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The synthesis of solutions for the prevention and suppression of forest fires

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Abstract

The study aims to investigate the synthesis of solutions for the prevention and suppression of forest fires. The research is based on the author's methodology of functional technological analysis with the implementation of scientific, technical and patent searches. As a result, the technical solution is aimed at increasing the efficiency of extinguishing forest fires by creating a shock wave of tremendous strength and amplitude to bring down the fire flame. In conclusion, an important way to solve the problem is the accelerated development of

innovative technologies and techniques for the prevention and suppression of forest fires.

Keywords: Trees, Bushes, Patent, Information, Forest Fires.

La síntesis de soluciones para la prevención y extinción de incendios forestales

Resumen

El estudio tiene como objetivo investigar la síntesis de soluciones para la prevención y supresión de incendios forestales. La investigación se basa en la metodología de análisis tecnológico funcional del autor con la implementación de búsquedas científicas, técnicas y de patentes. Como resultado, la solución técnica está dirigida a aumentar la eficiencia de la extinción de incendios forestales mediante la creación de una onda de choque de tremenda fuerza y amplitud para apagar la llama del fuego. En conclusión, una forma importante de resolver el problema es el desarrollo acelerado de tecnologías y técnicas innovadoras para la prevención y extinción de incendios forestales.

Palabras clave: árboles, arbustos, patentes, información, incendios forestales.

1. INTRODUCTION

Forest fires annually destroy 6 to 14 million hectares of forests around the world MOORE, HARDESTY, KELLEHER, MAGINNIS & MYERS (2003) and have become the main factors that, due to fire and smog, lead to the extinction of vast forests and adjacent territories, damage and sometimes destruction of the forests settlements,

buildings, structures, located on them. Being a powerful natural and anthropogenic factor, forest fires are also a factor significantly affecting the functioning and condition of forests, causing damage to the environment and the economy. For many countries, including Russia, the problem of protecting forest and non-forest territories from forest fires has become one of the global problems of national security, requiring substantiation of methods and the creation of all necessary conditions for their accelerated resolution. An important way to solve this problem is the accelerated development of innovative technologies and techniques for the prevention and suppression of forest fires (BARTENEV, MALYUKOV, GNUSOV & STUPNIKOV, 2018).

The significance of this problem convincingly confirms the relevance of research aimed at creating an updated knowledge base for making strategic and operational decisions in the field of detection, prevention and suppression of forest fires. The basis for the formation of such a knowledge base is an expanded patent information search and system analysis of the status and development trends of technologies and equipment in the studied field of research. During the research, special attention was paid to technologies and equipment that ensure the execution of operations to prevent and extinguish forest fires with the continuous movement of basic forest machines. Among these forest machines, machines have been identified that ensure the formation of mineralized strips, cutting of trees and shrubs (TSV), and filling the edges of forest fires with soil. The potential of the obtained knowledge base for the creation of technological equipment for forest machines for the prevention and suppression of forest fires, which is

part of the set of multifunctional equipment for forest machines, is studied. The possibility of using the generated knowledge base for the development of patentable solutions to technology options for the prevention and suppression of forest fires with the continuous movement of forest machines, as well as technological equipment for such technologies, is shown (CONARD & IVANOVA, 1997).

2. MATERIALS AND METHODS

The aim of the study was to form a knowledge base on the state and development trends of technology and equipment for the detection, prevention and suppression of forest fires as the basis for the synthesis of new patentable solutions.

For this, a systematic expanded patent information search of technologies and equipment on the named problem and the subsequent analysis of research and development results of domestic and foreign scientists and developers, as well as inventors, were carried out. The collection of materials was based on the fact that an active search for solutions to the aforementioned problem is carried out by many scientific and experimental design organizations, universities and enterprises.

The research is based on the author's methodology of functional technological analysis with the implementation of scientific, technical and patent searches and systematization for the formation of an informed knowledge base. Analysis of scientific publications and

patents was focused on identifying their promising areas of research in the field of transportation of food raw materials and food products by tractors and cars. It was taken into account that it is innovative technological and technical developments that contribute to the stability and development of the economic sphere of any country.

Therefore, serious attention was paid to the analysis of patentable technological and technical solutions, since such an analysis allows, firstly, to objectively not only identify the state and development trends of technology and technology objects in various areas of the economy, and secondly, to be used as analogues and prototypes for the development of fundamentally new for the commercialization of effective technical and technological solutions (VAGANOV, FURYAEV & SUKHININ, 1998).

