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THE MACHINERY THAT DRAWS OUT THE STALKS FROM CHEERIES AND SOUR CHEERIES

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Summary: The machinery that draws out the stalks from cherries and sour cherries' main purpose, as its name also says it, is to draw out the stalks from cherries and sour cherries, which are than used to obtain the cherries and sour cherries compote.

The principle of this machinery consists in the tangential garbing of the stalks, pulling them and detaching them from the actual fruit. In order to increase the friction, the rods are covered in white alimentary rubber, obtained throw rapping the rods with a hose. This is the way to draw out the stalk without harming the fruit. After detaching the stalks, the fruits roll along the rods, which form an inclined plane, they are collected on a transporting strip and introduced in the technological flux.

1 Procedural

The procedural of this machinery includes three stages: grabbing the stalks between the rods, pulling them off and detaching them.

a) In the first stage, the one of grabbing the stalks between the rods, the stalk is being grabbed with a certain strength (=Q). This force produces between the rod and the stalk the force $\overline{N}$ and the friction force $\overline{F}$, where $F = f_t N$.

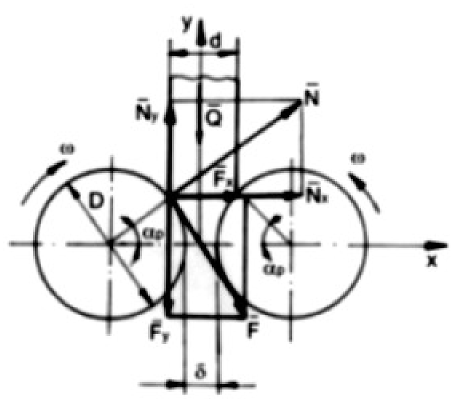

Fig.1

The grabbing is completed if:

$F_y > N_y$ (1)

Results

$\alpha_p \triangleleft e_t$ (2)

$$cos\,\alpha_p = 1 - \frac{d-\delta}{D} \quad (3)$$

where:

D – the rod's diameter; d – the stalks diameter in the grabbing section;

δ - Distance between the rods

b) In the second stage, the one of extraction, the stalk gets between the rods and is being rolled.

The action of the rods can be explained with the forces $\overline{N_t}$ and $\overline{F_t}$.

The $\overline{F_t}$ force is the resultant of the friction forces between the rod and the stalk, and its extreme value is:

$F_t = f_t N_t$,

where

$F_t = tge_t$;

e_t – the friction angle between the rod and the stalk

In order for the stalk to be pulled off throw the rods, either the

$F_{ty} > N_{ty}$ (4)

Condition has to be accomplished, or $N_t \sin\alpha_1 < N_t f_t \cos\alpha_1$ which results

$\alpha_1 < e_t$ (5)

$\overline{N_{tx}}$, $\overline{F_{tx}}$ components of the resultants $\overline{N_t}$ and $\overline{F_t}$ cause the transversal deformation of the stalks from the initial dimension „d" to the „δ" dimension (the distance between the rods), and the components $\overline{N_{ty}}$ and $\overline{F_{ty}}$ produce the extraction of the stalks.

The relative deformation of the stalks becomes:

$$\psi = \frac{d - \delta}{d} \qquad (6)$$

The continuity and the extraction of the stalks in the case of the rods is assured if the transversal deformation is done without changing the perimeter of the section. This is possible if the relative deformation $\psi \leq 0{,}9$. The rolling angle of the stalk is shown in picture no. 2.

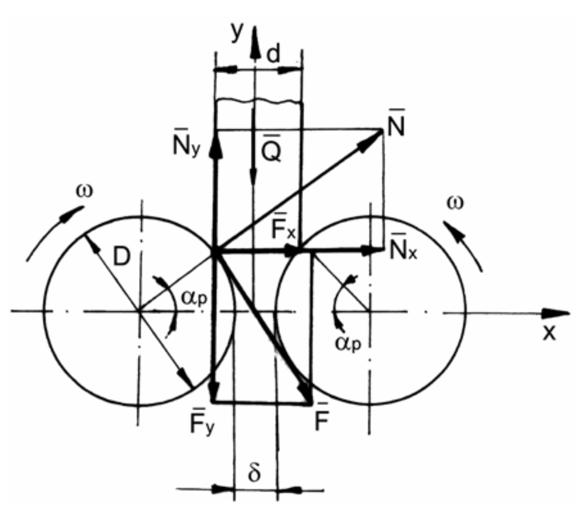

Fig.2

c) The detachment force begins the moment the fruit touches the surface of the rods. The cheery, having a larger diameter than the stalk can't get pass the rods and it opposes to the extraction of the stalk. From this moment on, the stalk is not only transversally deformed, but also stretched.

