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REVIEW OF EXTERNAL PROBLEMS OF REACTIVE MISSILES OF REACTIVE VOLLEY FIRE SYSTEMS

Стаття представляє огляд сучасних керованих реактивних снарядів зарубіжних реактивних систем залпового вогню. Аналізуються основні світові тенденції розвитку, та зазначається необхідність створення сучасного керованого реактивного снаряду для України.

Ключові слова: *реактивна система залпового вогню, керований реактивний снаряд, керована ракета, система наведення, органи керування.*

Статья представляет обзор современных управляемых реактивных снарядов зарубежных реактивных систем залпового огня. Анализируются основные мировые тенденции развития, и отмечается необходимость создания современного управляемого реактивного снаряда для Украины.

Ключевые слова: *реактивная система залпового огня, управляемый реактивный снаряд, система наведения, органы управления.*

The article presents the review of the modern guided reactive missiles of the foreign multiple volley fire systems. The main world tendencies of the development are analyzed, although the attention is drawn to the necessity to create the modern guided rocket for Ukraine.

Keywords: *reactive volley fire systems, guided reactive missile, guidance system, management system.*

Introduction

One of the widely used, highly effective and promising types of tactical missile artillery weapons is the reactive volley fire systems (RVFS). With the help of the RVFS at any time of day and in different weather conditions it is possible to inflict the enemy's living force, armored and light-armored equipment on marches and places of concentration, artillery and mortar batteries, to destroy command posts, military infrastructure objects and communication nodes . Taking into account the aggravation of the military-political situation in the world, the RVFS is one of the most demanded types of weapons in most of the world's armies. In particular, it is for Ukraine in conditions of armed conflict in the east of the country.

Ammunition for similar RVFS may be: unmanaged rockets, the flight of which is carried out on a ballistic trajectory without any adjustments or control; corrected rockets, the flight of which is adjusted only on the active part of the trajectory with the help of

a special angular correction engine; as well as rective guided missiles (RGM), equipped with a control system and controls to improve the accuracy of the shooting. The latter can also be classified as a guided missile class.

Guided missiles are by definition the most accurate and, accordingly, the most effective in terms of carrying out combat missions. Undoubtedly, high accuracy is achieved by installing more complex and expensive equipment, which affects the cost of unitary ammunition. However, the use of high-precision shells reduces the overall material and time costs for the task, by reducing the number of munitions needed for its implementation, as well as reducing the high risk of losses and failures by reducing the number of operations. In addition to a significant increase in the effectiveness of strikes, the use of controlled shells reduces casualties among the civilian population, which is also an important factor.

Accordingly, in this review, guided missiles of foreign SVFS were considered in order to analyze the main trends and prospects for their development. In particular, the cattle in Russia, the USA, China and Israel were considered.

SVFS “Smerch” (Russia)

The reactive volley fire system 9K58 "Smerch" was developed in the USSR and was adopted in 1987. The distinguishing features of this SVFS are the availability of an autonomous correction system for the flight of the missile [1].

Developed by FSUP DNVP "Splav", rocket launchers are equipped with a flight control system that corrects the trajectory of pitch and riding. Correction is carried out by a gas-dynamic device driven by a high-pressure gas from an on-board gas generator [1].

In addition, the stabilization of the missile in flight is due to its rotation around the longitudinal axis, which is provided by the previous promotion during the movement of the tubular guide when the two conductive pins with the P-shaped screw grooves interact, supported in flight by the installation of the openings of the stabilizing blades, under some angle to the longitudinal axis of the missile. When firing a gun, the missile dispersion of this design does not exceed 0.21% of the firing range. 300-mm projectiles SVFS "Smerch" are equipped with a solid-fuel jet engine on blended fuel, have a length of 7600 mm and a mass of 800 kg [1].

