FEATURES OF MECHANISMS AND MACHINES WITH RETARDED FEEDBACK

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Summary. Many constructional, road, agricultural and other machines have bearing wheels or skiing installed on working/execution unit/mechanism. Therefore it has retarded feedback in kinematical scheme. Minor alteration of rute depth, formed by supports, effects major change in depth of processing or width of its capture. Required quality maintenance of technological operations performance of these cars can be achieved with consideration of their constructional features.

Key words: Mechanisms, machines, retarded feedback, the working/execution unit/mechanism, wheels, depth.

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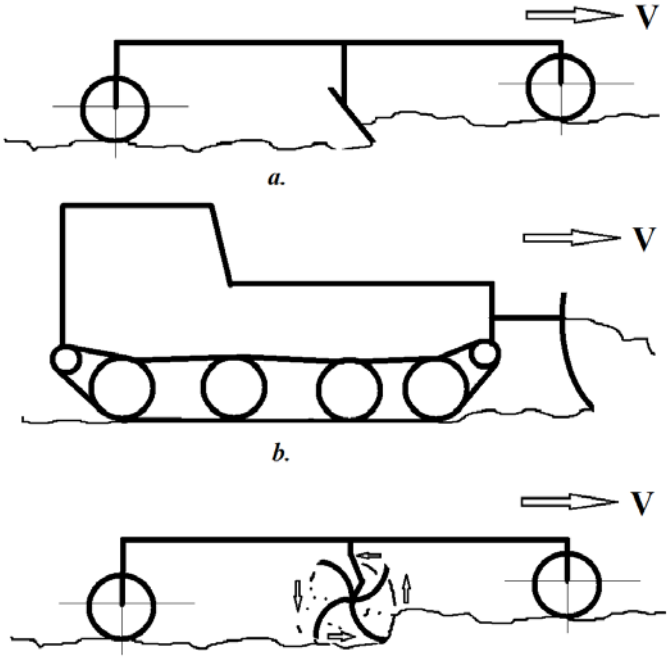
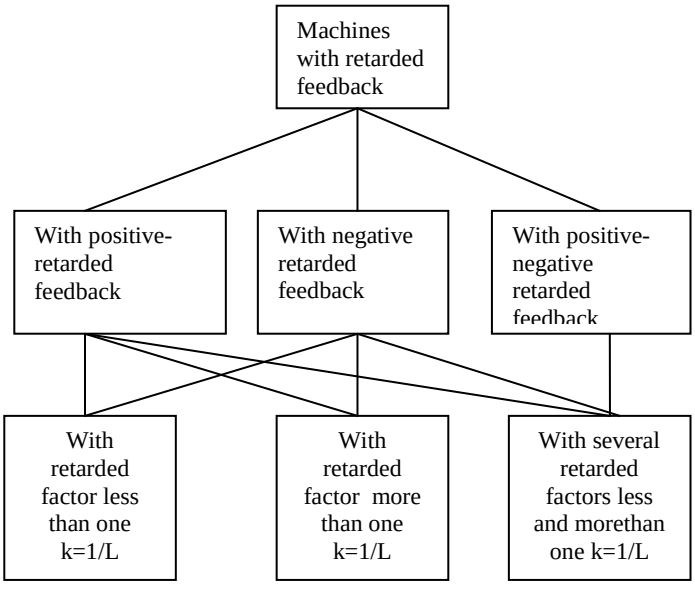
Initial purpose of machines and tools development is to ensure the required quality of technical operations (eg, depth of soil cut), what is the designation of machines and tools itself. For this task, various constructional schemes are used in existing groups of machines and tools classification. In the prototype formation of machines and tools, including frame features and quality assessment of machine under examination it is possible to optimize the constructional schemes, optimal parameters for the various external effects (eg, surface roughness of the field). For the preparation of their prototypes constructional schemes of machines and tools was studied, and it was determined that the supporting elements such as wheels, running roller, ski, bearing located behind the execution unit and move on surfaces generated by this unit during the execution of operation in the majority of groups of machines. (Pic .1).

In kinematical schemes of these machines and mechanisms there is inclosed circuits of influence transfer: the deviation down the bearing parts located behind execution unit, is transferred through a frame to execution unit, and from the last through a surface of movement formed by it to a bearing part. Thus, transfer of influences on a bearing part-frame-execution unit chain a forms direct link, and from execution unit through a surface formed by it again to a bearing part – backup/1/. Feedback at the specified machines is retarded: deviations of the bearing parts located behind execution unit, are caused by offsets of the last, but in relation to them delay in time occurred which depends on distance from execution unit to a bearing part and forward speed of machine movement. In the majority groups of machines and mechanisms this concept is used mainly in agriculture, for an example, soil-cultivating, sowing and other cars, tools and separate mechanisms for agricultural purpose, and also ameliorative and road-building machines.

