Surveying the dynamics of improved AKMS rifles mentioning the viscosity of water

Khảo sát động lực học của súng AKMS khi kể đến ma sát của nước

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Abstract

After improving AKM-S riflesto being able to fire in two environments, the bolt carrier's travel distance and the gas port'sdiameter were also increased due to the moving details are prevented by the resistance of water. Therefore, calculating the dynamics of the gun is very important and necessary. With the added viscous damper function, the paper has calculated the dynamics of the rifles, and compared the displacement chart of the bolt carrier before and after the improvement to affirm the reliability of these rifles. The calculation results have affirmed the correctness of improving the AKMS rifles to be able to fire in two environments.

Từ khóa:

Súng AKMS; Động lực học; Lỗ trích khí; Thuật phóng trong.

Tóm tắt

Sau khi cải tiến súng AKMS để bắn được ở hai môi trường, quãng đường chuyển động của bệ khóa tăng lên và lỗ trích khí cũng rộng hơn, việc tính toán động lực học của súng là rất cần thiết vì cả khâu cơ sở và các khâu làm việc đều chịu ma sát của nước khi chuyển động. Với việc đưa thêm vào hàm cản nhớt, bài báo đã tính toán động lực học của súng, so sánh đồ thị của khâu cơ sở trước và sau cải tiến để khẳng định khả năng làm việc tin cậy của súng. Các kết quả tính toán đã khẳng định tính đúng đắn của việc cải tiến súng để khẩu súng này có thể bắn được hai môi trường.

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1. INTRODUCTION

Research, improving the AKMS gun into the environment two guns is an imperative job because that is the improvement of available guns into firearms were both underwater and on land. On the basis of scientific publications on environmental firearms two of the authors of domestic and international, the paper did mention the kinematic viscosity of the fluid medium when calculating. Study the theoretical basis of the dynamics of the gun when shot in the water to assess the reliability of the automatically machine improved. Some gun structural improvements as: bolt, carrier spring, receiver, gas block, magazine... to ensure technical features for gun (figure 1). The bullet also been redesigned with caliber 7,5 mm, length of the bullet 125mm, diameter of disc nose 1,5mm, water depth 5m (figure 2). The survey dynamics automatic machine gun to assess the reliability when firing the second fire.

Figure 1. AKMS gun after improvements

Figure 2. Bullet after improvements

2. CONTENT CALCULATION

2.1. Dynamics improved AKMS gun when fire

Build equations motion of bolt carrier with equations of interior ballistics, thermodynamic equations in gas chamber, thereby allowing us to calculate the dynamics of the underwater gun.

2.1.1. Equation of the automatically machine motion [4]

The motion of the automatic machine when firing underwater is not much different than when fire in the air. However, when firing under water, the parts of the automatically machine will bear the water's drag, this makes a larger force than the resistance of the air. Therefore, it will examine the operation of the automatically machine when firing underwater as when firing in the air but taking into account the influence of water resistance to the parts of the automatic machine when working.

According to [2]. We have equations of motion of the bolt carrier:

$$\begin{cases} \dfrac{dX_{bk}}{dt} = v_{bk} \\ \dfrac{dv_{bk}}{dt} = \dfrac{1}{M_{11}}\left(P_1 - C_0 X_{bk} - F_c\right) \end{cases} \tag{1}$$

2.1.2. Drag exerted on the automatically machine when firing underwater

According to [2] Drag translational moving object is calculated according to the formula:

$$F_c = \frac{1}{2}\rho\, v^2 C_D\, A \tag{2}$$

Inside: A is the cross-sectional area; ρ is the specific gravity of the fluid; v is the velocity of motion of the object; C_D is the drag coefficient depends on the shape of the object.

According to [2],[6], from the process of surveying the movement of automatic machine guns AKMS, we see the largest vollocity of bolt carrier around 6m/s. So, can be consider motion of the bolt carrier is moving with low speed and determined the resistance according to the formula (2).