In the case of an adjusted 9M55K missile, the combat part is 243 kg. In the cassette, 72 pieces of ammunition weighing 2 kg each. The angle of their meeting with the target is not 30-60º, as in the ordinary missile, but direct due to a special device. The cones of such shells with ease break through the towers, the upper cover of armored personnel carriers, combat vehicles, SAC, where the armor is not too thick, and the covers of tank transmissions [1].

In the ammunition complex SVFS "Smerch" includes the following types of missiles:

1. 9M55K – is 300-mm rocket missile with a cassette main part 9H139 with fragmentary combat elements 9H235. It contains 72 combat elements carrying 6912 ready-made heavy fragments designed to defeat unarmed equipment, and 25920 ready-made light fragments designed to defeat the enemy's live force in places of its accumulation; total - up to 32,832 fragments. The area of the element's defeat is 300-1100 m². At a distance of 10 m the shell punches armor in the thickness of 5-7 mm, at a distance of 100 m - 1-3 mm. 16 shells contain 52,512 ready-made fragments. The most effective in open areas is in the steppe and the desert [2].

2. 9M55K1 – is rocket missile from a cassette HR 9H142 with self-aiming warheads (SAW). Cassette HF carries 5 SAW "Motiv-3M" 9H349 equipped with dual-band infrared coordinators looking for a target at an angle of 30 degrees. Each of them is able to break through an angle of 30 ° armor in a thickness of 70 mm from a height of 100 m. Suitable for outdoor use - in the steppes and in the desert, almost impossible to use in the woods, difficult to use in the city. It is designed for vertical damage to groups of armored vehicles and tanks [2].

3. 9M55K4 – is rocket missile with a cassette 9H539 GH for anti-tank landing. Each projectile contains 25 anti-tank mines PTM-3 with an electron non-contact detonator. In total in one volley of installation of 300 anti-tank mines. It is intended for operative remote creation of anti-tank minefields in front of units of enemy combat equipment, located at the turn of the attack or in the area of their concentration [2].

4. 9M55K5 – is rocket missile with a cassette 9H176 HD with cumulative and fragile fighting elements. Cassette HF contains 646 military elements of a cylindrical shape with a length of 118 mm, or 588 elements of length 128 mm and weighing up to 240 g. 118 mm elements capable of breaking through the normal to 120 mm of homogeneous armor, 128 mm to 160 mm. Missile is as effective against the motorcycle on the march, located in the BTR and BMP. A total of 12 shells contain 7752 or 7056 combat elements. It is intended for the defeat of open and hidden vitality and light-armored military equipment [2].

5. 9M55F – is reactive missile with a split-high-explosive HF separator. It is designed for defeat of living power, unbridled and light-armored military equipment in places of its concentration, the destruction of command posts, communication nodes and infrastructure objects [2].

6. 9M55C – is reactive missile with thermobaric HF 9M216 "Excitement". The explosion of one projectile creates a thermal field of not less than 25 m in diameter (depending on the terrain). The temperature of the field - more than + 1000 ° C, time of action - not less than 1,4 s. It is intended for the defeat of the living power, open and hidden in the fortified structures of the open type and objects of unarmed and light-armored military equipment. Maximally effective in the steppe, desert, city, objects located on plain terrain [2].

7. 9M528 – is reactive missile with a fragmentary-high-explosive HF. It is pinpoint pin, instant and slow action. It was designed for defeat of living power,

unarmed and light-armored military equipment in places of its concentration, the destruction of command posts, communication nodes and infrastructure objects [2].

8. 9M534 – is experimental reactive missile with a small-sized reconnaissance unmanned aerial vehicle type "Tipchak". It was designed for operational intelligence purposes within 20 minutes. In the vicinity of the UAV goal falls down on a parachute, scanning the situation and transmitting information by coordinates of the explored goals to a management complex at a distance of up to 70 km for the rapid decision-making on destruction [2].

At the end of April 2012, an export sample passport was approved for a 300-mm CGS 9M542 increased firing range with a non-separable fragmentation-explosive main part. The minimum range is 40 km, the maximum range is 120 km [3].

