*

Abstract. *This practical application seeks to simplify the signalling system of road vehicles and especially of the attached trailers. It is intended to decongest the wires from the dashboard and within the vehicle and to suppress the high voltages currents in the signalling system, thus avoiding the risk of electric short circuit fire. For system operation only three bonding wires are used: a positive pole, a negative one and very thin wire of command and response. This system is unique from the conceptual point of view and has not been met on any vehicle.*

Keywords: Serial-encoder, PWM, Signalization, Inter-Integrated Circuit.

Introduction

The electric cable harness of vehicles has undergone little change for a long time. There hasn't been a major change in the vehicle electric cable harness since the end of World War II. This study tries to simplify the signal light circuit of vehicles and of trailer towed by them in particular. This could also engage other components, such as the windscreen wipers, the windscreen-washer motor, the turn-signals wipers, the acoustic warning signs, the car side window lifters, the rear window defroster. This system would also involve a response of executing the command which would be signalled on the dashboard for the driver to be aware of it. This suggested method could be used for commanding all the dashboard indicators of vehicles and trailers with no limits. The application has been designed for the auto field. It was first used on a boat trailer but it can be used in any field. This can be achieved through a three-electric wire command, the

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same for signal lights and for their response of well functioning - one way from the vehicle dashboard to the signal lights and their execution and the other way from the latter to the dashboard. This study suggests the simplification of the vehicle cable harness, which could be done mainly by two wires only, as the third is the vehicle electric mass itself, which significantly decreases the intensity of the electric current in the dashboard, thus eliminating the danger of fire by a short circuit. The present-day signal light circuit and command in use is done by engaging at least one wire for each command that is switched-on by the driver, leading to a bundle of 25 or 30 connected wires. When hooking up a trailer, 7 or more recently 13 wires are used. See Fig. 1.

Fig. 1: Plugs
A plug for 7 pin out; B plug for 13 pin out; C new plug 3 pin out.

With the suggested method only three wires are involved, a positive pole which would supply the power to the consumers, a negative pole which is the car body shell and only one wire for command and response. This wire starts from the dashboard and goes to each and every consumer.

The positive pole also reaches the consumer. For this simplification, a serial coding and decoding of the electric command signal has been the option. The present-day method involves a high number of wires, which means a lot of labour and a lot of copper. See Figures 2 and 3.

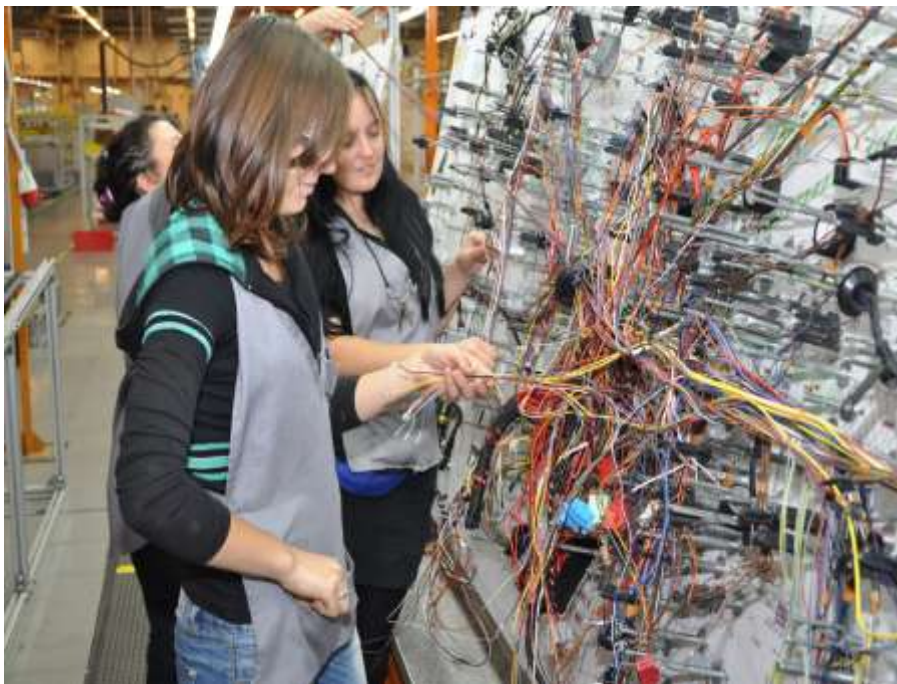**Fig. 2:** Unassembled vehicle cable harness [6]

Fig. 3: Manual labour for assembling the cable harness [7]

The proposed system description

This study suggests focusing not on the commands of signalling and using of another service (windscreen wipers or ascending/ descending of the lights), but on the spot where commands are carried out.

