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The Modernization of the MAC – 3 Machines from the Substitution of the Mechanism of the Pressing Room

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Abstract

In this paper is presented the press room of the MAC – 3 machines endowed with two pressing mechanisms, while also showing the advantages of the new system. Also is presented the diagram of the tow pressing mechanisms is also given, while equations are established for determining the speed distribution by using the independent cycle method.

Key words: *MAC – 3 machine, pressing room, pressing mechanism*

Introduction

MAC – 3 machines works in aggregate with U – 650M tractor and is destinated to harvest the stems of corn, sunflower, drying hay put in furrow, creeping stalk of beans, pea etc [1]. The machine works on the ground plane or on the flank with inclination until 10^0 [2]. The material that was added is press and unloads like a hayrick at the extremities of the plots.

MAC – 3 machines had a mechanism for feeding the pressing room, a mechanism with gear quadrant [4]. In place of this mechanism are introduced a new mechanism formed by articulated beams, replaced the gear quadrants of the vehicle mechanism.

Paper Data

In figure 1 is presented the scheme of the pressing mechanism vehicle who is formed from nine mobile elements (the 3 and 4 elements had tow semi crows cogged with contact in point N), 12 superior kinematics couples:

- inferior couples i = A, B, C, D, E, F, G, H, L, K, M, R, P
- superior couples s = N, G.

i = 12 – inferior couples;
s = 2 – superior couples;
m = 9 – mobile elements.

The mobility degree of the mechanism is calculated with the relation (1):

$$M = 3m - 2i - s \tag{1}$$

Therefore: $M = 3 \cdot 9 - 2 \cdot 12 - 2 = 1$

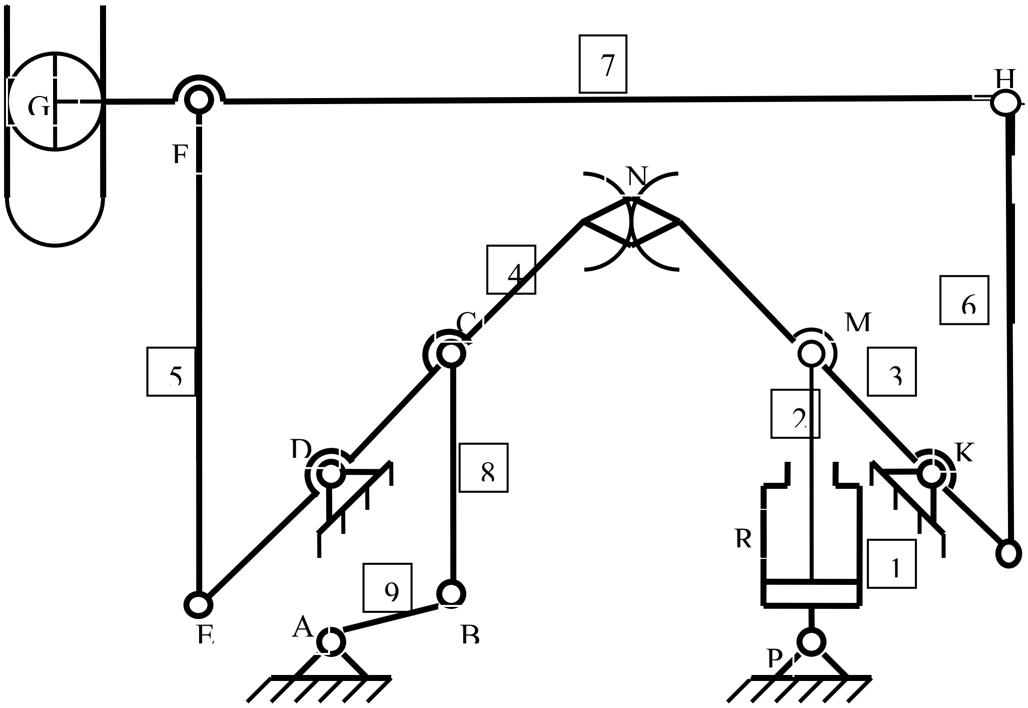

Fig. 1. Scheme of the pressing room vehicle

The old mechanism of pressing have a single degree of freedom therefore is a desmodromic mechanism.