There are two standard task depending on machines and tools designation /3/. The first standard task is solved by machines which creates flat surface of a field (in relation to conditionally set base surface). The second standard task is solved by machines which maintain constant depth of processing (in relation to surface of a field relief) /3/. Simultaneously, there are high agro technical requirements set for technological operation of both groups. The first machine's group formed by schedulers and other machines for continuous processing of the soil or a ground. Among agricultural tools to the second group of machines belongs the share-fall off (лемешно отвальный) plows having rear furrow wheels, moving on a bottom of furrows, formed by share advanced corps; the milling and combined units having basic running roller, located behind execution unit, seeders vomer etc.



Picture 1. Scheme of machines with retarded feedback a) scheduler b) bulldozer c) milling machines.



Picture.2 Classification of machines and mechanisms with retarded feedback by V. A. Ksendzov

Picture.3. Planner with positive retarded feedback

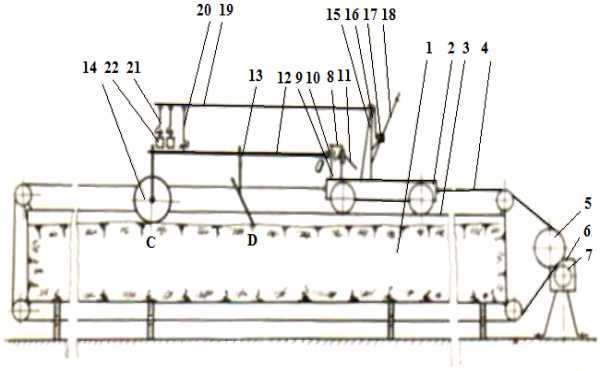
Feedbacks can be positive and negative. Positive feedback possess ability to force processes, to strengthen reaction of system to influence. Negative on the contrary, possess feature to stabilize processes, to reduce system reaction. Among considered group of machines there are machines with positive, and negative feedback. Machines shown in picture 1 a) and 3 belongs for the first group. In the initial moment its knife is deepen so that it forms a surface lying below the initial. The support located behind a knife, copying this fall, through a frame will cause a new deepening of a knife and formation of the surface, located is even lower. New copying will cause a knife deepening again, etc. The total deepening of a knife will exceed the initial.

Other machines and mechanisms, such as milling units (picture 1 c)), equalizer with the running roller, certain vomer knots have negative feedback. At these machines and mechanisms execution unit conducts such functions as loosening or pulling soils, pulling the soil to the center which elevates surface. The subsequent return of support, for example, of running roller, on this excalation causes reduction of a execution body deepening, and consequently soil fluff of size etc. As a rule, operation of these machines and mechanisms is accompanied by considerable consolidation of a fluffed layer by running roller that can essentially reduce effect of retarded feedback.

For endorsement of theoretical thesis, identification of factors which are affected deviation of calculated processes from actual, registration of modifications with the aim of their rapprochement, and also test of the developed methods of calculation there were laboratory installation designed.

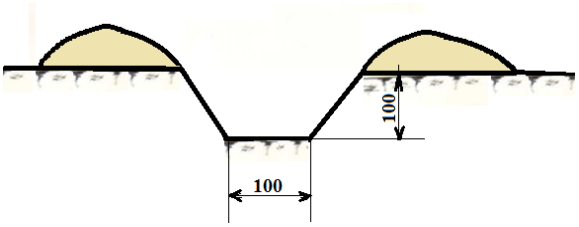
The laboratory work program provide research of model transients at a push alike deviation of point of trailer10 and change of track depth of, identification of the significant factors causing a deviation of calculated transients from actual laboratory and the registration of modifications for the purpose of rapprochement, research of trench-digger model on specially designed device for modeling of soil-cultivating and ameliorative machines and tools with feedback at occasional stationary impact on model, comparison of the achieved results with theoretical thesis and identification of the factors causing their divergence, test of a graphical method of calculation of transients.

Experiments were conducted in the soil channel. The soil in the channel – loamy at middle level. The length of trench - 1000 cm, width – 95 cm. Cart 2 were established on rails 3 of soil trench 1 the cart 2 (picture 4) which is actuated by the driving mechanism consisting of a driving cable 4, the reel 5 with the clutch, two transmission 6 and the electric motor 7 with the capacity of 1,4 kW and the speed 1450 revolutions per minute. Constant speed of cart moving maintained constant, equal to 0,4 m/s.



Picture 4. Scheme of laboratory installation.

The model of a trench-digger joined the cart 2 via the mechanism of a hitch point 0 deviation. The mechanism of a hitch point 0 deviation contains support 8 attached to the cart, a vertical axis 9 with slider 10 and the lever II, which retains slider in the top position. At lever II turn slider 10 is released and slides down on an axis 9 under the influence of tool model and additional weight. Slider 10 joins to frame12 of tool model via hinge through a horizontal axis. The least has execution unit 13 and basic wheels 14 with a rack.



