Proceedings of Online International Conference on Advances in Scientific Research and Developments
Organized by Novateur Publications, Pune, Maharashtra, India
JournalNX- A Multidisciplinary Peer Reviewed Journal
ISSN: 2581-4230, Website: journalnx.com, August 8th, 2020.

PRINCIPLES OF OPERATION AND ACCOUNT OF HYDRAULIC TARAN

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Abstract:

In the calculation of hydraulics, the equation of motion of a fluid, the equation of pressure drop, and the equation of inertia are used. Dependence on water supply has been identified.

Keywords: *hydraulics, shock wave, rectilinear, inverse, Zhukovsky formula, wave propagation.*

A hydraulic pump is a device that lifts water upwards and is based on a hydraulic event, in which the energy of the supplied water is converted directly into electricity without converting it into electricity. Due to the simple and automatic operation of the hydraulic structure, it is easy to use.

The hydraulics are composed of the following elements: ZarbklapaniK_1, transfer valve K_2 and air bag. The supply pipe is connected to the hydraulic tank by means of T_1, the water supply to the upper tank through the supply pipe T_2. From the supply source, the water is transferred to the air bag through the water supply valve with H pressure, and the supply pipe rises to a height h, where the percussion valve K_1 is closed and the supply valve K_2 remains in the optional position.

If we open the percussion valve with the help of an external force, water starts to flow through the valve, the kinetic energy increases with speed, and the potential energy in the room decreases, and the valve closes at once. The sudden closing of the valve results in a pressure drop in the valve. Under the influence of the impact, the water is transferred to the top through the air sac.

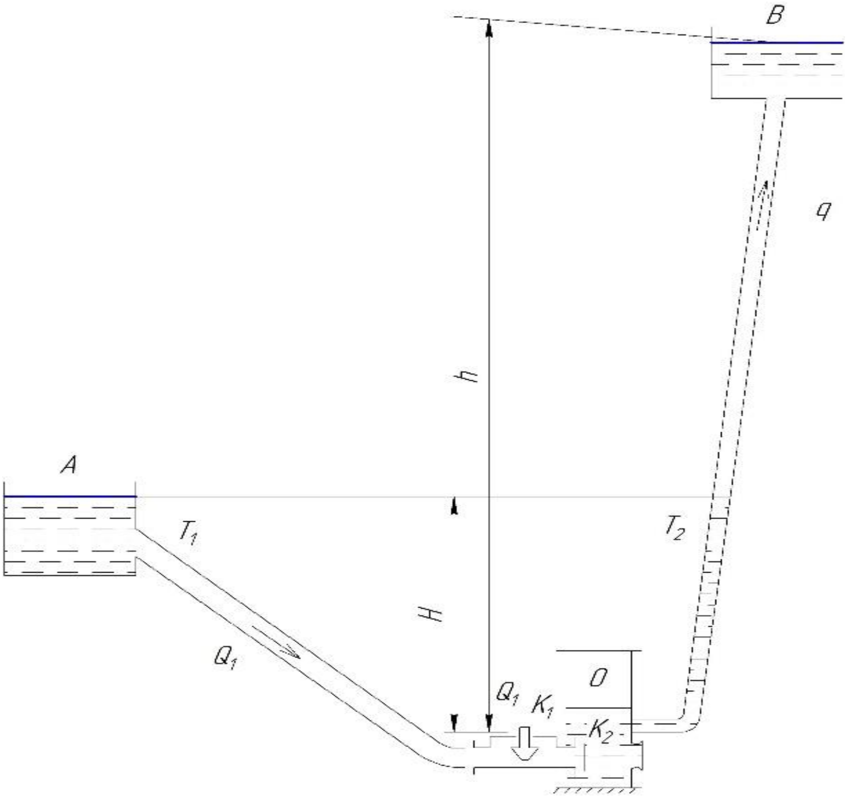

Figure 1. Scheme of hydraulic taran

The increase in hydraulic pressure is determined by the following Zhukovsky formula:

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〖ΔR〗 _z = rV_0 · a (1)

Here r is the viscosity;

V_0 is the average flow rate in the supply pipe;

a is the frequency of the shock wave.

The propagation speed of the shock wave is as follows:

a = a_0 / √ (1 + d / d · K / E) (2)

here a_0 is the frequency of the liquid sound wave propagation; in water under normal atmospheric conditions:

a = 1425 m / s

d is the inside diameter of the pipe, m;

d is the thickness of the pipe wall, m;

K - modulus of elasticity of the liquid, Pa;

Elasticity modulus of e-pipe material, Pa.