When the machine's automatic submachine guns AKMS work, hammer is rotation part around a fixed axis. So drag hammer function is determined by the document [4] as follows:

$$F_c = \int_0^l \frac{1}{2} \rho\, C_D\, a\, (\omega\, x)^2 dx = \frac{1}{6} \rho\, a\, C_D\, l^3 \omega^2 \quad (3)$$

Inside: a the width of the hammer, l is length of hammer, ω is the angular velocity of the hammer.

The input parameters of the drag function:

The liquid density	$\rho = 1 kg/dm^3$
Drag coefficient	$C_D = 1.05$
Cross section area of the bolt carrier	$0.0393\ dm^2$
The width of the hammer	0.1 dm
Length of hammer	0.35 dm

2.1.3. Input parameters

a) Parameters of guns, ammunition when calculating.

Table 1. Parameters of guns, ammunition

Parameters	Symbol	Unit	Bullet 7.5x30 mm
The caliber of the bullet	D	dm	0.075
The mass of bullet	Q	kG	0.0416
Length of the bullet	l_d	dm	0.125
The length of the bullet taper portion	l_s	dm	0.025
Cone angle of bullet	B	độ	4
The volume of the combustion chamber	W_0	dm^3	0.00165
The length of the barrel	l_d	dm	3.7
Diameter of the gas port	d_c	mm	3.7
Diameter of the gas port after improvements	d_c	mm	4.8

b) Parameters of underwater bullet

Table 2. Parameters of the interior ballistics problem

Parameters	Symbol	Unit	Value
The mass of propellant	ω	g	0.7
The density of the propellant	σ	kG/dm^3	1.638
Burn thickness of propellant	$2e_1$	dm	0.00113
Coefficient of propellant burning speed	u_1	$(dm)/(KG/dm^2)$	0.0000108
Characteristic shape of the propellant	χ		1.16667
	λ		-0.4
Adiabatic exponent	k		1.2
Propellant force	f	(kG.dm)/kG	950.000

c) Environmental parameters

Table 3. Environmental parameters [3]

Parameters	Symbol	Unit	Value
The density of the water	ρ	kg/dm^3	1.02
Kinematic viscosity coefficient of water	υ	dm/s	0.0000105
Acceleration of gravity	g	dm/s^2	98.1

3. CALCULATION RESULTS

To solve systems of equations on simultaneously, according to [1], [3], [5], [7], using software Maple with the parameters of the guns and bullets were identified, the control variable to put the input data correctly and reasonably. From there, determine the energy of the fire provides automatic machine work; speed and movement of the bolt carrier when firing underwater. Through calculation results, performance evaluation factors reduce reliability, from that determining the necessary energy supply for automatic machine working reliability when firing underwater.

3.1. When shooting in the air environment

The calculation of the movement of the bolt carrier in the air have been many topics, the article in question. With this subject, there has been improvement in the texture of the parts of the gun. Calculation results are as follows: (figure 3).

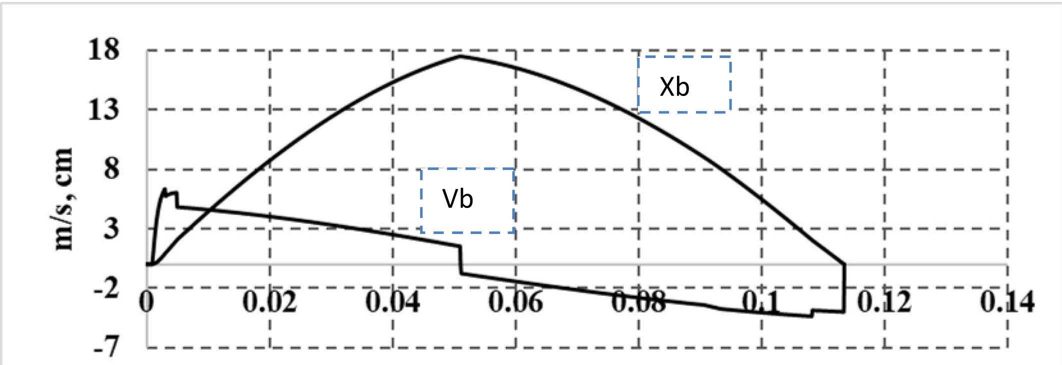

Figure 3. Graph velocity and displacement of the bolt carrier when firing in the air

3.2. When firing in the water environment

In the water environment, bolt carrier is prevented by kinematic viscosity of water. Therefore, the velocity decreases while the travel distance increases (figure 4). According to [6] then the gas ejected through the barrel grooves that help water before the bullet out of the barrel when fire and this very small volume of gas should not affect the amount of gas flowing into the gas chamber.

