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Original article

Renaissance of Russian high-power artillery

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ABSTRACT

The article aims to find answers to questions about the process of forming the high-power Russian artillery. The conclusions from the analysis of the development process of the Russian artillery included in the work may justify the statement that at the threshold of the 21st century, the return to the high-power artillery may be a harbinger of changes in the Russian approach to ways of performing tasks as part of groupings fighting in depth.

KEYWORDS

high-power Russian artillery, modernization, conversion

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Introduction

In the Russian Armed Forces, artillery, along with infantry, is one of the oldest military branches. According to the records in the chronicles of the Resurrection Monastery in Istra, the genesis of Russian artillery is associated with the reign of the Grand Duke of Moscow Dmitry Donskoy (1359-89) and his successors[1]. The first documented use of artillery was recorded on August 23, 1382, while repelling Tokhtamysh's assault on Moscow. In armed conflicts with the participation of Russian Armed Forces, in most cases, the artillery fire determined the course of battles and campaigns. That is why the tsarist artillery developed dynamically during the Rurik and Romanov Dynasties. The Russian artillery played a significant role in the wars with Sweden, Turkey, and during the First and Second World War. In the years of the Cold War, the high-power artillery prepared for the use of nuclear ammunition was decisive for the success of a strategic deep offensive operation.

[1] Vasily I of Moscow (1371-1425), the eldest son of Dmitry Donskoy, provided the Moscow Kremlin with in 1408 with guns to repel the Golden Horde of Emir Edigey. During the rule of Vasily I canners appeared in the strongholds of Novgorod, Pskov, Smolensk, and Tver, where the production of guns and gunpowder began. Ivan III of Russia (1440-1505), Dmitry Donskoy's great-grandson, brought a Venetian architect Rodolfo Fioravanti to Moscow, who in addition to the construction of the Uspensky Council, created the foundations of Russian metallurgy while training the first masters of bell-founding. Fioravanti participated in several war expeditions of Ivan III, where he commanded artillery. Moreover, he took part in the sieges of Novgorod (1477-78), Kazan (1485) and Tver (1485).

Firearms were used for the first time in Russia at the end of the fourteenth century, however, the beginnings of the development of the Russian artillery date back to the turn of the fifteenth and sixteenth century. According to the records of the Herman Wartberg's chronicle, the Ruthenians, thanks to the Sword Cavalry, encountered the artillery in 1377 during the siege of the Drui castle on the Polocka Land. The thesis about the Western European roots of the Russian artillery was completed in 1784 by V.N. Tatishchev [1] indicating that in 1393 the Grand Duke of Moscow received several guns as the gift from Germany. The first Ruthenian stave cannons were produced by the method of forging iron (steel) staffs reinforced with metal hoops included caliber 30-40 mm long-bore hand guns, short-barrel bombards of the caliber of up to 75 mm intended for throwing grapeshots and homogeneous ammunition, as well as short-barrel cans with caliber of about 60 mm intended for direct and indirect fire, with homogeneous stone or iron ammunition [2, p. 227-30]. The construction of the fire measures possessed by the Ruthenian artillery at the end of the 14th century remained like the English guns used in the Battle of Crecy (1346). The primitive structure of the first fire measures limited their range and rate of fire. In medieval Rus, the range of guns fire (200-250 m) was determined in relation to the range of the bow (120-150 m, in England 185 m) as the main projectile throwing asset. The caliber, or rather the gauge of the gun, was determined by the mass of the projectile. At the end of the fifteenth century, thanks to Italian engineers in Russia, the first foundry workshops were established, where Ruthenian masters of casting and canning art were trained[2] [3]. In April 1483, a brass (bronze) barrel of the first gun was cast in Rus. Three years earlier, the Rus field artillery seated on a wheeled gun carriage was blocking the crossing on the Urga River against the Tatars. The bronze-casted guns were expensive, however, they used the energy of gunpowder gases to a greater extent; when utilizing larger loads, they were able to throw bigger projectiles and had a greater range and accuracy. The change in production technology resulted in the simplification and acceleration of the production process of firing weapons, which began to be equipped with the first sights and wheeled carriers. The first completely independent Russian production was a hand gun cast in 1485 by master Yakov. In the mid-sixteenth century, the first iron barrel gun with a mass of 1020-1200 poods (about 17-19 tons) was cast in Moscow (1554-55) while reducing production costs. During the reign of Ivan the Terrible in 1547, the artillery accounting for approximately 2,000 barrels was separated from the infantry, the new Artillery Prikaz[3] was responsible for the development of a new type of weaponry. In the second half of the 16th century, the iron and bronze barrels were cast in accordance with a uniform gauge in Pskov, Novgorod, Vologda and Veliky Ustyug.

[2] After the death of Fioravanti, in 1488 the Grand Duke Ivan III founded in Moscow (in the vicinity of the Spasskaya Tower) Artillery Chamber, the first bell foundry, where the gun barrel and bells were cast.

[3] The first artillery command body – the Pushkarsky Prikaz was established on October 10, 1577, in 1701 it was renamed into the Artillery Prikaz and in December 1862 into the Main Artillery Directorate, and from November 19, 1960 it was known as the Main Directorate of Rocket and Artillery Forces of the General Staff of the Armed Forces of the USSR.

Fig. 1. The work of Master Chokhov – 183 mm hand gun Lion and 152 mm hand gun Scorpio
Source: [4].

