THE MACHINE GUN

VOLUME II, PART VII

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THE MACHINE GUN

History, Evolution, and Development
of Manual, Automatic, and Airborne
Repeating Weapons

Compiled by
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PREFACE

The series of books entitled "The Machine Gun" was begun with the belief that the next best thing to actual knowledge is knowing where to find it. The research summarized within the covers of these volumes has been compiled by the Bureau of Ordnance, Department of the Navy, in order to place in the hands of those rightfully interested in the art of automatic weapon design, the world's recorded progress in this field of endeavor.

Part VII of Volume II is devoted to developments in the Soviet Union and her satellites. A study of each progressive step was made in order to ascertain why certain principles were abandoned and the circumstances that influenced any radical change in design.

Inventors and the automatic firing mechanisms they originated are presented in the sequence their devices were adopted by the High Command of the Soviet Regime. Weapons related in operating principles are considered together.

The potentialities and limitations of all basic operating systems of automatic weapons are so well known, that once the all important factor of establishing a trend is accomplished, the most trivial bit of information furnishes a yard stick to measure progress.

While nothing is claimed for this volume except that it is the result of tedious and laborious research, it is believed that in some manner it will help to point the way to a better understanding of past development.

Quotations from actual writings of the inventors, manufacturers, and professional critics are given wherever possible, as well as excerpts from reports and instruction manuals pertaining to specific weapons.

Great stress has been laid upon the inclusion of actual photographs of the guns discussed, thus corroborating the old Chinese proverb to the effect that a picture is worth a thousand words and, in addition, giving the reader an opportunity to view the weapon from the camera's eye and drawing whatever conclusions are pertinent to his interests in examining this volume.

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It would be impossible to over-evaluate the high technical skill displayed by Mr. Daniel D. Musgrave in his over-all work on this project. He not only performed meticulous basic research but also supervised the illustrators and photographers so as to reveal the pertinent features desired. His extensive knowledge in the field of identification and markings contributed greatly to the completeness of the publication.

Lastly, the preparation of the material deserves special mention. The manuscript was edited by Miss Marie Frauens. From a mass of technical data drawn from such widely divergent sources as captured material, foreign handbooks, and intelligence reports, she devised a presentation which facilitates comparing the various guns. Within this framework, she revised the text into readable and compact form.

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Frontispiece. Soviet women armorers preparing belted ammunition for a 20-mm. aircraft cannon.

PART VII

WEAPON DEVELOPMENT IN THE SOVIET UNION AND HER SATELLITES

Chapter 1

BACKGROUND OF SOVIET ARMS DEVELOPMENT

Infantry Armament in the Nineteenth Century

By the eighteen sixties, the World powers, including Russia, were becoming interested in new types of weapons to replace the old conventional armaments. This interest was stimulated by our War between the States. During this war, officers of many European countries had visited the United States and had seen all manner of new weapons tried.

At this time and up to approximately the turn of the century, the Imperial Russian Army was almost totally dependent on foreign sources for its infantry armament. In the eighteen eighties, a gigantic order for military revolvers was placed with the American arms producing firm of Smith and Wesson. Instead of with the customary S & W, revolvers were marked with the Imperial double eagle and Russian lettering. Even the 3-line (7.62 mm) Mossin Rifle, Russia's first modern shoulder arms of native design, was originally mass produced at the famous French Arsenal, Chatellerault. (See fig. 1–1.) The use of the measure "line" as a designation of gun bore diameter was abandoned by Russia at the end of the Czarist Regime.

In 1871, General Gorloff was sent by the Czar's government to the Gatling Gun Company plant at Hartford, Conn., on a mission to procure this company's manually operated machine guns, which were constructed to use the cartridge of the Russian infantry rifle. Various contemporary military journals estimated that 400 Gatling guns in all were bought.

The guns were delivered in a few months, and most of them were distributed in the garrisons of European Russia. Some of them were used for the auxiliary armament of fortresses; others were assigned for field service. One battery was provisionally attached to the cavalry for trial purposes. Forty-eight guns were sent to the Caucasus, and 24 to Central Asia.

The guns were all stamped with General Gorloff's name as that of the officer who had superintended their manufacture, with the result that for some years machine guns were known in the Russian Army as "Gorloffs."

In the Central Asia campaigns, the machine guns proved to be highly effective weapons against the mass charges of the Turcoman Cavalry. In the Khiva campaign, on one occasion a section of two guns was the chief factor in repulsing a dangerous attack made by an enormous force of the enemy in the early hours of the morning. The advancing cavalry was barely visible, but the indistinct target was so large that it was impossible to miss. As the stream of bullets tore through the mass of horses and men, the Turcomans were seized with panic and turned to flee, "leaving heaps of their dead in front of the Russian lines."

These guns were later manufactured in Russia. As they were copied from the original weapons bearing General Gorloff's name, the rank and file accepted the gun as being originated by the General.

Introduction of Maxim's Automatic Machine Gun

In the eighteen eighties, Hiram Maxim's automatic machine gun was creating a sensation in military circles in Europe. Arrangements were made for Maxim to exhibit a gun in St. Petersburg before a number of high ranking officers. Many years later, in telling of the incident, Maxim said that they seemed dubious of his gun, and, despite all the accounts previously published in European newspapers, no one present seemed to realize what an automatic gun was. They seemed to think that, like the Gatling, the new weapon required an outside source of operating energy.

When firing commenced, they were astonished to see the weapon fire 333 times in a half minute. Despite the remarkable performance, it was some years before Maxims were purchased and then only in limited quantity.

Figure 1–1. Exhibit in the Museum of the Tula Arsenal on the occasion of its 235th Anniversary. The rifle shown is the early version of the 3-Line (7.63-mm) Mossin, and in the background is the portrait of its designer.

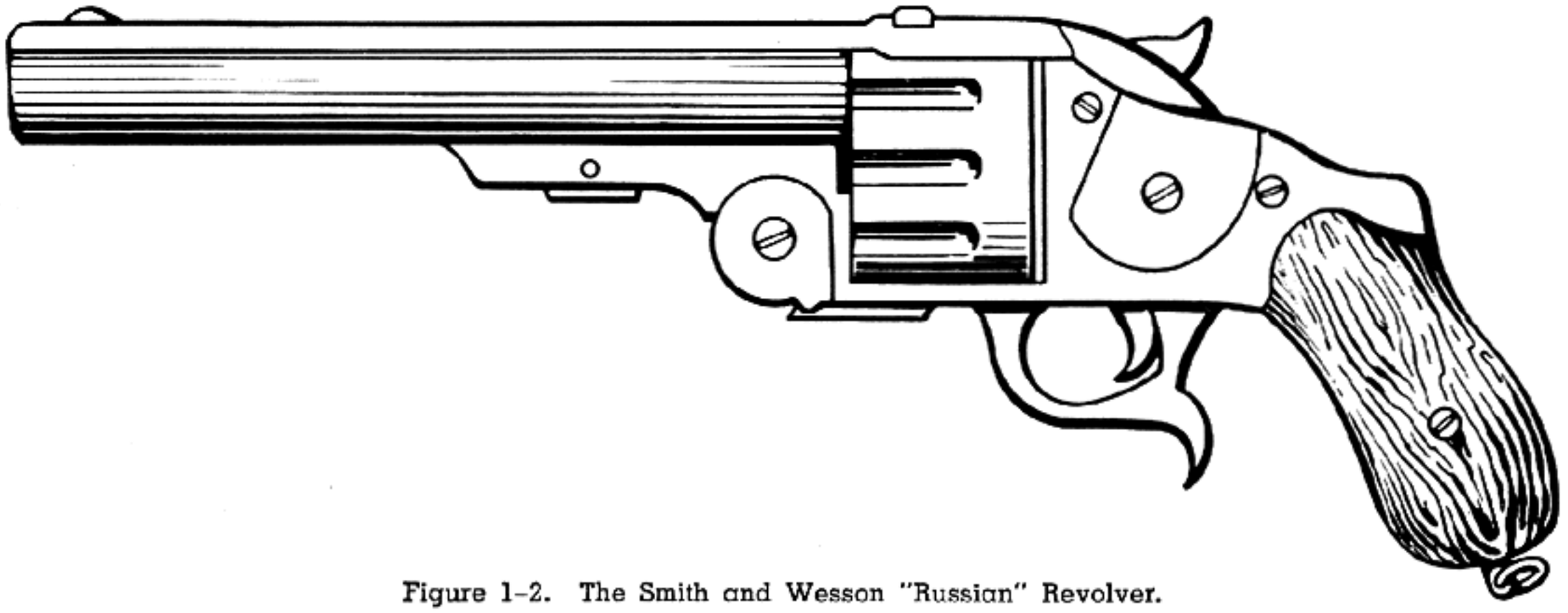

Figure 1–2. The Smith and Wesson "Russian" Revolver.

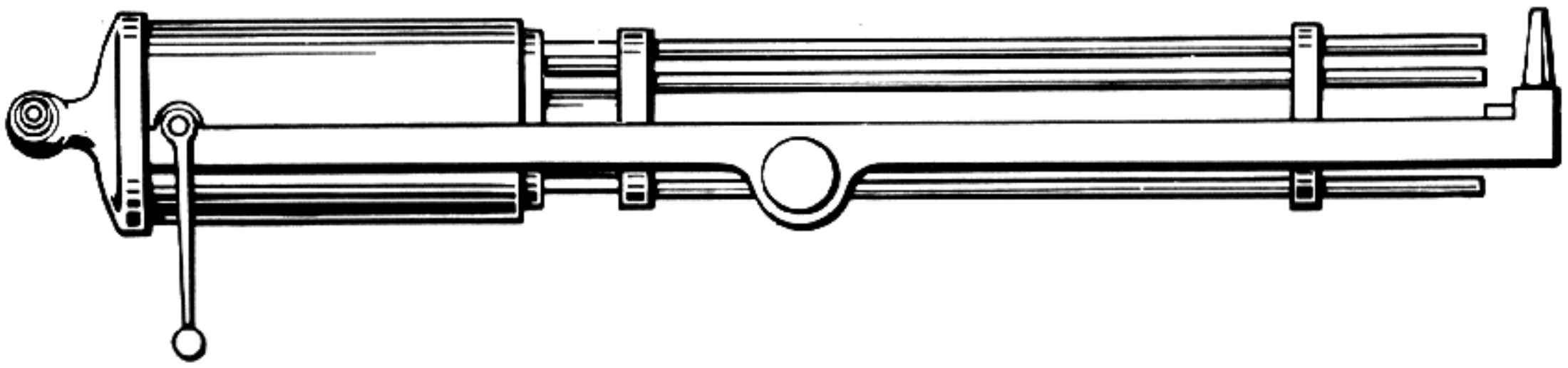

Figure 1–3. The 4.2 Line (10.6-mm) Gatling Gun, made in the United States for the Czarist Army.

During his stay in Russia, Maxim was subjected to police surveillance. It is interesting to note that such methods were applied to foreigners going to Russia even in those times, regardless of the fact that they were invited there by the regime. The president of Colt's Patent Fire Arms Company reported that he was similarly shadowed when he visited Russia shortly before World War I to discuss certain arms matters with the government.

Prior to 1900, there were no organized machine gun units, and no effort had been made to organize them. Literature on machine guns was scanty. The Artillery Administration of the Army, after experiments with both the Maxim and the Hotchkiss, equipped the fortress artillery units with the Maxim.

A certain Colonel Kern prepared a pamphlet on machine guns, which included maintenance methods and a firing chart. He indicated peculiarities of the weapon and discussed methods of correcting them.

The Artillery Administration of the Army worked out detailed sketches of machine parts, as well as sketches of spare parts and accessories. Such sketches were used in the acceptance of guns and

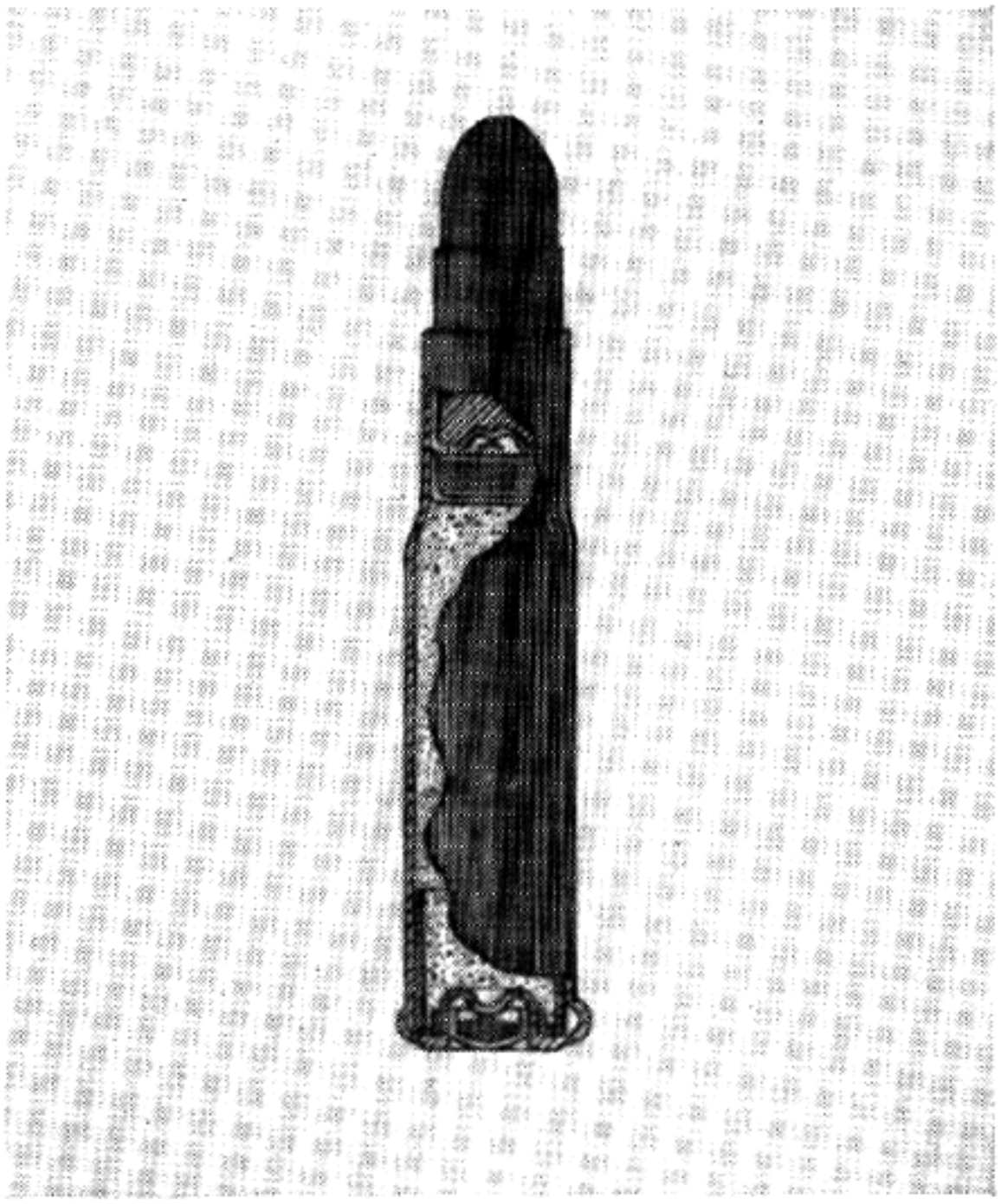

Figure 1–4. The 4.2-Line (10.6-mm) Cartridge, standard in the Russian Army prior to the eighteen nineties.

parts made in foreign countries. Tula Arsenal made barrels for these early Maxims, and some consideration was given to the idea of establishing a factory for making complete guns.

For several years the Maxim was tested for ballistic characteristics at the Artillery Range under the supervision of one Colonel Zhukov. The Colonel later assembled his data into a manuscript, but it was found to be of little use for training field units because of the scientific and technical nature of the treatise.

Manufacture of the Maxim machine gun first began at the Tula Arsenal about 1905. Nothing like mass production was achieved; however, the date is notable, for production of a small lot of the same guns occurred contemporarily in the United States. The American factory which made the Maxim had already made quantities of another automatic gun, and within a few years was producing a third. It was 20 years before any other design than the Maxim was made in quantity in Russia.

An improved version of the Maxim, also produced by the Tula Arsenal, was issued after 1910. The principal improvements were in the substitution of lighter and stronger steel parts for some formerly made of bronze. The action of the gun was unchanged.

Madsen Gun

In the early years of the twentieth century, light machine guns capable of transport by one man began to appear in several countries. Russia was one of the first to put them to use. Small numbers of the Madsen, made in Denmark, were purchased even before the Russo-Japanese War of 1904–5. Cavalry were armed with this gun, for it was well suited for horse transport, while the infantry and fortress units retained the Maxim.

It is indeed remarkable that this arrangement was worked out at a time when other armies were debating the usefulness of machine guns in general, and only a few experts realized that two distinct classes of guns must be provided. Although excellent guns were adopted by Russia, the notorious corruption and inefficiency of the Czar's government in matters of finance and supply prevented the most efficient use of the weapons. Even though it was obvious that Russia could not hope to produce guns in sufficient quantities, purchases abroad were very meager until World War I commenced.

Machine Guns Used From 1900 to 1914

In the Boxer Campaign of 1900, four machine gun units were improvised and sent to the front. Each company had eight guns of the Maxim fortress type, mounted on a limber. These machine gun sections participated in several actions, completing the capture of the Tientsin Arsenal and the Relief of Peking. The international nature of the campaign gave an opportunity for observation of other forces and led to further developments in the use of the Maxim.

In 1901, it was decided to form five machine gun companies for an experimental period of 3 years. These companies were each issued a gun of the same type used in the Boxer Campaign, but later the mounting was improved. Each gun was allotted 36,000 rounds per year. This figure was found to be too small for an adequate program, and almost twice as much ammunition was used. A representative of the Maxim firm, I. K. Miller, gave con-

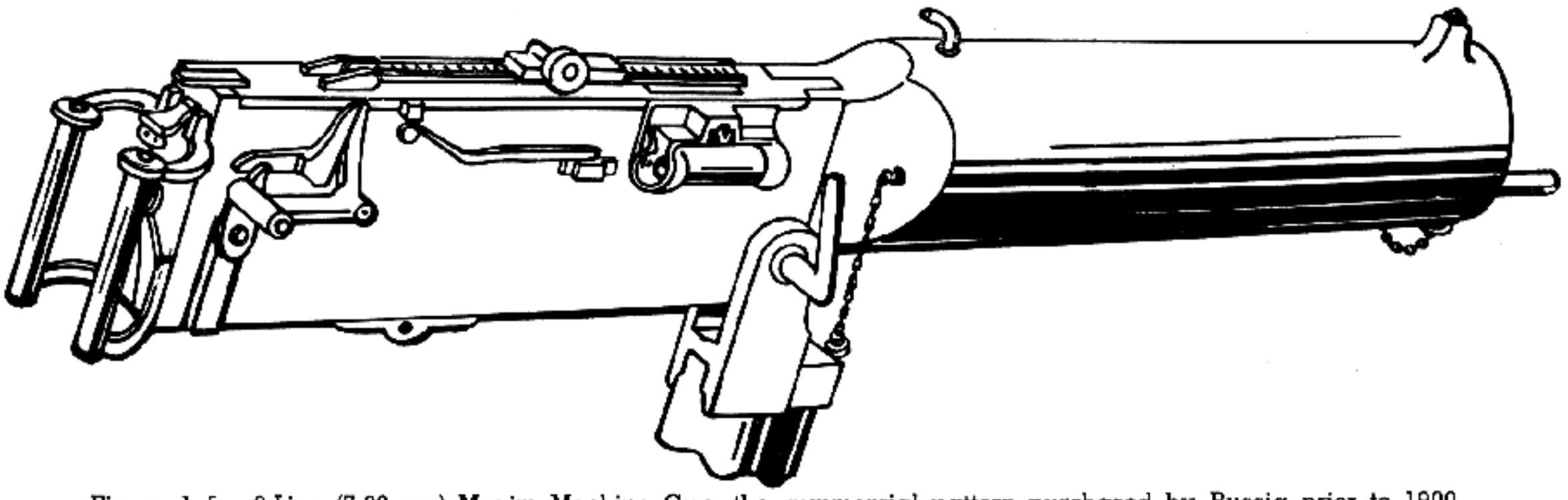

Figure 1–5. 3-Line (7.62-mm) Maxim Machine Gun, the commercial pattern purchased by Russia prior to 1900.

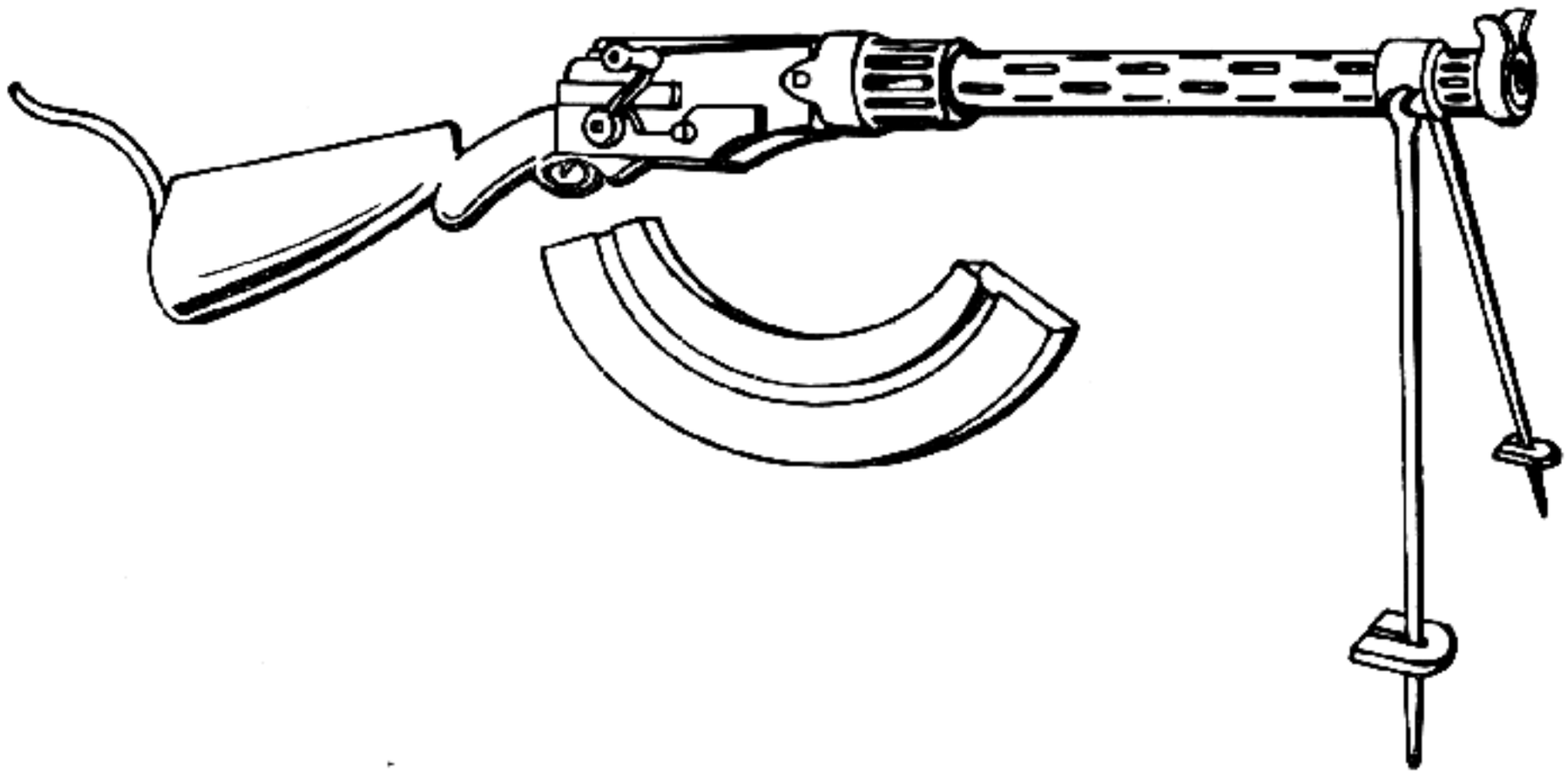

Figure 1–6. 3-Line Madsen Light Machine Gun Model 1902, the commercial pattern imported from Denmark prior to World War I.

siderable instruction to the machine gun personnel. These companies fought in the Russo-Japanese War, along with several newly organized units.

In this war, for the first time, there appeared situations where it was possible to see the destructive effects of the gun when properly used. After the war, there was a complete tactical reorganization of the machine gun units, acknowledging the importance of the weapon. Its tactical employment was officially introduced under War Department Order Number 684 of 1906.

There is no doubt that experimentation with different actions was beginning during this period. However, it is difficult to separate propaganda from history when we consult Russian works on weapon history. The statement that D. I. Mandeleyev, Russian chemist, invented smokeless powder, is certainly in contravention of the facts.

Other more plausible claims are: that V. G. Federov drew up plans to convert the infantry rifle to a semi-automatic in December 1905; that Y. U. Roshchepei, a regimental blacksmith, developed an automatic rifle with a fixed barrel in 1907; and that P. P. Tretyakov and A. A. Pastukov made a light machine gun which competed with the Vickers in tests in 1909. The fact that the Vickers was exhibited in Russia probably inspired the 1910 Maxim. The proving ground at the Officers' School at Oranienbaum was the place where foreign arms were tested, and several of the men who later became important designers in the Soviet Regime were stationed there before World War I.

Weapons Used in World War I

Desperate shortages of arms occurred in Russia soon after World War I began. Agents were sent to various friendly or neutral countries to buy weapons to bolster the sagging armies. Machine guns were extremely difficult to obtain, for most of the producing nations were in the war at the outset. France and England supplied some; but soon Russia, like several other nations turned to the United States for supplies. The Mossin was manufactured in the United States repeating the history of the Russian arms shortage at the end of the nineteenth century when this rifle was manufactured at Chatellerault. The Colt Company began making Vickers machine guns chambered for the 7.62-mm Russian cartridge. A large order was given to the Marlin-Rockwell Corporation of New Haven, Conn., for the Colt gas-operated machine gun, and 40 inspectors were needed at the plant to accept the finished guns.

In addition to the guns made at home and those purchased, all captured guns were used, but even then there never was a sufficient supply. During the 2 years of civil war after Russia withdrew from the war against Germany, a Russian named Federov designed an automatic shoulder rifle of which only a few were used. In the development of ordnance, the civil war was of principal importance because the Soviets had an opportunity to acquire "Imperialist" weapons for study, the White Armies having received considerable supplies of arms from the Western Powers.

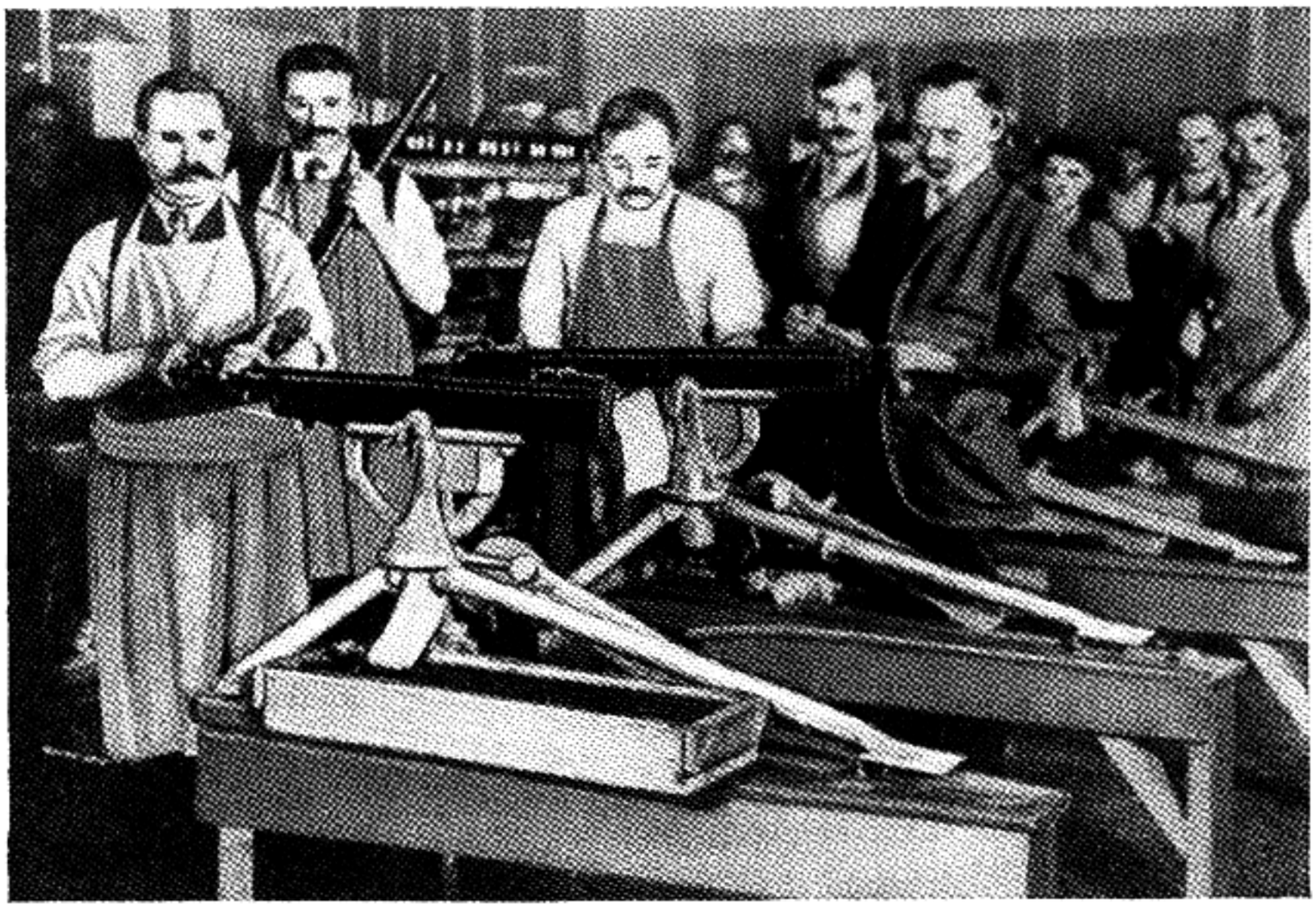

Figure 1-7. In World War I, Russian Inspectors at the Marlin-Rockwell Corporation, New Haven, Conn. Guns being accepted are the old Colt-lever type.

Development of the National Armament Industry

When the Soviet finally made peace with their many enemies, their forces were still armed mostly with foreign arms. The Federov automatic shoulder rifle had been only moderately successful. The Russian military press itself has since admitted that the mechanism was entirely too complicated. A nation that continually shouted to the World that Communism and Capitalism cannot live together needed something to back up its doctrine.

In the early nineteen twenties, a decision was made to develop a strong, self-contained national armament industry during the first Five-Year Plan. One of the initial steps was the establishing of the Design Office in 1924, in a small building at the Kovrov Machine Gun Factory. The chief was V. G. Federov, and he selected for his chief assistant V. A. Degtyarev. These men had worked together at the Sestrorets Small Arms Plant when the Federov automatic shoulder rifle was made and on the proving ground at Oranienbaum, where finished weapons were tested.

At its inception, the Design Office had several skilled machinists and eight machine tools. This was the real beginning of the automatic weapon industry in the U. S. S. R. Small as it was, this office was the forerunner of the Fourteenth, Fifteenth, and Sixteenth Bureaus of the Ministry of Armaments, which supervised the design and production of at least a million machine guns in World War II.

At the same time the Design Office was established, the U. S. S. R. was still an agricultural nation. The failure of "War Communism" even to feed the people during the various wars from 1917 to 1921 had necessitated a change to a "New Economic Policy." This NEP, as it is often abbreviated, had the effect of legalizing small businesses; under it, the government also granted several valuable concessions to foreign capitalists. The NEP did not further the armament industry, however, since it was in effect only a policy for the production of consumer goods. Consequently, it was supplanted in October 1928 by the first Five-Year Plan.

This plan, though widely heralded as intended to improve the lot of the masses through industrialization, was actually a thinly disguised scheme to establish a strong armament industry. The 4¼ years that this plan was in operation placed heavy burdens on the people, for all efforts were concentrated on industry. Many warlike slogans made their appearance and were adopted, emphasizing the hostility of the outside world. When the pro-

Figure 1–8. Soviet small arms designers Tokarev and Degtyarev, in uniform, as deputies of the Supreme Soviet of the U. S. S. R., in March 1941.

gram terminated at the end of 1932, the goals previously set had not been reached, but remarkable design progress had been made in various lines of military equipment.

Several existing circumstances served to further the ambitions of the Soviets. The complete domination of the people by the regime assured that any needed effort could be channeled to the proper place. The friendship with Germany in the early nineteen twenties, although short-lived, provided help and guidance of incalculable value. Throughout the world, tireless party members were seeking out and forwarding every scrap of military information they could get their hands on.

Communism recognizes no property rights in regard to foreign patents, accordingly, many of the world's inventors saw their ideas used by the Russians without compensation. However, since information disclosed in a patent may be insufficient for evaluating a piece of ordnance, from time to time efforts were made to purchase individual pieces of promising automatic firing mechanisms from the manufacturer. At the same time, however, every effort was made to keep information on Russian weapon progress from reaching the outside world.

It was indeed fortunate for the Soviet that the first Five-Year Plan progressed in a peaceful period. The Russians engaged in one minor clash with China in 1929. Otherwise, there was no warfare involving their forces, so it was possible to work patiently and unhurriedly on a Degtyarev design, which seemed the most promising of those so far tried. A need for independent testing facilities led to the use of several research organizations. This policy was in direct contrast to the situation in the old army, where testing was carried out any place that was available, with or without scientific assistance.

One of these research organizations was the NIAP, or Ordnance Department Proving Grounds, which was attached to the Military School KUKS, meaning Kursy Usovershenstvovaniya Komendnago Sostavs or School for Improvement of Qualifications of Commanding Personnel of the Red Army. The NIAP was located at Solnechnogorsk, 75 kilometers Northwest of Moscow, on the Moscow-Leningrad Railroad. The proving ground was established there about 1926, after being removed from the vicinity of Novo Gireevo, which was a station on the Moscow-Kursk Railway, 14 miles from Moscow.

The equipment at the disposal of NIAP was relatively poor compared to West European and American laboratories, but it was better than in other Soviet research organizations. It consisted of a few ordnance testing devices, such as instruments for calculating rate of fire, pressure gages, interior barrel gages, and devices for measuring velocity. NIAP had neither piezoelectric quartz apparatus for measuring pressure inside the gun barrel nor equipment for testing the quality of the metal.

The school had no technical or pyrotechnical laboratories; however, it proved to be a good mechanical workshop which was used principally for the production of trainee equipment. The personnel was relatively large, fluctuating between 60 and 150, since almost the entire teaching staff of the KUKS School participated in the work.

NIAP was engaged in work for the more important small arms manufacturing plants, and also on special tests for the Ordnance Department of the Army, the Research and Development Section of the General Staff, and on special assignments for the Commissariat of Defense.

While trying to improve the Degtyarev light machine gun, the NIAP also worked on correcting the design of the pointed nose type bullet. This work was in collaboration with the Artillery Academy, the NIIS–OAKh, and the laboratories of the Shostenski power plants. The performance of this bullet had never been particularly good. In the course of the Civil War and Revolution that followed, it had degenerated through poor manufacturing to such an extent that it could not even be used for target practice or training exercises. As a result, all firing of any importance, such as tests or competitions, was carried out with American manufactured cartridges, mostly the Remington, which coincidentally had been left over from the huge orders placed during World War I.

The first Soviet-made cartridges which could be considered fairly satisfactory bear the identification 1925 on the aft end of the case. At that time (1925), small orders for ammunition for the Russian rifles were placed with American firms—Winchester, Remington, and Peters. Powder similar in type to that used in American cartridges (duPont powder), was made by the Soviet and has been used

since then for loading their cartridges. The switch from black powder (carbon sulphur base) to smokeless powder for the Nagant revolver model 1895 was made about the same time. However, no special propellent for revolver cartridges has been developed; pyroxylin powder for hunters' shotguns (Model Glukhar) was used, though hardly suitable for revolver cartridges.

Another organization known as the NIIS TsS OAKh collaborated with NIAP on the improvement of rifle and revolver ammunition. After 1928, NIAP worked with the Tula Arms Plant in modernizing the Russian combat rifle 1891 model and in constructing a new military cartridge for the medium machine gun. The latter was similar to the German "SS" (heavy pointed bullet with metal jacket). These efforts resulted in the development of a modernized rifle, model 1891–1930, and a model 1930 heavy cartridge for mounted machine guns. During this period, NIAP branched out and devoted much time and effort to testing machine guns for airplanes, tanks, and other special purposes.

The NIIS OAKh (Scientific Research Station and Proving Grounds of the Central Council of Oscaviakhim) was located near Kuskovo, South of Moscow. This is the scientific research station and proving ground of the Oscaviakhim.

The ostensible aim of the NIIS OAKh (Nauchno-Ispytatelnaya Issledovatelskaya) was to serve the requirements of civilian groups engaged in recreational rifle and pistol shooting. However, as the sport was actually a means of training in Army practices and as Army weapons were used to a great extent, the work of this research laboratory had a definite military slant.

This station began its operation about 1927. It was organized by A. A. Smirnsky, sportsman and marksman, and a former artillery officer in the Czar's Army. In 1926, Smirnsky was attached in some more or less minor capacity to the staff of the Red Army; later he became a permanent consultant and an active worker at the NIAP.

The confusion which existed at the Oscaviakhim characterized operations at the proving ground. During the period from 1927 to 1941, NIIS changed directors ten times. There was one year when three different directors succeeded each other, and the following year there was no director at all. These head men were sometimes engineers, often students, and in some instances half-educated enthusiasts engrossed in a hobby. Notwithstanding this chaos, the organization achieved substantial results, thanks to the near fanatical enthusiasm of some of its members.

From 1927 to 1928, NIIS was engaged mainly in improving the quality of combat and small caliber cartridges (22 long rifle). At the shooting competitions which took place between 1927 and 1932, cartridges loaded at the NIIS Testing Station were used almost exclusively. NIIS ordered powder, cartridges, and arms from western Europe and America and tested them. They also kept in constant contact with the cartridge plants in Tula, Lugansk, and Kuntsevo.

The laboratories of the NKVD Sports Organization Dinamo also engaged in the study of ballistic matters; however, a discussion of their work is not pertinent here.

The largest proving ground of the USSR was located at Anapa in the Crimea, on the shores of the Black Sea. There the Artillery Academy conducted tests of machine guns and pistols. The principal work was in the field of exterior ballistics. From 1928 on, the testing laboratory worked out procedures for maintenance of weapons. Each year up to World War II, the laboratory published some new "temporary" rules for the maintenance of arms.

A small reference library was kept at Anapa. It included documents provided by the Intelligence Service, official military handbooks of foreign powers, and "capitalistic" magazines and books concerned with arms and ammunition.

The second Five-Year Plan was proposed in December 1933 and ratified in early 1934. As far as automatic weapons were concerned, the first plan had been concerned mostly with research and development. The second included the etsablishment of new production facilities, as well as progress in design work of Soviet machine guns of larger-than-rifle caliber. While the arsenal of Tula continued to produce several different types of guns, varying from the oldest model to the most recent design, a new works called the Voroshilov Factory, at Kolomna, was put into operation.

From 1931 to 1933, a number of experimental automatic rifles by Tokarev, Degtyarev, and others were tested at NIAP. Pistols and submachine guns

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were also under trial, but little interest was shown in the latter until the Gran Chaco War in South America. After that, a Russian design was improved and introduced into the Red Army.

The years 1934 and 1935 were devoted mainly to efforts to improve the rifle cartridge, which performed very poorly in a certain new machine gun. From 1935 on, NIAP was busy testing machine guns, anti-tank guns, mortars, automatic and semi-automatic rifles, and, after the Finnish War, submachine guns.

At the same time, NIIS was similarly concerned with ammunition problems, and it also developed a model of a sniper's rifle and conducted a school for teachers of sniping. Methods of training riflemen and standard designs for rifle and machine gun ranges were worked out. A small caliber machine gun for training purposes was developed, as well as several small caliber rifles and pistols.

Theoretical calculations concerning aircraft armament were in progress at the Central Aero-hydrodynamic Institute, and the practical tests were performed at one of the proving grounds assigned to these programs. This Institute had excellent personnel and equipment, the mere fact that it concerned itself with aircraft armament was considered secret. It was still engaged in this work when the second Five-Year Plan ended in December 1937.

In 1938, when the third Five-Year Plan commenced, all Europe was feverishly preparing for war. This period is marked by Soviet concentration on aircraft weapons, especially the heavier calibers. They utilized experience furnished by the Spanish Civil War, as did the other nations which sent observers to Spain. The slow development of the heavy Russian aircraft guns may be accounted for by the necessity for developing suitable ammunition.

Figure 1-9. Hero of Socialist Labor Boris Gabrielovich Shpitalny, automatic weapons designer, at his drawing board.

Shpitalny

In the late nineteen twenties, Boris Gabrielovich Shpitalny designed a lightweight, high-speed, rifle caliber aircraft machine gun in collaboration with Komaritsky. The design was enthusiastically received and led to Shpitalny's appointment as Chief of OKB 15 (Special Construction Bureau) in the Ministry of Armaments.

Born in 1898, Shpitalny was associated with the Bolsheviks. He was known as a hero of socialist labor from the time of the overthrow of the Czar. He is acclaimed as an instructor in the Red Army, as one of Russia's most prolific designers of automatic weapons, and as author of several books on small arms.

His early association with the Bolsheviks gave Shpitalny a distinct advantage. He was given every opportunity by the new regime to carry on in his chosen field. He developed to the fullest his natural aptitude in the design of automatic firing mechanisms.

Boris Gabrielovich Shpitalny was 1 of the 12 men recognized by the government to carry on development immediately preceding World War II; for his work in this field he was awarded the Stalin Prize, first class.

In 1935, Shpitalny was decorated for the successful design of a machine gun. In 1936, he was appointed Chief of the Special Research Bureau for the Development of Automatic Weapons. However, from 1936 through 1943, Shpitalny produced nothing original; by the time World War II had reached the halfway mark, he was beginning to be considered by qualified circles as a "has been." The lightweight, high speed machine gun that he designed had by then been improved repeatedly, and though it was the most widely used during the early stages of aircraft arming, it became less important as the trend became more pronounced toward larger bore automatic guns.

Shpitalny, always the student, then began to be heard of in an academic way; more so than from any notable achievement in weapon design. He held titles such as Doctor of Technical Science in the Ukraine Academy and Chief of Chair of the Ukraine Correspondence Polytechnic Institute. The Academy of Science of the U. S. S. R. lists his name among the candidates for the title of Academician.

While the machine gun that Shpitalny helped to produce had too many features that had been used for half a century to allow it to rise to the dignity of invention, it most certainly was a very noteworthy step in the right direction.

After being brought to the realization that the small rifle caliber machine gun was fast being outmoded by the demands in aviation for a weapon employing an explosive projectile, Shpitalny attempted what practically all other Russian inventors have tried, that is, scaling up the dimensions of a successful rifle caliber machine gun until it fills the needs at hand. The large bore automatic firing mechanism that resulted did not prove successful.

Beresin

Another automatic firing mechanism, comparable in importance to the Shpitalny, is associated with the name "Beresin."

Mikhail Ergenievich Beresin served as a designer on the staff of Tula Arsenal. For his work, he was rewarded with an important post in Central Construction Bureau Number 14. This Bureau is credited with making and sponsoring the improved version of this gun, which appeared soon after World War II began.

Wehrmacht Attack

When the Wehrmacht attacked, machine gun production was concentrated in three factories, Number 2 at Kovrov, Number 366 at Tula and Number 74 at Izhevski. In the course of the war, Tula and Kovrov were evacuated. Tula joined factory Number 66 at Slatoust-Urzhumka, which made the old reliable Maxim. New factories were established at Kuibyshev and Stalinsk. By the end of 1942, Tula and Kovrov were reoccupied. The Russians never revealed even to their allies what shortages existed in their armies. The most revealing information was gathered early in the war by the German Intelligence through tales told by deserters.

Figure 1–10. The Russian Maxim Machine Gun on ski transport, as used in the U. S. S. R. invasions of Finland in the nineteen forties.

Lend-Lease

A vast quantity of material was given to Russia by the Allies; its ultimate disposition is unknown. At the time when the United States was shipping gigantic supplies of ordnance, an American officer of considerable determination, who handled certain lend-lease shipments, managed to obtain a Degtyarev light machine gun, a rifle, and one or two light tanks for the Army's Foreign Ordnance Collection, located at Aberdeen, Md. The Russians attached to the gift a stipulation that no test of the equipment was to be made by the United States. When a Russian liaison officer at Aberdeen Proving Ground at a later date noticed a piece of armor had been removed from one of the tanks for analysis, he protested violently. Yet Russian officials never seemed embarrassed to ask for specimens of our most secret ordnance, always using the pretext that it would greatly aid their war effort. Actually, of course, such material was wanted for long-range development projects, and it was in no way associated with actively carrying on the war. Sometimes the Russians got what they asked for.

Soviet Production in 1944

During the later days of the war, Soviet production began to recover from the Wehrmacht attack. Substantial levels were reached by the year 1944. Soviet sources show the following production figures for 1944 for various types of guns. Later chapters give details regarding each weapon listed here.

Weapon:	*Quantity*
Maxim	270, 000
Degtyarev Infantry	120, 000
Degtyarev Tank	40, 000
Degtyarev-Shpagin Heavy	50, 000
Goryunov	10, 000
Shkas	40, 000
Beresin	60, 000

Types of Soviet Aircraft Armament in World War II

An official Soviet publication dated 1943 includes a table of data which coincidentally summarizes some of the intelligence presented in this and the chapters that follow.

A translation of the table follows. A table in chapter 9 shows the Russian characters indicating

Basic Data on Soviet Machine Guns and Cannon Used for Arming Airplanes of the Air Force of the Red Army

Designation data		Designations of the Machine Guns										
		7.62-mm machine gun Shkas			12.7-mm machine gun of one Beresin system			20-mm cannon Shvak			23-mm gun VYa	37-mm gun
		Turret	Wing	Synchronized	Turret	Wing	Synchronized	Turret	Wing	Engine		
Caliber (mm)		7.62	7.62	7.62	12.7	12.7	12.7	20	20	20	23	37
Rate of fire (shots/min)		1,800	1,800	to 1,500	800–1,000	800–1,000	800–1,000	700–850	700–850	700–850	550–650	220
Initial speed of projectile	(m/sec)	820	820	840	840 860	840 860	840 860	815	815	.....	910–920	900
	(ft/sec)	2,638.4	2,683.4	2,748.8	2,748.8 –2,814.2	2,748.8 –2,814.2	2,748.8 –2,814.2	2,667.05	2,667.05	.....	2,975.7 –2,008.4	2,843
Total length	(mm)	952.5	932	1,097	1,397	1,397	1,397	1.726	1,679	2,122	2.145	.....
	(inches)	37.5	36.69	431.5	55	55	55	67.95	66.1	83.54	84.44	.....
Weight	(kg)	10.6	9.8	11.1	21.431	21.412	21.438	42	40	44.5	66	161
	(lb)	23.32	21.56	24.42	47.15	47.1064	47.16	92.4	88	97.9	145.2	354.2
Average weight of cartridge (grams)		23	23	23	130	130	130	185	185	185	467	720
Weight of link (grams)		10	10	10	37	37	37	38	38	38	94	.....
Force for extraction of cartridge from link	(kg)	6–13	6–13	6–13	8–16	8–16	8–16	3–6	3–6	3–6	20–30	.....
	(lb)	13.2 –28.6	13.2 –28.6	13.2 –28.6	17.6 –35.2	17.6 –35.2	17.6 –35.2	6.6 –13.2	6.6 –13.2	6.6 –13.2	44–66	.....
Force for discharge	(kg)	8–12	.....	.....	8–10	10–12	10 12	8 10	10 12	8 10	11 15	.....
	(lb)	17.6 –26.4	.....	.....	17.6–22	22 26.4	22–26.4	17.6–222	22–26.4	17.6–22	24.2–33	.....
Force for reloading	(kg)	76–106	.....	.....	100–120	100 120	100–120	.....	.....	.....	67 70	.....
	(lb)	167.2 –233.2	.....	.....	220–264	220–264	220–264	.....	.....	.....	147.4 –154	.....
Pressure of compressed air in cylinder of pneumatic reloader in atmospheres.	(kg)	.....	.....	.....	.....	.....	.....	.....	.....	.....	30–35	.....
	(lb)	.....	.....	.....	.....	.....	.....	.....	.....	.....	66–77	.....

