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**COMPARATIVE ANALYSIS CONDUCTED ON A CONSTRUCTIVE-
FUNCTIONAL BASIS ON TUBERS DISTRIBUTION SYSTEMS OF
POTATO PLANTERS**

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Abstract: *The paper presents the main types of tuber distribution systems used for potato planters. The following tuber distribution systems are carried out under a comparative basis, both constructively and functionally: rotating discs in vertical plane, elevator belts or elevator chains with cups moving in vertical plane and elevator belts (conveyer) moving in horizontal plane. For analytical purposes, the paper presents representative types of tuber distribution systems used for potato planters manufactured by well-known companies in the field.*

Keywords: *potatoes planter, tubers distribution system, belt elevator with cups, chain elevator with cups, belt horizontal conveyer*

1. INTRODUCTION

Mechanized planting of potato tubers consists in simultaneously performing of the following three operations: open the furrow in the soil, distribution of tubers with a tubers distribution device and cover the tubers with a soil layer with thickness of 8 ... 10 cm (ridges formation) by means of covering organs.

Agrotechnical requirements of potato planting have imposed the tuber distribution systems which ensure the placement uniformity on row, avoidance of empty nests and duplicates, avoidance of injuries during planting, the possibility of planting to all potato varieties regardless of the shape and the tubers size, the possibility of planting the pre-cutted or pre-sprouted tubers, all at working speeds determined by the agrotechnical conditions. At the operation of these distribution systems be permitted an injury of max. 2% on a tuber depth of up to 5 mm.

The tubers distribution devices can be actuated mechanically, by transmission from the contact / actuation wheels of the machine or from the cardan shaft of the tractor's synchronous PTO shaft, or by means of some hydraulic or electrical motors mounted at the machine. In some cases, certain segments of the cinematic chain can be actuated and from 12 V DC electric motors, and even more, The distribution system can also include and exhausters for producing the absorption for the pneumatic catching of tubers.

In the case of actuation of tubers distribution devices from the tractor PTO through the cardanic shaft, PTO is coupled into synchronous system position and the cardanic shaft speed and implicitly the distribution mechanism speed is proportional to the tractor velocity. In the case of actuation from rotary hydraulic engines, the system is with command, adjustment and electronic control. The actuation with direct current motor are usually applied at the actuation of the supplying bands of the feeding rooms from the bottom of bunkers (band with cups system, spoons chain) or at the feeding of horizontal distribution systems with round belts, to those with round belts and bands, and to those with bands and profiles with rotating surfaces.

2. COMPARATIVE ANALYSIS OF TYPES OF DEVICES FOR THE DISTRIBUTION OF TUBERS

Analysing the construction and operation mode of tubers planting machines manufactured on the international market, the tubers distribution devices can be grouped into three main types: with elements having a rotational motion in the vertical plane, with elements having elevators with movement in the vertical plane and with elements having elevators with movement in the horizontal plane.

The distribution systems with elements with rotational motion (discs) in the vertical plane [1, 2, 4, 5] are characterized in that the tubers are taken over from a common hopper placed between two distribution devices actuated from the common shaft. From this group belong the devices: with spoons and gripping fingers (Fig. 1), with flaps (palettes) and alveolus on disk (Fig. 2), with rotating disc and gripping mechanism with needles (Fig. 3).

In the case of distribution devices with vertical disc with alveoli and gripping flaps (Fig. 2), on the feeding chamber side of the disc 1 are mounted the gripping flaps 3 with the end from the push rod on the other side of the disc where copies the profile of a profiled cam 2. At the stage of immersion in the feeding chamber, the flaps are held attached to the disc by a spring 4 of the side facing the cam. In the process of browsing the tubers layer from the feeding chamber, the 12 flaps are opened controlled by the profiled cam, catch the tubers in the alveole of rotating vertical disc with the pressing force of the tensioned spring.

