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LAYOUT OF A UNIVERSAL-ROOWED TRACTOR WITH ADJUSTABLE TRACK

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Abstract. With the expansion in the republic of the acreage of cotton plantations sown with a row spacing of 76 cm, there was a need for tractors working on this row spacing. Whereas the serial universal-row tractors used in the republic are designed to work only on the aisles of 60, 70 and 90 cm and their tracks in the classic version do not coincide with the aisle of 76 cm. To solve this problem, the KTTSM has begun work on the development of a new universal-row tractor with an adjustable track, working on the aisles of all crops cultivated in the republic, i.e. on the aisles of 60, 70, 76 and 90 cm. This article shows the layout of this tractor under development.

Keywords: universal-row tractors, layout, wheel, row spacing, track, running system, base, protective zone.

Introduction. In the republic, when cultivating cotton, 3- and 4-wheeled universal-tilled tractors are used, designed to work on cotton crops and related crops sown with row spacing of 60, 70 and 90 cm [1].

In recent years, with the creation of cotton-textile clusters [2], the proportion of cotton sown with row spacing of 76 cm has begun to increase. Some cotton-textile clusters are equipped with a set of agricultural machines designed for row spacing of 76 cm. Whereas the serial 3- and 4-wheeled universal-row tractors used in the republic in cotton growing, as already mentioned, are designed to work on row spacing of 60, 70 and 90 cm and their tracks in the classic version do not coincide with the row spacing of 76 cm [3, 4]. To solve this problem, it became necessary to develop such a tractor, the track of which would correspond to the row spacing of all crops cultivated in the republic, i.e., row spacing of 60, 70, 76 and 90 cm.

Materials and methods. The development of any tractor begins with its layout. When assembling a newly developed tractor, they proceed from the specifics of the technological operations performed by it and its functional purpose [5].

The layout of the tractor itself is characterized by the mutual arrangement of its units and systems, the presence of free space for connection with agricultural machines, as well as for the installation of containers with technological material. The main parameters of the layout scheme are the type and parameters of the running system, the base, the track, the agrotechnical clearance, the coordinates of the center of gravity, the minimum turning radius, the location of the operator's workplace [6].

The layout scheme determines the traction properties and controllability of the tractor, visibility from the place of work of the driver-operator and the man-made impact of propellers on the soil, longitudinal and transverse stability, aggregatability with agricultural machines and linking the track width of the tractor and the width of

the row spacing of cultivated crops, maneuverability during running and on the turn lane, convenience of technical and technological maintenance and repairs.

Results and discussions. To solve the problem that has arisen, work has begun in DTCAE on the development of a universal-row tractor with an adjustable track, working on the aisles of all crops cultivated in the republic, i.e. on the aisles of 60, 70, 76 and 90 cm. Taking into account the experience of using serial universal-row tractors in the republic and relying on advanced achievements in the field of tractor construction, the layout of a mock-up sample of the tractor being developed was made (Fig. 1).

When assembling the tractor under development, all classical techniques were taken into account, but taking into account the peculiarities of cotton cultivation in the republic and its accompanying crops.