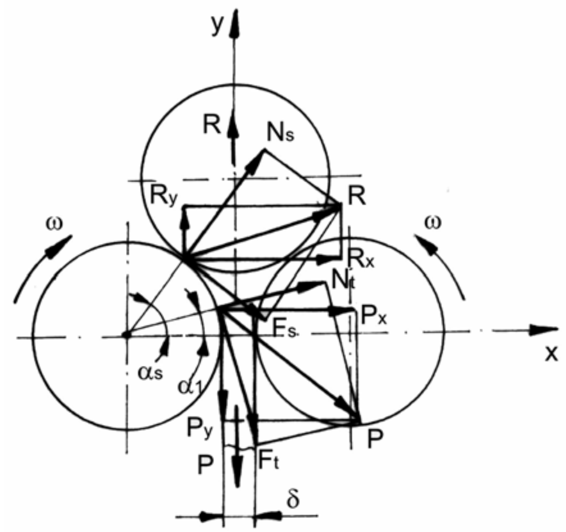

Fig.3

The bond between the fruit and the stalk breaks, as having a low resistance.

The stalk is extracted and passes throw the rods, whereas the fruit rolls on the inclined plane and is being introduced in the technological flux.

The maximum force $\overline{T}$ for extracting the stalks is:

$$T = 2P_y = 2N_t\left(f_t \cos\alpha_1 - \sin\alpha_1\right) \qquad (7)$$

The extracting force $\overline{T}$ also produces, in the leaning points of the fruits on the rods, the perpendicular forces $\overline{N_s}$ and the friction forces F_s. The maximum values of this force are:

$$N_s = \frac{T}{2\sin\alpha_s}; \qquad F_s = f_s N_s \qquad (8)$$

Where:

α_s – leaning angle of the fruit on the rod ;

f_s – the friction coefficient between the fruit and the rod

In order for the fruit not to roll between the rods the $N_{sy} > F_{sy}$ condition has to be accomplished; which means: $N_s \sin\alpha_s > f_s N_s \cos\alpha_s$ and this concludes that:

$$\alpha_s > e_s \qquad (9)$$

Where:

e_s – the friction angle between the fruit and the rod.

If the $a_s > e_s$ condition is accomplished the fruit is pulled by a rod with the force:

$$R_y = N_s(\sin\alpha_s > f_s \cos\alpha_s) \qquad (10)$$

The total force for rejecting the fruit is $R = 2R_y$.

Relation (10) shows that the rejecting force R_y, grows once with the leaning angle α_s, and decreases when the friction coefficient f_s between the fruit and the rod grows.

The elements in picture no. 2 conclude:

$$\cos\alpha_s = 1 - \frac{d-\delta}{D} \quad (11)$$

The leaning angle α_s grows, when the rod's diameter D and the distance between the rods δ decrease.

The extracting of the fruit is completed if the condition: $R > R_r < T_{(12)}$ is accomplished. Where

R_r – The breaking resistance of the fruit-stalk bound.

If you take into consideration relations (7), (8) and (10) and the fact that

$f_t = tge_t$, $f_s = tge_s$, (12)

Than relation (12) becomes:

$$\frac{2N_t(e_t-\alpha_t)\sin(e_s-\alpha_s)}{\sin\alpha_2\cos e_t\cos e_s} \triangleright \frac{2N_t\sin(e_t-\alpha_1)}{\cos e_t} \quad (13)$$

In this conditions a transversal compression is applied to the fruit:

$$R_x = \frac{Nt\sin(e_t-\alpha_1)\cos(\alpha_2-e_s)}{\sin\alpha_2\cos e_t\cos e_s} \quad (14)$$

The R_x force produces the transversal deformation of the fruit. The R_x component decreases, whereas the R_y component grows, when the rod's diameter D, decreases. If we decrease the diameter D, the grabbing condition becomes worse and so the stalk's extracting force decreases.

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