In figure 2 is presented the scheme at the new pressing mechanism, in his composition intervene the 4’ and 7’ elements, also N’, $G^{'}_{CR}$ rotation couples and $G(t)$ translation couple.

At the new mechanism we have a number of 11 mobile elements and 16 inferior kinematics couples.

$$\text{i} = A, B, C, D, E, F, G(t), G^{'}_{(R)}, H, L, K, M, N, N', P, R$$

The mobility degree of the new mechanism is:

G(t) - 7' – G'(R) – 7 – H – 6 – L – 3 – K.

Are observed that the new mechanism have the mobility degree equal to one, just like the old mechanism, therefore and this mechanism is a desmodromic mechanism.

The graph associated at the new mechanism is presented in figure 3. Are observed that is a planar graph with five independent cycles.

Is considerate like bases of independent cycles the outlines of the disjoint interior domains of the graph, therefore we have:

- cycle I: P – 1 – R – 2 – M – 3 – K;
- cycle II: P – 1 – R – 2 – M – 3 – N - 4' - N' – 4 – D;
- cycle III: D – 4 – C – 8 – B – 9 – A;

- cycle IV: A – 9 – B – 8 – C – 4 – E – 5 – F – 7 – G'(R) - 7' – G(t);
- cycle V: G(t) - 7' – G'(R) – 7 – H – 6 – L – 3 – K.

