



Structure Design of a Forest Embers Clearing Car

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Abstract: Once the forest fire occurs, it will cause great harm. At the same time, the occurrence of fire is sudden and unscheduled. After a forest fire, there are many scattered embers left on the forest floor, which are likely to reignite. In this paper, the structure of the forest embers detection robot is studied. The robot adopts the crawler mobile mode, which is mainly composed of mobile platform, detection sensor and fire extinguishing device, and it provides technical equipment support for the detection of forest embers.

Keywords: Forest, ember, clear, sensor, Crawler.

1. Introduction

Forest is an important natural resource for human beings. Forest fires are very sudden and do great harm to the forest. After a forest fire, there will be residual embers on the forest floor and dead wood, which will easily form secondary combustion and further expand the fire scope. How to effectively solve the problem of embers clearing is very important [1-2].

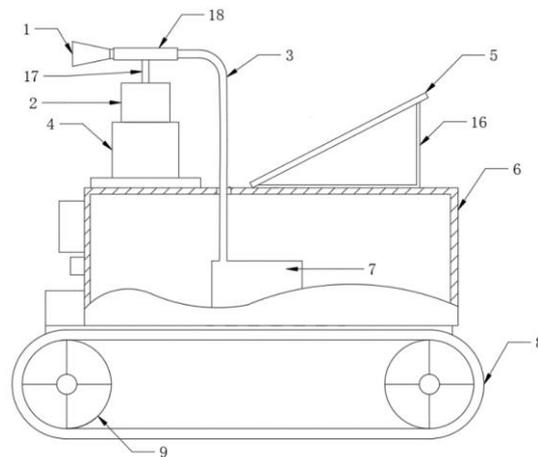
Forest fire has become a worldwide concern, the United States, Japan, Russia and other countries have mature technology and equipment[3]. In recent years, China has made great technical breakthroughs and achievements in fire robot technology, but there is still a gap with foreign developed countries, especially in reliability and environmental recognition ability and there is obviously room for improvement[4-6]. Therefore, it is of great practical significance to study the robot suitable for forest detection and clearing.

2. Design of Forest Embers Cleaning Car

2.1 Structural Design of Forest Embers Clearing Car

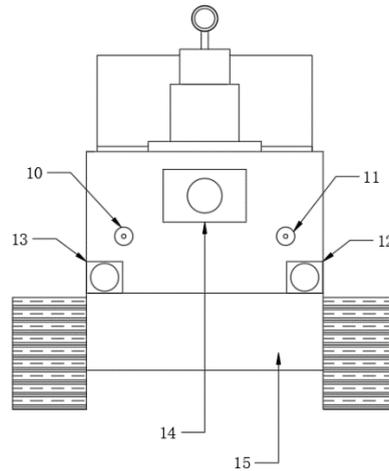
The structure of the forest fire clearing car consists of the following parts: crawler chassis, fire extinguishing device that can be rotated up and down, front-end sensors and cameras, solar panels and internal fire extinguishing agent storage bin.

The overall working process of the car is as follows: when the operator gives instructions to the remote control device, the motor inside the chassis drives the rotating shaft, and the power wheel rotates synchronously, so that the track is horizontally driven, and the car chassis and the fireproof shell are driven forward. When there are obstacles in the driving process, the operator will observe them in the camera and avoid them in time. In the turning operation, one side of the track rotates forward, the other side of the track rotates backward, to achieve steering. The temperature sensor can perceive the temperature image of the forest in front of the distance, and find the residual fire that is difficult to observe with the naked eye in time. The distance sensor can calculate the distance between the residual fire cleaning car and the fire source and transmit it to the operator, who uses the remote control to control the car forward to the residual fire. When working at night, turn on floodlights 1 and 2 for high light. After approaching the embers, the operator shall control the lifting platform to adjust the height, control the rotating platform to adjust the direction, and drive the steel pipe and sprinkler head to rotate until the sprinkler head is directly above the embers. At this time, the hose connected to the fire extinguishing agent storage bin inside the fire proof shell shall be opened, so that the extinguishing agent can be eject from the sprinkler head to complete the fire extinguishing operation.



