CHAPTER IV

AUTOMATIC RIFLES AND CARBINES

These are personal weapons intended to engage individual targets, differing from magazine rifles (q.v.) in that forces generated during the firing cycle are harnessed to reload automatically.

An automatic rifle fires continuously once the trigger has been pressed, stopping only when the trigger is released or the last round has been fired. A self-loading or semi-automatic rifle requires the firer to release the trigger and press again to fire another shot.[1] Excepting the so-called assault rifles, discussed in chapter 3, self-loaders have been distributed more widely than fully automatic patterns; they are usually more accurate and use ammunition more economically, yet are capable of sufficient volume of fire for most normal military purposes.

Use of automatic and self-loading rifles, compared with manually-operated weapons, considerably reduces the time required to fire an aimed shot and allows a rifleman to observe the target continuously during combat. Fatigue is also greatly reduced.

The problem of increasing rapidity of fire had arisen long before the first automatic rifles emerged. As early as the fifteenth century, gunsmiths in Russia and elsewhere strove to solve the problems. Their efforts may look primitive today, but are still of great interest.

The earliest multi-barrel systems comprised several horizontally mounted barrels, firing either sequentially or simultaneously ('salvo'). Single barrel multi-charge guns were also made, with a slow-match along the breech to light separate charges placed one behind another. Naturally, the one nearest to the muzzle was fired first!

The Soroka [2] or "Ermak's gun", used in the Russian army in the sixteenth century, had seven parallel 18mm-calibre barrels secured to a wooden bed with two iron bands. By the seventeenth century, Russia had triple-deck batteries with three ranks of eight parallel barrels - 24 in total. All three ranks could be fired simultaneously or, alternatively, each level could be discharged separately.

There were also machines with several rows of barrels mounted on a revolving drum. Each row lay tangentially to the drum surface, the axis being perpendicular to that of the drum. An individual row was fired after the drum had been rotated with a handle until it pointed at the target. It was generally possible to reload an expended row of barrels, yet still keep several loaded ranks in readiness.

Amongst the most interesting developments were weapons in which the barrels revolved around a single longitudinal axis. In Russia, Muscovite gunsmiths were the most successful in the search for a principle that would ultimately be used in high-power aircraft weapons.

Though ingenious solutions were found by many inventors, the earliest multi-shot guns had common disadvantages - they were generally tortuous to load, excessively large and too heavy to be readily manoeuvrable. It became clear that reloading was practically impossible in battle, especially when the enemy cavalry was charging. Only in the second half of the nineteenth century, once self-contained cartridges and breech-loading weapons became available, did the first effectual machine-guns appear. The best of them had an impressive rate of fire and provided the basis for the first truly automatic patterns (see Chapter 5).

The first Russian automatic rifles

Russian inventors such as Rudnitsky and Glinsky began work in the 1880s, basing their first designs on the M1870 (Berdan) rifle. Unfortunately, the black-power cartridge soon demonstrated its unsuitability for automatic operation and the resulting weapons could not fulfill military requirements. The need to develop an effectual magazine rifle for a new smokeless cartridge was much more pressing.

Smokeless propellant possessed immense advantages over black powder. Charge for charge, the former produced more energy than the latter. Made of saltpetre, sulphur and charcoal, black powder yielded hard residue of up to forty per cent of charge weight. Smokeless propellant raised the average chamber pressure, while reducing its peak value. This resulted in increased muzzle velocity and greater reliability both in the performance of the cartridge and the gun in which it was being fired. Cartridges loaded with the new propellant could also be stored with less care.

The reduction in fouling not only simplified cleaning, but also allowed the bore diameter to be reduced; this, in turn, improved ballistics. The lack of propellant smoke removed the curtain that had previously obscured the target and improved shooting efficiency.

The Russo-Japanese War of 1904-5 was the first large-scale conflict in which large-scale use was made of machine-guns. The success of Maxim and Hotchkiss guns drew attention to the potential utility of an automatic rifle. Consequently, designers such as Vladimir Fedorov, Fedor Tokarev, Yakov Roshchepey and Vasiliy Degtyarev began work. Beginning by adapting the standard M1891 (Mosin) rifle to work automatically, they soon graduated to highly original models which subsequently attained international renown.

However, the lack of suitable developmental facilities - the design bureaus favoured in post-Revolutionary days being unknown - most pre-1914 efforts were doomed to fail. It proved impossible to produce reliable automatic mechanisms, or even begin a proper scientific investigation of their operating principles.

The introduction of automatic weapons in the Russian army was greatly inhibited, as elsewhere, by misguided tactical concepts preva-

lent in military science. Commanders could not grasp that rapid technological progress was being made in military matériel. Consequently, the growing power of rapid-firing field artillery was underestimated - and so, too, was the ability of machine-guns to replace 40-50 riflemen apiece without affecting fire-density adversely.

On 21st February 1912, after attending a lecture on the automatic weapon - given by Vladimir Fedorov in the Mikhailovskaya Artillery School - Tsar Nikolay II peremptorily stated that the weapon had no future.[3] Fedorov later served alongside the famous pilot, Petr Nikolaevich Nesterov. In his book Tri dara Rodine ('Three Gifts for the Motherland'), Fedorov recalled that Nesterov, in a discussion with friends, had been filled with indignation over the refusal to arm aircraft with machine-guns. He had also related a revealing dialogue: "Fedorov once had visitors during a lecture - Nikolay II with all the king's men. Having ordered the lecture to go ahead, he sat down at a student desk and started listening to the inventor. Later, when a break was announced, the Tsar approached Fedorov and asked if he had invented the automatic rifle. Fedorov replied that he had. 'I am definitely against it in the army', the Tsar declared. Fedorov asked if he might know the reason. 'We do not have enough cartridges', the Tsar declared; and immediately left the class."[4]

The Tsar was not the only leading figure prejudiced against automatic rifles. Lieutenant-General Aleksey Manikovsky, one-time head of the Chief Artillery Directorate, wrote that 'during the decade preceding the war (and even when the war began), much was done to hinder rather than help Russian industry in general and the military industry in particular - even including the state ordnance works'.[5]

Writing about the 1912 lecture in March 1958, Vladimir Fedorov admitted that the the 'opinion expressed by Nikolay II was widespread at the time amongst the high-ranking military commanders. That was why armourers, myself included, could not obtain noteworthy assistance in work on the automatic rifle'.[6] Consequently, only an insignificant number of 6.5mm-calibre Fedorov automatic rifles saw combat during the First World War.

The first Soviet designs

The first steps were taken during the Civil War, credit for the creation of the first successful rifle belonging to Fedor Tokarev.

Son of a Cossack, Fedor Vasilevich Tokarev (1871-1968) was born in the Stanitsa - or large Cossack village - of Egorlykskaya, now in the Rostov district. After studying in the local parish school, Tokarev entered the metalwork training workshop of the second-class school of the Stanitsa in 1885. His first teacher was the designer of the six-line cap-lock Cossack rifle, the Tula gunsmith Chernolikhov. In 1891, he completed training in the ordnance section of the Novocherkassk military-vocational school and was sent to the 12th Cossack Regiment as an armourer. Graduating from the Cossack Military School in 1900, Fedor Tokarev re-

Fedor V. Tokarev

turned to his regiment to serve until early 1907 as the master armourer.

Later in 1907, while attending courses at the Oranienbaum officers musketry school, Tokarev created his first prototype automatic rifle. Originally converted from an 1891-pattern magazine gun, the new weapon was perfected in the Sestroretsk small arms factory in 1908-14. However, the commencement of the First World War interrupted work. Tokarev was sent to the Front, returning to Sestroretsk to continue his work only in 1916.

The success of Tokarev's design activity had to await the October Revolution. In 1925, the MT or Maxim-Tokarev light machine-gun (q.v.) was adopted for the Red Army. In 1927, He developed the first submachine-gun for the Nagant cartridge in 1927, and the TT self-loading pistol was officially adopted for the army in 1930. Another success was provided by the 1938-pattern self-loading rifle (SVT-38), successfully modernised in 1940 as a result of combat experience gained during the Russo-Finnish Winter War of 1939-40. The SNT sniper rifle and AVT automatic rifle were derived from the SVT.

The success of Tokarev's small arms gained him the titles of Hero of Socialist Labour and State Prize Laureate; decorated with numerous orders and medals. he was also an honorary Doctor of Technical Sciences.

In his diary - given to the author, who subsequently donated it to the Military-historical Museum of Artillery, Sapper and Communication Troops - Fedor Tokarev offered interesting information about work he had undertaken on automatic rifles in 1916-18 in the Sestroretsk ordnance factory:

'The barrel was...movable. The bolt was massive, and reciprocated in a straight line. To house the lock, and connect the lock securely with the barrel, I used a rotating cylindrical sleeve which was screwed loosely over the breech on one side. A groove in the rear allowed the bolt-locking lugs to pass through. As the action closed, helical grooves rotated the sleeve around the axis of the breech to catch the bolt. The main spring in the hammer-type firing mechanism acted simultaneously on the hammer and the sear. I retained this type in the 1938 and 1940 rifles.'[7]

In 1919, taking this rifle as a basis, Tokarev created an automatic carbine in the Izhevsk ordnance factory. The weapon was discussed on 4th October 1921 by the Artillery Committee, which concluded that the 'proposed Tokarev model is of undeniable interest and its further development for the small-calibre (Japanese) cartridge is desirable; instructions have already been issued by the Chairman of RVSR to manufacture ten samples of this model in the Tula ordnance factory (five with long barrels and five with carbine barrels). Further development should eradicate those defects present in the design of the rifle itself and...the cartridge'.[8]

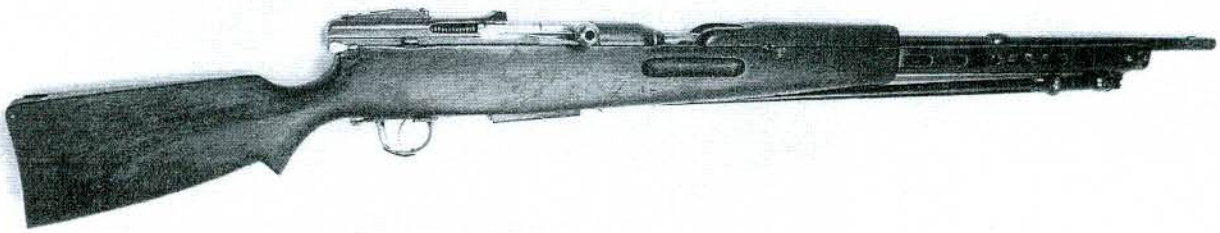
The first competitive trials

The conclusion of the Civil War allowed development work to begin in earnest on a light machine-gun and an assortment of automatic rifles. Fedorov, Tokarev, Degtyarev, Kolesnikov and Konovalov each faced the challenge of creating a weapon weighing less that 4kg, chambering the standard 7.62mm rifle cartridge, capable of single-shot or fully-automatic fire, and accepting a knife bayonet. The first competitive trials were undertaken in January 1926.