During the Livonian War (1558-83), after 1577, Ivan the Terrible's troops had at the disposal 21 heavy guns and 36 hand guns, and the same number of heavy gun barrels called Ingor, Eagle, Bear, Wolf, Lion, Scorpio, Yusup, Aspid and Vixen cast by master Andrey Chokhov for the purposes of the campaign. The service of the artillery park required the involvement of 12,724 people and 4,123 horses. The towing of Ingor alone (caliber 216 mm, length 5.16, weight 7436 kg) required 74 horse sleds. Due to the mass of the cannons in the middle of the 16th century, river barges were used for their transport, the fire assets were delivered to the destination in the disassembled form. The homogeneous ammunition used included iron, bronze, steel, stone projectiles and cartridges loaded with stones or metal fragments. In the years 1558-83, the first incendiary bullets in the form of homogeneous shells covered with flammable material were also employed.

Fig. 2. The Wolf hand gun that was cast in 1579 went to Stockholm as a war trophy
Source: [5].

The bronze bombard Tsar Cannon cast by Chokhov in 1586, which was a monument to the craftsmanship of the Ruthenian bell founders, constituted the crowning achievement of Russian metallurgy at the end of the 16th century. The barrel with the length of 5.34 m, the external diameter of 1.2 m, the caliber of 890 mm and the mass of 39.31 tons was placed on a decorative carriage from 1859. It was originally intended for throwing stone projectiles – cartridges with the mass of approximately 819 kg, according to experts, at least one shot was fired from this bombard. In 1598, the death without heir of the last of the Ruriks stopped the development of the Ruthenian artillery, and on February 21, 1613, the ascending of the throne by the Romanov dynasty ended the period of the Great Smuta and opened another chapter in the development of the Russian artillery.

1. Russian artillery in the 17th-19th century

In the middle of the 17th century, in about 100 cities and 4 monasteries in the territory of Russia, there were 3,573 canners operating approximately 2,637 artillery assets, of which 755 were bronze casts. In the years 1630-39, the first infantry regiments appeared in the tsarist army in Russia, whose work and training process was similar to the Western European models. Moscow became the center of the production of artillery assets and ammunition, and the manufacture of cast iron guns was launched in Tula and Novgorod. At the end of the 17th century, during the reign of Fyodor III, 63 infantry regiments with a total of about 90,000 soldiers and rifle regiments consisting of about 40,000 soldiers were maintained in the tsarist army. The regimental artillery (artillery battery with 6-8-guns) was provided with cast bronze guns in accordance with the then applicable standard, including 14 different calibers, which were mounted on unified carriages. In 1699, Peter I of Russia created the function of the chief head of artillery, the term of the corps artillery appeared in the artillery dictionaries, and artillery grenades (the shell filled with gunpowder and closed with a shaft with a fuse) came into use. In Western Europe, the gauge became standardized and operational guns with an average barrel length of 17-28 mm caliber were introduced into service and began to replace the long-barrel culverins (33-38 mm calibers). The introduction of 48-pound kartouwen, 24-pound semi-kartouwen, 12-pound quarter-kartouwen and 6-pound octaves into the equipment facilitated the ammunition production method (kartouwen – canvas bags with a propellant charge), as well as operation and transport of fire measures. The turn of the 17th and 18th centuries (two expeditions to the Azov Fortress, the defeat at Narva and the loss of 145 cannons) resulted in the reform of the tsarist army. The field artillery was organized into artillery regiments, the final manpower of which was adopted in 1712. The park of artillery equipment included fire assets in 12 basic calibers, which were divided into guns, howitzers and mortars. The field artillery included artillery subunits from infantry and cavalry regiments. Two 2-pound guns and four mortars were kept in the infantry regiments. The cavalry regiments had 6-8 guns (two 3-pound guns and four mortars, or four 4-pound howitzers and four mortars). In 1706, a total of 157 guns were kept in the regimental artillery. Altogether, approximately 120 guns, mostly 3-pound ones, and about 7,000 horses were kept as part of the field artillery (artillery regiments) in 1724. In 1723, about 120 guns, 24- and 18-pound ones, 40 heavy mortars and about 200

6-pound mortars were kept in the siege artillery. The subunits had the stock of 500 projectiles per cannon. In 1723, the siege artillery was divided into three corps located in St. Petersburg, Bransk and Osered [6, p. 42-4]. During the Seven Years' War (1756-1763), the Russians used the horse artillery in combat operations for the first time. Moreover, in the years 1758-62, about 70 howitzers with an unusual structure designed by General Peter Shuvalov prepared to throw grenades, canister shots, and stone balls were maintained in the Russian artillery park. At the end of the 18th century, the invention by the Englishman Henry Shrapnel (1784) began to replace the traditional canister shots. At the beginning of the 19th century, the Russian artillery was reorganized according to patterns referring to the solution implemented in the French army by Jean-Baptiste Vaquette de Gribeauval. In 1805, the park of Russian artillery was based on 6- and 12-pound guns and 3-, 10- and 20-pound howitzers. From 1796, the Russian artillery batteries comprised 12 guns; in the stationary variant they were four 20-pound howitzers and eight 12-pound guns. Light and horse batteries consisted of four 10-pound howitzers and eight 6-pound guns. In the years 1806-07, the artillery brigade consisting of two stationary and one light battery were kept in the composition of the infantry and cavalry divisions. Officers' staff was educated for the needs of the tsarist artillery in the Mikhailovsky Artillery School (Academy from 1855) established in St. Petersburg (1820). Another attempt to reorganize and modernize the Russian artillery was made after the end of the Crimean War (1853-56). In June 1859, the garrison artillery in fortresses (artillery garrisons) was renamed as the fortress artillery, while the artillery districts were renamed the fortress artillery districts. The fortress artillery was supervised by the artillery inspector at the Artillery Department (from 1862 – the Main Artillery Directorate). After the introduction of a system of military and administrative division of the state territory (the division into military districts took place in accordance with the Milutin reforms in the years 1863-64), 9 districts and 43 garrisons and 69 artillery units were disbanded. After 1864, the fortress artillery got subordinated to the Artillery Directorates of individual military districts. The first threaded guns, initially bronze and cast iron guns (model 1867), which in 1868 were settled on steel carriages. The first 107 mm breech-loaded gun with a threaded steel barrel was introduced into the equipment of the tsarist army in 1877 together with the emergence of combined ammunition and the first recoil mechanisms. The lack of significant progress in the process of modernization of the Russian artillery was confirmed in the next war with Turkey in 1877-78. At the beginning of the 20th century, the Russian siege artillery (with obsolete means of the 203 mm caliber) was maintained as part of the artillery parks of the fortress in Brest-Litovsk, Kiev and the Caucasus. In 1891, when attempting to break the deadlock, the technical documentation and license for the 152- and 75-mm sea guns from the system developed by Gustav Canet were purchased in France (in 1916, the Baltic and Black Sea Fleets totaled approximately three hundred 152 mm Canet guns). The need for the development of heavy field artillery was confirmed by the conclusions of the Russian-Japanese War of 1904-1905, but the assumptions of the then preferred French maneuvering war decided on stopping the further development of the Russian high-caliber artillery.