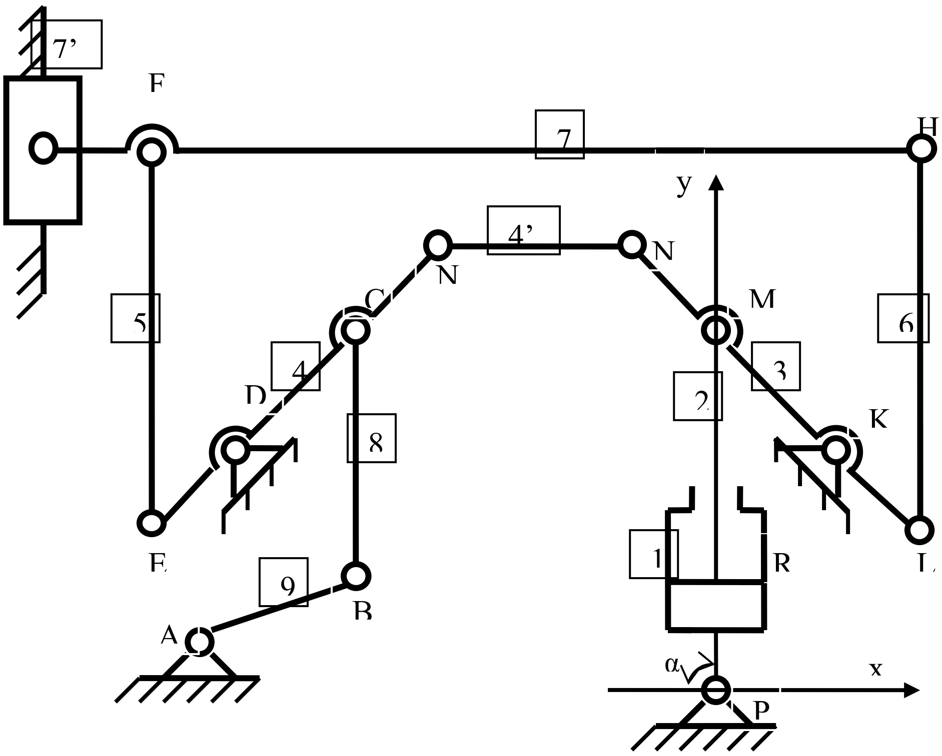

Fig. 2. Scheme of the new pressing mechanism

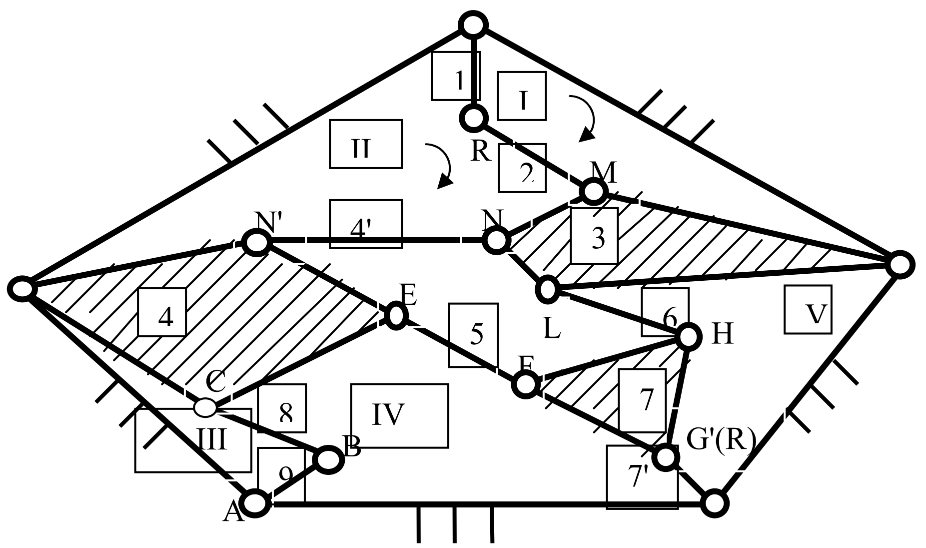

Fig.3. The graph associated to the new pressing mechanism

Considering an axis system x0y in the plane mechanism, with the origin in P, and knowing the *x* and *y* coordinates of the kinematics couples is obtained the equations system (2).

$$\begin{cases} v_{R21}^{x}+v_{M32}^{x}-\omega_1\left(y_R-y_P\right)-\omega_2\left(y_M-y_R\right)-\omega_3\left(y_K-y_M\right)=0 \\ v_{R21}^{y}+v_{M32}^{y}+\omega_1\left(x_R-x_P\right)+\omega_2\left(x_M-x_R\right)+\omega_3\left(x_K-x_M\right)=0 \\ v_{R21}^{x}+v_{M32}^{x}+v_{N4'3}^{x}+v_{N'44'}^{x}-\omega_1\left(y_R-y_P\right)-\omega_2\left(y_M-y_R\right)-\omega_3\left(y_N-y_M\right)- \\ -\omega_{4'}\left(y_{N'}-y_N\right)-\omega_4\left(y_D-y_{N'}\right)=0 \\ v_{R21}^{y}+v_{M32}^{y}+v_{N4'3}^{y}+v_{N'44'}^{y}+\omega_1\left(x_R-x_P\right)+\omega_2\left(x_M-x_R\right)+\omega_3\left(x_N-x_M\right)- \\ -\omega_{4'}\left(x_{N'}-x_N\right)-\omega_4\left(x_D-x_{N'}\right)=0 \\ v_{C84}^{x}+v_{B98}^{x}-\omega_4\left(y_C-y_D\right)-\omega_8\left(y_B-y_C\right)-\omega_9\left(y_A-y_B\right)=0 \\ v_{C84}^{y}+v_{B98}^{y}+\omega_4\left(x_C-x_D\right)+\omega_8\left(x_B-x_C\right)+\omega_9\left(x_A-x_B\right)=0 \\ v_{B89}^{x}+v_{C48}^{x}+v_{E54}^{x}+v_{F7'5}^{x}+v_{G'7'7}^{x}-\omega_9\left(y_B-y_A\right)-\omega_8\left(y_C-y_B\right)-\omega_4\left(y_E-y_C\right)- \\ -\omega_5\left(y_F-y_E\right)-\omega_{7'}\left(y_G-y_{G'}\right)=0 \\ v_{B89}^{y}+v_{C48}^{y}+v_{E54}^{y}+v_{F7'5}^{y}+v_{G'7'7}^{y}+\omega_9\left(x_B-x_A\right)+\omega_8\left(x_C-x_B\right)+\omega_4\left(x_E-x_C\right)+ \\ +\omega_5\left(x_F-x_E\right)-\omega_{7'}\left(x_G-x_{G'}\right)=0 \\ v_{G7'0}^{x}+v_{G'77'}^{x}+v_{H67}^{x}+v_{L36}^{x}-\omega_{7'}\left(y_{G'}-y_G\right)-\omega_7\left(y_H-y_{G'}\right)-\omega_6\left(y_L-y_H\right)- \\ -\omega_3\left(y_K-y_L\right)=0 \\ v_{G7'0}^{y}+v_{G'77'}^{y}+v_{H67}^{y}+v_{L36}^{y}+\omega_{7'}\left(x_{G'}-x_G\right)+\omega_7\left(x_H-x_{G'}\right)+\omega_6\left(x_L-x_H\right)+ \\ \omega_3\left(x_K-x_L\right)=0 \end{cases} \tag{2}$$