Figure 1–11. The Soviet DT Machine Gun. In 1944, production of this weapon reached a rate of 40,000 guns yearly.

inventors' names and technical identifications such as turret, wing, and synchronized.

Earlier than 1944, Germany had accurate information concerning not only Soviet weapons and ammunition, but also those of Great Britain and the United States. The insides of the front and back covers of this book show wall charts captured in a German ordnance school in 1944. The chart in the front of the book shows types of aircraft weapons which were advanced models at this time; the chart in the rear of the book shows the types of aircraft ammunition used in World War II by the three countries mentioned.

Soviet Armament After World War II

As a result of the downfall of Germany and the occupation of some of her important factories by the Russians, the latter are today in possession of complete data on both production and experimental German weapons.

From time to time, reports of manufacturing of machine gun material in the Russian Occupied Zone have been issued. Such material might well include replacement parts to maintain existing stocks, as well as manufacture intended to result in new guns. Even more important are reports concerning the work of German ordnance engineers who have gone

over to Russia, either voluntarily or under duress.

In addition to their own industry, the Soviets have several of the world's most famous factories under their control today. These include: two German firms, Walther and Haenel; the Austrian Steyr Works; the "Danuvia" arsenal, at Budapest; the Skoda heavy ordnance plant and the company producing the Brno ZB Machine Guns, both of Czechoslovakia. Many other factories of lesser importance are also controlled, and they provide a valuable addition to the Soviet armament industry.

Weapons developed by some of these countries have vitally affected the pattern of Russian machine gun development in ways that are suggested in this Volume and Volume I in the chapters on Brno ZB and Skoda. The work of the Walther, Haenel, and Steyr firms in pistols, submachine guns, and rifles are outside the scope of these volumes and, accordingly, are not included.

In the pattern of Russian machine gun armament there is a distinct trend, just as there is in every field of Soviet endeavor. In Russia, even as in "capitalistic" lands, successful ordnance inventors are well rewarded for their services. The fact that a design may incorporate pirated features is no hindrance as long as the gun succeeds in combat. After 20 years, during which gas operation dominated the scene in the latter part of World War II, a new group of designers became prominent after introducing a mechanism powered by the forces of recoil. The most important of these is Alexander Emmanuilovich Nudelman, Armament Engineer in the Sixteenth Bureau of the Ministry of Armaments.

Summary

As a vast, continental land power, Russia has always relied on a huge ground Army for both offense and defense.

While during the later years of World War II their Navy and Air Force got greater attention than in previous wars, the Army was still the dominant component of the Russian Military Machine, and its needs dictated the design of weapons.

The background of the present Soviet War Machine (officially created on 23 February 1918 as the Red Army) must be understood to appreciate the great strides made during its 34 years of existence. During the nineteen twenties, the Red Army was thoroughly reorganized. In spite of the changes made, which included intensifying political education, top commanders continued to have little authority.

By 1925 a general plan for standardization of arms and equipment was adopted, with weapon design incorporated with plans for the future. In 1937 the great purge of the military took place. Many of the top leaders were victims. As a result of these mass killings in their own ranks, the officer corps severely limited their own scope of action.

Most of these purges took place under Marshal Voroshilov, the then Commissar of Defense (1927–40). Marshal Timoshenko, who succeeded Voroshilov, continued the reforms but gave the loyal military more authority. The most outstanding change was abolishing the Political Commissar in order to give the unity of command to the military leaders. This revolutionary act was possible because of the great prestige enjoyed by Timoshenko, who had distinguished himself by breaking the Finnish Mannerheim Line.

On 19 July 1941, less than a month after Germany launched her invasion of the Soviet Union, Stalin assumed the position of Commissar of Defense and at once reinstated the Office of Political Commissar. The latter change was doubtless brought about by the near hysteria of the people over the daily retreats of the Red Army. This order was revoked by October of the same year.

By this time weakness of the cumbersome Soviet Military Machine was revealed as was the dire need for up-to-date weapons, especially machine guns. Earlier measures for raising the general level of education were beginning to show results in the increased number of technically trained personnel. The "smashing" tactics toward the old technical intelligensia had changed to a policy of conciliation and solicitude in cases where the intellectuals had turned toward the Soviet power. These changed conditions brought on changes in organization from the high command down to the designers and the smallest manufacturers.

Emerging victorious from the War in Europe, the Soviet military machine was a huge infantry-artillery army, with little emphasis being placed on large mobile units. However, in her campaign against the Japanese in Manchuria, Russia showed the world that she was capable of flexible and expedient handling of large mechanized forces, and a few new

or modified weapons were revealed, showing signs that automatic armament design was being synchronized with this type of warfare and breaking away from merely scaling up or scaling down to meet a requirement.

In 1946, the Soviet High Command reorganized the entire structure of the Armed Services. The Army, including its own Air Force, and the Navy and Naval Air Force were coordinated into a single Ministry of Armed Forces, with the former Red Army General Staff becoming the Armed Forces General Staff. In other words, the Army high command took over the other branches. At this point there was little resemblance between the horse drawn, carelessly trained and led Red Army of 1939.

During World War II, Russia had resources and time to produce only already existing weapons that were basically simple in design; but with the surrender of Germany and the taking over of the great manufacturing arsenals of her Satellites, Russia entered into an entirely new phase of weapon development. The new program is without parallel in military history. Only a few phases of it can be mentioned at this time.

Russian realism in dealing with the educational background of the masses is worthy of note. The simplicity of the designs of the Soviets' automatic weapons reflects an attempt to have modern and reliable weapons in spite of the fact that the soldiers have little background in operating and maintaining any type of mechanical device.

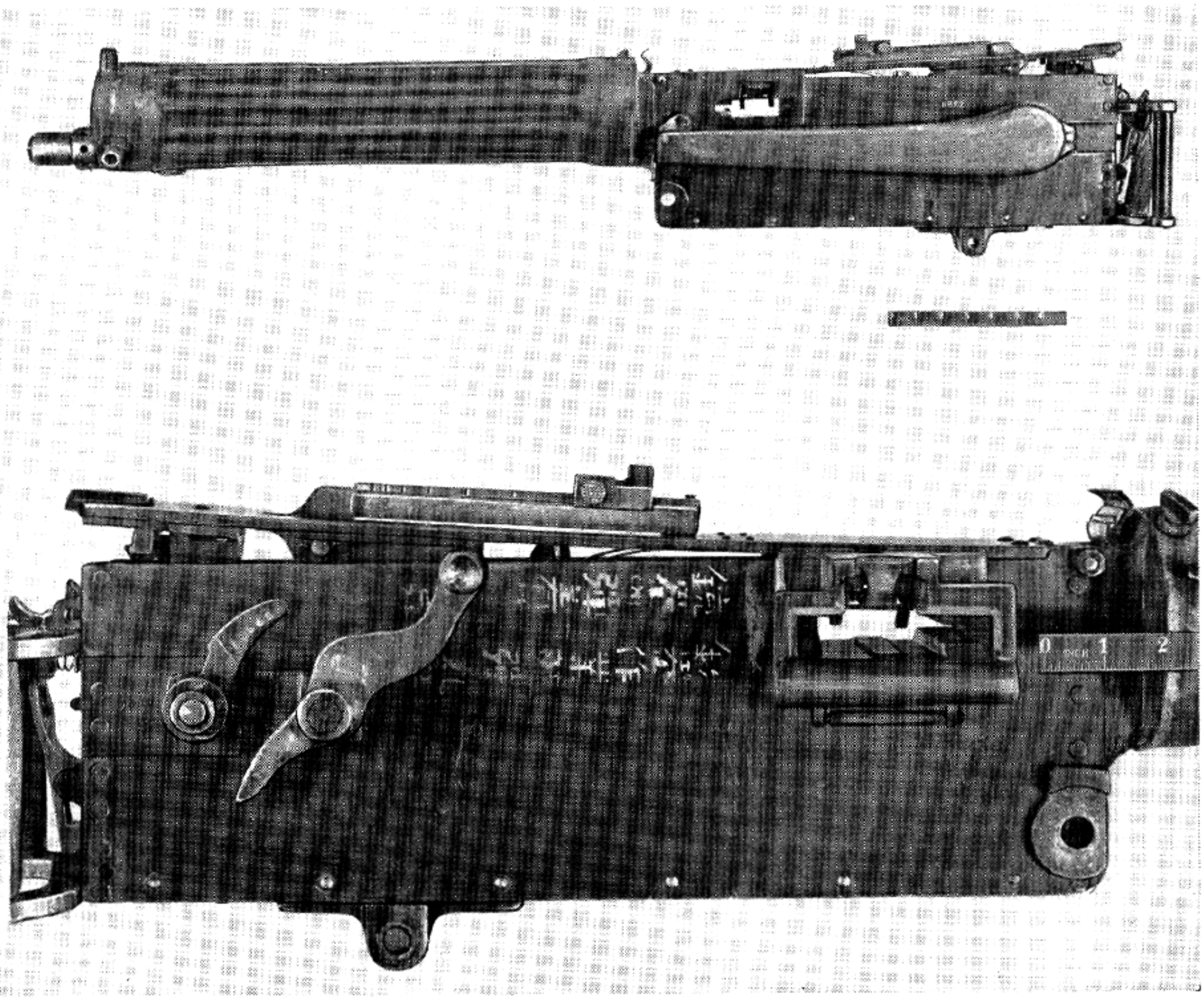
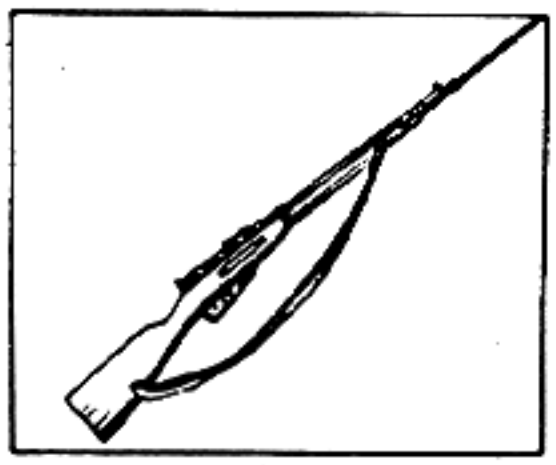


Figure 1–12. Russian Maxim Machine Gun, Model 1910, captured from Chinese Communist Forces in Korea.

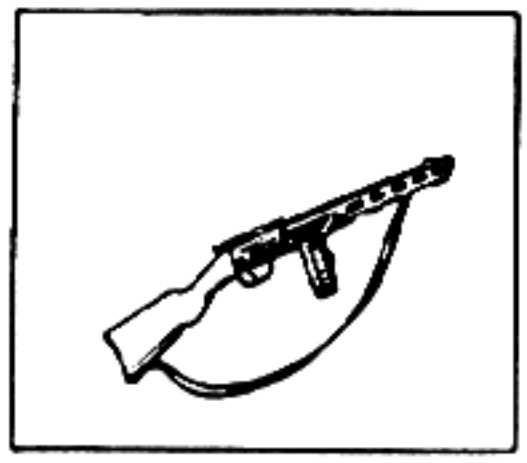
Таблица 28.

СОВЕ́ТСКАЯ А́РМИЯ *(22)* И ВОЕ́ННО-МОРСКО́Й ФЛОТ *(23)*.

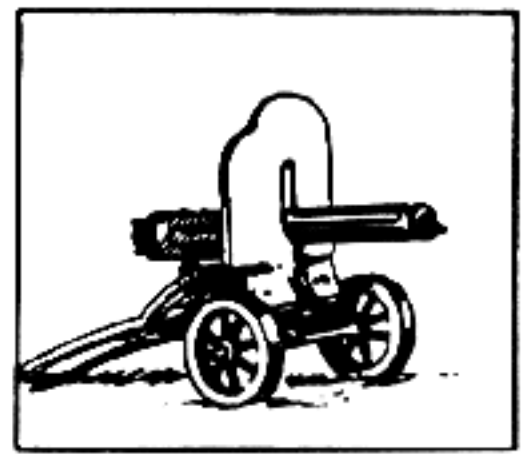
ВООРУЖЕ́НИЕ *(24)* И СНАРЯЖЕ́НИЕ *(25)*.



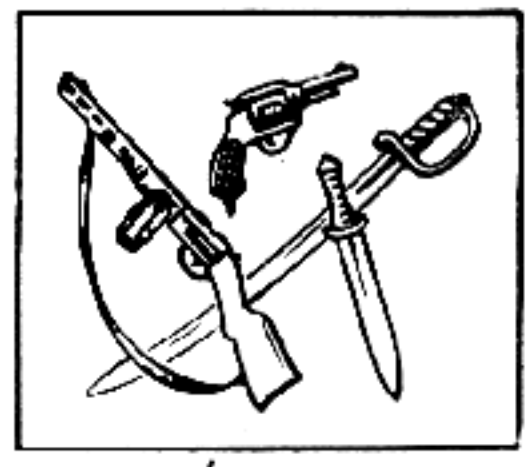
ВИНТО́ВКА *(1)*.



АВТОМА́Т *(2)*.



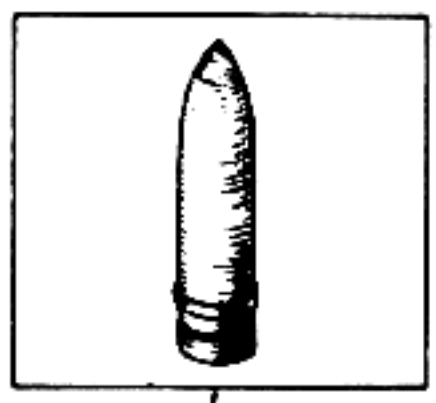
ПУЛЕМЁТ *(3)*.



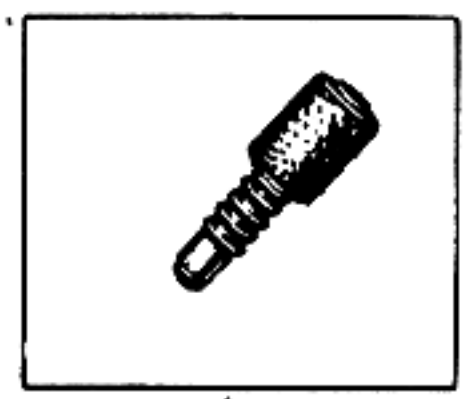
ОРУ́ЖИЕ *(4)*.

ПАТРО́Н *(5)* И ПУ́ЛЯ *(6)*

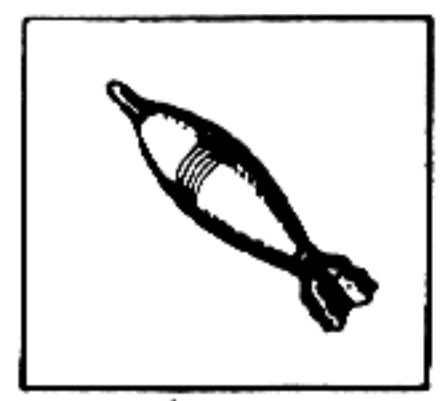
БО́МБА *(7)*.



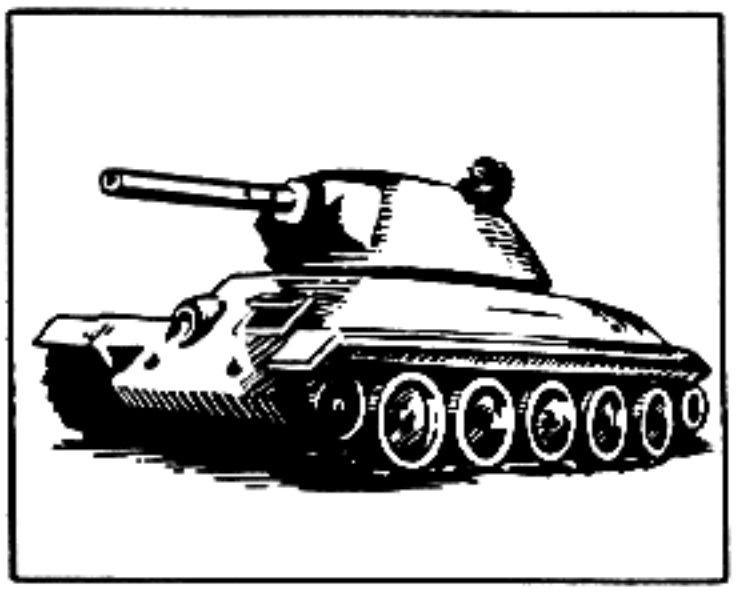
СНАРЯ́Д *(8)*.



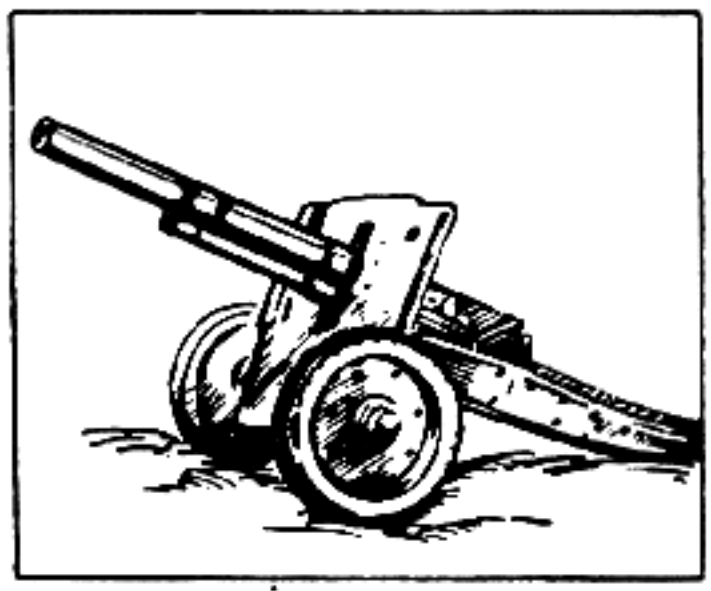
ГРАНА́ТА *(9)*.



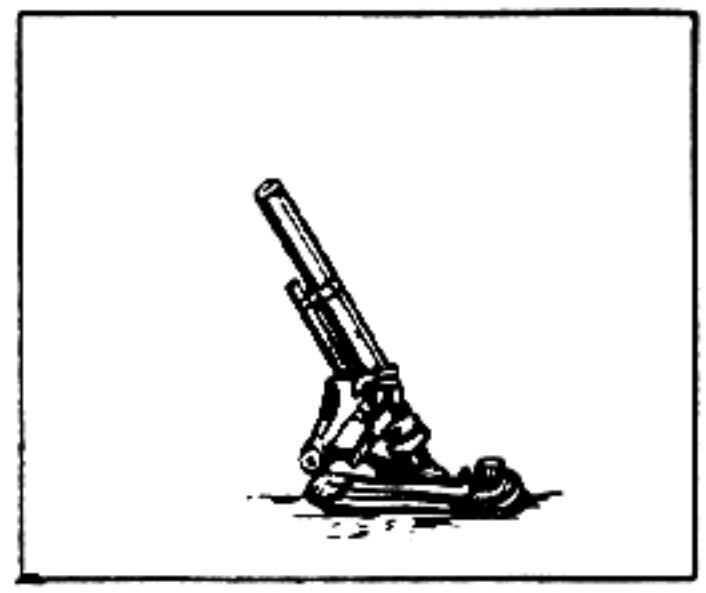
МИ́НА *(10)*.



ТАНК *(11)*.



ПУ́ШКА *(12)*.



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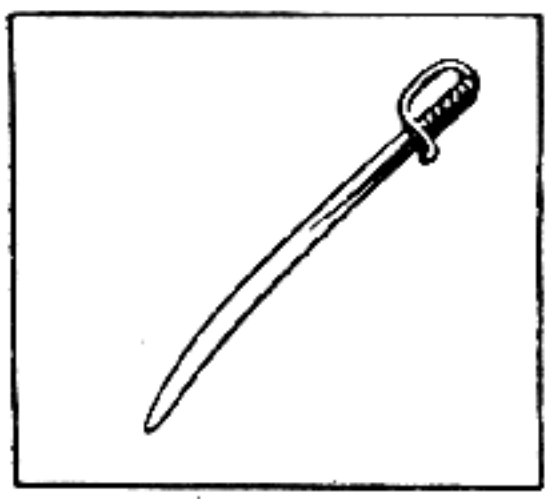
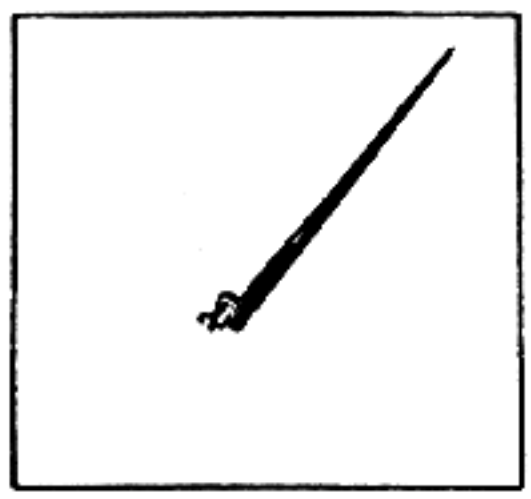
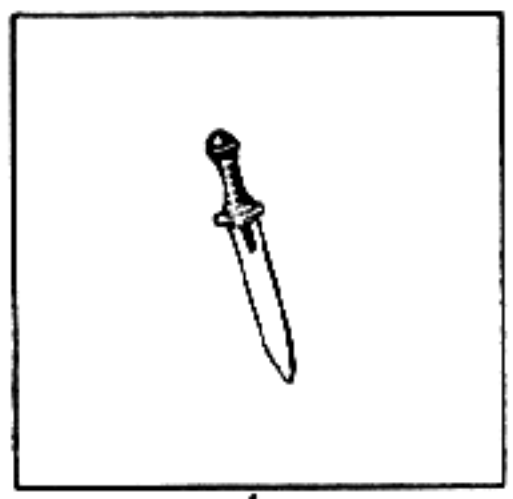


САБЛЯ *(14)*.

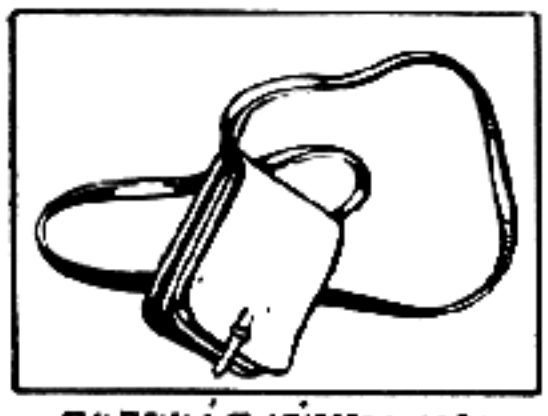


ШТЫК *(15)*.

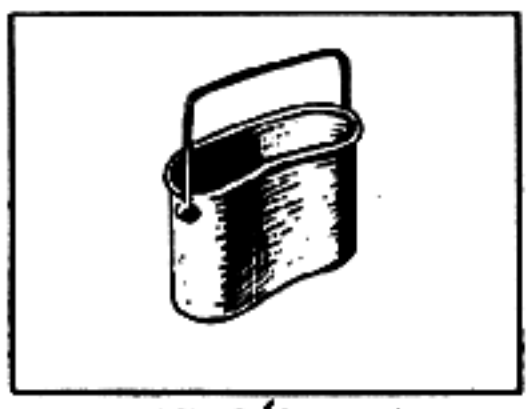


КИНЖА́Л *(16)*.

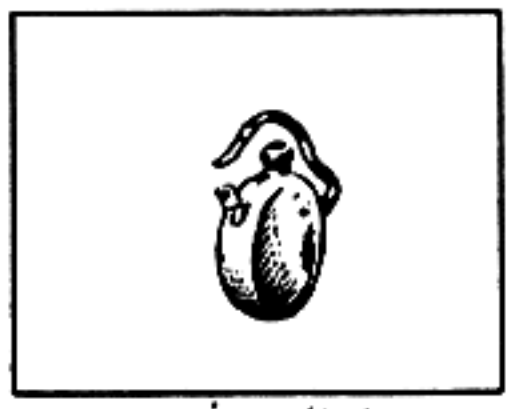
РЕВОЛЬВЕ́Р *(17)*.



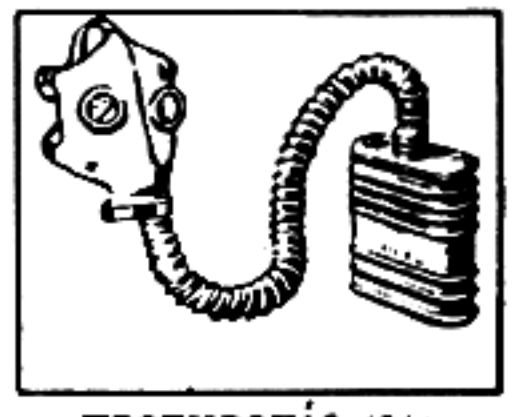
ПОЛЕВА́Я СУ́МКА *(18)*.



КОТЕЛО́К *(19)*.



ФЛЯ́ГА *(20)*.



ПРОТИВОГА́З *(21)*.

Figure 1–13. Page from a Soviet primer published in 1950.

In training Soviet and Satellite personnel the problem of inexperience is combined with that of illiteracy in any or in a common language. One outstanding solution to this problem is suggested by figure 1–12, which shows a Soviet Maxim machine gun which was captured from Chinese Communist Forces in Korea. Painted on the side of the receiver is critical information, basic to the reliable functioning of the weapon. The fact that the gun was being used by Koreans indicates the wisdom of depending on a few simple words, presented so that they cannot be lost, to inform personnel on the use of the gun.

Another aspect of dealing with the educational background of the masses involves manufacturing specifications. The Soviets have taken into account the lack of skilled labor and the lack of equipment to produce machined surfaces and finishes; accordingly weapons are designed to require a minimum of moving parts and fine finishes.

Whether or not these requirements of simplicity and ease of manufacture will apply to another generation is a matter of conjecture. Soviet educators are pursuing some of the latest educational trends in preparing text books, as illustrated by the page from a Russian primer published in 1950, shown in figure 1–13. It is interesting to note that the Communist children are learning at an early age not only to read but to recognize the weapons their older brothers are learning to use.

Chapter 2

MAXIM TYPE MACHINE GUN AND FEDEROV AVTOMAT

Weapons Included in This Chapter

Maxim Type Machine Guns

Design	Applicable symbol	Bore diameter	Use
English-made	.....	7.62-mm	Ground.
Model 1905	.....	7.62-mm	Ground.
Model 1910	PM	7.62-mm	Ground.
Aircraft	PV–1	7.62-mm	Aircraft.
Maxim-Tokarev	M-T	7.62-mm	Ground.
Maxim-Koleshnikov	M-K	7.62-mm	Ground.
Esiunin	.....	13-mm	Ground.

Federov "Avtomat"

Designation	Bore diameter	Use
"Avtomat"	6.5-mm	Ground.

History and Background

Since late in the nineteenth century, when it was first introduced in the Czar's Army, there has never been an interval when the Maxim was not actively in use in Russian forces. It has proved to be not only the first successful automatic firing mechanism but also one of the most reliable. Its rugged construction and moderate rate of fire make it ideal for arming troops that have little mechanical aptitude; it rarely gets out of order. For generations, Russian soldiers have been trained on this mechanism, even after the introduction of newer and supposedly better types.

The early guns used were built at the Maxim Company in England, and the first step toward manufacture in Russia was the making of barrels at the Tula Arsenal. Other steps were taken gradually before complete guns were manufactured, one of which was the Model 1905 gun. Russian literature describes this gun as weighing 69 pounds dry and 78 pounds with its bronze water jacket filled. Specimens fitting this description have been noted with dates as late as 1909 on their fusee spring housing, the place where Maxim guns were marked in

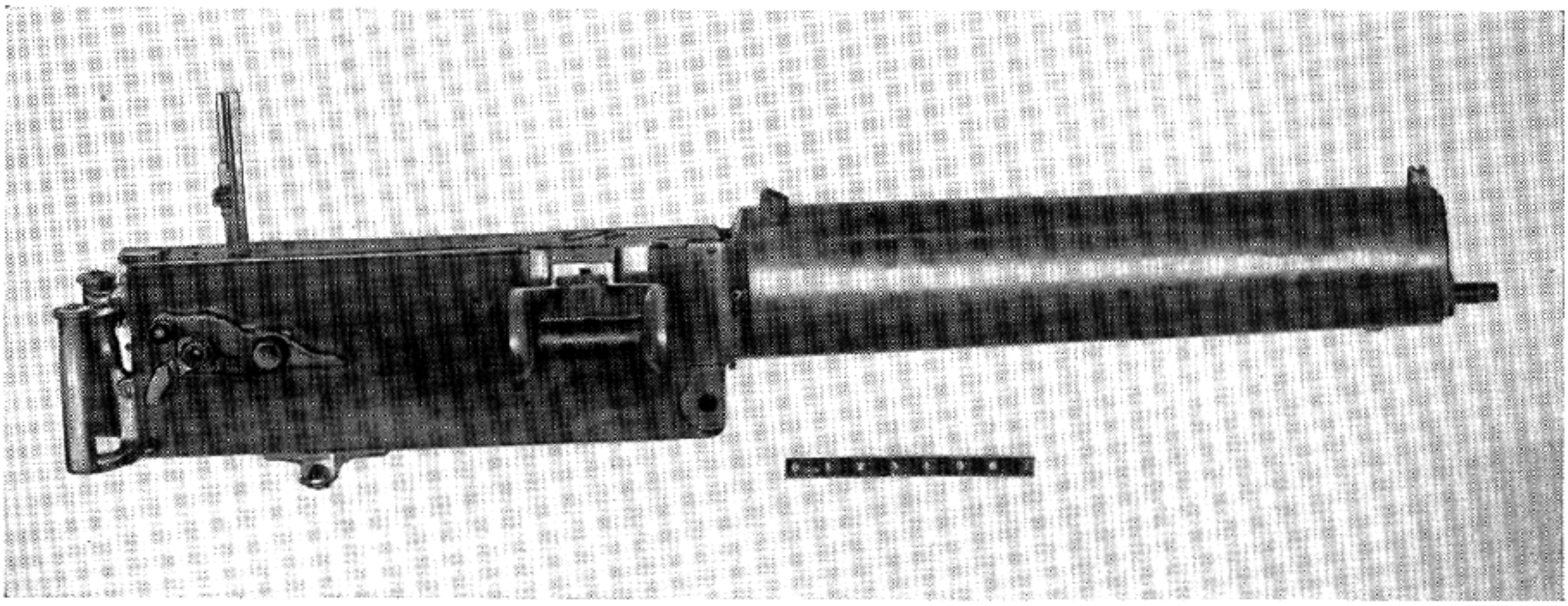


Figure 2–1. Russian 7.62-mm Maxim Machine Gun Model 1905. Date of manufacture, 1909, appears on spring housing.

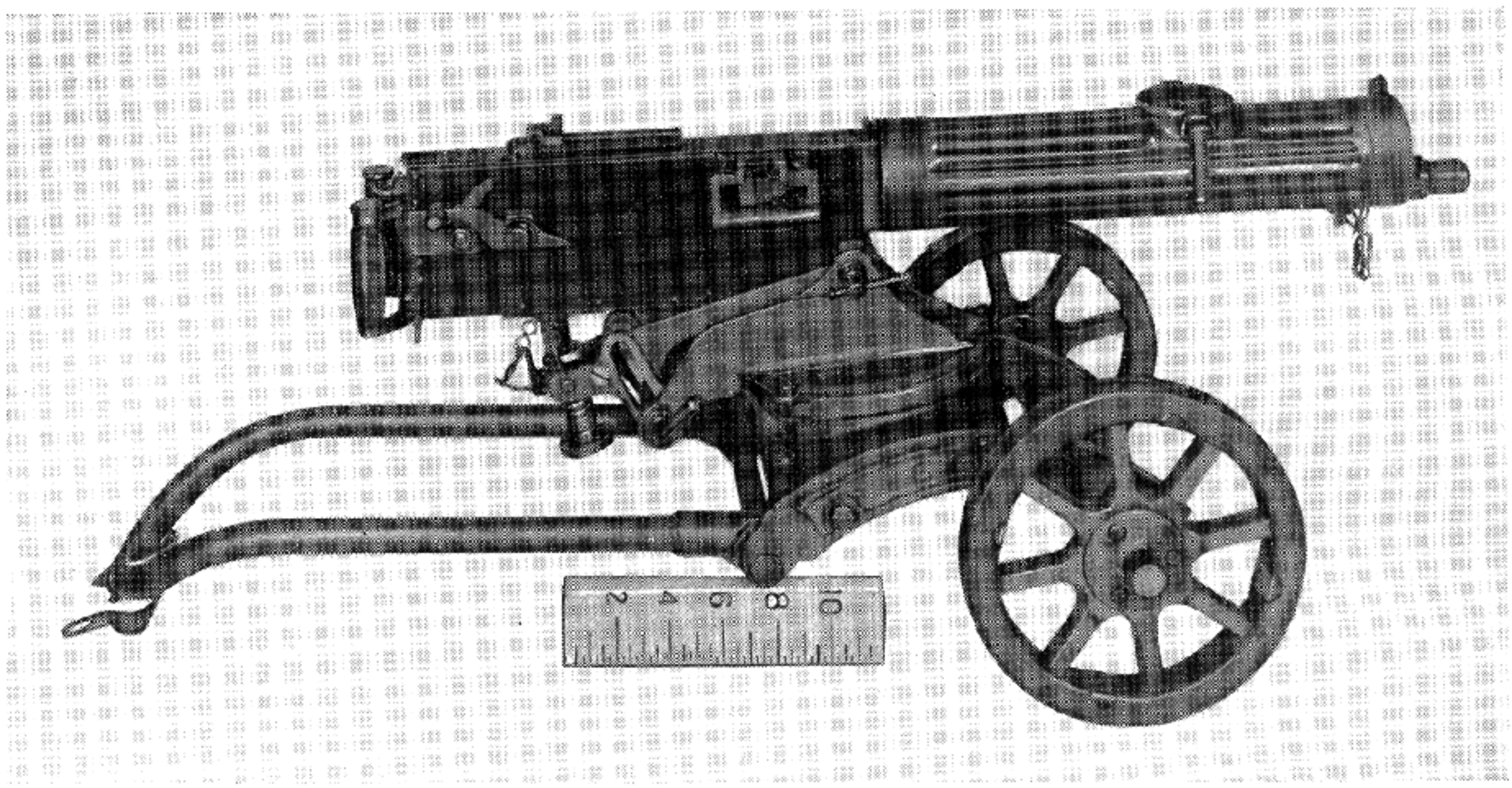


Figure 2–2. Russian 7.62-mm Maxim Machine Gun Model 1910 on Sokolov Mount. The gun is a late version.

the early days, not only in Russia but in England and Germany as well.

In a military publication dated 1912 there appears a mention of a new version, Model 1910, which differs from its predecessor in the substitution of lighter materials, thereby reducing the weight to 54 pounds with water jacket filled or 44 pounds dry. The favorite Soviet system of mounting for the Model 1910 is the Sokolof two-wheeled arrangement, which has also been used with very little deviation for over forty years.

The outstanding feature which appears in recent modifications of Model 1910 is the tractor-type radiator design used on the water jacket to expedite filling. This design was originated by the Finns and copied by the Russians. The steam and overflow pipe is very similar to the kind used on American heavy farm machinery.

During the decade preceding World War I, all the nations of Europe were interested in the advent of the light machine gun, or machine rifle. The influence of the Maxim gun was strong during this period. Most interest was concentrated on gas operated weapons of the fixed barrel type, but in Russia there was little activity in this direction. However, the reliable action of the Maxim gun which had been imported from England had been incorporated into the thinking of military men in Russia.

Soon after World War I, the Russians made a conversion from their ground Model 1910, making a fixed weapon adaptable for aircraft use. Its official designation was PV–1. This type differed from Model 1910 in that it had an improved type of booster that gave it a substantial increase in rate of fire. The barrel jacket was slotted to allow air cooling, and provision was made for the installation of a synchronizing gear. Infantry rifle cartridges were used; they were fed by means of a metallic

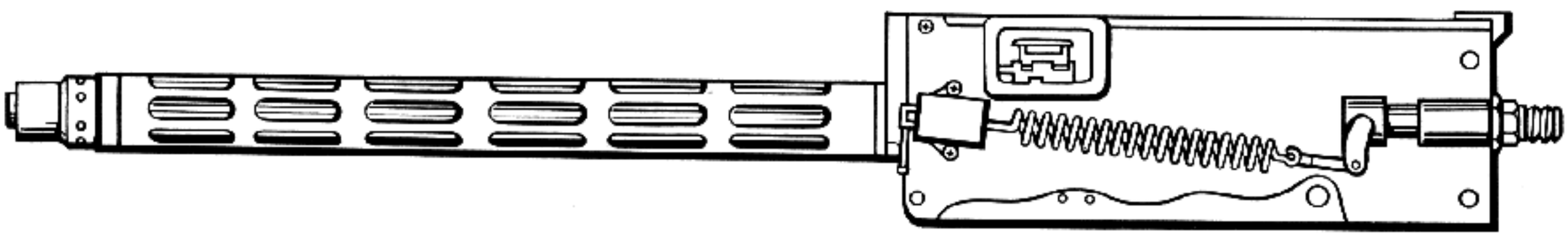


Figure 2–3. The 7.62-mm PV–1, an early Soviet aircraft machine gun, which features the Maxim action.

belt. The weight was considerably less than that of the water-cooled model; the finished product weighed only 31.7 pounds.

Shortly after the end of the war with Poland, an attempt was made to lighten the Maxim and produce it in an air-cooled version. The design of this particular weapon was under the direction of F. V. Tokarev, and it was designated M–T to indicate, Maxim-Tokarev. Tokarev was doubtless inspired by both the German Parabellum and the British Vickers. The arrangement of the trigger and the shoulder stock resembles very strongly that illustrated in United States Patent No. 942167, which was granted in 1909 to Dawson and Buckham, assignors to Vickers.

The M–T represents another refinement of the Maxim principle, the main difference from the Maxim being its method of mounting. It has two

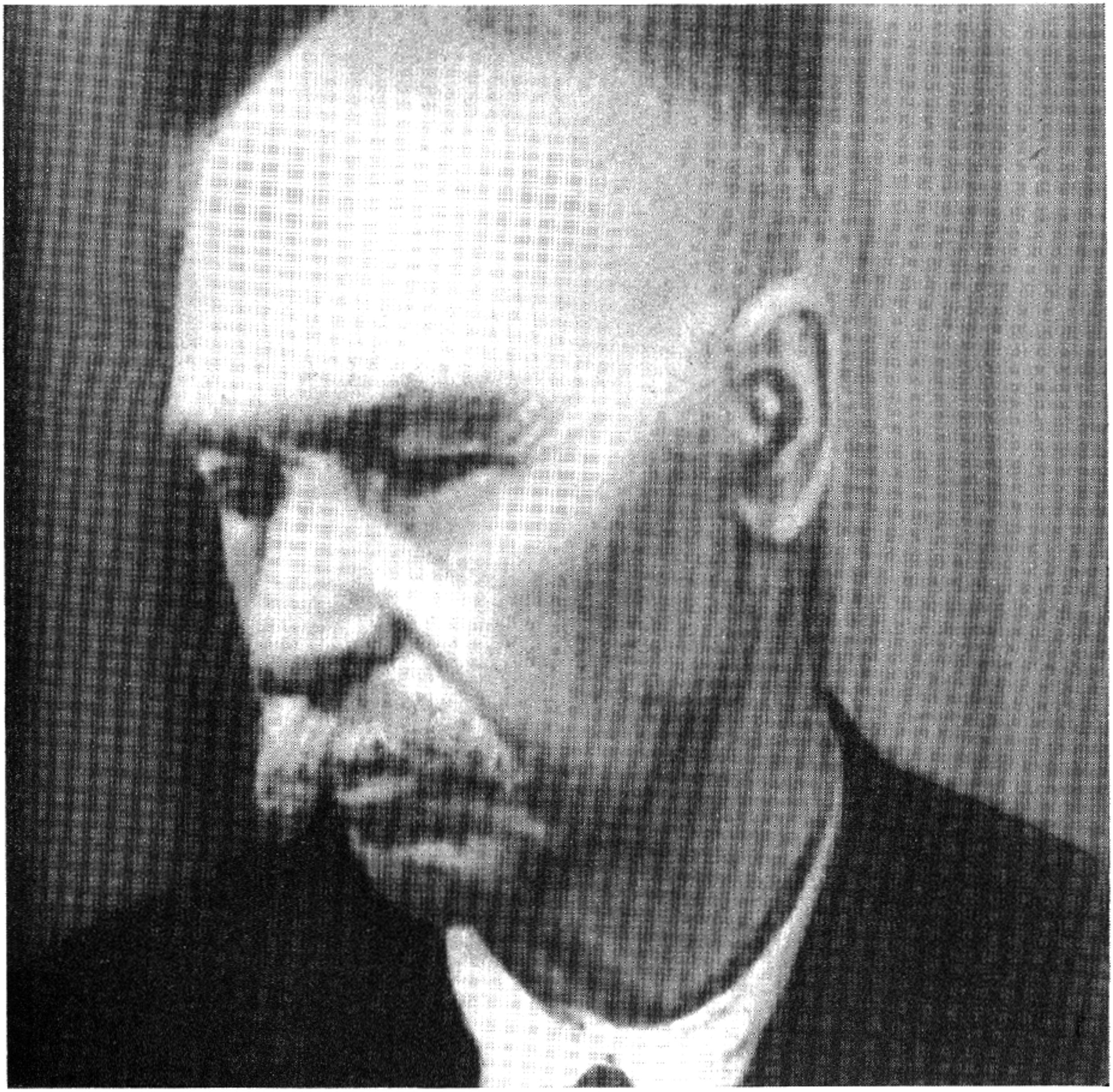


Figure 2 4. Fedor Vasil'vevich Tokarev, Soviet small arms designer and one-time officer in the Cossack Cavalry of the Czar.

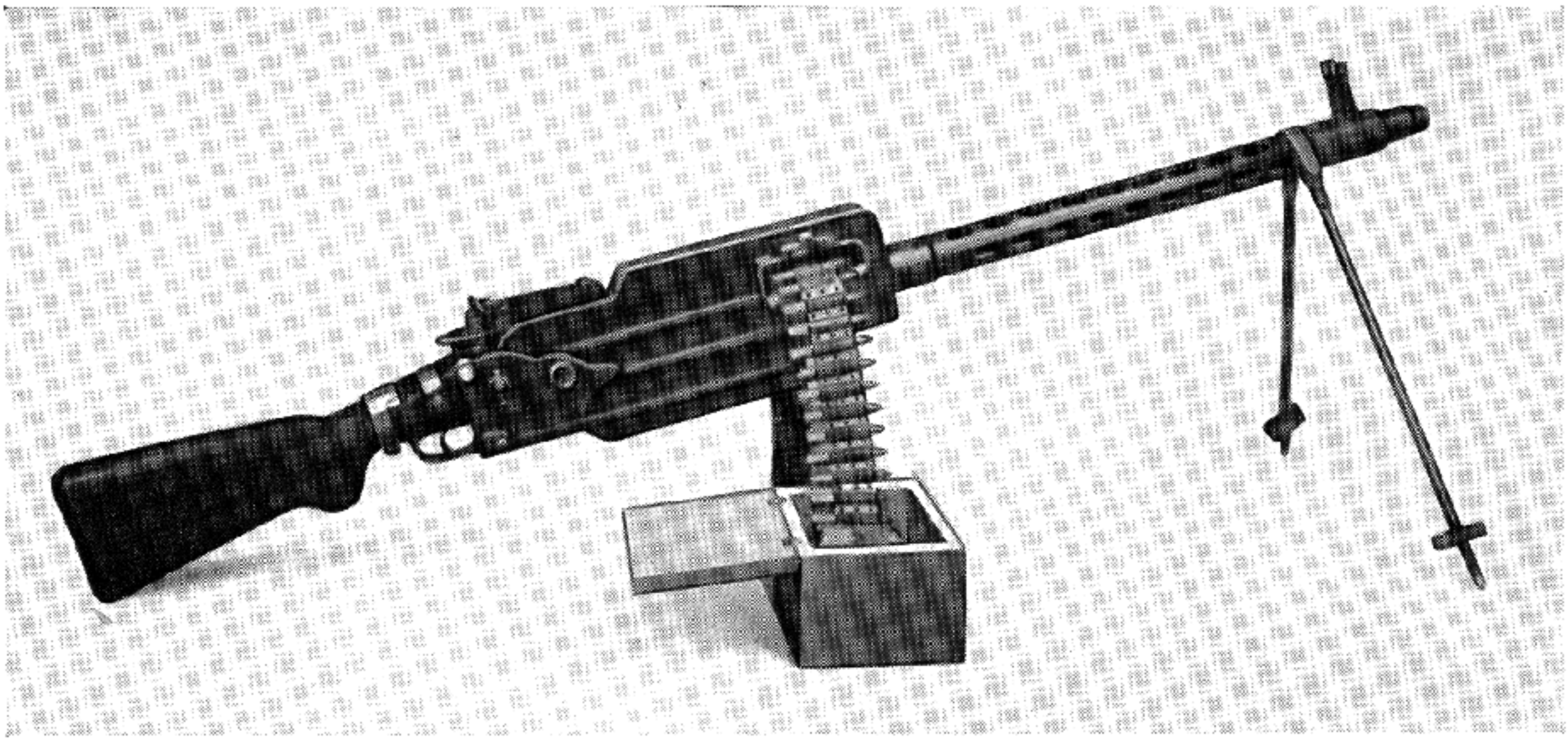


Figure 2 5. Maxim-Tokarev Machine Gun, 7.62-mm, as used in the Spanish Civil War.

metal legs in front and a wooden stock that fits against the operator's shoulder. This weapon was chambered for the standard 7.62-mm infantry rifle cartridge.

In 1928, a test of the M T was announced in the Russian press. Publicity was given to the event as part of a campaign to encourage native inventors and to promote production of automatic weapons.

