

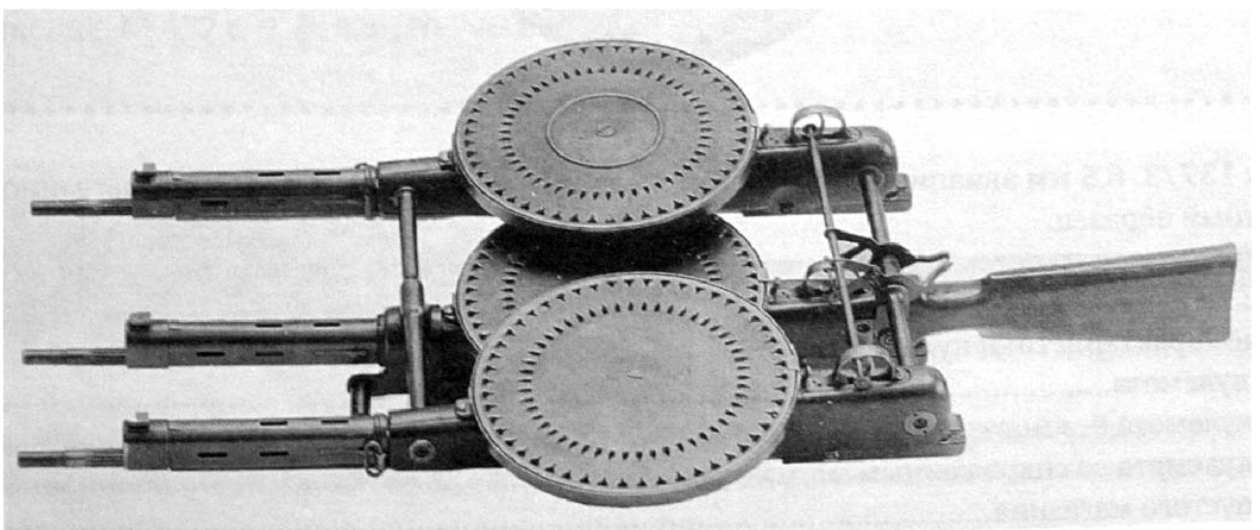
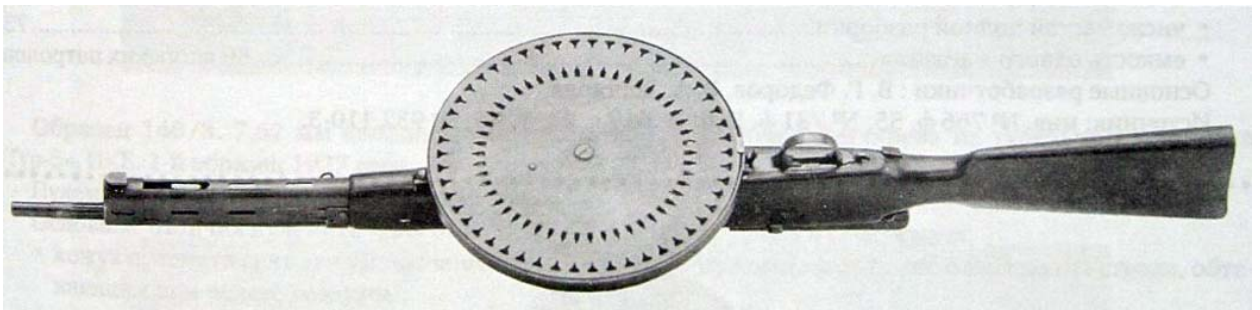
The prewar experimental aircraft MGs of Vasily Degtyarev

By Evgeny Aranov

In the history of the Soviet school of aviation small arms, the most famous are the ShKAS rapid-fire machine gun (MG) and the ShVAK and VYa cannon, as well as a number of post-war systems. Few people are aware that these successful weapons were preceded by a long period of experimental evolution, beginning at the time of the First World War with the work of the oldest Russian weapon designer, Vladimir Fedorov.

During the period 1922-25, Fedorov, in co-operation with two other designers who would become well-known in the future, Vasily Degtyarev and George Shpagin, developed a whole series of universal weapons for use by light infantry and as tank and aircraft MGs. This work took place at the PKB, the Design Bureau for Manual and Automatic Small Arms based at the Kovrov machine-gun plant.

This universal MG was designed around the Japanese Arisaka 6.5x50SR cartridge, a large quantity of which remained in Russia after World War I. It used a short-recoil system of automatic operation and an original 50-round pan magazine. The weapons were very light (4.4 kg without magazine), 1,055 mm long with a 520 mm barrel, and fired at 600 rpm. It is interesting that in the tank and aviation versions the guns were inverted, with the bolt at the bottom and the trigger on top. Twin and triple installations of this Fedorov-Degtyarev MG were also developed with a common trigger, in which the guns were staggered vertically to accommodate the bulky magazines.



