Climate control in road-building machinery

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Abstract. Climate control is an advanced air conditioning system that allows controlling the temperature in the machinery cabin more effectively in any weather conditions. Today, almost all new road-building machinery is equipped with this system. This system allows adapting the temperature in the cabin according to your needs more effectively. Climate control allows controlling the climate in the cabin regardless of the weather conditions outside the machine. Climate control works just like home air conditioners, thanks to the automatic control of the heating, ventilation and air conditioning systems. With the help of electronics, the temperature is automatically maintained at the level set by the driver. This system is necessary not only to maintain a stable temperature in the cab, but also to maintain the efficiency and concentration of the driver. However, there is no air conditioning system in the old road construction machines. In the Republic of Sakha (Yakutia) the material and technological foundations in many road enterprises are outdated for now. And in order to keep the driver operating and protect his health, this article discusses the possibility to equip road-building machinery with climate control. THE Volvo BL61B forklift was chosen as an example. This machine initially lacked a climate control system, but thanks to a temperature control device, it was possible to achieve the optimum temperature in the cabin.

1. Introduction

The health of the driver is an important factor that determines his readiness to control a car, which ultimately affects traffic safety. A person feels comfortable if certain ambient temperature is reached. “Climate in the car” directly affects the driver’s condition, the safe driving of a car, and overall road safety.

Comfortable temperature in the car is determined by the outdoor ambient temperature and the amount of air exchange in the cabin:

- at low outdoor temperatures, e.g. -20 °C
  high cabin temperature 28°C
  high air exchange 8 kg / min.

- at high outdoor temperatures, e.g. 40°C
  moderate cabin temperature 23°C
  high air exchange 10kg / min.

- at moderate outdoor temperatures, e.g. 10°C
  moderate cabin temperature 21.5°C law air exchange 4kg/min.

Scientific studies conducted by the World Health Organization have shown that the degree of concentration and rapid reaction of a driver under adverse stress on his body are significantly reduced.
Such an unfavorable factor is heat. For the driver to feel comfortable, the ambient temperature in the cabin of the car should lie in the range from 20 to 22 °C. [5,6]

This problem is most urgent for drivers of road-building equipment, as the enterprises of the road industry often operate the equipment manufactured at a time when they did not focus on the air conditioning system. Driver's health and traffic safety are fundamental to any industrial work. The construction season, almost in any city of Russia, falls on the summer period and therefore the system for maintaining a favorable temperature in the driver’s cabin is an important component. This article shows the possibility of installing a climate control system in road construction equipment of the old model, but operated in many road enterprises of the Republic of Sakha (Yakutia).

2. Results and Discussion

STC-1000 is a ready-made device with two relays, one for cooling and heating. One of the advantages of the thermostat is the calibration and programming of the temperature received from the sensor. Intelligent control digital thermostat controls the temperature of cooling, heating, automatic STC-1000 temperature controller products, refrigeration, heating is automatically converted, using temperature hysteresis. It is a cost-effective, versatile product. Table 1 shows the technical characteristics of the thermostat. [7-9]

| Characteristics of the STC-1000 |
|-------------------------------|
| Type of thermostat | electronic |
| Supply voltage | 220 V |
| Method of installation | embeddable |
| Load switching | relay |
| Minimum temperature | -50°C |
| Maximum temperature | 100°C |
| Maximum power | 2.2 kW |
| Hysteresis | 1-30°C |
| The division value of the thermostat | 0.1°C |
| The accuracy of the thermostat | 1°C |
| Calibration | Is available |
| Controlled minimum temperature | -50°C |
| Controlled minimum temperature | 100°C |
| On delay | Is available |
| Type of thermostat | electronic |
| Supply voltage | 220 V |
| Method of installation | embeddable |

This STC-1000 thermostat was set in the VOLVO BL61B excavator loader (figure 1).
Connect the temperature sensor to the power supply of the excavator loader, the air conditioner and the heating system, using tape and a flat screwdriver, as close as possible to the driver (figure 2).

After connecting the temperature sensor, measure the temperature in the cabin (figure 3). Next, adjust the controller in the cab of the excavator loader by connecting to the air conditioner and heating system.
The display of the STC-1000 thermostat shows two modes of operation: heating and cooling. There are four control buttons: turn on / off, enter programming mode (S) and two up and down arrows. Turn on and off by holding the power button for at least 3 seconds. After the first switch on the thermostat shows the temperature of the medium in which the sensor is located.

To view the temperature that the controller is programmed to maintain, press "up" (Can be set in the range from -50 to 99.9 degrees with an accuracy of one-tenth. The default of 10.0 Sec).

Pressing the down arrow displays the hysteresis that the controller is configured for (It can be set from 0.3 to 10 degrees to the nearest tenth. In factory settings 0.5 degrees).

To enter the programming mode, press and hold the S button for at least 3 seconds, F1 will appear on the display.

Press the S button and hold. The set temperature is displayed. Without releasing the button S arrows "up" or "down" set the required temperature.

Release the S button and press the up arrow. The display shows F2. Press the S button and the display will show the set temperature delta. Hold down the S arrow "up" and "down" set the required Delta.

Release the S button and press the up arrow. The display shows F3. Press the S button and the display will show the delay to turn on (default 3 minutes, the range of available values from 1 to 10 minutes). Release the S button and press the up arrow. The display shows F4. Here you can set the sensor calibration value. (Values range from -10 to +10°C in 0.1 increments. The default value is 0).

To exit the programming mode while saving the settings, press the on/off button briefly.

If you need to exit without saving the settings, the controller will automatically enter the operating mode if you do not press the buttons for 30 seconds.

If the display shows Er (error), then press any button and hold until the controller reboots. After that, all settings will be reset to the factory settings. [10]

Like any technical system, climate control has its advantages and disadvantages. Advantages of such a system are:

➢ in providing comfortable conditions for staying in the cabin of vehicles for driving;
➢ automatic operation reset;
➢ in a large number of regulated parameters;
➢ in minimizing the participation of a human in the work of the system;
➢ in a simple, convenient and intuitive interface that provides quick learning how to work with the system.

The disadvantages of climate control are:

➢ high cost of maintenance and repair;
➢ increased consumption of fuel in case of running the system
➢ self-repair of climate control is not possible. [11], [12]

However, despite the fact that there are some disadvantages, machines equipped with a climate control system increases the comfort of the driver.

3. Conclusion

During the construction of roads, drivers of road vehicles constantly expose their lives to the risk of harmful vapors and gases of asphalt aerosols, increased dust, ionizing radiation, temperature fluctuations, various aspirator diseases, microorganisms and many other negative factors [13].

The climate control system allows the driver to create a comfortable atmosphere in the cab for work.

This article has shown the possibility of setting the SCT-1000 thermostat in the VOLVO BL61B excavator loader to improve the climate control in the cabin.

This system creates comfort for the driver, and secondly, minimizes participation in operating the system.
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