The 9M542 sink has the following technical characteristics: the caliber is 300 mm, the weight of the projectile is 820 kg, the weight of the main part is 150 kg, the length of the projectile is 7600 mm, the mass of the explosive 70 kg, the number of finished fragments weighing 50 g, 500 pieces, range 40 – 120 km [3].

The projectile consists of an electron-temporary device, a control system block, a main part and a rocket part [3].

Thus, an increase in the flight range of this projectile was achieved by reducing the mass of the main part, as well as increasing the mass of the charge of solid fuel by extending the rocket part. At the same time, the total length of 7.6 m for all shells was preserved, while the total mass of the projectile was increased by 5-10 kg [3].

SVFS M270 MLRS (USA)

M270 MLRS (Multiple Launch Rocket System) –is american universal launcher, used as a RCD and a setup for launching tactical missiles. Designed by Lockheed Martin Missiles and Fire Control. Adopted for the armed forces of the United States in 1983 [4].

American rockets missiles are class-driven and equipped with an inertial guiding unit based on the global GPS positioning system and small aerodynamic controls located behind the aerodynamic "duck" scheme, which provides overall maneuverability and increased accuracy of the rocket. The new US-controlled missiles (guided missiles) include the M30 Guided MLRS Rocket and the XM30 Guided Unitary MLRS Rocket [5].

The M30 Guided MLRS Rocket, developed since the late 80's, has a maximum range of 70 km. Main characteristics of the M30 GMLRS projectile: 227 mm; length - 4000 mm; main part - cassette; The mass of the projectile is 308 kg. The HD is equipped with 404 cumulative and fragmented military elements M77 or M85 [5].

Controlled missile XM30 Guided Unitary MLRS Rocket with a flight range of up to 70 km developed by Lockheed Martin in 2003. The XM30 is equipped with a high-explosive non-separable main part of the penetrating type (mass up to 89 kg) and designed to destroy protected objects of the military industrial infrastructure of the enemy. The main part is equipped with a detonator with three units, which

provides an airborne burst, when encountering the obstacle and slowing after penetration into the target. Main characteristics of the projectile XM30: caliber 227 mm; length - 4000 mm; the mass of the projectile - 308 kg [5].

In 2008, Lockheed Martin reported testing a GMLRS Rocket missile with an increased flight range, which struck a target at a distance of 85 km from the launch point. In 2009, due to similar tests, a range of 92 km was achieved [6].

In 2008, Lockheed Martin announced the first launch of four guided missiles with the use of a new universal fire control system, which provides the ability to shoot guided shells, in the construction of which is using impedance protection technology. And in 2010, Lockheed Martin announced the successful testing of a GMLRS + Rocket guided missile equipped with a semiautomatic self-homing head (SHH) [7].

SVFS Lynx (Israel)

The Lynx Modular PCB is developed by Israel Military Industries. This SVFS surpassed the American analogue of the M270 SVFS MLRS for universality.

In our consideration, the main interest is the EXTRA rocket. EXTRA (Extended Range Artillery) Ammunition refers to tactical-range artillery missile and provides outstanding accuracy for land-based targets. It was designed for the arming of Israeli and foreign armies. The main characteristics of the RS: the caliber is 300 mm, the length of the RM is 3970 mm, the range of shooting is 20-150 km, the starting mass is 450 kg, the weight of the combat unit is 120 kg, the circular probable deviation <10 m [8].

EXTRA missiles are placed in container packs of four units in each. For use by ground-based launchers and for more precise strikes, these RM may be equipped with a GPS guidance system. Among the design features of the presence of gas rudders, which correct the trajectory during the flight of the projectile, in addition to the nose and tail are aerodynamic surfaces. Thanks to disposable sealed container packages, long service life and low maintenance costs are achieved [8].

