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CHARACTERISTICS OF AN AUTOMATIC SEEDLING TRANSPLANTER SUPPLY SYSTEM

BY

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Abstract. The synchronizing operation of the supply and planting systems is an essential part of the working process of the automatic seedlings transplanter. The determination of those corresponding time operations verifies the theoretically postulated operating conditions and give an evaluation of the designed machine’s functional limits.

Key words: time; operation; seedling; automatic.

1. Introduction

Designing an automatic seedling transplanter involves the determination of the different running times of the machine systems, in order to obtain the seedling supply and planting operations synchronization (Balan, 1998).

The determination of time intervals corresponding to various stages of the operation carried out by the transplanter is operated in the stationary mode, by means of an electronic equipment connected via a data acquisition card to the computer.

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2. Aspects of Seedling Transplanter Working Process

2.1. Seedling Time Planting Composition

The seedling transplanter prototype, shown in Fig. 1, working at V_m speed, is planting the seedling in a t_p period of time, consisting in the following time components:

− return time t_{rev} in which there are two separate movements: the first one is the completing of the YX arch by the oscillating driving lever, in the opposite direction regarding the wheel movement and the second movement, of the wheel planter control rod with its speed, on the YA arch;

− pause time t_0, corresponding to the control rod peripheral movement on the BX arch, with V_m speed;

− the transport t_t corresponding to the the control rod and driving lever on XY arch browsing, with V_m speed.

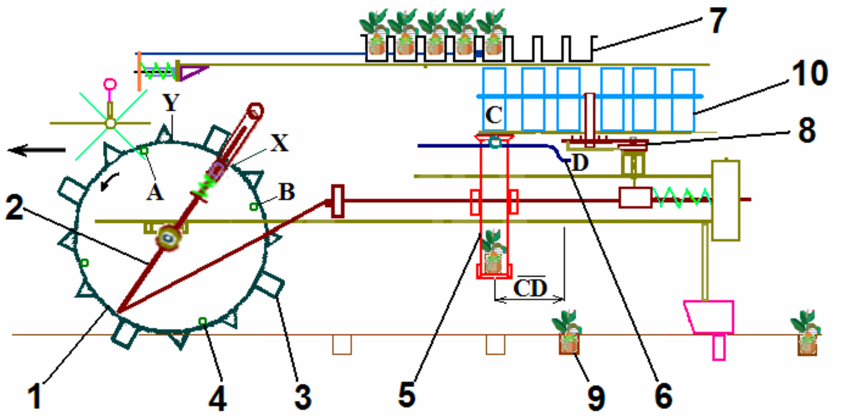


Fig. 1 − Aspects regarding constructive and functional parameters of the automatic transplanter: 1 − planting driving wheel; 2 − transmission; 3 − spur; 4 − driving rod; 5 − planting device; 6 − cam guide; 7 − seedlings tray supply system; 8 − distribution device; 9 − seedling.

So, planting time period is given by:

$$t_p = t_{rev} + t_0 + t_t \quad (1)$$

At the start of the return movement due to the springs, the step-by-step rotation of the distribution apparatus is triggered by the actuation of the ratchet mechanism, thus realizing the seedling supply of the planting apparatus. The supply is possible if at the end of the seedling reception tube permutation movement (held during t_{per} period of time), the planting device is in rest position, below it; *i.e.*, the planting device return time has to be less than the reception tube permutation time and has to wait the seedling gravity supply during the pause time. The condition imposed by these factors is expressed by the relationship:

$$t_{rev} \leq t_{per} \tag{2}$$

Verifying this relationship is achieved by measuring the time involved and their direct comparison (Xnote Stopwatch Software).

2.2. Determining the Appropriate Time Seedling Supply

2.2.1. *Determining Return Time of Planting Device*

In order to measure the planting device return time from the seedling issue and till returning to the supply rest position (browsing CD segment) it is being used an electronic system shown in Fig. 2, mounted on the transplanter (Fig. 3).

