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THE THEORETICAL AND PRACTICAL ASPECTS RESPECTING THE PARAMETER CALCULATION FOR AN FLOAT BOWL

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Abstract : In this article are presented details for the realization of an solar heating water instalation of small dimentions, portable, with natural circulation (based on termosiphon), oriented after the sun, integral demountable used for camping. This instalation presents a series of inovations for operation, easy demounthing and this instalation can be transported, and the volum of heat water is the volum of water that is consume. Another novelty in this area for this instalation is the existence of an float bowl which was projected in the way to avoid the block of this between the circular bowl wall and can be turnover. Are presented calculation to prevent the self locking and the float bowl turnover.

1. Introduction

The increasing number of habitants and the increasing of technology from the last century create semnificative problems at global level, in the way of covering the energy needs that are very high. The fear that the existing resources of fossil fuel will be exhausted in present, and now must be find other alternative sources of energy. More, when we will cover the energy needs in principal for the burning of fossil fuel, the impact for the medium will be considerable. The technologies based on renewable energy have a large advantage because they used inexhaustible resources, low poluted, with insignificant changing contribution at the climatic changings. The objective of the thesis of doctorat is to realised a heat water instalation of small dimensions (~20 l heat water and one volum „pliat" of ~ 0.35 m^3), portble, natural circulation (with termoiphon), orientated after the sun, integal demounthing, for use in champing. This instalation besides that increase the confort at champing (fgive 30 – 40 l heat water in batch) represent an inovation in the field of solar instalation with natural circuit – for operation, easy demounthing and this instalation can be transported. The bowl in which will be the heat water stocked present some inovative solutions and special the exitence of an float bowl which have caught in the lower part (centric) with a spiral pipe which will assume the heat water and in this way will be send to the solar collector. In the next figures are presented the prototype instalation:

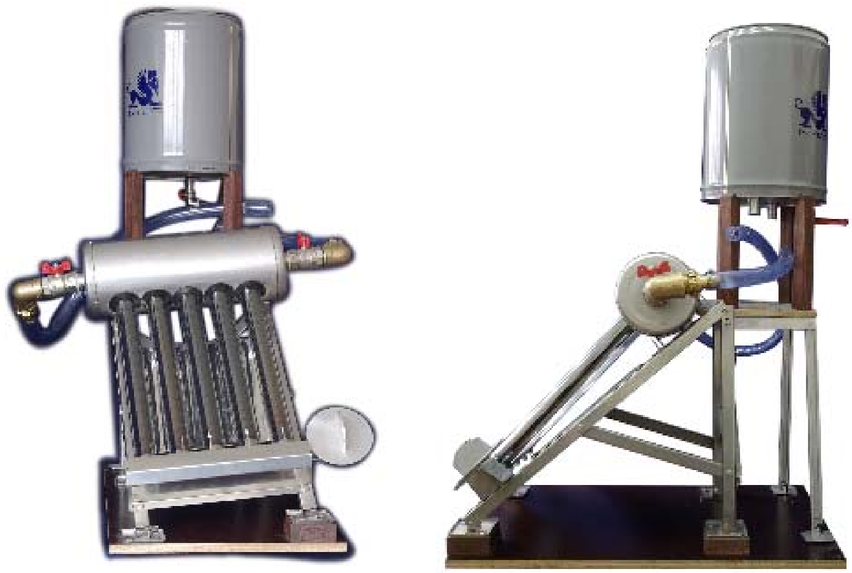

Fig.1.

2. Hystory of the problem

In the papers „ The interdependence between the blocking and the yawn of the translation couple with invariable dimensions" [1] and „The interdependence between the blocking and the yawn of the translation couples with variable dimensions" [2] tackle for the first time more detail in the problem of blocking the mobile semicouple which are comprisedin a fixed semicouple.

In this paper has been presented a special situation when the coefficients of friction from the points of bearing are diffrent. Because of the hypothesis of simplification the results from this paper can't be used.