From the driver's seat, all commands would be multiplexed (serially coded), only one wire of 5-10 milliamperes being involved. Some signal components that operate according to the method suggested can be seen in the functional mock-up. The signal command switchers and the signal command receivers that execute the tasks can be seen here. There is only one electrical wire that starts from the dashboard and goes to each consumer that has been engaged. At the same time, the positive pole also gets to the consumer. For this simplification of the system, the option has been a serial coding and decoding of the signal. A well-known serial coding/decoding Inter-Integrated Circuit could have been used but this involves using four connected electrical wires and, together with the seven existing wires, it would not have meant a significant simplification of the system. Moreover a logical encoding would have been used, which could have led to the system failure, a problem that can be fixed only by resetting the microprocessor, and the work speed would be lower, causing a significant diminution of possible commands. A hybrid, analogical and logical solution has been opted for. A process of serial encoding and decoding with modulation signals during the impulse has been developed.
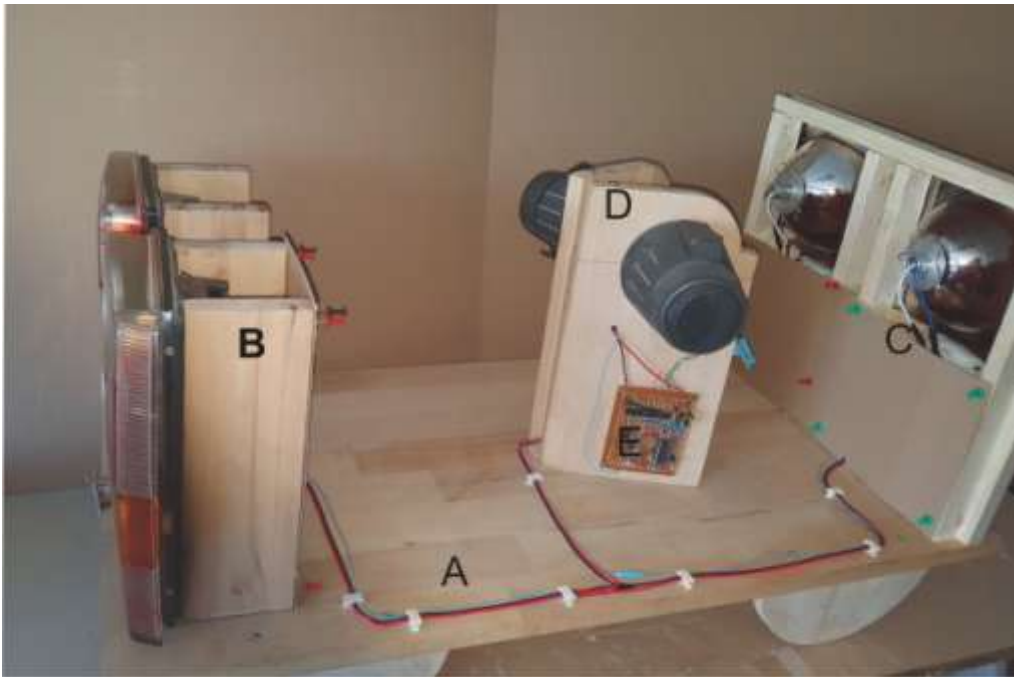

Fig. 4: Functional mock-up view
A electric wiring 3 wires; B, C decoder with block of lights; D block of commands E encoder.