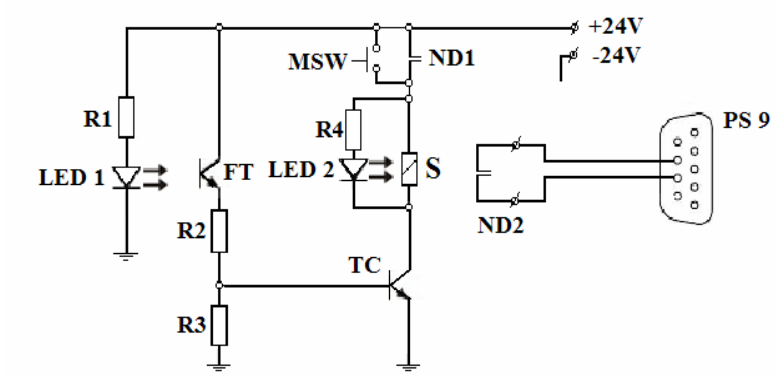


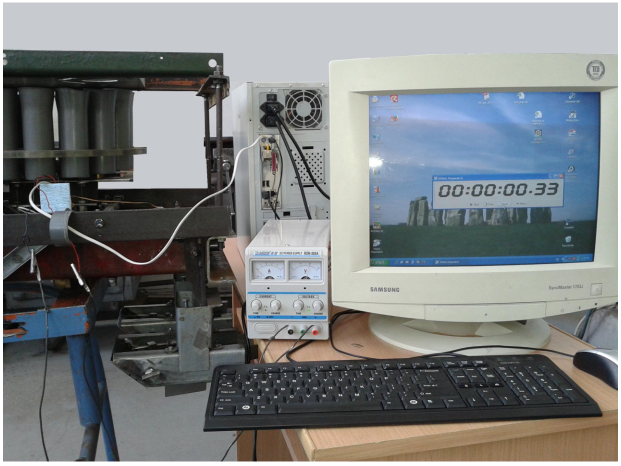
Fig. 2 – Electronic control installation: R1 – 2 kΩ electrical resistance; R2 – 8 kΩ electrical resistance; R3 – 0.560 kΩ electrical resistance; R4 – 2 kΩ electrical resistance; LED 1 – light in infrared emission; LED 2 – light in infrared emission control; MSW – micro-contact; T – control transistor; ND1 – normally open contact; ND2 – normally open contact; S – solenoid; SS9 – PC 9-pin serial port.

The stand operating mode is based on the reciprocating movement of the slide oscillating device as follows:

– at the end of the loaded seedling planting device movement, the micro-contact is actioned, triggering computer timer;

– under the action of springs, oscillating slider device returns to its original position, interrupting the ray emission produced by infrared light phototransistor sensitive to infrared light control and Xnote Stopwatch Timer program performs computer shutdown timer, the recorded time being displayed.

Recorded values are shown in Table 1; the processed data by calculating the average standard deviation, give for the return time planting device the value of 0.3506 ± 0.0025 (s).



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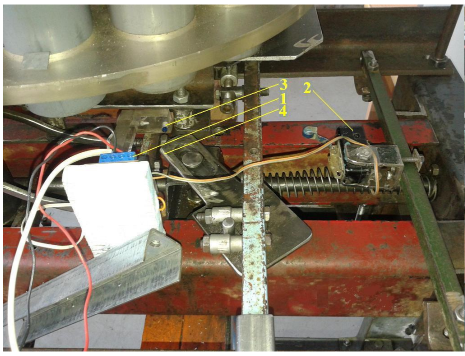
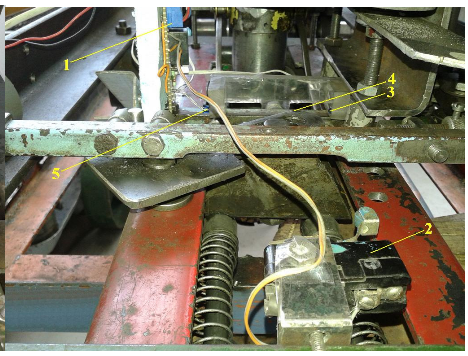




b *c*

Fig. 3 − Installation used to determine the return time of the planting device:
a − general-view; *b*, *c* − mounting details 1 − data acquisition board; 2 − micro-contact; 3 − LED Infrared; 4 − oscillating slider device; 5 − infrared photo transistor.