The kinematics conditions from bundles are presented in form (3)

$$\begin{array}{ll} \dfrac{v_{R21}^{y}}{v_{R21}^{x}}=-tg\alpha & v_{E54}^{x}=v_{E54}^{y}=0 \\ v_{M32}^{x}=v_{M32}^{y}=0 & v_{F75}^{x}=v_{75}^{y}=0 \\ v_{N4'3}^{x}=v_{N4'3}^{y}=0 & v_{G77'}^{x}=v_{G77'}^{y}=0 \\ v_{N'44'}^{x}=v_{N'44'}^{y}=0 & v_{G7'0}^{x}=0 \\ v_{C48}^{x}=v_{C48}^{y}=0 & v_{H67}^{x}=v_{H67}^{y}=0 \\ v_{B98}^{x}=v_{B98}^{y}=0 & v_{L36}^{x}=v_{L36}^{y}=0 \end{array} \tag{3}$$

Introducing the conditions (3) in equations system (2) is obtained the equations system (4).

$$
\begin{cases}
v_{R21}^{x} - \omega_1\left(y_R - y_p\right) - \omega_1\left(y_M - y_R\right) - \omega_3\left(y_K - y_M\right) = 0 \\
-v_{R21}^{x} tg\alpha + \omega_1\left(x_R - x_P\right) + \omega_1\left(x_M - x_R\right) + \omega_3\left(x_K - x_M\right) = 0 \\
v_{R21}^{x} - \omega_1\left(y_R - y_P\right) - \omega_1\left(y_M - y_R\right) - \omega_3\left(y_N - y_M\right) - \omega_{4'}\left(y_{N'} - y_N\right) - \\
-\omega_4\left(y_D - y_{N'}\right) = 0 \\
-v_{R21}^{x} tg\alpha + \omega_1\left(x_R - x_P\right) + \omega_1\left(x_M - x_R\right) + \omega_3\left(x_N - x_M\right) + \omega_{4'}\left(x_{N'} - x_N\right) + \\
+\omega_4\left(x_D - x_{N'}\right) = 0 \\
-\omega_4\left(y_C - y_D\right) - \omega_8\left(y_B - y_C\right) - \omega_9\left(y_A - y_B\right) = 0 \\
\omega_4\left(x_C - x_D\right) + \omega_8\left(x_B - x_C\right) + \omega_9\left(x_A - x_B\right) = 0 \\
-\omega_9\left(y_B - y_A\right) - \omega_8\left(y_C - y_B\right) - \omega_4\left(y_E - y_C\right) - \omega_5\left(y_F - y_E\right) = 0 \\
\omega_9\left(x_B - x_A\right) + \omega_8\left(x_C - x_B\right) + \omega_4\left(x_E - x_C\right) + \omega_5\left(x_F - x_E\right) = 0 \\
-\omega_7\left(y_H - y_{G'}\right) - \omega_6\left(y_L - y_H\right) - \omega_3\left(y_K - y_L\right) = 0 \\
\omega_7\left(x_H - x_{G'}\right) + \omega_6\left(x_L - x_H\right) + \omega_3\left(x_K - x_L\right) = 0 \\
-\omega_6\left(y_L - y_H\right) - \omega_3\left(y_K - y_L\right) = 0 \\
\omega_6\left(x_L - x_H\right) + \omega_3\left(x_K - x_L\right) = 0
\end{cases}
\tag{4}
$$