3. Hypothesis and calculations

The portable instalation of water heating have a new major novelty for the volum of water heat is the same with the volum of water which is comsumpted. Because of this the instalation heat a variable volume of water which in time will be low. Can be made the hypothesis that the volume remission can be made in steps, because the time when the water discharge is very short in ratio with the time when the water is heating.

The bowl of water is circular and have a float bowl circular. When the instalation is designed, can start from an interior diameter given by the bowl (a semicouple comprehensive fixed), from which can be determine the float bowl dimensions (mobile semicouple comprehensive).

The material recommended for the bowl is non oxidable pipe or sheet tested against corroding. The material recommended is the polystyrene expanded. The depth can be analyse from condition that the superior part of the float bowl to be above water, that is under the forces action which are oriented from up to down from the spiral pipe, the float pipe can't be immersed entire. Can be made specific calculations, relative simple in this case.

Were used the next symbols:

- D - the internal diameter of the bowl;
- d - diameter of the float bowl;
- j - the yawn between float bowl and the bowl;
- φ_A - the angle of friction between float bowl and bowl wall in the immersed area;
- φ_B - the angle of friction between float bowl and bowl wall in the non immersed area;
- q - the radius area from which begin the blocking;
- $\mu_A = miuA = tg\varphi_A$ - coefficient of friction between float bowl and bowl wall in the immersed area;
- $\mu_B = miuB = tg\varphi_B$ - coefficient of friction between float bowl and bowl wall in the non immersed area.

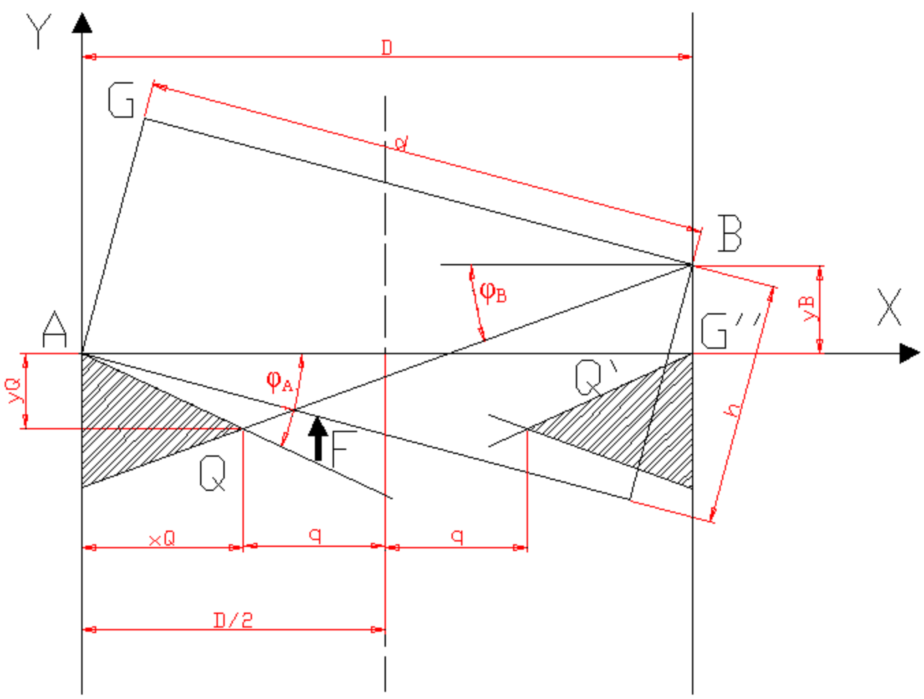

Fig.1.