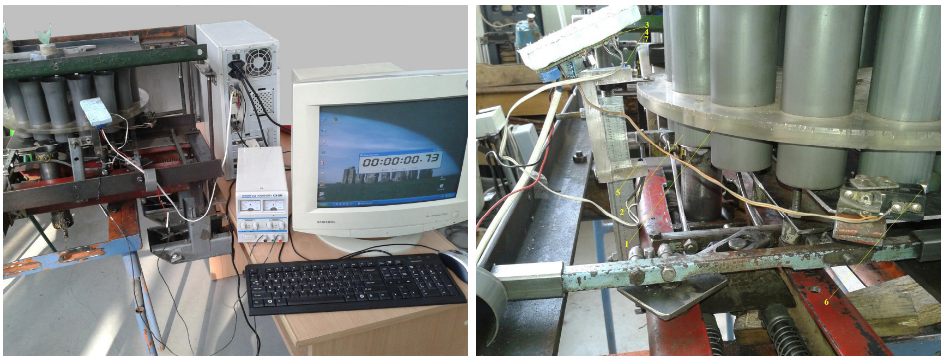
2.2.2. *The Determination of the Distribution Device Permutation Time*

The determination of this time is carried out by the same electronic installation, mounted on the planting machine (Fig. 4), so as to determine the time consumed for a permutation of the distribution device receiving tube, in order to supply the transplanter. The operation is based on the interposition of the shutters, located on the rim of the distribution device, between the infrared light and infrared photo-sensitive transistor, so as to carry out the interruption of the timer (by Xnote Stopwatch Timer Program), initiated by micro contact activated by a tube reception during working process.

The data obtained are shown in Table 2, and data processed by calculating the mean square error of the arithmetic mean leads to the determined time permutation value of 0.7744 ± 0.01492 (s).

Table 1
Measured Values of the Planting Device Return Time

No.	Return time t_{rev} [s]	No.	Return time t_{rev} [s]	No.	Return time t_{rev} [s]
1.	0.37	13.	0.35	25.	0.35
2.	0.34	14.	0.34	26.	0.36
3.	0.36	15.	0.35	27.	0.33
4.	0.38	16.	0.33	28.	0.33
5.	0.36	17.	0.37	29.	0.32
6.	0.35	18.	0.34	30.	0.34
7.	0.33	19.	0.36	31.	0.34
8.	0.35	20.	0.35	32.	0.35
9.	0.36	21.	0.36	33.	0.37
10.	0.33	22.	0.36	34.	0.37
11.	0.33	23.	0.34	35.	0.35
12.	0.37	24.	0.37	36.	0.36



a *b*

Fig. 4 − Apparatus for determining the distribution device permutation time: 1 – distribution device; 2 − reception tube; 3 − acquisition data board; 4 − LED Infrared; 5 − infrared photo transistor; 6 − micro-contact; 7 − shutter.

Table 2
Measured Values of the Permutation Time

No.	Permutation time t_{per} [s]	No.	Permutation time t_{per} [s]	No.	Permutation time t_{per} [s]	No.	Permutation time t_{per} [s]
1.	0.73	5.	0.75	9.	0.87	13.	0.72
2.	0.81	6.	0.84	10.	0.80	14.	0.84
3.	0.76	7.	0.78	11.	0.76	15.	0.69
4.	0.83	8.	0.68	12.	0.83	16.	0.70

3. Conclusions

1. A direct comparison, between both mean values and extreme values of the two quantities that express running times, shows that relation (2) is complied.

2. The determined standard deviations have low values, which indicates both a correct measuring and an appropriate design of the ratchet and return system of the transplanter

3. The calculated values comparison shows that there is still sufficient margin to allow machine operation at higher speeds and for a greater number of spurs.

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CARACTERISTICILE SISTEMULUI DE ALIMENTARE AL UNEI MAŞINI AUTOMATE DE PLANTAT RĂSADURI

(Rezumat)

Timpul de plantare al unui răsad este un indicator calitiv al funcţionării maşinii de plantat care permite determinarea parametrilor funcţionali (viteză de deplasare, frecvenţa plantării) şi economici (capacitatea de plantare a maşinii). De asemenea, mărimea şi structura acestuia determină corelarea funcţionării sistemelor componente ale maşinii.

Lucrarea prezintă condiţia de funcţionare a sistemului de alimentare cu răsaduri, modul de determinare al timpilor de revenire al aparatului de plantare, respectiv al timpului de permutare al aparatului de distribuţie şi verificarea datelor obţinute.