SVFS type WS-2 (China)

In 2004, the SCAIC Corporation introduced a new WS-2 SVFS with rocket propulsion systems equipped with a trajectory correction system. By creating a 400mm projectile, the SCAIC has proven the maximum range of the RS WS-2 to 200 km, the minimum distance is 70 km. The weight of the projectile WS-2 was 1285 kg. For rocket launchers, four types of MC are developed: a cassette with 560 or 660 anti-tank; high-explosive fragmentation with pre-minted spectacular elements - steel balls; high-power high-power; bulk explosion. The WS-2 catcher is equipped with a 200-kg combat unit. On the shells, a three-channel flight control system, which includes an inertial platform with inexpensive sensors, is used. Chinese missiles do not twist at startup. During the flight, they accelerate to a speed of 5.6 times the

sound. Number of guides is 6 pcs. The transition of the MRC from the original position into combat takes no more than 12 minutes [9].

In 2007, Chinese sources announced the development of a version of the WS-2C with a range of 300 km. The missile is equipped with a passive radar, which is used on the final section of the trajectory. According to some sources, the WS-2C SVFS range can reach 350 km [9].

In addition, the CPMIEC Corporation, together with SCAIC Corporation, has developed the following modification of the WS-2D SVFS with a maximum range of 400 km (the minimum is still 70 km). This allows the WS-2D SVFS to be positioned as the most widely used shooting range in the world. At the same time, the mass-gross characteristics of the WS-2D are higher than in the base version. The length is 8.1 m, the diameter is 425 mm in comparison with 7.15 m and 400 mm respectively in WS-2, the mass of the HH remains unchanged - 200 kg, as well as the maximum flight speed - 5.6 M. KIU at the maximum range is less than 600 m. For comparison, KIW WS-2 is 600 meters on a distance of 200 km. The WS-2D can be equipped with various types of combat units, including a cassette carrying three self-powered shells [9].

Number of guides on control system is 6 pcs. The transition of CS from the original position in the combat room takes no more than 12 minutes [9].

SVFS type WS-3 (China)

The new Chinese SVFS WS-3, developed by the SCAIC Corporation, is equipped with six 400-mm rockets. Externally, the WS-3 launchers are very similar to those of the previously developed WS-2 SVFS, but they are equipped with new RDS. The range of shooting remained the same - 70-200 km. At the same time, the accuracy of firing shells has significantly increased. The KIW of a new munition, equipped in the basic version with an inertial navigation system, at a maximum range of shooting is 300 m. RPS can be equipped with guidance systems based on the GPS complex. This allows you to aim a fire with a very high accuracy. Deviation from the target at a distance of about 200 km does not exceed 50 m [10].

The length of the new cattle is 7.15 m, the diameter is 400 mm. It is equipped with four stabilizers in the tail section and four control planes in the bow. The shell may be equipped with various combat units of up to 200 kg mass, including a high-explosive, bulk explosion, and a cassette with 540 sub-ammunition of small caliber. Time of deployment of CS at the firing position is about 12 minutes [10].

Global positioning systems are actively being used to create new Chinese SVFS. This kit allows the cattle to detect the target and hit it as accurately and effectively as possible. In order to prevent the impact power of the SVFS suppressed by interceptor missiles, Chinese engineers have decided to provide some models of their installations with so-called WS-1B misspelled labels that are virtually devoid of charge [10].

Shortly thereafter, an updated version of this SVFS WS-3A was launched with an increased maximum flight range of cattle to 280 km (the minimum - former, 70 km), resulting in an increase in the starting mass of the projectile to 1398 kg. In this case, the diameter of the projectile - 400 mm, length - 7150 mm, as well as the mass of the GP - 200 kg, remained unchanged [11].

The number of guides also did not change is 6 pcs, but now the time of deployment CS at the firing position decreased to 7 minutes. Type BH - fragmentation-high-pressure, cassette. The guidance system is an inertial + satellite that operates throughout the flight, while the KIW is less than 50 m. The flight path of the RM is aerobalistic [11].

In their press release, developers claim that the WS-3A is a SVFS with controlled ammunition, with the use of the launching technology for RBM from TPK, which simplifies the processes of storage, transportation and launching of the projectile. For a single WS-3S shotgun, the SVFS WS-3A can hit 6 different targets in an area of 10x10 km [11].

