THE EFFECT OF THE LENGTH 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).

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 $C_{s1}$. 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 $\omega$, the capacity of the condenser $C_s$, we can realized one mathematical model with we can calculated: the sonic flow $Q_{a max}$, the sonic pressure $p_{a max}$, 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 $\omega$, the capacity of the condensers $C_s$ and $C_{s1}$, we can realize one mathematical model with we can calculated: the sonic flow $Q_{a\max}$, the sonic pressure $p_{a\max}$, 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:

$$p_{a\max} = \frac{Q_{a\max}}{\omega \cdot C_s};$$  \hspace{1cm} (1)

$$p_{a\max} = C_f \cdot Q_{a\max};$$  \hspace{1cm} (2)

$$p_{a\max} = \frac{Q_{a\max}}{\omega \cdot C_{s1}};$$  \hspace{1cm} (3)

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

$$p_{a\max} = p_{a\max} \left| C_s + p_{a\max} \left| C_f + p_{a\max} \right| C_{s1} \right.$$

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

$$p_{a\max} = Q_{a\max} \left( C_f - \frac{C_s + C_{s1}}{\omega C_s \cdot C_{s1}} \right).$$

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

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

$$p_{a\max} = Q_{a\max} \sqrt{C_f^2 + \left( \frac{C_s + C_{s1}}{\omega \cdot C_s \cdot C_{s1}} \right)^2}.$$  \hspace{1cm} (6)

By relation (6) result:

$$Q_{a\max} = \frac{p_{a\max}}{\sqrt{C_f^2 + \left( \frac{C_s + C_{s1}}{\omega \cdot C_s \cdot C_{s1}} \right)^2}}.$$  \hspace{1cm} (7)

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

$$p_{a\max} = C_f \cdot Q_{a\max}.$$  \hspace{1cm} (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:

$$p_{a\max} = C_f \cdot Q_{a\max}.$$  \hspace{1cm} (9)
and the mechanical capacity absorbed are:
\[
N = \frac{p_{a_{\text{max}}}^2}{2 \cdot C_f} \quad (10)
\]
\[
Q_{a_{\text{max}}}^2 \cdot \left[ C_f^2 + \left( \frac{C_s + C_{s_1}}{\omega \cdot C_s \cdot C_{s_1}} \right)^2 \right] = \frac{2 \cdot N}{2 \cdot C_f} \quad (11)
\]

The friction value for this mechanical capacity when have the maximum values are:
\[
\frac{dN}{dC_f} = 0 \quad (12)
\]
amely:
\[
\frac{Q_{a_{\text{max}}}^2}{2} \cdot \left[ 2C_f^2 - \left( \frac{C_s + C_{s_1}}{\omega \cdot C_s \cdot C_{s_1}} \right)^2 \right] = 0 \quad (13)
\]
If \( \frac{Q_{a_{\text{max}}}^2}{2} \) are different by zero, must the quantity in the parentheses to be equal with zero:
\[
C_f^2 - \left( \frac{C_s + C_{s_1}}{\omega \cdot C_s \cdot C_{s_1}} \right)^2 = 0 \quad (14)
\]
Then result the value of the friction coefficient \( C_f \):
\[
C_f = \frac{C_s + C_{s_1}}{\omega \cdot C_s \cdot C_{s_1}} \quad (15)
\]
The value of the sonic pressure \( p_{a_{\text{max}}} \) is:
\[
p_{a_{\text{max}}} = \sqrt{2} \cdot Q_{a_{\text{max}}} \cdot \left( \frac{C_s + C_{s_1}}{\omega \cdot C_s \cdot C_{s_1}} \right) \quad (16)
\]
or:
\[
Q_{a_{\text{max}}} = \frac{p_{a_{\text{max}}} \cdot \omega \cdot C_s \cdot C_{s_1}}{\sqrt{2} \cdot (C_s + C_{s_1})} \quad (17)
\]
The capacity factor make by relation:
\[
\cos \varphi = \frac{N}{N_{a_p}} \quad (18)
\]

Know the \( p_{a_{\text{max}}} \) and \( Q_{a_{\text{max}}} \) we can calculated the absorbed capacity with relation:
\[
N_{a_p} = \frac{\sqrt{2} \cdot Q_{a_{\text{max}}}^2 \cdot (C_s + C_{s_1})}{2 \cdot \omega \cdot C_s \cdot C_{s_1}} \quad [W] \quad (19)
\]
With the relation (16) we can calculate the fall of the pressure by the friction resistance:
\[
\Delta p_{Rf} = C_f \cdot Q_{a_{\text{max}}} \quad (20)
\]
The value of the friction coefficient \( C_f = R_f \) we can determined by relation: \( C_f = \frac{\gamma \cdot 1}{g \cdot k} \), were
\[
k = k_2 = \frac{V_{ef}}{d} \left( 100 + \frac{9}{V_{ef} \cdot d} \right). \text{The maximum speed is: } v_{\text{max}} = \frac{Q_{a_{\text{max}}} \cdot S_f}{S_f} \text{ and efficacy speed:}
\]
\[ v_{ef} = \frac{v_{max}}{\sqrt{2}} \]  

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

\[ l = \frac{C_f \cdot S_f \cdot g}{k_2 \cdot \gamma} = \frac{C_f \cdot S_f}{k_2 \cdot 10^3} \]  

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.**

<table>
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<tr>
<th>( d ) [mm]</th>
<th>( S ) [mm(^2)]</th>
<th>( v ) [m/s]</th>
<th>( v_{ef} ) [m/s]</th>
<th>( k )</th>
<th>( l ) [m]</th>
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We find that the length of the friction resistance is one exponential variation in function of the interior diameter of this.

**Figure 3** The variation of the length of the friction resistance by function of diameter, for \( n = 1000 \) rpm

3. REFERENCES