Single and triple aircraft MG Fyodorov-Degtyarev

But Fyodorov-Degtyarev's design was not fitted to aircraft. Only a small number of them were used in the 1920s, on tanks.

In 1926, Mosin's 7.62x54R cartridge was chosen as the standard for all rifles and MGs in the USSR.

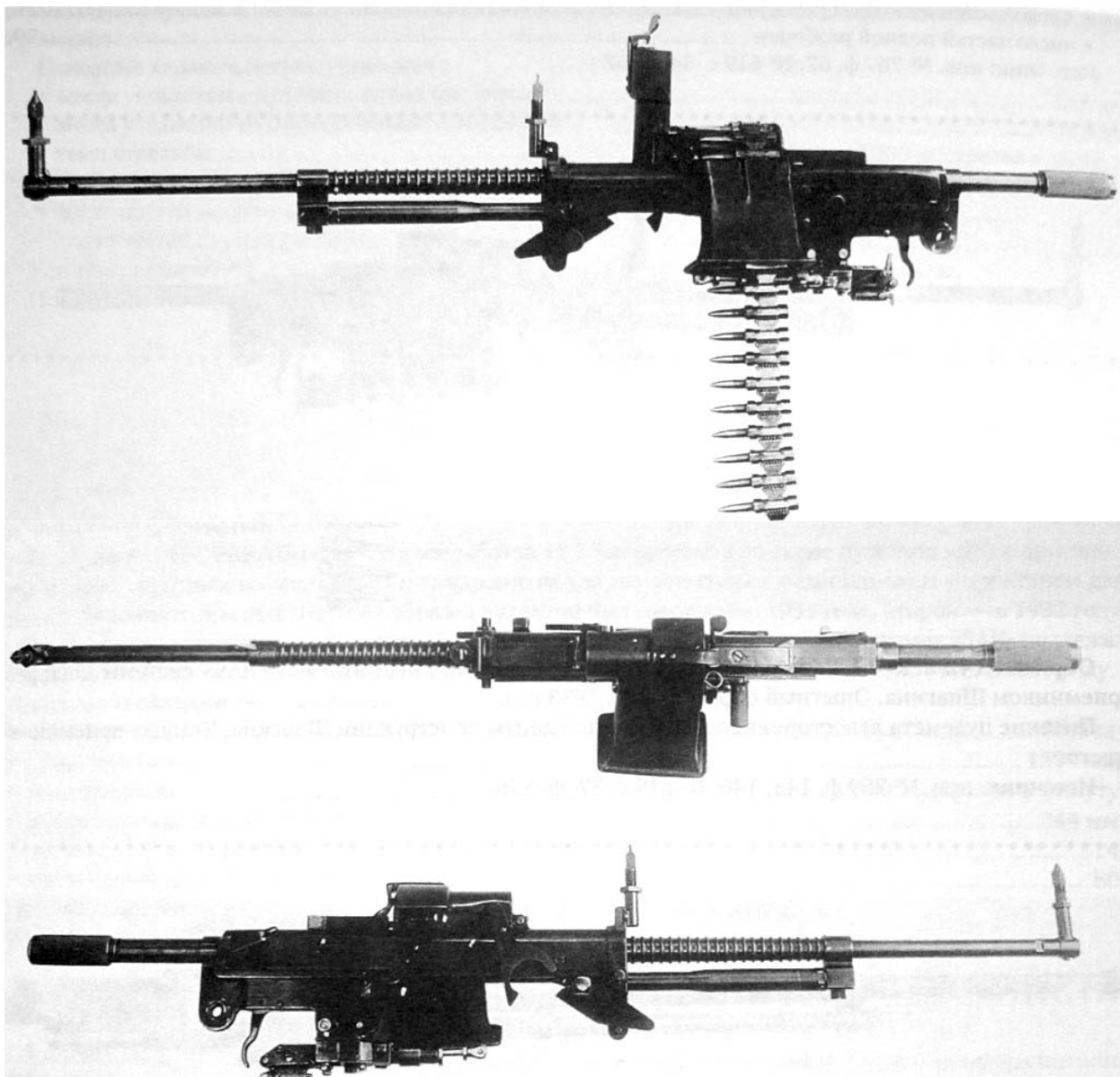
Since 1924 Vasily Degtyarev had also been working on a universal light machine gun (LMG) in parallel with Fyodorov's weapon. The result of his work was a gas-operated design, which served as the basis for a whole series of weapons for various purposes and in different calibers. The most famous example of Degtyarev's design was an infantry LMG, adopted for service in 1927. It used the original pan magazine designed for Fedorov's MGs but, in view of the fact that the 7.62x54R cartridge was less compact than the Japanese 6.5x50SR, the magazine's capacity was reduced to 47 rounds. In the 1930s, the tank and aircraft versions of the Degtyarev MG were also produced in the USSR as the DT and DA. They differed from the infantry version only in external appearance and in having a new, more compact three-row magazine with 63 cartridges.