A sufficient quantity of the M–T guns was made up for troop trial. The troops pointed out certain objectionable features, and when these were added to changes suggested by the factory engineers, it was discovered that the whole added up to a basic change in mechanism that had to be redesigned in its entirety. Thus, the principal advantage of the original design, the possibility of producing the action with machinery used for Model 1910, was lost. The Maxim-Tokarev appeared in battle for

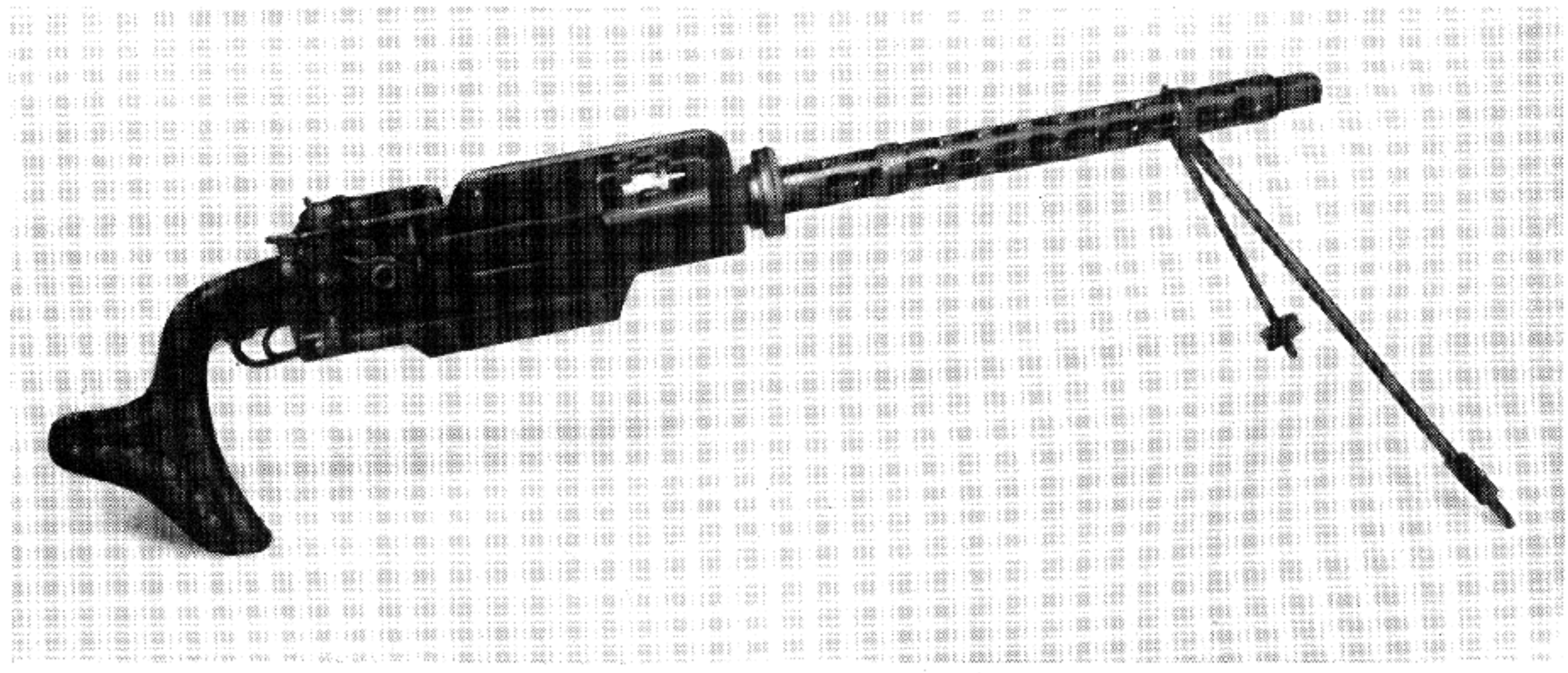


Figure 2–6. Maxim-Koleshnikov Machine Gun, 7.62-mm, as used in the Spanish Civil War.

the first time during the Spanish Civil War and later in the war between Finland and Russia.

In competition with the M T was another version of the Maxim. This gun was modified by Koleshnikov and therefore called the M–K (Maxim-Koleshnikov). It differs outwardly from the M–T in the shape of the stock, but otherwise there is little difference. Koleshnikov was not successful in securing adoption of this weapon, but enough were made for trial to allow its use in the Spanish Civil War.

A designer of the same name is credited with the development, some years later of a machine gun mount for a caliber 12.7-mm gun that was then being issued to the Russian Infantry.

There was still another Russian version of the Maxim, inspired by the German T. u. F. of World War I. The Soviets accomplished the design by simply scaling up the rifle-caliber weapon until it handled a 13-mm cartridge. It is sometimes known as the Esiunin machine gun from the name of the engineer who is credited with the design.

With Russia's defeat and the Czar's overthrow, the Bolsheviks were slow in getting the country's production potentialities under control and almost nothing was done in the development of machine guns, other than trying to modify a number of Maxims left over from imperialist days to use a 13-mm cartridge. This work was first attempted in 1926 at the principal government arms manufacturing arsenal (Tulski Oruzhenic) at Tula, where E. Esiunin was design engineer.

In an official test, the prototype had a rate of fire of 300 rounds per minute. At a distance of 120 yards, it would penetrate a thickness of 30-mm of armor plate. Only a few heavy machine guns so modified were actually made; in fact, records show that only eight were delivered and these were distributed among the instructional departments of the Moscow garrison's military educational establish-

Figure 2-7. The Maxim Model 1910 in World War II. Personnel are in Naval uniforms of this period.

ments. Subsequently, all work stopped on this heavy type Maxim, and production activity centered on the standard rifle caliber weapon.

Federov "Avtomat." One noteworthy departure from the Maxim design involved two names now well known in this field of endeavor. In the early nineteen hundreds, Captain of the Guards Vladimir Grigorevich Federov worked on a design for a fully automatic shoulder rifle. In the course of his work, at the Proving Ground at Orenienbaum, he met a young soldier who had been a machinist at the Tula factory, Vasiliy A. Degtyarev. The meeting was the beginning of a long association, which lasted until Degtyarev died.

In 1908, these two men were working at Sestorets Fire Arms Plant; at the same time, Cossack F. V. Tokarev was working there on another automatic rifle design. Other systems were under development by Roschepei, Schukinn, and Frolov.

In 1910 and 1911, trials were conducted on several automatic rifle systems. The Roschepei system showed considerable promise; however, in 1912 an order was given to produce 150 of the Federov design. Work proceeded slowly, and the outbreak of World War I stopped the program.

Between 1911 and 1914 Federov was working on a second model of his weapon; however, before conclusive tests were made, he was forced to drop this line of endeavor to go abroad on a mission to buy rifles in Japan and Europe. The Japanese rifles which were purchased probably had some influence on the selection of the Japanese cartridge for the second model of Federov's gun, which was produced in a small lot at the Sestorets Plant in 1916.

The "Avtomat" saw service in the Russian Civil War, but it was not a success. About 3,000 in all were produced, making it the first Russian designed automatic arm to be produced in any quantity.

SECTION 1. MAXIM TYPE MACHINE GUN

General Data on Maxim Model 1910

Caliber: 7.62-mm.
Rate of fire: 300–500 rounds/minute.
Muzzle velocity: 2,620 feet/seconds with heavy pointed ball (yellow tip bullet).
Gun length: 43.4 inches.
Gun weight: 39 pounds without mount and with water jacket empty; 145 pounds on mount with full jacket.
System of operation: Short recoil with muzzle booster assist.
System of locking: Toggle joint.
System of feeding: Belt, fabric.
Method of charging: Manual crank arrangement.
Method of cooling: Water.
Rate increaser: Muzzle booster over barrel end.
Barrel weight: 6 pounds 8 ounces.
Barrel length: 28.4 inches.
Barrel removal: This is not a quick change barrel.
Bore:
  Number of grooves: 4.
  Groove depth: 0.14–0.21 inch.
  Groove width: 0.375–0.390 inch.
Pitch: 5° 41′.
  Direction of twist: Right hand.
  Form of twist: Standard constant.
Method of headspace: Adjusting toggle locking nut.
Location of feed operation: Right side.
Location of ejection opening: Bottom of receiver.

Description of the Maxim Action

This gun derives its operating energy from short recoil with an assist from a muzzle booster. After recoiling ¾ inch, the bolt is unlocked; then the recoiling forces and remaining high residual pressure in the chamber accelerate the bolt assembly to the rear. The recoil movement causes a cam lever action that moves the entire feed block slide to the right. The feed pawls move over to engage the incoming round in the belt, which is being held in position by the bottom belt-holding pawl, and at the same time compress the barrel return spring.

Counter-recoil movement of the barrel and its extension returns the feed block slide to the left, indexing the incoming round into position against the cartridge stops for engagement by the sliding T-slot. The backward movement of the bolt assembly is stopped by tension applied by the fusee spring. Charging is accomplished manually with a crank arrangement located on the right side of the piece. Although the weapon is relatively simple in con-

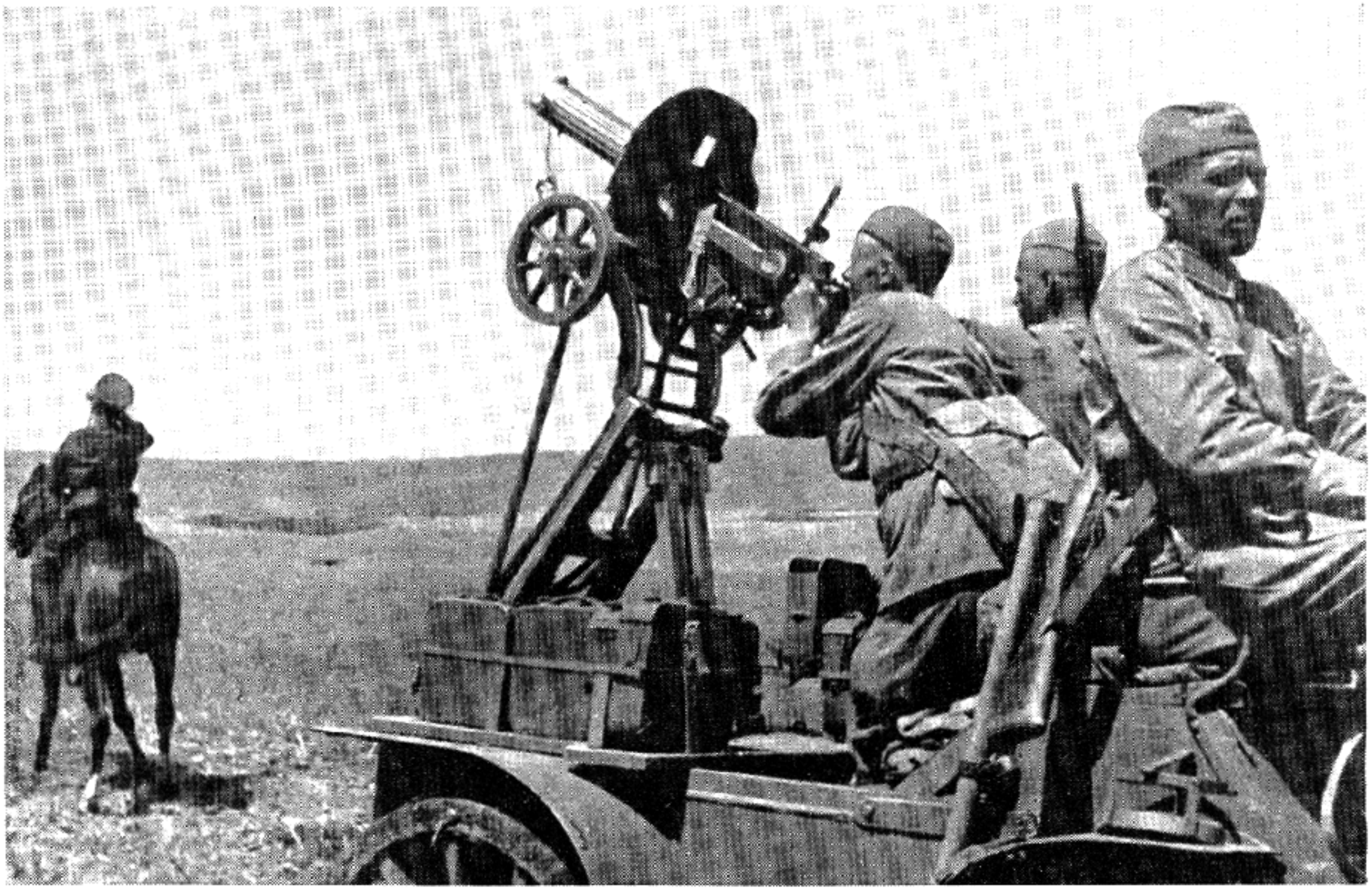


Figure 2–8. Soviet-Asiatic Troops in World War II with the Maxim Model 1910 on an AA Mount with horse-drawn transport.

struction, mass production has remained a difficult problem through the years it has been in use.

Cycle of Operation

To fire any of the Maxim type guns, the gunner inserts the loaded ammunition belt into the upper right side of the receiver to the position where the cartridge comes to rest on the stop. He then rotates the cocking handle all the way forward and releases it. He raises the safety catch, which permits the thumb piece to be pushed forward actuating the trigger bar and sear; then the firing pin is released. As the powder charge is ignited and pressure is built up to its peak, the barrel and bolt are securely locked. They remain locked as long as the bullet is in the bore.

After recoiling ¾ inch, the bolt is unlocked by the crank engaging the unlocking cam, freeing the bolt. The recoiling forces aided by residual pressure in the bore accelerate the bolt assembly to the rear and further rotate the crank. This motion winds the actuating chain, loading the extension type driving spring while the recoiling mechanism completes its rearward stroke.

At the first movement of recoil after unlocking, the sliding bolt face (T-slot) begins simultaneous extraction of the empty case from the chamber and withdrawal of the loaded round from the belt. Continued rearward movement engages cams in the receiver to force the sliding bolt face downward and bring the loaded round into alignment with the chamber and the empty case in position for ejection through the bottom of the receiver.

The cartridge to be chambered is held in place by a latch arrangement located in the face of the T-slot. During recoil, a cam lever action moves the entire feed block slide to the right. The top feed pawls move over to engage the incoming round in the belt, being held in position by the bottom belt-holding pawl, at the same time compressing the barrel return spring.

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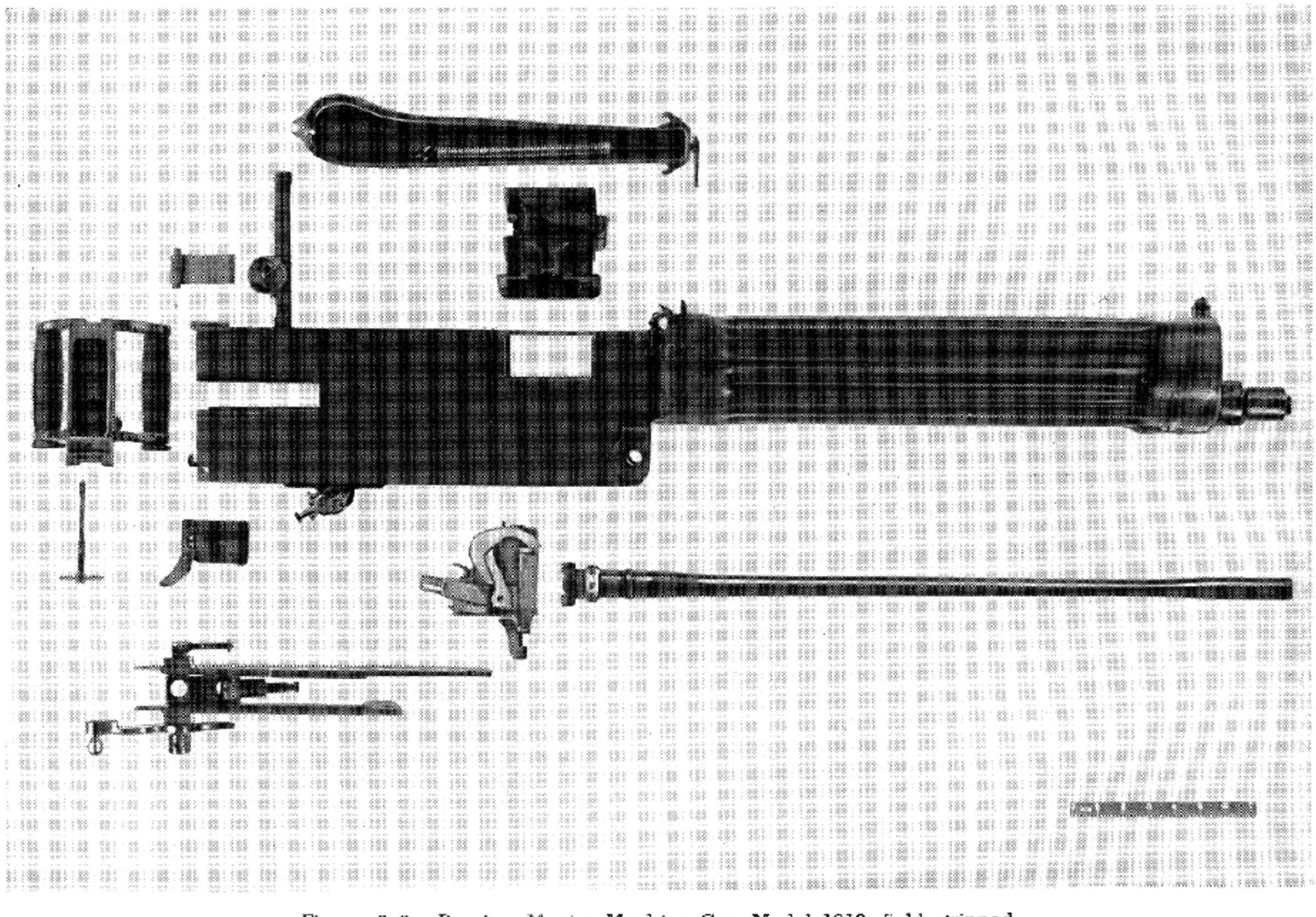

Figure 2-9. Russian Maxim Machine Gun Model 1910, field stripped.

After completion of the full recoil stroke, the forward action of the barrel and barrel extension returns the feed block slide to the left, indexing the next round in the ammunition belt against the cartridge stops for engagement by the sliding T-slot.

After the complete force of recoil has expended itself, the extended spring starts the movement of counter-recoil. As the bolt moves forward, the cartridge to be chambered is positioned. With this being accomplished, the T-slot rises and "wipes" itself clear of the spent case and continues upward to slip over the incoming round in the belt.

When the bolt has reached its extreme point in forward travel, the toggle joint is forced slightly below the horizontal by the connecting rod. At this securely locked position, the sear is depressed and disengaged from the firing pin, removing the safety feature, allowing continued pressure on the trigger piece to cause a continuation of automatic fire.

Disassembly by Groups

To Strip the Gun:

1. Take out joint pins, crosshead and elevating and remove the gun from its mounts.

2. Drive out fixed pin of joint pin cover, remove collar and joint pin, press cover lock forward, and take off cover.

3. Remove feed block and lock. Take off fusee spring and cover.

4. Drive out taper pin from rear cross-piece; take hold of the handle with the left hand and strike the top edges of the breech casing alternately with a wooden mallet. The rear cross-piece will then lift out. Drive out taper pin from check lever and remove collar and check lever. Unscrew and remove packing gland and packing. Remove slides right and left. With the handle of the crank upward, draw out the barrel.

5. Remove the trigger spring and lift out the trigger bar. Place the barrel casing on a bench,

Figure 2–10. Soviet horse-drawn machine gun unit in World War II, equipped with the Maxim Model 1910 Gun.

support the breech casing with the left hand immediately in front of the elevating bracket; then strike the top edges of the breech casing alternately with a wooden mallet, near the barrel casing, taking care not to strike the metal. The breech casing will then come away.

Assembly by Groups

To assemble the gun, reverse the foregoing procedure.

Detailed Disassembly and Assembly

To Strip the Feed Block. Drive out spring fixing pin. Drive out bottom lever, and remove top lever and slide. Unscrew and remove fixing screws of feed block springs and remove the latter. Drive out axis pins of bottom pawls, and remove pawls. Drive out taper pin from roller axis pin and remove collar pin. Remove stop screw. Remove top pawls from slide by pressing them outwards.

NOTE. The slide springs are riveted to the slide.

To Assemble the Feed Block. Reverse the procedures for stripping the feed block.

To strip the Lock. See that the lock spring is released. Remove the keeper pin of lock-spring pin and drive out the latter. Remove keeper bracket, extractor levers, and lock spring. Remove keeper pin of trigger pin and drive out the latter to remove trigger. Drive out tumbler pin; remove tumbler. Drive out sear pin; remove sear and firing pin. Remove keeper pin of extractor stop pin and drive out this piece. Remove extractor stop, extractor, and gib spring cover. Take out gib spring and gib. The extractor pin is riveted to the extractor.

NOTE. Keeper pins may be removed by straightening and drawing out with pliers.

To Mount the Lock. Reverse the procedures for stripping the lock.

NOTE. When the tumbler pin is in its place, clinch it with a few blows of a small hammer and clean it off if necessary with a file.

SECTION 2. FEDEROV AVTOMAT

General Data

Caliber: 6.5-mm.
Rate of fire: 350-400 rounds/minute.
Muzzle velocity: 2,145 feet/second.
Gun length, without bayonet: 39 inches.
Weight:
  Gun without bayonet: 9.7 pounds.
  Magazine, empty: 0.88 pounds.
  Magazine, loaded: 1.76 pounds.
System of operation: Short recoil.
System of locking: Pivot lock.
System of feeding: Box magazine, capacity 25 rounds.
Method or charging: Manual.

Description of the Weapon

The Federov "Avtomat" is an intermediate weapon of a more powerful type than the submachine gun but not equalling the firepower of the light machine gun. Although it fires the old Japanese infantry cartridge it is handicapped by the lightness of its barrel, which overheats rapidly in automatic fire. The best known version is the Model 1916, which was reported in use in the Spanish Civil War. The use of the term "Avtomat" to describe this class of weapon is somewhat similar to the British usage of "automatic" to describe the weapons known in the United States as machine rifles and light machine guns but the terms are not interchangeable.

The gun is operated by short recoil, and locking is accomplished by a pair of pivot locks on the rear of the barrel. The design is very complicated and shows traces of influence of the Mauser pistol, which was sold commercially in Russia long before World War I. A detachable box magazine is used, the capacity of which is 25 rounds, and the cartridges are staggered. A holding-open device is provided to facilitate reloading through the receiver without removing the magazine. The firing mechanism is of the hammer type. The trigger arrangement allows single shots or full-automatic fire at will, by setting the change lever.

Cycle of Operation

When a shot is fired, barrel and bolt recoil together a short distance. During this motion, the barrel spring is compressed. The locks are then cammed down and the bolt is free from the barrel. At this time a projection on the accelerator strikes a bridge in the receiver and, pivoting on its axis, imparts a greater velocity to the bolt, thus separating it from the barrel. Then the rearward movement of the barrel is stopped by a projection in the receiver, and it is held rearward by the barrel stop. Meantime the hammer has been cocked, and extraction and ejection have taken place.

Under action of the return spring, the bolt moves forward, striking the accelerator and turning it. This disengages the barrel stop from its coupling in the receiver. Barrel and bolt now move forward, and locking takes place when the pivots are cammed up by the projections in the receiver. The weapon is now ready to fire again.

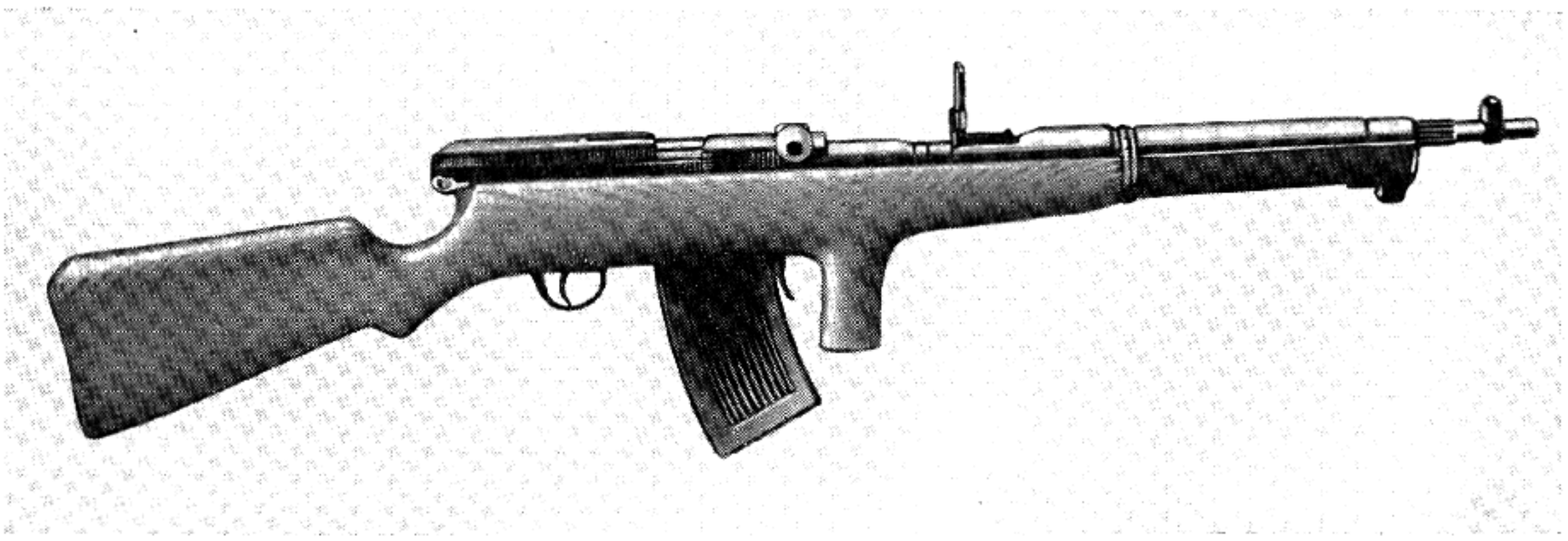

Figure 2-11. The Federov "Avtomat".

Chapter 3

DEGTYAREV AND GORYUNOV MACHINE GUNS

Weapons Included in This Chapter

Degtyarev Machine Guns

Design	Applicable symbol	Bore diameter	Use
Degtyarev Infantry.	DP	7.62-mm	Ground.
Degtyarev Aircraft..	DA	7.62-mm	Aircraft.
Degtyarev Tank....	DT	7.62-mm	Tank.
Degtyarev Infantry Modified.	DPM	7.62-mm	Ground.
Degtyarev Tank Modified.	DTM	7.62-mm	Tank.
Degtyarev 1946 Infantry.	"Company"	7.62-mm	Ground.
Degtyarev Medium.	DS	7.62-mm	Ground.
Degtyarev Heavy...	DK	12.7-mm	AA.
Degtyarev-Shpagin Heavy.	DShK	12.7-mm	AA.

Goryunov Machine Gun

Design	Applicable symbol	Bore diameter	Use
Stankovaya Goryunov 1943.	SG–43	7.62-mm	Ground.

History and Background

In the early nineteen twenties, Vasiliy Alexeyevich Degtyarev, the noted small arms inventor, began to coordinate the design of a machine gun intended for various uses and designated to identify the designer (D) and the use (P, A, T, etc.). The symbols used on Soviet machine guns and aircraft cannon are explained in chapter 10. An illustration of markings on a Degtyarev DTM infantry machine gun appears on page 44. The DShK combined the design talent of both Degtyarev and Shpagin. Obituaries of both designers have appeared in official Soviet newspapers, indicating that they died in good favor.

Degtyarev worked for four years on the first model of the DP (Degtyarev Infantry) before it was tested in 1926. The DA (Degtyarev Aircraft) appeared in 1928. The DT (Degtyarev Tank) made its initial appearance in 1929.

By 1933, the DP was being produced in quantity. The three models just mentioned were originally manufactured at Tula Arsenal. Later, production of the DA was supplemented elsewhere.

The early version of the DP was known outside the U. S. S. R. by the early thirties. It saw service in the Spanish Civil War, where it proved the Russians had one of the most reliable and simply constructed light machine guns known at that time.

The DK (Degtyarev Heavy) appeared about 1934 and was a predecessor of the DShK, which ap-

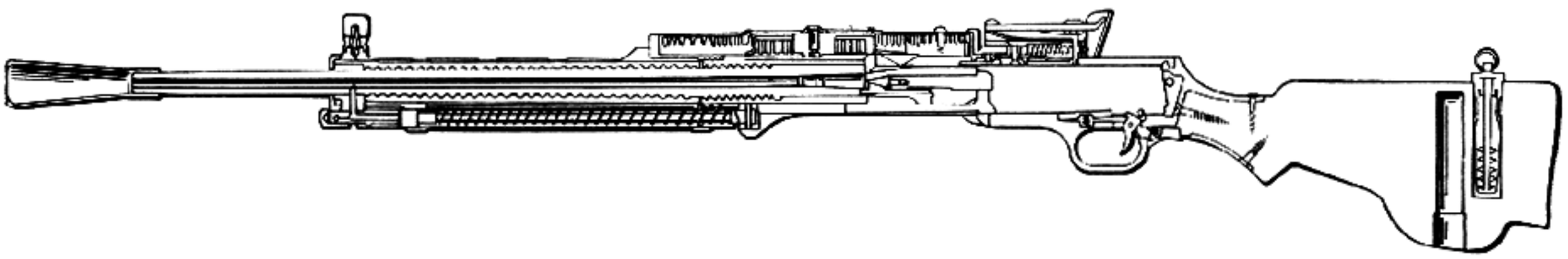

Figure 3–1. Degtyarev 7.62-mm Light Machine Gun Model DP, sectional view.

Figure 3–2. Degtyarev Tank Machine Gun in antiaircraft firing position.

Figure 3-3. Hero of Socialist Labor, Vasiliy Alexeyevich Degtyarev (deceased), one-time Major-General of the Artillery Engineering Service.

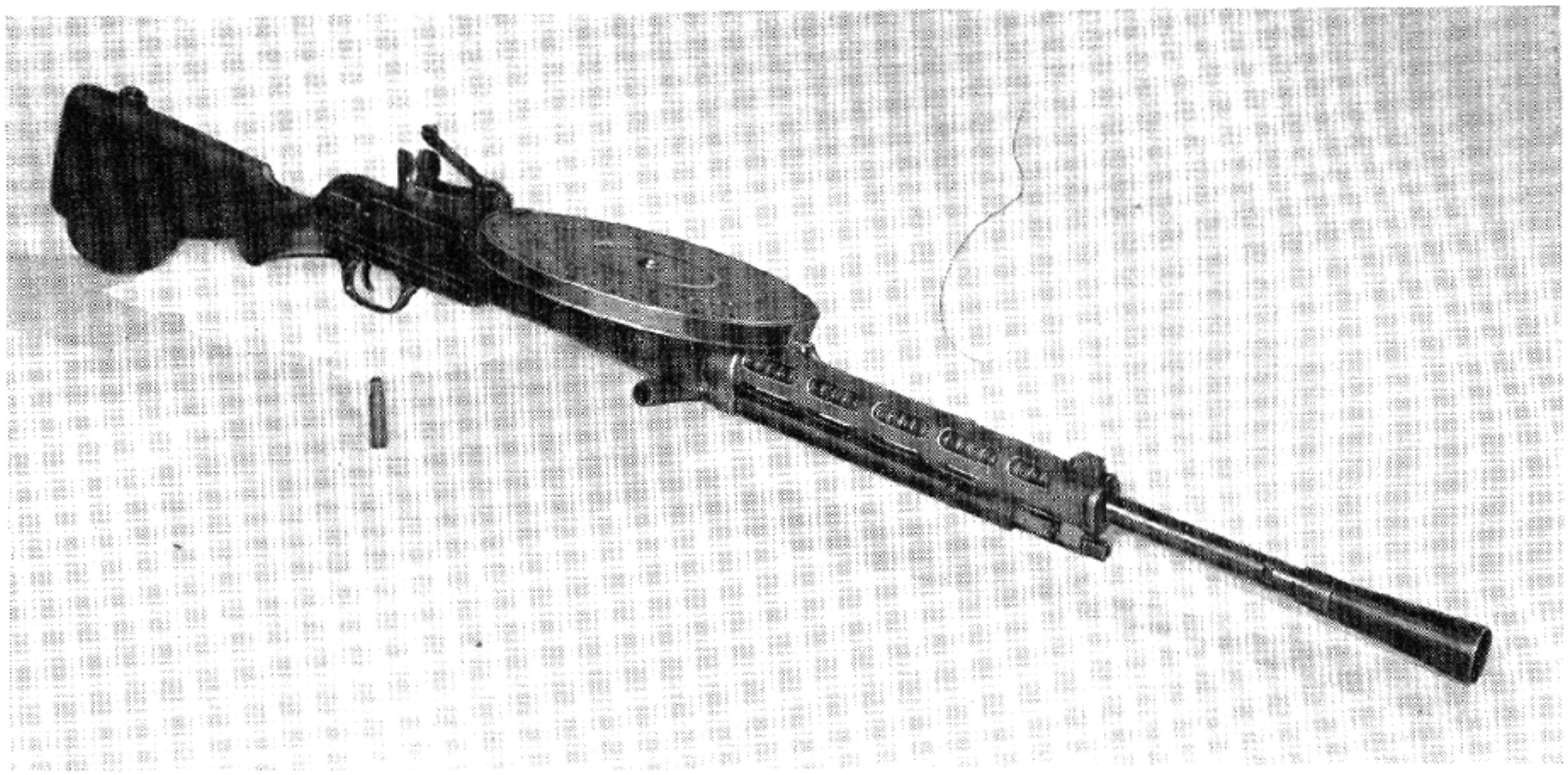

Figure 3-4. The 7.62-mm Soviet Light Machine Gun commonly called the DP, which identifies it in the Russian Service as "Degtyarev Infantry."

peared in 1938. The DK had very limited use.

The DS (Degtyarev Medium) was the white hope of the Soviets in their campaign to replace the Maxim Model 1910. This Maxim model had been in use and under manufacture in Russia for over four decades. Many designs reputed to be superior to the Maxim were on the drafting boards. Of these possibilities, the DS was chosen for careful development and production. However, features of the DS including its "deluxe" exterior finish made it too difficult to manufacture. True to their temperament, the Soviets began to ignore the DS in their literature. Few specimens have been found.

The DTM (Degtyarev Tank Modified) is a modification of the DT. It appeared at the close of World War II.

The "Company" (Degtyarev 1946 Infantry) is the latest model used by the infantry.

SG–43. The Soviet's need for a new machine gun to replace the Maxim is well known. After the DS (Degtyarev Medium) was abandoned, attention was centered on a weapon with an entirely different appearance. Its first official designation was Stankovaya Goryunov 1943; this was soon abbreviated to SG–43.

This automatic firing mechanism was engineered by the gifted designer Peter Maximovitch Goryunov. The designer barely lived to see the results of his labors; he died at the age of 41, within a few months after his gun had been officially accepted by the military authorities in charge of procurement of automatic arms. His brother M. M. Goryunov and an engineer named Voronkov, who assisted him on the original model, were given official orders to carry on development work for the purpose of improving the existing model.

SECTION 1. DEGTYAREV MACHINE GUNS

General Data

The following models have characteristics which are the same or similar to the DP except as noted in footnotes to the following table.

DA (Degtyarev Aircraft).
DT (Degtyarev Tank).
DPM (Degtyarev Infantry Modified).
DTM (Degtyarev Tank Modified).
"Company" (Degtyarev 1946 Infantry).

Figure 3-5. Hero of Socialist Labor George S. Shpagin (deceased), co-designer with Degtarev of the DShK.

Table of Characteristics of DP (Degtyarev Infantry) Production Version

Caliber: 7.62-mm.
Rate of fire:
  Cyclic: 500–600 rounds/minute.
  Effective: 80 rounds/minute.[1]
Muzzle velocity: 2,770 feet/second.
Effective range: 880 yards.
Gun length: 50.5 inches with flash hider.[2]
Gun weight:
  With bipod: 20 pounds.
  Without bipod: 15 pounds.
System of operation: Gas operated.
System of locking: Swinging locks.
System of feeding: Flat spring loaded drum holding 47 rounds.[3]
Method of charging: Manual.
Method of cooling: Air.
Barrel weight: 4¾ pounds.
Barrel length: 23⅞ inches.
Barrel removal: Quick change.
Chamber pressure: 44,000 p. s. i.
Bore:
  Number of grooves: 4.
  Groove depth: 0.015 inch.
  Direction of twist: Right hand.
  Form of twist: Standard.
Method of headspace: Key that locks barrel gives minimum clearance when securely in place.
Location of feed opening: Top of receiver.
Location of ejection opening: Bottom of receiver.
Type of safety: Grip safety.[4]

Figure 3–6. The 7.62-mm DS in action. A Soviet propaganda photo of World War II: actually, an insignificant number of this model were made.

NOTE 1. The tank versions are claimed to have an effective rate of fire of 125 rd/min. The "Company" 1946 model is claimed to have an effective rate of 80 rd/min with disk magazine and an effective rate of 250 rd/min with the belt feed.

NOTE 2. Gun with adjustable stock is 39.8 inches long without flash hider when the stock is retracted.

NOTE 3. The tank versions have a 60-round disk magazine. The "Company" 1946 model can use the 47-round disk magazine or 50-round link belts. Belts may be linked together for greater periods of sustained firing. The "Company" may be belt-fed also. See Note 1.

NOTE 4. All other models have safety lever.

General Data on DS (Degtyarev Medium)

Caliber: 7.62-mm.
Cyclic rate of fire:
  Normal: 500–600 rounds/minute.
  Fast: 1,000–1,200 rounds/minute.
Type of fire: Full automatic only.
Muzzle velocity: 2,650 feet/second.
Chamber pressure: 44,000 psi.
Gun length, overall: 46 inches.
Gun weight:
  Gun only: 26.4 pounds.
  With tripod and shield: 72 pounds.
System of operation: Gas.
System of locking: Swinging locks.
System of feeding: 250-round canvas belt or 50-round metallic link belt.
Method of charging: Manual.
Method of cooling: Air.
Rate control: Buffer adjustment.
Barrel length: 28.4 inches.
Barrel removal: Not quick change.

General Data on DK (Degtyarev Heavy) and DShK (Degtyarev-Shpagin Heavy)

Caliber: 12.7-mm.
Rate of fire:
  Cyclic: 550–600 rounds/minute.
  Usable: 125 rounds/minute.
Muzzle velocity: 2,763 feet/second.
Gun length: 62.3 inches.
Gun weight: 73.48 pounds.
System of operation: Gas.
System of locking: Swinging locks.
System of feeding: Metallic link belt.
Weight of 50 rounds in belt: 19.8 pounds.
Method of charging: Manual.
Method of cooling: Air.
Chamber pressure: 52,000 psi.
Barrel length: 39.37 inches.
Barrel removal: Not quick change.
Location of feed opening: Top.
Location of ejection opening: Bottom.
Maximum effective range: 3,792 yards.

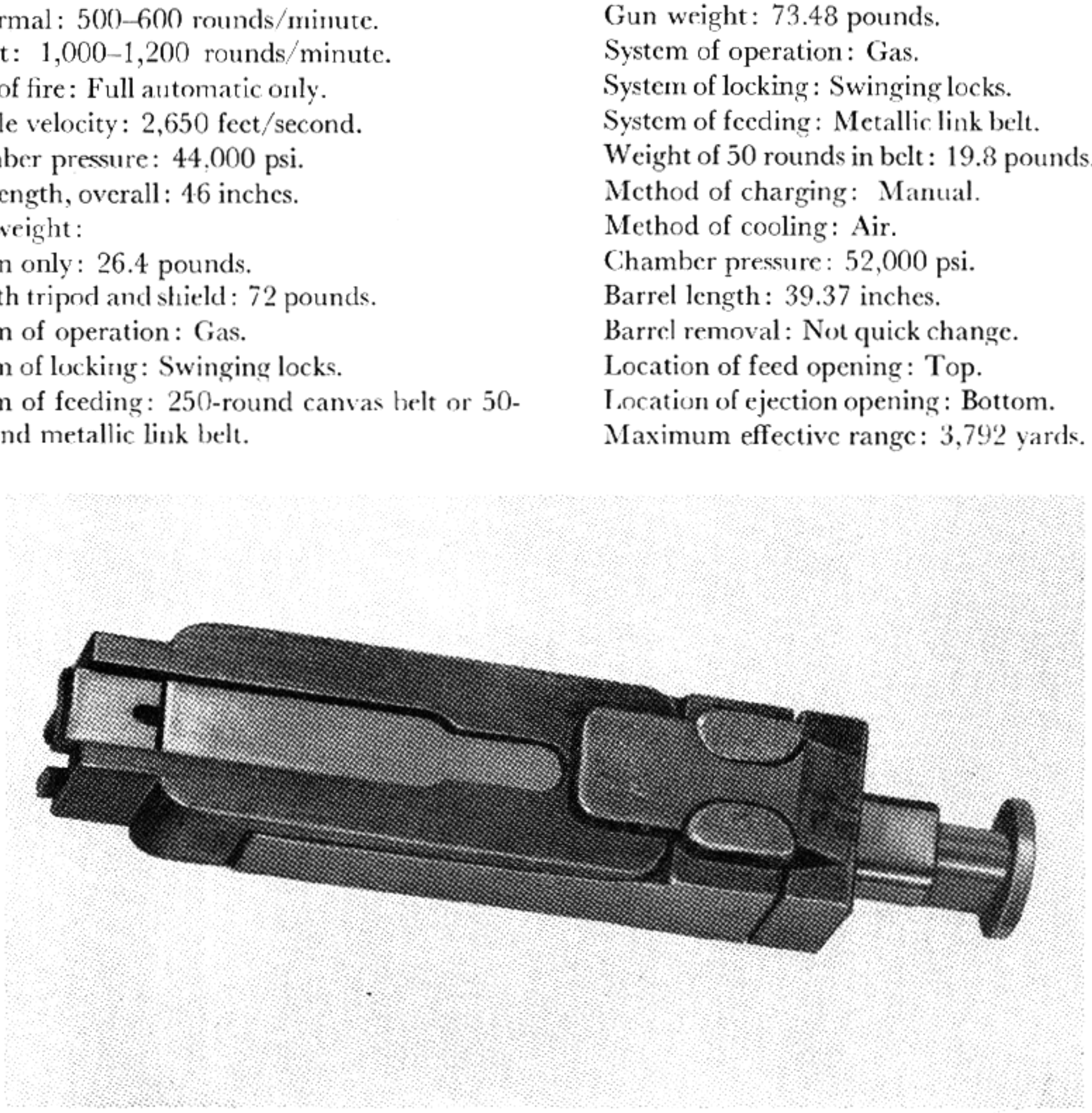

Figure 3 7. Symmetrical locks, pivoting in the bolt body: this method is employed in all Degtylarev-designed machine guns.

Description of the Weapon

DP (Degtyarev Infantry). This is a light machine gun and is the basic type in the group of machine guns designed by Degtyarev. The other models are variations or improvements of the basic design.

This gun is notorious for its unfinished appearance; the production pattern, involving a preponderance of semiskilled labor, did not allow for refinement of manufacture.

The locking system is composed of two swinging pieces that securely hold barrel, receiver, and bolt together while the bullet is in the bore. The system of locking is an adaptation of one of Paul Mauser's early actions, which he used on an experimental semiautomatic rifle, and it is also very similar to the Swedish Kjellman-Friberg locking system, used on the machine gun of that name. However, Degtyarev reversed the principle; instead of the firing pin advancing and thrusting the locking levers out at the front of the bolt, it cams the base of two small swinging locks out to butt against the locking plates when pressure is brought to bear on the face of the bolt. Where Mauser and Friberg employed recoil to unlock, Degtyarev used gas pressure to drive the piston rearward together with the firing pin, which held the two wing-shaped locks into engagement. After the firing pin has been withdrawn the angles on the faces of the breech locks and their locking seats are such that the locks cam themselves out of contact and recoil with the bolt while holding the firing pin to the rear.

The drum feed is very similar in construction and operation to the one used on the Vickers-Berthier aircraft machine gun, differing from the Lewis-type drum in that the inner part of the drum rotates while the outer part remains stationary.

There is a marking on the pancake-style drum to indicate that it holds 47 instead of 49 cartridges. This was done because field use proved performance more reliable when the lesser number of rounds were loaded.

On all guns after the prototype, a cone-shaped flash hider was incorporated in the design. The use of the flash hider necessitated threading the barrel to receive it.

On some guns, the cooling ridges on the barrel were omitted to facilitate production. Both types of barrels may be encountered.

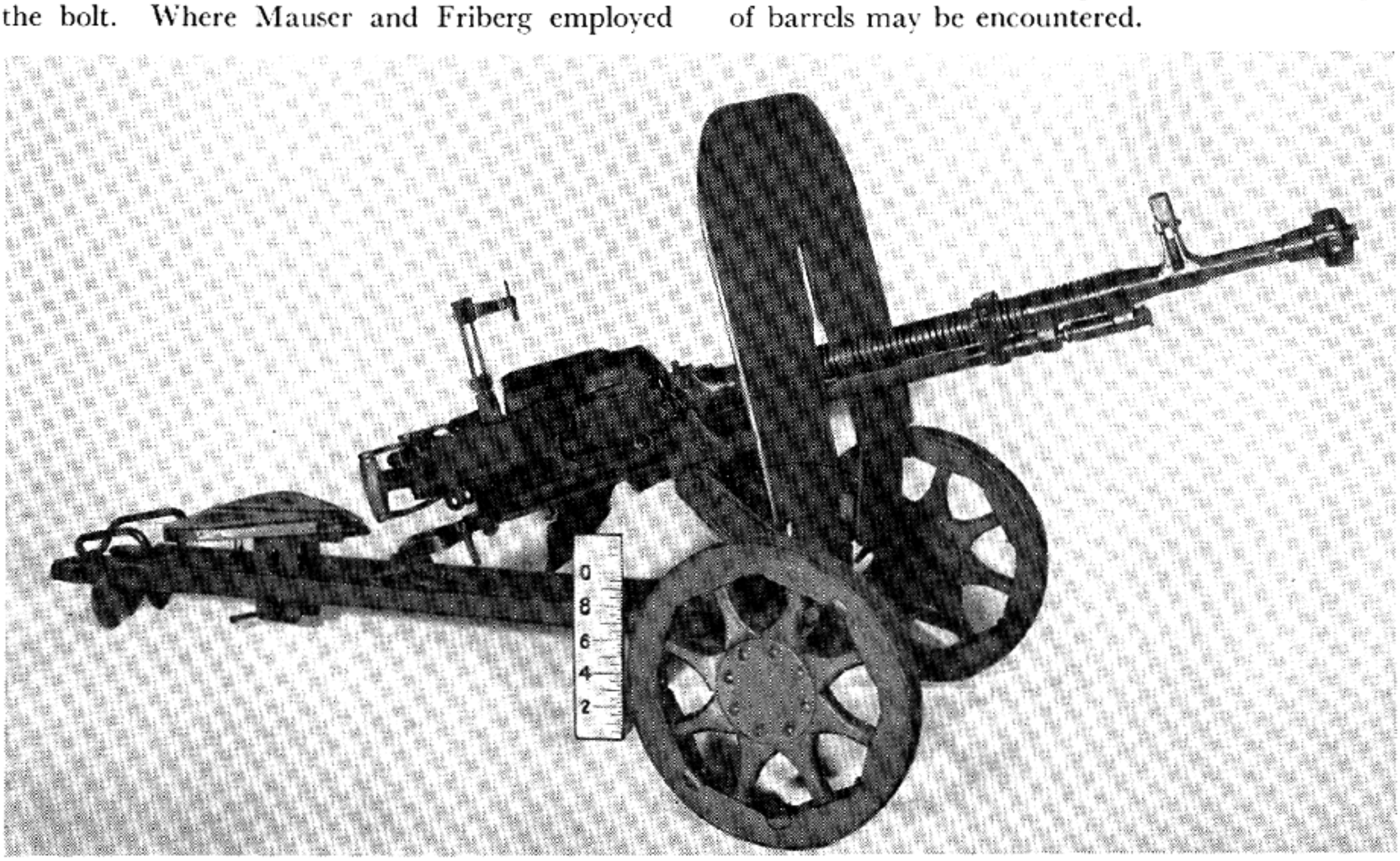

Figure 3–8. The 12.7-mm Heavy Degtyarev Machine Gun which was standardized in 1938 as the DShK. The specimen shown was manufactured in 1945.