For a designer, the tests are a nerve-wracking time. Only the designer can understand the emotion with which the firestorm on the range is heard, guessing which of the many barks belong to his own particular weapons. The smallest stoppage reduces the chance of a favourable decision; lengthy silence may signify complete failure. The passage of a few hours can decide whether an invention is retired to a museum, accessible only to a restricted circle of specialists, or - prize of prizes - honoured with official adoption. The efforts of inventor and his closest assistants are not always in vain.

The tests proved the rifles developed by Fedorov, Degtyarev and Tokarev to be the most effectual.

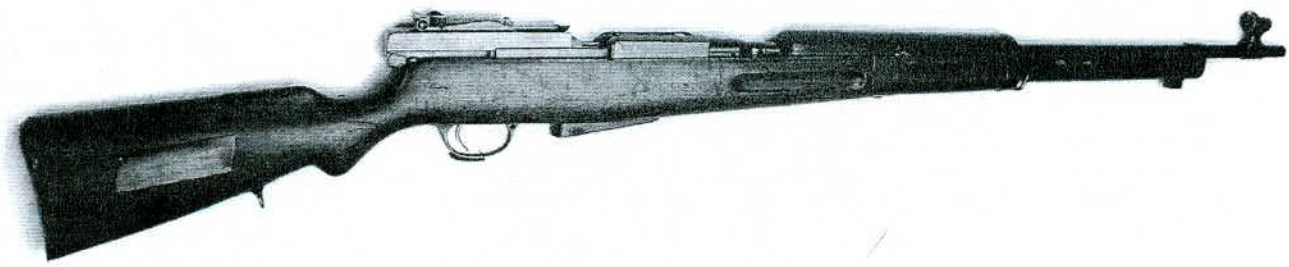
Fedorov rifle experimental model 1925



Improved version of Fedorov rifle experimental model 1925, made in 1928.

The Fedorov rifle, an adaption of his 1912 pattern, was operated by allowing the barrel to recoil a short distance. Rocking lugs locked the barrel and bolt at the instant of firing. The design of the trigger system and the firing mechanism allowed single shots or automatic fire to be selected at will. Spent cartridge cases were withdrawn from the chamber by an extractor attached to the upper part of the bolt, then expelled by a deflector rigidly attached to the receiver bottom. The rifle fed from an integral magazine containing five cartridges in a staggered row. When the last round had been fired and the spent case ejected, the bolt was held open by a stop; the magazine could then be replenished from a charger, special guide-grooves being machined in the receiver. The tangent-curve back sight, graduated to 2,000 metres, had a sighting aperture and a lateral adjustment mechanism.

Degtyarev rifle experimental model 1925



Improved version of Degtyarev rifle experimental model 1925, made in 1928.

The Degtyarev rifle was a modification of the designer's 1916-vintage carbine, operated by bleeding propellant gas out through an aperture below the bore. The action was locked by swinging a locking bar laterally into the receiver-side. The hammer-type firing mechanism and trigger system allowed single shots or continuous fire to be selected with an appropriate lever in the rear part of the trigger guard; the safety catch lay on the front web of the guard. The recoil spring was concentric with a guide rod in the lid of the receiver, the front end of the rod entering the rear of the bolt-bar aperture. Expulsion of spent cartridge cases was undertaken by a spring-loaded extractor located in the upper part of the bolt and a blade rigidly attached to the receiver bottom. Cartridges fed from an integral five-round magazine, loaded by a charger locating in special grooves in the receiver; after the last shot, the mechanism was held open by the bolt stop. The 2,000-metre tangent-curve back sight had a sighting aperture and provision for lateral adjustment.

Tokarev rifle experimental model 1925

The Tokarev rifle was operated on short-recoil principles, its barrel sliding backward to rotate the bolt carrier in the receiver far enough to disengage locking lugs on the bolt from the receiver wall. The hammer-type trigger mechanism, controlled by a combination safety catch/selector in the rear part of the trigger guard, permitted single shots or continuous fire. Expulsion of spent cases was done by a spring-loaded extractor on the forward part of the bolt and a deflector rigidly attached to the receiver bottom. Cartridges fed from an integral magazine holding ten cartridges in a staggered row. The magazine was loaded from a charger inserted into vertical grooves cut in the cover of the receiver. After the last shot had been fired, the bolt was held open by the magazine follower. To replenish the magazine, the bolt could be held in its extreme rear position by a catch operated by a thumb lever on the right side of the receiver. The tangent-curve back sight, graduated to 2,500 metres, had a sighting aperture and a lateral-correction system. An integral spike bayonet, with a cruciform-section blade, was attached to the front part of the barrel casing.

Tokarev also submitted several of his 6.5mm-calibre automatic carbines.

Tokarev, Fedorov and Degtyarev rifles withstood firing-ground tests satisfactorily. However, as none completely met the three basic requirements - simplicity, strength and reliability - the trials commission asked the inventors to modify the guns to comply with a revised specification. Rifles were to be self-loaders, have barrels of 630mm, carry five- or ten-round magazines, and be fitted with an integral quadrangular bayonet; the tangent-curve sight was to have a dioptre.[9]

Initial testing of the new automatic rifles caused the question of a smaller calibre to be raised. A document issued by the Artillery Committee on 27th February 1928 stated that 'the existing self-loading rifles are somewhat too heavy; it is probable that - to lessen their weight - the calibre should be reduced, possibly down to 2.5 lines [5.35mm]. This point is already under discussion and will evidently be solved as soon as the Revolutionary Military Council of the USSR approves the new armament system'.[10] It is evident that work on reducing calibre was nearly complete by 1936, even though its ultimate realisation occurred only when, decades later, Kalashnikov designed his 5.45mm weapons.

The trials of 1928

The second competition was held in June 1928. Three differing guns submitted by an inventors' collective comprising Fedorov, Degtyarev, Uraznov, Kuznetsov and Bezrukov competed against those proffered by Tokarev.

One of the 'collective rifles' had a recoiling barrel, with the bolt rigidly locked at the moment of discharge; it was actually little more than an improved Fedorov Avtomat chambered for the standard rimmed 7.62mm cartridge. The other two collective rifles were gas operated, similar to the previous Degtyarev system; they differed from each other in the design of the bolt and locking lug. In one the lug was connected with the bolt, moving with it during recoil, while the alternative non-reciprocating pattern was fixed to the receiver.

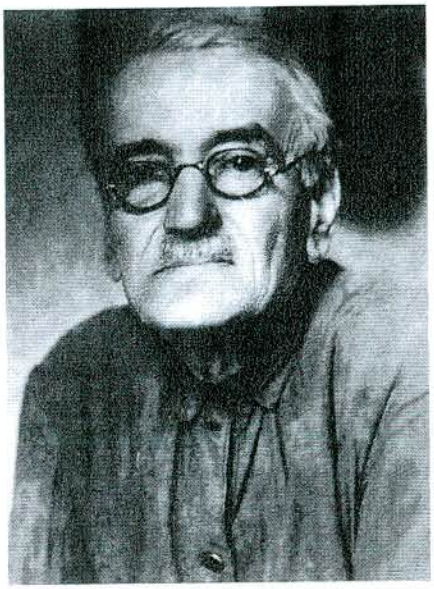
Tokarev submitted a refined version of his previous rifle, still relying on a recoiling barrel locked by the bolt at the moment of firing.[11]

The test results were considered on 5th November 1928 by the Artillery Committee, which noted that 'none of the aforementioned models had been refined to such an extent that a pattern could be finally established and a definitive order issued'.[12]

The Roshchepey rifle

A self-loading rifle designed by Yakov Roshchepey was contemporaneous with the 1928 trials. The otherwise little-known inventor had perfected his original retarded blowback rifle by 1907, on the basis of the 1891 (Mosin) infantry pattern. Though the Tsarist authorities had been unimpressed by the absence of an effectual breech lock, retarded blowbacks of several forms were subsequently and successfully used in many automatic weapons - e.g., the Austrian Schwarzlose machine-gun, patented in the early 1900s, or the American Pedersen automatic rifle of the early 1920s.

On 24th August 1928, the Scientific and Technical Council of the Weapon and Machine-gun Directorate considered the new Roshchepey rifle operated by short recoil of the barrel. The rotating bolt was held by a lock in the receiver. With the bolt in its extreme forward position, the lock prevented premature opening by engaging the rear



Yakov Roshchepey

part of the bolt. The hammer-type firing mechanism had a separate main spring, whilst the trigger was restricted to single-shot fire. Cartridges fed from a box magazine holding ten rounds in a staggered row. The magazine was loaded from a charger through a port in the upper part of the receiver. Spent cartridge cases were withdrawn from the chamber by a spring-loaded extractor in the front of the bolt, then deflected by a rigid ejector placed in the bottom of the receiver. The rifle chambered a special rimless 7.62mm cartridge. The Scientific and Technical Council noted that the Roshchepey prototype had several advantages over its rivals.[13] However, further development could not be contemplated owing to the use of a non-standard cartridge.

