

THE PROPORTIONAL FLOW AND PRESSURE IN THE LONGS PIPES

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Abstract: In this paper we present the characteristic values of the sonic flow in the long pipes, with the variables section. Also in this paper we are present some examples to calculus the sonic flow and the sonic pressure in this pipes.

Key words: sonic flow, sonic pressure, sonic capacity, friction coefficient, sonic induction and sonic inertia.

1. GENERAL NOTION

In the pioneer in the hydraulics synchrony transmission was realised by Gogu Constantinescu in year 1920, who are elaborated the theory to peer this systems.

Important papers in this domain was realised by Schlosser, Prokes, but Hibi upon him self the possibility of the cinematic construction and project to the hydraulics transmissions with tree phases alternate flow. The same investigation to this domain was effected also in Hungary start in 1969 [1].

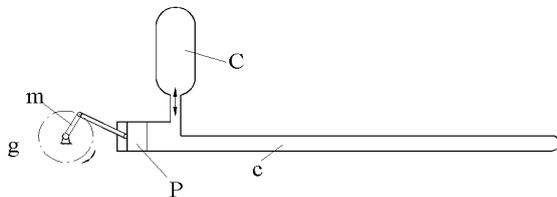


Fig.1 The tree phases system transmission

The area of applicability of this hydraulics transmission, that other case, cannot define exactly. The results of the investigating going to conclusion that on the system who the starting moment and big power, the transmission upper need specify can be used with success.

We can suppose that in the case on closed pipe, with an equal length with the multiple of wave length, it will be set in communication with it, and in the neighbouring of piston, a vessel (C) with rigid walls, with a considerable volume from the moved volume at piston movement (P), Figure1, [3].

At each advance course of piston, it will be created a flow through the orifice of vessel, which will compressed the liquid from precincts and at each course of withdrawing of it; the liquid will relax [3]. Taking into account the volume of vessel, a certain smaller or bigger quantity of liquid will flow in or from the vessel, at each rotation of crack (m). The capacity (C) will work as an arch, which will absorb the energy of direct or reflected waves, when the pressure is high and given it back when the pressure is decreasing. The

medium pressure (C) in pipe will be the same, though after the waves reflected successive in the pipe will reach a certain amplitude equivalent with medium pressure, the piston will develop energy in order to compressed the liquid from (C) at moving forward course, and in this case the liquid working as a resort, will restore to the piston thee energy needed for the back race. The effect consists in that that the producing of reflected waves will give birth in the piston of the pipe a series of stationary waves, none raising energy in liquid will results, pressures won't outrun fixed limit.

In conclusion, by using a precinct of each type (C) the pipe could be closed partially or totally. So, it will be possible to set at one extreme end or at one intermediary point, apparatus for partial use of wave's energy, and the rotative crack (m) will execute mechanic thing only in the measure that energy is efficiently used. We see to can transmit columns of gas, liquid and solid, periodic variation of the volume pressure, which can circulated then of long of column,

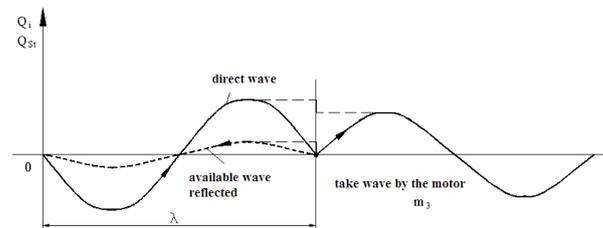


Fig. 2.

to forces the particle to vibrate (oscillation) to the medium position [3].

In the hydraulics transmission with the harmonic flow, the liquid realised one periodic alternate movement, (sinusoidal) between the convertor of the energy, Figure 2, [2].

The hydraulics actions with alternate flow (sonic) have the big advantage who function to the reduce revolution, but the synchrony motor move under in charge. Also to this type of action we don't have the connection between the generators, respective motor and the elements of stocked the fluids of work (the oil reservoir).