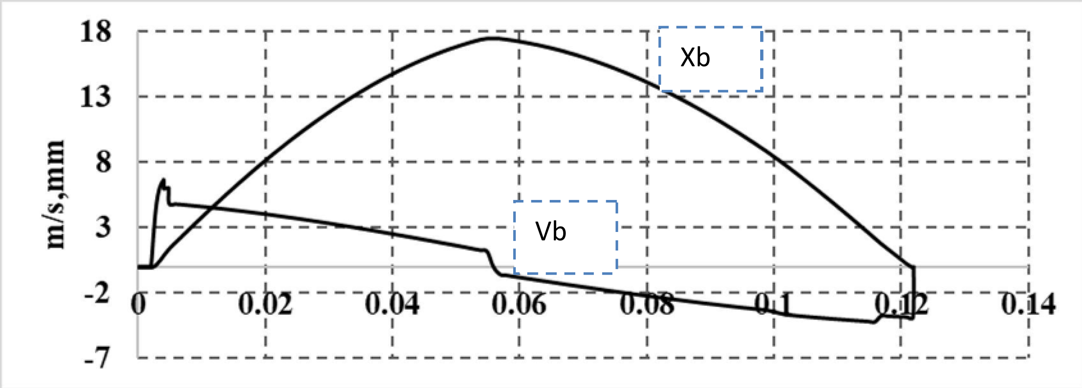

Figure 4. Graph velocity and displacement of the bolt carrier when firing underwater

Comparing the two graphs in Figure 3 and 4 we see: When shooting in the air environment, with the gas port diameter d = 3.7mm the machine's automatic guns AKMS normal operation and the velocity of the bolt carrier at the end of the return itinerary is: V_{bc} = 1.51 m/s.

- A itinerary time of bolt carrier: t_{bc} = 0.1135 s.
- Working cycle of automatic machine:

$$T_{\Sigma} = t_{bk} + t_m + t_{ph} = 0.1135 + 0.001 + 0.015 = 0.1295 \text{ s.}$$

- Theoretical firing speed:

$$V_{max} = \frac{60}{T_{\Sigma}} = \frac{60}{0.1295} = 463 \text{ (throw/min)}$$

When firing in the water environment, with the gas port diameter d = 4,8 mm the machine's automatic guns AKMS normal operation and the velocity of the bolt carrier at the end of the return itinerary is: V_{bc} = 1.17 m/s.

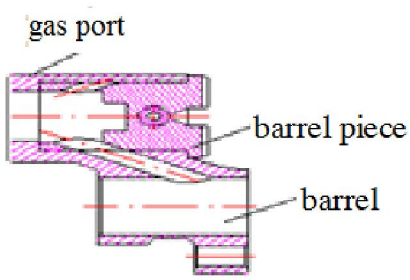

Figure 5. The gas port structure after improvements

- A itinerary time of bolt carrier: t_{bc} = 0.12193 [s].
- Working cycle of automatic machine:

$$T_{\Sigma} = t_{bk} + t_m + t_{ph} = 0.12193 + 0.001 + 0.020 = 0.14293 \text{ [s].}$$

- Theoretical firing speed: $V_{max} = 435$ throw/min.

From the calculated results we see: The theoretical firing speed of the improved gun less than but firing underwater is acceptable.

4. CONCLUSION

The content of the paper has conducted a study and improve some parts, details of AKMS gun suitable for firing underwater conditions, thereby underpinning the process of experimentation later. From the research results obtained, to draw some conclusions:

- After improvement work are reliable gun in the water environment.
- Improve some details of the gun with the gas port diameter 4,8 mm, the gun still enough energy to perform fire the second.
- Theoretical firing speed be reduced but still suitable for underwater combat conditions.

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