During the preparations to carrying out maneuver operations in 1910 as part of the reform of the armed forces, the organizational structures of the tsarist artillery units were

changed. The field artillery intended for direct support of troops included subunits of light, horse, mountain artillery, as well as the howitzer artillery and heavy field artillery. Following the resignation from the heavy siege artillery, in 1910-11 the large-caliber fire measures were withdrawn from service (1867 and 1877 model guns) produced in the middle of the 19th century. The acceptance of the concept of maneuvering war led to the abandonment of a large caliber and in the field artillery the caliber of 152 mm was considered appropriate for the heavy artillery. In the years 1911-21, the planned modernization of the heavy artillery was to result in reaching new capabilities by 1925 [7].

In the effect of the reorganization, until August 1, 1914, a total of approximately 7,088 fire measures remained at the disposal of the tsarist artillery, including 512 howitzers and single experimental pieces of the high-power artillery (203 mm howitzer, model 1913). Twenty-four fortresses and fortified areas (in total over 60 artillery units) lacked in about 45% of fire assets. Only few 280 mm mortars (model 1877) with limited fire capabilities were preserved within the fortress artillery. The project of the purchase of sixteen 280 mm mortars (model 1912/14) of the Schneider system was during the implementation phase. As part of ammunition stock for 107 mm and 152 mm guns only 48-50% of the required amount (about 1000 shells per gun) was kept, while for the 75 mm caliber, twice more than the required number of projectiles was prepared.

Fig. 3. 305 mm howitzer (model 1915) and 280 mm mortar (model 1914) of the Schneider system *Source: [8, 9].*

On the threshold of the first global conflict of the twentieth century, the tsarist artillery was ready to participate in the maneuver warfare. The Russian field artillery consisted of divisional artillery brigades, composed of two battalions of three batteries each (forty-eight 76 mm guns) and a corps artillery battalion with twelve 122 mm light howitzers (model 1909). In the initial phase of the war, due to the small number of fire assets, battalions of heavy field artillery (a total of about 20) were formed at the level of the army. Experiences from the initial phase of the war (the siege of the Przemysl Fortress) resulted in the acceleration of the process of forming the Russian heavy artillery of special purpose (тяжелая артиллерия особого назначения – ТАОН). In the years 1914-16 two heavy artillery regiments were created, and 203 mm howitzers (model 1915) and

305 mm howitzers (model 1915) and 280 mm mortar (model 1914-1915) were introduced into service. Until January 1917, the special heavy artillery (TAOH), or the 48th Artillery Corps, was separated as part of the field artillery, which included six heavy artillery brigades (200, 201, 202, 203, 204, 205). In 1917, on the four fronts (south-west, Romanian, western and northern) the tasks were carried out by 389 heavy artillery batteries, a total of 1 434 fire assets of the caliber 107-305 mm [10].

2. Soviet high-power artillery

After the end of the civil war, in the years 1924-1927, as part of the reorganization of the Red Army in formed shooting corps, apart from the divisional artillery (the artillery regiment, 2-3 squadrons, fifty-four 76 mm guns (model 1902), eighteen 152 mm howitzers (model 1910)) the 107 mm guns squadrons (model 1877) and 152 mm howitzers (model 1910) were kept, which in the following years were developed into heavy artillery regiments. Eighteen 305 mm howitzers (model 1915) and 280 mm Schneider mortars (model 1914/15) were inherited after the tsarist TAOH (from 1933, 34 guns). For the unknown reasons, the first batch of 406 mm howitzers (model 1918) capable of throwing projectiles weighing over 880 kg was dismantled in Obuchow. In 1926, a modernization program was launched with the aim of replacing artillery fire assets with guns of domestic production. In 1932, the task of developing new fire assets was given to the design office No. 2 (305 mm howitzer) and the design office of the Bolshevik plant (400 mm mortar, 305 mm howitzer, 203 mm gun). After having settled the competition, the design of the Bolshevik plant was selected for further work, and the full implementation of the project guaranteed the transfer of a significant number of artillery high-power fire assets to the Armed Forces until 1939. The completion of the program was disturbed by the decisions of M. Tukhachevsky and the commissioner for heavy industry S. Ordzhonikidze. As a result, in 1933, the 203 mm B-4 howitzer (model 1931) founded on a tracked chassis that allowed a change of fire position within the radius of approximately 5 km at the speed of approximately 15 km/h. In the marching position, the 17.7-ton gun was transported as decomposed into five subassemblies. Despite the failures during the tests, in 1935 the 152 mm BR-2 cannon was adopted. In the marching position, the cannon weighing about 14 tons was transported as decomposed into two main subassemblies.