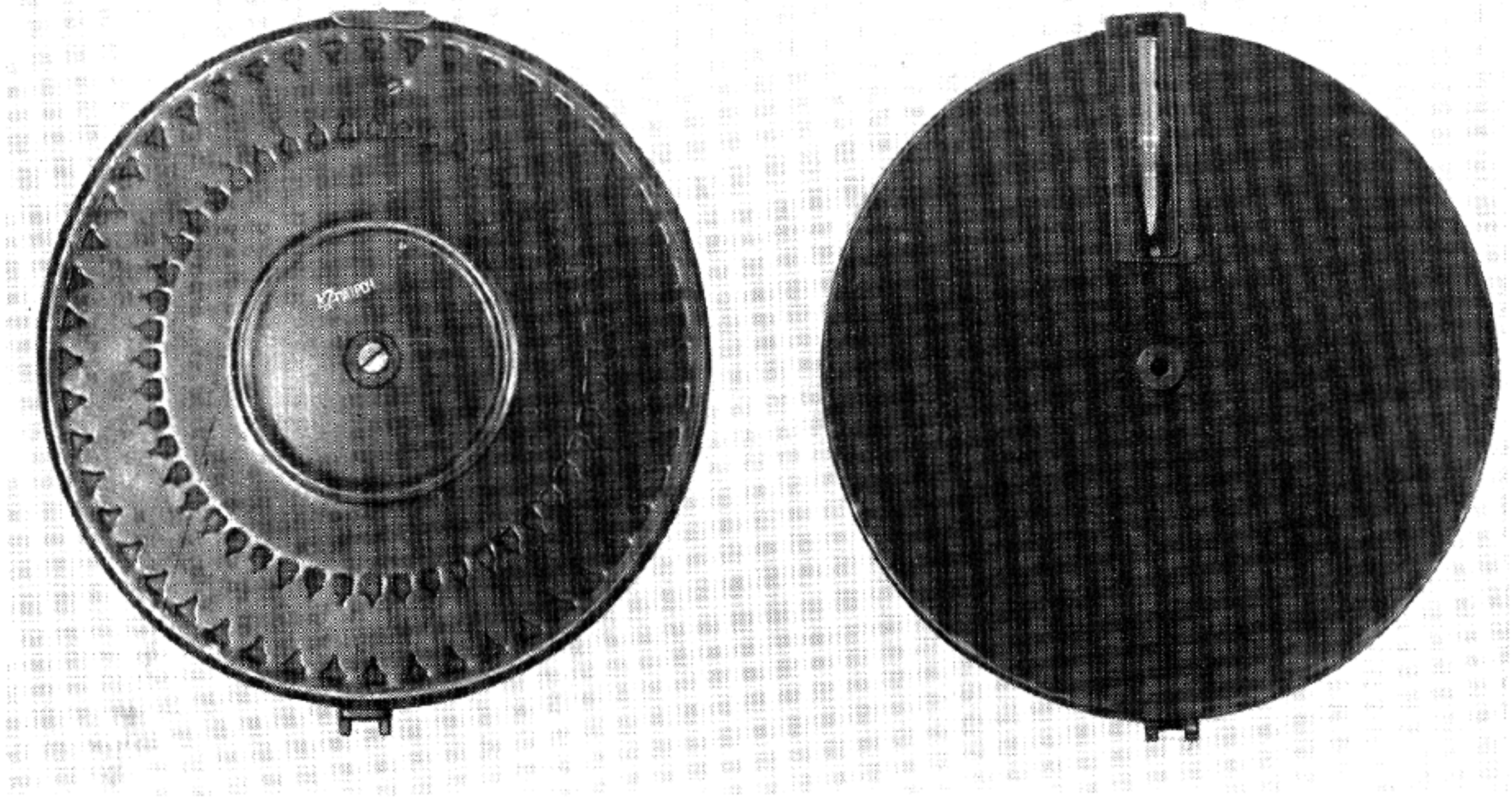

Figure 3–9. The drum magazine used with the DP gun. The marking specifies 47 rounds as the drum capacity.

The original version of the DP was chambered for the Russian infantry 7.62-mm rifle cartridge and weighed 15 pounds without bipod or the 49-shot flat drum-type magazine. It was gas operated and air cooled, with a non-recoiling barrel. The principal parts were the receiver, barrel, gas cylinder and piston, bolt and lock, firing pin, and driving spring.

The magazine feed of this original DP model caused considerable difficulty and changes were made in the second version to correct this weakness.

The original version of the DP did not provide for quick barrel change. After 400 to 500 shots had been fired in rapid succession, the barrel became so hot that aiming at the target was impossible because of heat waves. Restrictions were drawn up for limiting burst firing to a small number of rounds until the weapon could be modified. The improved version has a quick-change barrel. The number of parts was slightly reduced.

Barrel change is accomplished on this model by the following steps: After unscrewing the flash hider and the gas cylinder nut, the cylinder was then slid to the rear of the gas cylinder body. The two securing pins were drifted out and the barrel with its interrupted threads was then separated from the receiver by use of a tool on the rear of the flash hider. While this method was more complicated than that employed on most other machine guns of similar design, it could be done in a short time by the average operator.

In the original model, the return spring for the recoiling parts was housed in the cylinder under the barrel; this caused the spring to heat. This condition was corrected in the production version of the DP by means of ventilation slots in the barrel jacket, which permitted better circulation of air. A gas regulator on both versions gave ten shots a second at the maximum opening.

A novel squeeze type of safety was located at the rear of the trigger guard and was so designed that when the operator places his hand around the upper part of the shoulder stock, it depresses the safety.

The DP served the Soviets well during World War II, and since the end of the war it has made an ideal weapon for arming the satellite forces. Because of the difficulty of reloading the magazine, particularly in cold weather, a loading device officially called the PSM has been added. The PSM allows the soldier to refill the magazines from any position: sitting, standing, or lying down.

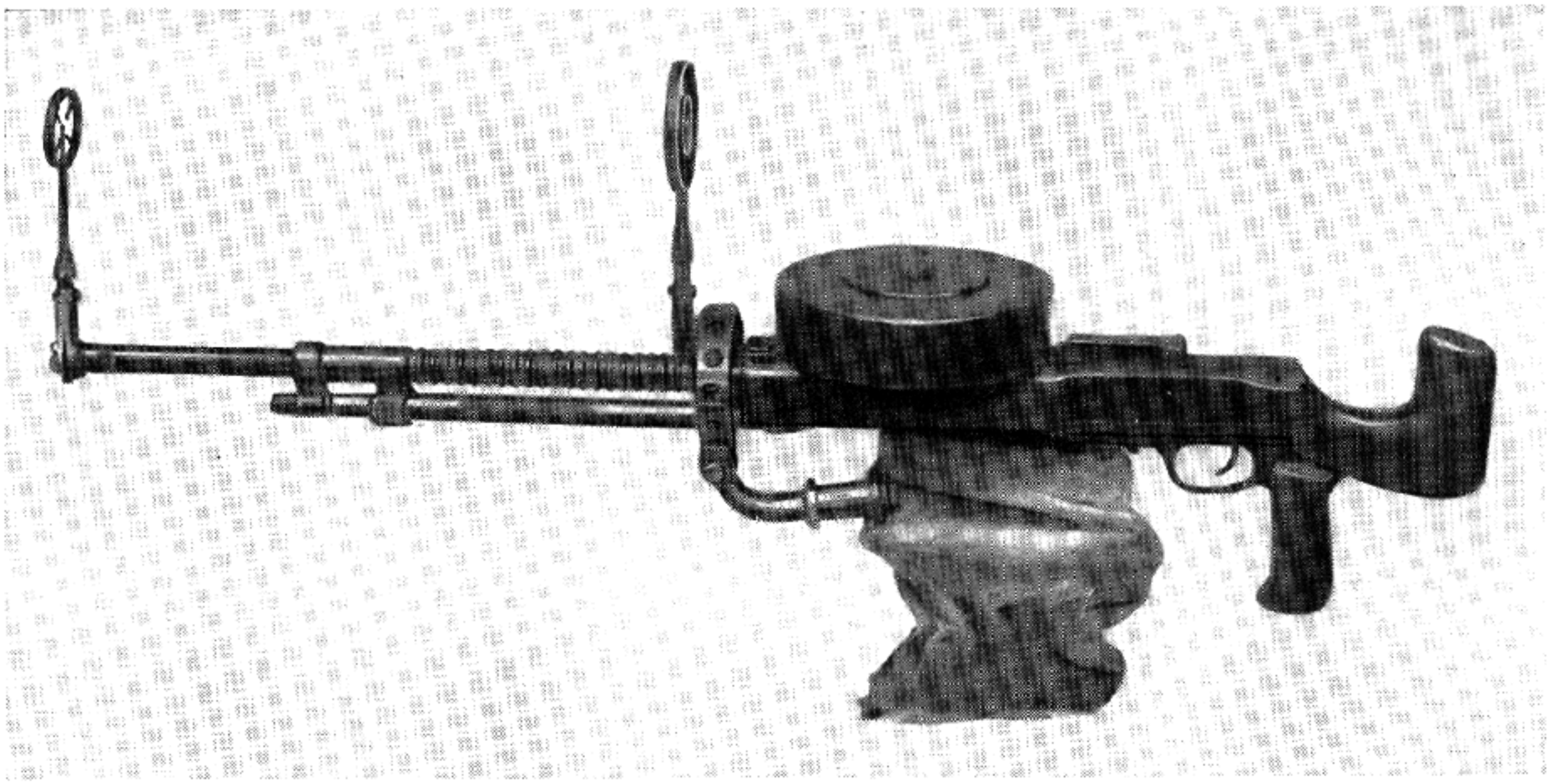

Figure 3–10. Degtyarev 7.62-mm Aircraft Machine Gun DA. Although obsolete for aircraft use, these guns are now employed by Russia's satellites in less important roles such as fixed antiaircraft defense.

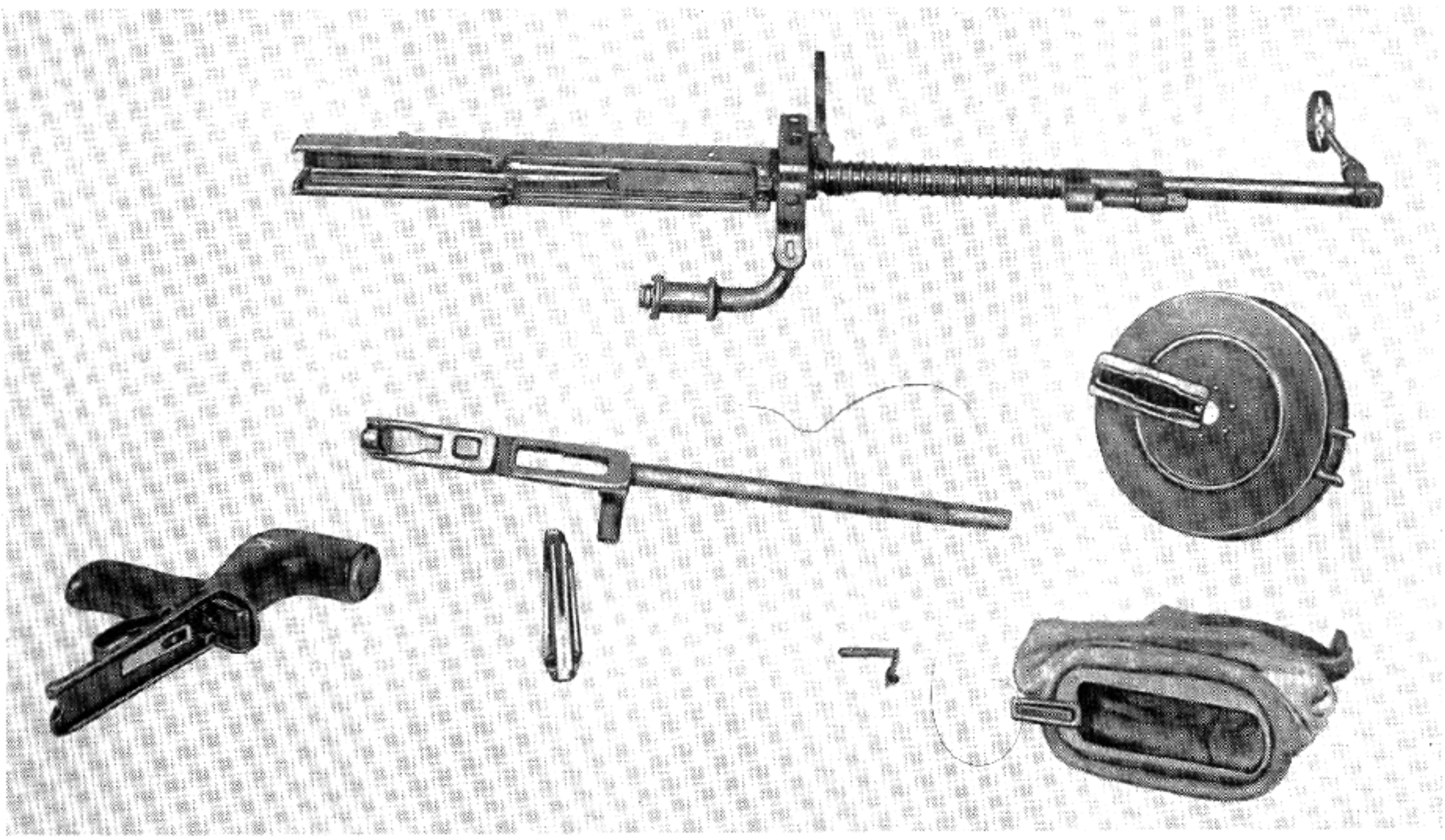

Figure 3–11. Degtyarev 7.62-mm Aircraft Machine Gun DA, field stripped.

While the construction of the weapon is very simple, it is believed by many that its exaggerated simplicity impairs to a great degree its function in the field. One of the most serious deficiencies is the existence of large flat bearing surfaces in the mating operating parts, which could interfere with both aim and cycle of operation.

The most prevalent malfunction to take place during combat has been listed by the Russians as insufficient recoil, due to the following reasons: (*a*) penetration of dirt into the mechanism, (*b*) too-thick lubricant on the mechanism, especially in winter, (*c*) choking of the gas port regulator by carbon or dirt, and (*d*) escape of gas between the gas regulator and the piston, brought about by a defect in the manufacture of these pieces.

On the counter-recoil stroke, the most common stoppages have been listed as (*a*) dirt getting into the action, and (*b*) too-thick oil on the recoiling parts.

The magazine rotates through the action of a wound spring. This feature is often found to be to blame for failures especially when the spring becomes too weak to turn the disk the one space necessary to index the incoming round.

The gas piston is very similar to all other automatic firing mechanisms with such an action. One end is formed into a piston and enclosed with the driving spring in a tubular housing beneath the barrel.

When trigger pressure is removed at the end of a long burst, the bolt remains to the rear in a cocked position, thus preventing a round being left in an overheated chamber.

DA (Degtyarev Aircraft). Through desperation more than intent, the Russians pressed the Degtyarev ground gun into service in the air and named it the DA. Its usefulness was limited; and just as soon as an adequate weapon was made to replace it, the DA was abandoned. The rate of fire was far below what was considered to be the minimum for aircraft weapons. While the ground gun served the troops well and was well received by them, the DA did not

Figure 3–12. Degtyarev 7.62-mm Tank Machine Gun on tank mount with stock telescoped.

enjoy such popularity from the Air Force, especially since the latter has always leaned toward the largest gun that could be mounted in a plane.

The DA–2 is the twin mount of the DA and has been called the "SPARKA".

DT (Degtyarev Tank). The DT is the early tank version of the DP. This gun features increased magazine capacity (60-round), telescoping shoulder stock, and a pistol grip. The drum is smaller in diameter than the DP magazine, but it carries two layers of ammunition.

A bipod and a detachable front sight are used with this gun when it is utilized as a ground weapon.

The rear sight is the aperture type; it is sighted from 400 meters to 1,000 meters.

The DT barrel is heavier than that of the DP and is not of the quick-change type. A safety lever replaces the safety grip of the DP.

DPM (Degtyarev Infantry Modified). This is an improvement of the basic Degtyarev. The operating spring has been relocated because the spring heated on the DP.

The DPM has a pistol grip. The recoil spring housing extends to the rear of the receiver. The shape of the stock differs from that of the DP. The bipod has been modified and is not detachable.

A safety lever replaces the grip safety of the DP. The safety is located on the right side of the receiver above the trigger.

DTM (Degtyarev Tank Modified). This gun is a modification of the DT. The major change was moving the operating spring from under the barrel to the rear of the receiver, as on the DPM.

"Company" (Degtyarev 1946 Infantry Gun). This is the latest model designed for the ground forces. It features a detachable belt-fed mecha-

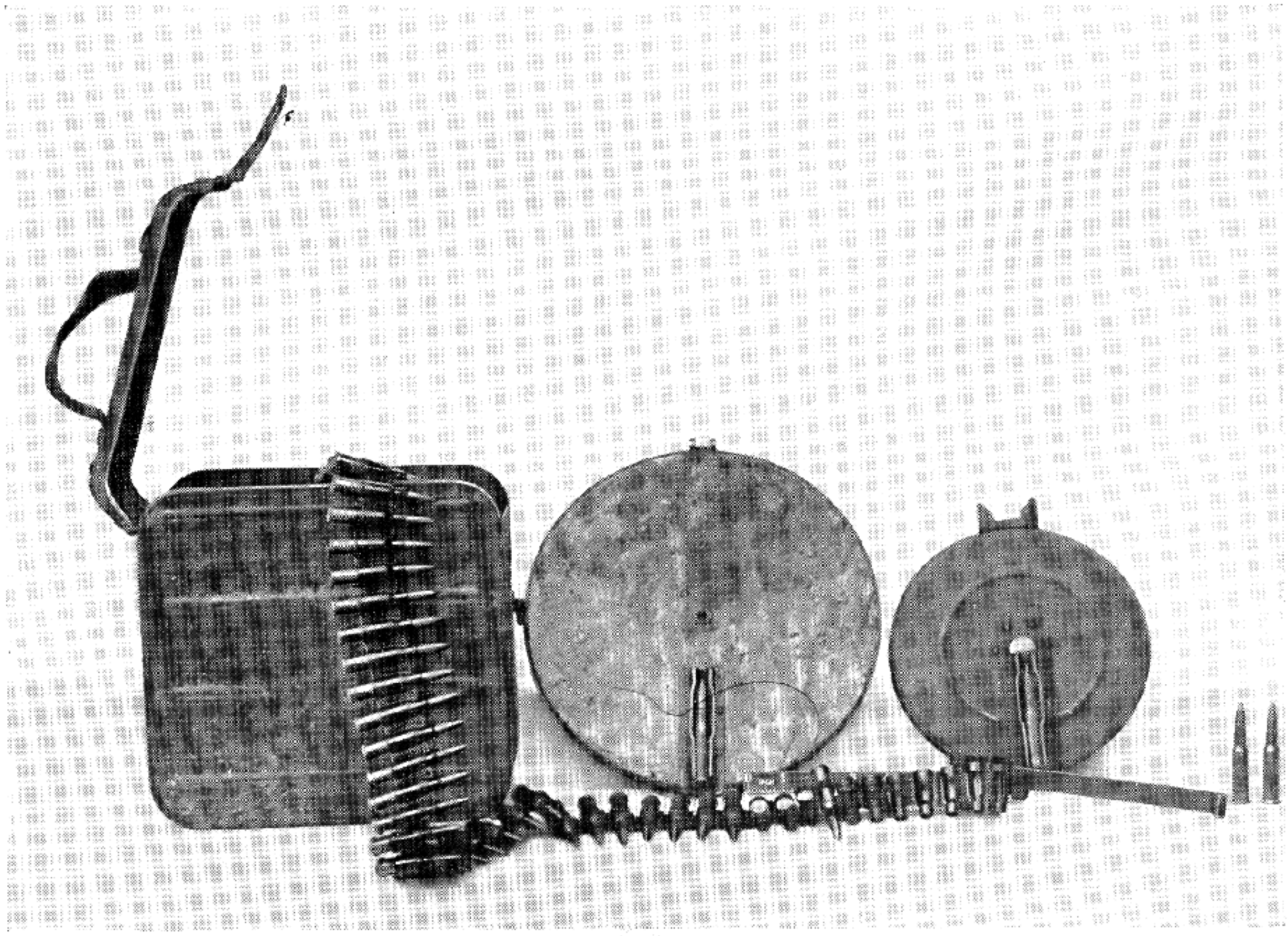

Figure 3–13. Comparison of Soviet machine gun feeds: left, ammunition box and belt for belt-fed infantry guns; center, drum for DP; right, drum for DT and DA.

nism for the use of a metallic link belt holding 50 rounds. Belts may be linked together for longer periods of sustained firing. The belt is the same as that used with the SG–43.

The standard 47-round drum can also be used with this gun. The barrel is heavier than that of the DP. The gun has a pistol grip. The bipod has been strengthened for greater stability.

DS (Degtyarev Medium). The DS which appeared in 1939 includes many improvements over the earlier designs of Degtyarev guns. It was designed for tripod mounting and, for purposes of sustained fire, had a heavy barrel with cooling rings and was belt fed.

It differs in external appearance because of its comparatively fine finish. The same system of barrel change is incorporated, using lugs on the barrel to engage in recesses in the receiver. The rear face of the barrel includes grooves shaped to receive the face of the bolt. Thus the gun cannot fire if the barrel is not in the locked position, as the bolt cannot reach battery.

The forward handle is arranged for carrying either the complete weapon or a spare barrel only. The gas port adjustment by the operator is accomplished in a very simple manner by moving an adjustment lever to either of two positions, marked 2.2 and 2.5 (diameter of orifice in millimeters).

Twin spade grips are provided for the operator. Each grip has a trigger for the index finger, but a thumb latch on the left grip must be depressed before the trigger can be pulled rearward. The right grip contains a brush and oil reservoir.

A retracting slide handle is located on the lower right of the receiver and rides in machined grooves on the outside, but this part seems needlessly engineered. On the other hand, the braided driving spring is contained in a simple sheet-metal housing outside the receiver and may be instantly removed from the gun in a single easy motion of one hand.

Figure 3–14. Soviet Tank Machine Gun DT, employed as a ground gun in World War II.

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Figure 3–15. Close-up of the receiver of the DTM. The housing for the driving spring protrudes to the rear. The year of manufacture appears just behind the rear sight.

Although the feed block is machined in a curve, this gun does not have a true rotary feed. The only purpose of the curve in the mechanism is to reduce its complexity and bulk. This mechanism, unique in this model, utilizes the motion of the piston extension, which is at the bottom of the receiver, to move the belt across the top of the receiver. The manufacturer of the curved parts was a serious production problem, since the curved shuttle operates in two similarly curved bearing slots.

Because the snatch from the belt is accomplished by twin extractors overriding the rim at 90 degrees and 270 degrees, support must be provided in the receiver at 0 degrees and in the cover at 180 degrees to prevent stubbing the noses of the rounds. The extractors maintain position control over the cartridge until it is cammed into the T-slot. This occurs during the early part of the rear stroke. The same cam is pivoted in such a way that it becomes a lever, (actuated by the rear of the bolt) and it then pushes the round down into alignment with the chamber. The unfired cartridge forces the empty case down the T-slot and out. The combination cam and lever permits the cam to be less steep.

Although disassembly is possible without tools, it is not as easy as in most guns designed in this period. All major parts bear the gun number, which is an indication of a low standard of interchangeability. There is little evidence of engineering with mass production in mind. This weapon was never

Figure 3 16. The 7.62-mm Degtyarev "Company" Machine Gun.

produced in large numbers, and it has been referred to as a failure; however, its weakness appears to have been in difficulty of production rather than in performance.

This weapon uses either a metallic belt or a canvas belt, the latter being the belt of the Maxim machine gun. For this reason, there is a rather large clearance in the feedway. The rate of fire can be adjusted by rotating the buffer.

DK (Degtyarev Heavy). This 12.7-mm gun appeared about 1934 at a time when interest in machine guns of approximately one-half inch bore was becoming very strong throughout the world. It appears to have been only a trial weapon, and its importance lies in the fact that it served as the basis for the DShK, which appeared about 1938.

DShK (Degtyarev-Shpagin Heavy). The DshK, the principal anti-aircraft defense of the Russian ground troops, was also in wide use in other branches of the Armed Forces in World War II. This weapon used the 12.7-mm rimless cartridge. In figure 3–24 it is shown in use on the deck of a small vessel of the Soviet fleet.

The feed system on this weapon was originated by Shpagin, a fact that accounts for the official designation being DShK. The first letter stands for Degtyarev, the originator of the firing mechanism, the second and third letters for the designer of the feeding arrangement, and the fourth letter for "heavy."

G. S. Shpagin, a well known mechanical engineer in the Soviet Union, was the designer of the rotary type of feed that became practically synonymous with certain types of Russian automatic weapons. This system was so widely used and with such success, the inventor received many honors from his country, rose to the rank of Lieutenant General, and was placed in charge of a large scientific research organization.

The DShK has an external appearance that differs greatly from the drum-fed Degtyarev

Figure 3-17. The 7.62-mm Degtyarev Belt-fed Machine Gun known as the DS. Very few specimens of this version are in existence.

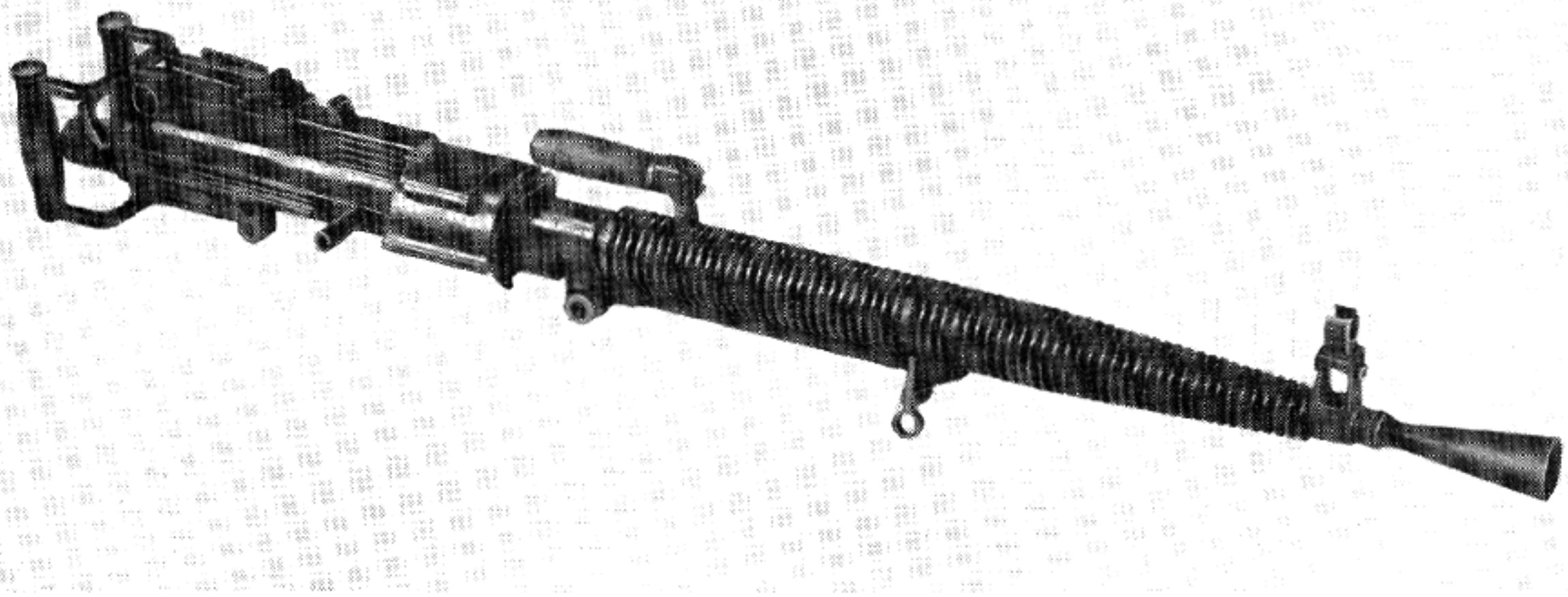


Figure 3 18. The DS dismounted from its tripod.

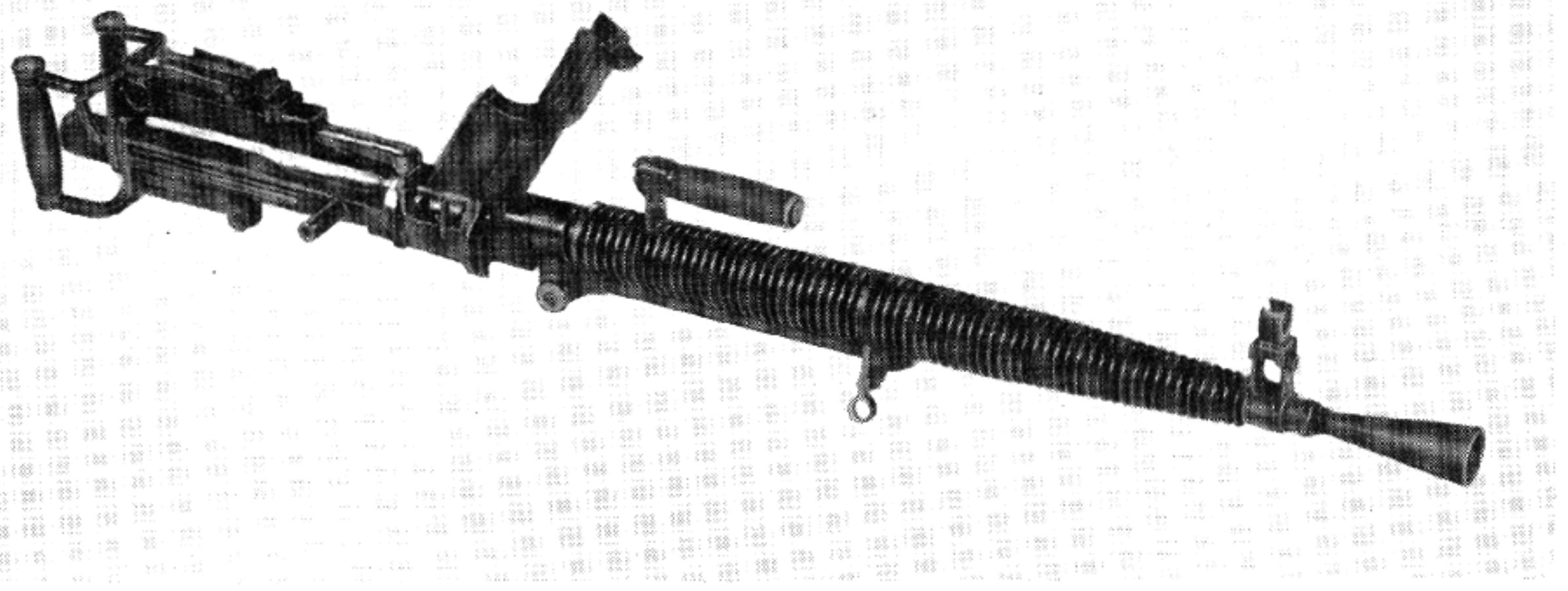


Figure 3–19. The DS with the feed cover opened to permit access to the feedway.

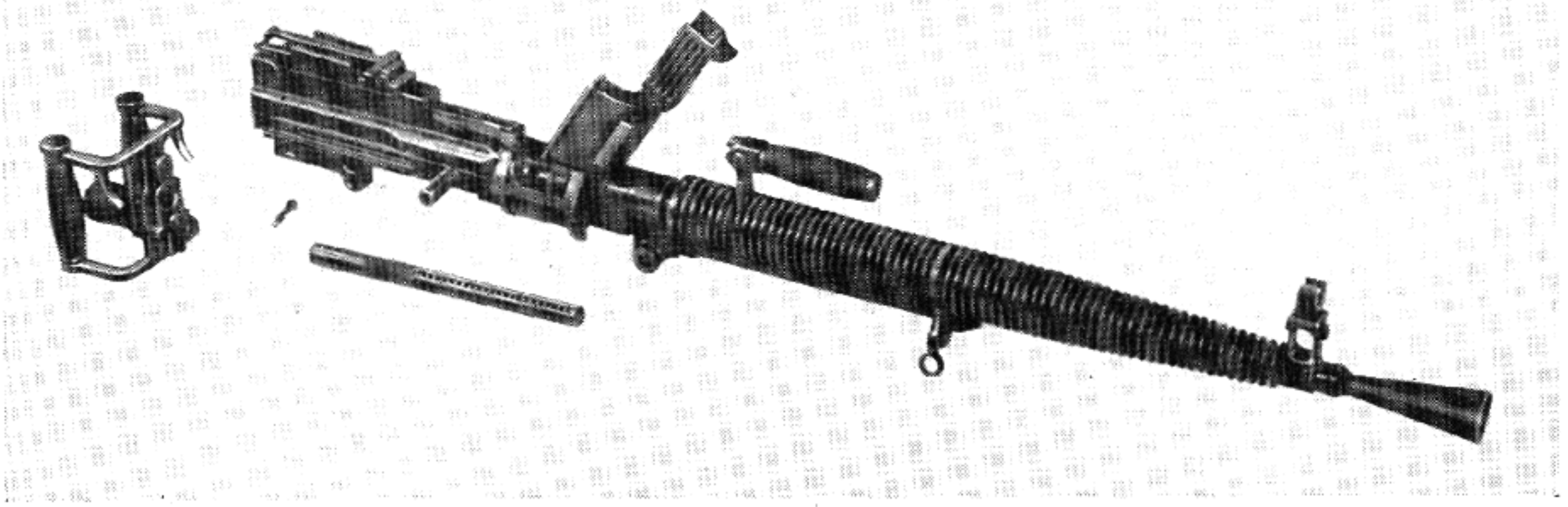


Figure 3–20. Stripping the DS: back plate group and housing removed.

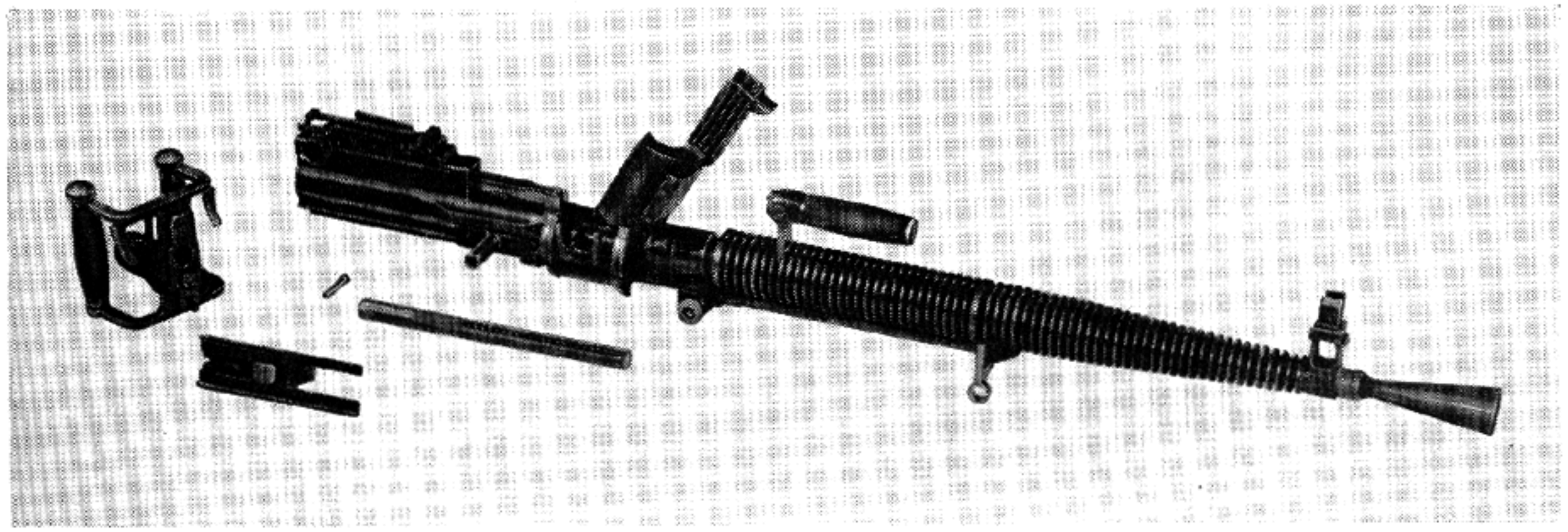


Figure 3–21. Stripping the DS, continued: sear group removed.

Figure 3–22. Stripping the DS, continued: operating slide and belt group have been removed together. The next step is the removal of the handle from its guideway.

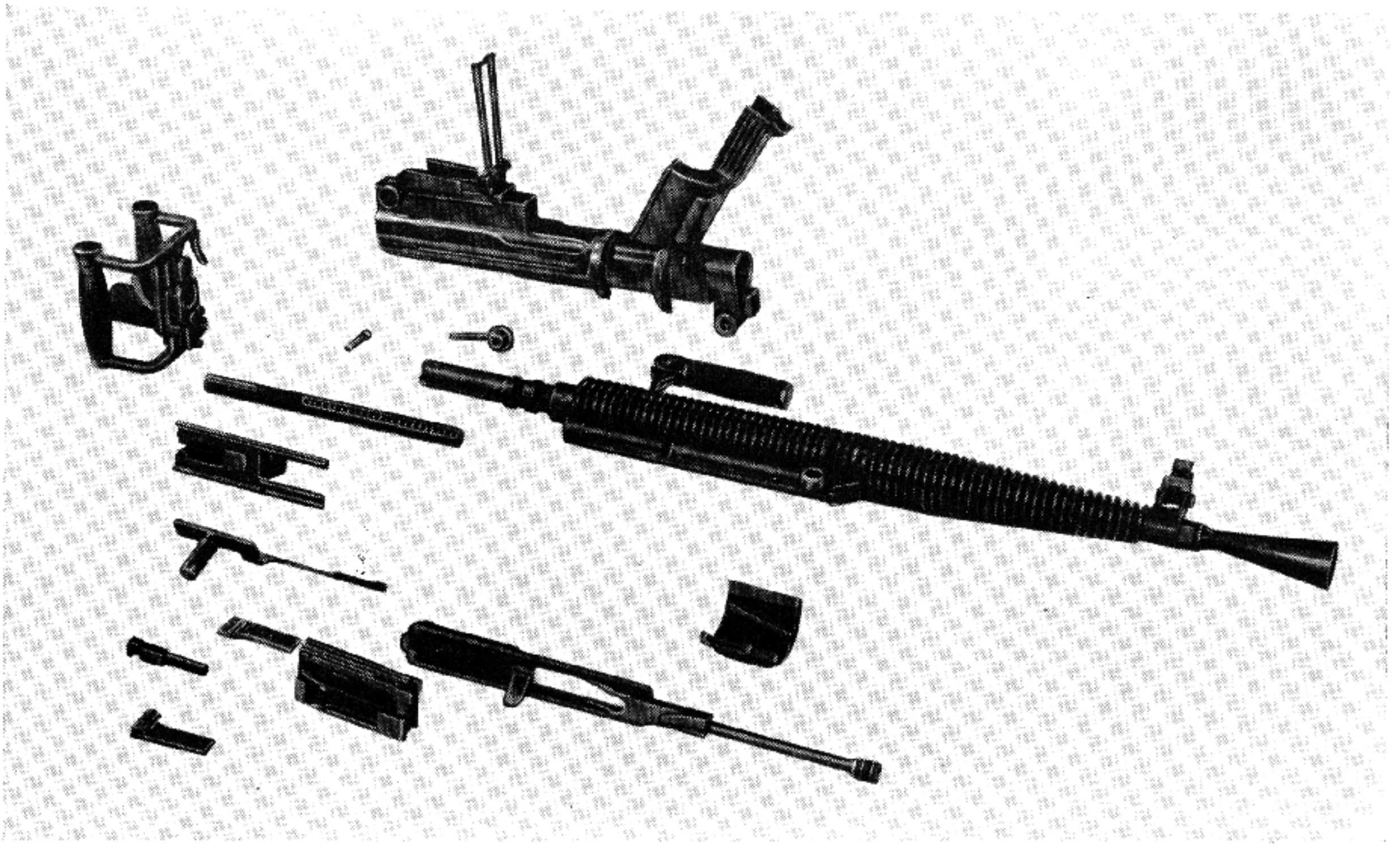


Figure 3–23. The DS, field stripped.

weapons; however, with the exception of the rotary feed, the mechanism is very similar to the drum-fed models. Although there are superficial external resemblances between this gun and the DS, the similarity in the mechanism is confined to the locking action.

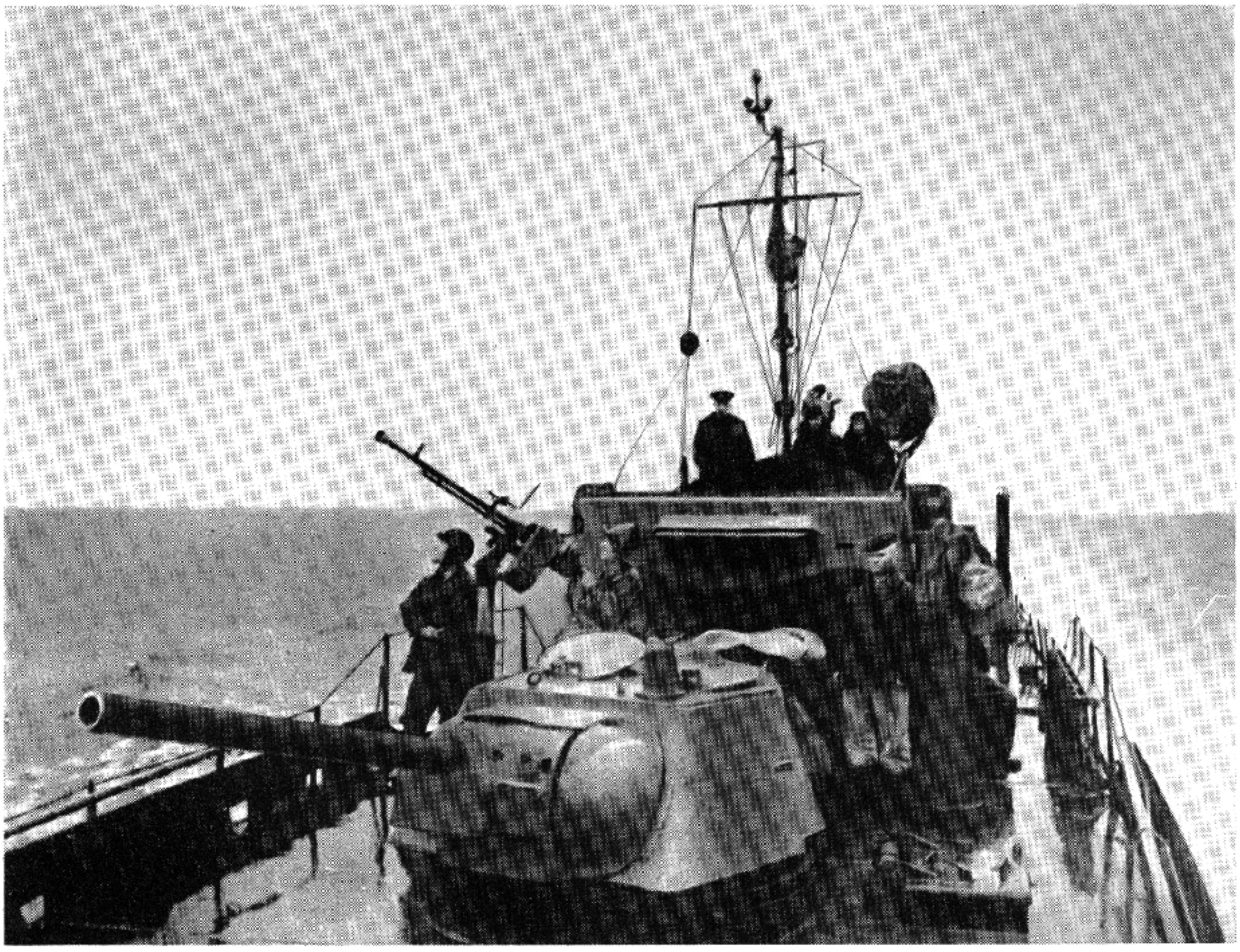


Figure 3–24. The 12.7-mm DShK Machine Gun as antiaircraft defense for a small vessel of the Red Fleet. Mounted in the foreground is a turret of the type found on the Russian T34 tank.

In the DShK, rounds are stripped from the links in the rotary feed which positions them in a feed mouth from which they are stripped by the bolt in its forward travel. This feature is shown in figures 3–27, 3–28, and 3–29.

The gun has on the receiver a leaf sight for fire against normal ground targets and can also use a model 1938 or model 1941 sight for fire against aircraft or moving surface targets including those with thin-skinned armor.

The DShK is a very heavy gun, and since the barrel cannot be readily removed for man-handling, a wheeled mount is provided. The complete weapon makes an excessive load even for two men.

Barrel removal is accomplished by means of a wrench; accordingly, there are some shallow grooves near the muzzle. The barrel is screwed into the receiver until its stump rests against the inside shoulder of the receiver. When it is in the correct position lines on barrel and receiver coincide.

To keep the barrel from loosening during the vibrations incident to firing, it is secured by a locking stud, which is screwed into the receiver from the right side. The locking stud is constructed in the form of a bolt; the middle part between the threads and the conical head make possible the selection of clearances in attaching the barrel.

Interesting Features of the 7.62-mm Degtyarev Machine Guns

Russian Army manuals used in troop-training describe the firing of automatic rifles in varying bursts.

Figure 3–25. The DShk Heavy Machine Gun, mounted on its tripod for antiaircraft use.

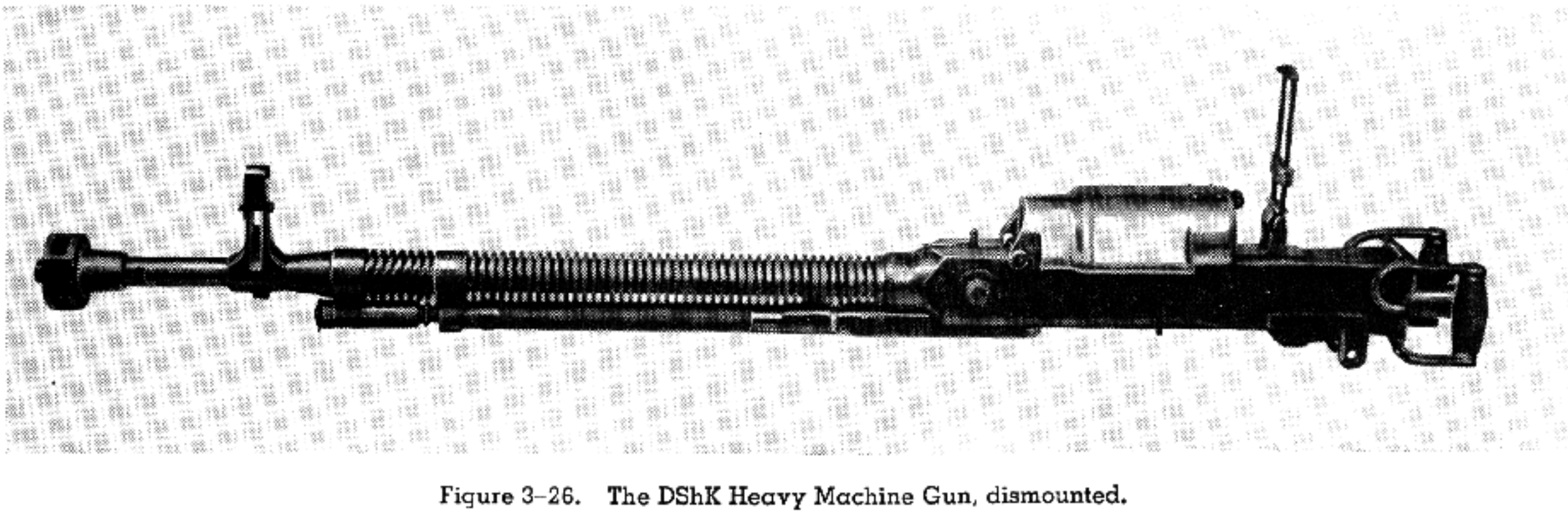


Figure 3–26. The DShK Heavy Machine Gun, dismounted.