In the formation of the knowledge base, special attention was paid to technologies and equipment for preventing and extinguishing forest fires directly on the cutting area using basic forest machines. Attention was also focused on multifunctional specialized technological equipment hung on forest machines for use in preventing and extinguishing forest fires.

Based on the generated knowledge base using functional technological synthesis, new solutions have been developed for technology options, as well as technological equipment for forest machines for such technologies to prevent and extinguish forest fires by cutting TSV with continuous movement of base forest machines.

3. RESULTS AND DISCUSSION

To monitor forest fires, specialists from the ABAIMOV, ZYRYANOVA, PROKUSHKIN, KOIKE & MATSUURA (2000) Military Space Academy VALENDIK, MATVEEV & SOFRONOV (1979) developed a probabilistic satellite system. The satellite system includes spacecraft in circular orbits, equipped with a scanning wide-angle optical-electronic infrared system with a linear photodetector for detecting a forest fire and a tracking optical-electronic infrared system. The satellite system's spacecraft is equipped with one infrared tracking optical-electronic system with several photodetector arrays for detecting and determining the parameters of a forest fire focus, as well as generating a forest fire warning signal. The system can provide continuous monitoring of the entire territory of our country (or the selected area) with the ability to quickly obtain and process data on the ecological condition of forest land.

Military Academy of Logistics, named after Army General ANDRIANOV, BELOV, NIKITIN & SHURTAKOV (2019) proposed a set of inventions, including a monitoring method and an integrated system for the early detection of forest fires (BELYAEV, RULEV, ESAKOV & RULEV, 2019). This contributes to the early identification of fires in forests at a distance of up to 50 km from settlements and important strategic sites.

To detect forest fires, ground-based monitoring methods are used (from towers, using land transport and walking around), as well as aircraft and space monitoring methods. The Energia Rocket and

Space Corporation (RSC Energia) has patented a method for controlling a forest fire from a spacecraft (XINGLEI, MD AZHARUL, PERRY, PATERSON, WYSE & CURRAN, 2019), from which fire is shot on the underlying earth's surface and the coordinates of its contour are determined from the received image. This method has technical novelty, increasing the accuracy of monitoring the spread of fire and obtaining data on the line of the most rapid spread of fire to a given area of the underlying surface. In this case, young species of various breeds, other types/subtypes of vegetation, swamps, etc., types/subtypes of relief formations, geographical objects, engineering/infrastructure objects/structures and other fragments/areas/objects of the underlying surface can be considered as types of underlying surface., at the border of which the speed of propagation of fire can change (accelerate or slow down).

The National Research Tomsk Polytechnic University has patented a forest fire alarm device (FURYAEV, VAGANOV, TCHEBAKOVA & VALENDIK, 2001), in which the ability to transmit radio signals from a fire source is achieved by the fact that the device is able to take off above a forest massif and above a forest fire flame. In this case, the forest will not be able to absorb the level of the radio signal, and the flame of the forest fire will not be able to exert a screening effect on this signal. The device has the following features: a radio transmitter is connected to a thermoelectric converter; the radio transmitter and engine are housed in a cylindrical housing; the body is made of fireproof material; the body is equipped with a head fairing and tail; Cold junctions of the thermoelectric converter are brought to

the outer surface of the housing; Hot junctions are located inside the housing, in the area of the engine; the engine is connected to the igniter; part of the igniter is brought outside the cylindrical body. If a fire occurs in the area of the device, the igniter ignites. This causes the engine to start. With a vertical start, the device rises above the fire flame shielding the radio waves and the radius of the line of sight of the radio transmitter increases. As the fuel burns out, the hot junctions of the thermoelectric converter heat up, and its cold junctions are blown by the incoming airflow and remain cold. As a result, a thermo electromotive force is generated that enters the input of the radio transmitter. As a result, the radio sensor on the active and passive sections of the device's flight starts broadcasting warning radio signals that can be received by any forest protection station, the Ministry of Emergencies and other services. We believe that the considered solution develops research (TYRYSHKIN & ANDRAKHANOV, 2009).

A method for monitoring the location of a peat fire on forest lands was proposed by the Russian State Agrarian University - Moscow Agricultural Academy named after Timiryazev. The novelty of the method lies in the fact that fire hazardous areas are allocated according to the maximum value and direction of the peat layer filtration coefficient in the horizontal plane, and vertical wells are placed in one row in the direction of the maximum value of the filtration coefficient.