SVFS WS-63 and WS-64 (China)

Designed by SCAIC, the SVFS WS-63 is a representative of the new generation, which can be used both for fire support on the battlefield and for high-precision impact. This SVFS uses a system for starting a projectile from TPK, integrating the processes of storage, transportation and launching of cattle. For one salvo, the RCC can hit a few point goals. Number of guides is 8 pieces [11].

The starting mass of the projectile is 957 kg, the weight of the HC is 150 kg, the length is 7400 mm, the diameter is 300 mm. The flight range of the catcher is 120 to 260 km. The KIW, in the case of an inertial guidance system with satellite correction, does not exceed 30 m, and in the presence of a radar GSN for guidance in the final section of the trajectory is reduced to 10 m. The developer also specifies the KIW less than 90 m for the case of carbon fiber HF corps. It is also reported that the missile is maneuvering in flight in order to overcome the enemy's air defenses. In addition, he can perform a heights turn over the target area and apply a vertical blow to maximize the impact power. The WS-63 can be equipped with a fragmentation-explosive, semi-armored, penetrating BF, as well as a BF, the body of which is made of carbon fiber (presumably to reduce the mass of BF) [11].

A similar characteristic is the further modification of this SVFS WS-64. This system applies single-stage solid-state catalytic converters, whose flight takes place in low atmospheric layers. At an insignificant (20 km) increase in the flight range of cattle to 280 km, the weight of the warhead was increased by one third - 200 kg, resulting in a significantly increased starting mass of the projectile, becoming equal to 1470 kg, as well as an increase in diameter - 400 mm. At the same time, the length of the cattle even slightly decreased (by 200 mm) to 7200 mm. It is also believed that the system has adaptive and simplified startup capabilities, since it can launch the RM, both in the upright position and at a certain angle. The flight path of RS is

aerobalistic. Number of guides on PU is 6 pieces. The time for deployment of the system at the firing position is 8-9 minutes [11].

SCAIC is positioning the WS-64 as the world's first SVFS adapted for the effective use of anti-precision precision guided missiles. For what, in particular, they use a half-armored combat unit. Thanks to the combined inertial and satellite (using the Beidou satellite navigation system), the system of guidance and broadband passive radar reconnaissance of the warhead at the end of the trajectory system is capable of effectively striking targets with high accuracy. The KIW is less than 30 meters and in the radar direction KIW is less than 10 m. Thus, the WS-64 radar guidance system can even destroy even moving targets, such as warships [11].

SVFS A200 and A300 (China)

The A200 and A300 are the latest Chinese SFVS equipped with the same name-guided missiles. A200 is able to cover a range of 50-200 km, and its modification A300 is 90-290 km. On the launcher, there are 2 containers with 4013 mm cattle each [11].

The A300 is a two-stage, which allowed to increase the maximum flight range compared with the A200 by 90 km. The flight of both shells is controlled, the guidance system is mixed: inertial and satellite, operating throughout the flight. KIW is from 30 (high warhead) to 45 (cassette warhead) meters. Thus, these projectiles are very accurate even at such a high range. The starting mass of the projectile A200 is 730 kg, A300 is 765 kg, with a length of 7264 mm and 7496 mm respectively [11].

As for the A200, this missile has a cubicle body with a maximum diameter of 301 mm. In the front part of the body of the main part are X-shaped steering, and in the tail - stabilizers of a similar design. The maximum width of the tail stabilizer's planes reaches 615 mm. The main part at the final stage of the trajectory is separated from the body and moves to the goal independently, control is carried out using aerodynamic steering wheels [12].