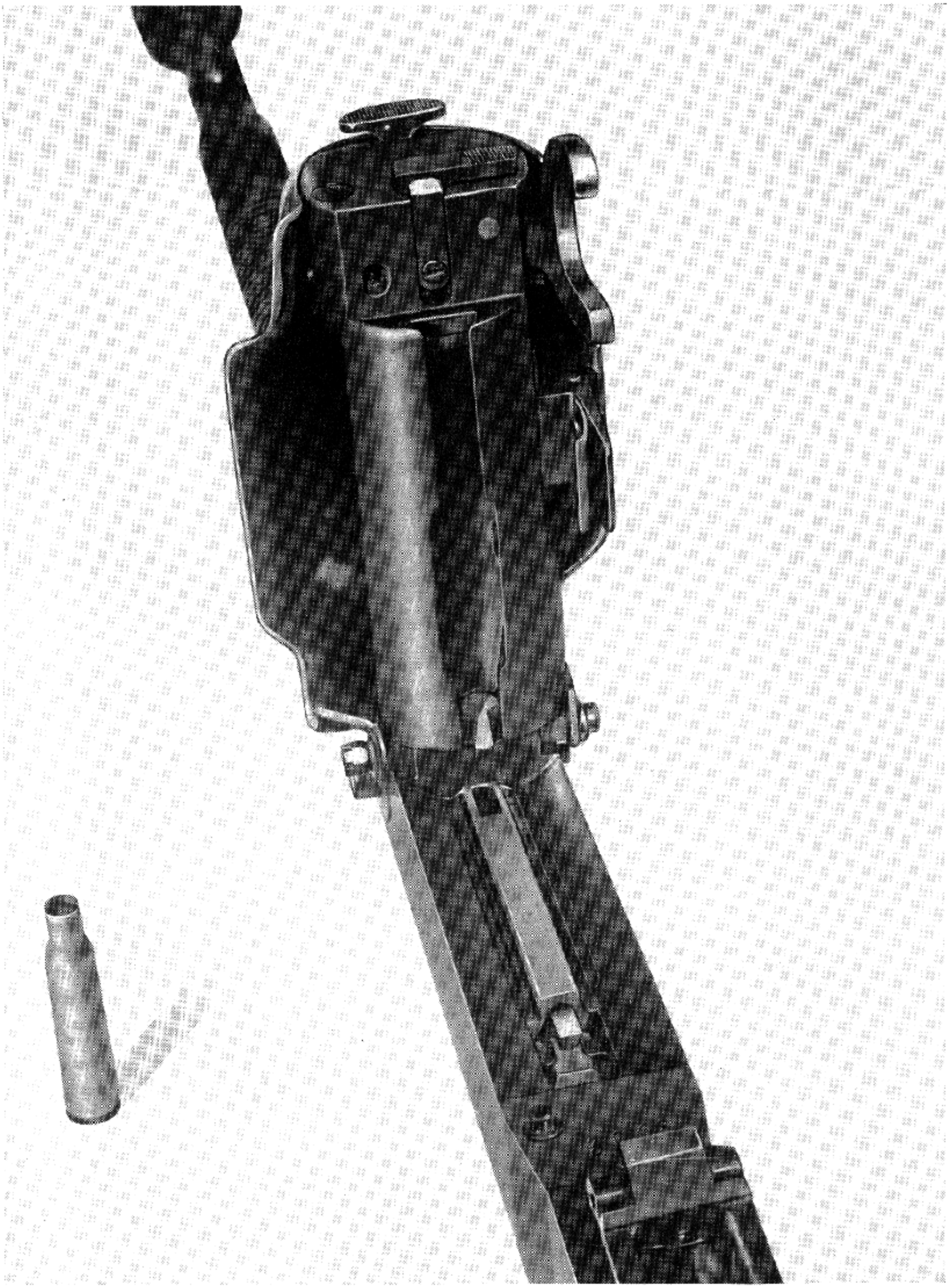


Figure 3–27. The 12.7-mm DShK Machine Gun with the entire feed hinged up, showing the lips from which the bolt picks up the round on the forward stroke. In this view, the bolt is in battery position.

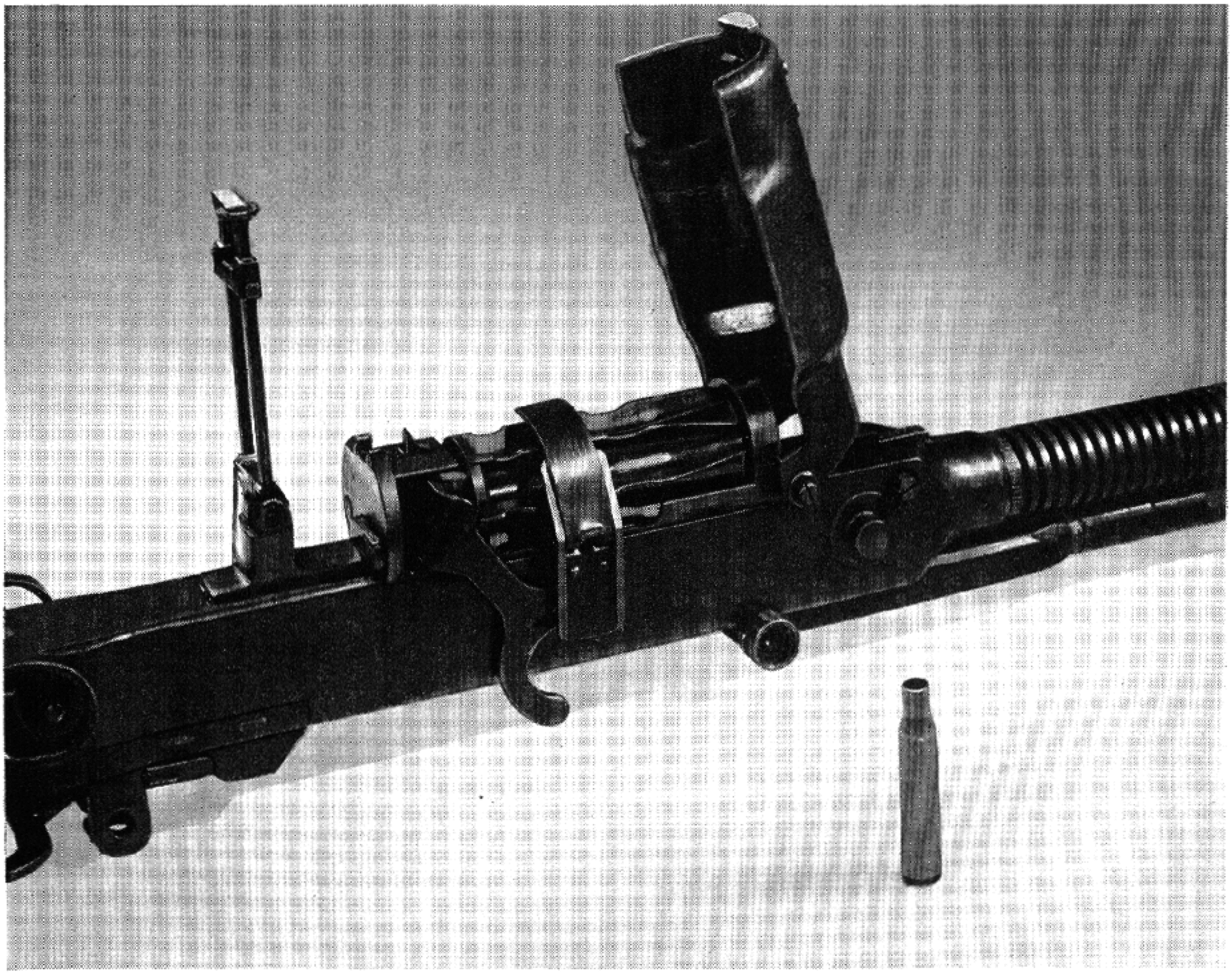


Figure 3-28. The 12.7-mm DShk with feed cover hinged up, showing the link stripper and the rotary sprocket.

The normal burst is given as four to six rounds with a shorter one of two of three shots being permissible. The whole magazine may be fired by one pull of the trigger; this is done only when desperate circumstances warrant it. Fire by normal bursts is regarded as the most expedient method, since it is very effective against most targets. Fire against small bodies of troops in skirmish line and on all very small targets can vary from short bursts to the whole magazine being expended, the choice usually being left to the discretion of the gunner.

The Soviets claim that the ballistic qualities of the Degtyarev are the same as those of their standard infantry rifle. This performance seems logical, since the trajectory of a single shot fired from the machine rifle is subjected to the same laws and influence as that of the rifle bullet.

The Soviet military authorities estimated that the normal zone of effective fire of the Degtyarev was roughly 1,500 yards and that under highly favorable conditions the maximum could be extended to 1,800 yards.

Reports describe a unique feature in the distribution of the Degtyarev machine gun. It is stated that only one gun was issued to a section, which consisted of the Commander, gunner, assistant gunner, ammunition carrier, and magazine loader. During drill, particular attention was paid to coordination and teamwork of the crew.

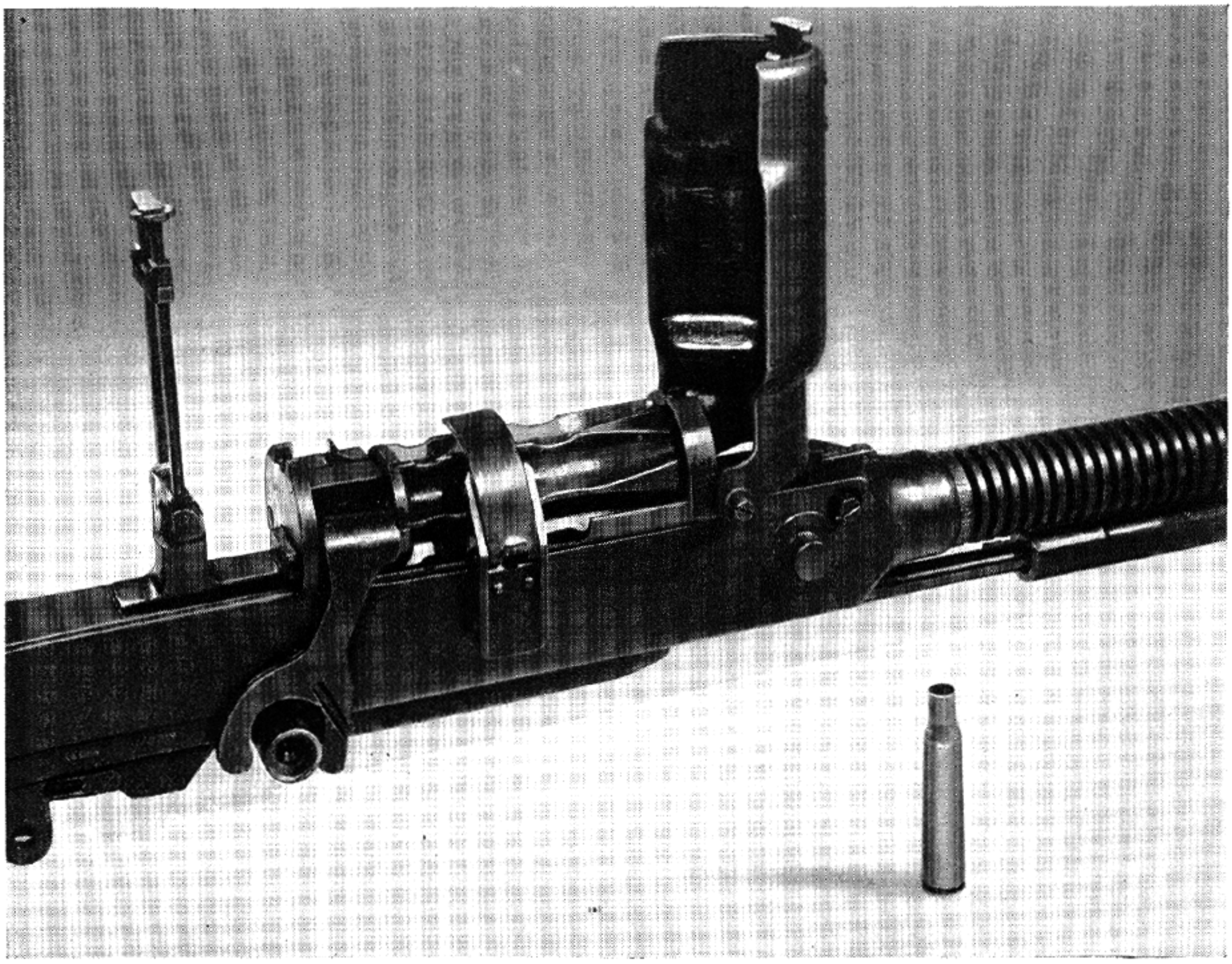


Figure 3–29. The 12.7-mm DShK with feed cover hinged up. Operating mechanism is in the retracted position. The retracting handle has driven the yoke to the rear, thus rotating the sprocket and indexing another round.

Cycle of Operation for Drum-Fed Models

To fire the drum-fed models, the gunner places a loaded drum into its holding catches on top of the receiver. The cocking handle on the right side is pulled completely to the rear until the spring-loaded hold-back engages its locking recess in the bottom of the gas piston. The weapon is now cocked and ready to fire.

By placing the right hand around the grip of the shoulder stock, the safety is depressed. Pressure backward on the trigger disengages the sear, allowing the compressed driving spring in the piston housing to pull the operating parts forward.

As the feed rib on top of the bolt comes in line with the opening in the rear of the drum feed mouth, it begins to shove the positioned cartridge out of its guideways into the chamber. The bolt reaches battery, first chambering the round and camming the extractor lip over its rim. At this point, the two swinging locks that have been holding the firing pin to the rear have reached a point opposite the locking shoulders milled in the stationary receiver. The firing pin is now free to advance, at the same time camming the locks into their recesses. The firing pin continues on through the bolt face into the primer that ignites the powder charge.

Before the bullet has left the bore, a portion of the propellant gas is diverted through a port in the bottom of the barrel into a short cuplike cylinder that houses the gas piston head. This action delivers

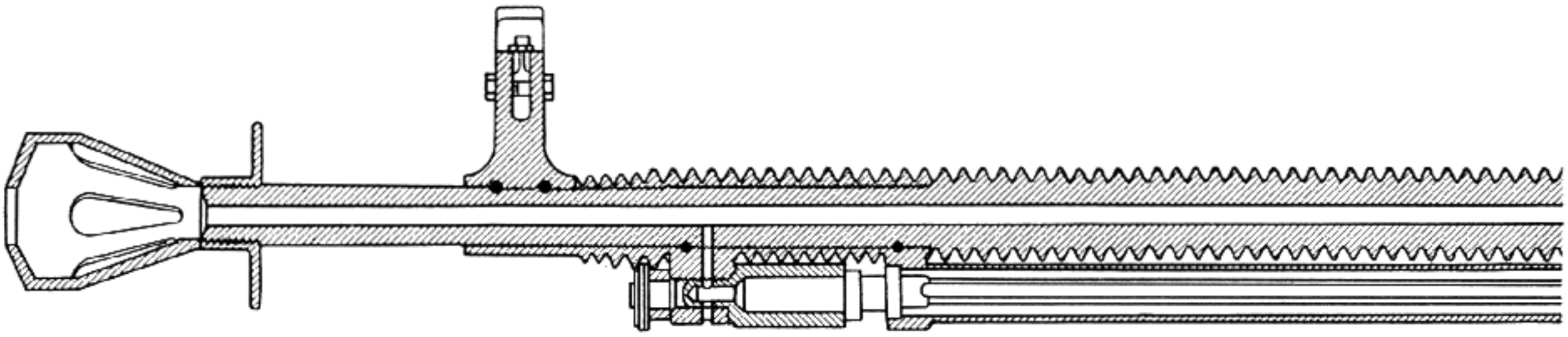


Figure 3–30. The DShK Heavy Machine Gun, sectional view.

an impact on the face of the piston, which then starts to recoil with the firing pin. After free travel for ⅜ inch, the firing pin cam is removed from the sides of the pivoting locks and the latter now folds back into the bolt body behind the firing pin, holding it to the rear. After a full inch of rearward travel, the gas piston leaves its short cylinder, and the gas that is thrusting it to rear is allowed to dissipate into the air. The first unlocking movement gives initial extraction, and the loosened cartridge case is held by the extractor until its base collides with the ejector. As a result, the empty case is knocked through the ejection slot in the bottom of the receiver. At the completion of the full recoil stroke, the cycle of operation continues as long as the trigger remains depressed.

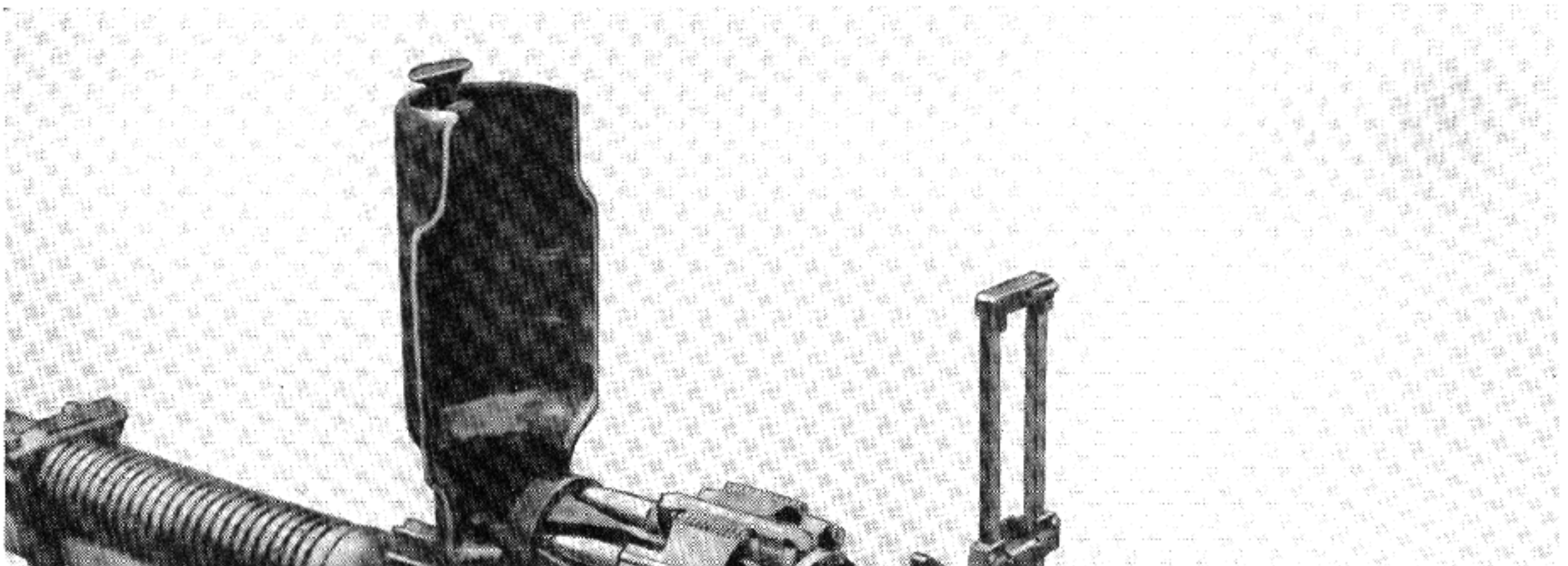
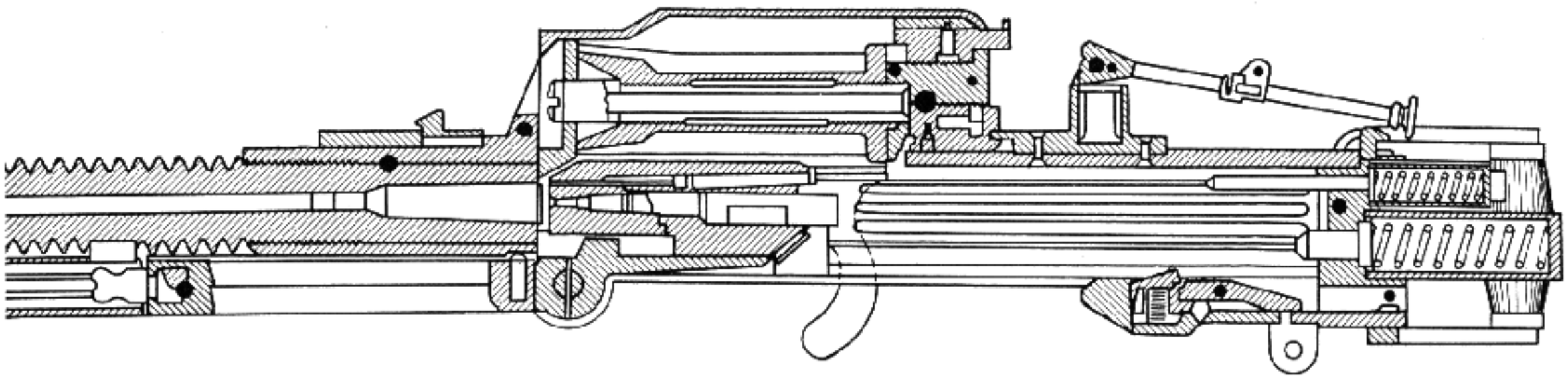


Figure 3–31. The DShK Heavy Machine Gun with feed cover hinged up, showing loaded belt positioned in rotary feed drum.



Cycle of Operation for the DS Gun

To fire the DS, the gunner retracts the bolt to the rear sear and places the first round in the belt over the belt feed pawls that are an integral part of the curved feed slide. The rim of the cartridge is positioned behind a rib in the feedway, preventing it from moving forward and stubbing when being engaged by the cartridge extractors.

The trigger is depressed, allowing the bolt to go home. As the mechanism approaches battery position, two spring-loaded jaws located in the top half of bolt body snap around the rim of the cartridge. The operating parts are now all the way home with the first cartridge held by the claws on the bolt.

The gunner again pulls the handle to the rear. Coincidental with the rearward movement, a pivoting bar arrangement that rides in the slotted portion of the bolt begins from the instant of withdrawal to cam the cartridge down into the T-slot. By the time the bolt reaches the seared position, the incoming round has been placed directly in line with the center of the chamber. The weapon is now cocked and ready to fire.

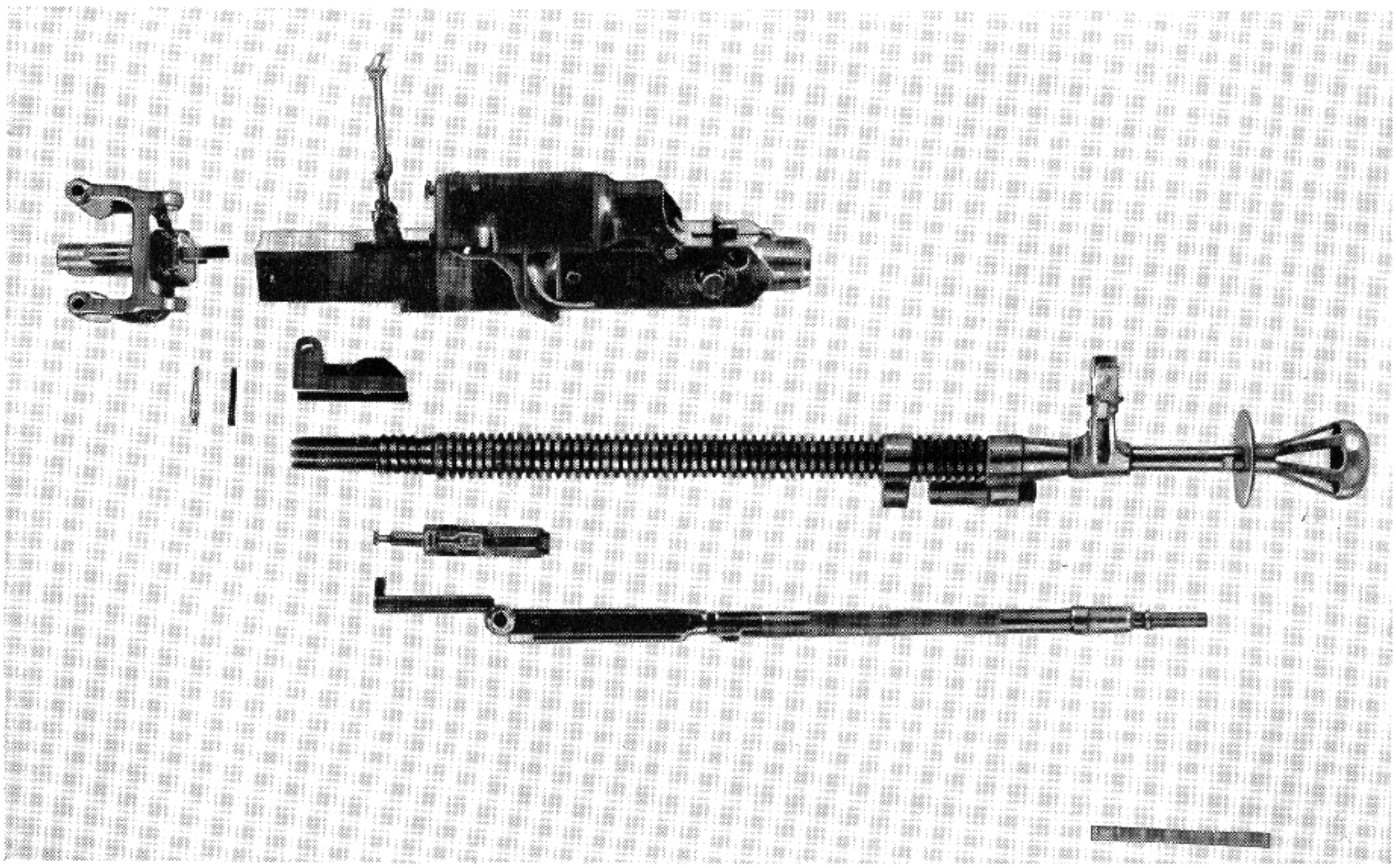


Figure 3–32. The DShK, stripped. See figure 3–23 for the difference in design of the belt-fed mechanisms of this model and of the DS.

By actuating the trigger, the bolt starts forward under compression of its driving spring, carrying the loaded round which is held securely in the T-slot on the face of the bolt. The operating parts reach home, the bolt body comes to a stop as the round is chambered.

During counter-recoil, movement of the gas piston, by which the feed system is actuated, positions the next cartridge in the belt to be picked up by the spring-loaded jaws. Since the gas piston continues to move forward when the two pivoting locks are directly alongside their recesses in the receiver, this last bit of movement of the gas piston not only cams the locks positively behind their abutments, but also causes the striker on the gas piston to come in contact with the firing pin, driving it into the primer and firing the powder charge.

The bolt continues to back up the cartridge until the gas pressure has reached a safe operating limit; at this time, the bullet has cleared the gas port in the barrel, and the gas in the barrel is metered into the gas cylinder and onto the face of the piston.

This gas pressure starts the piston to the rear with great force. As the piston starts to move rearward, its first function is to unlock the bolt. Both pieces start backwards together. With the incoming round entering the T-slot and as it is being positioned, the loaded round strikes the base of the empty case, forcing it downward out of the T-slot. The cartridge pawls in the feeder move outward to engage the next round, and the cycle continues as long as the trigger is depressed.

Cycle of Operation for the DShK Gun

To fire the DShK, the gunner raises the feed cover and places the end of the belt on the rotating drum, aligning the first link so as to engage the link stripper when feeding commences. The cover is then closed and the feed operating lever is operated by hand several times until the first cartridge has moved around to the feed lips. (During automatic fire this feed lever is operated by the retracting handle, for every shot.)

The pawl of the feed lever presses on the projection of a ratchet, on the drum, causing it to turn. There is a stop that is pressed back and engages the successive recesses in the ratchet, preventing turning of the drum backwards. In rotating, the drum steadily draws the belt with the cartridges into the feeder. The cover of the feed prevents them from being thrown upward. During firing, there are four cartridges in the drum, two of which are still in their links.

The weapon is cocked and ready to fire. With the actuating of the trigger, the bolt moves forward under tension from its driving spring and the feed rib pushes the incoming round forward. The bullet slides along a shoulder until the case reaches its opening. At this point, the bullet is aligned and starts into the chamber. The bolt reaches battery, first chambering the round and engaging the cartridge with the extractor lip snapping into the cannelure.

The two swinging locks that have been holding the firing pin to the rear have reached a point opposite the locking shoulders milled in the receiver. The firing pin now advances, at the same time camming the swinging locks into their recesses. The gas piston carrying the striker continues on to drive the firing pin into the primer, exploding the propellant.

As the bullet passes the gas port in the barrel, gas is diverted through a port into the gas cylinder that houses the gas piston head. This gas delivers an impact to the face of the piston, which starts to recoil and carries the firing pin with it. After free travel for 5/8 inch, the firing pin locking cam is removed as an obstruction from the sides of the swinging locks, which now fold back into the bolt body.

The first unlocking movement gives initial extraction, and the loosened case is held by the extractor until its base collides with the ejector. As a result, the empty case is knocked through the ejection slot in the bottom of the receiver. The operating parts continue rearward until they strike the buffer; then they begin counter-recoil. The cycle of operation continues as long as the trigger remains depressed.

Disassembly of the DP by Groups

Barrel. Pull the slide to the rear until caught by the sear. Press in on the barrel lock, which is on the left front side of the receiver. Turn the barrel 1/16 turn to the right and remove from the receiver.

Stock and Trigger Guard. Pull the trigger, allowing the slide to go forward. Remove the trigger guard bolt located on the right side of the receiver by unscrewing counterclockwise, and rotate the stock and trigger guard downward until the rear of

the trigger guard clears the receiver. Then remove the stock and trigger guard assembly to the rear.

Gas Piston, Slide, and Bolt. Press forward on the recoil spring sleeve and move ⅓ turn to the left. This sleeve is located at the rear of the gas cylinder tube. Now pull the slide, gas piston, and bolt out of the rear of the receiver.

Detailed Disassembly of the DP

Barrel. Unscrew the flash hider from the barrel. Remove the cotter pin from the gas cylinder nut and unscrew the gas cylinder nut. Slide the gas cylinder to the rear of the gas cylinder body. Drift out the two gas cylinder body pins and slide the gas cylinder body off the front end of the barrel.

Stock and Trigger Guard. Remove the three stock screws from the trigger guard (one screw is on the top tang of the trigger guard, one on the bottom tang, and the third on the inside of the trigger guard behind the end of the sear). The stock is now free to be removed. Drift out the trigger pin and remove the sear, sear spring, and trigger. Drift out the safety pin and remove the safety and safety spring.

Gas Piston, Slide, and Bolt. Lift the bolt from the top of the slide. Remove the firing pin from the rear of the bolt. Remove the bolt locks from the right and left sides of the bolt. Lift up on the front lips of the extractor. Pull the recoil spring to the rear of the gas piston and unscrew the gas piston. Slide off the recoil spring and recoil spring sleeve. Drift out the gas piston rod and unscrew the gas piston rod from the slide.

Receiver and Barrel Jacket. Drift out the rear sight pin and remove the rear sight leaf slide, the two slide locks, and the two slide lock springs. Drift the rear sight leaf spring to the front, and remove. Unscrew the rear sight base screw, and remove the base. Drift out the magazine latch handle pin and remove the handle. Slide the magazine latch to the front, removing it from the rear sight base. Remove the magazine latch spring. Lift up the front end of the ejector spring and slide it forward, removing it from the receiver. Lift out the ejector. Unscrew the barrel lock nut, using a screwdriver. Remove the barrel lock spring and barrel lock. Unscrew the front sight base screw, removing the base at the same time. Unscrew the front sight post.

Assembly

To reassemble the parts of this gun, the disassembly procedures just given are reversed.

SECTION 2. GORYUNOV MACHINE GUN

General Data on SG–43 (Stankovaya Goryunov 1943)

Caliber: 7.62-mm.
Rate of fire: 500–700 rounds/minute.
Muzzle velociy: 2,620 feet/second with heavy pointed ball (yellow tip) bullet.
Gun length: 44¾ inches.
Gun weight, with tripod less shield 77 pounds 14 ounces.
System of operation: Gas piston actuated.
System of locking: Propped bolt.
System of feeding: 250-round canvas belt or multiples of 50-round metallic link belt.
Method of charging: Manual.
Method of cooling: Air.
Rate control: Gas port type.
Barrel length: 28 inches.
Barrel removal: Quick change.
Chamber pressure: 44,000 psi (maximum).
Bore:
  Number of grooves: 4.
  Grooves depth: 0.015–0.021 inch.
  Groove width: 0.375–390 inch.
  Pitch: 5° 41′.
  Direction of twist: Right hand.
  Form of twist: Standard.
Method of headspace: Wedge barrel lock.
Location of feed opening: Top.
Location of ejection opening: Left side.

Description of the Weapon

The Russians hailed the SG–43 as an entirely new machine gun in every detail. Its exterior finish was crude, resembling in this respect the DP (Degtyarev Infantry) Gun. Some of its operating features were new to Russian weapons; they remind gun connoisseurs of principles and patents originated earlier by designers in other countries.

The weapon's general system of operation may be described as gas piston actuated with propped breech locking. The bolt comes to battery first, and the continued advance of the gas piston cams the rear end of the bolt over in front of its locking shoulder. This shoulder is in the right side of the receiver.

Backing up the bolt from the side of the receiver has been frowned upon by earlier machine gun designers because side loads are transferred to the normally thinner walls of the receiver. However, Goryunov used this idea with apparently no bad effects on either the over-all functioning of the gun or its components.

This principle was patented by John M. Browning of 20 August 1895 (Patent No. 544657), but he never saw fit to put it into use. In Goryunov's hands, this easily constructed locking system became the heart of a heavy machine gun system that is serving well the Soviet Army.

The piece that locks and unlocks the barrel is constructed so that when it is driven back into position a slightly angular surface takes up all slack in the barrel, forcing the aft end of the piece rearward until it butts against the locked bolt face. This simple and unique method of head space is used in

Figure 3–33. Soviet small arms designer Peter Maximovitch Goryunov (deceased).

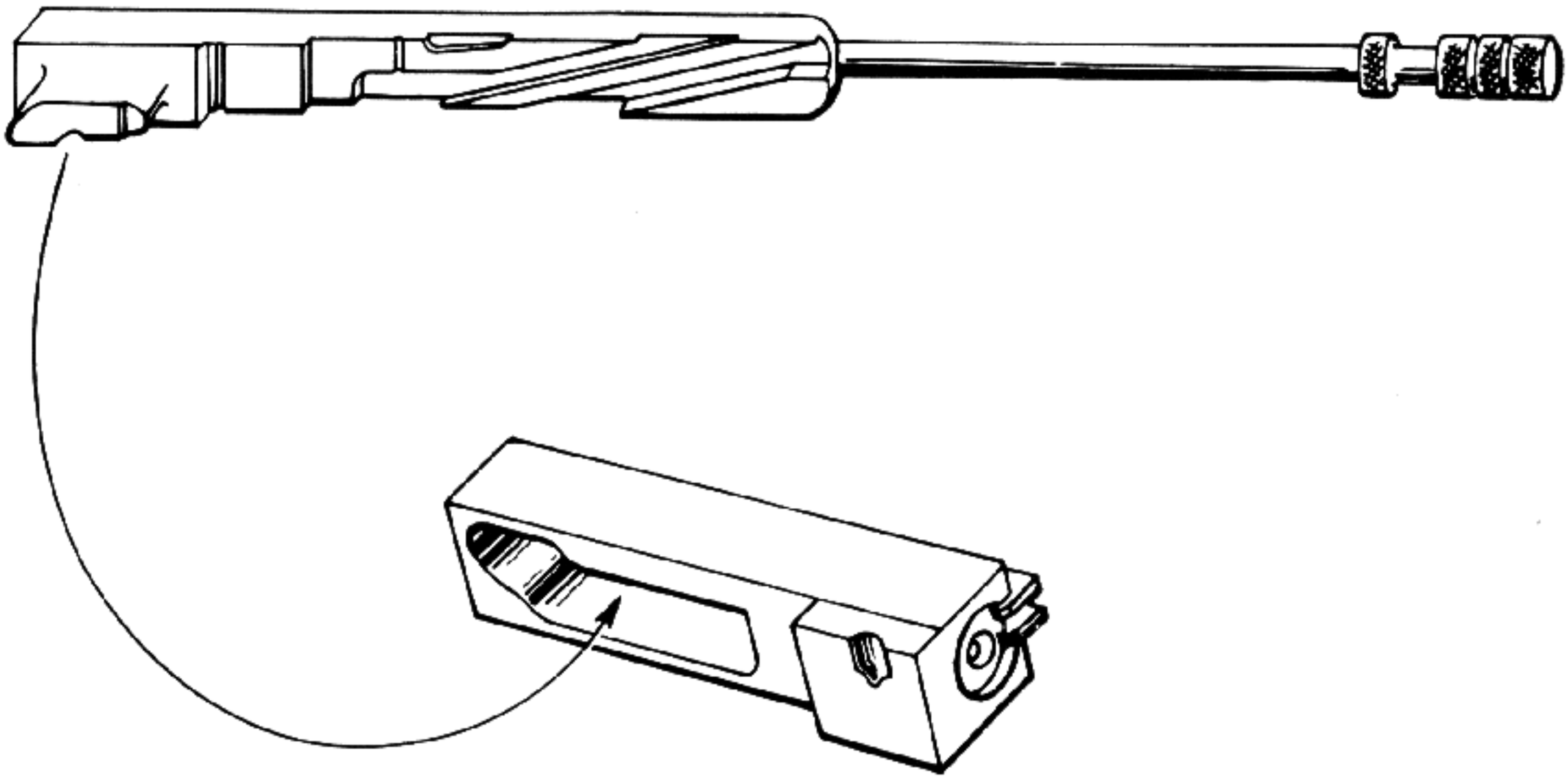


Figure 3–34. The Goryunov Machine Gun, showing operating slide (top) and bolt (bottom). The stud on the slide operates in the bolt slot to cam the bolt behind the locking shoulder.

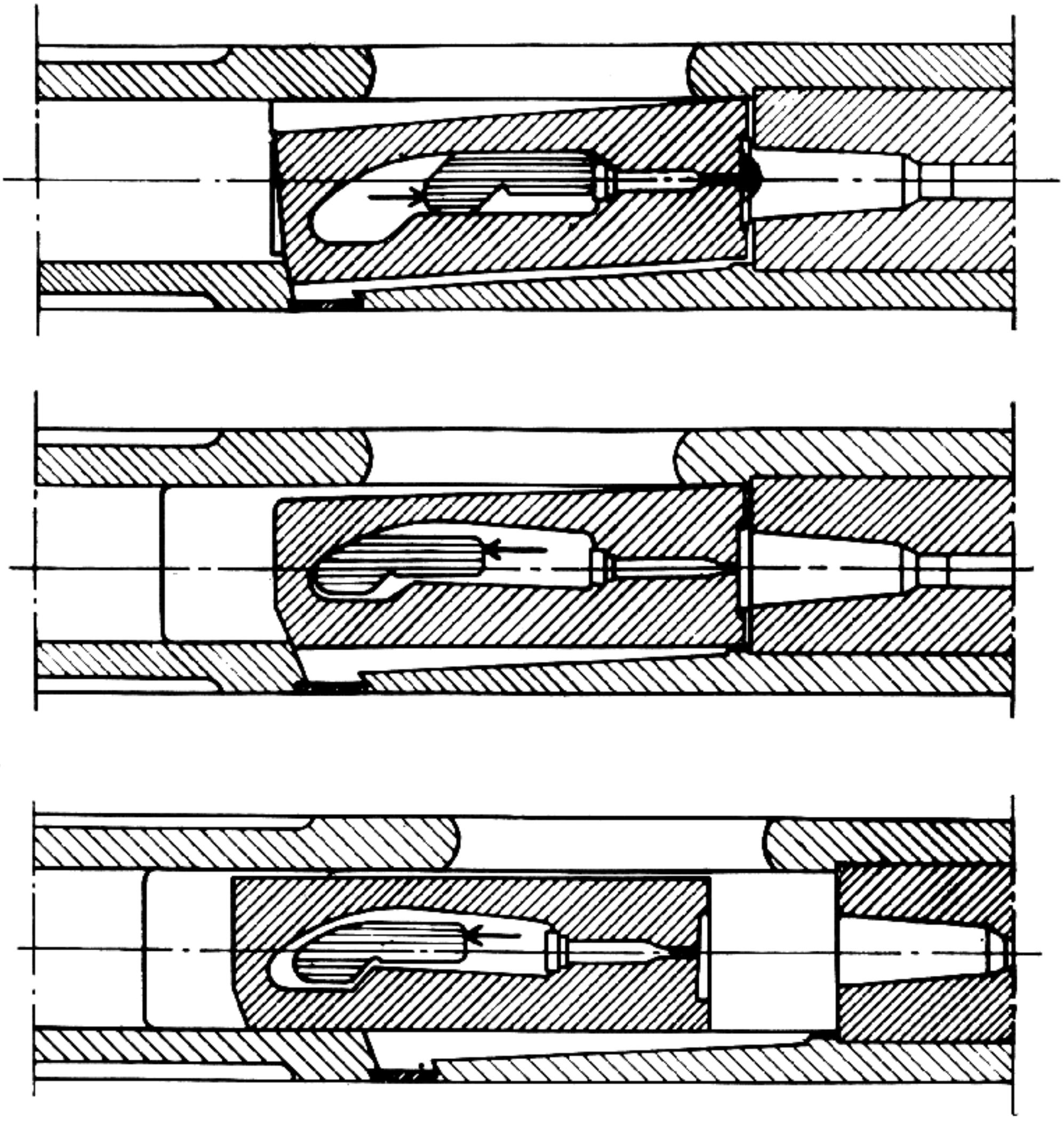


Figure 3–35. Plan of locking feature of the Goryunov Machine Gun. The steps shown are, top to bottom: ignition phase; unlocking; rear stroke.

many Soviet weapons. This method not only gives a very quick and practical fool-proof method of arriving at this critical measurement but also saves much intricate machine work such as the threading of the aft end of the barrel, serrated notches, and locking springs. While this system has a few disadvantages, its good features outweigh the bad ones.

The quick-change barrel of the SG–43 has a desirable safety feature. The barrel lock piece is located with the feedway in a position that requires the mechanism to be raised on its pivot before the barrel can be released.

When a barrel is inserted, the barrel holding device must be in the locked position before the feed mechanism can be lowered. Although with this arrangement firing a round is possible with the barrel securing piece completely removed from the receiver, this danger is no worse than the possibility of firing a round in the T-slot without a barrel in the gun, which can be done in certain well known machine guns.

The barrel handle can be used to remove a hot barrel, but it is too far forward of the center of gravity to be suitable for carrying the complete

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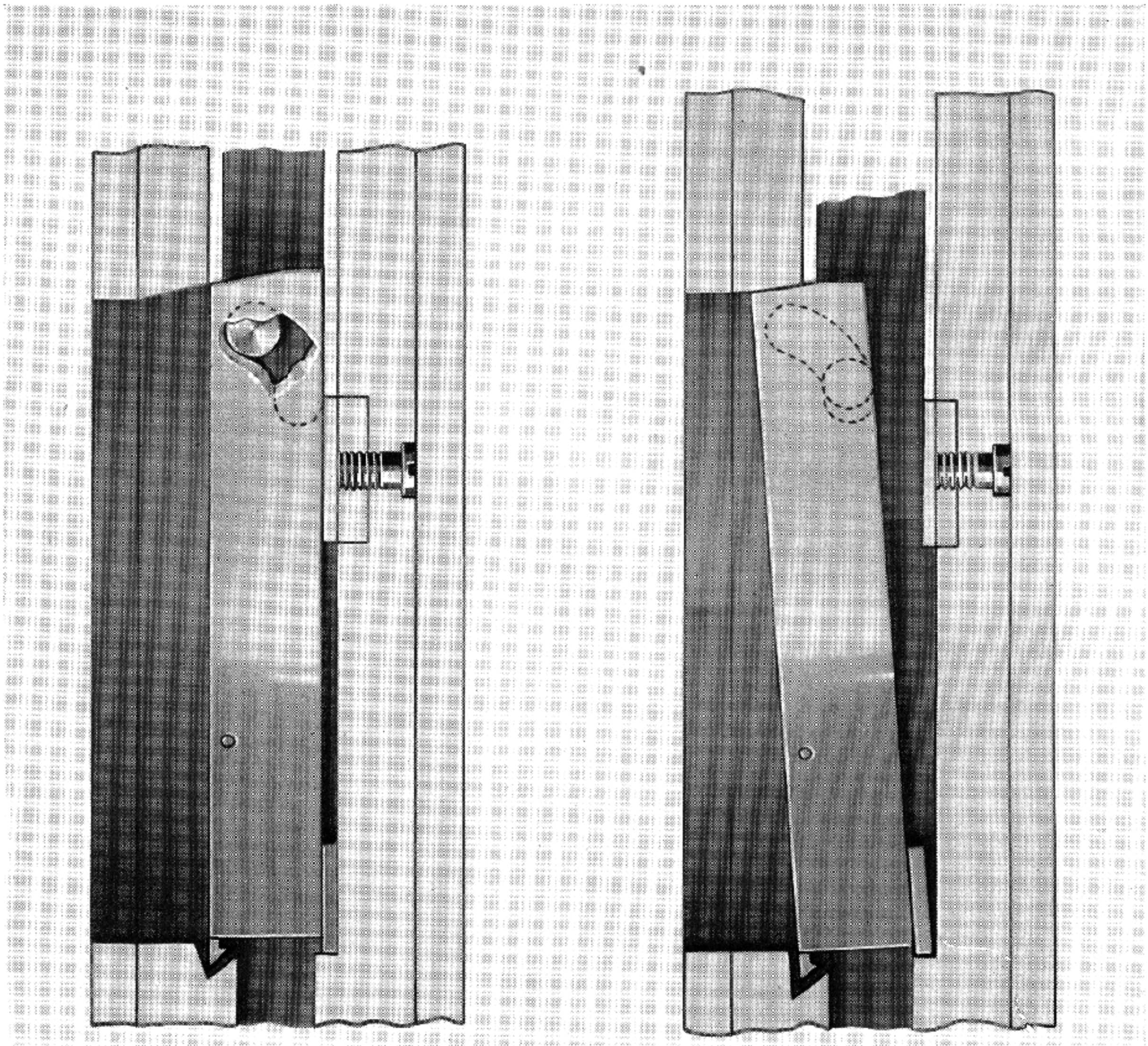

Figure 3–36. Plan of a locking feature patented by the American Gunsmith John M. Browning. This patent antedated the Goryunov lock by almost fifty years.

weapon. To make the barrel exchange easy, the cylinder connection to the receiver is flexible, and the piston is not rigidly connected to the operating slide of which it is an extension.

A feature of this weapon's construction which is found in few machine guns is the ejecting of the empty cartridge case on the recoil stroke. This is accomplished by a piece that juts through the bolt face striking the empty cartridge case on its base, causing it to be thrown through a parallelogram-shaped opening in the left side of the receiver wall. Up to this point the cartridge case is held securely

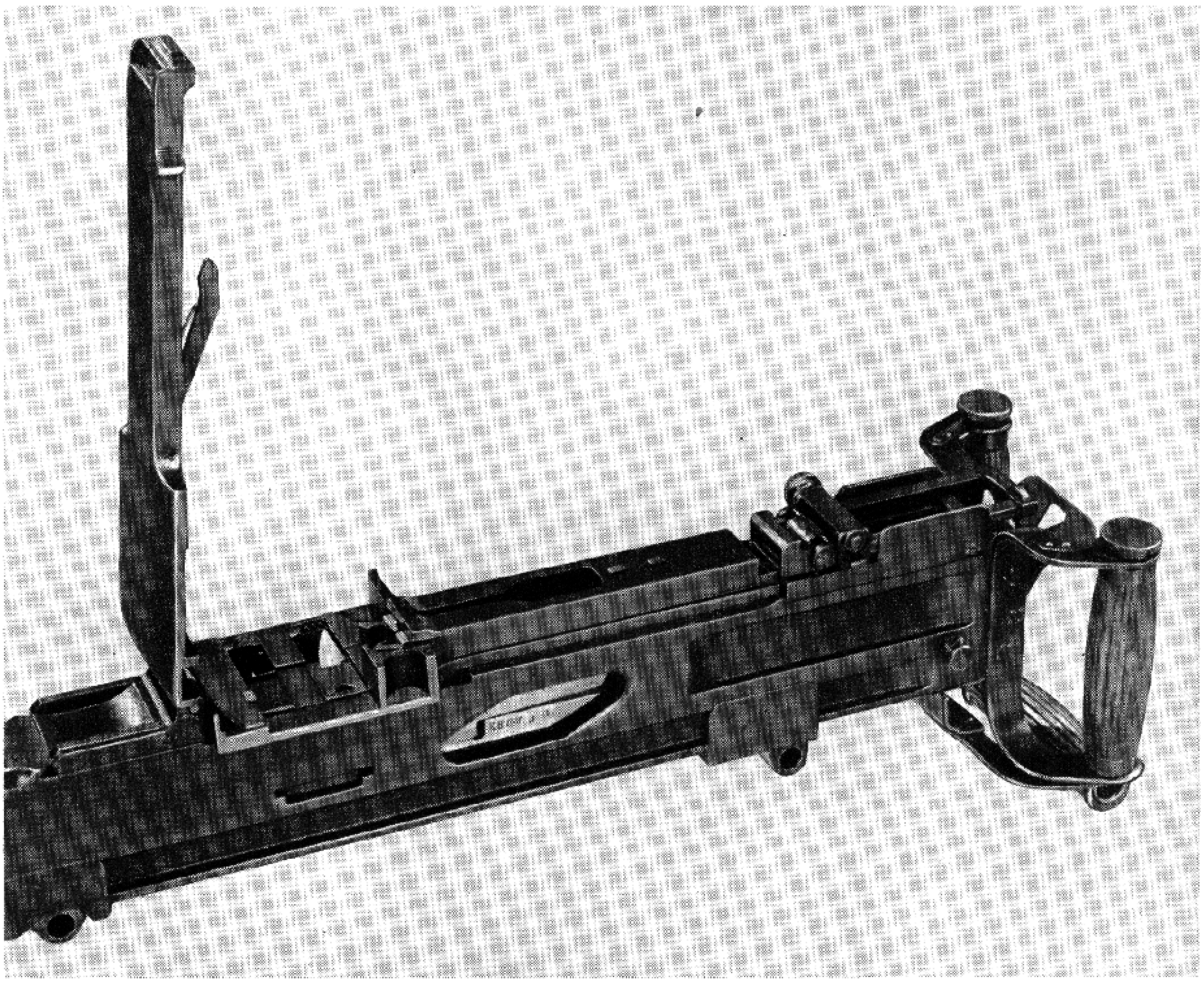

Figure 3–37. Receiver of SG–43 with cover open. Left side view showing cam which forces rounds down into the two-stage feed. Ejection takes place through the large diamond-shaped slot on the side of the casing.

to the bolt face by the conventional type of extractor, its spring-loaded lip snapping over the rim of the case.