To increase the impact pressure, click:

ΔR / g = (a · Δv) / g (3)

where ΔR-pressure, Pa;

Decreased velocity in the Δv-pipe, m / s;

g-gravitational acceleration, m / s ^ 2;

g is the volume by weight of the liquid, N / s.

According to the theory of hydraulics, when the hydraulic valve is opened, the water starts to flow out of the valve, and the speed of the water coming from the supply pipe increases, and the pressure on the valve increases as the speed increases. When the pressure exceeds the weight of the valve, the valve rises and closes. When the valve is raised, a hydraulic pressure is generated and the supply valve is opened by pressing the valve, thus closing the valve in a cyclic state.

For hydraulic fracturing to be continued, the hydraulic pressure must be set to t:

t = 2l / a (4)

here l is the length of the supply pipe;

The Zhukovsky formulas described above are theoretical formulas that cannot be used in the study of hydraulic fracturing. For example, energy is lost when a liquid moves in a tube, which means that the dynamic pressure is less than + Δh.

To determine the true dynamic altitude, we write the Bernoulli equation for the form of a steady-state valve that provides a steady state:

H + P_at / g + (v_0 ^ 2) / 2g = P / g + v ^ 2 / 2g + x_qu v ^ 2 / 2g + l / g dv / dt (5)

Here x_qu is the sum of the hydraulic resistances in the supply pipe.

We see the acceleration of a fluid at a constant diameter. In this case, we see the unsteady motion of a non-compressible fluid, that is, the velocity depends on time:

v = v (t)

dv / dt = dv / dt (6)

Inertia is used as follows:

h_t = 1 / g ∫_ (s_2) ^ (s_1) ▒ 〖dv / dt ds〗 (7)

This speed depends only on time, that is, if we integrate along the path:

h_t = 1 / g dv / dt ∫_ (s_2) ^ (s_1) ▒ds

If the path length is l:

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h_t = l / g dv / dt (8)

The equation of unstable motion for such a private property is:

z_1 + P_1 / g + (v_1 ^ 2) / 2g = z_2 + P_2 / g + (v_2 ^ 2) / 2g + h_w + l / g dv / dt (9)

If the valve is closed and suddenly opens, the liquid will move faster and faster:

h_w = (l l / d + ∑x) v ^ 2 / 2g = x_c v ^ 2 / 2g (10)

here x_c is the sum of the coefficients of resistance in the network.

To determine the true dynamic pressure, if the pressure drop in the system is taken into account, the following relation can be obtained:

H = (1 + x_c) v ^ 2 / 2g + l / g dv / dt

ве = д . п вм . (Р- (1-ч_с) м : 2 . 2п)

dt = 2l / (1 + x_c) dv / (2gH / (1 + x_c) -v ^ 2)

For stable motion, we find the water velocity in the network from the following formula:

v_c = √ (2gH / (1 + x_c)) (11)

In this case, the differential equation looks like this:

dt = 2l / (1 + x_c) dv / (v_s ^ 2-v ^ 2) (12)

Integrating this equation and taking v = 0 at t = 0, we get:

t = l / (v_t (1 + x_c)) ln〖(v_c + v) / (v_c-v)〗 (13)

t = l / (v_t (1 + x_c))

is a constant value that is expressed in terms of time.

If the resistances are not taken into account, the speed of the water is as follows:

v = √2gH

from:

t = l / (√2gH (1 + x_c)) (14)

t = t ln〖(v_c + v) / (v_c-v)〗 (15)

v = v_c (l ^ (t / t) -1) / (l ^ (t / t) +1) = Kv_c

K = (l ^ (t / t) -1) / (l ^ (t / t) +1) (16)

The hydraulic cycle can have a small value of kW / d / d, which represents the inertial force within the cycle, so it cannot be taken into account.

If the water level in the supply tank does not change, the water supply speed is very small, ie_0 = 0.

With this in mind, we obtain the following relation from the equation:

(P-P_at) / g = H- (1 + x_c) v ^ 2 / 2g (17)

At the beginning of the movement, at the end of the movement, the pressure in the front panel is equal to the pressure above. The height of the liquid is as follows:

h_g = h_1 + ∑h_w - [H- (1 + x_c) v ^ 2 / 2g]

If we define h = h_1 + ∑h_w, then h is the calculated transmitter.

In that case,

h_g / H = h / H-1 + (1 + x_c) v ^ 2 / 2gH (18)

v_c = √ (2gH / (1 + x_c)) based on the formula:

v_c ^ 2 = 2gH / (1 + x_c) (19)

In conclusion:

This means that, the speed depends on the load at a rate of 0.5 degrees. To increase the speed at which water is stored, it is necessary to reduce the diameter of the pipe, but the increase in speed reduces the hydraulic resistance. Increasing the valve frequency reduces consumption but increases pressure.

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