Fig. 4. 203 mm B-4 howitzer and 152 mm BR-2 howitzer
Source: [8].

In 1939, the Bolshevik triplex plant closed the Stalin's anvil series with the 280 mm BR-5 mortar with the mass of approximately 18.5 tons, based on a caterpillar track that was common to the whole program. When attempting to develop a heavy artillery modernization program, after a visit to the Skoda armaments plant (1937), the Russians launched a license production of the 210 mm BR-17 gun and the 305 mm BR-18 howitzer[4]. A lot of experimental weapons (3×BR-17 and 3×BR-18) were tested until the end of 1939. The series production of the guns was discontinued in June 1941 and out of the planned 10×BR-17 and 6×BR-18 only 6 and 3 respectively were delivered to the troops. Until June 22, 1941, a squadron of cannons composed of three batteries was formed as part of the Supreme Commander's Reserve (OND) composed of three batteries with 2×BR-17 in each, but due to the lack of ammunition it did not reach readiness. Moreover, the war interrupted the implementation of projects related to 450 mm BR-23 howitzers and the 500 mm TG-1 railway gun[5]. In June 1941, the OND maintained:

1. The 281st Heavy Artillery Regiment, 30×305 mm howitzer (model 1915).
2. The 911th Heavy Artillery Battery, 4×305 mm howitzer (model 1915).
3. The 524 Heavy Artillery Regiment, 24×152 mm BR-2 cannon.
4. Six independent heavy artillery batteries, in each 2×152 mm BR-2 gun.
5. Thirty-three heavy artillery regiments, in total 792×203 mm B-4 howitzer.
6. Eight independent mortar squadrons, a total of 25×280 mm mortar (model 1915) and 47×280 mm BR-5 mortar.

By June 1941, the Red Army had a reserve of about 7,000 280 mm mortar grenades and about 7,500 305 mm projectiles. In the western military districts, most of ammunition stockpiles and five hundred and seventeen 203 mm B-4 howitzers, seventeen 280 mm mortars (model 1915) and forty-seven BR-5 mortars were concentrated. In the Far East, as part of the Pacific Ocean Fleet, the 911th Heavy Artillery Battery and a reserve of about 1800 305 mm projectiles were kept. Both during the winter campaign in Finland and in the first stage of military operations in 1941, the Soviet command mistakenly used its assets. In Finland, 280 mm mortars (model 1915) carried out a spoiling fire on the possible routes of displacement of the Finnish reserves instead of destroying the fortifications on the Mannerheim Line. In July 1941, heavy artillery subunits carried out fire tasks until the ammunition was exhausted, firing only in the direction of the enemy's expected approach. In August 1941, the majority of heavy artillery units were withdrawn into the operational group, until the autumn of 1941, the Soviet Armed Forces lost seventy-five

[4] On April 6, 1938, a contract was signed for the purchase of experimental 210 mm cannons and a 305 mm howitzer with a set of ammunition and technical documentation, with a deadline for submission set on December 1, 1939. The license production of a series of 6 cannons and 6 howitzers was launched in the Plants No. 221 Barricades. The BR-17 and BR-18 were introduced into service on May 8, 1938.

[5] In 1937, projects on TP-1 train sets with 356 mm guns and 500 mm TG-1 howitzers were launched. The TG-1 project was carried out at the mechanical plant in Novokramatorsk. By the end of 1942, it was planned to build sixteen TG-1 guns for eight OND heavy artillery batteries (three transport wagons, three power supply wagons, two ammunition wagons each with 24 projectiles, a battery commander wagon, an operational wagon, two cannons, an emergency wagon for the reconstruction of the railway track). The project of the 450 mm BR-23 howitzer was created in 1940 in the production Plants No. 221. The prototype was to be ready for field tests in the first quarter of 1942.

B-4 howitzers and nine 280 mm mortars. In the autumn of 1942, the Breaching Artillery Division (DAP ODN) began to be formed within the OND and debuted on the front on November 19, 1942. The Division was composed of 6-7 brigades with 76 mm cannons and 122 mm howitzers, two brigades with 152 mm howitzers, 203 mm heavy howitzers, mortars, and rocket artillery (a total of about 360 fire assets). In April 1943, the formation of another eight DAP ODNs commenced, which were included in the ten Corps of the Breaching Artillery (a total of over 1000 guns). As a result, at the end of World War II, the share of OND artillery fire assets increased from the initial 8% (June 1941) to 30% [11, p. 6]. After regaining the strategic initiative, in August 1944, two four-cannon squadrons were formed as part of the OND using the captured 211 mm Mr 18 cannons on the wheeled chassis. In December 1944, the 1st, 2nd and 18th Guards Heavy Artillery Regiments were formed based on four independent squadrons with 152 mm BR-2 cannons and three 210 mm BR-17 cannons. In addition, in 1944, three 305 mm BR-18 howitzers were transferred to the Armed Forces and used to form the 233rd Independent Heavy Artillery Squadron. However, the subunit did not reach combat readiness and until the end of the war was subordinated to the Moscow Military District. By the end of 1945, heavy artillery subunits included 16 captured 21 mm K-38 guns, which were used to form four independent heavy artillery divisions.

Fig. 5. 280 mm BR-5 mortar and modernized 203 mm B-4M howitzer
Source: [8].