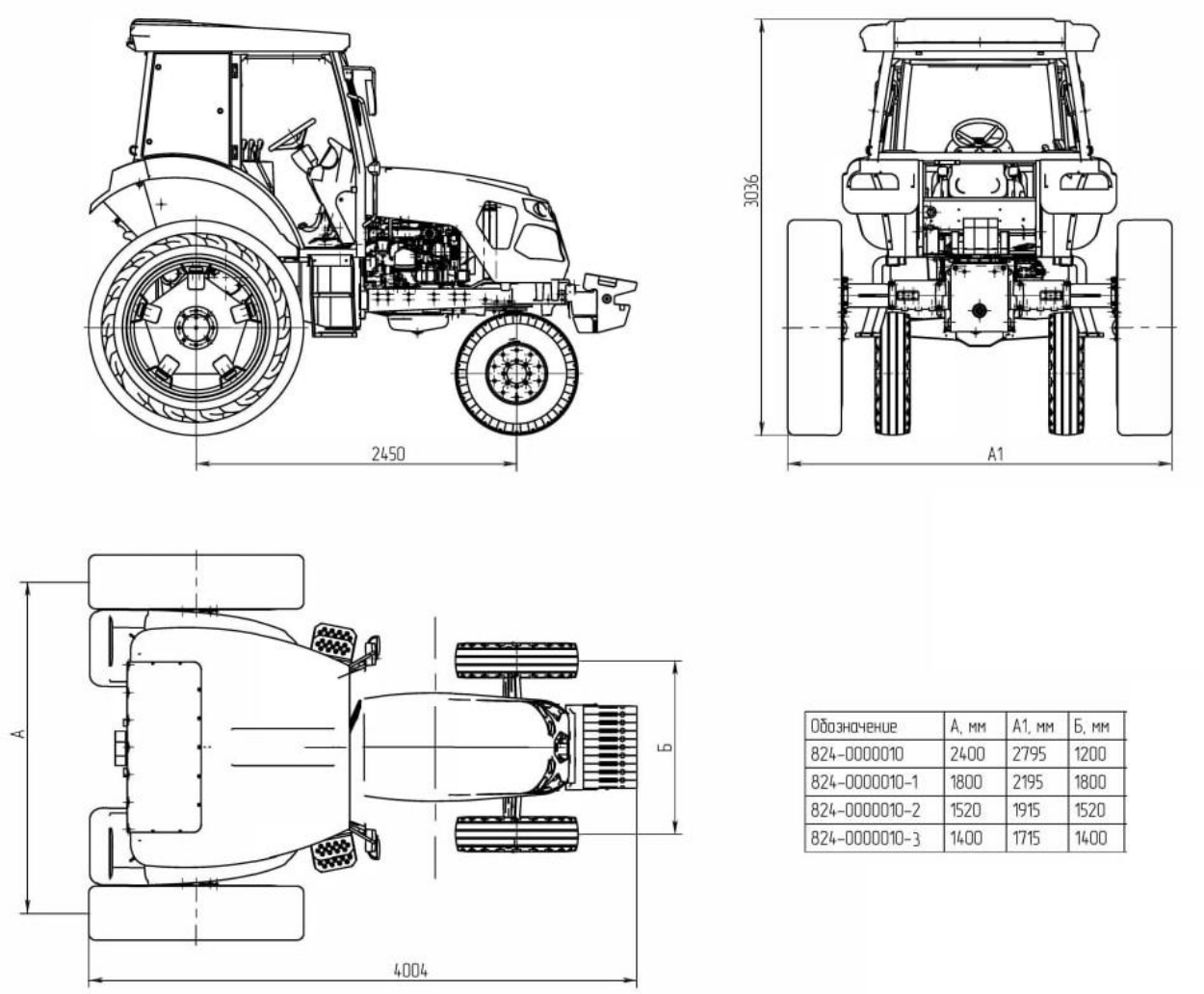
As is customary, there is an increased requirement for the layout of universal row tractors, which is due to their work in row spacing of row crops. At the same time, special attention is paid directly to the visibility of the position of the front steerable wheels relative to the row of cultivated plants, to the magnitude of the negative anthropogenic impact on the soil, to the fit of the running system in the aisle; to controllability in order to track the trajectory of the wheels and the working bodies of the machine in the aisle without damaging the treated plants.

The listed requirements are most fully met by tractors of a classic layout with front wheels of a smaller diameter than the rear ones.

Frontal visibility largely depends on the overall dimensions of the engine and its height relative to the operator's workplace. The narrower the engine is and it is located lower in height relative to the operator's workplace, the better the frontal visibility. To ensure sufficient frontal visibility, we use a single-row engine of the D-243 type.

Universal-row tractors working on row spacing of field crops should have high maneuverability.

The maneuverability indicator is the minimum turning radius of the tractor, which is equal to half the diameter of the circle from the middle of the track of the front outer wheel when the tractor is moving, when the front steerable wheels are turned to the maximum angle.



Обозначение	А, мм	А1, мм	Б, мм
824-0000010	2400	2795	1200
824-0000010-1	1800	2195	1800
824-0000010-2	1520	1915	1520
824-0000010-3	1400	1715	1400

Fig. 1. General layout of the tractor with adjustable track

The main maneuver of a tractor operating as part of a machine-tractor unit, when performing the technological process, is to turn the unit on the turn lane and drive into the field for a new pass. At the same time, for the effective use of acreage, the width of the turning lane should be minimal. Based on this requirement, the turning radius of the tractor unit, depending on the minimum turning radius of the tractor, should be as small as possible.

When performing technological operations with mounted machines, a significant part of the shift time is taken away for idle turns, arrivals and departures of the unit at the ends of the rutting and it mainly depends on the kinematics of the rotation of the unit. Consequently, for the developed universal-tilled tractor working on these operations, the turning radius is of no small importance in determining not only the width of the turning lane, but also reducing the time for idle turns, arrivals and departures of the unit.

When working on a universal-tilled tractor being developed with trailed machine tools, the width of the turn lane being processed should not exceed the minimum due to the possibility of unhindered rotation of the trailed unit and the need for subsequent processing of the turn lane.