The trials of 1930

The third round of competitive testing was undertaken in March 1930. The five Degtyarev rifles had five-round integral magazines - or detachable ones for ten and fifteen cartridges - whilst the five Tokarevs were provided with detachable magazines holding five and ten cartridges. The rival rifles each perpetuated the design characteristics of comparable guns tested two years previously.

The trials commission concluded that 'the self-loading rifles of both systems tested, owing to the large number of stoppages, flaws and various breakdowns, cannot be considered reliable enough for combat conditions and cannot, therefore, in their present from, be considered suitable to arm the RKKA'.[14]

On 4th-6th April 1930, the Artillery Directorate convened a special conference with Vladimir Fedorov, Fedor Tokarev and Vladimir Markevich, the proving-ground representative responsible for testing rifles. A resolution was adopted to halt development of the recoil-operated Tokarev, which was deemed unsuitable owing to its inability to fire rod-type rifle grenades.[15]

Vladimir Fedorov opined that, though many automatic rifles had been submitted - including designs by luminaries such as Degtyarev and Tokarev - the problems in 1930 remained as they had been in 1916. The only difference was that the best of the original submissions had been the recoil-operated Fedorov, instead of the newer gas-operated Degtyarev.[16]

This opinion needs clarification. As the result of progress by Soviet inventors in many related disciplines, it had become possible by 1930 not only to investigate the design and operating principles of the various automatic rifles, but also to define the basic requirements they were to meet. The most important criteria were:

1. That the calibre of automatic rifles for military service should lie within 7mm-8mm; new rifles were to use the regular cartridge.[17]

2. That the weight of an automatic rifle must not exceed 4kg, minimising the burden placed on the infantryman under combat or march conditions.

3. That the automatic rifle should employ a detachable magazine, holding 10-15 cartridges in staggered rows to reduce its depth. Alternatively, an integral magazine holding 5-10 cartridges could be accepted.

4. That the trigger mechanism must prevent the gun firing unless the bolt was properly locked, and ensure against unwanted shots even with a cartridge in the chamber.

5. That a muzzle brake should be introduced, in addition to a device reducing the rate of fire to diminish recoil, minimise scattering during continuous fire, and keep expenditure of ammunition to a minimum.

6. That a detachable bayonet be developed - to be carried at all times on the gun, yet easily reversed and held securely in both positions.

7. That the construction should be as simple as possible to manufacture; that the action should be reliable; and that the whole weapon should be convenient to handle.

Attempts to develop effectual autoloading rifles being made outside Russia were no more successful at this time. Efforts were particularly strong in the USA, where an assortment of weapons was tested at Springfield Armory in 1928-9: 'many rifles have been tested there, all of them considered deficient mainly due to their excessive weight, but also to their constructive complexity'.[18] The Pedersen system was considered superior and is thus of special interest. However, 'French military specialists considered this weapon too complicated for a typical private. It has 103 parts, among them eleven springs. In addition, its parts require steel of the best types, as they must be enormously resistant. The system as a whole is too sophisticated'.[19]

Analogous conclusions were formed elsewhere; the 'Austrian military department considered this rifle unfit for the army, because the bolt must be adjusted too carefully. When this adjustment is inadequate, the rifle either fires too rapidly...or, on the contrary, often fails to operate. Additionally, it needs a lot of lubricant'.[20]

Even the Americans themselves were none too happy about their rifle. 'According to the latest evidence cited in the Washington Military Herald, this rifle refused to fire after several rounds'.[21]

These opinions come from verbatim records taken during a sitting of the Scientific and Technical Council of the Artillery Directorate on 14th December 1930. They permitted the statement that 'the latest model, which had caused an enthusiastic outcry all over the world and been widely discussed in almost all magazines, was abandoned. It seems that no suitable automatic rifle exists to replace the magazine rifle in the infantry'.[22]

The first effectual gas-operated guns

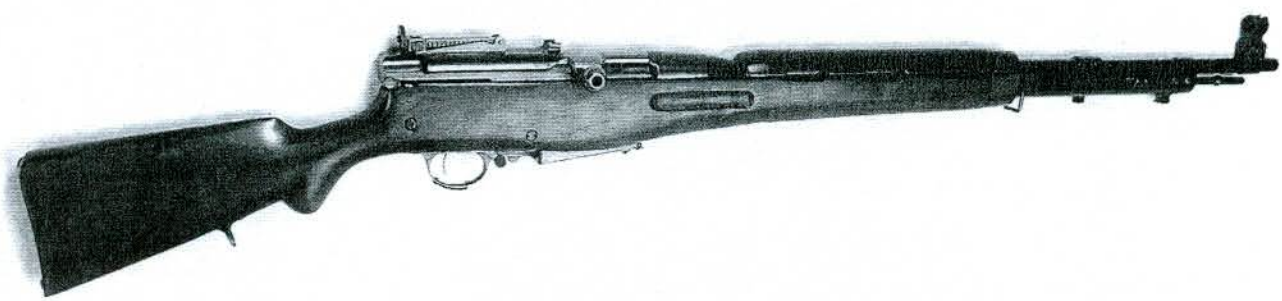
For the Soviet automatic-rifle designers, 1930 was a watershed: the year in which short-recoil principles and sliding barrels were abandoned in favour of gas operation and fixed barrels. As practically all subsequent Soviet designs followed a basic gas-operated design, only deviations from this accepted norm will be explained in the details that follow.

By 1930, Fedor Tokarev had already developed a new gun. 'In view of the fact that a rifle with movable barrel does not satisfy service requirements,' noted the report of the Artillery Committee conference held in April 1930, 'designer Tokarev presented a model of a fixed-barrel self-loading rifle whose...action is achieved by employing the force of propellant gases'.[23]

The breech was locked by the interaction of a diamond-shaped stud, located in the rear part of the breech frame, and the curved groove on the bolt bar. This rotated the bolt out of engagement shortly after the gun had been fired and propellant gas had been led back from the barrel port. The hammer-type firing mechanism permitted single shots or continuous fire, the thumb lever of the selector appearing on the rear web of the trigger guard. Spent cartridge cases were expelled by a spring-loaded extractor in the front part of the bolt and a deflector rigidly attached to the bottom of the receiver. Cartridges were fed from an integral magazine holding ten rounds in a staggered row; the magazine was filled from a charger inserted in vertical grooves in the receiver lid. After the last cartridge had been fired, the bolt was held back by a catch activated by the magazine follower. The catch was released by the thumb lever on the right side of the receiver. The leaf sight with rotating dioptre was graduated to 1,500 metres. A muzzle-brake/compensator improved stability during automatic fire, whilst a lock for a detachable bayonet was incorporated in the front-sight base plate and the rear end of the muzzle brake.

The conference resolved to order two Degtyarev and two Tokarev rifles. However, considering that the creation of a serviceable automatic rifle was being delayed unnecessarily, and under the existing circumstances could not be completed rapidly, the Revolutionary Military Council of the USSR decided to commission a test series of Degtyarev rifles on 28th April 1930.[24]

The 1930-model Degtyarev rifle



On 28th December 1931, the Scientific and Technical Committee of the Artillery Directorate adopted the Degtyarev as the '7.62mm self-loading rifle, M1930'.[25] Degtyarev subsequently designed a sniper rifle on the basis of this gun.

The weapons were field-tested by the Moscow Proletarian Rifle Division in 1933.[26] By that time, however, a more effectual rifle had been designed by Sergey Simonov.

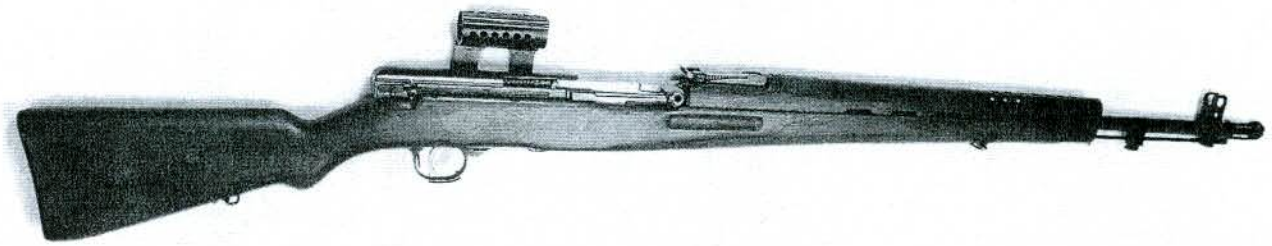
Vasiliy Degtyarev recorded in his memoirs how 'in 1918, a young fellow, Sergey Simonov, came from the village

to our shop. He worked as a metal craftsman, adjusting the series-made parts of the Fedorov automatic rifles. From the first days...he developed an intense interest in our work. Fedorov and I both noticed this. When work was assigned to him, he carried it out conscientiously and industriously. We began to assist Simonov and very quickly he became a first-class gunmaker. Having studied the principles of automatic operation, he more than once impressed us with his proposals for improvements - and his inventive capabilities, which were apparent in his everyday work. Simonov began to be commissioned for independent work and he handled it successfully'.[27]

Simonov presented his prototype automatic rifle at the beginning of 1926. It had a fixed barrel and tapped propellant gas at the muzzle. The gas acted on a piston and rod located on the right side. The action was locked at the moment of firing by elevating a support block into a groove on the underside of the bolt.

Having considered the design of the automatic rifle, the Artillery Directorate stated in its journal - on 7th April 1926 - that the Simonov was reasonably simple, but did not have any advantages over rival systems and could not be submitted to testing in its existing form.[28] The worst of several flaws was the position of the operating rod on the right side of the rifle, unprotected along its top edge. It greatly increased the width of the fore-end and spoiled handling characteristics. In addition, stresses resulting from the shift of the centre of gravity to the right of the centre-line resulted in the bullet striking to the left of the expected aim-point. The open-top operating-rod casing allowed moisture and dust entering the mechanism too easily, whilst dismantling and reassembly caused difficulties; for example, it was necessary to separate the butt and the butt handle to remove the bolt.