The ammunition used in this model is the 7.62-mm standard infantry rifle cartridge. It is generally contained in a metal can manufactured specifically to hold multiple metallic belts of already linked cartridge and so designed that the top of the cam hinges back to permit it being closed at the end of a burst or at any time to keep out rain, dust, or any other foreign matter. The old-style canvas belt can be used in an emergency.

During the initial phase of feeding, the rim of the cartridge is brought to bear on a rib in the floor of the feed, bringing the round to a position whereby the rim positively stops its forward movement. This prevents a "short round" from being formed by jamming the body of the bullet down into the throat of the cartridge case. By holding the rim solidly, the spring-loaded jaws, located on the upper portion on the front part of the bolt face, can snap around the cannelure of the cartridge, putting the base into a device which has the efficiency of a T-slot. This is an unusually simple way to accomplish what was heretofore considered to be a very difficult act; however, its value is problematical since a rimmed cartridge is required.

The bracket that supports the gas chamber is

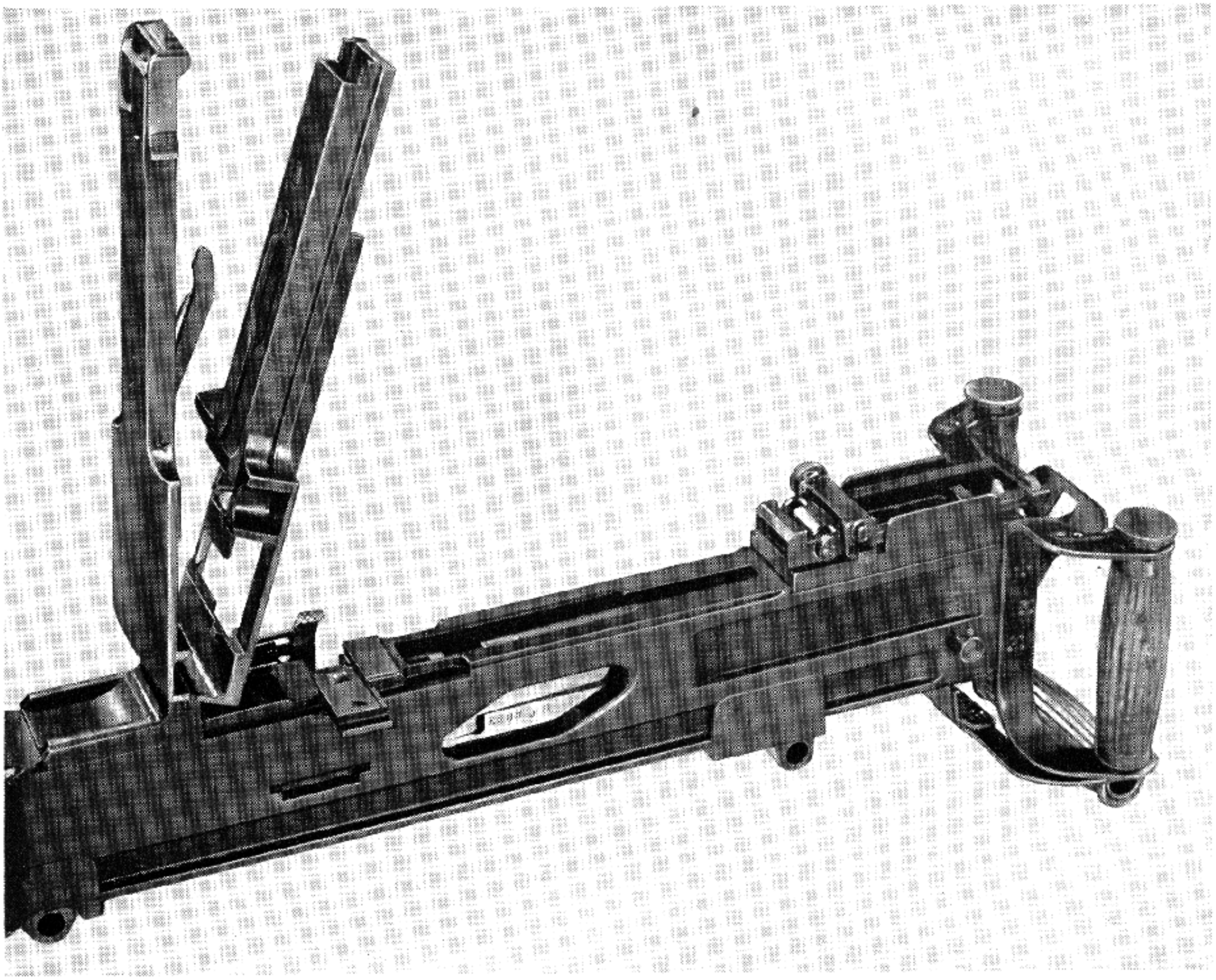

Figure 3 38. Receiver of SG 43 with cover and feedway hinged up to permit barrel securing wedge to be pulled out to release the barrel.

designed so that the operator can make a choice in rate of fire, allowing him to speed up or slow down the gun at will. This feature was thought necessary by the Russian High Command since so much of their fighting was expected to take place in extremely low temperatures. By opening the gas port, a gun that was sluggish from the cold could be given more operating power until it had time to warm up.

This weapon includes an advanced feed design, a development necessitated by the rimmed 7.62-mm cartridge which its uses. Since a solid T-slot machined on the bolt face could not be used and a push out belt is not possible with rimmed cartridges, a method of feeding in several stages was devised by which the round remains under mechanical control at all times, even when the gun is fired inverted.

In the first stage, spring loaded jaws take a firm grip on the round in the feedway and draw it rearwards. As the moving parts reach the rearmost position, the round is forced down by a spring loaded rib under tension into engagement with the extractor recess.

The second stage occurs during forward motion when the top rib of the bolt moves through the lip and rams the cartridge into the chamber. As the round is chambered, the ejector snaps over the rim of the case.

The front of the bolt is countersunk to receive the base of the cartridge; a clearance cut is provided

to prevent binding when the bolt locks. This cutting is done on the barrel to avoid cutting away of the circumference of the countersink on the bolt.

The belt feeding pawl is operated directly by the slide. This arrangement results in an undesirable protrusion of this assembly from the right of the gun. A cover spring is employed to hold up the cover when desired, somewhat in the manner employed on American type machine guns. The combined mounting bracket and stirrup are also reminiscent of the standard United States gun.

The absence of a buffer is best explained by the comparatively heavy slide. This gun fires from an open bolt so there is no danger of cook-off. This weapon can be fed only from the right side. Those in authority believe that to do otherwise would involve the manufacture of intricate parts, an effort not worth the cost.

The Soviet Army's favorite method of mounting is on their familiar low-wheel cart of the Sokolov type, which has a shield in front to protect the gunner operator from shell fragments and grenade particles, and even offers protection to a limited degree from rifle and machine gun fire. The weapon uses the improved version of the 1931 "Universal" type tripod.

A small metal hand-operated wheel located directly underneath and to the rear of the receiver allows the muzzle to be raised or depressed at will. The charging rod with its assembly is located underneath the operating slide and fits in the longitudinal grooves in the receiver. To charge the piece, the handle of the rod is pulled smartly to the rear until the piston is engaged by the sear. Now the handle is shoved forward into position.

The spade grip handles are very similar to practically all contemporary machine guns. However, the addition of the charging handle at the bottom gives the weapon a peculiar appearance.

The rear sight is graduated from 0 to 2,300 meters for the 1930 heavy ball round and from 0 to 2,000 meters for the 1908 light ball round.

Various markings appear on the receiver cover. The number of the weapon is stamped on the forward portion of the receiver.

Several reasons are immediately apparent why a T-slot could not be used on the bolt face. The locking action includes a displacement of the rear of the bolt to the right. To allow for this motion, a T-slot would have to be made with a loose fit around the cartridge head. The position of the operating slide caused interference, so it was necessary to use a Mauser type extractor and ejector and throw the empty cases to the left. This extractor rises over the rim of the cartridge just as the parts are coming into battery.

Doing away with all unnecessary springs is one of the greatest accomplishments of Goryunov; in fact, the driving spring and its telescoping guide, which is also spring loaded, are about all the springs employed for the gun's operation. In the event of a feed malfunction, the gunner can quickly unlatch the cover and by simply raising it up can get to the offending cartridges or links.

A cone-shaped flash hider is screwed to the threaded portion on the muzzle end of the barrel and helps to a great extent to keep the flame from the exploding powder charge from giving away the gun's position. This device is practically identical with the ones found on other Soviet machine guns and automatic rifles. Use of this device is more common at night when the wheel mount is converted into an antiaircraft mount. In this application abnormally long bursts are often necessary, in which there is a tendency for the flash to increase.

Cycle of Operation

To fire the SG–43, the gunner checks to see that the bolt is to the rear, then inserts in the feedway the cartridges contained in a flexible metal belt. He then positions the first cartridge to the left as far as possible, or until the belt holding pawl snaps behind the second round in the belt.

The gunner then actuates the trigger, allowing the action to go forward. The rim of the positioned cartridge being held top and bottom by the rib in the feedway permits the jaws of the cartridge pulling device to snap around the rim of the round. By retracting the action again, the cartridge is pushed down out of the grooves into a feed mouth to be picked up by the face of the bolt. The weapon is now cocked and ready to fire by pulling back on the trigger.

The firing mechanism starts forward, driven by the energy of the compressed driving spring. The angular cams on the gas piston extension start the movement of the two spring loaded cartridge hold-

ing pawls to the right until they are behind the second round in the feedway. Continued travel towards battery starts the chambering of the round which is completed with the bold arriving at the end of its counter-recoil movement.

At this moment, the rear end of the bolt body is shoved over into its locking recess in the receiver by the influence of a projection located on top of the gas piston riding in a curved slot in the bottom of the bolt.

The rear end of the bolt is now tilted over and it removes the obstruction that holds the gas piston retracted for a fraction of an inch. It starts forward and continues until stopped by the lug on the gas piston coming in contact with the firing pin driving it into the primer. This sequence just stated discharges the weapon.

The bolt is held securely locked behind the fired cartridge until chamber pressure reaches a safe operating limit. This factor is controlled by an orifice metering gas onto the face of the piston. Impact on the face of the piston starts the operating components rearward. The first fraction of an inch, the operating parts have free travel. Then the lug on the piston engages the unlocking slot in the bolt, pulling the aft end of the bolt out of engagement with its recess and drives the whole assembly rearward at great speed.

The first part of the unlocking action withdraws the lug from behind the firing pin, which retracts from spring pressure. The extractor claw pulls the cartridge from the chamber and holds it against the bolt face until the bolt travel is stopped; at this point, a pin protrudes through the bolt face pivoting the empty case through the ejection slot in the left side of the receiver.

As the gas piston starts to the rear, its grooves engage its corresponding ribs in the receiver body and move the feed floor towards the center of the feedway. As the gas piston reaches its position of rearmost travel, the rim of the cartridge is held top and bottom by the rib in top and bottom of feed way. The spring loaded jaws, located at the top, on starting to the rear pull the first round from the belt. Then a pivoting member in the feed cover pushes the loaded round down and into a form of feed mouth from which it is picked up and shoved into the chamber. The procedure is continued as long as the trigger is depressed.

Disassembly

To disassemble the SG–43, perform the following steps.

1. To open cover: Push the cover latch of the receiver forward, open cover and raise it upward.
2. To separate the frame of the receiver and slide from the base of the receiver: Raise the base of the receiver and remove the frame and the slide from the grooves of the base; move the base of the receiver forward to the cover; remove the slide from the frame.
3. To separate the backplate from the receiver group: Clasp the linch pin of the backplate with left hand and with the right hand move the handle a little to the right; while holding the backplate with the left hand of the left handle pull out the linch pin of the rear plate with the right hand, pulling the lower of the rear plate toward the body with both hands, push down slightly, and separate it from the receiver group; remove recoil spring from guide rod.
4. To raise the locking stud of the barrel: In order to disengage the barrel, raise the locking stud to the left as far as possible and leave it in a raised position.
5. To separate the belt feed slide from the receiver group: With the fingers of the right hand grasp the belt feed slide and lift it from the receiver group.
6. To remove the slide from the receiver group: Pull the slide back to the end of the receiver group, with the reloading handle. Grasp the bolt and frame with the left hand, lift them from the receiver group and remove the bolt from the frame; slide the reloader handle from the grooves of the receiver group.
7. To separate barrel from receiver group: While raising the rear plate of the barrel, shift the barrel forward by the handle until it is disengaged from the receiver group.

Field Stripping

This process involves the removing of the locking pin from the butt plate, removing the plate, and pulling the charging lever to the rear. This action withdraws all parts of the firing mechanism.

Assembly

To assemble, use the steps of disassembly in the reverse order.

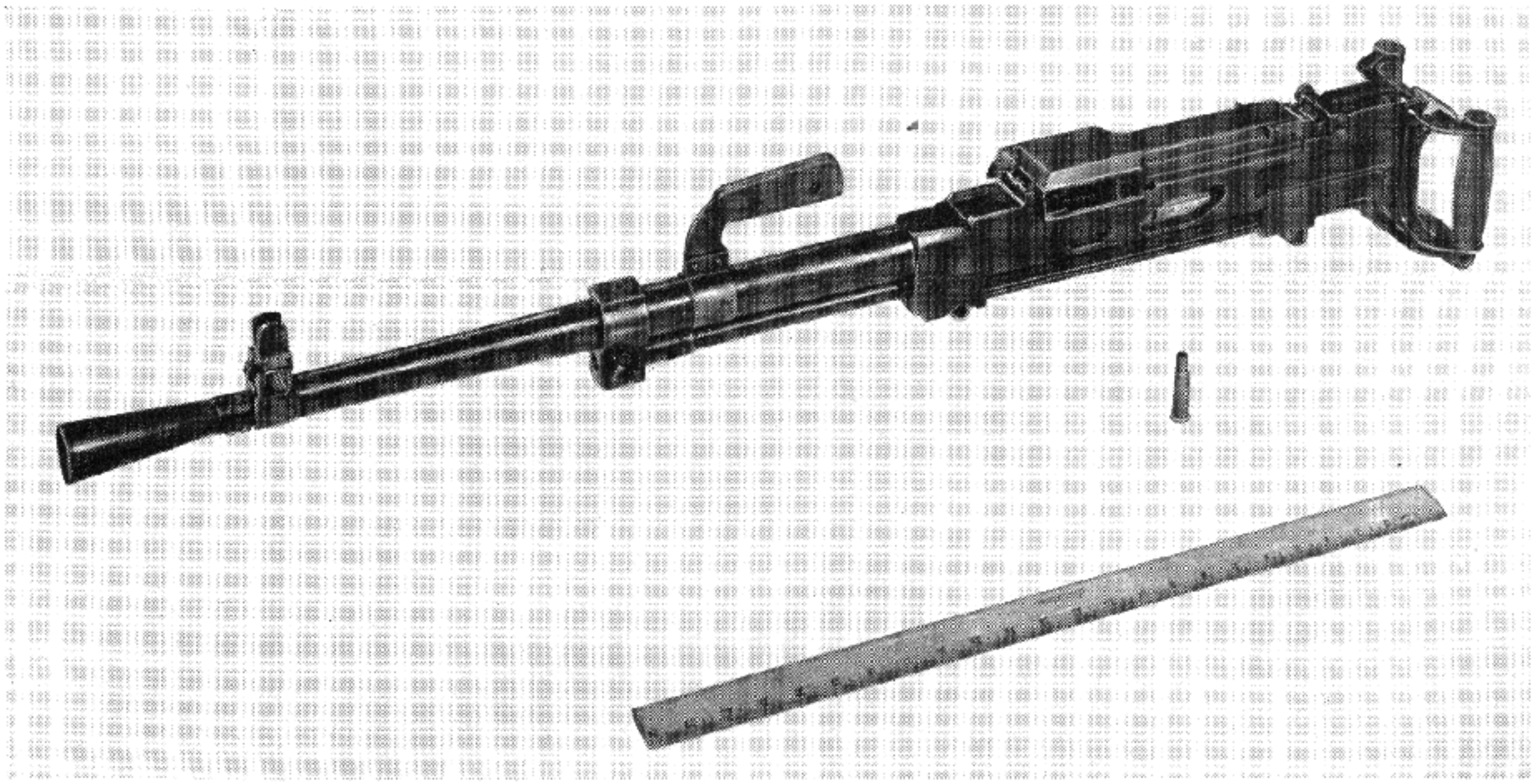

Figure 3–39. SG–43 dismounted from its tripod, left-side view.

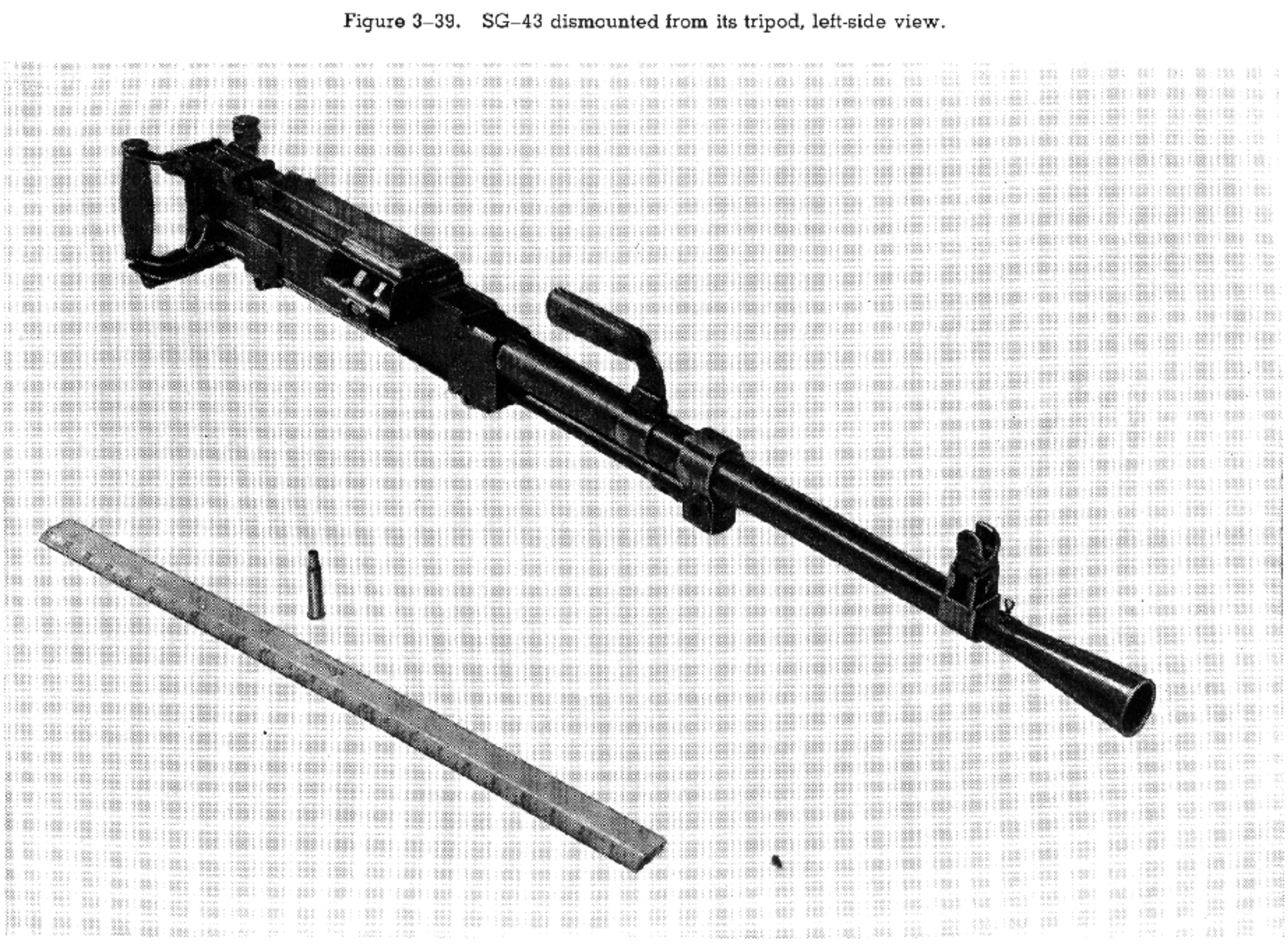

Figure 3–40. SG–43 dismounted from its tripod, right-side view.

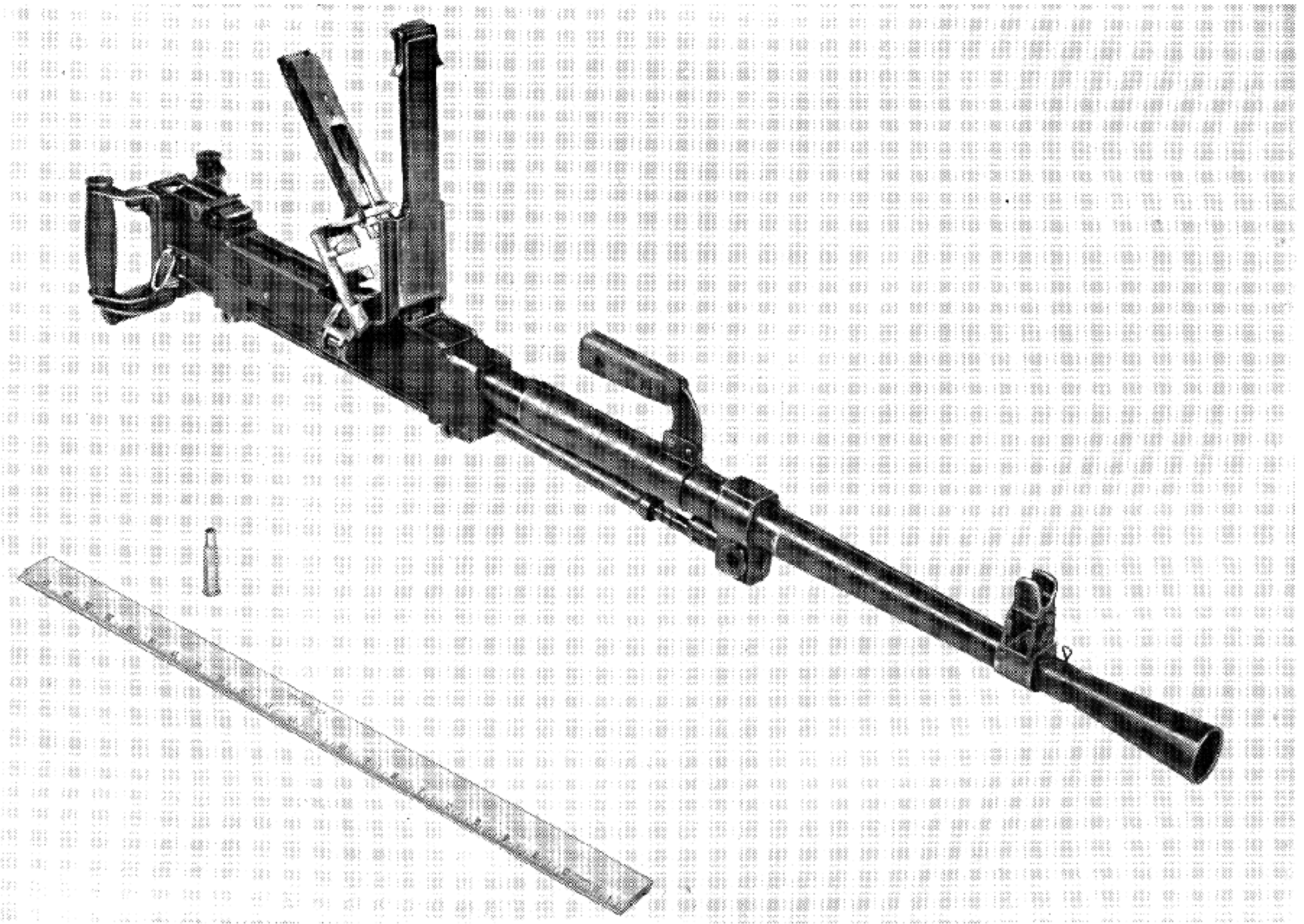

Figure 3-41. Stripping the SG-43. Feed cover opened and two-stage feed hinged up. Barrel has been released and started out of its seat.

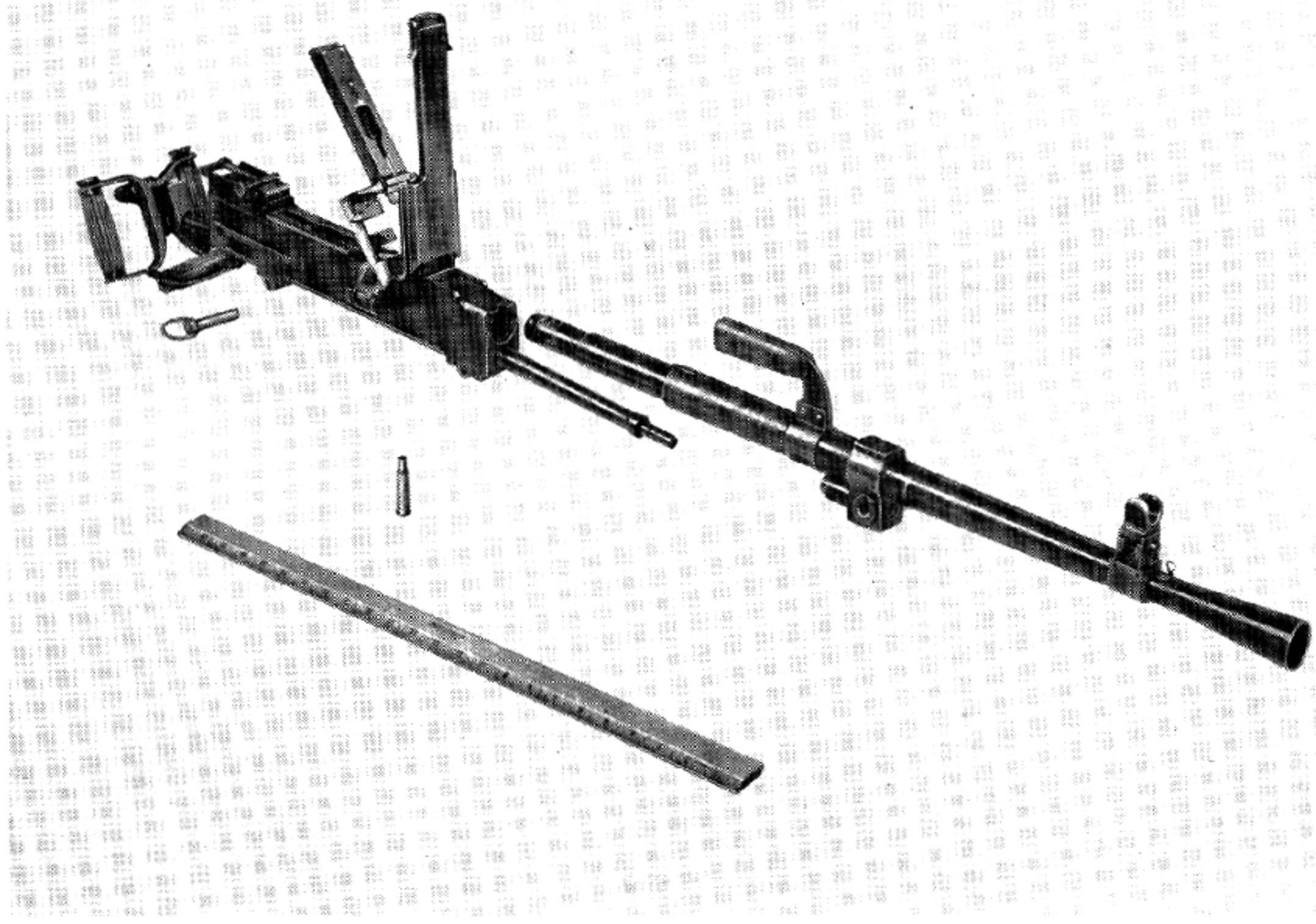

Figure 3-42. Stripping the SG-43, continued. Backplate group released by pulling out retaining pin. Barrel has been removed to the front.

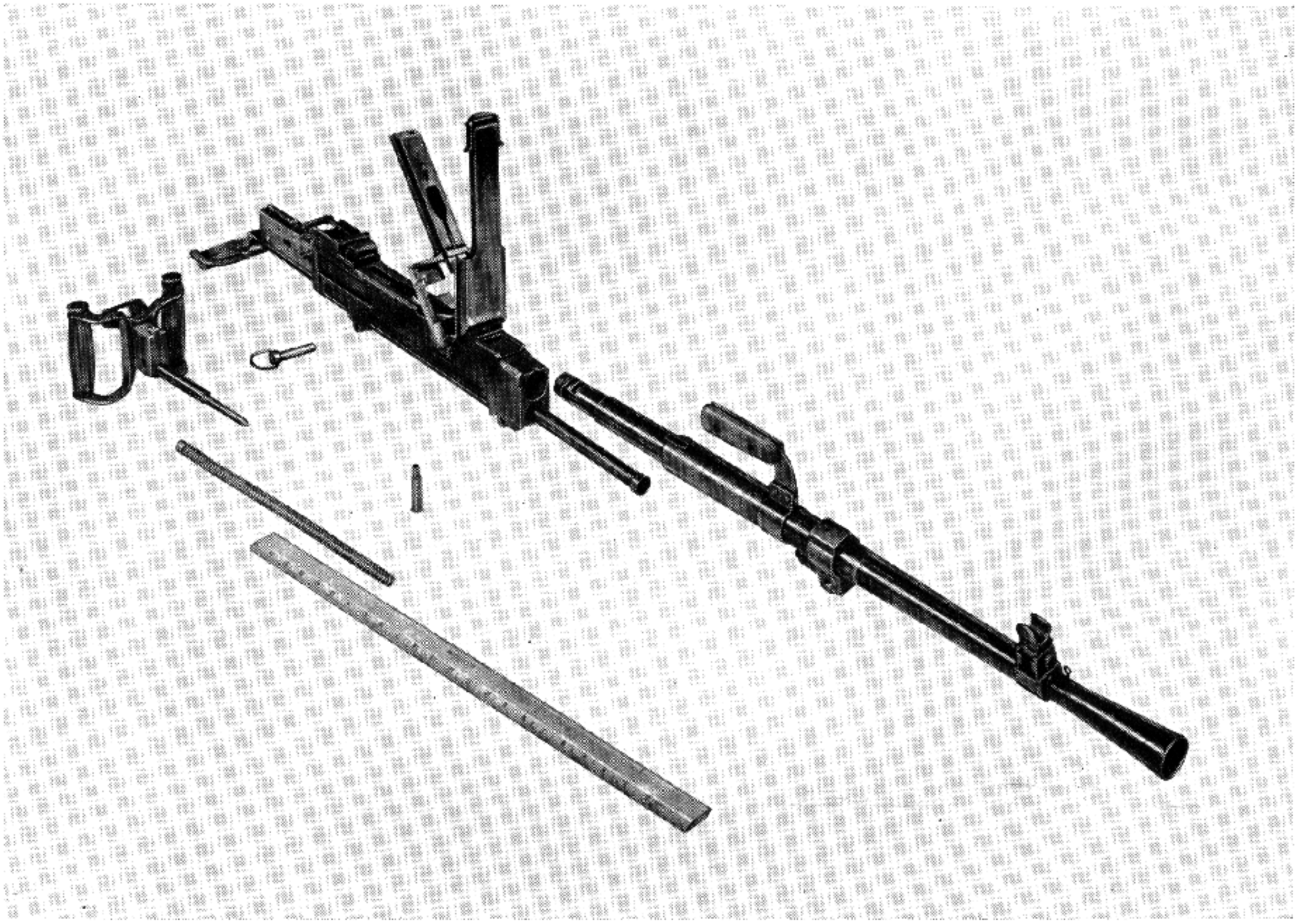

Figure 3–43. Stripping the SG–43, continued. The backplate group and the mainspring have been removed. The recoiling parts have been started out the rear by a pull on the retracting handle.

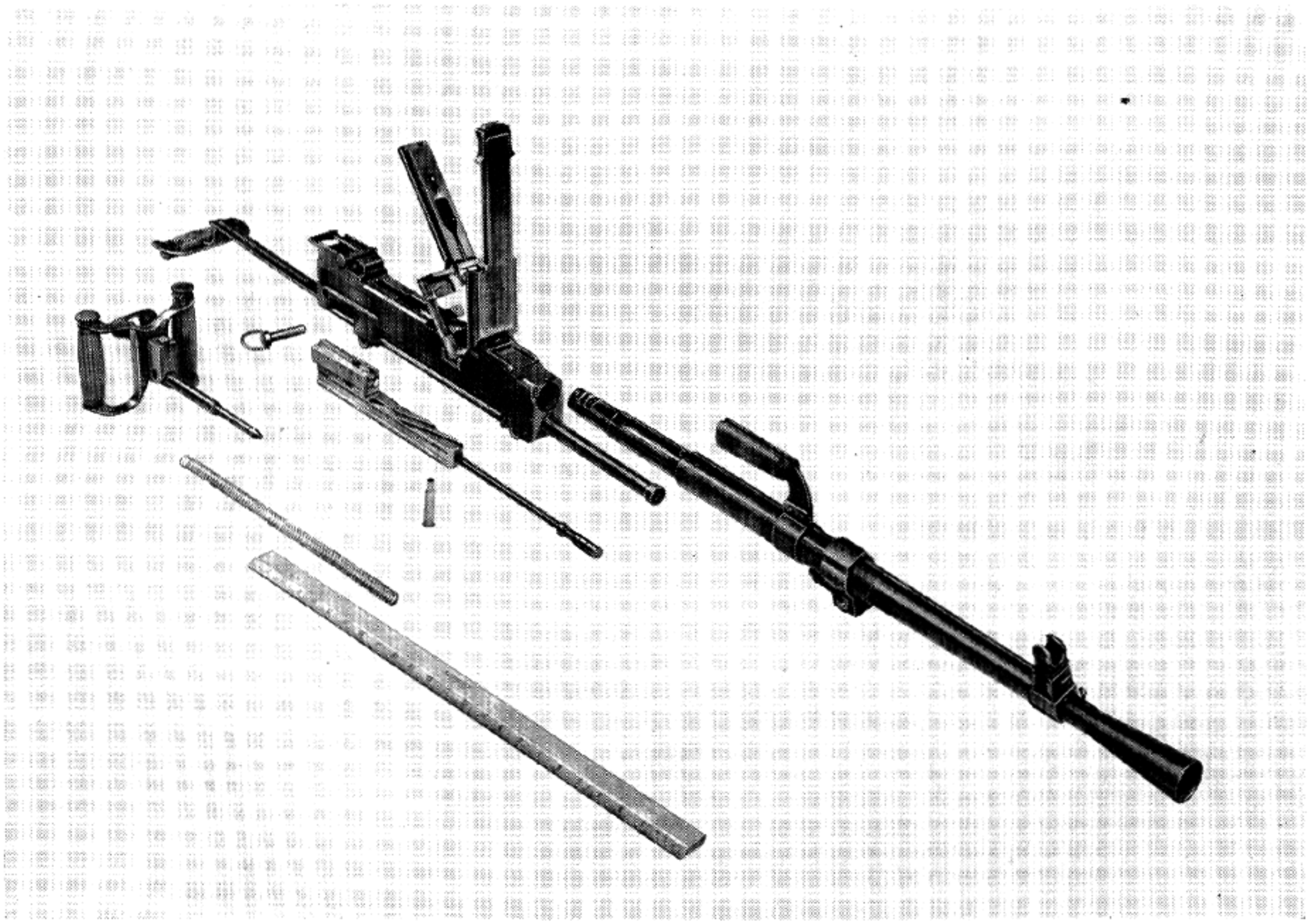

Figure 3–44. Stripping the SG–43, continued. The bolt and the operating slide, with piston attached, have been removed.

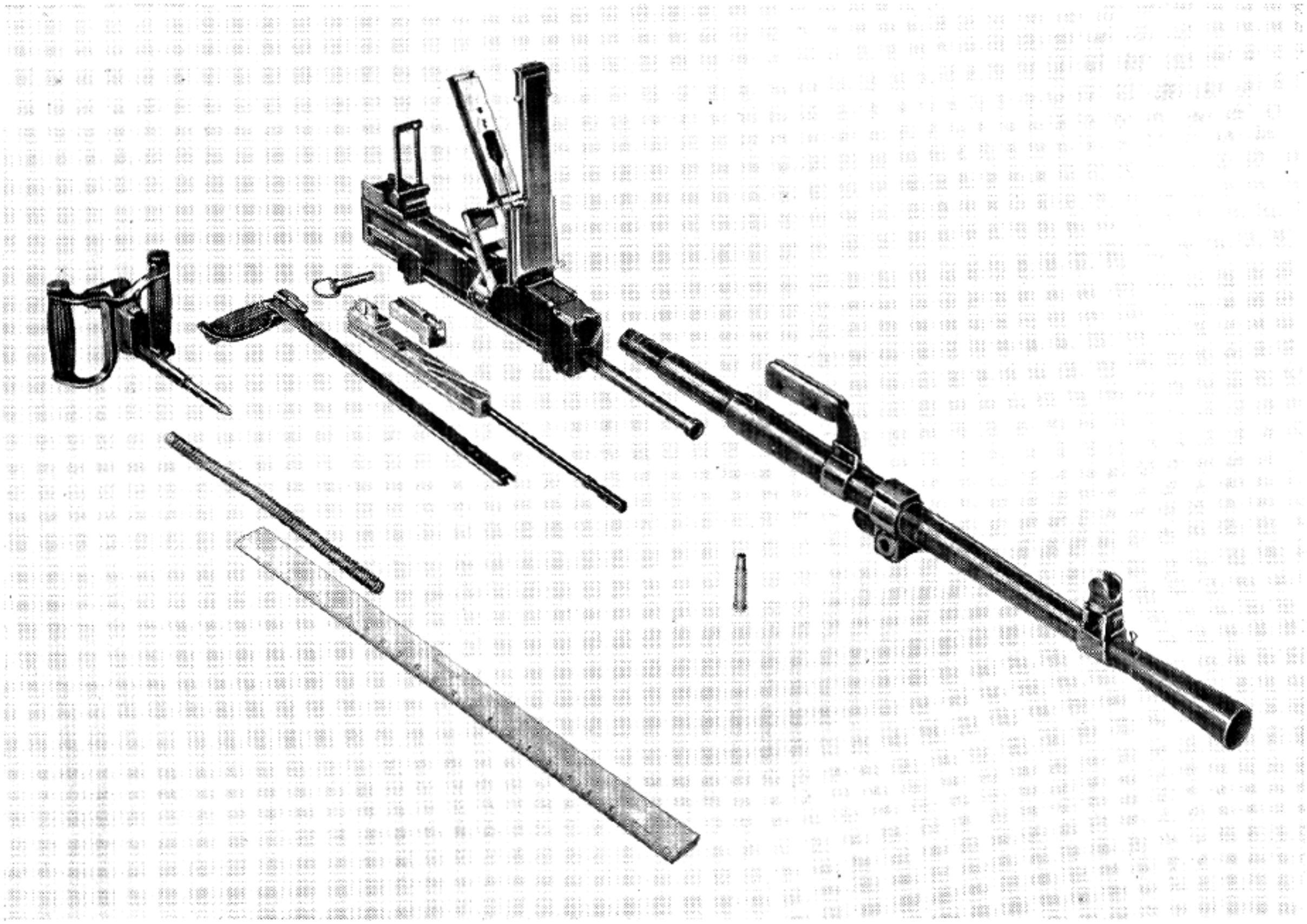

Figure 3–45. Stripping the SG–43, continued. The retracting handle has been removed. The bolt has been separated from the operating slide.

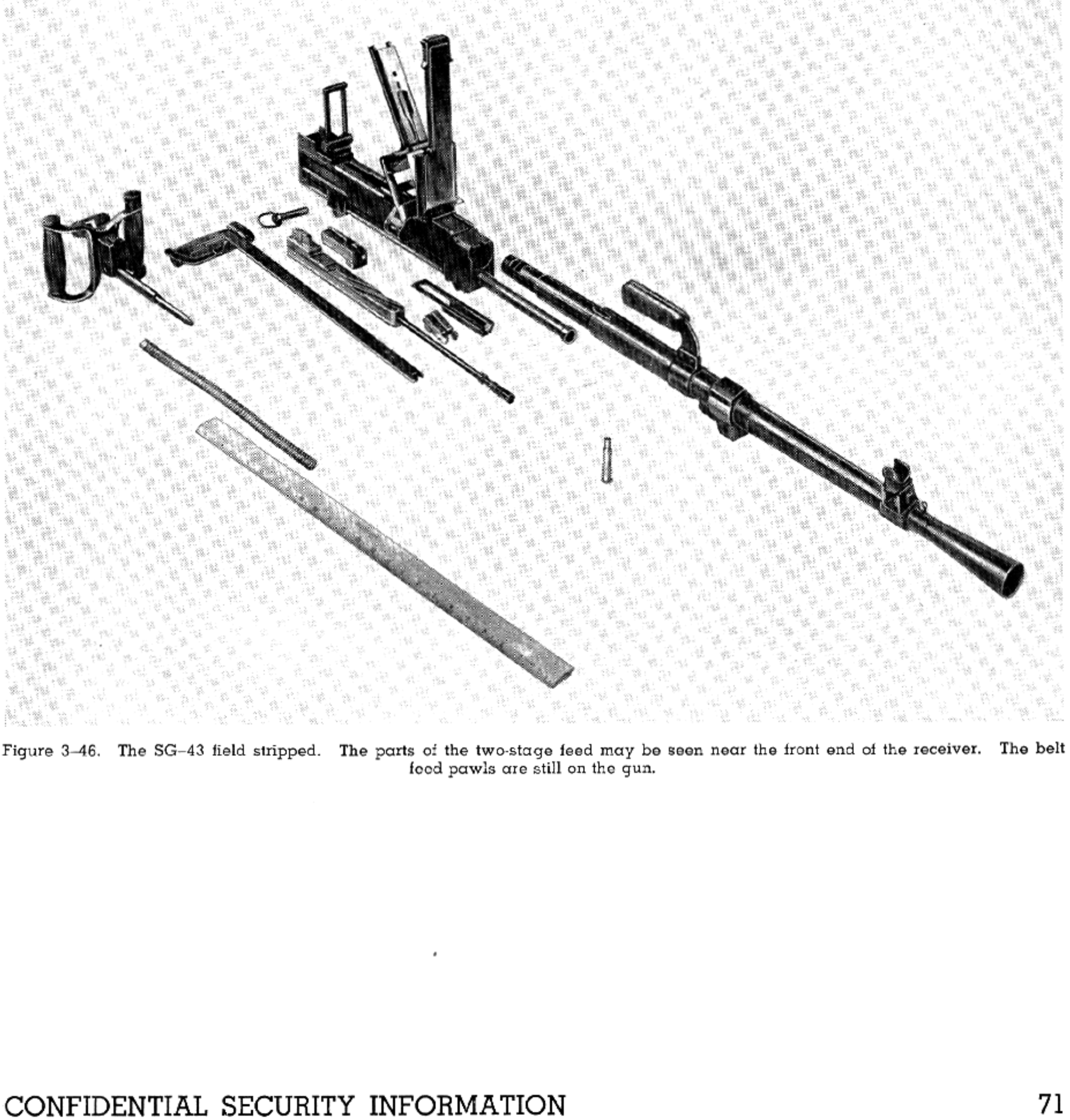

Figure 3–46. The SG–43 field stripped. The parts of the two-stage feed may be seen near the front end of the receiver. The belt feed pawls are still on the gun.

Chapter 4

SHKAS 7.62-mm MACHINE GUNS AND SHVAK AUTOMATIC GUNS

Weapons Included in This Chapter

Shkas Aircraft Machine Guns of the 426 Series*

Designation	Bore diameter	Use	Year of appearance
Machine Gun 426	7.62-mm	Prototype	1932
KM-33	7.62-mm	Flexible	1933
KM-35	7.62-mm	Flexible	1934
	7.62-mm	Wing	1935
KM-36	7.62-mm	Flexible	1936
	7.62-mm	Synchronized	1937
Model 1941	7.62-mm	Wing	1941

*All Shkas machine guns include the number 426 in their markings. By substitution of parts, it is possible to change the tactical employment of the guns marked K. M. (Constructed Model) and Model 1941.

Shvak Automatic Aircraft Guns (Shpitalny-Vladimirov)

Use	Designation	Time of appearance	Caliber
Motor	MP	Early part of World War II.	20-mm
Wing	KP	do	20-mm
Flexible	TP	do	20-mm
Synchronized	SP	do	20-mm
		do	12.7-mm
Prototype		Latter part of World War II.	37-mm

History and Background

The Russians boasted in the early nineteen thirties of an aircraft machine gun of native design that was equal to that of any European power. The appearance of this gun marked the successful conclusion of a development program that had been carried on with the utmost secrecy for a number of years and resulted in the production of a high-speed weapon adapted to aircraft use and suited to both fixed and flexible use on fighter planes.

The finished product was officially given the name of Shkas. The first and second letters stand for the co-inventor, Boris Gabrielovich Shpitalny; the letter K, for the other half of the design team, Irnarh Andrievich Komaritisky; the fourth letter for the Russian word meaning aviation; and the final letter for the Russian symbol for high speed. In other words, the name Shkas means the Shpitalny-Komaritsky Aircraft High-Speed Machine Gun. The weapon was rigidly kept in secret status, but reports as early as 1932 showed that the U. S. S. R. had done much experimenting before accepting the newly designed gun.

The first known model other than the prototype was the KM–33. The translation of "KM" is "constructed (or manufactured) model," and "33" represents the date of origin. Letters were used to designate use: 'T' for flexible, K for wing, S for synchronized. From that time on, all SHKAS guns were marked accordingly.

All progress on the weapon's development was kept in close security. In 1936, Russian reports of its use in the Spanish Civil War referred to it simply as "special machine gun."

Air-firing with the early model Shkas in fighter planes showed good results, but the original construction model made in 1933 was soon eliminated in favor of the production gun "type 426." The latter, however, had only a few minor modifications that were thought necessary to fill more adequately the requirements for aircraft installations.

The KM–33 used a conventional Russian type 6 front sight and a type 5 rear sight. When first

mounted, it was adapted to fit the outmoded Degtyarev mount. The saddle shaped ammunition can was located underneath and held 250 cartridges. A wooden handle piece was used to rotate the feed to index the rounds for loading.

The KM–35, which appeared in 1935, was the standard version. This was followed by the KM–36 which had only a few changes, mostly in mounting and sights. In 1937, a synchronized version appeared. This was definitely an improvement, both in refinement and rate of fire, and it finally backed up with fact a boast made in a May Day speech in the early nineteen thirties to the effect that Russia had an aircraft machine gun of native design which was equal to that of any European country.

A steady production of this superior machine gun allowed the Soviets to put it into use.