This is called PWM (Pulse Width Modulation), which is a current technique to fluctuate the tension in a device in a time depending controlled manner. A signal

of a certain duration is assigned to every dashboard command, a longer or shorter duration, depending on the switcher position, on or off, even when this is not being used. Variable commands can also be approached, commands such as the ascending/descending of the lights. All the dashboard command signals form a series of impulses with PWM signals. In Figure 4 is presented the functional mock-up with 6 commands: left signal, right signal, position, low beam, fog lamp, reverse lamp

There are several advantages in using this method:
- the simplification of the vehicle cable harness, which involves less labour and less material
- the decrease in the current intensity that goes through the dashboard, the risk of fire being reduced
- the vehicle dashboard simplification and less labour required for fitting, troubleshooting and maintenance
- less wiring when towing the trailer and safer functioning
- the use of the same circuit both ways on the same wires, from the dashboard to the consumers and from the consumers to the dashboard. A real-time update of their status can be shown on the dashboard

Figure 5 presents a schematic layout of the encoder and decoder for the light unit configuration.
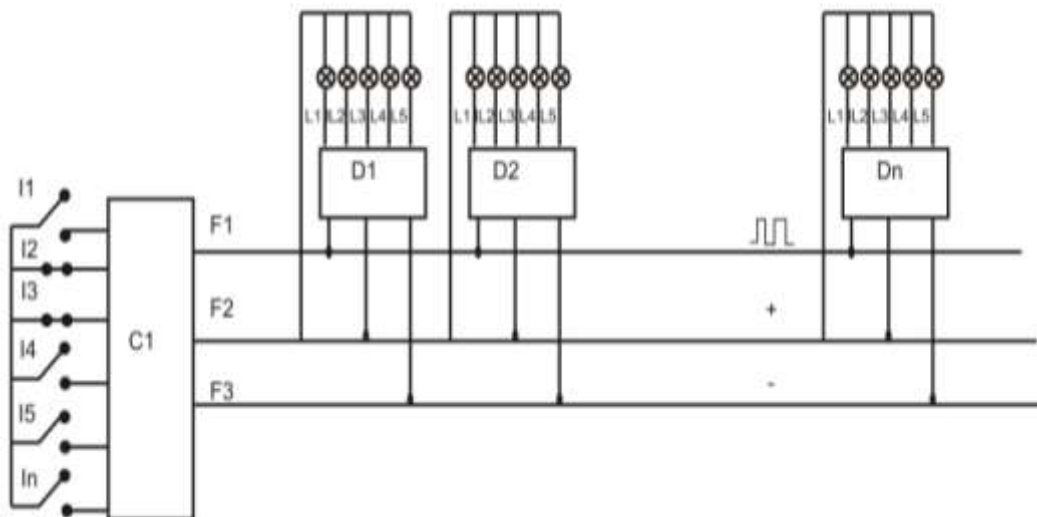

Fig. 5: Schematic layout of the encoder and decoder

As it can be seen, the unit being simplified to a few signal lights but virtually hundreds of contacts could be installed. The light unit with the decoder, D_1, D_2... D_n represents the front or rear light units or other service consumers, the windscreen wipers, the water pump for the windscreen washer tank, the back window motor, etc. As the solution suggested, the simplified signal circuit is made up of a command block (Fig. 5) and consists of: I1, I2, I3, I4, I5... In, the status of which is encoded by the C1 encoder in a wave train PWM, involving a signal for each command.

Conclusions

The suggested system for 6 commands on one way is implemented on the functional mock-up. This system functions with no errors. The way it is put into practice may not be the best one and some execution errors may occur, but for a first demonstration and checking, it is sufficient. The aim is to go on with the research so that the application could be really put into practice. A Romanian Mija 12 D tractor which tows a trailer would be used to implement the whole system, on both ways.

Putting this research into practice could be a revolution in all the factory departments, such as the electric wire harness modification, the trailer electrical plug simplification, the robotised changing and making of the light units. All these would lead to an electrical cable harness simplification, less manual labour, easy troubleshooting and maintenance.

Acknowledgement

Abbreviations
Pulse-width modulation (**PWM**), or pulse-duration modulation (**PDM**), is a modulation technique used to encode a message into a pulsing signal.

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