Both racers are equipped with 150 kg warheads. The combat unit is separated. Several kinds of BW are available: high-explosive, fragmentary-rich, penetrating and cassette. The launch unit is capable of operating as a single shot or a gun. It takes 50 seconds to complete a volley of 8 shells. Each of them can be provided individually. Thus, the A200 in one salvo can strike eight different targets on an area of 10x10 km, but the A300 can hit a similar number of targets already on an area of 20x20 km. The maximum flight speed of the catcher reaches 4.5 Mach, and the maximum flight altitude reaches 48,000 meters. The flight path of the RM is aerobalistic. It is reported that the missile maneuvered in flight in order to overcome enemy air defenses. In addition, the cattle can make an elevation over the target area and apply a vertical blow to maximize damage [11].

The time for the LS to start from the march less than 7 minutes, with a horizontal position of less than 3 minutes and less than 0.5 minutes from the incline [11].

SVFS AR-3 (China)

The SVFS AR-3 was developed by specialists of NORINCO Corporation. The AR-3 rocket firewall is designed to destroy the enemy's most important goals, located far from the front line. The AR-3 missile system includes unmanaged and guided 300mm caliber rockets, which can be completed with different types of head parts. These include fragmentation, explosive, inflammatory, volume detonating action, as well as cassettes equipped with anti-personnel, anti-tank mines and SPBE [13].

All AR-3 missile shells are similar in design - a cylindrical body with a tapered main ramp. In the tail section of the body is provided with a stabilizer with six planes, decaying after leaving the TPK. In addition, there are small X-shaped steering wheels in the back of the main flap that are used to control the projectile in flight. The design of complex tail stabilizers is unique for all shells of the family, and the shape and other features of the steering wheel depend on the particular product. Used as large complex rods, and relatively small, the size of which allows you to not fold them before placing a shell in the container [13].

The shells of a caliber of 300 mm have a start weight of 840-850 kg and carry a combat part weighing about 200 kg. Similar information about 370-mm projectiles is missing. Probably, their starting mass exceeds 1000-1100 kg, and the mass of the combat unit reaches 250-300 kg. The shells have a similar design. In their main part there is a guidance device, a combat part is located behind it, and a solid fuel engine is located in the tail compartment. According to official data, only some shells of the family are managed. However, the flight range of officially unmanaged shells (up to 130 km) suggests that they are equipped with some means of preserving a given flight path, such as the inertial control system used on the “Smerch” SVFS [13].

It is known that the following SVFS are used for the AR-3 RM:

— BRC3. RM with caliber 300 mm equipped with a cassette combat unit with various types of combat equipment. Range of flight - up to 70 km [13];

— BRC4. A similar caliber ammunition 300 mm with a cassette combat unit. The BRC3 is characterized by a more powerful engine, which provides a range of 20 to 130 km [13];

— BRE2. 300-мм RM with a fragmentation-explosive military unit. By its size and characteristics, a similar product BRC4 [13];

— BRE3. Controlled (with a system of guidance to a given target) RM caliber 300 mm. Carries a fragmentation-explosive combat unit and can hit targets at distances of up to 130 km [13];

— Fire Dragon 140A. Controlled ammunition with a range of up to 140 km. Has been presented relatively recently and is the further development of the previous RM type [13];

— BRE6. Another one controlled by RM with a fragmentation-explosive military unit. It has a caliber of 370 mm and can fly at a distance of 100-220 km [13];

— Fire Dragon 280. Relatively new development. Chassis caliber 370 mm with a range of up to 280 km [13].

According to the manufacturer, all RM-controlled SVFS for AR-3 with a range of up to 220-280 km have a KIW of 50 m. There is no precise information about the type of guidance system that achieves such indicators. The appearance of the cattle, which do not have any specific features of the main ramp, suggests the presence of an inertial or satellite navigation system [13].

New Chinese munitions have considerably smaller dimensions, so that at one launcher is placed up to 8 RM with the maximum possible range of shooting up to 280 km. Thus, with the increase in the maximum range of shooting, the Chinese complex retains the ability to shoot guns in the area. The time for a full salvo is 60 seconds, and the reload time is about 20 minutes [13].

