Structure of the formation of a classification description of forest rakes

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Abstract. When performing work related to the proper maintenance of a number of infrastructure facilities, the structure of technological processes often provides for the technological operation of collecting and raking logging residues, carried out by mechanization. The article discusses the issues of classification of technical means of mechanization of performing these works, provides a formula for creating a description of technical means of mechanical removal of logging residues, considers the sequence of formation of a classification description of specific models of forest rakes, provides examples of their classification, and formulates a conclusion about the creation of a unified approach to systematization of produced forest rakes.

1 Introduction

When carrying out work related to the proper maintenance of a number of infrastructure facilities (right of way of roads and railways, product, oil and gas pipelines, water intake areas, airports, border clearings, etc.) [1-3] in the structure of technological processes for cleaning these objects from unwanted growth, the technological operation of collecting and raking logging residues is often provided [4-10]. This operation, if performed mechanized, is carried out by specialized technical means, aggregated with such basic vehicles as tractors and multifunctional machines (including specialized chassis) and called 'forest rakes'.

In [11], we considered the issue of identifying and interpreting the relationships between the qualitative and quantitative characteristics of technical means for collecting and raking unwanted vegetation. We developed a classification of these technical means, and identified 3 primary classification features, 7 secondary ones, 5 classification features of the third level, 2 classification features of the fourth level and 36 classification rows (taking into account the effect of the facet structure). However, the issue of forming a classification description of specific models of forest rakes (taking into account their initial design and technological parameters) remained unconsidered, which is the purpose of this study.

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2 Methods and materials

The development of a classification description of forest rakes was carried out using a systematic approach using the method of analyzing various sources of information, both scientific and general technical [12]. To assess the reliability of the studies, the resulting data array was processed using the software package for statistical analysis Statistica StatSoft.

3 Results and discussion

In order to unify the descriptions of forest rakes for introducing their production into practice, it is proposed to use the following formula for creating a description of the technical means of mechanical removal of logging residues:

$$FR = M_a + M_f + P_f + W_w + D + A + T_a + T_d + D_i + T_{sp} + T_{ss} + P_{cd} + A_{sd} \quad (1)$$

where FR – is a generated description of a technical means of mechanical removal by collecting and/or raking logging residues (forest rake); M_a – method of aggregating forest rakes; M_f – fastening method; P_f – placement features; W_w – working width; D – density; A – appointment; T_a – type of aggregation; T_d – type of drive; D_i – direction of influence; T_{sp} – tooth surface profile; T_{ss} – tooth surface section; P_{cd} – presence of clamping devices; A_{sd} – availability of safety devices.

In accordance with our proposed classification and based on formula (1), we will create a graph diagram of an algorithm for the classification description of technical means for collecting and raking logging residues (Fig. 1).

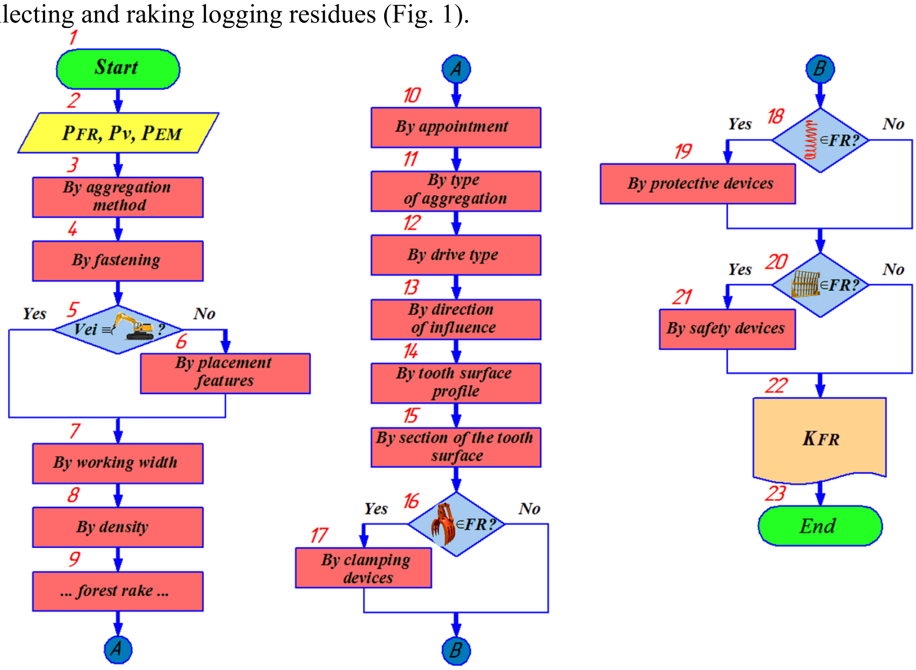


Fig. 1. Graph diagram of the classification description algorithm forest rake

As an explanation in the table 1 shows the symbols of the graph diagram under consideration.

The beginning of the algorithm (Fig. 1) is carried out in block 1.