In the same cases to the other system of transmission of the energy,

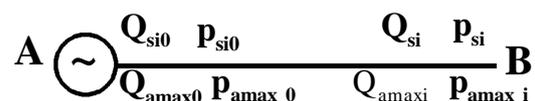


Fig. 3 The long pipe between the generator A

only one part of the hydraulics power can be used by the hydraulics system whit alternant flow. Other parts of this, can be transformed in heat in the resistance, the other parte can participated to create the vibration in liquid without to produce the usefully mechanical work [2].

2. THE FLOW AND PRESSURE IN THE LONG PIPES

In case of transmission long distance is necessary to take by the effect of the capacity and the inertia of the liquid himself [5].

C_f , L_s , C_p and C_s ; friction, inertia, perdittance and respective the capacity are considerate. The capacity are considerate the unity of the long to the liquid mase to the long pipe, and this part is dx of this. Either $\bar{p}_{a_{max}}$ and $\bar{Q}_{a_{max}}$ the vectorial value of the sonic presure and sonic flow.

If $d\bar{p}_{a_{max}}$ ids the sonic pressure who produce the movment of the liquid plat in the part dx and $d\bar{Q}_{a_{max}}$ the difference flow between the extremity and the dx part (produce by C_s and C_p), we have some situation:

a) the sonic pressure need for defeat the suplimentary resistance forces cted by the necessity to move the liquid mase in pipe, as to win the friction, quantify by relation [3]:

$$d\bar{p}_{a_{max}} = \bar{Q}_{a_{max}} \cdot C_f dx + j \cdot \omega \cdot \bar{Q}_{a_{max}} \cdot L_s \cdot dx \quad (1)$$

b) the lost of the flow [3] (perdittance coefficient C_p) and the volume of aparent „lost” fluid (sonic capacity C_s), quantify by relation:

$$d\bar{Q}_{a_{max}} = \bar{p}_{a_{max}} \cdot C_p dx + j \cdot \omega \cdot \bar{p}_{a_{max}} \cdot C_s \cdot dx \quad (2)$$

Then:

$$\frac{d\bar{p}_{a_{max}}}{dx} = C_f \bar{Q}_{a_{max}} + j \cdot \omega \cdot L_s \cdot \bar{Q}_{a_{max}} \quad (3)$$

$$\frac{d\bar{Q}_{a_{max}}}{dx} = C_p \bar{p}_{a_{max}} + j \cdot \omega \cdot C_s \cdot \bar{p}_{a_{max}} \quad (4)$$

Noted by:

$$\bar{L}_s = L_s - j \cdot \frac{C_f}{\omega} \quad (5)$$

$$\bar{C}_s = C_s - j \cdot \frac{C_p}{\omega} \quad (6)$$

If we are considered the generator to the Figure 3, were we have the flow Q_{si0} to the end of the generator and the flow to the receptor in the point B, Q_{si} , the value of the sonic pressure to the generator are p_{si0} .

We can make the flow value in the point B, Q_{si} and the available power. If we have the relation

$$\begin{cases} p_{si0} = p_{si} \cos \alpha + j Q_{si} \sin \alpha \\ Q_{si0} = Q_{si} \cos \alpha + j p_{si} \sin \alpha \end{cases} \quad (7)$$

In this case then the receptor B do not have the inertia and also the capacity, Q_{si} and p_{si} are in phases, we obtaine the relation: $p_{si} = \psi \cdot p_{a_{max}}$; $Q_{si} = Q_{a_{max}}$, the relation (7) become [5]:

$$\begin{aligned} p_{si0} &= \psi \cdot p_{a_{max}} \cdot \cos \alpha + j \cdot Q_{a_{max}} \cdot \sin \alpha \\ Q_{si0} &= Q_{a_{max}} \cdot \cos \alpha + j \cdot \psi \cdot p_{a_{max}} \cdot \sin \alpha \end{aligned}$$