Conclusions

Thus, after analyzing various samples of RM in the countries of the world, one can distinguish the main tendencies of recent years in the field of development of SVFS and Rhizosphere in particular. The main directions of development at the moment are increasing the range of flight and accuracy of missiles.

The first is achieved, mainly due to the increase in fuel charge, which in turn leads to an increase in the diameter and length of the rocket, as well as its launch mass, as is observed in a number of Chinese RM. The second option is to reduce the weight of the payload, as was done in the case of RM 9M542. However, there are certain "but" here. For example, it is advantageous to replace old, heavy and large equipment, new, lighter and more compact. However, a decrease in the mass directly of the charge of the BC will lead to a decrease in the power of the projectile. Finally, the last resort is the use of a multi-stage scheme, as in the Chinese A300, although traditionally the RMs are developed exclusively in single-step. Such a constructive solution allowed to increase the maximum range of the projectile compared with its predecessor, A200, by 45% from 200 to 290 km [11], while maintaining the mass-overall characteristics and not reducing the payload. However, in this case, the design should have been complicated and the product's reliability lowered. It is also not necessary to forget about the creation of new high-energy blended fuels for solid-fuel engines, although this issue is rather technological rather than design.

The precision of the missiles is increased by installing on board a combined inertial and satellite guidance system that reduces the KIW to 30-50 m, as well as the establishment of radar (and other) GSN, as in the case of the Chinese high-precision

SVFS WS-64, where at a range of 280 km of KIW was reduced to 10 m [11], but American GMLRS + Rocket.

High precision, together with a large range, allows you to strike point targets that are deeply in the blaze of the enemy. At the same time, the most important advantage is that at one launcher there are several guides at once. On modern samples is about 6-8. Also, the latest installations allow each shell to be used for its own purpose. Accordingly, one installation can cause a series of punch-strokes due to the enemy's burst resulting from one start-up. At the same time, the SVFS, in addition to high-precision, also retains the possibility of massive rocket attack on the area.

It should be noted that a number of the above factors allows us to bring as much as possible the modern SVFS into operational tactical missile systems. At the same time, SVFS retains its advantages in the form of high mobility and speed of deployment, which reduces the vulnerability of artillery fire and strikes of aircraft of the enemy.

We should not forget the probability of overcoming anti-missile defense (missile defense) of the enemy. On the one hand, the cattle keep a high flight speed, reaching the mark 5.6 Maxy (WS-2D) [9], which greatly complicates the task of interception. On the other hand, modern BFDs have the ability to maneuver in flight in order to overcome the enemy's air defenses as a result of the use of aerobalistic trajectories of flight at altitudes of up to 50 km. It is also important to note the possibility of a high-speed turn over the target zone for vertical impact to maximize the impact power (A200, A300, WS-63, WS-64)

Considering a number of advantages of modern high-caliber SVFSs, such as high precision and efficiency, high flight range, maneuvering capabilities to overcome the enemy's missile defense, and high-level rotation over the target area to maximize damage. And also a number of advantages of the system as a whole, such as the possibility of applying both point and salvo shocks, high mobility and speed of the launch of the launch. It is worth considering the possibility of developing in Ukraine as a modern large-caliber jet system of salvo fire as a whole, as well as cattle to it, which would correspond to the best foreign models and would take into account the main world trends in the development of RM SVFS.

Previously, it is possible to formulate such requirements for a promising RM: the mass of the projectile up to 1500 kg, the weight of the payload to 250 kg, the range from 300 to 500 km (the limitation under the international agreement "Mode of control over rocket technology"). The maximum accuracy is KIW of about 10 m, the aerobaltic trajectory with the possibility of maneuvering throughout the flight, as well as turning over the target area for a vertical impact. It is also worth considering the development of various types of MS: a fragmentation-explosive, penetrating, cassette, bulk explosion, as well as a projectile with a small-scale reconnaissance unmanned aerial vehicle for conducting operational intelligence in the target area and the transfer of information to the fire control complex for adjusting the firing.

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