Block 2 is provided for generating the following initial data: P_{FR} – design and technological parameters of the classified rake; P_V – parameters of the basic vehicles used (for installation of classified rakes); P_{EM} – environmental conditions (predominant use of the classified rakes), including – characteristics of the areas to be cleaned.

In blocks 3 and 4, the formation of a general classification description of forest rakes begins with an indication of methods for aggregating and securing classified technical means for collecting and raking logging residues.

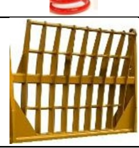
In block 5, the correspondence of the basic vehicles Vei (with classified rakes) planned for use (with classified rakes) is established with a vehicle based on an "excavator" chassis equipped with a manipulator boom. If no compliance is identified, the classification of forest rakes indicates (block 6) the features of their placement on the base vehicle.

Blocks 7 and 8 indicate the working width and density of classified technical means for collecting and raking logging residues. In block 9, the classification description of the technical means in question, completed in blocks 3, 4, 6-8, is linked with the description performed in subsequent blocks by inserting the phrase 'forest rake'.

Blocks 10...15 indicate the purpose, type of aggregation, type of drive, direction of influence, profile and cross-section of the surface of the teeth of classified technical means for collecting and raking logging residues.

In block 16, the affiliation (presence) of clamping devices to the structure of the classified forest rake (FR) is determined. If affiliation is identified, the presence of clamping devices is noted in the classification of technical means for collecting and raking logging residues (block 17).

Table 1. Symbols of the graph diagram of the algorithm for the classification description of forest rakes.

Symbol	**Explanation of the symbol**
	chassis of a hydraulic excavator on pneumatic wheels or caterpillar tracks with a rotating platform, operator's cabin, engine and boom-manipulator
	clamp(s)
	protective device(s)
	safety device(s)

In block 18, the affiliation (presence) of protective devices to the design of the classified forest rake is determined. If affiliation is identified, the presence of protective devices is noted in the classification of technical means for collecting and raking logging residues (block 19).

In block 20, the affiliation (presence) of safety devices to the design of the classified forest rake is determined. If affiliation is identified, the presence of safety devices is noted in the classification of technical means for collecting and raking logging residues (block 21). In block 22, the final classification description of the forest rake is formed (K_{FR}).

Block 23 is the end of the algorithm diagram for the classification description of technical means for collecting and raking logging residues.

Let's perform examples of classification of some models of forest rakes (Table 2):

Table 2. Examples of classification of forest rake models.

Model, country	**Classification**	**Image**
1	**2**	**3**
Norm Engineering Stick Rakes (Australia)	Mounted, stationary, avant-garde in placement, medium-wide, extra-dense forest rake for general purpose, aggregated with a multifunctional machine, hydraulic drive, direct action, with a broken profile of a constant cross-section of the tooth surface	
Homan 34 Stickrake (Australia)	Mounted, overhead, avant-garde in placement, extra-wide, extra-dense forest rakes for special purposes, aggregated with a bulldozer, hydraulic drive, direct action, with a straight profile of variable tooth surface section	
Fravizel Brush Rake (Portugal)	Trailed, stationary, rear-guard in placement, medium-wide, dense forest rake for general purpose, mounted with a tractor, hydraulic drive, reverse action, with an arc profile of variable tooth surface section	
Digga Stick Rake-1200 (Australia)	Mounted, stationary, medium-wide, dense forest rake for general purpose, aggregated with a multifunctional machine, hydraulic drive, universal action, with a complex profile of a constant cross-section of the tooth surface	
Aquamec Dredger forest rake (Finland)	Mounted, stationary, medium-wide, dense forest rake for special purposes, aggregated with a multifunctional machine, hydraulic drive, reverse action, with an arc profile of a constant cross-section of the tooth surface	

Bedrock BDR 14 Rake (USA)	Mounted, overhead, avant-garde in placement, medium-wide, dense forest rakes for general purpose, aggregated with a bulldozer, mechanical drive, direct impact, with a straight profile of a constant cross-section of the tooth surface	
Wallace Industrial Tractor Rake (USA)	Mounted, stationary, avant-garde in placement, medium-wide, general-purpose forest rake of normal density, aggregated with a multifunctional machine, hydraulic drive, direct action, with an orthogonal profile of a constant cross-section of the tooth surface and the presence of a safety device	
NM MAX550 Grapples (Canada)	Mounted, stationary, medium-wide, general-purpose forest rake of normal density, aggregated with a multifunctional machine, hydraulic drive, reverse action, with an arc profile of variable tooth surface section and the presence of a clamping device	
Cat Excavator Rakes CB-Linkage (USA)	Mounted, stationary, narrow in width, sparsely dense general purpose forest rake, aggregated with a multifunctional machine, hydraulic drive, reverse action, with an arc profile of variable tooth surface section	

4 Conclusion

The graph-scheme we have developed for the formation of a classification description of technical means for collecting and raking logging residues will provide a unified approach to systematizing currently produced (as well as previously produced and promising) forest rakes according to a number of characteristics related to the parameters of the mechanization means in question, with the parameters basic vehicles as well as the environment.

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