Picture 5. The channel scheme of the trapezoidal section with depth up to 10 cm, width on a bottom 10 cm and with a 1:1 slope establishment.

Double dumped execution unit 13 creates channel (picture 5) with trapezoidal section with the depth up to10 cm, width on a bottom 10 cm and with a 1:1 slope establishment. Basic wheels are replaceable and also have a cylindrical or conic rim. Diameter of wheels is 270 mm. Width of a cylindrical wheel rim is 70 mm, and conic - 42 mm with a cone in 90. The least is applied in experiences with sharp change of track depth an established support. The execution unit and wheels can be regulated on height and to move along a frame to which they are attached by means of collars.

Laboratory installation (picture 4) has also the mechanism of model's frame lifting for transportation position and additional weight retention-lowering a frame. Mechanism's support 15 is attached to cart 2 by bolts, and has two axes 16 and 17, on an axis 16 is hung G-shaped lifting mechanism's lever 19 on which end there are hooks 20 and 21 for a hanging of weights and lifting of a frame 12 for transportation position. Another end is affected by the fist lifting mechanism with an axis 17. For automatic weight lowering 23 hung on the lever 19, ring with a wire set for the end of the lever 18. Wire is at necessary length when pulled the lever 19 is released and lowers weights 22 on a frame. II – shaped weights in 10kg are hung on lever 19 hooks (picture 4). Height of weight lowering is about 10 mm. It is possible to hang up to 5 weights on a frame at the same time.

The trajectory of execution unit's edge movement registered on the paper tape attached to the vertical screen, established along the soil channel. Registration means with

pencil holder is attached to one end of the lath, second end pressed on a frame of tool model

Other two ends of a lath join via two sliding bearings to the cart. Record of several executions unit's movement trajectory curves at the same tape is achieved by turn of the pencil holder. The basic line recorded by writing means attached to the cart. Pressure of pencils upon a tape is regulated by adjusting screw's spring compression measure.

Depth of a track, created by a wheel, measured by depth gage with measuring ruler, attached to a rack, a horizontal board and directing cores. Measurements were made each 15 cm of passed track.

Experiments were carried out at constant density and humidity of the soil and speed of installations movement at soil channel

Humidity of the soil supervised by weight method, via drying of removed samples. Calculation formula of the soil relative humidity is as below:

$$W\% = \frac{a}{A} 100\%$$

where a–difference of weight of the soil before and after drying, A – weight of absolutely dry soil. Experiences were carried out at humidity of the soil W = 15-17 %.

Experiments on the transients caused by a deviation of a hitch point, were carried out as follows.

Positions of the execution unit and supports were established on a horizontal adjusting board with the consideration of track formed by support. At the beginning of a models's movements hitch point (picture. 4) with the slider was kept in the top position by the dumping mechanism. Wheel with a cylindrical rim is established to exclude formation of a big track and influence of digging depth fluctuation measure by the change of last.

On a models' frame additional 3 weights were hung near a point10 in gross weight of 30 kg that promoted sharp falling of a hitch point in the moment of dumping operation activation. Necessary parameters were set according to experiences schedule. In test the size of deviation (falling) of a hitch point is equal to h_1 = 130 mm.

After the first preliminary pass of installation the layer o soil were removed to maintain constancy of average digging depth at transients. It is necessary to exclude influence of model's load change in a transient mode.

Thereafter main experiments were conducted. By winch switching installation were moved from one end to another. When execution unit approached to the end of establishment table the hitch point automatically fell. The trajectory of execution unit movement and the basic line registered by writing means. Upon termination of experiment, tool transferred to transportation state and returned to initial position for the next experience of repeated frequency. Frequency of experiences the 10-time.

Experiments on the transients caused by a change of track depth, were carried out as follows.

For the purpose of receiving essential change in track depth, formed by support, wheel with a conic rim were established. To prevent of hitch point fluctuations slider were suspended. In actual condition change of track size is observed when change of surface density of movement or loading measure. A dense surface created by installation at the beginning of the channel board, and the soil of the soil channel were less dense.

The sock of execution unit and support were established at one level. After preliminary pass the part of the soil was taken away to keep constant digging depth in transient.

At recopying of a semi-cylindrical surface experiments semi-cylindrical surface in radius of R = 130mm were established between execution unit and support on furrow bottom. Experience frequency – 10 time.

Theoretical transients calculated in the assumption of affecting tool module by an individual push.Many construction, road, agricultural and other machines and mechanisms have basic wheels or skis established behind the execution unit. Or they have retarded feedback in the kinematical scheme. Minor alteration of rurte depth formed by support, effects in considerable change of processing depth or their capture width, to violation of technological process. Required quality maintenance of technological operations performance of these cars can be achieved with consideration of their constructional features.

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