An initial failure did not stop Simonov, who had soon created improved models. In each, he attempted to find fresh solutions to problems, perfect separate parts, and refine operation. Success came comparatively quickly; in 1931, only five years after presenting his first prototype, the designer produced a much more effectual weapon.



Experimental semiautomatic sniper rifle system Simonov 1934.

The breech was locked by a wedge travelling vertically in grooves milled in the receiver. A stud in the front part of the bolt bar raised the wedge during the return stroke to lock the action, and a sleeve propelled by the gas-piston rod lowered the wedge during recoil to release the bolt. First applied satisfactorily by Sergey Simonov in an automatic rifle, this locking system enabled the load placed on the lock at the moment of firing to be distributed over as large an area as possible. This allowed the weights of the bolt and the entire rifle to be reduced. The striker-type trigger mechanism allowed both single shots and full automatic fire, the selector lever being located in the front web of the trigger guard. The safety catch, mounted in the rear web, could be applied to block the trigger.

The return spring lay in the detachable receiver cover. Spent cartridge cases were expelled by a spring-loaded extractor in the upper part of the bolt body and a deflector rigidly attached to the bottom of the receiver. Cartridges fed from a detachable magazine containing 15 cartridges in a staggered row. Charger guides were provided so that the magazine could be replenished without removing it from the gun. When the last round had been fired and ejected, the bolt was held rearward by a stop activated by the magazine follower. The tangent-curve back sight was graduated to 1,500 metres and a pivoting quadrangular-bladed bayonet could be locked forward when required for an assault.

Once the Simonov successfully passed its firing-ground tests, the authorities decided to manufacture a batch of rifles for field trials. Simultaneously, it was proposed to accelerate development of the manufacturing processes so that the batch could be completed in the first three months of 1934.[29] It was anticipated that series production would begin in July. Consequently, the organisation of rifle production in the Izhevsk small-arms factory was assisted by Simonov himself.

Mindful that problems were inevitable with any new design, the Defence Committee resolved on 22nd March 1934 that mass production of the Simonov automatic rifle would begin in 1935.

Sergey Simonov designed an automatic carbine in September 1934. Known as the AKSI, it differed from the rifle largely in the barrel, which was suitable shortened, and internal refinements; total weight was reduced by 400gm. The carbine was tested on the firing range on 16th April 1935. However, flaws in the design of the rate-retarder prevented the range staff recommending production of a batch of Simonov carbines.[30]

Experimental Simonov automatic carbine 1934.

The Tokarev guns 1933-4

Fedor Tokarev continued work on his automatic rifle throughout the period under review, introducing a number of important changes to his gas-operated weapons in 1933. The gas cylinder, which had previously lain beneath the barrel, was moved to the top. The back-sight bed was moved from the receiver-cover to a new position ahead of the chamber; the leaf was replaced with a tangent-curve sight; magazine capacity was raised to fifteen cartridges; and the adoption of a detachable magazine allowed the bolt stop to be discarded.

Experimental Tokarev semiautomatic rifle 1933.

Experimental Tokarev automatic carbine 1932.

In 1934, Tokarev submitted a carbine based on the new prototype rifle. Unlike his earlier guns, which had locked by rotating the bolt, the carbine was locked by displacing the tail of the bolt downward until it was wedged against a special support-bar in the bottom of the receiver. The face of the bolt-head closed against the back edge of the chamber whilst the bolt handle (attached to the bolt carrier) was still moving forward. Only as the handle reached the end of its travel did a lug on the carrier allow the hammer to be released to fire the next shot. 'In this way', Tokarev wrote, 'the shot can occur only after the bolt head plugs the breech and the bolt-handle has reached the edge of the breech ring'.[31]

The 1936-model Simonov rifle (AVS)

After the competition of 1930, the greatest successes in Soviet automatic rifle design were achieved by Sergey Simonov and Fedor Tokarev. Which of the systems should be adopted for service issue would be decided in the contest between them. The description given here of the guns created by these two talented inventors shows the devotion with which they improved existing patterns or developed new ideas. Rifles presented by Simonov and Tokarev were thoroughly considered, the strengths and weaknesses of each were analysed, and manufacturing problems were solved. Only then did test-firing start.

Numerous tests undertaken in 1935-6 favoured the Simonov automatic rifle. Although individual examples performed poorly, the trials commission realised that this was due more to manufacturing defects than basic design. A firing-range report made on 19th July 1935 noted that the veracity of the basic design was confirmed 'by the first test models of the AVS, which withstood up to 27,000 shots and did not have any of the failings observed in the [previous] test specimens'.[32]

The AVS-36 (Avtomaticheskaya vintovka Simonova, 'Simonov automatic rifle) was officially adopted by the Red Army in 1936. Among the changes made from the pattern submitted in 1931 were the introduction of a muzzle brake had appeared and alterations to several parts (e.g., the shape of the bayonet latch). The AVS was demonstrated for the first time during the 1938 May Day military parade, when the weapons were carried by the 1st Moscow Infantry Division.

Contemporaneously with the introduction of the AVS, Simonov developed a special semi-automatic sniper-rifle derivative. This was used during the Russo-Finnish Winter War of 1939-40, but soon disappeared.

Once the AVS had been officially adopted, production, which had formerly been confined to small batches, increased perceptibly. The 106 rifles made in 1934 were followed by 286 in 1935, 10,280 in 1937 and 24,401 in 1938. Total production had amounted to 65,800 when worked stopped in 1940.

On 26th February 1938, the director of the Izhevsk ordnance factory, Abram Bykhovsky, reported that the manufacturing pattern of the Simonov automatic rifle had been perfected; series production had begun.[33]

Engineers Melekhin, Michkov, Sobolev and Korkin; fitters Bogdanov, Kurochkin, Bukharin and Vakhrushev; lathe operator Berdyshev; milling-machine operators Burdin and Fedyukov; and metal worker Bekhterev were among those who rendered valuable assistance to Sergey Simonov during development work on the automatic rifle and its subsequent refinement for production.[34]

AVS-36 sniper version.

AVS-36 bayonet in scabbard.

The creation of an automatic rifle suitable for large-scale service issue was a tremendous achievement for the Soviet arms industry. In 1936, no other army had issued such a weapon. A belief was prevalent in the USA, where attempts to perfect the Garand were still underway, that only the USA was technologically advanced enough to mass-produce an effectual self-loading rifle. However, Garrett Underhill in his article 'Armament of the Red Army' published in the American Infantry Journal in August 1942 wrote that the 'Russian troops received their own self-loader earlier than we delivered the Garand rifle'. Only in 1942 did the German army receive its first series-made self-loader.

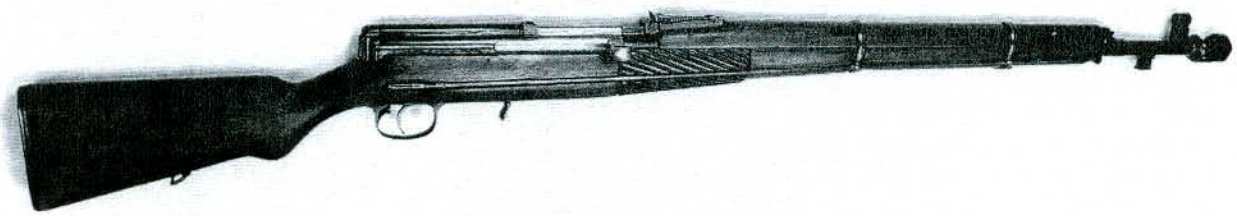
The operating principles of the AVS were based on a well-tried system. In designing the separate components and sub-assemblies, Simonov showed great ingenuity and achieved a notable creative success. Nevertheless, his rifle was comparatively complicated to produce and more difficult for untrained soldiers to master than the bolt-action Mosin had been. The AVS also proved to be sensitive to dusting and variations in air temperature. Though some flaws were due to cartridge design - the protruding case-rim gave problems in the large-capacity magazine - the authorities decided to continue the search for a better weapon.

Sergey G. Simonov

The trials of 1938

On 22nd May 1935, in accordance with instructions from the People's Commissar of Defence and the People's Commissar of the Defence Industry, a competition to find an ideal self-loading rifle was announced. Commander First Class Boris Shaposhnikov, director of the Red Army general headquarters, and his staff devised the tactical and technical requirements for suitable rifles. Submissions should operate faultlessly with all standard and substitute cartridges, be convenient to handle and carry, easily maintained, simple to manufacture, and durable enough to withstand the rigours of service. They were to be simple, so that soldiers could master them quickly, and should not fail under any natural atmospheric conditions - though lubrication was permitted even under normal temperatures, and the outer surface could be wiped during the dusting experiments.

Firing-range trials were undertaken from 25th August to 3rd September 1938. The principal competitors were the gas-operated guns developed by Fedor Tokarev, Sergey Simonov and Nikolay Rukavishnikov.

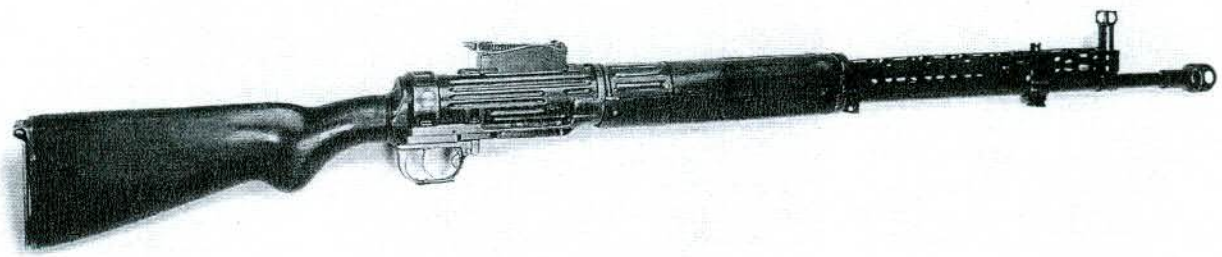


Experimental early version of SVT-38.

