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THE EFFECT OF THE LEGHT TO THE FRICTION RESISTANCE IN THE HYDRAULIC ASSEMBLING FORMS BY TWO CONDENSERS AND ONE FRICTION RESISTANCE

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ABSTRACT
In this paper we show some equations for the experimental results to the series assembling forms by two condensers and one friction resistance in the hydraulic system with the alternant flow. We calculated the formula for the length to the friction resistance in this application and we are certificated by the experimental result the effect of this by function of diameter.
Keywords: sonic pressure, temperature**,** friction coefficient, sonic installation, series assembling.

1. GENERAL NOTIONS

The precision of the analyzed, projection and realized to the automat system depended in good measure by the possibility to the complete modulation, by equation, to the characteristics to the same components or groups of components.
Same is important the precise determination to the value of the same constants by equation, and with them we can establish the frequencies functions.

2. THE SERIES ASSEMBLING BY TWO CONDENSERS AND THE FRICTION RESISTANCE

For establish the mathematical of the mono-phases models series assembling us drawing the system (figure 1).

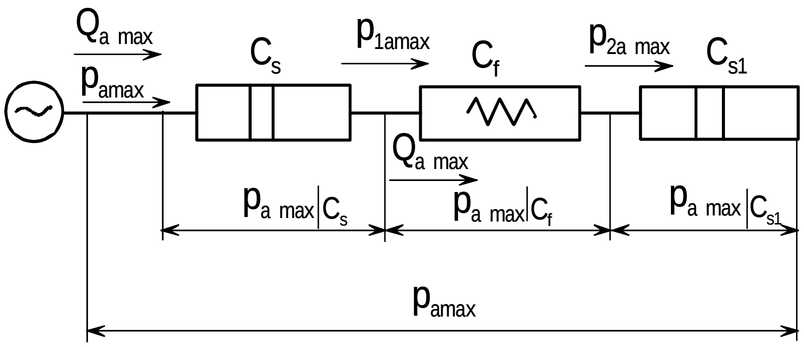

Figure1. The sonic circuit with the friction resistance series assembling

The system are composed by one sonic generator G_S who produce the sonic flow, the generator are connecting in series by one pipe with the friction resistance C_f (R_f), who absorb the energy adapted for upper the temperature by sonic flow. The friction resistance is connected by one capacity C_S. This capacity has the cylindrical form contain fluid. The friction resistance is connecting to the C_{S1} cylinder capacity.
The instantaneous flow Q_i give by the generator produce in the pipe one variation to the instantaneous pressure to be due to the effect combine by the friction, inertia and perditance.
Know the generator parameters, the angular speed ω, the capacity of the condenser Cs, we can realized one mathematical model with we can calculated: the sonic flow $Q_{a\,max}$, the sonic pressure p_{amax}, and the mechanical work realized by the generator and to absorb for to warm the friction resistance. If in this case of the installation we are used the short pipe we can considerate the loss in the pipe negligible.

Know the generator parameters, the angular speed ω, the capacity of the condensers Cs and C_{s1},, we can realized one mathematical model with we can calculated: the sonic flow $Q_{a\,max}$, the sonic pressure p_{amax}, and the mechanical work realized by the generator and to absorb for to warm the friction resistance.

For the assembling in series we can write the equation:

$$\bar{p}_{a\,max}\Big|_{C_s} = -j\frac{\bar{Q}_{a\,max}}{\omega \cdot C_s}; \tag{1}$$

$$\bar{p}_{a\,max}\Big|_{C_{fs}} = C_f \cdot \bar{Q}_{a\,max}; \tag{2}$$

$$\bar{p}_{a\,max}\Big|_{C_{s1}} = -j\frac{\bar{Q}_{a\,max}}{\omega \cdot C_{s1}} \tag{3}$$

When the elements of the circuit are assembling in series Cs, C_f and C_{s1}, the sonic pressure of the extremity installations can be:

$$\bar{p}_{a\,max} = \bar{p}_{a\,max}\Big|_{C_s} + \bar{p}_{a\,max}\Big|_{C_f} + \bar{p}_{a\,max}\Big|_{C_{s1}} \tag{4}$$