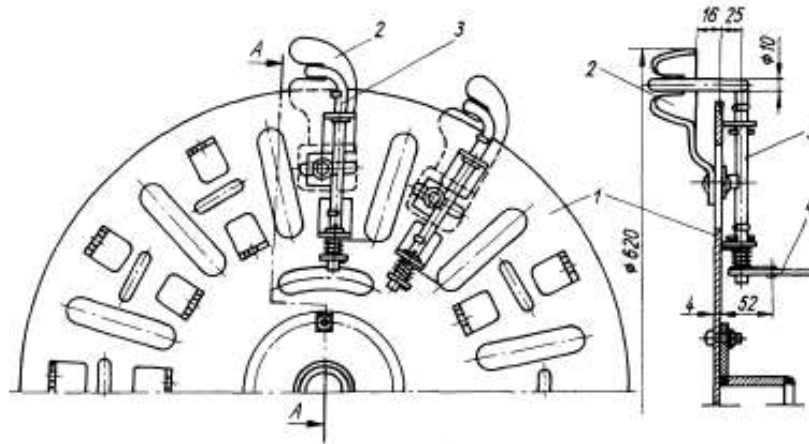


Figure 1. Tubers distribution devices with spoons and gripping fingers

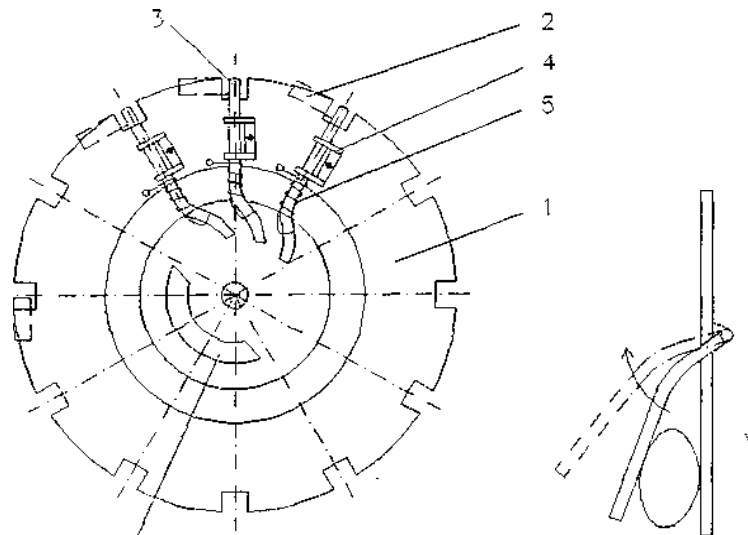


Figure 2. The tubers distributing device with vertical disc with flaps and alveoles

The distribution device with vertical rotary disc with gripping mechanism with needles (Fig.3) is less known in Europe, being particularly prevalent in America. From the constructively point of view consists of more gripping devices mounted on the disc 1, the oscillating arm 3, actuated by the roller with profiled cam 6, and the tension spring 5. On each arm 3 are mounted two needles 4, which in normally closed position go out through the forearm openings 2 and in this position catch the tubers by snatching, at their passage through the immersion zone of the feeding chamber. The tuber detachment is achieved by withdrawing the arm 3 with the needles 4 through

the counter-arm 2 and at the action of the profiled cam 6 and is released in furrow.

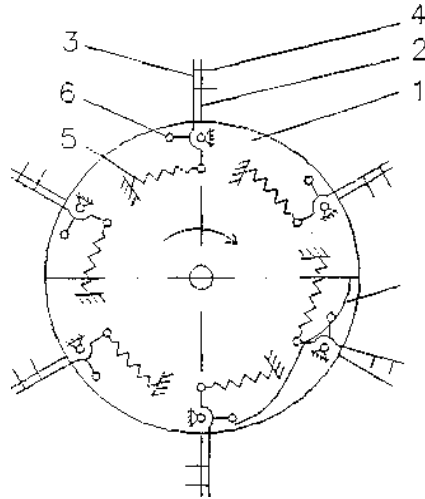


Figure 3. Tubers distributing device with rotary disc and gripping mechanism with needles

The distribution systems with elevators with movement in the vertical plane [5,6,7] can be with bucket conveyor chains (Fig.4) and with bucket conveyer belts (Fig. 5). The buckets (spoons), as supporting element for transportation, are mounted on a single row or on double-row staggered. There are also systems with the buckets mounted in three rows staggered for tubers planting in strips. In all these cases, the tubers are transported in a vertical plane on different trajectories (vertical, oblique or horizontal) determined primarily by the geometrical shape of the supporting element for carriage, after which is made the selection of a single one tuber on the support element, the conveyor.