The earliest Soviet fighter planes sent to the Spanish front were armed with two Russian-made 7.62-mm guns for synchronized firing through the propeller. A Shkas was mounted as a free gun on a Soviet version of the well-known Scarff ring. Later, two more Shkas guns were added for fixed firing, but they were mounted outside the propeller arc.

These Shkas guns were capable of firing at a speed of 1,800 rounds per minute. When the improved model was issued in 1937, the speed rate was stepped up to a cyclic rate of 2,000 shots per minute when the longest barrel and the largest permissible gas orific were used. As fast as they became available, the improved guns replaced the earlier Shkas models.

Since 1937, the weapon has undergone numerous modifications, most of which are external refinements on such items as barrel lengths, grips, sights, and methods of mounting. Basically, the weapon has remained identical with the first model, as the Russian Air Force believed it had in this machine gun the best of its caliber in existence. The main tactical use of Soviet aircraft, both fighter and bomber, was to support ground troops at a low altitude. A battery of these high-speed machine guns was excellent for strafing.

Soviet policy has always been to retain only proved weapons. This was adhered to so closely during the early part of World War II that it retarded development work on newer weapons. The Shkas, for example, having already been proved in the Spanish Civil War, was relied upon until it became obvious in World War II that all small caliber machine guns were outmoded both for offense and defense. But whenever a rifle-caliber machine gun could be employed to advantage, the Shkas bore the brunt of the work.

For fixed synchronized installation, extra long barrels were supplied. Such barrels caused the muzzle to protrude from the fuselage, making a blast tube unnecessary, and added slightly to the velocity of the bullet. The standard, or short, barrel was used as a free gun.

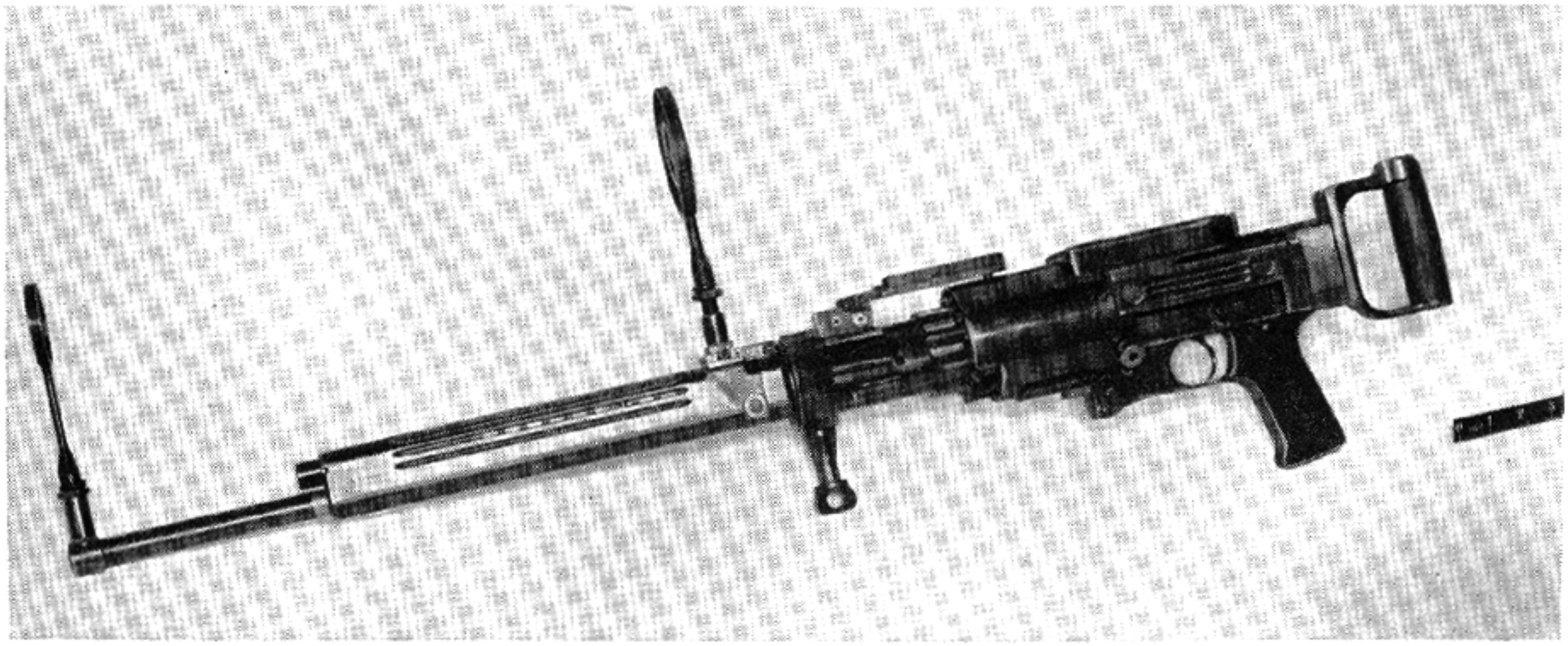

Figure 4–1. 7.62-mm Shkas Flexible Aircraft Machine Gun, left side view.

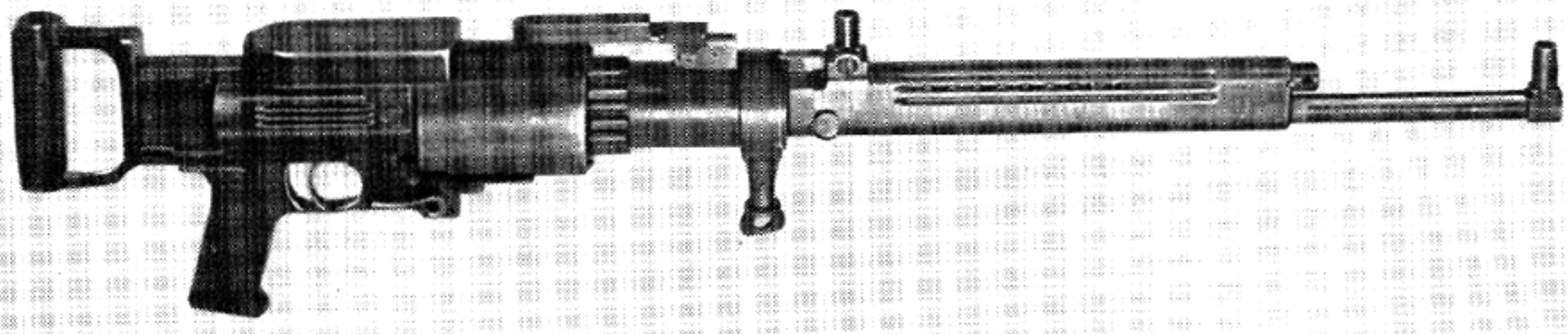

Figure 4–2. 7.62-mm Shkas Flexible Aircraft Machine Gun, right side view.

The Shkas guns which appeared in Spain were non-synchronized; they were marked with dates as early as 1936. After the German attack of 1941, the existence of other versions was confirmed, as shown in figure 4–3.

The Russians demonstrated great skill in adapting at low cost the best of time-proved principles to their particular needs. Construction was in two phases: a quick, coarse, machining operation on all parts followed by final fitting and assembly on the work

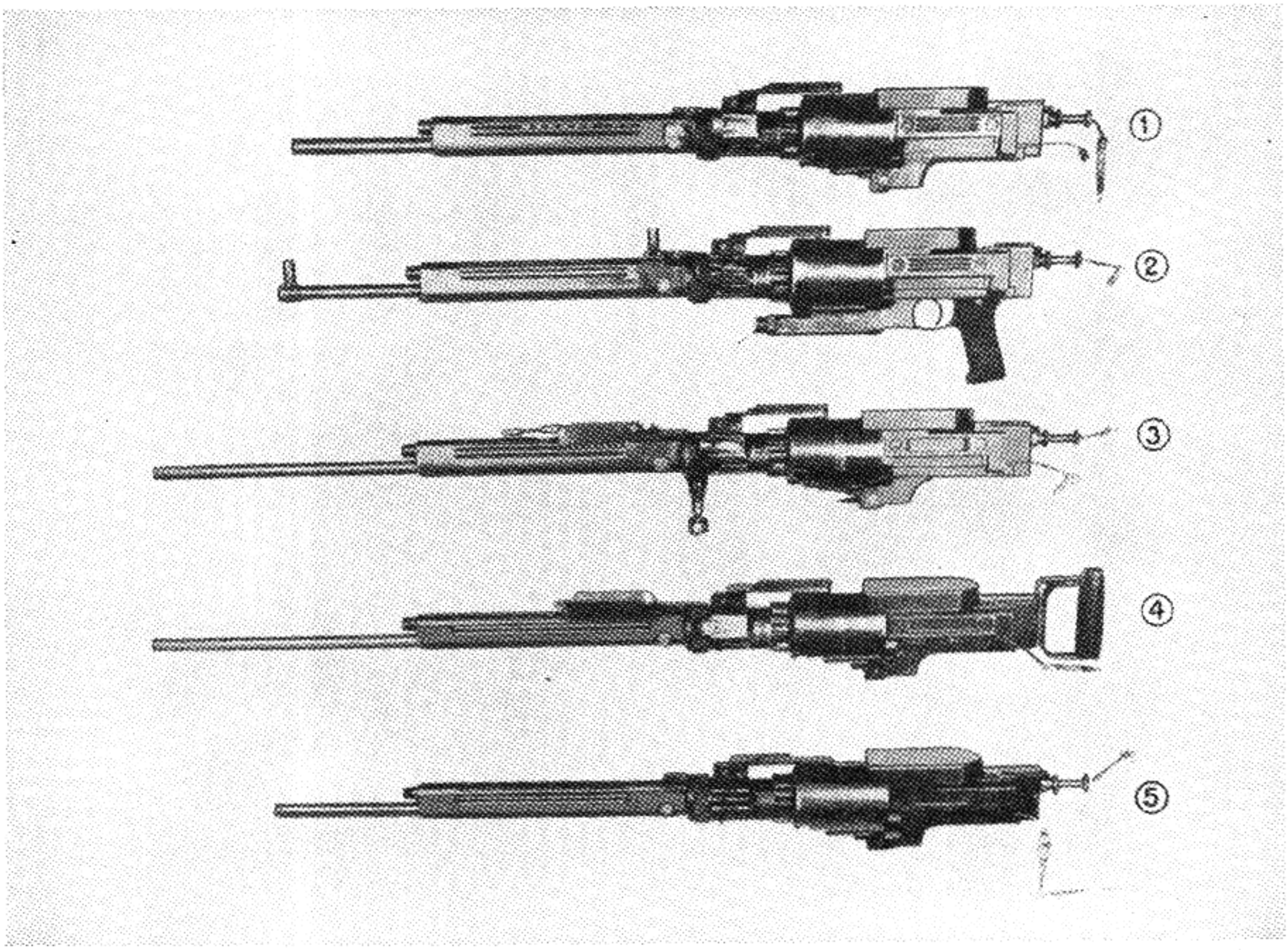

Figure 4–3. Variations of the Shkas: (1) Wing (KM–35; (2) flexible (KM–35, but with mount of KM–33); (3) synchronized, cable retraction (introduced 1937); (4) synchronized, handle retraction; (5) wing, 1941 type.

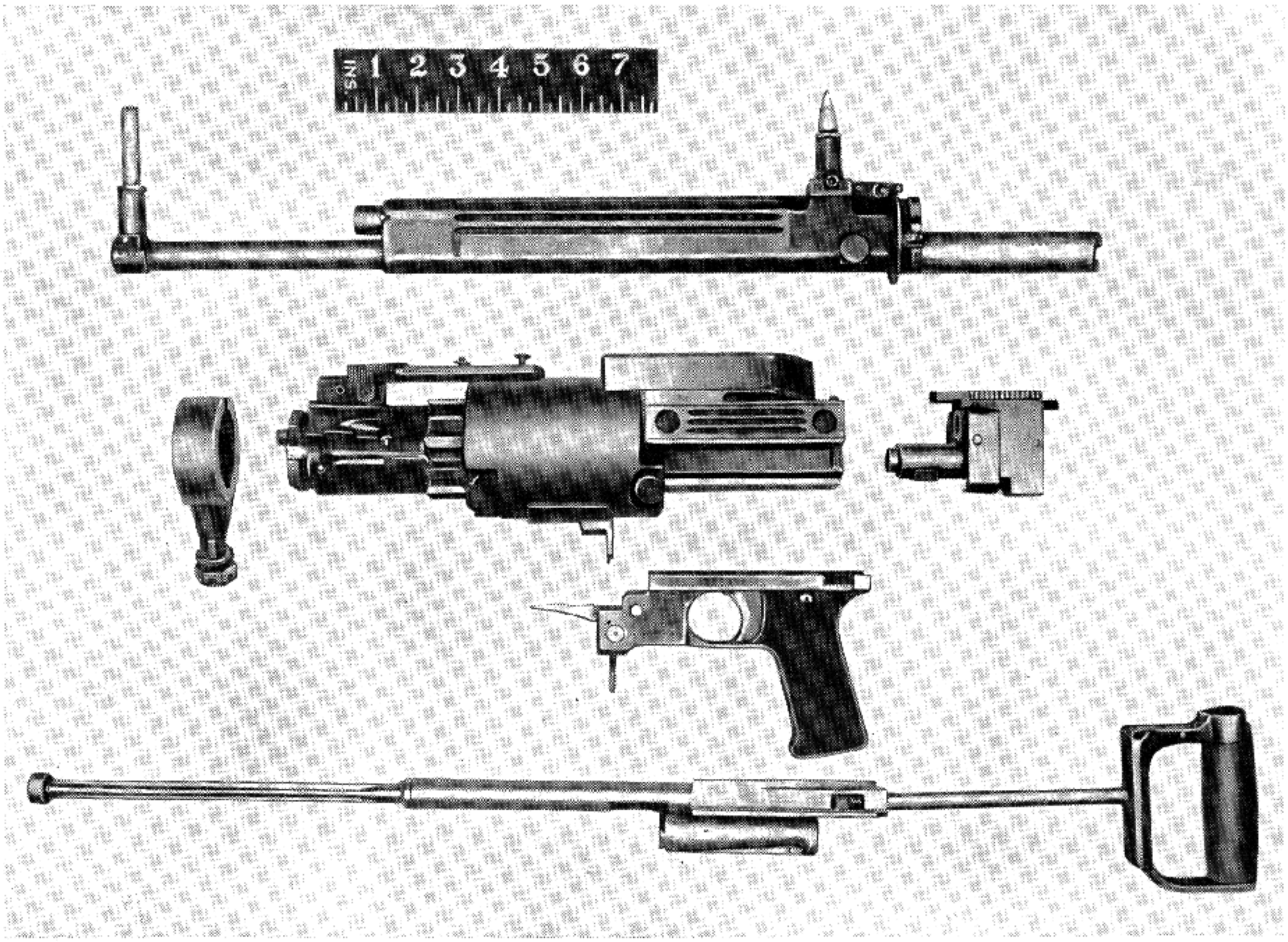

Figure 4–4. 7.62-mm Shkas Flexible Machine Gun, field stripped.

bench. Maximum use was made of semi-skilled labor with a minimum of fine gaged machine tool work. The need for spare parts was reduced by rugged construction of the original components.

For the sake of economy, very low standards of finish were purposely used, resulting in a gun unrefined in appearance and with only a moderate degree of interchangeability. Finish was considered secondary to ease of manufacture. The rough surfaces do not indicate lack of skill or facilities for high-grade production.

The Shkas continues in use today. It has been observed in action in the Korean Operation and is known to be in service in the Air Forces of various Soviet satellites. Figures 4–5 and 4–6 show a fixed version of the Shkas which was captured from the North Koreans by United States Forces.

Shvak Automatic Guns. The Shvak 20-mm automatic cannon, the first of its kind, appeared for the first time during the earliest days of World War II. It was originated by Boris Gabrielovich Shpitalny and S. V. Vladimirov. The gun was brought into being by desperation rather than by forethought. It is a scaled-up version of the 7.62-mm Shkas machine gun. The similarity is confined to the basic principles of the feed mechanism and the operating mechanism. It is noticeable that for the reason of either economy or lack of ideas, the Soviets followed the practice of scaling up rifle caliber weapons.

A 12.7-mm machine gun along the same lines was made at the same time. This gun was dropped, however, because it complicated the ammunition supply. The original Degtyarev cartridge was supplied without the rim; to add a rim to this cartridge

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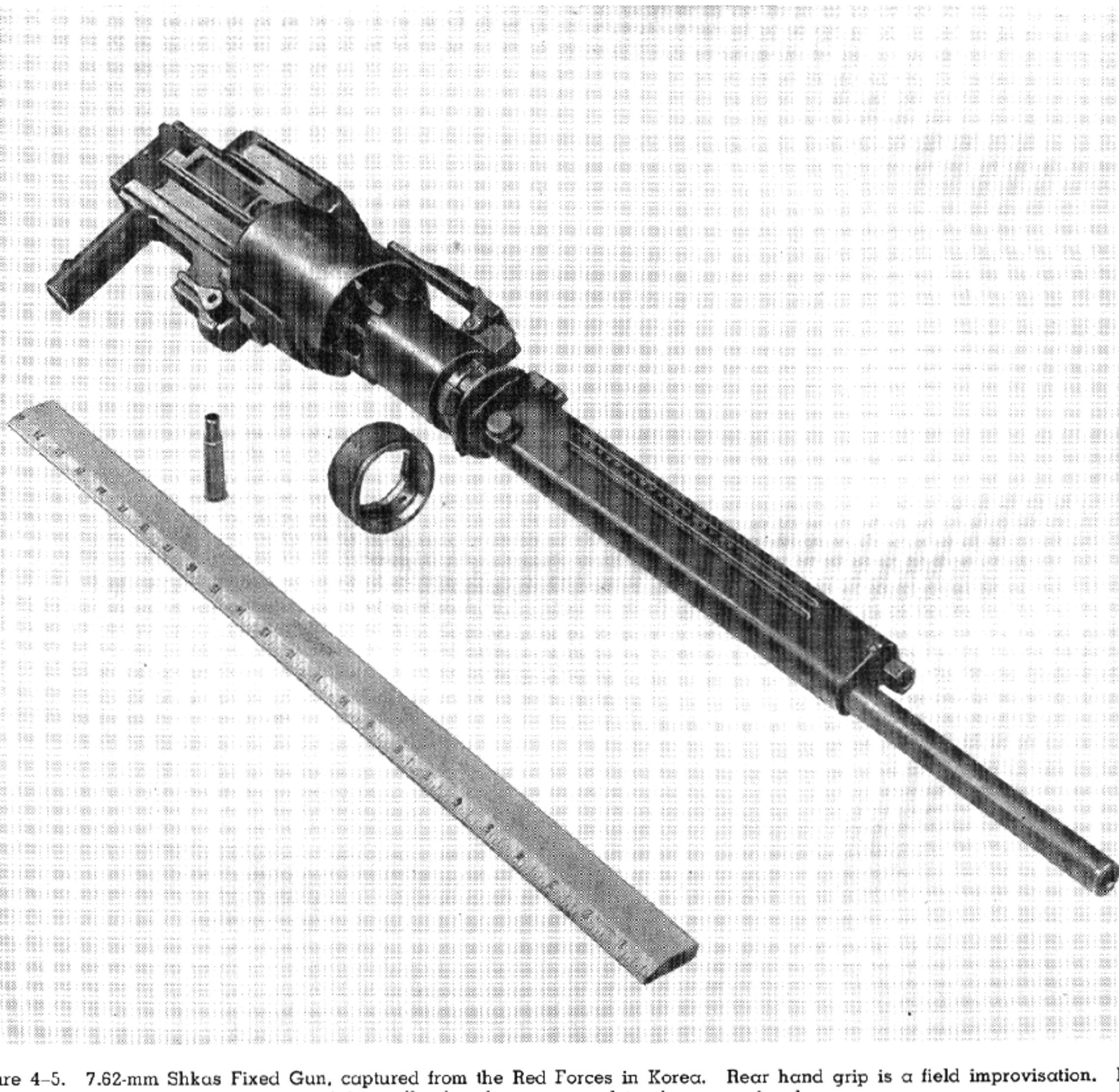


Figure 4–5. 7.62-mm Shkas Fixed Gun, captured from the Red Forces in Korea. Rear hand grip is a field improvisation. Barrel retaining collar has been removed to show securing lugs.

Figure 4-6. 7.62-mm Shkas Fixed Gun, with barrel assembly removed.

at the production stage necessitated considerably more work. (The Shkas design requires rimmed cartridges.)

The 20-mm aircraft cannon used a scaled-up Gatling (Gorloff) cartridge which was practically without taper. However, the Gatling round, which was designed for the manually operated weapon, was about caliber .42.

There were two flexibly mounted versions of the 20-mm type of cannon, one with twin grips and the other with a pistol handle arrangement underneath. Records show that these versions were used extensively in tanks. Shvak guns were also mounted in turrets of aircraft, but with an automatic fire interrupter.

On 20-mm Shvak cannon, the markings are: MP for motor, KP for wing, TP for flexible, and SP for synchronized.

Attempts to scale up the 20-mm to 37-mm size were made but did not prove successful.

SECTION 1. SHKAS 7.62-MM MACHINE GUN

General Data on Later Models

Caliber: 7.62-mm (special aircraft cartridge).
Rate of fire: 1,800–2,000 rounds/minute.
Muzzle velocity: 2,430 feet/second.
Gun length: 27½ inches.
Gun weight: 23 pounds 8 ounces.
System of operation: Gas piston actuated.
System of locking: Propped breech (Berthier). Bolt is forced down in front of lock shoulders.
System of feeding: Belt and revolving cage.
Method of charging: Manual.
Method of cooling: Air.
Rate control: Rate can be varied by gas regulator.
Barrel weight: 2 pounds 10 ounces.
Barrel length: 23½ inches.
Barrel removal: Not a quick change barrel.
Chamber pressure: 44,000 psi.
Bore:
Number of grooves: 4.
Groove depth: 0.0065 inch.
Groove width: 0.158 inch.
Pitch: One turn in 10 inches.
Direction of twist: Right hand.
Form of twist: Concentric.
Chamber: Has flutes to aid extraction.
Method of headspace: Factory established headspace is held secure by barrel lock catch.
Location of feed opening: Bottom center.
Location of ejection opening: Upper left side of receiver; ejects forward.

Description of the KM-33

This gun can be identified easily, as it has a barrel jacket that extends its full length. It is very compact and rugged in construction. Reports claim that the mechanism is practically trouble-free and that unusually high rates of fire of 1,800 rounds per minute have been attained.

The Shkas is belt fed and gas operated. It weighs 25½ pounds and is chambered for the Russian 7.62-mm cartridge with a muzzle velocity of 2,750 feet per second. Although it is admittedly complicated in appearance, it is reliable in every respect.

An interesting departure was made from the heretofore orthodox practice of feeding ammunition to a gun of this caliber. The feed, somewhat resembling a grooved revolver cylinder, is an integral part of the gun, and the cartridges remain axial throughout the entire operation.

The cylindrical feed cage is rotated by an arm that engages a slot in the gas piston. A helical groove in the drum arrangement withdraws the cartridges from the metal disintegrating link belt as it moves through the feedway by engaging their rims and gradually camming the cartridges rearward. The freed cartridges are then presented at the bottom of the receiver for chambering by final rotation.

This circular type of feed holds ten rounds. Several phases are required to completely delink a round and roll it up into position for being shoved into the chamber. A small folding handle held on the top side is used to rotate the feed drum when filling with cartridges.

Camming the round slowly out of the belt with this type of feeder causes practically no drag when the weapon is fired at high speed. It has belt pull enough to take care of practically any length belt desired.

The ejection system is a novel application of the early Maxim method of pushing the empty cases

forward out of the receiver instead of down or to the side. The ejector opening, located in the top left side of the receiver, is in the form of a tube.

The ejector consists of a cam-operated lever with a projecting arm that sweeps the empty cartridge case off the bolt face and holds it so that on counter-recoil of the piston it will strike the rim of the empty case, driving it forward out of the tubular opening. Many advantages can be found in this type of ejection.

The grip used for flexible firing also serves as a charging handle merely by pushing in on the release button at the top of the grip and pulling it all the way to the rear. When a pistol grip handle is used, a small charging handle is located in the rear.

The center section of the barrel is made up of several aluminum cooling fins to help dissipate the heat. No provision is made for single shots, there being only two choices on the selector switch: AUTOMATIC FIRE and SAFE. The firing pin is not attached to the gas piston, in contrast to other gas-operated firing mechanisms, but is pinned in the bolt body and allowed to float. Not being spring-loaded, the round is cammed rearward as the empty cartridge case is swept from the bolt face. The buffer consists of two heavy springs, the smaller one nested in the larger.

The normal amount of ammunition carried in fixed mountings is 750 rounds, but in some turret installations the container holds as many as 1,000 to 1,500 cartridges. This fact speaks eloquently for the abnormal belt pull of the weapon with its slow-camming revolving-type feed. The Russian Air Force nicknamed this circular arrangement the "bird-cage" feed. It is an adaptation of a system first used by the Polish designer, Gabriel Szakats.

The unlocking action, by which all machine guns are classified, is that of the much-copied Berthier. In this system, the piston driven to the rear lifts and unlocks the bolt, carrying it to the buffer. This procedure is followed by counter-recoil, at the end of which the bolt is locked. The function of unlocking is then repeated to begin another cycle.

Thus the Shkas is an innovation based on the features of the Maxim (ejection and buffer), the Szakats (rotating feed), and the Berthier (piston-actuated, propped breech, locking). Hardening processes are rarely used in the construction of this weapon. Rough tool marks are seen on nearly all components, most of them bearing evidence of hand filing. The most accessible surfaces are turned and hand finished; where machine finishes are interrupted, the projections or flats are finally shaped by hand filing. Sharp edges are unevenly chamfered,

Figure 4–7.. 7.62-mm KM–33, an early version of the Shkas Aircraft Machine Gun.

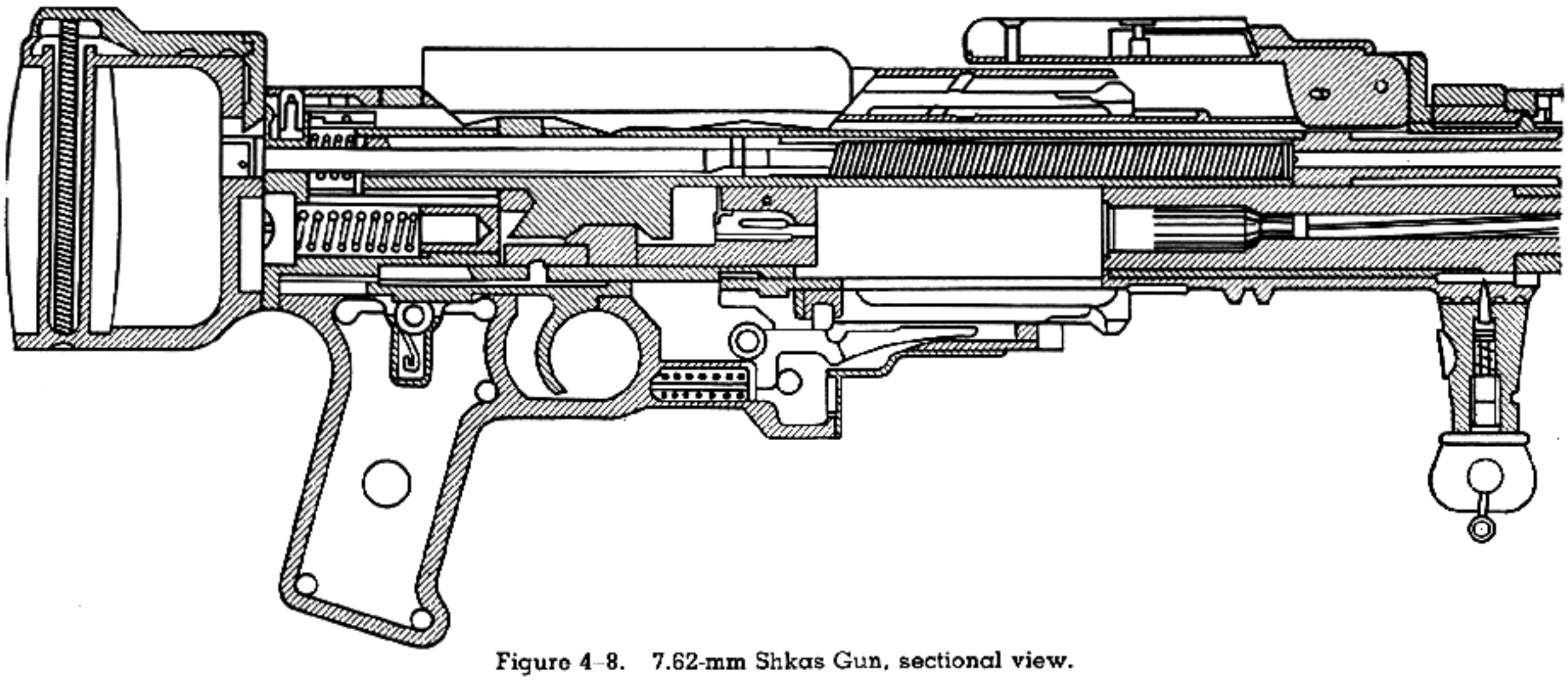


Figure 4–8. 7.62-mm Shkas Gun, sectional view.

also by hand; and the crude uneven radii shown in cross-section drawings suggest that components are not held to close tolerances by gages.

While the gun is known for its unusually high rate of fire, it does have provision for regulating the cyclic rate. This is done by changing the position of the holes in the gas regulator, which comes with holes of three different sizes, 1/12-inch, 1/10-inch, and 1/8-inch. The smaller the orifice used, the more moderate is the rate of fire obtained.

No flash eliminator is attached to this gun, contrary to the custom in practically all Russian machine guns. However, some barrel ends have been found to be slotted, and in some instances they are threaded. It is assumed that a flash eliminator is fitted to some of the later models.

Cycle of Operation

To fire the Shkas, the gunner introduces the loaded belt into the first flute of the circular feeder and then raises the folded handle on top of the receiver, pulling it down and to the left as far as it will go.

The rounds are moved around by a ratchet movement and cammed out of the belt until ten are in the cage and the first cartridge indexed.

The button on top of the hand grip is pushed in and the bolt assembly is pulled back until the rear sear engages the gas piston, holding the operational parts in the cocked position.

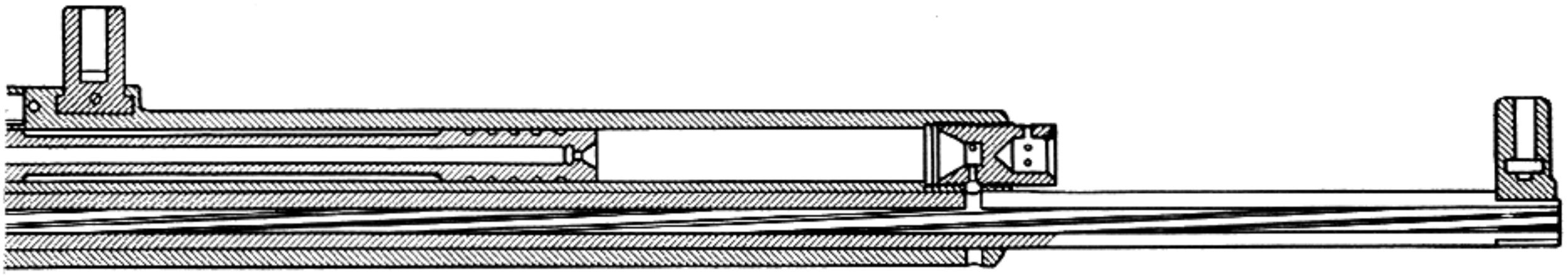
The grip handle is then shoved forward until its securing latch clicks into position. The weapon is now charged and ready to fire.

When the trigger is pulled, the gas piston and bolt fly forward. Engagement of the stud on the gas piston with a groove in the circular feeder causes it to rotate half the indexing distance and to kick a cartridge into the guideway for chambering.

As the bolt goes into battery, it first brings the locking lug on its aft end in alignment with its recess in the barrel extension. The continued movement of the piston pushes the lug down into the locked position out of the way of the piston projection. Further travel drives the floating firing pin into the primer of the cartridge.

Once the bullet has passed the port in the barrel, gas enters the cylinder that houses the piston and the latter is shoved to the rear. For the first half inch, the barrel and bolt remain locked together. The locking lug on the piston then cams the bolt lug up and out of engagement, and the assembly of bolt and piston moves rearward with the extractor holding the empty cartridge case to the bolt face.

After the assembly has moved a distance slightly greater than the overall length of the cartridge, a cam-actuated lever sweeps the cartridge from the face of the bolt and holds it in the up position. The projection of the gas piston, upon engagement with the feed groove, turns the circular feed half of the indexing distance between rounds, and the operating assembly recoils until it hits the heavy spring-



loaded buffer which deflects it forward into counter-recoil.

As the counter-recoiling parts pass the rear of the feed cage, the empty cartridge case is struck by a shoulder of the gas piston and driven forward out of the upper left side of the receiver. The advancing bolt then begins to chamber the round. The rotating feed has previously been positioned, and the final movement to battery of the gas piston locks the bolt and fires the cartridge to repeat the cycle.

Disassembly by Groups

To disassemble the Shkas, the following procedure is adhered to.

1. Push the ammunition follower release lever inward, and turn in a counterclockwise direction until it is approximately at right angles with the barrel of the gun.
2. Depress the cocking handle catch, and pull the cocking handle to the rear.
3. Depress the backplate lock plunger, and slide the backplate lock to the rear; then unscrew the backplate lock groove (right hand thread).
4. Turn the handle 180°, and remove.
5. Turn the backplate 45° in a clockwise direction, and remove.
6. Slide the trigger housing group to the rear and off the receiver.
7. Replace the cocking handle.
8. Slide the plate on the right side of receiver to the rear.
9. Turn the sear release lever 90° in a counterclockwise direction.
10. With the gun lying on its right side, push the cocking handle approximately half-way home. This motion releases the ejector bar pivot from the operating groups. Then pull the operating group from the receiver.
11. Repeat step 4.
12. Lift the bolt from the gas piston rod assembly.
13. Drive up the firing pin with the retainer pin; remove the firing pin.
14. Remove the cartridge stop pin; remove the cartridge stop.

Assembly by Groups

To assemble the Shkas, reverse the disassembly procedure just given.

Detailed Disassembly

For detailed stripping, use the following procedure.

1. Lift the trigger and the trigger bar from the frame.
2. Turn the safety lever 90 degrees in a counterclockwise direction from the firing position; drive it out from left to right, being careful to catch the safety lever plunger and the spring.
3. Turn the ammunition follower release lever straight up and press it out from left to right, being careful to catch the ammunition follower. Release the lever plunger and spring, at the same time holding the follower down to prevent the follower spring from jumping out.
4. Raise the follower slowly until the follower spring is released, and then remove the follower spring.
5. Drive out the ammunition follower pin and remove the ammunition follower.
6. Slide the ammunition rack pole cover on top of the receiver to the rear, and lift it off.
7. Lift off the ammunition rack pole assembly.
8. Pull off the ammunition rack pole, plunger cam, and roller pin from the left side.
9. Remove the ammunition rack pole roller.
10. Remove the ammunition rack pole plunger cam by driving it out.
11. Remove the ammunition rack pole plunger cam and the roller link.
12. Remove the ammunition rack pole plunger release lever pin; remove the lever, being careful to

catch the spring and also to keep the plunger from jumping out under pressure of the plunger spring.

13. Slide out the ammunition rack pole plunger and the spring.

14. Release the barrel lock catch by sliding the small knurled knob and lifting.

15. Turn the barrel lock 45 degrees in a counterclockwise direction, and slide the barrel and gas cylinder group forward.

16. Drive out the front sight pin, and slide the front sight pin off the front end of the barrel.

17. Slide the barrel out to the rear.

18. Drive out the gas regulator pin, and unscrew the gas regulator (right hand thread).

19. Drive out the barrel lock catch pin, and remove the barrel lock catch, being careful to catch the spring.

20. Remove the guide by pulling the catch rearward and lifting, then slide the collar off the front of the receiver.

21. Remove the ammunition rack by sliding off the front of the receiver.

22. Remove the ammunition rack bushing lock screw (right hand thread); slide the ammunition rack bushing off the front of the receiver, being careful to catch the cartridge case guide spring.

23. Remove the cartridge case guide spring.

24. Slide the ejector bar pivot to the rear, and lift out the ejector bar group.

25. Slide the ejector bar pivot off the ejector bar.

NOTE. The searing mechanism cannot be disassembled in the field.

Assembly of Components

Reverse the procedures just given.

The applied safety on this weapon is a safety lever located on the right side of the trigger frame, which, when rotated until the lever points to the front of the gun, prevents the trigger from being pulled to the rear. The only mechanical safety is the camming down of the bolt just as it reaches the forward position, thereby locking the bolt at the instant of firing and not allowing the lug on the gas piston rod extension to hit the rear end of the firing pin.

SECTION 2. SHVAK 20-MM AUTOMATIC GUNS (SHPITALNY-VLADIMIROV)

General Data for Shvak 20-mm Automatic Gun

Caliber: 20-mm.
Rate of fire: 700–750 rounds/minute.
Muzzle velocity: 2649 feet/second.
Gun length: 83.5 inches, 69.3 inches.[1]
Gun height: 6.09 inches.
Gun width: 6.06 inches.
Gun weight: 149.6 pounds, 88 pounds.[1]
System of operation: Gas.
System of locking: Rear of bolt rises against locking shoulders in receiver.
System of feeding: Belt; cage holds 11 rounds.
Method of charging: Mechanical on earlier models, pneumatic on later models.
Method of cooling: Air.
Rate control: Automatic only.
Barrel weight: 21 pounds.
Barrel length: 64.9 inches.
Barrel removal: Quick change.
Chamber pressure: 42,660 psi.
Bore:
  Number of grooves: 8.
  Groove depth: 0.013 inch.
  Groove width: 0.20 inch.
  Pitch: 1 turn in 20 inches.
  Direction of twist: Right hand.
  Form of twist: Constant.
Method of headspace: Factory established headspace is held secure by barrel lock catch.
Location of feed opening: Top of body (Revolving type).
Location of ejection opening: Bottom-right side (a tube arrangement can be adjusted so that expended case can be ejected either forward or to the rear).

NOTE 1. These numbers may represent differences between the long- and the short-barrel weapons.

Description of the Shvak 20-mm Automatic Gun

The weapon has a rough exterior, since no unnecessary finish was applied to improve external appearance. However, in comparison with the rifle caliber Shkas, the external appearance is very clean. In relation to its power, the gun is very light and extremely compact.

One of the outstanding features of this weapon is the method of solving blast tube difficulties, a troublesome problem in all installations of aircraft cannon in fighter aircraft. The Soviets' simple solution was to thread the end of their standard barrel and then screw on for whatever length was needed a heavy piece of tubing, the bore diameter of which was slightly greater than that of the rotating band of the projectile. This arrangement allowed the blast and gas to leak around the projectile before it cleared the tube, not only reducing the blast effect of the weapon but also by its added length safely leading the blast and projectile past portions of the plane that would otherwise have been injured.

Gas operation presented the Soviets with a convenient method of obtaining a high rate of fire. The simple construction and generous working tolerances permit reliable performance in spite of the lack of final finishing by skilled workmen.

From the economic standpoint, worn-out guns can be rejuvenated to operational status simply by taking advantage of the wide ratio allowed by the noncritical measurements. Accordingly, worn parts can be reproduced and replaced by semiskilled personnel. Complete change of components is necessary only in connection with major inspection and overhaul.

The methods used in construction are similar to those used in previous weapons in that the Soviet

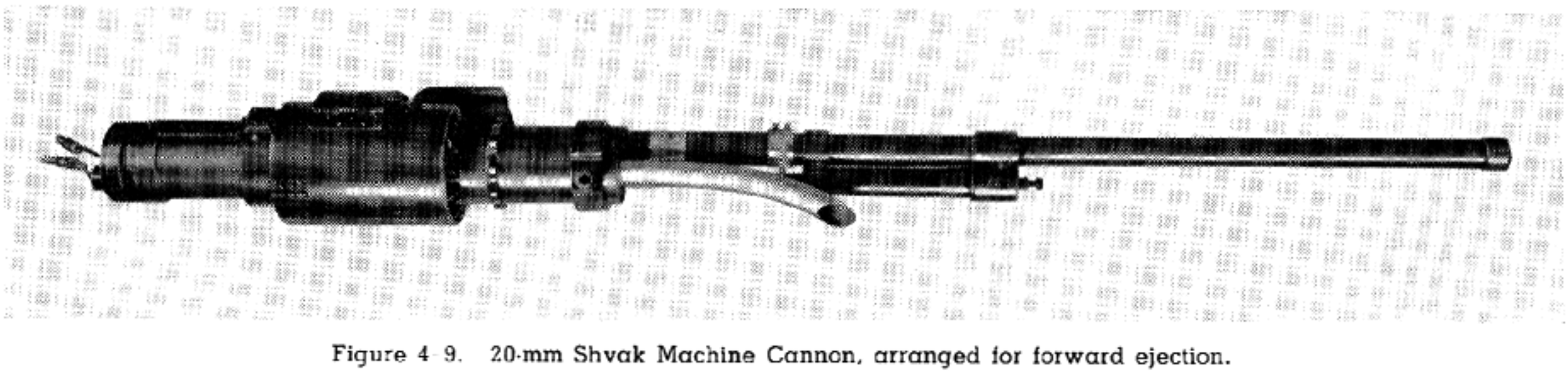


Figure 4–9. 20-mm Shvak Machine Cannon, arranged for forward ejection.

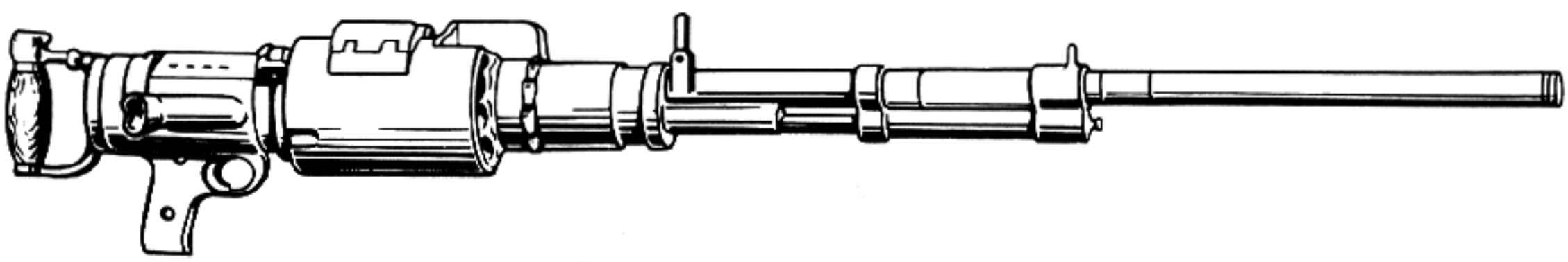


Figure 4–10. One version of the 20-mm Shvak, mounted as a flexible gun.

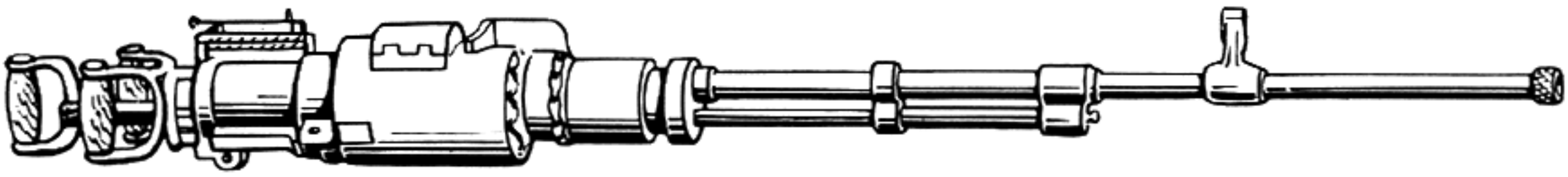


Figure 4–11. Another version of the 20-mm Shvak flexible gun.

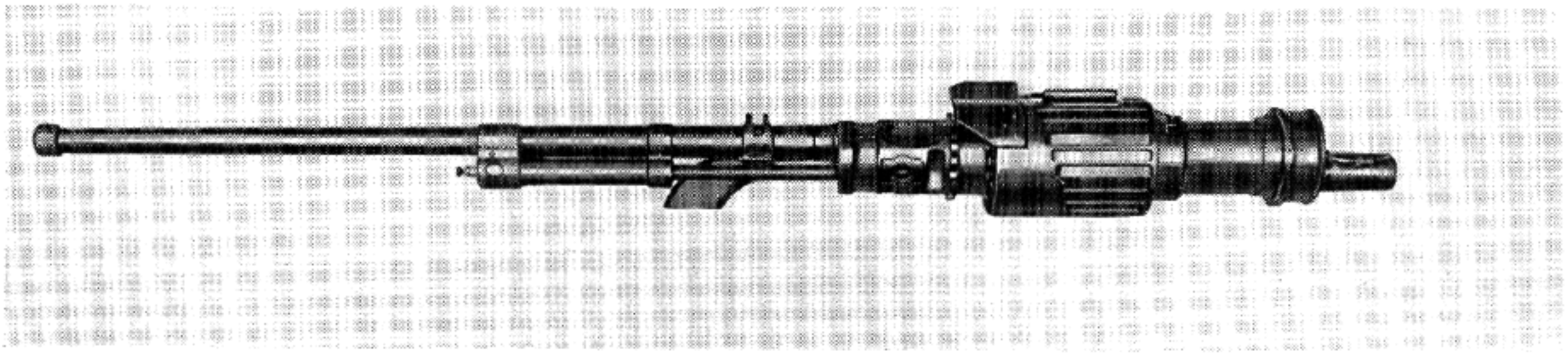


Figure 4–12. The 12-mm version of the Shvak. A rare gun requiring a special cartridge case.

practice of using soft materials is predominant. This form of manufacture is a disadvantage in some respects, but it is well suited when no great antishock requirement is demanded of certain component parts. This practice is advantageous in large caliber weapons (1) for obtaining a high rate of fire, especially when a short life expectancy is acceptable, and (2) for instituting a further safety margin against failure by breakage. These parts were not heat treated; they, accordingly, deform and bend well in advance of fracture.