Replace in the relation (1), (2) and (3) in relation (3) results:

$$\bar{p}_{a\,max} = \bar{Q}_{a\,max}\left(C_f - j\frac{C_s + C_{s1}}{\omega C_s C_{s1}}\right)$$

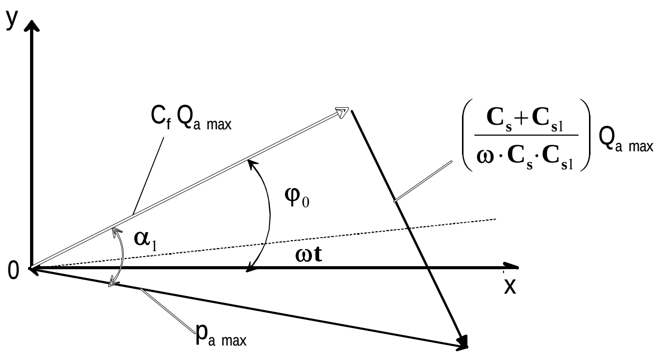

Figure 2. The vector diagram of the sonic series assemblina

(5)The vector $\bar{p}_{a\,max}$ is a result of the $C_f \cdot \bar{Q}_{a\,max}$ vector and to the $\frac{C_s + C_{s1}}{\omega \cdot C_s \cdot C_{s1}}$ vector emphases ahead of $Q_{a\,max}$ with $-\frac{\pi}{2}$ (figure 2).

In module the $p_{a\,max}$ have the relation $|p_{a\,max}| = \sqrt{Re^2 + Im^2}$ and obtains:

$$p_{a\,max} = \sqrt{Q_{a\,max}^2\, C_f^2 + Q_{a\,max}^2\left(\frac{C_s + C_{s1}}{\omega \cdot C_s \cdot C_{s1}}\right)^2} = Q_{a\,max}\sqrt{C_f^2 + \left(\frac{C_s + C_{s1}}{\omega \cdot C_s \cdot C_{s1}}\right)^2}$$

$$p_{a\,max} = Q_{a\,max}\sqrt{C_f^2 + \left(\frac{C_s + C_{s1}}{\omega \cdot C_s \cdot C_{s1}}\right)^2} \tag{6}$$

By relation (6) result:

$$Q_{a\,max} = \frac{p_{a\,max}}{\sqrt{C_f^2 + \left(\frac{C_s + C_{s1}}{\omega \cdot C_s \cdot C_{s1}}\right)^2}} \tag{7}$$

In relation (6) the $p_{a\,max}$ components is in phases with $Q_{a\,max}$ and he produce the mechanical work, this is:

$$p_{a\,max} = C_f \cdot Q_{a\,max} \tag{8}$$

and the mechanical capacity absorbed are:

In relation (5) the $p_{a\,max}$ components is in phases with $Q_{a\,max}$ and he produce the mechanical work, this is:

$$p_{a\,max} = C_f \cdot Q_{a\,max} \tag{9}$$

and the mechanical capacity absorbed are:

$$N = \frac{p_{a\max}^2}{2 \cdot C_f} \tag{10}$$

$$N = \frac{Q_{a\max}^2 \cdot \left[C_f^2 + \left(\frac{C_s + C_{s1}}{\omega \cdot C_s \cdot C_{s1}} \right)^2 \right]}{2 \cdot C_f} \tag{11}$$

The friction value for this mechanical capacity when have the maximum values are:

$$\frac{dN}{dC_f} = 0 \tag{12}$$

namely:

$$\frac{Q_{a\max}^2}{2} \cdot \left\{ \frac{2C_f^2 - \left[C_f^2 + \left(\frac{C_s + C_{s1}}{\omega \cdot C_s \cdot C_{s1}} \right)^2 \right]}{C_f^2} \right\} = 0 \tag{13}$$

If $\frac{Q_{a\max}^2}{2}$ are different by zero, must the quantity in the parentheses to be equal with zero:

$$\frac{C_f^2 - \left(\frac{C_s + C_{s1}}{\omega \cdot C_s \cdot C_{s1}} \right)^2}{C_f^2} = 0 \tag{14}$$