In July 1942, General Lieutenant W. G. Grabin, who was tasked with developing a set of new heavy fire artillery, took the post of the head of the Central Artillery Construction Office. Until the end of the war, the Grabin's team developed two sets of heavy artillery, including: a triplex comprising a single carriage and three towed fire assets (180 mm S-23 gun, 210 mm S-33 howitzer and 280 mm S-34 mortar) and a duplex comprising 210 mm S-72 guns and 305 mm S-73 howitzers (replacement of BR-17 and BR-18). Despite the good results achieved during the tests, further implementation of the delayed programs was finally discontinued. In 1955, in the absence of modern solutions, striving to increase the maneuverability of the assets being maintained, as part of the modernization, the construction from the 1930s was placed on a circular carriage (BR-5M, B-4M, BR-2M). When searching for successors for artillery fire assets from the war period in 1954-57, 420 mm 2B1 Oka self-propelled mortar and 406 mm 2A3 (SM-54) Capacitor

self-propelled cannon were developed. Nonetheless, a number of defects in design and operational limitations (dimensions and mass) were identified and both guns without going beyond the stage of four test prototypes were excluded from further work in 1960. The failures of 2B1 and 2A3 resulted in the discontinuation of research and development programs of high-powered artillery, and the focus was placed on the development of missile weapons capable of performing tasks using nuclear ammunition.

In the next stage, the directions of development of the Soviet high-power artillery were decided by conclusions from the course of local conflicts, in which the fire assets of Soviet production were confronted with their western counterparts[6]. The change of the strategy and the removal of the spectrum of the nuclear disaster on a global scale confirmed the increase in the importance of local and regional conflicts carried out with the use of tactical nuclear weapons[7]. In the case of this scale of conflicts, the tasks of destroying the enemy's fortified objects were to be implemented using new self-propelled fire assets of high-power artillery prepared for operation on the nuclear battlefield. In December 1967, work on a self-propelled cannon commenced so as to replace 203 mm B-4 towed howitzers and B-4M howitzers[8]. Perspective sets were intended to arm the squadrons of OND heavy artillery squadrons. For the needs of the project, the usefulness of the 180 mm S-23 gun on the T-55 tank, 210 mm S-72 guns on the chassis of the 429 object, and 180 mm MU-1 sea gun (BR-402) on the T-55 chassis was assessed. As a result, in 1969 a recommendation was prepared including the advantages of 210 mm S-72 cannon with caliber reduced to 203.2 mm and increased requirements for the carrier.

Officially, the research and development program of the 203.2 mm 2S7 Pion self-propelled gun set (Object 216 with a 2A44 cannon) was launched in July 1970. The 2S7 Pion set was accepted in 1975 and manufactured until 1985. Then, in the years 1986-90 the 2S7 Pion guns were replaced with a modernized version of 2S7M Malka, a total of over 500 sets of which were handed over to the troops. The last batch of sixty-six 2S7M Malka self-propelled guns[9] was provided to the Soviet subunits of high-power artillery in 1990.

As a standard, a high-power artillery unit armed with sets of 203.2 mm 2S7 cannons consisted of three four-gun batteries. The OND heavy artillery brigade maintained up to

[6] In the absence of ready-made solutions, an attempt to return to the concept of Grabin's 180 mm S-23 towed cannon whose export production resumed in 1971 can be described as the act of desperation.

[7] In 1964, project work was initiated on the 240 mm 3BW4 nuclear missile for 240 mm M-240 mortars, the 203 mm 3BW2 nuclear missile for 203 mm B-4M howitzers, and 152 mm 3BW3 nuclear missile for 152 mm D-20 and 2S3 gun-howitzers. In 1977, a new type of tactical nuclear ammunition was developed for the 2S7 Pion set.

[8] On December 16, 1967, the Minister of Defense of the USSR issued an order to develop a self-propelled, high-power cannon, prepared to fire nuclear and conventional ammunition at a range of not less than 25 km. Officially, the research and development program of the 203.2 mm 2S7 Pion self-propelled gun set (object 216) was commissioned in accordance with the decision of the Council of Ministers of the USSR No. 427-151 of July 8, 1970.

[9] In the years 1983-85, a modernization program for 203.2 mm 2S7M Malka self-propelled gun was completed, which received a new multi-fuel W-84B engine, fire control set (data display for shooting installed on the commander's and sight's position, data passed directly from the fire officer's battery) reducing preparation time for shooting. The gun ammunition reserve was increased and the number of crew was reduced.

four squadrons of 2S7 cannons. At the end of 1990, at least seven Heavy Artillery Brigades were kept in the Soviet Land Forces, in total about 347 sets of 2S7 remained in the zone to the Ural[10] [13, p. 39]. After the collapse of the USSR, about 327 sets of 2S7 were kept in the Armed Forces of the Russian Federation, most of them were withdrawn to the bases of equipment and weapons and arsenals outside the zone of the application of the CFE-1 Treaty (except the 45th Heavy Artillery Brigade of the Moscow Military District). In addition, about 200 sets were available to the Armed Forces of at least nine countries[11].

