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NEW TECHNOLOGY FOR SHAPING DITCHES – MULTITASKING DEVICE IN THE WATERCOURSE

Summary

Correct and secure position of a multitasking device inside watercourse is the basis of regenerative technology to shape the open watercourses. The article describes the ways to drive a device when performing basic operations related to holistic treatment of reclamation, beginning from the placing the device into the watercourse through the work and avoidance of the obstacles inside the watercourse, and ending with the removal of the device beyond the watercourse.
***Key words**: technology of the melioration; machines in melioration, driving a melioration machine*

NOWA TECHNOLOGIA KSZTAŁTOWANIA ROWÓW MELIORACYJNYCH – PROWADZENIE URZĄDZENIA WIELOZADANIOWEGO W CIEKU WODNYM

Streszczenie

Podstawą nowej technologii regeneracyjnego kształtowania otwartych cieków wodnych jest prawidłowe i bezpieczne umiejscowienie urządzenia wielozadaniowego wewnątrz cieku wodnego. W artykule przedstawiono sposoby prowadzenia urządzenia podczas wykonywania podstawowych operacji związanych z całościowym zabiegiem melioracji, od wprowadzania urządzenia do cieku wodnego, pracę i omijanie przeszkód wewnątrz cieku, aż do wyprowadzania urządzenia poza ciek wodny.
***Słowa kluczowe**: technologia melioracji; maszyny w melioracji, prowadzenie maszyny melioracyjnej*

1. Introduction

A new approach to the maintenance and restoration of watercourses described in detail assumes a working machine in the bottom of the watercourse. This, in turn, forced the engineers to develop a device that meets all requirements for reclamation. Detailed guidelines have been developed for technological operations. The main objective was to operate the machine on the bottom of a single caterpillar and propping up the two side arms. All the operations related to running the equipment in watercourses and to the placing and moving the device from the watercourse are carried out from these side-arms. Many concepts of the implementation [1] of the arms themselves meet a few basic assumptions:

- the machine moves in the course using the drive, and the lateral secondary role in a circle while maintaining direction and stability,
- the machine moves along roads and fields using the wheels side arms, and Caterpillar only supports them,
- the machine is inserted into the watercourse using side arms, and Caterpillar is designated to support,
- the machine enters the watercourse on the track, and the side wheels are used to change direction and maintain stability,
- the device has the ability to circumvent obstacles such as trees or infrastructure.

Within the framework of the project the prototype of the new multitasking device (fig. 1) has been built and tested.

The prototype meets functional and tracked drive arms assumptions in terms of:

- keeping the device in a watercourse,
- input and output of the trench,
- avoidance of obstacles located in the watercourse.

Source: own work / Źródło: opracowanie własne

Fig. 1. Prototype of the new multi-task machine [2]
Rys. 1. Prototyp urządzenia wielozadaniowego [2]

2. Methods of driving equipment while working in the watercourse

Methods of placing the device into a ditch at the stage of virtual prototyping. Then made numerous field tests and found that the proposed techniques allow for proper implementation of treatments. The level of complexity of the motion system of the machine was high [3, 4], a large number of mobile nodes, the need for surveillance of multiple variables by the operator while working, a multitude of terrain conditions and the diversity of the geometric layout control make the trenches complicated and not always fully predictable. Security requires a lot of practice and maintaining concentration during work. The presence of a bystander during the work is prohibited.

2.1. Inserting the multi-task device to a watercourse

Research on insertion equipment to watercourse made for minimizing the risks associated with uncontrolled declining machines for watercourse and its damage [5]. First, you drive into the trench so close to the side arm placed on the opposite side [6] (fig. 2).

Source: own work / Źródło: opracowanie własne

Fig. 2. Setting the device along the edge of the slope of the ditch
Rys. 2. Ustawienie urządzenia wzdłuż krawędzi skarpy rowu

In the trenches with a width of over 3 m, it is not possible to move the arm on the opposite slope (arm is too short). Hence, in this case, it is necessary to track setting on the edge of the ditch and support the machine using the side arm on the bottom of the ditch - fig. 3.

Source: own work / Źródło: opracowanie własne

Fig. 3. Insertion of the side arm to the bottom of the ditch
Rys. 3. Wstawianie ramienia bocznego do dna rowu

Then the device is raised on the shoulders and moved towards the ditch until track setting is on a slope of the ditch (fig. 4).

Source: own work / Źródło: opracowanie własne

Fig. 4. Setting the track on the slope of the ditch
Rys. 4. Ustawienie gąsienicy na skarpie rowu

In the next stage the side-arm is located on the bottom of the trench and moved on the opposite slope in order to allow for the transport of the device in the middle of the ditch. The second arm is then moved in the direction of the device (fig. 5 and fig. 6).

After setting the device on the middle course, the Caterpillar is started on the shoulders of the side, until it is put at the bottom of the trench (fig. 6).

Source: own work / Źródło: opracowanie własne

Fig. 5. Insertion of the side arm in the slope
Rys. 5. Wstawianie ramienia bocznego na skarpę

Source: own work / Źródło: opracowanie własne

Fig. 6. Setting the device over the watercourse
Rys. 6. Ustawienie urządzenia nad ciekiem melioracyjnym

Source: own work / Źródło: opracowanie własne

Fig. 7. Lowering the device into watercourse
Rys. 7. Opuszczenie urządzenia do cieku melioracyjnego

2.2. Take out the Multitasking Device from watercourse

For the purpose of issuing a multitasking device with watercourse where the height and slope of the escarpment course excludes the driving test after the escarpment, in the first phase it should be up to eject the side arm beyond the outline of the channel (fig. 8).