Is given : D, j, h, φ_A, φ_B, D-j=d

Is asked :

$$q = \frac{D}{2} - X_Q$$

A is the origin of the system xAy

$$X_B = D$$

From the triangle AGB results

$$AB = \sqrt{h^2 + d^2} = \sqrt{h^2 + (D - j)^2}$$

From the triangle AG”B results:

$$y_B = \sqrt{AB^2 - D^2} = \sqrt{h^2 + (D - j)^2 - D^2}$$

Is observed ca y_B is negative

In this case ,

$$h^2 + d^2 = D^2 = AB^2$$

then y_B =0 (the limited case when $G'' \equiv B$)

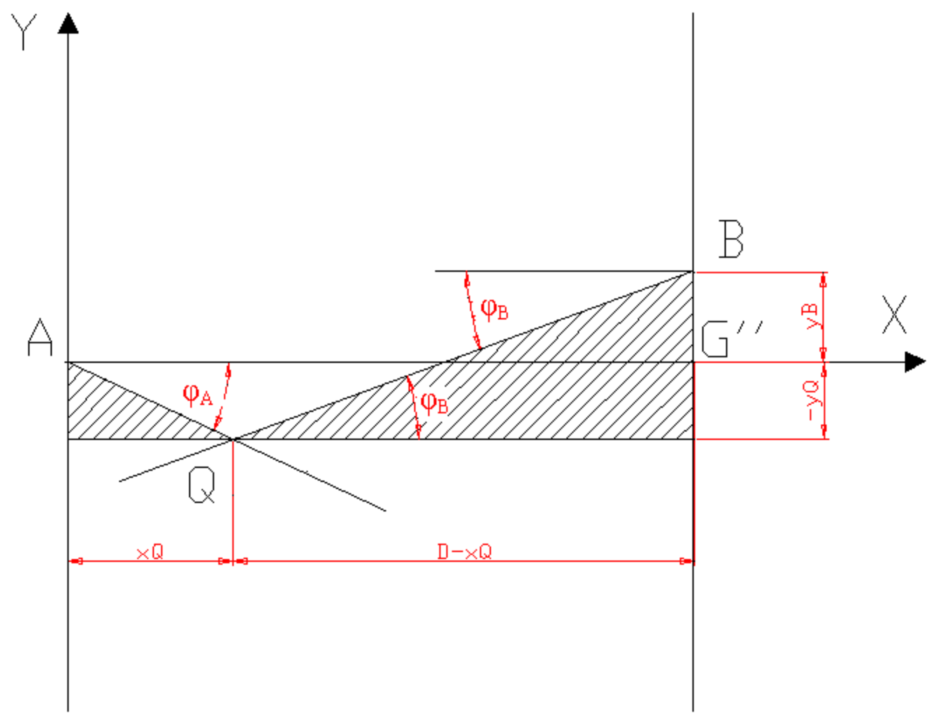

Fig. 2.

$$\frac{Y_B - Y_Q}{D - X_Q} = \tan(\phi_B) = \mu_B$$

$$\frac{(D \cdot \mu_B) - \sqrt{h^2 + (D - j)^2 - D^2}}{\mu_A + \mu_B}$$

$$Y_B = \sqrt{h^2 - 2 \cdot D \cdot j + j^2}$$

Control : j=0, results

$$Y_B = \sqrt{h^2} = h$$

Accordingly we have:

$$\frac{D \cdot \mu_B - \sqrt{h^2 - 2 \cdot D \cdot j + j^2}}{\mu_A + \mu_B} = X_Q$$

4. The condition of being problem of the yawn j

The problem is laying in using the limit yawn $j_{\lim}$ an which is produced the turnover the float bowl.

$j_{\lim} \Rightarrow AB$=D

For any j at which AB<D can produce the turnover

Then is begin from:

$$\begin{cases} AB = D \\ h^2 + d^2 = AB^2 \\ j_{\lim} = D - d \end{cases}$$

$$j_{\lim} = D - \sqrt{D^2 - h^2}$$

Accordingly j< $j_{\lim}$

At design must be put an certain yawn: j_{impus}

For the turnover can't made, j must be strict more lower then $j_{\lim}$, that is $j_{impus} = j < j_{\lim}$.