In the Tokarev rifle, the propellant gas acted on a piston capable of only a short longitudinal movement. The breech was locked by tipping the bolt downward at the rear. The hammer-type firing mechanism was restricted to single-shot fire, and a thumb-lever safety catch blocked the trigger when applied. Spent cartridge cases were expelled by a spring-loaded extractor in the bolt and a deflector rigidly attached to the bottom of the receiver. A detachable magazine, containing ten cartridges in a staggered row, could be replenished from chargers inserted in grooves cut in the receiver cover. After the last round had been fired and ejected, the bolt was held open by a separate bolt stop. The tangent-curve back sight was graduated to 1,500 metres. A muzzle-brake/compensator increased stability during firing. Unlike the bayonets previously issued in the Red Army, the detachable Tokarev knife pattern was usually carried in a scabbard on the rifleman's belt.

Experimental semiautomatic rifle system Simonov 1938.

The breech of the Simonov rifle was also locked by tipping the bolt downward and, like the Tokarev, the hammer-type firing mechanism was restricted to single shots. The recoil spring, surrounding a guide rod in the receiver cover, projected forward into the rear of the bolt-bar aperture. A thumb safety catch in the rear web of the trigger guard blocked the trigger when required. Spent cartridge cases were expelled by a spring-loaded extractor in the front part of the bolt and a deflector rigidly attached to the left wall of the receiver. The detachable box magazine contained fifteen cartridges in a staggered row. The tangent-curve back sight was graduated to 1,500 metres. A short stock provided a distinguishable feature of this gun, as the front part of the barrel and piston tube were covered with a ventilated metal casing.



Experimental automatic rifle system Rukavishnikov 1938.

The Rukavishnikov rifle was locked by rotating the bolt to the left. The striker-type firing mechanism was restricted to single-shot fire, and the return spring lay in a tube in the butt. Empty cartridge cases were expelled by a spring-loaded extractor in the front part of the bolt and a deflector rigidly attached to the bottom of the receiver. Cartridges fed from a detachable staggered-row box magazine. The tangent-curve back sight was graduated to 1,500 metres, whilst a muzzle brake and a bayonet lug were fixed to the barrel. A bracket on the left side of the receiver was designed to accept an optical sight. Isolated from the bolt, the charging handle did not reciprocate during firing.

Rukavishnikov rifles could be identified by their straight-line construction; by a short butt with a folding shoulder plate; and by the short wooden fore-end. The protective sleeve around the piston tube was slotted to promote better air circulation.

On the basis of the test results, the commission concluded that none of the self-loading rifles satisfied the competition requirements. The Tokarev system was considered best, as it provided the necessary durability. The inventors were each asked to refine their rifles, making some individual components stronger, simplifying others, and improving the entire design. Final elimination would then take place.

The trials were undertaken on 20th November 1938. The Tokarev rifle was again victorious, and - on 26th February 1939 - was adopted for issue in the Red Army as the '7.62mm self-loading rifle, Tokarev system, Model 1938 (SVT-38)'.

The design of the Simonov rifle, compromised during the final trials by weakness in the firing pin and extractor, still generated interest. On 19th January 1939, Sergey Simonov reported to the Central Committee of the All-Union Communist Party (VKP[b]) that he had eliminated all the deficiencies noted in the trial reports, refined the operating system, and greatly increased reliability.

On 20th May 1939, in accordance with instructions from the People's Commissar of Armament and the head of the Artillery Directorate of the Red Army, a commission was formed to evaluate the mass-production potential of the competing Simonov and Tokarev rifles.

The commission reported that more time was needed to produce a single SVT than a Simonov. The weight of the metal used for one SVT rifle was 1.74kg more than for the Simonov model. The additional cost of each

A group of well known soviet gun-designers photographed in 1936. Sitting, left to right: M.P. Ponomarev (Air Force), I.I. Slustin, F.V. Tokarev, I.V. Savin, V.A. Degtyarev, A.K. Norov, P.I. Mayn. Standing: N.F. Tokarev, V.I. Silin, G.S. Shpagin, S.G. Simonov, M.I. Blyum.

Tokarev amounted to 6 rubles 79 kopeks in wages and 1 rubles 85 kopeks in material. The Table in page 109 lists comparative data.

The investigating commission concluded that the Simonov was superior to the Tokarev in all virtually every respect - total weight; number of parts; number of critical dimensions; ease of production; expenditure of metal; use of tools and equipment; and manufacturing cost. As the Simonov rifle was easier and cheaper to make, so it should be adopted as the basic model of the self-loading army rifle provided that it met tactical, reliability, durability and performance requirements.

However, in spite of the many advantageous features the Simonov rifle seemed to possess, its superiority over the rival Tokarev could only be shown by prolonged testing; theoretical calculations could not show how the weapons would behave in combat. As the SVT had already passed its firing-range tests with good results, and series production had begun, the Defence Committee - guided by a personal order from Stalin - resolved on 17th July 1939 to discontinue work on self-loading rifles and concentrate on mass-production of the SVT-38.

Recalling the events of those long-gone days, Vladimir Novikov, formerly Deputy People's Commissar of Armament, wrote 'we hesitated when we had to decide which rifle was to be preferred - the one designed by Tokarev, or the other by Simonov. The Tokarev rifle was heavier, but had shown its durability; it had suffered far fewer breakages. The slim and light rifle presented by Simonov, though superior to the Tokarev model in many other respects, was inferior in a major one; the firing pin fractured inside the bolt. Caused by nothing other that the inadequate material of which the firing pin was made, that failure determined the results. Not without importance was the fact that Tokarev was well liked by Stalin, who knew nothing about Simonov. Another perceived flaw of the Simonov rifle was its short bayonet, which resembled a heavy knife [now almost universal on assault rifles]. At that time, some people insisted that in hand-to-hand combat the old long multi-edged bayonet was much more useful. The problem of the self-loading rifle was discussed at a meeting of the Defence Committee, where only B.L. Vannikov sided with the Simonov rifle by trying to prove its superiority'.[35] Stalin subsequently accused none other than Vannikov of adopting the Tokarev rifle.

The rapid adoption of the SVT-38 owed a great deal to an over-estimation by Stalin of the role of automatic rifles - and to the readiness of the highest commanders to applaud one of Stalin's favourite maxims, that 'a soldier with a self-loading rifle will easily replace ten armed with manually-operated guns'.[36]

But it would do the inventor a great injustice if his rifle were to be underestimated. The adoption of a self-loading rifle for the Red Army reflected great credit on Fedor Tokarev. Despite the comparatively high power and inconvenient rimmed case of the standard 7.62mm rifle cartridge, he had succeeded in designing one of the best self-loading rifles - if not the best - to be issued prior to 1945.

SVT-38 and SVT-40 rifles were used also in the northern fronts.

The attributes of the Tokarev rifles were recognised, in particular, by Garrett Underhill in his article 'Light Firearms of the Red Army' published in the American Infantry Journal in May 1945; '...in 1936,' he wrote, 'the Red Army adopted a rifle of a completely new design. It was the Simonov semi-automatic rifle which operated on the principle of using part of the propellant gases of each shot. Although the Simonov rifle was used during the Russo-Finnish War of 1939-1940 and was well liked by the Finns, it did not satisfy the Russians and in 1938 was replaced by the Tokarev model rifle. This is only a self-loading rifle. The Tokarev 1938 model was improved in the 1940 model - lightened in weight to 8.1/2 pounds from 10 pounds and given an entirely birch stock.[37] The Tokarev rifle was popular in the German Army and was used on all German fronts. At the time, after the first encounter with the Tokarev rifle, the high command of Germany was in a delicate position in evaluating self-loaders suitable for the German troops. Although German engineers confirmed that Russian rifles were not the solution to semi-automatics, the Nazis energetically introduced the Model 41 rifle, which was worse.'

These words need some clarification. The first automatic rifle adopted for the German army was the Walther-designed Gew. 41(W), issues of which began only in 1942-3 after exhaustive tests under combat conditions. A smaller quantity of the competing Mauser Gew. 41(M) had also been made for trials, but proved less than effectual. However, even the Walther had serious flaws. A report on its utility complained that the rifle was 'a disappointment... Every third or fourth shot results in stoppages arising from defective extraction or improper bolt-locking, or because sliding parts become dirty. Cleaning must be done most thoroughly, since the propellant residue makes all sliding parts stick together; thus, stripping this rifle is a very difficult task. The rifle is too heavy, and...easily misdirected during firing so that the target is lost. In addition, too much effort is required to carry the rifle on the march. After using this rifle in several battles, one soldier returned it with a demand for a 98k carbine instead - as the self-loading rifle had brought him more trouble than benefit'.

A similar report on the Mauser Gew. 41(M) followed: 'This rifle is too heavy. All sliding parts must be heavily lubricated. Special attention should be paid to the flash damper, because it wears out after about 30 shots... The rifle is highly sensitive to dust, causing stoppages and - consequently - doubts concerning the entire feed mechanism. There were nine stoppages in seventy shots, and seven in forty'.[38]

The abortive 1941-pattern rifles were eventually superseded by the much more effectual Walther Gew. 43, which combined the locking system of the Gew. 41(M) with a gas system adapted from that of the Russian SVT-40.

Notable assistance was given to Fedor Tokarev by engineer-designers Vasilev and Churochkina, senior metal

worker Kalinin, mechanics Kostromin and Tikhonov, milling-machine operator Fomin, and fitter Promyshlyaev. Paying them due tribute during a scientific conference held in the F.E. Dzherzhinsky Artillery Academy in March 1940, Tokarev said that he had been assisted by the most skilful engineers, draftsmen and workers: 'we have been working together for many years (15-18)...'[39]

On 2nd June 1939, the Defence Committee accepted a plan that would greatly increase production of Tokarev rifles; fifty thousand pieces were to be manufactured in 1939, followed by 600,000 in 1940, 1.8 million in 1941, and two million in 1942. To ensure that the progress demanded by the government could be met, a unique design bureau was created in the Tula small-arms factory. This united leading specialists from other disciplines, including bureau director Charskiy, deputy director Romanov, leading constructor Sobolev, senior designer Butakov, senior technologist Sigorskiy, technological-group leader Ivanov, analysis-group leader Dmitriev, and Matveev, deputy director of the workshop. Some of these men subsequently rose to notable positions in the defence industry.[40]

At the time of its creation, this complex design bureau was the first - and, indeed, only - organisation in the Soviet Union capable of applying the most modern approaches then known to factory practice to the perfection of existing small arms and development of new ones.