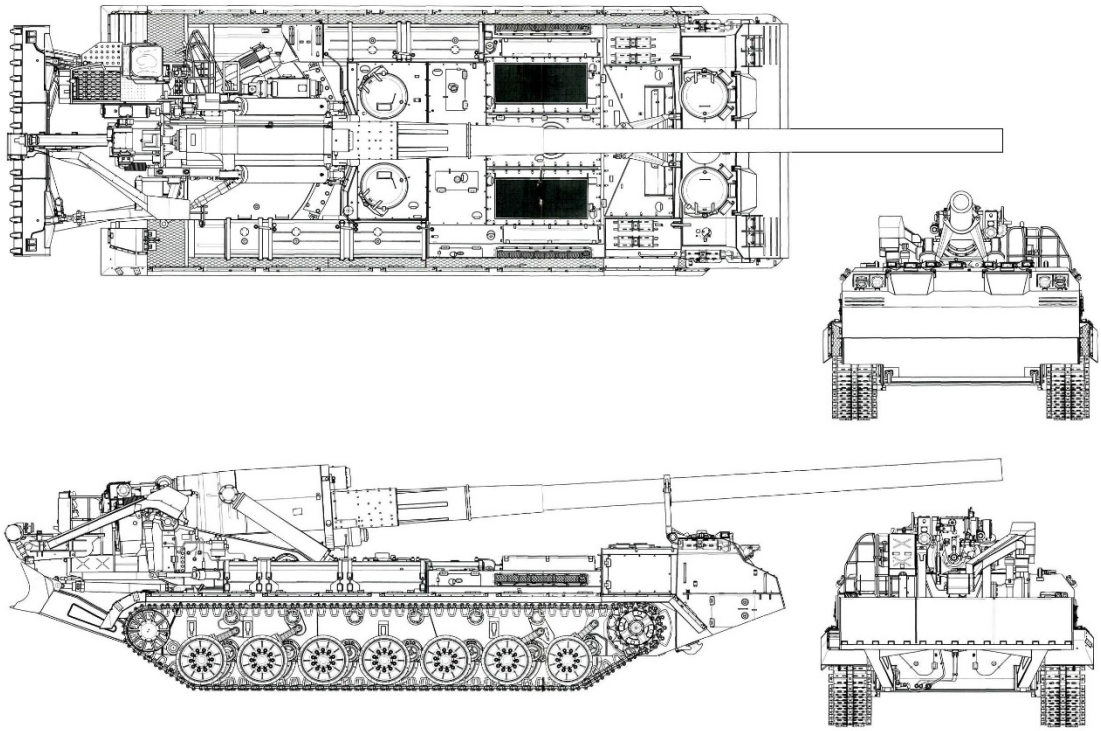

Fig. 6. 203.2 mm 2S7 Pion self-propelled gun
Source: [12].

In 1966, in the design office of the Ural Production Plant of Transport Machinery, works started on a self-propelled artillery set (Object 305) including a 240 mm 2B8 mortar mounted on the GZM transporter's hull, which was to replace the 240-mm M-240 towed mortar. At the turn of May and June 1969, there were three prototypes that carried out

[10] The 303rd Guard Heavy Artillery Brigade of the Western Military Group, the 13th Heavy Artillery Brigade of the Belarusian Military District, the 184th Heavy Artillery Brigade of the Odessa Military District, the 188th Heavy Artillery Brigade of the Subcarpathian Military District, the 228th Heavy Artillery Brigade of the Moscow Military District, the 289th Heavy Artillery Brigade of the Leningrad Military District, the 384th Heavy Artillery Brigade of the Baltic Sea.

[11] In the Armed Forces of Angola – 12, Azerbaijan – 12, Uzbekistan – 48, Ukraine – 99. They were withdrawn from the Armed Forces of Belarus – 36, Poland – 8 (from 1985 in 5th Artillery Brigade from Glogow, then to 2006 in 23rd Artillery Brigade from Boleslawiec), Czech Republic – 12 and Bulgaria – 12. In 2006, one set was maintained in Georgia, 5×2S7 was bought from Ukraine in 2007, 4 were destroyed in August 2008, and 2 captured by the Russians in the Gori area.

tests completed in 1971 with the decision on the adoption of the set to the Land Forces weaponry.

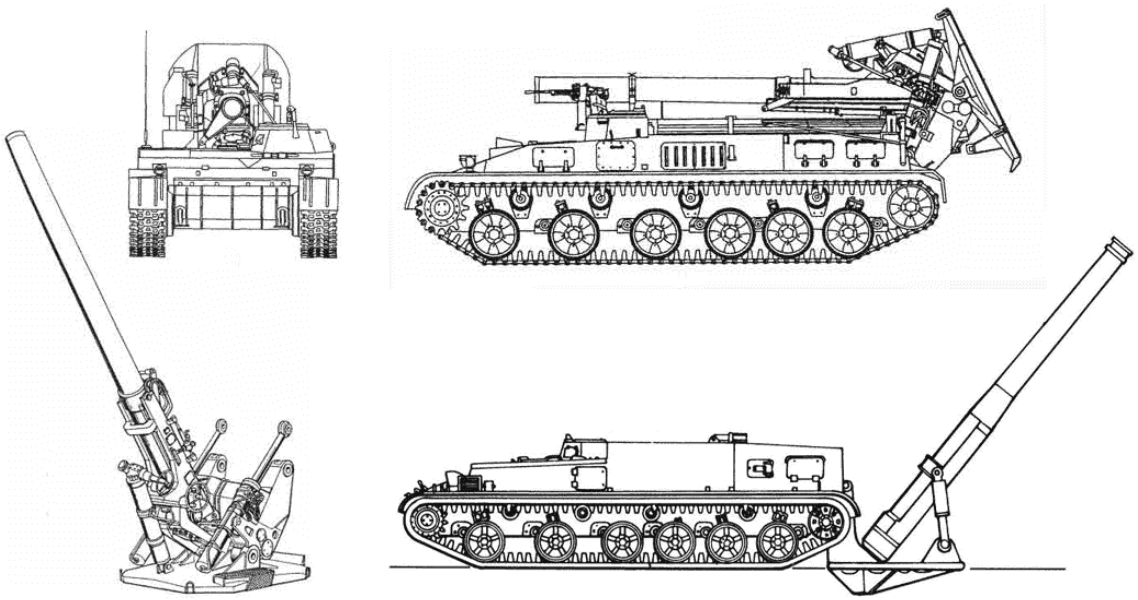

Fig. 7. 240 mm 2S4 Tulipan self-propelled mortar
Source: [14].