Source: own work / Źródło: opracowanie własne

Fig. 8. The Multifunction Device in the watercourse
Rys. 8. Urządzenie wielozadaniowe w cieku melioracyjnym

After the completion of this operation, the second arm should probably resist on the opposite bank of the ditch (fig. 9).

Source: own work / Źródło: opracowanie własne

Fig. 9. The sticking out a side arm in the escarpment
Rys. 9. Wystawienie ramienia bocznego na skarpę

In the next step you must lift machine on wheels side arms and move it beyond the outline of the ditch (fig. 10).

Source: own work / Źródło: opracowanie własne

Fig. 10. Embedding track on a escarpment
Rys. 10. Osadzenie gąsienicy na skarpie

If there is a need to switch the arm outside the watercourse, it is for the purpose of preserving stability, it is advisable to support machine by excavator boom in bottom trench (fig. 11).

Source: own work / Źródło: opracowanie własne

Fig. 11. Insertion of the side arm to the bottom of the watercourse
Rys. 11. Wstawienie ramienia bocznego do dna cieku

The last procedure is the displacement of the device at a distance of 2-3 meters in addition to grading and your arm from the bottom of the trench (fig. 12).

Source: own work / Źródło: opracowanie własne

Fig. 12. Setting the device on the side of the ditch
Rys. 12. Ustawienie urządzenia na poboczu rowu

3. Take in and out a driving device along the escarpment of watercourse

In the case of ditches and low gradient slopes it is possible to drive to the course without the need for execution of an insertion operation as described in the previous section. This task should be performed by forward side arms (fig. 13 and fig. 14). This configuration will prevent loss of balance on the wet ground.

Source: own work / Źródło: opracowanie własne

Fig. 13. Entering to small ditches without escarpment grading
Rys. 13. Wjeżdżanie do małych rowów bez rozkopywania skarp

Source: own work / Źródło: opracowanie własne

Fig. 14. Leaving small ditches without escarpment grading
Rys. 14. Wyjeżdżanie z małych rowów bez rozkopywania skarp

In the case of ditches and high gradient slopes, in particular in areas with poor soil compactness it is digging up the slopes (fig. 15 and fig. 16).

Source: own work / Źródło: opracowanie własne

Fig. 15. Digging up the escarpment by spoon
Rys. 15. Rozkopywanie skarpy łyżką podsiębierną

Source: own work / Źródło: opracowanie własne

Fig. 16. Entering the device into a ditch after escarpment grading
Rys. 16. Wjazd urządzenia do rowu po rozkopanej skapie

4. Running a multitasking device in watercourse

Multitasking device movement in the course of watercourse is done using a track based on the bottom of the trench and the wheels side arms in the escarpment. Turning in the watercourse is performed by braking the side arms wheels.

Source: own work / Źródło: opracowanie własne

Fig. 17. Machine in watercourse
Rys. 17. Maszyna w cieku wodnym

5. Passing by the plants in the watercourse

Design solutions implemented in multitasking device allows you to pass by plants on slope without leaving ditches. If necessary, increase the space to pass bushes, branches, roots and small trees that can be removed using the grubber fig. 18.

Source: own work / Źródło: opracowanie własne

Fig. 18. The grubbing-up of the branch in the area of ditches
Rys. 18. Karczowanie gałęzi znajdujących się w przestrzeni rowów

To avoid an obstacle, you must fold a side arm so as not to touch it (fig. 19). It is required then to slightly tilt the machine, until loss of contact with the ground. The device moves on the track and on the wheels of the arm opposite the obstacle.

Source: own work / Źródło: opracowanie własne

Fig. 19. The tilting of the machine while passing by the trees on a escarpment
Rys. 19. Przechylanie maszyny podczas omijania drzew rosnących na skarpie

Boom with a tilted suspended tool is beyond the outline of the ditch (fig. 20). This moves the Centre of gravity of the machine. This significantly decreases the risk of overturning multitasking device. The increase is also a response to the wheels in the escarpment.

Source: own work / Źródło: opracowanie własne

Fig. 20. The deflection of the boom during passing by plants growing on a slope
Rys. 20. Odchylanie wysięgnika podczas omijania roślinności rosnącej na skarpie

After circumventing obstacles lateral wheel arms stand on the escarpment slope (fig. 21).

Source: own work / Źródło: opracowanie własne

Fig. 21. Stop the side arm on a escarpment
Rys. 21. Odstawienie ramienia bocznego na skarpie

6. Drive of a multitasking device to the implementation of the technological treatments

In order to minimize degradation of the ground surfaces and to allow traffic on the paved roads a multi-purpose device has the ability to move only with pneumatic wheels, side arms (fig. 22).

Source: own work / Źródło: opracowanie własne

Fig. 22. The movement of the multi-purpose device on a ground road by means of the side wheels
Rys. 22. Poruszanie się urządzenia wielozadaniowego na drodze gruntowej za pośrednictwem kół bocznych

7. Summary

In the course of inspections, it was found that the machine allows you to perform tasks without additional equipment. The same has been shown about the usefulness of multitasking device to carry out the work according to the new technology. Developed object satisfies all design requirements, enables independent driving in the watercourse, on the roads, enter the watercourse, examination of the arrival and obstacles in the watercourse.

It was observed that the most difficult part, the most absorbent and dangerous is the insertion and removal of the device from the deep waterways. These operations require the preservation of specific concentration and control of multiple variables, such as the draft angle shoulders, traction, the coordinates of the center of gravity, etc. In addition, the operator must demonstrate sense of predicting the behavior of a machine, for example. in terms of the impact of the wheels side arms on the ground in terms of low carrying capacity of the land.

8. References

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