The development of mass-production systems required engineering and technical staff to face the challenge of creating a highly efficient process based on the latest techniques. However, lengthy experimental and labour-intensive work in the manufacture of sophisticated tools had to be avoided. The solution was found in the employment of highly productive machinery and equipment to improve output considerably. Realising that time was short, and that errors were bound to occur, the authorities created a special projection system. This encouraged the simultaneous theoretical modelling of a project by several technologists, usually working independently; the best solution was chosen from those that had been developed concurrently, or by combining elements of several proposals.

Once the plans had been agreed, the production path was critically assessed by highly qualified engineers and technologists who had been specially assigned to the task. Concurrently, a 'paper test' of material allowances and dimensional tolerances was run in accordance with a method specifically developed to plan the large-scale manufacture of weapons. Each calculation made by an individual working in an analytical group was approved by the designer charged with the supervision of the entire system; and the drafts for all tools, equipment and gauges were then checked by specially-assigned testers.

The Tula small-arms factory entirely abandoned work on Mosin-pattern rifles to concentrate on the Tokarev. To become the leader in its field, Tula created the best and most modern machine tools and measuring equipment, improved the quality of its steel, and refined the manufacture of items such as band and wire. Large-scale manufacture of the SVT involved much technological novelty, automation and mechanisation. A conveyor-belt assembly line, operating to pre-determined output levels, ensured both speed and quality.

The monumental changes made in the way in which the Tula factory operated resulted in an unbelievably short period - less than six months - during which the SVT-38 progressed from prototype to serial production. The first rifle was completed on 16th July 1939; regular assembly of small batches began on 25th July, and mass-production commenced on 1st October.

The first Tokarev rifles emanated from the Izhevsk small-arms factory in 1940, production of the AVS-36 having ceased.

Comparison of the 1938-pattern Tokarev and Simonov rifles

Characteristics	SVT-38	1938 Simonov
Total weight of the rifle with empty magazine, bayonet and scabbard, gm	4825	4175
Total number of parts	143	118
Number of sub-assemblies, field-stripped	6	7
Number of sub-assemblies, completely stripped	15	14
Number of springs	22	16
Number of differing steels required in construction	12	7
Special steels included in previous category	2	2

SVT-38 with bayonet and scabbard.

The 1940-model Tokarev self-loading rifle

The SVT-38 received its baptism of fire during the Russo-Finnish Winter War of 1939-40. Experience of combat, opinions expressed by the troops and firing-range testing persuaded the Defence Committee to adopt an improved version on 13th April 1940. This was issued as the '7.62mm Tokarev self-loading rifle, Model 1940 (SVT-40)'.

Most of the changes were minor, to improve the combat-worthiness of the gun as a result of battle experience. However, a number of flaws were ignored on the grounds that correcting them required substantial changes in the basic rifle design. They included inconvenient gas regulation and loss of the detachable magazine. In addition, the Tokarev had proved to be sensitive to dust, mud, thick lubrication and freezing conditions.

On 22nd October 1940, Boris Vannikov reported to Marshal Kliment Voroshilov and Nikolay Voznesensky, then chairmen of the Defence Committee and Defence Industry Council respectively, that manufacture of the M1891/30 magazine rifle had ceased in favour of the SVT-40 with effect from 1st July 1940. Production of the new Tokarev rifles had amounted to 3,416 in July 1940; 8,100 in August; 10,700 in September; and 11,960 in the first eighteen days of October.

The 1940-model Tokarev self-loading sniper rifle

A modified version of the SVT-40 was adopted for the Russian snipers, differing from the standard gun only in the attachment of a mounting bracket for an optical sight. Greater attention was paid to finishing the bore, in a quest for greater accuracy, but the shooting of the earliest samples was tested only against the regular self-loaders. This hid the fact that the accuracy of the Tokarev sniper rifle was inferior to that of the manually-operated M1891/30 pattern.

By the time the advent of war increased the demand for sniper rifles virtually overnight, the Soviets faced a dilemma. Production of the M1891/30 rifle had ceased in 1940 and efforts to improve the shooting of the self-loading Tokarev sniper rifle revealed that the problems could not be solved without radical alterations. Early in 1942 therefore, production of M1891/30 sniper rifles recommenced and, by 1st October 1942, work on the Tokarev pattern was abandoned.

The 1940-model Tokarev automatic rifle

Inspired by the success of the semi-automatic weapons, Fedor Tokarev developed the SVT-40 to fire fully automatically. The changes were largely confined to the trigger mechanism, the safety catch being modified to serve as a selector lever for single shots or continuous fire.

The Tokarev automatic rifle, or AVT-40, was intended to fulfil the same basic tasks as the SVT; its basic operating mode, therefore, was single-shot fire. Firing in short bursts was to be permitted only when light machine-guns were scarce, whilst continuous fire was to be restricted to the harshest battle conditions.

The State Defence Committee ordered the automatic rifles into immediate series production on 20th May 1942, and the first guns reached the troops in July.[41]

The advent of the automatic Tokarev was due largely to the shortages of sub- and light machine-guns at the beginning of the war. The automatic rifle was a temporary answer to insufficient density of fire in the infantry units. However, the SVT had not been designed to sustain the rigours of protracted automatic operation - nor was it powerful enough to satisfy the long-term demands of infantry service.

Combat experience soon showed that automatic Tokarev was not strong enough to operate faultlessly. The addition of the selective-fire capability compromised the efficiency of several individual components and increased the frequency of stoppages. The most serious problems included non-ejection of spent cases, partially ruptured case-heads, premature unlocking of the bolt, and persistent misfiring. These failures were caused by the inadequate rigidity of the barrel and receiver, combined with a trigger mechanism that was unfit for continuous firing. The accuracy of the automatic Tokarev was worse than that of the 1938-pattern Mosin carbine when firing single shots, and inferior to the PPSh-41 (Shpagin) and PPS-43 (Sudaev) submachine-guns when firing short bursts. In addition, it retained all the disadvantages of the original self-loading rifle.

Reports from the Fronts during the Great Patriotic War noted that 'both the self-loading (SVT-40) and the automatic (AVT-40) rifles are used ineffectually in combat conditions, which the troops attribute to their complex design, unreliability and inaccuracy'.[42] In view of these disadvantages, production of Tokarev rifles was greatly reduced. A total of 1,031,861 had been made in 1941, but only 264,148 appeared in 1942. The corresponding figures for the sniper derivatives were 34,782 and 14,210 respectively.[43]

Tokarev succeeded in perfecting some of the rifle parts, but, in spite of protracted efforts, could not overcome the basic flaws. One project was particularly interesting from a technical viewpoint, though not justified by results. The inventor took the SVT as the basis for an entirely new weapon embodying a rarely-encountered operating principle: primer actuation. After each shot, pressure generated by the combustion of propellant in the cartridge case forced the primer-cap backward in its seat in the base of the cartridge-case head. The movement was sufficient to push back the striker (attached to the bolt carrier) far enough to unlock the bolt.

The major drawback was a need of cartridges with thick-bottom bases, which would complicate ammunition production and create supply problems in the field. Additionally, gas leaking through the primer pocket fouled the operating mechanism. On 3rd January 1945, therefore, the State Defence Committee decreed that production of the SVT-40 should ceased immediately.[44] No AVT-40 had been made since the summer of 1943.

Experimental SVT-40 conversion to short cartridge model 1943.

The first self-loading carbines

By the time the first self-loading Tokarev rifles were being delivered to the Red Army, work on an accompanying carbine had begun. Fedor Tokarev presented the first prototype for firing-range trials in January 1940. Based on the SVT-38, it performed satisfactorily enough; however, contemporaneous improvements being made in the rifle indicated that changes would also be required in the carbine. In September 1940, therefore, Tokarev submitted a carbine derivation of the SVT-40 with an additional selector to allow fully-automatic fire.

Sergey Simonov had also presented a carbine based on his improved or 1939-pattern rifle. Unlike the rifle, however, it had an integral ten-round charger-loaded magazine. The length of the barrel was greatly reduced and the maximum sighting range decreased to 1,000 metres.

The Tokarev and Simonov carbines were tested on the firing range in October 1940, but were found to have an assortment of flaws.

Automatic carbine system Tokarev 1940.

The 1941-model Simonov self-loading carbine

In April 1941, Sergey Simonov completed design work on two self-loading carbines, improvements on those tested in October 1940. One gun had an integral magazine loaded from a special ten-round charger, while the other had a five-round magazine accepting the standard 1891/30 charger. Both carbines successfully passed firing-range testing.[45]

On 1st July 1941, the Artillery Committee noted in its journal that the Simonov self-loading carbine - with integral five-round magazine - satisfied the basic technical and tactical requirements, excepting that it had jammed too many times during the endurance trial. Its principal distinguishing characteristics were its light weight and integral magazine.

The Artillery Committee recommended that fifty examples of the five-shot Simonov carbine should be manufactured for field trials. Special attention was to be paid to adjusting the magazines in an effort to eliminate jamming. Work was to continue on the alternative (and potentially advantageous) carbine with the integral ten-round magazine, to develop a suitable feed mechanism in general and a satisfactory charger in particular.[46] Owing to military activity and the evacuation of several factories, manufacture of the Simonov carbines was delayed until 1944. When work recommenced, the weapons had been re-chambered for the M1943 cartridge.