Then:

$$\bar{Q}_{si0} = Q_{a_{max0}} = \sqrt{Q_{a_{max}}^2 \cdot \cos^2 \alpha + \psi^2 \cdot p_{a_{max}}^2 \cdot \sin^2 \alpha} \quad (8)$$

If $p_{a_{max}}$ is the value of the $p_{a_{max}}$ to stop of the receptor, to upper equation result for $Q_{a_{max}} = 0$, we can write:

$$Q_{a_{max0}} = \psi \cdot p_{a_{max}} \cdot \sin \alpha, \text{ respective}$$

$$p_{a_{max}} = \frac{Q_{a_{max0}}}{\psi \cdot \sin \alpha} \quad (9)$$

Are evident as $p_{a_{max}} > p_{a_{max}}$, while

$Q_{a_{max0}} > Q_{a_{max}} \cdot \cos \alpha$ to stop the receptor, the sonic presure to generator, change verry little.

Calculus example:

If have the elements $Q_{a_{max}} = 500 \text{ cm}^3$, $\cos = 0,44$, $\sin = 0,9$, $\psi = 63^{\circ} 50'$, $\omega = 35$, $p_{a_{max}} = 100 \text{ kg/cm}^2$, we must calculate the sonic flow

$Q_{a_{max0}}$ and the sonic pressure $p_{a_{max}}$.

In conformityby relation (8) we can calculate the sonic flow:

$$\begin{aligned} Q_{a_{max0}} &= \sqrt{(Q_{a_{max}} \cos \alpha)^2 + \psi^2 (p_{a_{max}} \sin \alpha)^2} \\ &= \sqrt{(500 \times 0,44)^2 + (35)^2 (100 \times 0,9)^2} = \\ &= \sqrt{200^2 + (90 \times 35)^2} = 3157 \text{ cm}^3 / \text{s} = 3,157 \cdot 10^{-3} \text{ m}^3 / \text{s} \end{aligned}$$

then:

$$p_{a_{max}} = \frac{Q_{a_{max0}}}{\psi \sin \alpha} = \frac{3157}{35 \cdot 0,9} = 100 \text{ kg/cm}^2 = 9,81 \cdot 10^6 \text{ Pa}$$

The sonic pressure to generator can be:

$$p_{a_{max}} = p_{a_{max}} \cos \alpha = 100 \cdot 0,44 = 44 \text{ kg/cm}^2$$

when the receptro is disconnected.

When the receptor is in fonction, the sonic pressure are:

$$\begin{aligned} P_{si0} &= \sqrt{(p_{a_{max}} \cos \alpha)^2 + \left[\left(\frac{p_{a_{max}} \sin \alpha}{\psi} \right) \right]^2} = \\ &= \sqrt{(44)^2 + \left(\frac{100 \cdot 0,9}{35} \right)^2} = \sqrt{1936 + 5,0625} = \\ &= \sqrt{1941,0625} = 44,07 \text{ kg/cm}^2 \end{aligned}$$

Conclusion:

We observ when the sonic pressure to receptor is more than double to the pressure of the generator.

REFERENCES

1. Constantinescu, G., (1985), *The theory of the sonicity*, Bucure ti, Editura Academiei.
2. Carmen Bal, (2007), *Caloric effect in the circuits by harmonic flow*, Cluj Napoca, Ed. ALMA MATER.
3. Carmen Bal, (2006), *Research and contributions about the drive systems with the harmonic flow*, the doctoral thesis Technical University of Cluj Napoca.
4. Pop I. Ioan, Carmen Bal, Marcu Lucian a., (2007), *The sonicity applications. Experimental results*, Ia i, Ed. Performantica, ISBN 978-973-730-391-2.
5. Pop I. L., (2006), *The treaty of the sonicity theory*, Ia i, Ed. Performantica.