The constructive conditions are:

$$
\begin{aligned}
&\omega_1 = \omega_2 = \ldots\ldots\ldots\ldots \\
&\omega_{7'} = 0 \\
&\omega_7 = \omega_{41} = 0
\end{aligned}
\tag{5}
$$

Introducing in system (4), the constructive conditions is obtained the equation system (6).

$$
\begin{cases}
v_{R21}^{x} - \omega_1\left(y_M - y_p\right) - \omega_3\left(y_K - y_M\right) = 0 \\
-v_{R21}^{x} tg\alpha + \omega_1\left(x_M - x_P\right) + \omega_3\left(x_K - x_M\right) = 0 \\
v_{R21}^{x} - \omega_1\left(y_M - y_P\right) - \omega_3\left(y_N - y_M\right) - \omega_4\left(y_D - y_{N'}\right) = 0 \\
-\omega_4\left(y_C - y_D\right) - \omega_8\left(y_B - y_c\right) - \omega_9\left(y_A - y_B\right) = 0 \\
\omega_4\left(x_C - x_D\right) + \omega_8\left(x_B - x_C\right) + \omega_9\left(x_A - x_B\right) = 0 \\
-\omega_9\left(y_B - y_A\right) - \omega_8\left(y_C - y_B\right) - \omega_4\left(y_E - y_C\right) - \omega_5\left(y_F - y_E\right) = 0 \\
\omega_9\left(x_B - x_A\right) + \omega_8\left(x_C - x_B\right) + \omega_4\left(x_E - x_C\right) + \omega_5\left(x_F - x_E\right) = 0 \\
\omega_6\left(x_L - x_H\right) + \omega_3\left(x_K - x_L\right) = 0
\end{cases}
\tag{6}
$$

The equations system (6) is a homogeneous system of eight kinematic unknowns who can be determinated.

The kinematic unknowns are: $v_{R21}^{x}, \omega_1, \omega_3, \omega_4, \omega_5, \omega_6, \omega_8, \omega_9$. These unknowns can be determinate from the equations system (6) who is a homogeneous system.

Having angular speeds and translation speeds of the mechanism with the help of the fundamentals of the apparent speed be determinate the maximum value of the pressing force.

Conclusions

Replacing of the old mechanism of the machine, lead at a better working, from removing the frictions and vibrations from gear quadrants to a metal economy and at a constructive achievement more simple.

References

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Modernizarea maşinii MAC-3 prin înlocuirea mecanismului camerei de presare

Rezumat

Lucrare prezintă camera de presare a maşinii MAC – 3, dotată cu două mecanisme de presare, şi de asemenea sunt arătate avantajele noului sistem. De asemenea este prezentată şi diagrama mecanismului de presare, fiind stabilite ecuaţiile pentru determinarea distribuţiei de viteze utilizând metoda ciclurilor independente.