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The first condition is determined based on the specific kinematic characteristics and agility of the trailer unit. Kinematic characteristics are determined by the length of the hook of the universal tractor being developed, the location of the center of the trailed unit (the distance between the tractor hook and the center of the trailed machine-tool), the length (the distance along the straight axial line of the unit between the trailer earring and the last rows of working bodies) and the width of the trailed machine-tool and the length of its exit, then the turnability is determined by the radius turn.

Of the above, the first condition is considered decisive in the design of tractors, since it cannot be changed after the design and manufacture of the tractor [7].

Among all the ways of turning the tractor, the best is considered to be turning the tractor by means of front steerable wheels, which served as the basis for the use of such a method of turning in the layout of the universal-row tractor being developed. Unlike others, with this method of turning, the maximum accuracy of the tractor movement is achieved in the row spacing of row crops. Turning in the aisle and at the end of the field on the turning lanes of the front steerable wheels of a smaller size is safer for damage to cultivated plants compared to steerable wheels of large diameter.

The minimum turning radius is one of the main operational indicators of the tractor, and it is limited by the angle of rotation of the front steerable wheels. The main factor limiting the magnitude of the angle of rotation of the front steerable wheels in the classical design of a cotton-growing universal-row tractor is the geometric parameters of the front steerable tractor wheels and the relative positions during the rotation of these wheels with a spar. At the maximum angle of rotation of the front steerable wheels, they should not rest against the tractor spar. The minimum track of the front steerable wheels is also limited by the relative position of these wheels with the tractor spar.

The track of a universal-tilled tractor is chosen with the possibility of regulation based on the row spacing of cultivated crops, taking into account its transverse stability. In the republic, taking into account the vast majority of finely contoured maps, the base is chosen based on the minimum turning radius, taking into account the longitudinal stability of the tractor. Indicators of the longitudinal and transverse static stability of the tractor are the maximum tilt angles at which the braked tractor does not tip over and does not slide down the slope.

The universal-tilled tractor being developed should work in different aisles. For example, on cotton plantations on row spacing of 60, 76 and 90 cm, and in fields where corn, beans, mash, etc. are sown on row spacing of 70 cm.

For the symmetrical passage of the wheel between the rows of plants, adjust the track width of the tractor or replace a set of wheels. There are various ways of changing the track width: moving the wheels along the half-axes; sliding the wheels together with the half-axes; "turning" the wheels, etc.

Among the listed methods for the tractor being developed, we accept a method of adjusting the track, sliding the wheels together with the semi-axles with an additional rearrangement of the disc relative to the rim of the rear wheels, according to a specially developed technical solution [8].

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One of the difficult issues in the layout of a universal tractor with an adjustable track is the choice of the size of the front steerable wheels. On the one hand, to ensure that the rows of cultivated crops fit into the aisles, good handling and a minimum turning radius, the dimensions of the front steerable wheels should be minimal. On the other hand, in order to reduce the negative anthropogenic impact on the soil and to ensure the load capacity associated with the hitching of agricultural machines in front of the tractor, the dimensions of the front steerable wheels should be maximized. Here the approach should be a compromise, and it should proceed from the condition of ensuring maximum rotation of the front steerable wheels with a minimum wheel track of the front axle.

On cultivated areas with tall and branched plants, which include cotton, the plant's fit into the lumen under the tractor or into the outline, i.e. into the contour formed by the lowest-placed structural elements of the tractor, is of no small importance.

For universal-tilled tractors of cotton purpose, the required agrotechnical clearance is 0.8 m, which was also accepted for the tractor under development.

The central place in the layout of the universal-row tractor was given to the creation of a comfortable environment for the driver-operator. It should be noted that in the layout scheme of the universal-row tractor being developed, the driver-operator's seat is located in the zone of high vibrations, above the rear axle of the tractor; therefore, the tractor layout was carried out using both a cab and a seat with high shock-absorbing properties.

According to the developed layout scheme, design documentation was developed and a mock-up of a universal-row tractor with an adjustable track was made according to them.

Conclusions. With the expansion in the republic of the acreage of cotton plantations sown with a row spacing of 76 cm, there was a need for tractors working on this row spacing. Whereas the serial universal-row tractors used in the republic are designed to work only on the aisles of 60, 70 and 90 cm and their tracks in the classic version do not coincide with the aisle of 76 cm. To ensure the possibility of adapting the running system to any row spacing from 60 to 90 cm, the DTCAE has developed a tractor design that provides stepless adjustment of the tractor track to the required row spacing.

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