In the years 1972-88, about 500 sets were handed over to the Armed Forces. In November 1990, approximately 430 sets of 2S4 were kept on the territory of the USSR in the zone to the Urals, and until 1991 most of them were withdrawn outside the zone covered by the CFE-1 Treaty. After the collapse of the Soviet Union, 2S4 sets were exploited in Iraq (10 since 1983), Czechoslovakia (8 in 1988-89) and Kazakhstan. In the European part of the Russian Federation, 48 sets of 2S4 were held in the 201th Heavy Artillery Brigade (four squadrons, Sloviansk in Kuban) and in the Mulino Training Center.

3. Return of the high-power artillery

In the years 1991-2008, the development of the tactical aviation as well as tactical and operational-tactical rocket sets hindered the development of high-power artillery, which would boil down to increasing the caliber of fire assets. The 2S7 and 2S4 sets, kept within the Rocket and Artillery Forces of the Russian Land Forces were moved to the Equipment and Armaments Bases. After 2009, within the framework of the Joint Operational and Strategic Command of the West Military District (PDO-S West) only two: the 18th and 19th independent self-propelled Artillery Units and the elements of the dissolved 45th Heavy Artillery Brigade of the Moscow Military District were maintained. In 2014, the reactivation process of high-power artillery units was launched; the subsequent sets of 203.2 mm 2S7M Malka self-propelled guns and 240 mm 2S4 Tulipan self-propelled mortars have been directed from the equipment and armaments bases to operational units (all 500 sets of 2S4 are planned to be modernized by 2020). The 2S7 sets,

which were brought back into operation, were prepared for receiving data from unmanned aerial vehicles, reconnaissance aircrafts, Specnaz and SOS elements, as well as satellites. By mid-2018, there had been developed:

1. In the reconstructed 45th Heavy Artillery Brigade (Tambov), PDO-S West: two 2S7M squadrons and one 2S4 squadron.
2. In the 291st Artillery Brigade (Troitsk, the Republic of Ingushetia) of the 58th Army, PDO-S South: the 2S7M squadron and the 2S4 squadron.
3. In the 305th Artillery Brigade (Ussuriysk) of the 5th Army, PDO-S East: the 2S4 squadron.
4. In the 165th Artillery Brigade (Nikolskoje, the Amur Oblast) of the 35th Army, PDO-S East: the reconstructed 2S7M squadron.
5. In the 385 Artillery Brigade (Tatskoye, the Orenburg Oblast) of the 2nd Army, the PDO-S Center: the reconstructed 2S4 squadron.
6. In the 120th Artillery Brigade (Jurga, the Kemerovo District) of the 41st Army, the PDO-S Center: the reconstructed 2S7M squadron.

One of the reasons for the return to the heavy artillery sets was seen in the course of the conflict in Ukraine[12]. It was somewhat reaction to the actions taken by the Ukrainian side.

Table 1. Basic tactical and technical data of Russian sets of high-power artillery

	2S7 Pion	**2S7M Malka**	**2S4 Tulipan**
Produced	1975-1985	1986-1990	1974-1988
Service	3+11	3+3(4)	5+5
Combat weight (tons)	45	46.5	27.5
Mass of the artillery part (tons)	14.55		3.3
Body length (mm)	10 500		6460
Length with a cannon (mm)	13 200		8500
Body width (mm)	3380		3250
Height (mm)	3000		2760
Clearance (mm)	400		450
Armor thickness (mm)	8-12		30
Engine (power, hp)	W-46-1 (780)	W-84B (840)	W-59 (520)
Travel speed (km/h)	50/25		62.8
Travel range (km)	675		500
Fuel supply (l)	1280		850
Switching to combat position (min)	6	7	2.5

[12] Within the framework of reactivation, 2S7 were handed over from depots to the 5th Artillery Battalion of the 26th Berdyczew Artillery Brigade of the Ukrainian Armed Forces. From December 8, 2014, the sets performed fire tasks in the operational zone near the Stanytsia Luhanska (2×2S7 and 5×D-30 were lost as a result of the counter fire). In January 2015, the Ukrainian 2S7 was detected during the displacement in the direction of Artyomovsk, probably to the region of Debaltseve or Horlivka.

	2S7 Pion	2S7M Malka	2S4 Tulipan
Switching to the marching position (min)	10	3-5	5
Additional weaponry	1×12.7 mm, 9K32 RPG-7		1×7.62 mm, RPG
Rate of fire (shots/minute)	1.5	2.5	0.8-1
The initial velocity of the projectile (m/sec)	960		158-362
Fire range of the standard projectile (km)	37.5		0.8-9.8
Fire range of the active-reactive projectile (km)	47.5		19.69
Fire range of the nuclear missile (km)	(3BW2, 3BW11, power 2Kt) 45		(3BW4) 18

Source: Own elaboration based on: [15, p. 184-9].