The distribution system with chain buckets (cups) elevator (Fig. 4) performs the selection of a single tuber in each cup 1, after passing through the immersion zone of the feeding chamber of the hopper 7 and capturing of several tubers in each bucket. When the bucket pass in the horizontal position, due to vibrations, the tubers excess 2 is removed, this falling back into the hopper through the tilted plane 5. In the oblique lowering zone, the tubers reach the posterior of buckets 4 up to the releasing zone (zone of the actuation wheel of the chain 3).

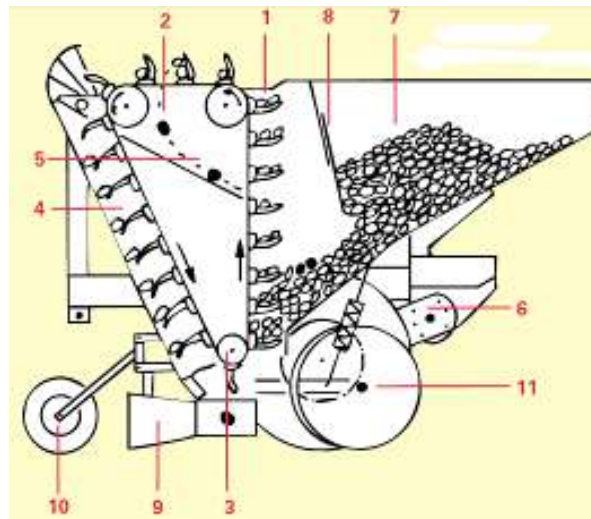


Figure 4. Distribution system of tubers with chain bucket elevator with movement in a vertical plane

The distribution device with bucket (cups) band elevator with movement in the vertical plane (Fig. 5), is similar to the previous one, but has no horizontal selection zone because the buckets allow to be filled with a single tuber, and the prospective surplus driven by the staggered rows of buckets is eliminated due to the rows separator and to the vibrator on the vertical zone (or almost vertically). The immersion zones, of lowering and for releasing the tubers are similar to the previous case.

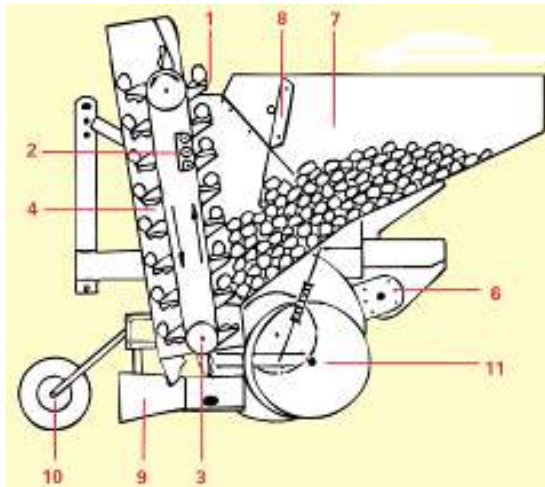


Figure 5. Distribution system of tubers with bucket band with movement in a vertical plane

The distribution systems with belts conveyor with movement in a horizontal plane (Fig.6) represents a newer generation. The dosage, directing the tubers, stringing and their preparation for the releasing phase is done without special gripping mechanisms. The constructive and functional elements of the system (Fig. 6) are as follows: the dosing band 6 placed under the tipper hopper 8, flaps 7 to retain the tubers 9, the group of belt wheels 1, the trough formed by round belts 4 in the guides 5 for the transport of tubers in string up to the belt wheels 13 and the gripping reel made of foam 14. Between the groups of belt wheels 10 is positioned the vibrating body 11 to eliminate the excess. The plastic reels 2 at the end of the trough formed by twenty-three round belts, leads the tubers toward the middle of the feeding zone, and at the other end toward the releasing zone where are placed the guiding plates 12 for returning the tubers eliminated by the vibrating body 11 from the string lined up for gripping. The five belts (longer) from the symmetry zone have the direction of travel toward the foam reel 14 and forms transportation trough for the releasing, and the other belts from the right and left of them forms two transportation surfaces of return and recharge, having the direction of transportation inversely toward the feeding belts