5. The determination of amount of blocking related in the interior semicouple comprehensive.

The situation of the area of blocking in the interior semicouple comprehensive fixed presents interested for an large raport or a very large between the semicouple mobile comprised (d) and the height (h)

The analitical condition: $X_Q > 0 \Rightarrow D \cdot \mu_B - \sqrt{h^2 - 2 \cdot D \cdot j + j^2} > 0$

The calculation are succed:

$$D \cdot \mu_B > \sqrt{h^2 - 2 \cdot D \cdot j + j^2} \Rightarrow D^2 \cdot {\mu_B}^2 > h^2 - 2 \cdot D \cdot j + j^2$$

$$D^2 \cdot {\mu_B}^2 - h^2 + 2 \cdot D \cdot j - j^2 > 0$$

$$j^2 - 2 \cdot D \cdot j + h^2 - D^2 \cdot {\mu_B}^2 < 0$$

$$\Delta' = D^2 - h^2 + D^2 \cdot {\mu_B}^2 = D^2 \cdot (1 + {\mu_B}^2) - h^2$$

Is necessary that $\Delta' \geq 0 \Rightarrow D^2 \cdot (1 + {\mu_B}^2) - h^2 \geq 0$

$$\left.\begin{aligned} & h^2 \le D^2 \cdot (1+\mu_B{}^2) \Rightarrow h \le D \cdot \sqrt{1+\mu_B{}^2} \Rightarrow h \le D \cdot \sqrt{1+tg^2\varphi} \\ & tg\varphi = \frac{\sin\varphi}{\cos\varphi} \end{aligned}\right\} \text{result}$$

$$h \le D \cdot \sqrt{1+\frac{\sin^2\varphi}{\cos^2\varphi}}$$

So $h \le \dfrac{D}{\cos\varphi_B}$

If $AB = \dfrac{D}{\cos\varphi_B}$ is arriving at limited case which is connected at $h \le \dfrac{D}{\sqrt{1+\mu_B{}^2}}$

In reality h<<D and thenthis condition is always default (is take in count the values for μ_B).

Is existing the case when $h \cong \dfrac{D}{\sqrt{1+\mu_B{}^2}}$. Is obvieus that in this case isn't an practical interes, because h is near to D.
Is recomanding o - h very low, is not diminuated the amount useful volume of water from the bowl.

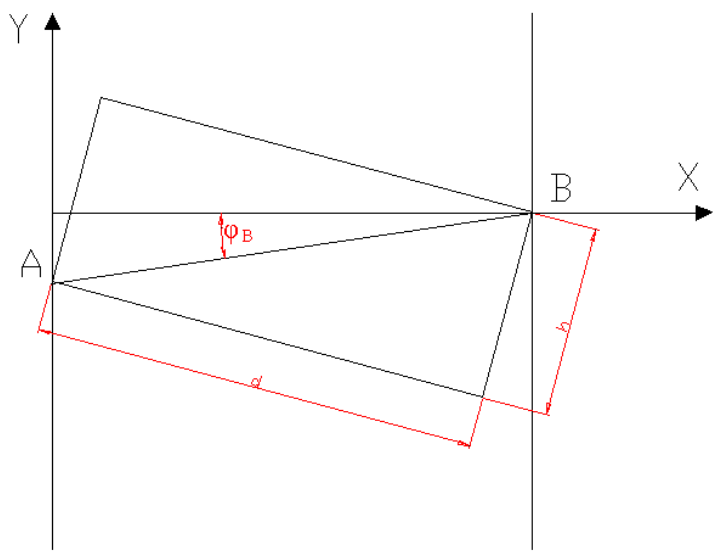

Fig.3.

The formula for this case is: $d^2 + h^2 = \dfrac{D}{\cos\varphi} = AB$

Is resume the relation : $j^2 - 2 \cdot D \cdot j + h^2 - D^2 \cdot \mu_B{}^2 < 0 \Rightarrow j \in (j_1, j_2)$.