1- nozzle 2- rotary table 3- hose 4- lifting table 5- solar panel 6- fire enclosure 7- fire extinguishing agent storage bin 8- track 9- power wheel 16- triangular bracket 17- bracket 18- steel pipe

Figure 1 Main view of forest embers clearing cart



10- range sensor 11- temperature sensor 12- lamp one 13- lamp two 14- camera
15- chassis

Fig. 2 Schematic diagram of sensor position of forest embers cleaning cart

2.2 Mobile Platform Design

The forest surface is complex, the road condition is bad, the terrain is uneven, and there are branches and stones everywhere on the road. The moving platform adopts the moving mode of caterpillar chassis, which is driven by the power wheel for transmission. Crawler walking has the following advantages :(1) it can adapt to complex ground operations in different environments, even soil, gravel and other environments can walk freely; (2) With good ability to adapt to the environment, can realize the change of posture in a variety of terrains, and can recover quickly after the change; (3) The track has good grip and does not slip, which can maximize the effectiveness of the motor[7]. In the design, the motor powered by solar panels is used for energy transmission of the whole car. In order to reduce the weight of thin plate and straight Angle steel materials.

Located in the chassis of the four power wheels, the left two and the right two are a pair of each, each has a motor connection, each side of the two power wheels can rotate in the same direction at the same time, through the control of the left and right sides of the steering to achieve the car forward and steering control.

2.3 Embers Detection Mechanism Design

Forest embers cleaning car not only needs to have high possibility, can walk freely in complex terrain, at the same time can monitor embers and real-time feedback to the operator, found that the human eye is difficult to observe the small residual fire, in order to fire treatment. The monitoring mechanism at the front of the car uses the temperature sensor to detect the smoldering material after the forest embers, detects the temperature change inside the smoldering material, and transmits the data to the operator.

In the process of embers detection, in order to make embers detection can collect information in many aspects, the distance sensor and camera are installed, and the use of these sensors and cameras can be more convenient and timely judgment and detection of embers.

2.4 Fire Extinguishing Mechanism Design

Considering the complex forest road conditions, the design method of cylindrical lifting rotary table is adopted. The bottom of the lifting table is fixed on the front surface of the fire proof shell through bolts, the top of the lifting table is connected with bolts at the bottom of the rotating table, and the rotating table is provided with a steel tube bracket, and the spray nozzle and hose of fire extinguishing agent are connected with the steel tube. The base of the fire extinguishing device is a round base, and the middle is a thin-wall shape for placing the motor of the rotary table and the lifting table.

The storage bin of fire extinguishing agent is arranged inside the trolley, connected with the nozzle through the hose and steel pipe, and the discharge valve above the storage bin is controlled by the motor to compress the gas in the storage bin so that the fire extinguishing agent is eject.

2.5 Other Structures

(1) Solar panels

The solar panel is located at the rear end above the fireproof housing, and the Angle of the solar panel is 45°. The power of the solar panel is mainly provided to the battery inside the chassis, which can ensure the long endurance of the car.

(2) fire proof shell

The shell is an important component to protect the inside of the car under harsh environment. The shell is made of lightweight carbon fiber, which has a hardness 10 times higher than that of ordinary steel, ensuring good strength in the car. Fireproof coating is applied on the surface of the shell to increase the fireproof performance of the car and better protect the internal components

3. Conclusion

The forest embers clearing cart is a fire fighting cart equipped with sensors, cameras, fire extinguishing devices and other institutions. By the visual sensor, temperature sensor and distance sensor of the multi-sensor detection system, realize the embers of detection, and will be the scene of the fire and the data transmission to the operator side device, which can realize the operator according to the real-time situation of fire extinguishing, both to ensure the operator safety, and avoid the secondary combustion, provide technology support for the detection of forest embers.

Acknowledgements

This paper was financially supported by National University Student Innovation Project (202210225046)

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