A reduction in power of cartridge

The Second World War clearly showed that a prime requisite of military small arms was that they should assure the greatest possible manoeuvrability of the soldiers who carried them - i.e., that they should be light and compact.

Saturating armies with mechanised equipment resulted in the greatest concentrations of men in battle developing very rapidly, and at comparatively short ranges. Infantrymen, therefore, needed to provide maximum firepower in the shortest possible time; artillery barrages, air strikes and other powerful means of support were not always available when required. Attempts to design automatic rifles and light machine-guns for the existing 7.62mm rifle cartridge showed that it was impossible to increase infantry firepower to the levels demanded by the Red Army without a notable deterioration in the combatworthiness of small arms. The submachine-gun, widely approved during the Second World War, successfully solved some of the problems faced by the infantrymen. It was comparatively light and had a good rate of fire, but could not provide effective fire at ranges beyond 200-300 metres.

One solution clearly lay in the development of a new cartridge whose size, weight and ballistic properties occupied the vacant position between rifle and handgun cartridges. This new round, owing to better accuracy and greater penetration, would have a significantly greater effective range than the handgun type; conversely, it would be appreciably less powerful than a rifle round and have a smaller recoil impulse. However, as the practical range of the conventional 7.62mm small arms - excepting heavy machine-guns - was rarely greater than 600-800 metres, the intermediate cartridge would still be able to fulfil their roles. At 600 metres, the bullet of the Soviet 7.62mm M1943 intermediate cartridge penetrated three 2.25cm pine boards and had a residual kinetic energy of about 196 joules (20kgm). This proved to be sufficient to incapacitate personnel in combat.

The rifle cartridges had been developed on the basis of preserving lethality at distances of 2,000 metres or more. Experience showed that small arms were rarely employed at these distances, even the specially mounted machine-guns, and that rifle cartridges were too powerful for their role.

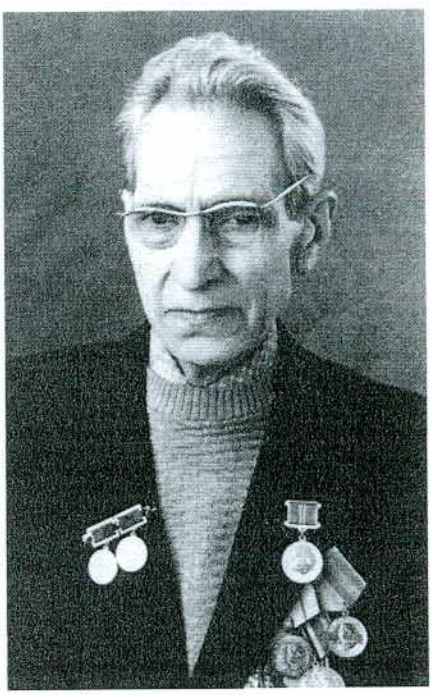
A major drawback of the rifle cartridge was the excessive recoil impulse produced on firing, which created insoluble difficulties for the designer of lightweight personal weapons. The impulses were impossible to control when firing automatically, placed too great a demand on the firer's strength, and too often promoted excessive mechanical failures. The intermediate cartridge, though retaining an acceptable maximum range, had a smaller recoil impulse. This enabled the weight of the weapon and its ammunition to be reduced appreciably.

The 1943-model intermediate cartridge

The creation of an intermediate cartridge began in the USSR in 1939, though the need had been identified many years previously. A special short-case 5.45mm round was developed, and a draft specification was issued for a suitably chambered self-loading rifle. Unfortunately, the war with Finland and the deteriorating European political situation necessitated transferring the designers to more pressing tasks. Work on light carbines chambering pistol cartridges also stopped, even though Sergey Simonov, Sergey Korovin and Vasiliy Degtyarev had all produced promising prototypes.

Development of an intermediate cartridge recommenced in 1943. The designers faced the problem of providing the bullet with a residual kinetic energy of at least 20kgm (196 joules) at 600 metres. The loaded cartridge was to weigh 15-17gm and the length of the gun barrel was to be 500-520mm. The prototype that most fully satisfied the tactical and technical requirements was the work of Nikolay Elizarov and Boris Semin. Consequently, it was adopted as the M1943 cartridge. Invaluable assistance was give to Nikolay Elizarov and Boris Semin by defence-industry factory workers Baskleev, Pavel Ryazanov, Serafim Orekhov and Ivan Melnikov, with Chief Artillery Directorate representatives Nikolay Dubovitskiy, Aleksandr Sergeev, Aleksandr Emetz, Aleksandr Bashmarin and Isak Litichevskiy.

Nikolay Elizarov

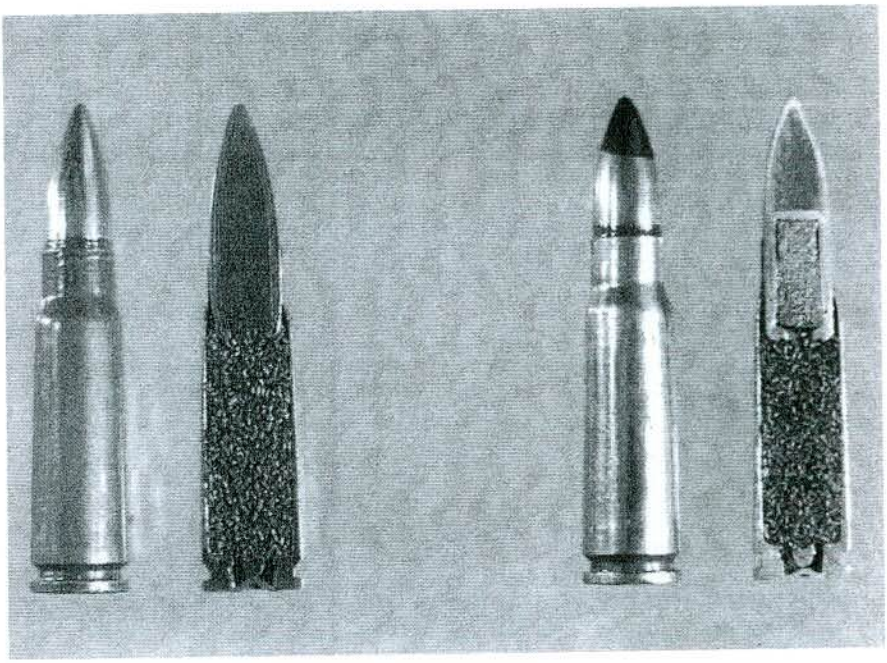


Boris V. Semin

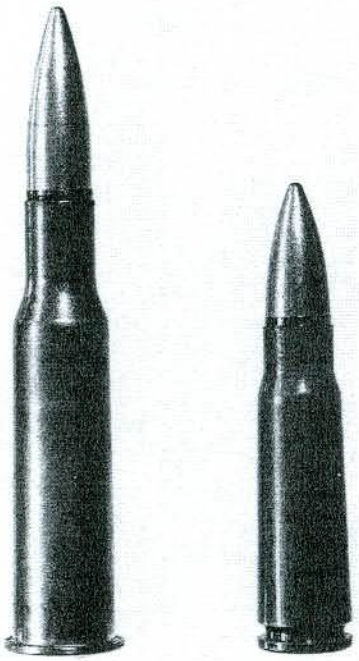
The perfected M1943 cartridge can be loaded with ball, tracer, incendiary, or armour-piercing-incendiary bullets to suit varying applications.

The regular bullet is intended for use against enemy manpower. It consists of a tombak-coated steel envelope, a lead jacket and a stamped-steel core. The soft lead jacket allows the bullet to press in the rifling with comparative ease; the envelope ensures a firm contact with the rifling, promoting the necessary bullet stability; whilst the steel core, in addition to economising on the use of lead, minimises deformation on contact with a resistive target and increases the penetrative ability of the bullet. A rounded base diminishes the resistance of the bullet as it passes through the air. The neck of the cartridge case is crimped into a cannelure around the centre of the bullet to retain the bullet firmly.

The tracer bullet is used to correct aim, indicate a target, signal, and - if necessary - disable enemy manpower. It consists of a tombak-coated steel envelope, a lead core, a tombak-coated steel cup, and a ring. The cup contains a pellet of trace compound and incendiary material (the 'initiator') with an embossed surface to promote reliable ignition. Propellant gas lights the initiator as the bullet moves along the gun-bore, and the initiator then fires the trace. The bright red trace-flame can be seen at any time of the day. The ring ensures that the exhaust-port diameter is maintained in differing bullets, whilst maintaining its position in relation to the longitudinal axis of the bullet. A tracer bullet is quite capable of igniting combustible obstacles such as a thatched roof or dry grass.



Intermediate cartridges M 1943, left normal ball, right tracer T-45.



7.62 long rifle cartridge compared with intermediate cartridge M 1943.

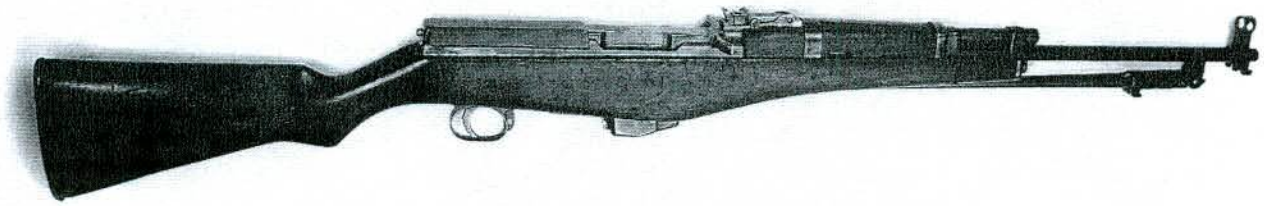
The armour-piercing incendiary bullet is used to ignite fuel or hit targets hidden behind thin armour plate. It consists of a tombak-coated steel envelope, a tombak tip, a hardened steel armour-piercing core, a lead jacket, and a cup containing incendiary material. When the bullet hits a hard obstacle, it stops abruptly. Propelled forward by inertia, the lead cup compresses the incendiary substance until friction causes it to ignite. The white-hot products thus created are forced forward through the hole formed by the hardened core, setting fire to the fuel behind the armour.