For the area of blocking which is in the interior of semicouple comprehensive, must be: $j \in (j_1, j_2)$.

$$j_1 = D - \sqrt{\Delta'} \text{ si } j_2 = D + \sqrt{\Delta'},$$

Then $\Delta' = D^2(1+\mu_B{}^2) - h^2$, si $\Delta' > 0$

If $j_1 < 0$, then $j_1 \in (0, j_2)$.

Practical, $j \in (j_{\min}, j_{\max})$

- $j_{\min} = 0$, if $j_1 < 0$
- $j_{\min} = j_1$ if $j_1 > 0$
- $j_{\max} = j_2$ if $j_2 < j_{\lim}$ - theoretical relation
- $j_{\max} = j_{\lim}$ if $j_2 > j_{\lim}$

For the current values of μ, $j_{\lim} << j_2$ which will lead $j \in (j_1, j_{\lim})$

6. Friction coefficient determination

For determination of μ_A si μ_B in condition of close reality is design the special mobile semicouple. Are obtained the next results:

Table nr.1

Low and medium quota at rul tribometer on moist			Low and medium quota at dark tribometer on moist		
Small interpolation value	Medium interpolation value	Interpolation average	Small interpolation value	Medium interpolation value	Interpolation average
0,2872	0,2880	0,2876	0,3432	0,3410	0,3421
0,2895	0,2896	0,2896	0,3200	0,3311	0,3256
0,2862	0,2861	0,2862	0,3119	0,3140	0,3130
0,2864	0,2869	0,2867	0,3494	0,3497	0,3496
0,3054	0,3058	0,3056	0,3457	0,3456	0,3457
0,3030	0,3040	0,3035	0,3567	0,3588	0,3578
0,2897	0,2911	0,2904	0,3321	0,3350	0,3336
0,2995	0,2998	0,2997	0,3418	0,3408	0,3413
		0,2929			0,3039

Table nr.2

Low and medium quota at dark tribometer on moist			Low and medium quota at rul tribometer on moist		
Small interpolation value	Medium interpolation value	Interpolation average	Small interpolation value	Medium interpolation value	Interpolation average
0,3110	0,3040	0,3075	0,3208	0,3216	,3212
0,3210	0,3070	0,3140	0,2869	0,2880	,2875
0,3636	0,2981	0,3309	0,3676	0,3682	,3679
0,4061	0,3241	0,3651	0,3399	0,3407	,3403
0,3642	0,2827	0,3235	0,3183	0,3180	,3182

0,3266	0,3068	0,3167	0,3370	0,3381	,3376
0,3180	0,2920	0,3050	0,3398	0,3402	,3400
0,3832	0,3262	0,3547	0,3164	0,3175	,3170
		0,3245			,3290

7. The case of prototype made

The case of prototyping realized is used an bowl which at the superior area, implement an easy strangulation. In this case the dates with which was worked are:

Table nr.3

D	h	j	d	j lim	miu A	miu B	xQ
284,00	96,00	0,00	284,00	16,72	0,31600	0,32700	-4,87
284,00	96,00	1,00	283,00	16,72	0,31600	0,32700	-0,21
284,00	96,00	2,00	282,00	16,72	0,31600	0,32700	4,60

Meaning $\Delta' < 0$ is the fact that float bowl default the condition of turnover. For this can't be made the prototype realised with the balancing all the forces from up and down in the way that the float bowl to be not turnover. The balancing have the aim to bring the results for the direct forces from up and down near to the symmetry axis of the float bowl.

8. Indication of design

If is worked with an internal diameter medium of the bowl like the one from the prototype, is recommending the next values which are calculated: D=284cm, h=96cm.
Is observed from the table that the variants proposed from the blocking area is an collar with width equal with X_Q, the external radius is equal with an internal radius of the bowl and at width under 80mm.

Bibliography:

[1] Prof. Dr. Ing. Seban BOBANCU, The interdependence between the blocking and the yawn of the translation couple with invariable dimensions,1982, Prasic
[2] Prof. Dr. Ing. Seban BOBANCU, The interdependence between the blocking and the yawn of the translation couples with variable dimensions,1982, Prasic