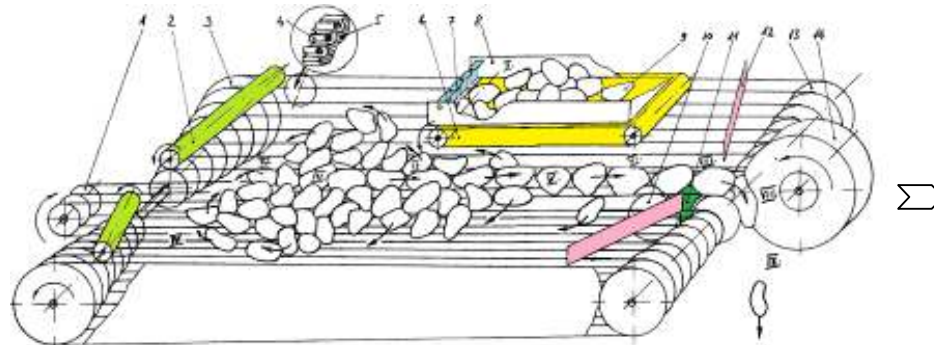


Figure 6. Distribution system of tubers with round belts conveyors with movement in a horizontal plane (STRUCTURAL)

Some companies have achieved a variant of the distribution system with movement in horizontal plane consisting of round belts conveyors and conveyors with belts (Fig. 7). These systems have the same working principle as the distribution system with round belt conveyors described above, The main difference consisting in the existence of two returning bands (replacing the round returning belts), and the returning rollers at the end

of the trough from the previous system are replaced by a single roller 2 with ribs having the propeller-shaped profile (threads) convergent with the guidance toward the middle, which also has a profiled plate 13 with superelevation. Additionally, as constructive and functional elements there are also the two elastic agitators 12 leveling the tubers in a single layer in the agglomeration area directing their detour at the end of the band, from the outside toward belts

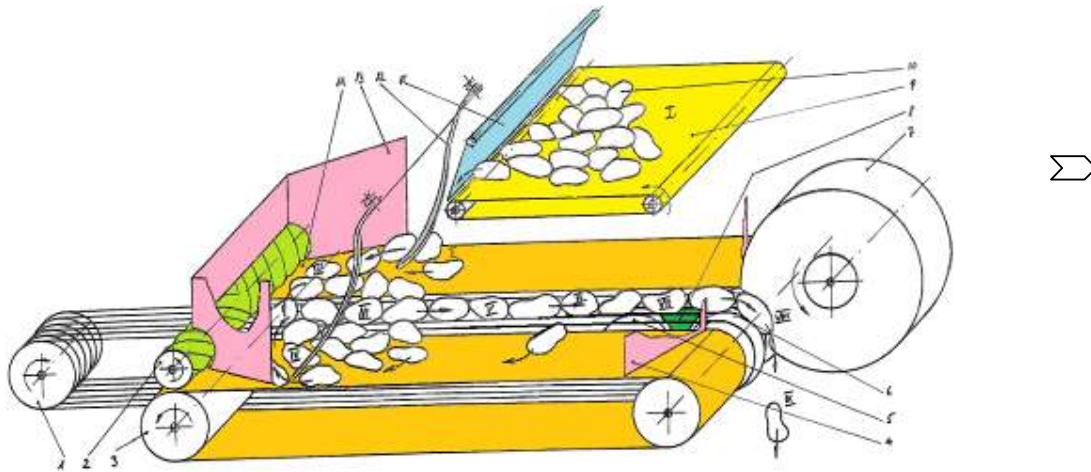


Figure 7. Distribution system of tubers with round belts and flat bands moving in horizontal plane (GRIMME)

3. CONCLUSIONS

- From the constructiv and functionally point of view, the tubers distribution devices from the potato planters must ensure the required uniformity along the row, avoidance the harming of tubers during planting, possibility of planting the tubers whatever of shape and size as well as the possibility of precut tubers planting;
- The potato planters manufacturers have endeavored to realize various functional types of tubers distribution devices (with rotating discs, belts elevators, chain elevators, belt conveyor). The use of machines equipped with diferent types of distributors is depending on the concrete conditions required by the crop.
- The tubers distribution devices of potato planters can be actuated mechanically (from the contact wheels the machine or from the tractor's synchronous PTO shaft), hydraulically or electrically.
- For the functionally monitoring of the tubers distribution devices the potato planters may be equipped with adjustment and control sytems containing electronic sensors of position, deplacemement and speed, electronic programming units, warning systems and, possibly, cameras and monitors system mounted in tractor cabin.

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