The incendiary bullet can ignite fuel in metal tanks with walls up to 3mm thick, and also fire material such as thatched roofs, haystacks or dry grass. It serves as an incendiary-tracer, as a red track is visible in daylight and at night. The bullet consists of a tombak-coated steel envelope, a tombak tip, a steel core, a lead jacket, and a tombak-coated steel cup containing the tracer/incendiary pellet and a priming mixture. When the bullet is stopped abruptly by its target, inertia propels the core forward to compress and ignite the priming substance. This in turn fires the tracer/incendiary pellet. The bullet-tip and envelope rupture, allowing the white-hot products of combustion to instantaneously ignite all flammable items in direct contact with them. If the core pierces an obstacle, part of the incendiary substance follows through the hole thus created, igniting flammable items behind it. At short ranges, the remaining portion of the burning trace element adds its effect to the incendiary action of the bullet.

The tracer, armour-piercing-incendiary and incendiary bullets are designated 'T-45', 'BZ' and 'Z' respectively.

The basic characteristics of the 7.62mm-calibre M1943 cartridge include a loaded weight of 16.2gm, a bullet weighing 7.9gm, and a propellant charge of 1.67gm. The cartridge measures 56mm overall, with a 26.8mm bullet and a 38.1mm case. The internal volume of the cartridge case is about 2.18cc, and the chamber pressure rises to a maximum of 274MPa (2,800 kg/sq.cm).

Experimental Kalashnikov self-loading carbine



Experimental Kalashnikov self-loading carbine 1944.

In 1944, Mikhail Kalashnikov developed a gas-operated carbine locked by rotating the bolt to the right. Although the principle was far from new, Kalashnikov greatly increased the angular rotation of the bolt until it far exceeded that of previous weapons. This substantially improved the reliability of the locking mechanism; in addition, placing the point at which force was applied to operate the mechanism in line with the locking lugs avoided undesirable stresses and enhanced durability in automatic fire. The hammer-type firing mechanism was restricted to single-shot fire.

The safety-catch lever, in the rear part of the trigger guard, blocked the trigger when applied. Empty cartridge cases were expelled by a spring-loaded extractor in the upper right part of the bolt and a movable defector mounted on the left wall of the receiver. The recoil spring lay in the bolt-carrier aperture; the rear of its guide rod entered the recess in the rear of the receiver to form a latch for the receiver cover. Cartridges fed from an integral magazine containing ten rounds in a staggered row. Charger guides were milled in grooves on the upper part of the bolt carrier. After the last round had been fired and ejected, the bolt was held to the rear by a bolt catch. The tangent-curve back sight was graduated to 800 metres, whilst a detachable knife bayonet could be mounted when required.

As Kalashnikov himself related, this self-loading carbine had provided not only his first success in small-arms design, but also a dress rehearsal for the solution of important problems faced during the development of his assault rifle. "When Sergey Gavrilovich [Simonov] was making the final adjustments in his carbine,' Kalashnikov recalled, 'I embarked on the design of a similar weapon of my own, for the new M1943 cartridge. This work was tremendously interesting and fascinating. I still remember how I erased my drafts to holes in a quest for a better way to construct automatic mechanisms, fix and detach the charger, or place the bolt handle. In this respect, I had some help from the American who had designed the Garand rifle. It was on his experience that I based my automatic: on his ideas - albeit modified - of how the cartridges should be fed into the loading port and how the empty clip should be thrown out after the last cartridge was expended. The location of the bolt handle on the left side was unusual, however. There were some other peculiarities as well.

"My work on this model gave me the joy of finding unexpected solutions and it became the starting point for another, but much better step forward. I feel I now have a right to say that had there been no Simonov carbine ready, my prototype might have had a different fate - who knows?"[48]

The 7.62mm Kalashnikov self-loading carbine was tested on the firing range in 1944-5. However, once the Simonov carbine had been adopted for the Soviet Army, the need of other such weapons receded. Mikhail Kalashnikov's efforts concentrated thereafter on his assault rifle - to the great effect related in detail in Chapter II.

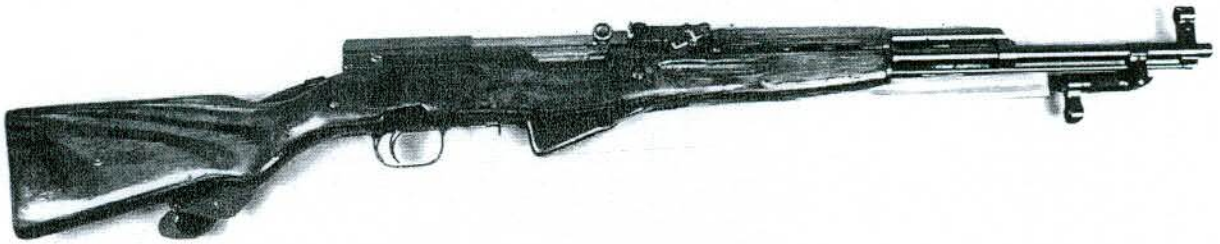
Simonov self-loading carbine 1945 (SKS)

Adoption of the 1943-pattern cartridge opened a new chapter in Soviet small-arms design. The rimless case allowed the feed mechanism to be made simpler and, as a direct consequence, much more reliable. The reduction in recoil improved the accuracy of fire, facilitating the development of the Simonov self-loading carbine (SKS), the Kalashnikov assault rifle (AK), the Degtyarev light machine-gun (RPD), and the Kalashnikov light machine-guns (RPK and RPKS).

The first Simonov carbine for M1943 cartridge was a minor adaption of the preceding, or 1941 pattern described above. Owing to the introduction of an integral knife-type folding bayonet, the muzzle brake was abandoned. The metal casing that had covered the gas port was replaced with a detachable gas chamber, integral with the hand guard, and the charger guides were transferred from the upper part of the receiver to the front part of the bolt carrier.

The first batch of carbines was sent to units engaged on the First Byelorussian Front and to the Vistrel officer-training school. Experience at the front soon revealed the positive qualities of the Simonov carbine; it was simple, light and manoeuvrable, and easily mastered during training. It was also convenient to fire, useful in a bayonet assault, and could be reloaded with little trouble. Disadvantages included excessive sensitivity to dust and mud, which resulted in frequent jams; occasional extraction failures, owing to cartridge cases sticking in the chamber; failures to eject; and feed jams caused by cartridges failing to enter the chamber.

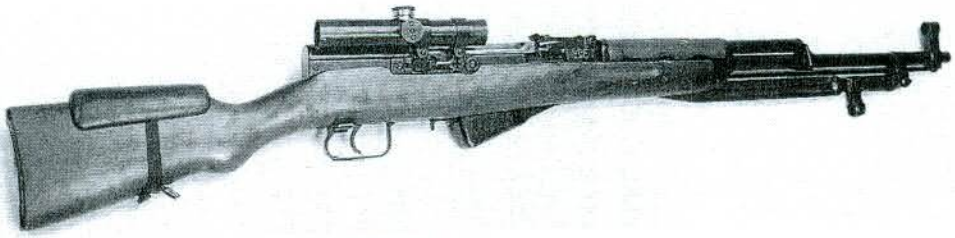
The trials commission of the First Byelorussian Front, realising that the



Normal production '7.62mm Simonov self-loading carbine, Model 1945' (SKS-45).

advantages far outweighed the flaws, recommended perfecting the carbine so that it could be adopted by the Soviet Army.[47] Sergey Simonov subsequently introduced a number of changes, improving the combatworthiness of his gun until - in 1949 - it was adopted as the '7.62mm Simonov self-loading carbine, Model 1945' (SKS-45).

Simonov continued work on his self-loading carbine even after it had been officially accepted. The Military-historical Museum of Artillery, Sapper and Communication Troops owns several examples of the SKS-45 exhibiting changes in design. Although few were produced in quantity, they offer an insight into the designer's efforts to improve his basic concept.



Experimental semiautomatic sniper carbine SKS-45.

Experimental semiautomatic carbine system Simonov M 1950.

A prototype presented in 1950 had the standard trigger system replaced with an automatic mechanism; the design of the sear was altered; the trigger guard pivoted around an axis pin, controlled by a front cam and a rear latch; the safety catch was mounted on the trigger guard; the shape of the barrel was altered; and the bayonet lug had a latch. The bayonet itself was detachable.

Experimental automatic carbine system Simonov M 1951.

The 1951 pattern had a differently shaped trigger-lever head, leading to the elimination of the standard trigger lever and the guard supporting the safety catch. The trigger guard, with a front tooth and a rear latch, was set on an axis pin; the bayonet was detachable, its lug being fixed with a latch and designed as a part of the gas chamber. Grooves in the front section of the receiver hid the catch for the stamped-metal box magazine, which was fitted with a special spring-loaded depressor lever.

Experimental semiautomatic carbine system Simonov M 1953.

A carbine submitted in 1953 shared the same firing mechanism as the original 1950 pattern. However, a groove was cut in the muzzle brake for the cleaning-rod head; the detachable bayonet was fixed to its lug by a latch; a fabricated multi-part receiver was used; the detachable box magazine had a stamped body and a spring-loaded depressor lever; and slots cut in the reinforcement at the front of the receiver hid the aluminium-alloy base of the magazine latch.

After the Kalashnikov assault rifle had been adopted, with similar ballistic characteristics to the SKS and far more effectual combat properties, the Simonov carbine was discarded in an attempt to simplify logistics by standardising a single weapon at platoon level.

Celebrating S.G. Simonov's 90th anniversary. Left to right: L.E. Bolotina, V.M. Martynov (a representative from the USSR Defense Industry Ministry), V.E. Skorokhodov (a representative from the Chief Rocket and Artillery Directorate, USSR Defense Ministry), S.G. Simonov, I.A. Glotov (weapons historian, Colonel [ret.]). Town on Klimovsk, Moscow district, October 1984.