To protect settlements and other objects from the forest or other fires, a method is proposed (KASISCHKE, CHRISTENSEN &

STOCKS, 1995), involving the use of a water tower and a reservoir (natural/artificial) with a pump station. The author proposed to install a fire-fighting water pipe with flowing nozzles of directional action along the perimeter of a settlement (another object). If necessary, the necessary amount of water is fed into it for directional extinguishing of the fire that has arisen.

The firefighting device developed by the South Ural State University contains a body with a fire extinguishing composition, a can of non-combustible gas, and a pin. On the lid of the housing, holes are made, sealed with thin membranes. Two holes are fixed above the holes, deployed in opposite directions relative to each other, and an elastic shell is fixed inside each socket. The device is used as follows. If a bottom fire is detected (fallen), the buster sticks a pin into the ground in the path of the possible spread of fire and the body with the can settles down. The pin pierces the membrane of the spray can and gas begins to escape from it. In the case, the pressure rises and the membranes breakthrough. Gas begins to blow out the extinguishing agent into the sockets; elastic shells are inflated in them. The composition for extinguishing fires is transferred to a swollen shell. In this form, this device is located until the moment when the swollen shells fall into the moving front of the flame, under the influence of which they burst and scatter the extinguishing composition on the burning surface.

To extinguish forest fires, a patented group of inventions can be used, including a method for creating the gas-droplet jet and installation for its implementation.

The technical solution is aimed at increasing the efficiency of extinguishing forest fires by creating a shock wave of tremendous strength and amplitude to bring down the fire flame. For this purpose, a device is used, consisting of a container with water and an explosive charge plastered C4 located in the center of the container in the amount necessary to turn the water used into steam when the charge is detonated, which detonates and expands at a speed of about 8000-9000 m/s. At the same time, the water turns into steam, expands at a great speed, a shock wave arises from steam and compressed air, which spreads in all directions knocking down the flame and extinguishing the fire.

The author offers options for using such devices:

- a) fixing devices along the path of the fire and their simultaneous undermining when approaching the fire;
- b) throwing devices with pneumatic control panels into the fire area and explosion of a substance in contact with the ground;
- c) the discharge of devices from the air using aviation.

4. CONCLUSION

The problem of detecting, preventing and extinguishing forest fires is worsening every year in many countries of the world. All stated above led to the expansion and deepening of research in the development of fundamentally new technologies and equipment to solve this problem. The creation of such technologies and equipment

cannot be achieved without the formation and use of a knowledge base on the status and development trends of technology and technology objects for the detection, prevention and suppression of forest fires

For many countries, including Russia, the problem of protecting forest and non-forest territories from forest fires has become one of the global problems of national security, requiring substantiation of methods and the creation of all necessary conditions for their accelerated resolution. An important way to solve this problem is the accelerated development of innovative technologies and techniques for the prevention and suppression of forest fires.

It should be noted that, despite the most serious work aimed at organizing the production of domestic fire extinguishing machines in Russia, this problem has not been completely resolved to date. At the same time, it should be noted that in recent years, a fairly serious scientific and experimental reserve has been accumulated in the considered area by Petrozavodsk State University and Voronezh State Forestry University.

A knowledgebase has been formed in the field of technologies, machines and equipment for the removal of TSV. The basis for the formation of such a knowledge base is an expanded patent information search and system analysis of the status and development trends of technologies and equipment in the studied field of research. During the research, special attention was paid to technologies and equipment that ensure the execution of operations to prevent and extinguish forest fires with the continuous movement of basic forest machines. Among these forest machines, machines have been identified that ensure the

formation of mineralized strips, cutting of trees and shrubs, and filling the edges of forest fires with soil.

Considering the fact that basic forest machines with a set of multifunctional technological equipment providing a wide range of operations are promising for forest users to develop forest plots, the prospects of machines and equipment for preventing and extinguishing forest fires for use in machine systems for preventing and extinguishing forest fires are shown. The equipment of such machines may be included in the set of multifunctional equipment for forestry machines. Technological and technical solutions developed by the authors for the options for cutting TSV with continuous movement of the basic forest tractors of work, machines and their structural elements for such technologies are presented.

During the analysis, an intellectual knowledge base is formed about improved or replaced objects of technologies and equipment (more than 200 literary sources and more than 100 inventions and utility models protected by patents of Russia and USSR copyright certificates in the study area. The database was used in the formation of intellectual property that protects work technology and patents structural elements of machines, including nine of the above patents.

The research results showed the effectiveness of the system's functional-technological analysis of technologies and equipment for logging operations for the synthesis of new intellectual property.

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