On the other hand, given the tactical and technical parameters of the 2S7 and 2S4 sets, as well as the dislocation of reactivated subunits and units, it should be concluded that one of the reasons for the return of high-power artillery may be the need to fill the gap created as part of the Rocket and Artillery Forces modernization. Because of replacing the sets of 9K79-1 Toczka-U operational-tactical rockets (the range of 15-120 km) with the sets 9K720 Iskander-M (the range of 50-500 km) and delays of the implementation of the program 152 mm 2S35 Coalition self-propelled gun-howitzers, a gap has been created in the Russian system of destruction, which can be filled with the means of high-power artillery capable of performing tasks using tactical nuclear ammunition. Consequently, the Russian Army Gun Artillery Group, which previously included 152 mm 2S19 (2A65) and 2S5 (2A36) gun-howitzers was again expanded by one-two squadrons with 203.2 mm 2S7 cannons. The return and modernization of the withdrawn fire assets of high-power artillery guarantee the ability to precisely control objects using guided munitions deep-dislocated within the enemy's group (about 30-40 km from the line of contact). The appearance of ammunition adjusted with laser, inertial and satellite guidance systems guarantees precision of impact within 5-8 m. The further direction of the high-power artillery development is linked to the possibility of using new types of ammunition, including cassette ones with a set of homing submunitions and ammunition with improved aerodynamic properties offering a much greater range of fire. In the search for the justification for the reactivation of the 2S4 Tulipan sets, one should take into account their undeniable fire values confirmed during conducting activities in built-up areas[13], thus the possibility of significant strengthening of the fire potential at the tactical level. In addition to the TOS-1A heavy fire throwers, the fire potential of the Russian divisions and brigades can be supplemented with the 240 mm 2S4 mortar squadrons. Moreover, the reactivation of Russian subunits of high-power artillery may also be regarded as one of the alternative (asymmetric) responses to the return of the United

[13] During the first Chechen campaign (1994-96), a squadron with four sets of 2S4 was engaged in combat operations. In the second campaign, 24 independent artillery squadrons with 10 sets of 2S4 carried out fire tasks in the area of Grozny and in the mountains. In January and February 2000, in Chechnya, the 2S4 sets consumed about 1510 missiles, including 1410 high explosive, 40 cassette and 60 guided 1K113 Smelczak ones, thus one can risk an assessment that most of the buildings in Grozny (2000) could be destroyed by Tulipans. After hitting the five-storey building, the Tulipan projectile reached the second floor where it exploded, while the demolition of a building of this size required two shells of the 2S4 set.

States to the concept of advanced tactical nuclear weaponry and lowering the threshold for using nuclear weapons, and, consequently, the return to the concept of the limited nuclear war in Europe and Asia, which suggests the intent to verify the American nuclear strategy.

Conclusion

The history of firearms in Russia and the Balkan Peninsula is closely related to the development of West European artillery, however in Eastern Europe, firearms appear a bit later[14]. The common history of artillery development is evidenced by the same wording of artillery terminology, for instance the word can is common in the Slavs in the Balkans and Central and Eastern Europe, as well as the similar structure of the first fire assets (e.g., bombards). The flourishing of metallurgy at the turn of the 15th and 16th centuries as well as contacts with Western Europe decided on the progress in the development of artillery in Ruthenia, which played a significant role in the conflicts accompanying the strengthening of the Rurik family. The Russian artillery of the Romanov era constituted a conclusive argument in confrontation with the Swedish power during the Third Northern War (1700-21), the war the Ottoman Empire in the 18th and 19th centuries, the war with Japan 1904-1905, and the First World War. Technological progress and the development of fighting means resulted in the formation of a specialized category of artillery measures intended initially to demolish fortresses and defenses (siege artillery) followed by field fortifications (heavy field artillery). Despite the evolution of methods of conducting armed struggle and changes in spatial parameters of the battlefield, artillery measures of the Supreme Commander's Reserve decided on the success of deep offensive operations carried out by the forces of the Soviet Fronts in the last phase of World War II. The initial stage of the Cold War and the emergence in the arsenals of rocket weapons carrying nuclear charges undermined the dominant role of the artillery of great power. In the second half of the twentieth century, technological progress and conclusions from the course of local conflicts resulted in a return to artillery means of great power capable of performing tasks using tactical nuclear weapons. The disintegration of the USSR, the end of the Cold War, and the concluded agreements on the arms reduction entailed the decommissioning of fire assets and the reducing of tactical relationships of high-power artillery. In the first decade of the 21st century, a renewed increase in tension and the lack of alternative solutions resulted in a return to the means of struggle, whose history is almost 100 years.

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[14] The first mention of firearms in Europe appeared in the Regulation of the Florentine City Council of 1326. In 1338, information about cannons, missiles and gunpowder provided by the Royal Fleet in Rouen was recorded. In 1340, firearms appeared in Rome, in 1341-42 in Toulouse and in 1348 in Frankfurt. On the Balkan Peninsula (Dubrovnik) firearms were first used in 1351, the first records on the use of firearms on the territory of Poland was included in a report by Jan from Czarnkow on the use of cannons at the siege of the castle in Pyzdry (1383).

Conflict of interests

The author declared no conflict of interests.

Author contributions

The author contributed to the interpretation of results and writing of the paper. The author read and approved the final manuscript.

Ethical statement

The research complies with all national and international ethical requirements.

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Renesans rosyjskiej artylerii wielkiej mocy

STRESZCZENIE Treść artykułu zawiera próbę znalezienia odpowiedzi na pytania dotyczące przebiegu procesu formowania rosyjskiej artylerii wielkiej mocy. Ujęte w artykule wnioski z analizy procesu rozwoju rosyjskiej artylerii mogą stanowić uzasadnienie dla stwierdzenia, że na progu XXI wieku powrót do artylerii wielkiej mocy może być zwiastunem zmian w rosyjskim podejściu do sposobów wykonywania zadań w ramach działań głębokich walczących zgrupowań.

SŁOWA KLUCZOWE rosyjska artyleria wielkiej mocy, modernizacja, przezbrojenie

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