Then result the value of the friction coefficient C_f :

$$C_f = \frac{C_s + C_{s1}}{\omega \cdot C_s \cdot C_{s1}} \tag{15}$$

The value of the sonic pressure $p_{a\max}$ is:

$$p_{a\max} = \sqrt{2} \cdot Q_{a\max} \cdot \left(\frac{C_s + C_{s1}}{\omega \cdot C_s \cdot C_{s1}} \right) \tag{16}$$

or:

$$Q_{a\max} = \frac{p_{a\max} \cdot \omega \cdot C_s \cdot C_{s1}}{\sqrt{2} \cdot (C_s + C_{s1})} \tag{17}$$

The capacity factor make by relation:

$$\cos\varphi = \frac{N}{N_{ap}} \tag{18}$$

Know the $p_{a\max}$ and $Q_{a\max}$ we can calculated the absorbed capacity with relation:

$$N_{ap} = \frac{\sqrt{2} \cdot Q_{a\max}^2 \cdot (C_s + C_{s1})}{2 \cdot \omega \cdot C_s \cdot C_{s1}} \quad [W] \tag{19}$$

With the relation (16) we can calculate the fall of the pressure by the friction resistance:

$$\Delta p_{Rf} = C_f \cdot Q_{a\max} \tag{20}$$

The value of the friction coefficient $C_f = R_f$ we can determined by relation: $C_f = \frac{\gamma \cdot 1}{g \cdot S} \cdot k$, were $k = k_2 = \frac{v_{ef}}{d} \cdot \left(100 + \frac{9}{\sqrt{v_{ef} \cdot d}} \right)$. The maximum speed is: $v_{\max} = \frac{Q_{a\max}}{S_f}$ and efficacy speed:

$$v_{ef} = \frac{v_{max}}{\sqrt{2}} \tag{21}$$

We can calculate also the length *l* of the pipe, when if are imposed the interior diameter of this pipe, thus:

$$l = \frac{C_f \cdot S_f \cdot g}{k_2 \cdot \gamma} = \frac{C_f \cdot S_f}{k_2 \cdot 10^3} \tag{22}$$

By the mathematical model for the installation present in figure 1, used the dates by the table 1, we are drawing the variation of the length of the friction resistance in function of the diameter.

Table 1.

d [mm]	**S [mm²]**	**v [m/s]**	**v_{ef} [m/s]**	**k**	**l [m]**
1	0,785375	837,7335668	592,3728	6616,419476	0,001745
2	3,1415	209,4333917	148,0932	862,9177272	0,053516
3	7,068375	93,08150742	65,8192	263,8335212	0,393828
4	12,566	52,35834792	37,0233	114,2048638	1,617446
5	19,634375	33,50934267	23,69491	59,78106911	4,828039
6	28,2735	23,27037685	16,4548	35,27994975	11,78064
7	38,483375	17,0966034	12,08924	22,61346334	25,01632
8	50,264	13,08958698	9,255824	15,39639837	47,9905
9	63,615375	10,34238971	7,313244	10,97641028	85,19598
10	78,5375	8,377335668	5,923728	8,114211498	142,2814
11	95,030375	6,923417907	4,895643	6,176654013	226,1656
12	113,094	5,817594214	4,1137	4,816714398	345,1485
13	132,728375	4,957003354	3,505164	3,833073965	509,0189

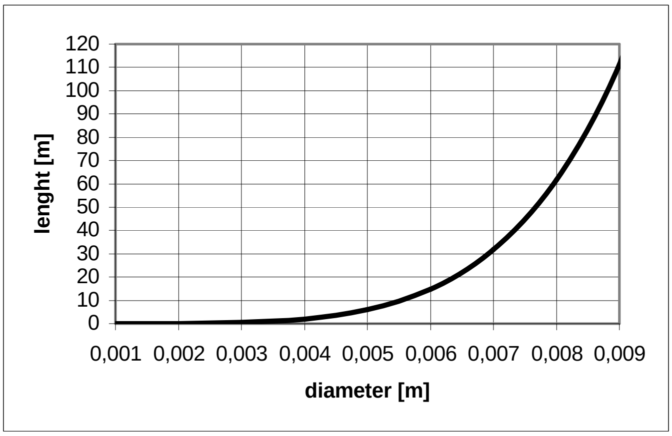

Figure 3 The variation of the length of the friction resistance by function of diameter, for n = 1000 rpn

We find that the length of the friction resistance is one exponential variation in function of the interior diameter of this.

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