The composition of individual components is not suitable for mass production in accordance with American standards; since final completion is by

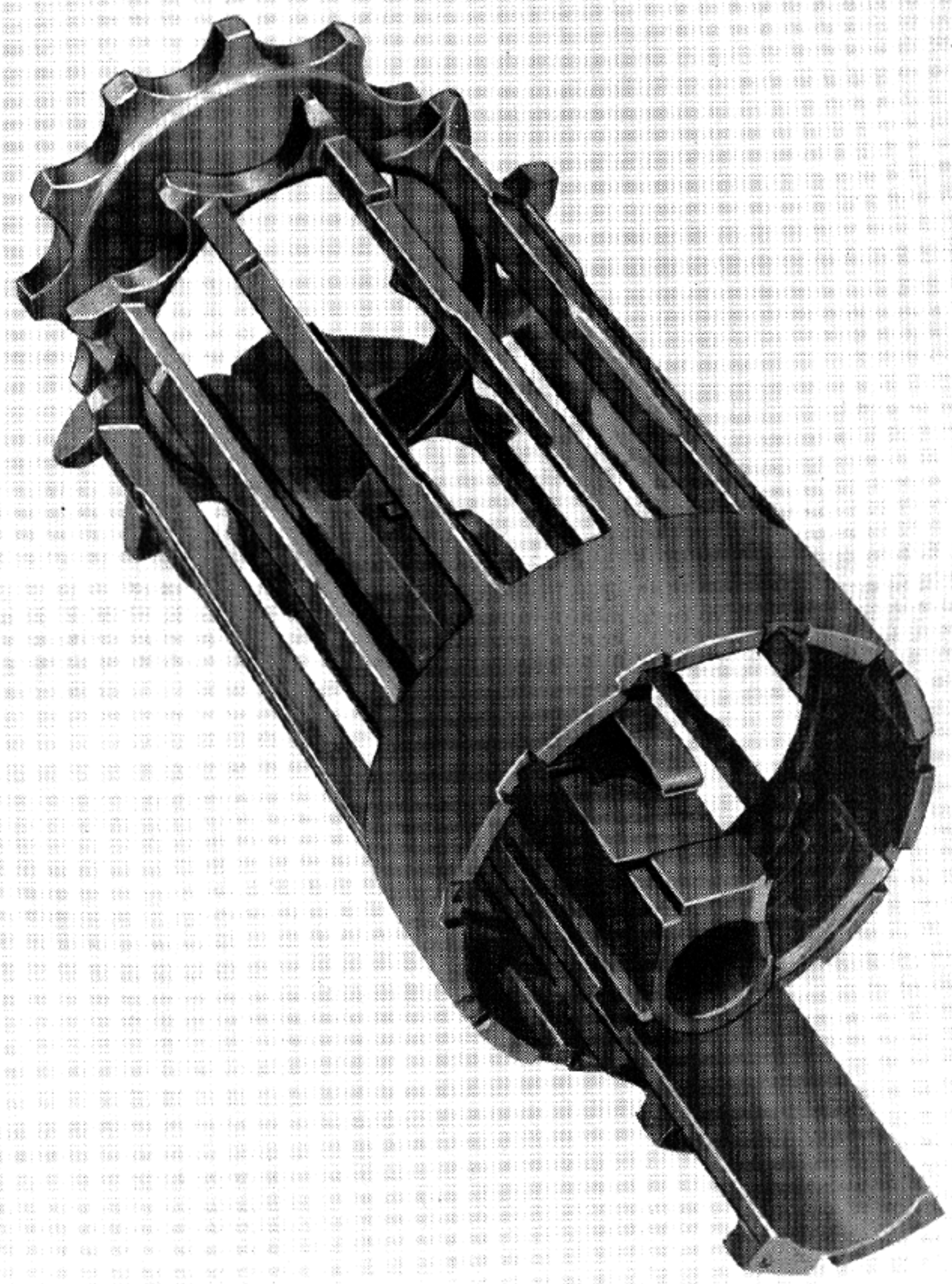


Figure 4-13. The "bird cage" of the Shvak feed as seen from the rear. This cage is the moving device for the belted rounds, each pair of teeth engaging a cartridge.

filing down, considerable turning and milling in the earlier stages is required. Sheet metal pressings are used for some of the exterior fittings. This is the first instance of this type of construction noticed in Soviet aircraft weapons. This fact is not considered significant, however, as it has no bearing on the general design.

Even though the 20-mm Shvak is relatively difficult to produce, documentary evidence indicates that the practical results achieved are generally good and the performance only slightly inferior to British and American guns of the same caliber. This weapon has a range comparable to our M3 cannon, although their short barrel version is 16 pounds lighter.

Mounting the gas cylinder below the barrel is perhaps the most noticeable difference between the Shvak and the Shkas. This feature gives the weapon a more compact assembly, thereby eliminating installation problems. The weapon is gas operated, using adjustable orifices. The feed takes place on the right-hand side and is not reversible. A disintegrating metal belt is pulled into the feedway by a cylindrical cage which rotates only in a counterclockwise direction.

Rounds remain coaxial with the barrel throughout the complete operation; on interruption of the fire, the breech is closed and the cartridge stays in the chamber. The weapon has no applied safety device. On engine mounted installations, this weapon is normally arranged to fire through the propeller hub.

A manually operated toggle provides the means to recock the weapon in the event of gun stoppage. The system, besides being crude, requires considerable physical effort by the operator. If judged by present day American standards it would be considered obsolete.

The motion of the feed cage and the feed from it is a decided improvement over the Shkas. However, the feed system in both weapons ensures the steadiest possible flow of ammunition; as the cage

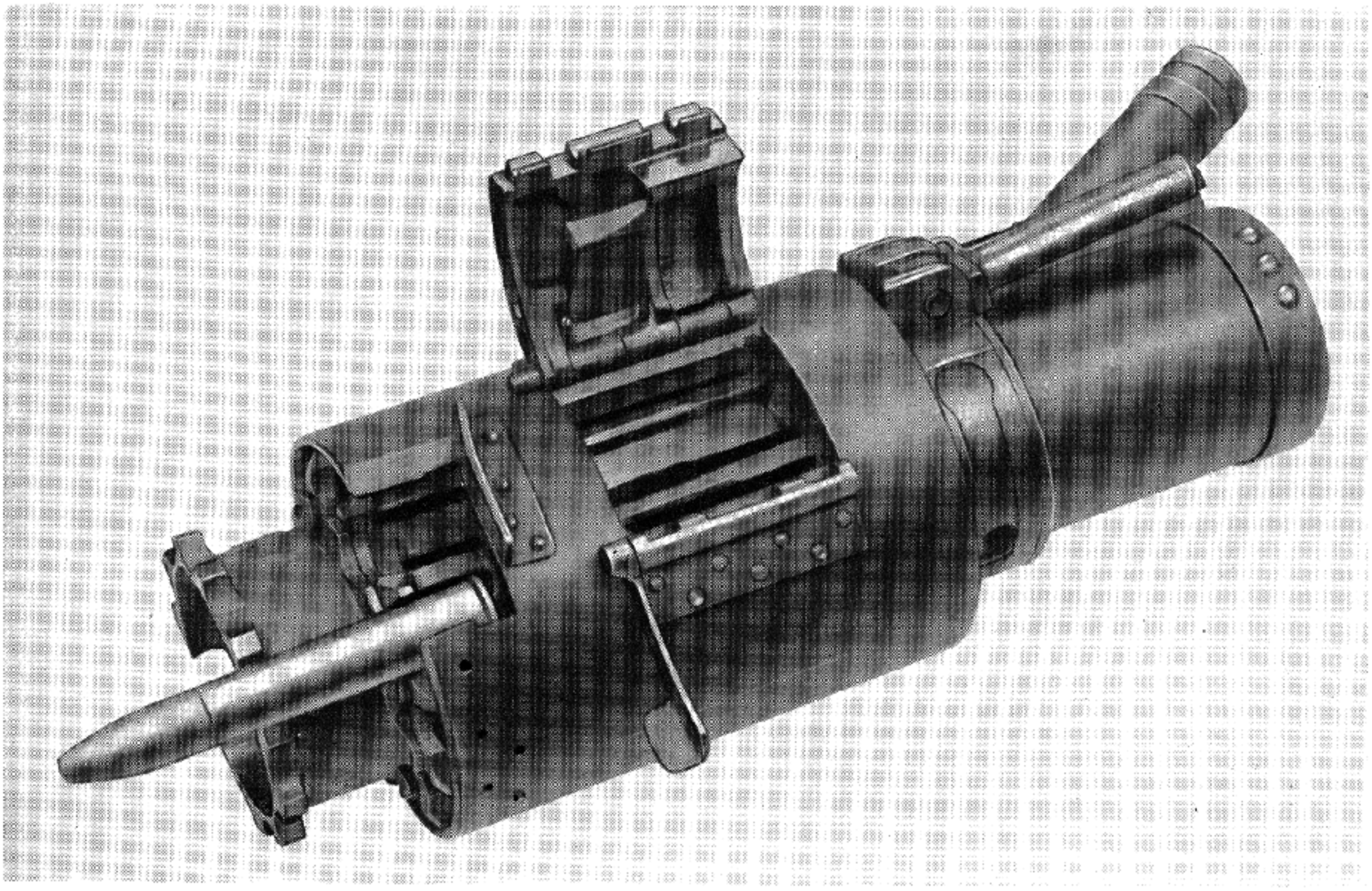


Figure 4-14. Rotary feed of the Shvak, showing a round at the position where the belt enters the feed. The rim of the cartridge is about to engage the groove (not visible) which will cam it to the rear.

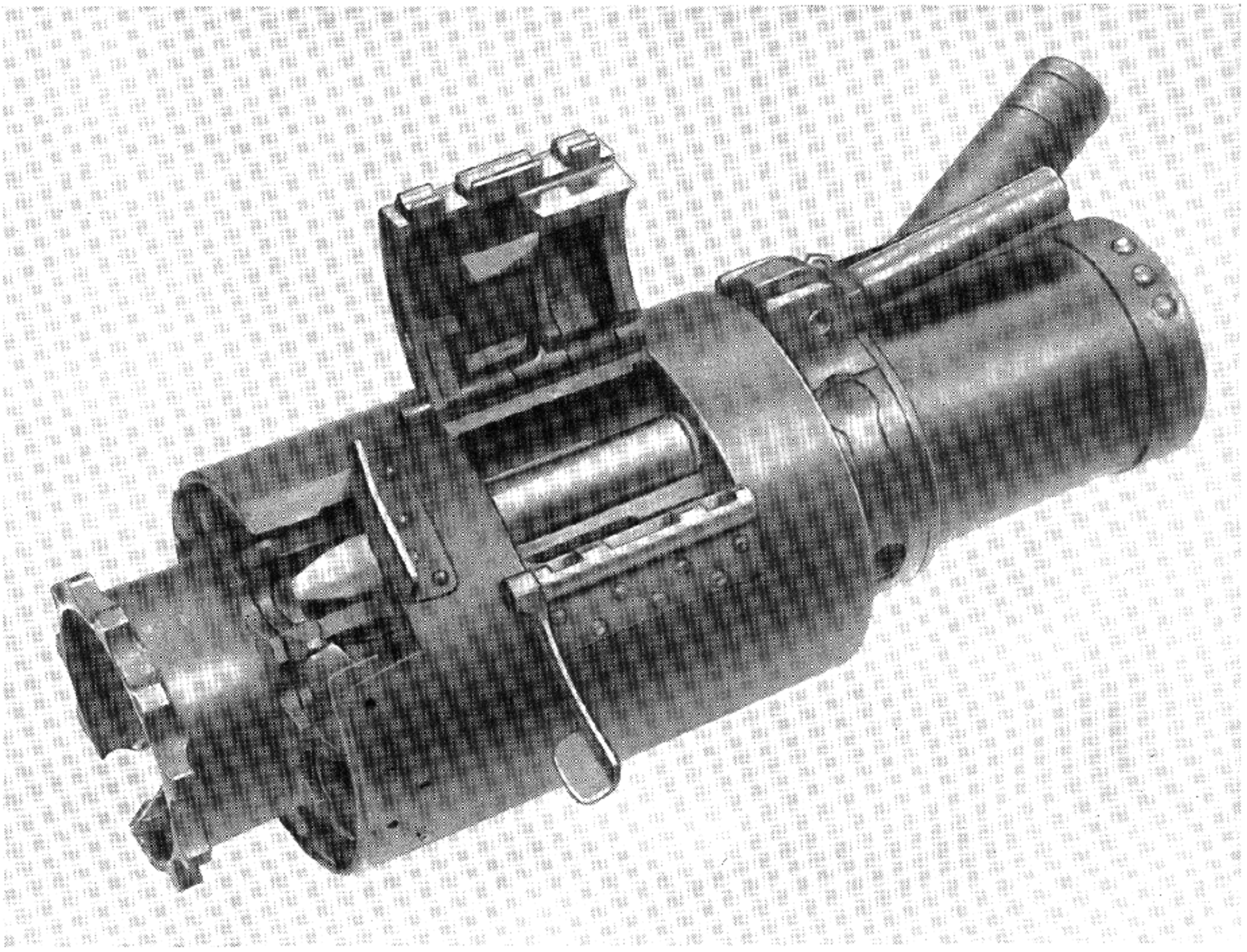


Figure 4 15. Rotary feed of the Shvak, showing the position of the round when it completes its circuit around the rotary feed. The cover is open to show the spring-loaded arm, which forces the cartridge through the feed mouth into the path of bolt travel. The end of the helical groove which withdraws cartridges is visible below the right of the cover hinge.

always rotates evenly in the same direction, the absence of belt lurch guarantees the accurate presentation of the round, free from variables associated with other types of feeds in which each round is forced from its own link.

The feed cage when fully loaded holds eleven rounds, and is rotated by pawls operated by a feed slide attached to the recoiling portion. Helical grooves in inner and outer fixed drums cause rounds to enter the cage which rotates between them.

The ejection tube is situated on the lower right side of the gun, inside the body. The ejector consists of a cam-operated bar fastened to an arm which sweeps the cartridge case off the face of the bolt. This action forces the firing pin back at the same time. The main spring is of the multiwire strand type. The barrel locking piece is placed in position; with a screw driver in the slot in the top of the splines, the piece is raised and rotated for alignment.

The system of operation is best described as gas piston actuated and is very similar to the action of the well known Berthier gun, having also incorporated the Berthier type of gas regulator which slides into the mouth of the gas cylinder and is held in position by a cotter pin.

The gas regulator has four holes marked 3.5, 4, 4.5, and 6, representing the sizes in millimeters. The gas port in the barrel is 7 mm in diameter; it is situated on the under side, about half way between the muzzle and breech.

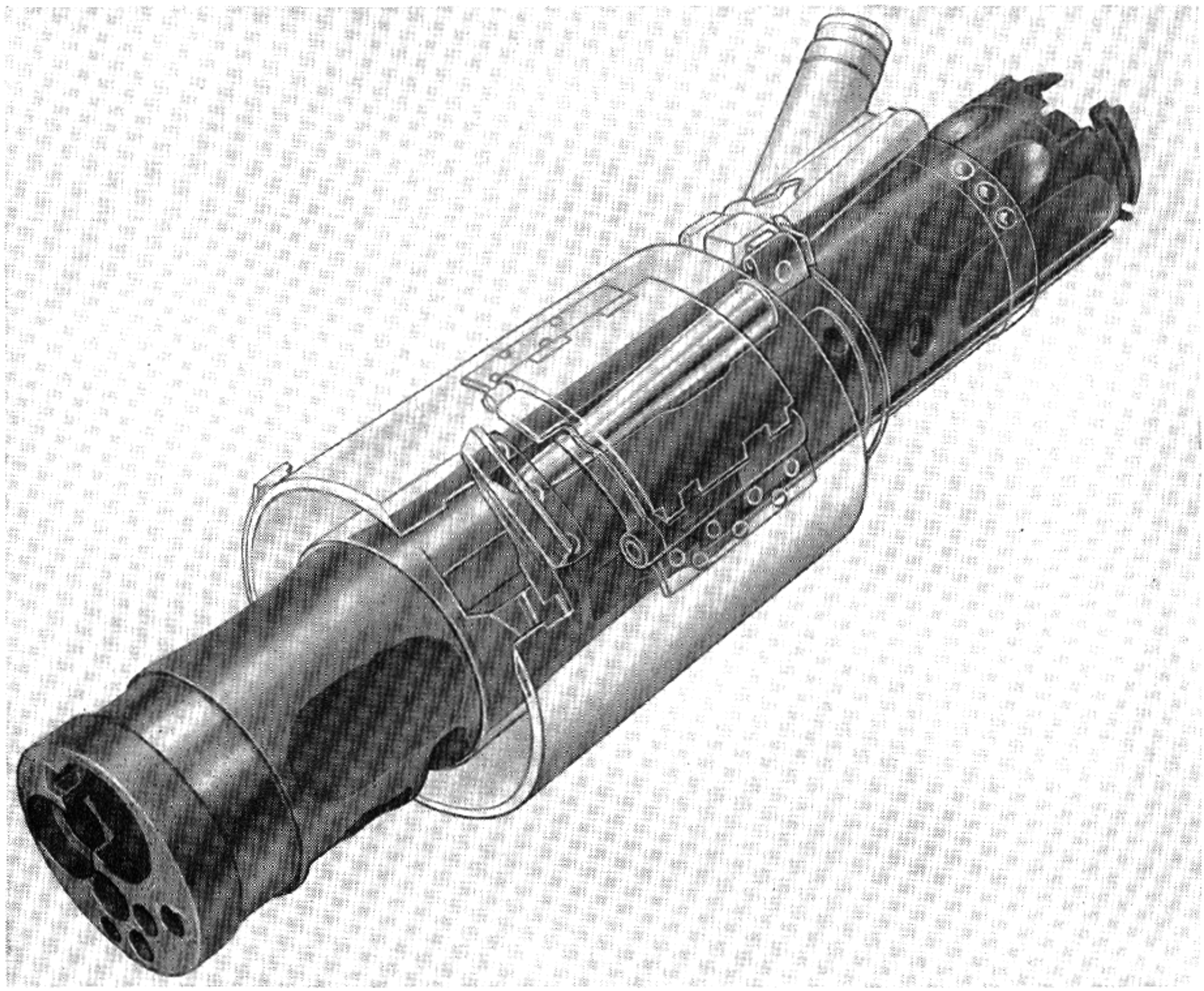


Figure 4–16. Phantom view of Shvak feed with cage removed, showing the round being forced through the feed mouth in the receiver.

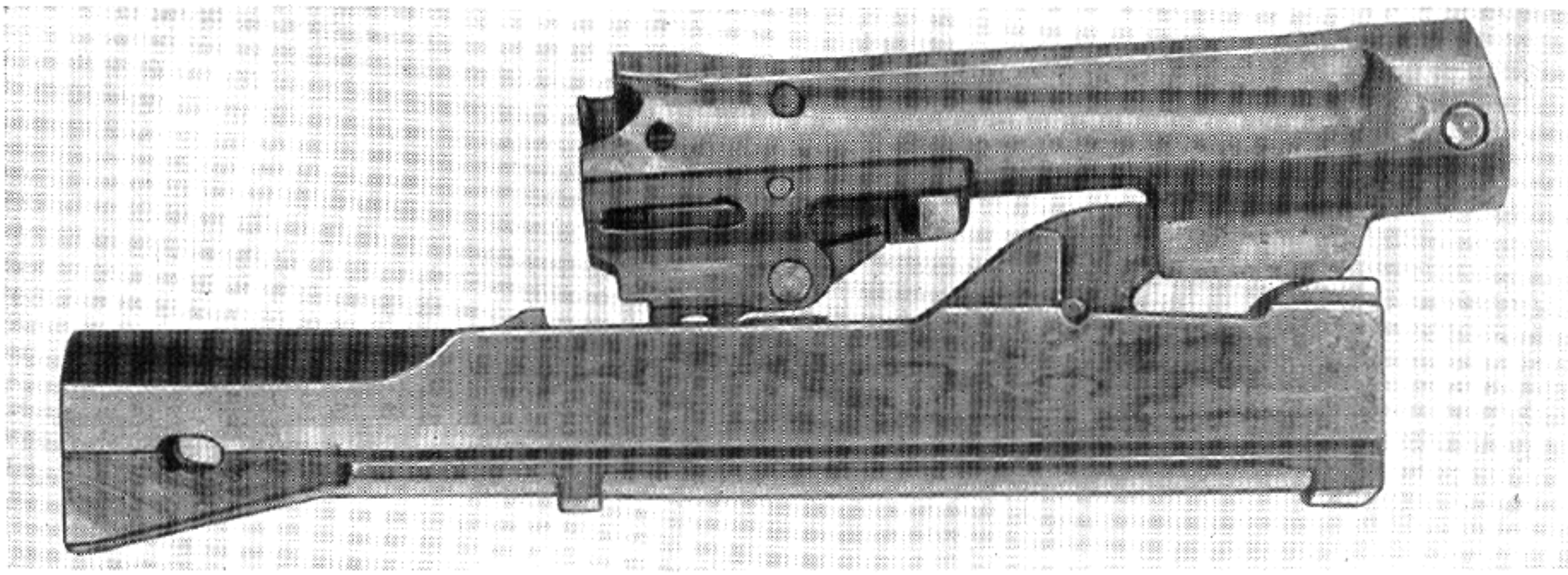


Figure 4–17. Locking action of the Shvak, showing how the rear of the bolt is cammed up in front of the locking shoulders (not shown).

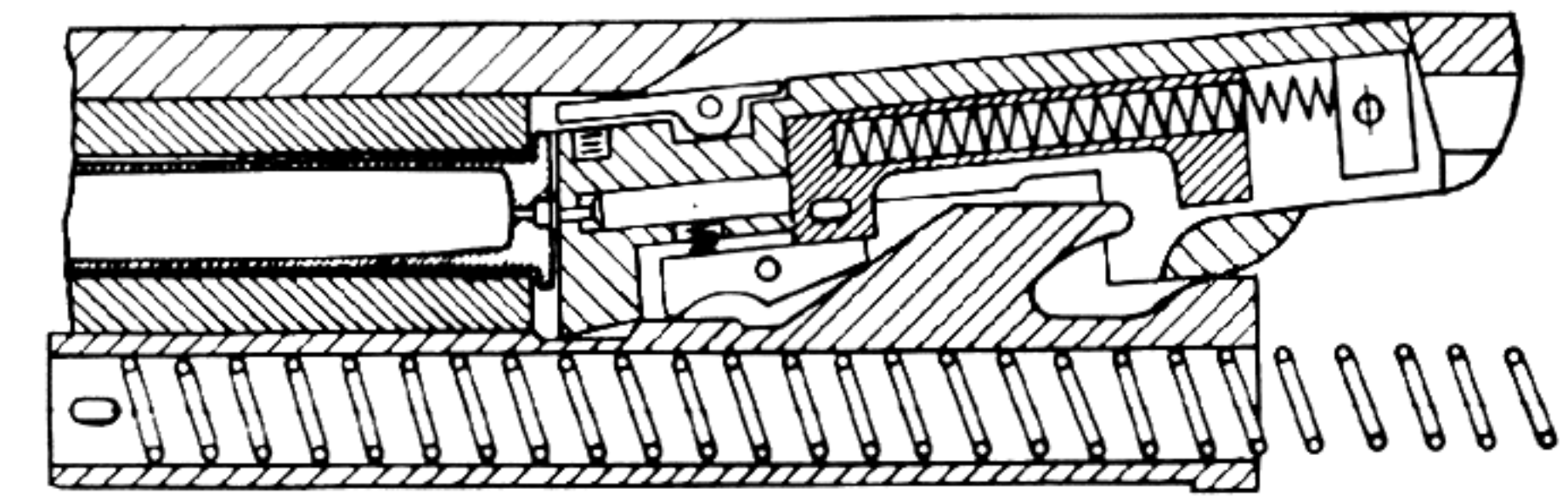


Figure 4–18. Locking action of the Shvak Cannon. Top to bottom: Ignition; commence unlocking; unlocked; reloaded, locked and cocked.

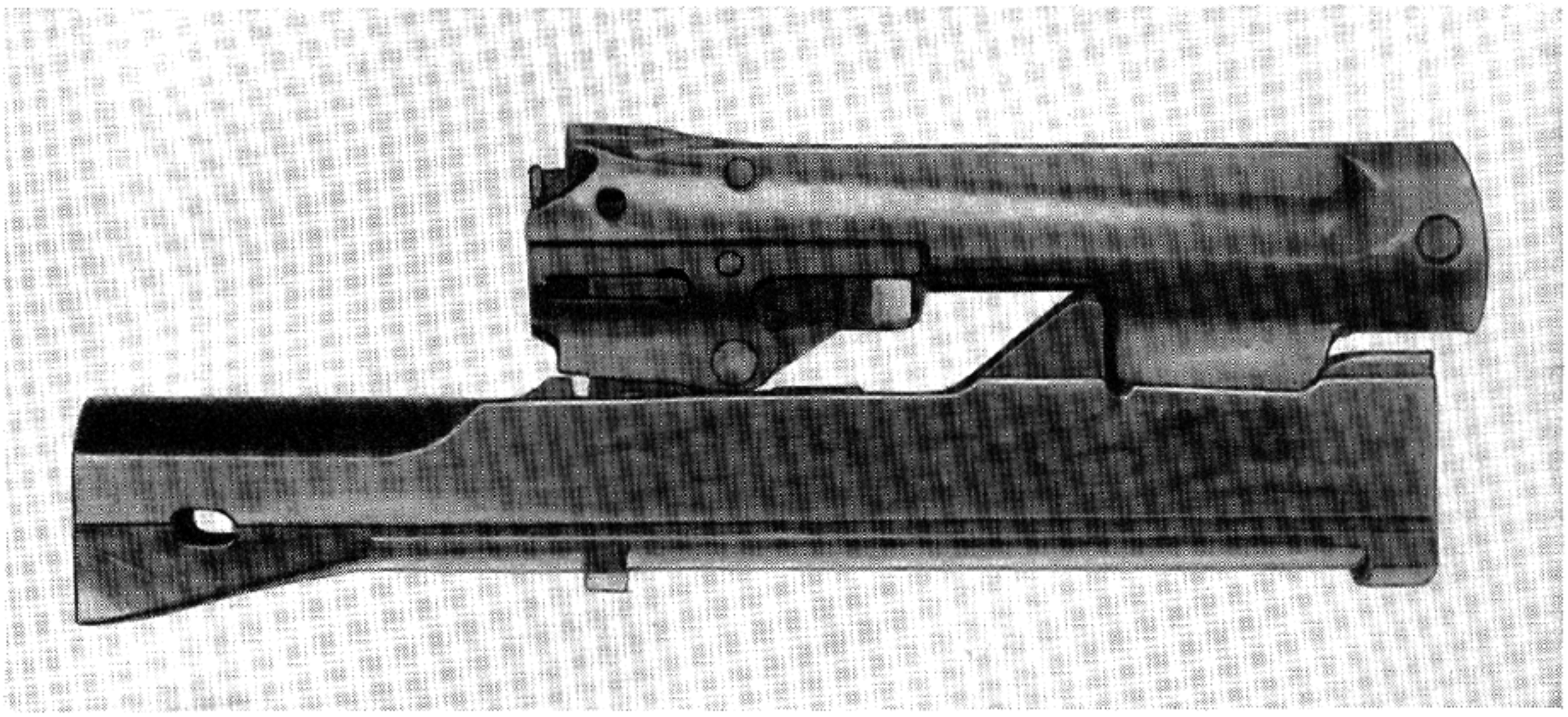


Figure 4–19. Bolt and actuating slide of the Shvak in the unlocked position.

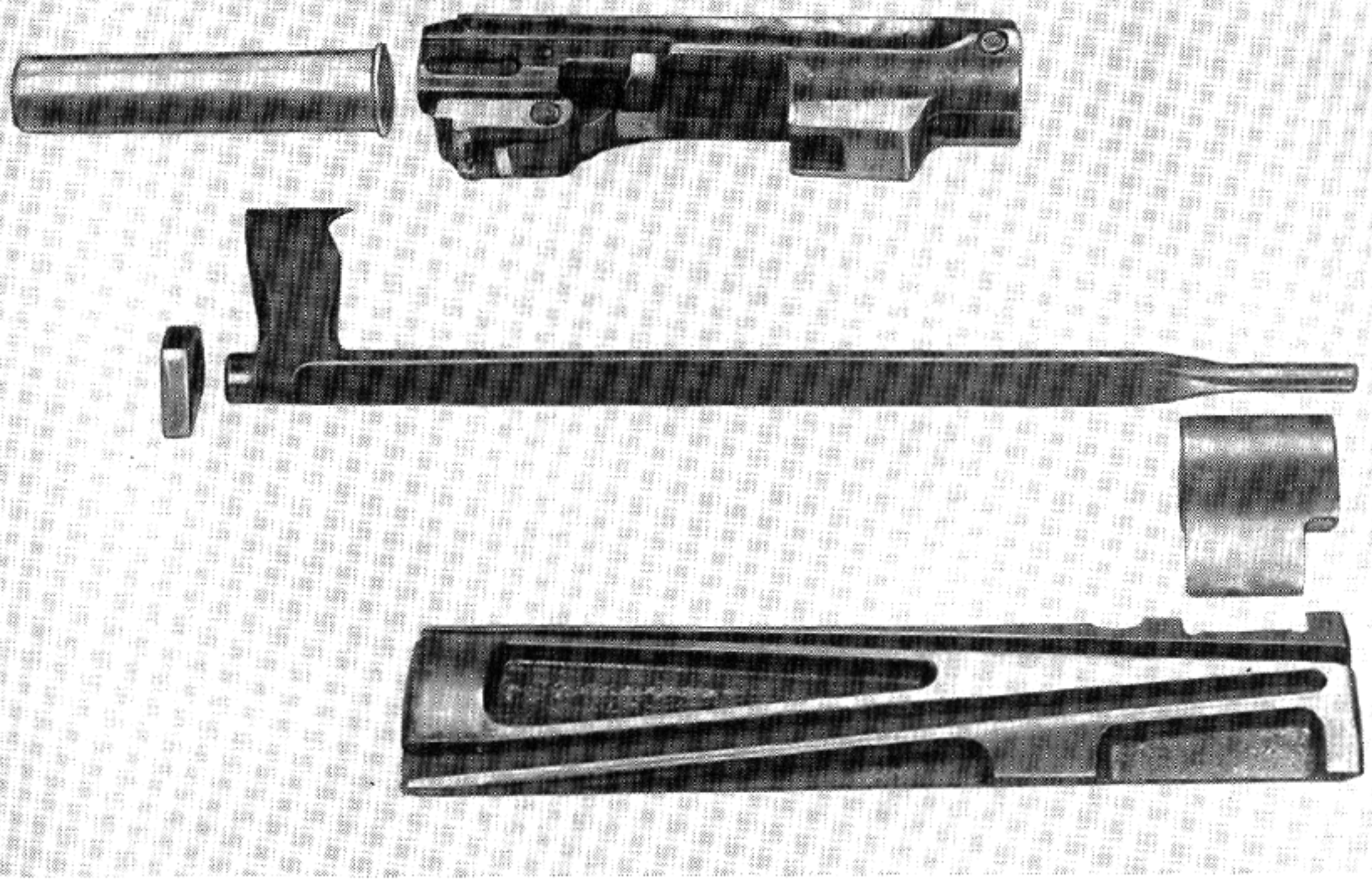


Figure 4–20. Shvak bolt and device which wipes empty cases from the face of the bolt.

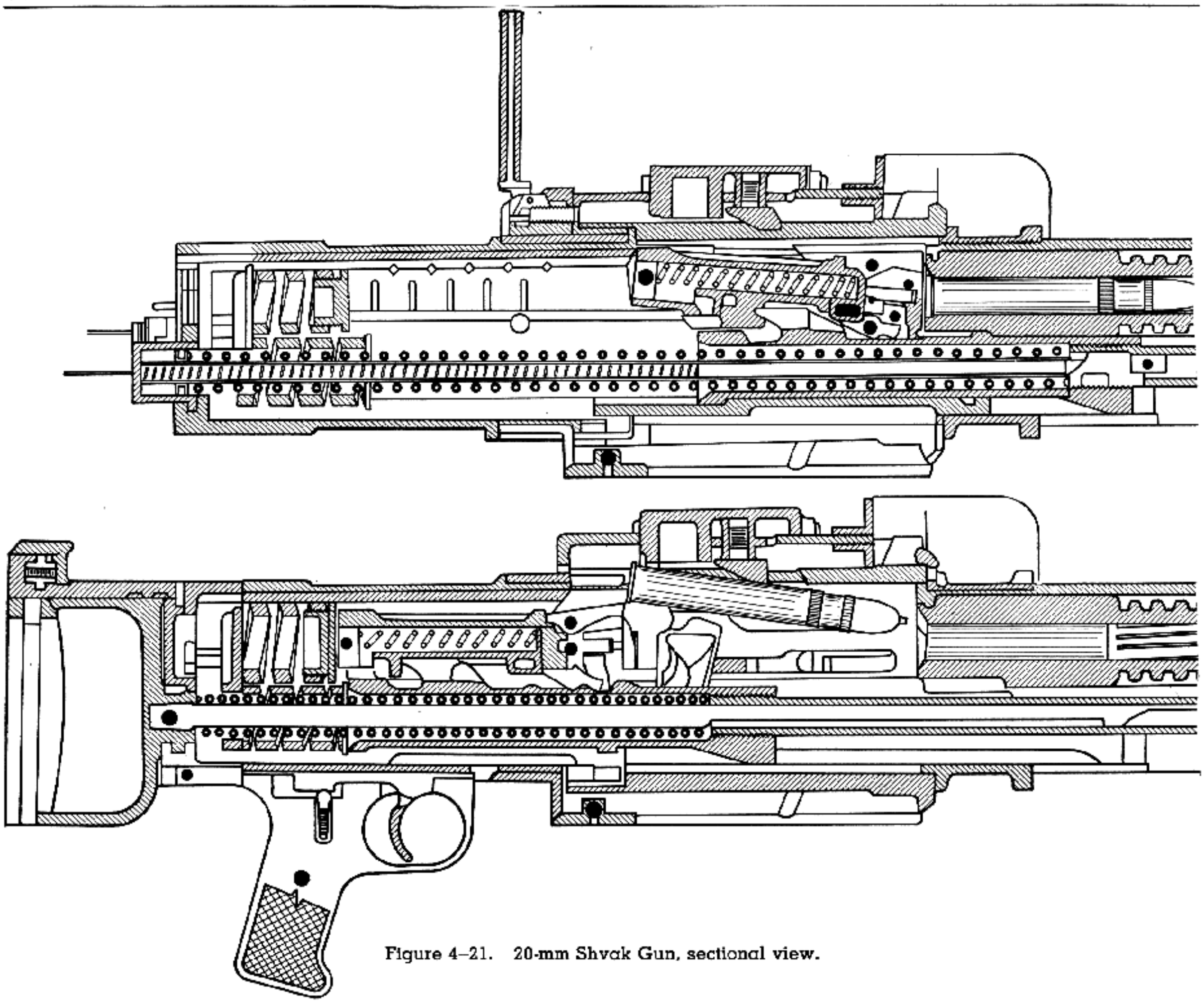
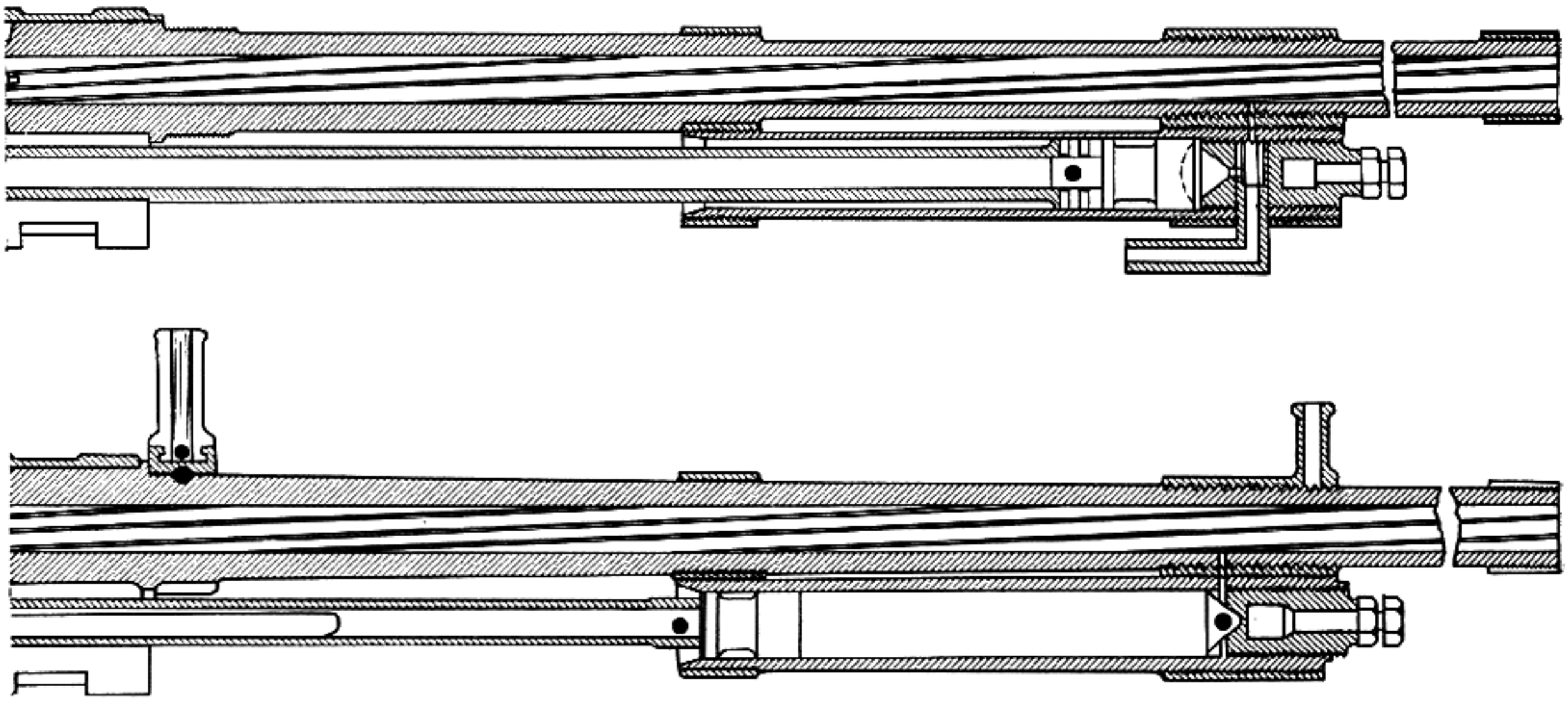


Figure 4–21. 20-mm Shvak Gun, sectional view.

There is a manual trigger and electric solenoid firing arrangement. The gun is fired by means of a cable when manual firing is desired. This cable protrudes through the rear buffer block. Attached to it is a catch or trigger which engages a hook on the end of a trigger bar; at the forward end of the bar is a trigger sear assembly fitted into the recess in the left-hand side of the gun. The trigger sear protrudes into the breechway and engages the hammer in the breechblock; when the cable is pulled, the bar is drawn to the rear and the sear is pulled inward to release the hammer. There is also an automatic searing device in the breechblock which engages the hammer when the hammer is forced back with the tongue of the piston post as the piston moves back to unlock the action. The automatic sear is released by a ramp at the rear of the recess in the piston extension making contact after the locking action has been affected by the piston still being in forward motion. The mainspring comprises four strands of 1/16-inch diameter wire. The coil is 7/8 inch in diameter and 37 3/4 inches long (free length). There are two heavy buffer springs, one for the breechblock and one for the piston extension. These assist in driving the recoiling portions forward on counter-recoil, as well as absorbing excess energy.

Cycle of Operation

The metallic link belt is pulled laterally into the feed by a cylindrical cage which rotates in a counterclockwise direction. During this rotation, the rounds are extracted from the belt by helical grooves in the drum, which exert a rearward camming action on the rim of the cartridge. When free of the



belt, the cartridge is forced into the center of the cage.

During the forward movement of the parts, the breechblock drives the cartridge into the chamber. The sloping projection at the rear end of the piston extension forces the rear of the breechblock upward into engagement with the locking shoulder in the body.

The piston continues to move forward, causing the sear to release the hammer, which flies forward and drives the point of the firing pin through the face of the bolt into the primer.

When the base of the bullet passes the gas port in the barrel, a portion of the gas is metered through the vent, and strikes the head of the piston; the piston extension then travels to the rear. When the piston has traveled approximately 0.4 inch to the rear, the striker post bears against the hammer forcing it to the rear. The inclined cam on the underside of the piston post forces the rear end of the breechblock downward from engagement with the locking shoulder in the body to unlock the breech. During this movement of the locking shoulder in the body, the raised portion on the sear has entered a recess in the piston extension, thus allowing it to engage the hammer.

Initial extraction occurs when the unlocking surfaces of the piston post engage the corresponding unlocking cams in the breechblock, causing the breechblock to drop and break contact with the locking shoulders in the body very slowly. Full extraction is now effected by the gas actuated parts being pushed to the rear. There are two recess shoulders on the face of the bolt into which the cartridge is positioned during the feeding cycle. These are in effect extractors; these claw-shaped spring-loaded pieces are situated in their side recesses.

A post serving as the ejector cam, which is connected to the feed slide, comes into contact almost at the extreme end of the rearward recoiling stroke. This action causes the ejector arm to sweep across the bolt face, engaging the cartridge case and forcing it into an ejection tube located in the right side of the body. At this point the guide ejection prong, situated on top of the ejection tube, guides and retains the cartridge case in the ejection tube.

Final ejection is completed during the forward movement, when the ejector arm moves upward out

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of the path of the breechblock, and a projection on the right side of the piston extension engages the base of the cartridge, driving it farther into the ejection chute.

A spring loaded stop is situated at the front of the ejection tube to prevent cartridges dropping back into the firing mechanism during firing at an elevated angle.

The piston extension strikes the buffer, rebounding into counter-recoil. On the way to battery, the face of the bolt picks up the positioned round in the bird cage feed, forcing it forward into the chamber. At this point, the breechblock arrives home, is tilted up, and locks into battery. The cycle of operation is repeated as long as the trigger is depressed.

Disassembly

The following procedure is adhered to.

Charge the gun by pulling aft on the cable coming through the larger boss in the rear, and release by pulling the other cable.

NOTE. Considerable tension is required to cock the gun.

Raise catch at rear of gun after securing the larger boss. Turn boss slightly to the right. Allow lugs to pass through clearances, then pull boss clear until rod and spring are protruding about 7 inches to rear of gun. Maintaining a firm grip on rod so as to counter tension on spring, pull cable back a few inches. Turn rod to the left to disengage front end from piston cotter key and ease off carefully rearward to remove rod and spring.

Make sure that recoiling parts are fully forward. Push in plunger in recess in right rear. Turn body and cap to the right until clear of separated flanges, then remove. Now remove roller on end of displacer rod.

Push up and remove buffer plate in rear of body. Take out piston and breechblock buffer springs. There is a protective covering over the springs.

Raise loading handle and rotate band as far as possible to the left. Unscrew and remove square-headed set screw. Return band to original position, pull back body casing until the rear end is just clear of the body.

Open cover in larger part of case. If feed cage has moved back with casing, push it forward so as to expose feed holes. Lift out front and rear end of pawls.

Open other cover in the casing which contains the cartridge positioning pawl. Then the body casing can be slid off the body rearward. Turn gun on right side and slide off rearward the feed cage, keeping left hand in position around body to prevent other components from falling out.

Lift out feed pawl operating slide from under side of piston; take ejection guide cam piece and spring from the recess in front side of body.

Force back the piston and remove displacing bar, pawl, and cam block. Remove also trigger bar with trigger sear block.

Remove spring clip retaining piston head by pushing out pin. Unscrew head and slide off clip.

Push piston to rear and remove bolt.

Press down on barrel locking piece screw, unscrew, and remove locking piece. Pull barrel forward and remove ejection chute.

NOTE. The recoiling portions should never be in battery when removing the body cap.

Assembly of Components

Assemble in the reverse order to disassembly, but note the following:

1. Piston carrier should be assembled with the flat uppermost. If this is not checked, the return spring, guide rod, and cocking piece with cable cannot be correctly assembled.

2. The hammer in the breechblock must be cocked to enable the breechblock to seat correctly on piston extension.

3. Make certain the displacer rod pawl and front end of rod are assembled correctly to conform with the contour of the body. Place the displacer cam block on the rear end of the rod so that its projection seats in the feed pawl slide before the piston and slide are pushed forward.

4. Keep the recoiling parts back halfway when replacing feed cage.

5. When replacing receiver, see that it is in correct alignment so that when pushed home, set screw holes are in correct alignment with recess in body.

6. It is more convenient to leave the ejection guide and spring out until ready to push casing forward. Then push home after assembling feed pawls.

7. When replacing end cap, be sure the friction cap is on the end of the displacer rod. Pull trigger cable out before rotating the cap to lock. Then

keep pushing the cable in as the cap is rotated to insure the engagement of the trigger catch with the hook of the trigger bar. Test when cap is fully assembled.

8. To replace return spring and guide rod, first push back the recoiling portions and then place a thin spanner wrench in the neck part of the piston head to prevent piston from going forward. With a small length of tubing which will fit over the bolt, engage the main stud on the boss with its catch. Push in guide rod and spring until rod is projecting only about $\frac{6}{12}$ inch. Then turn rod to the right; this is done by trial and error until the correct position is arrived at.

9. When the rod is free to turn, the cable will shoot forward denoting that the cocking piece on the end of the cable has passed the cotter. Turn the rod back slightly; the strain of compressing the spring is now taken by the cable end. Remove the spanner, push the rod home until lugs of boss enter recess in cap. Then turn to the left with the catch raised until the catch can engage in the recess in the side of the boss.

SECTION 3. SHVAK 12.7-MM MACHINE GUN (SHPITALNY-VLADIMIROV)

This gun was made at the same time as the Shvak 20-mm automatic gun and used the Degtyarev cartridge plus a rim. This is a rare gun; records show that the prototype was tested, but only a few guns were manufactured.

SECTION 4. SHVAK 37-MM AUTOMATIC GUN

Attempts were made to scale up the 20-mm to 37-mm size. It is assumed that this experiment did not meet with success, since no models have been found.

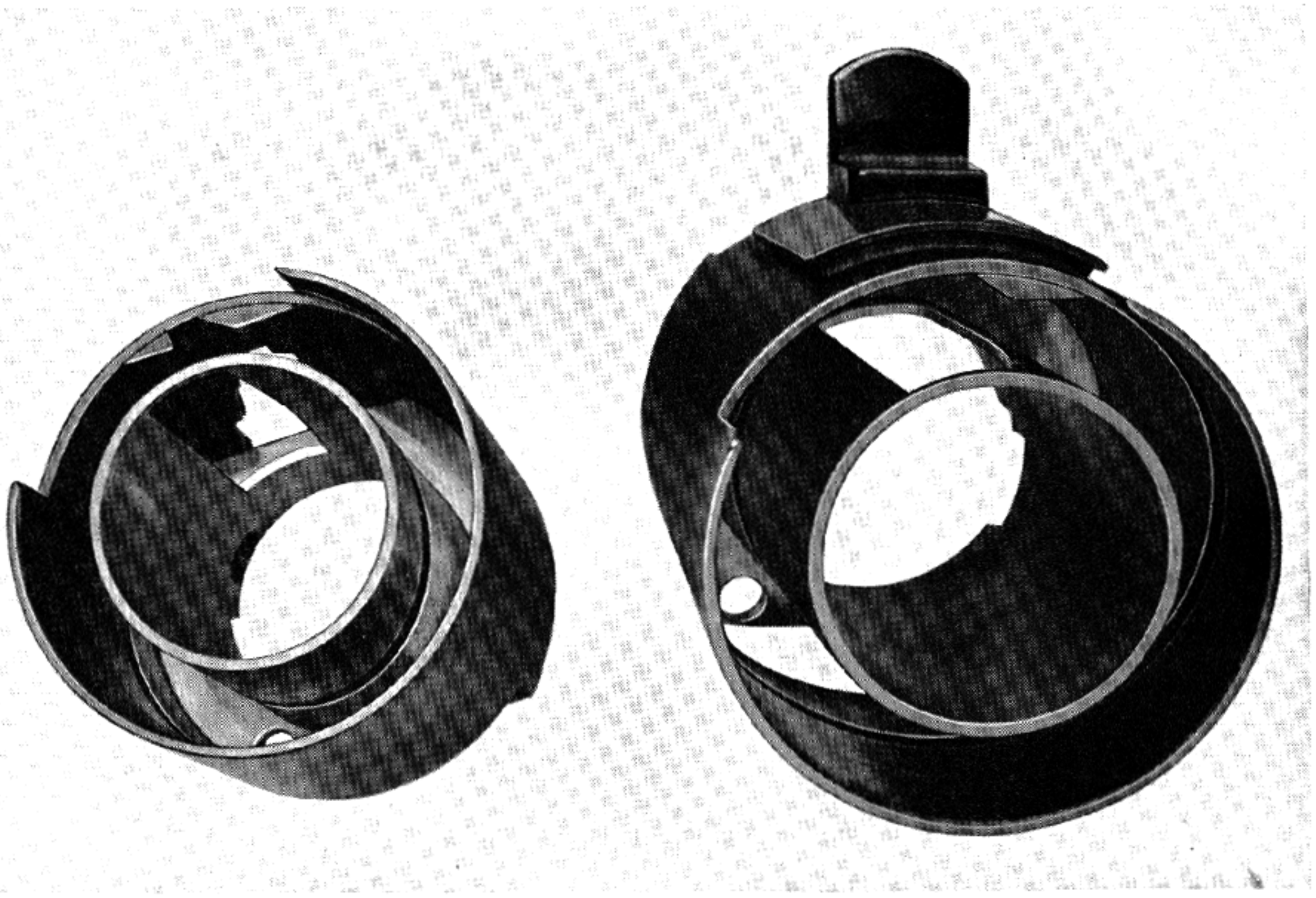

Figure 4-22. Part of the feed mechanism of the Shpitalny system. The cage rotates between the inner and outer cylinders with the rims of the cartridges sliding between the inner and outer helical grooves.