The tank and infantry MGs were destined to have a long life, successfully completing the entire war as the main armament of the Red Army. In contrast, it was clear from the outset that the aircraft DA and its twin version DA-2 were only a temporary solution. The rate of fire of about 600 rpm did not differ from the basic "ground" design; it was no better than that of foreign MGs from the beginning of the century and obviously could not satisfy the aviators. In addition, magazine feeding made them usable only as defensive weapons for installation in turrets. At that time the PV-1 MG was used on Soviet aircraft – an air-cooled modification by Alexander Nadashkevich of the old Maxim, used as a fixed weapon for synchronous and wing installations. The rate of fire of the PV-1 was slightly higher than that of the standard Maxim at about 850 rpm, but by the beginning of 1930s this was not enough to cope with the increased speeds of modern aircraft, in which "rags and sticks" were increasingly replaced by metal construction.

Thus, both types of aircraft MG – fixed PV-1 and turret DA – were to some extent improvisations designed to serve as a stage in the experience of the Soviet weapons school. As a result, as early as the beginning of the 1930s there was an urgent need to develop a fully-fledged aviation weapon.

In 1933 the DAS (Degtyarev Aviation Rapid-fire), a thoroughly developed aircraft MG, was presented for testing. Only the general principle of gas operation and the barrel length of 605 mm, with its four right-hand rifling grooves, were retained from the DP LMG. In other respects, the design of the weapon was considerably modified. Shpagin developed a new receiver with a disintegrating metal belt feeding from the left. To increase the rate of fire to 1,200 rpm, the operating system used a closed bolt (unlike previous models), with a lever-type accelerator. From the start the DAS was designed for use not only in a turret, but also in a fixed synchronised mounting, for which it was equipped with an appropriate firing control system.

Although the DAS was not a revolutionary design, it was by no means inferior to modern foreign models of aircraft MG in its basic parameters.



aircraft machine gun DAS

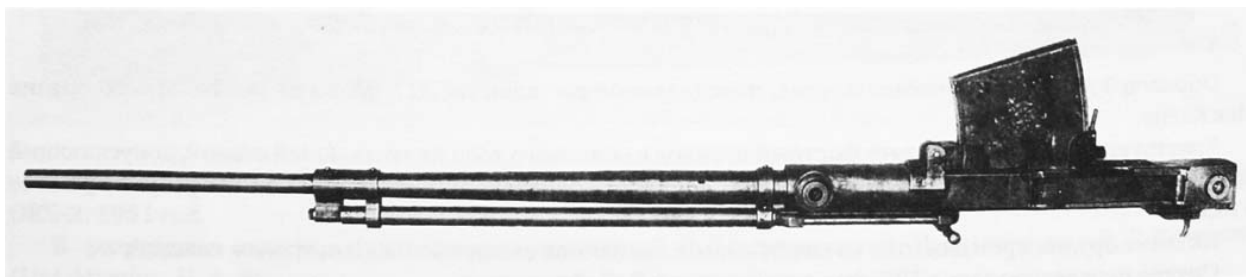
However, by the time the DAS appeared, the famous ShKAS had already been introduced; although it was heavier, more expensive and technologically sophisticated, its 1,800 rpm rate of fire was 1.5 times more than the DAS.

In March 1926, the PKB, headed by Vasily Degtyarev, received an order for the development of automatic guns in 25-mm and 40-mm calibres, but due to the workload involved in the development of the DP, work on these could only begin in 1928. In addition to developing the gun system, it was necessary to develop the ammunition as well, which was a completely new sphere of activity for the Kovrov plant.

By 1930, when seven types of gun and five types of feed system had been developed, the Artillery Department withdrew the order for a 40-mm gun and, after reviewing the projects, chose two types of automation to develop. At the end of 1930 the specification for a 25-mm automatic cannon was formulated, using the type of magazine designed by Kladov. The main difficulty was the simultaneous development of the gun and the cartridge. At that time, there was a prototype of a 25-mm cannon with a rigid clip for 12 cartridges of the Hochkiss type ("Sample

2-4"). By 1933, a prototype of a lightweight 25-mm automatic cannon was manufactured, based on scaling-up the operating system of the Degtyarev MG. This gun could be fed by a 7-round box magazine or a 12-round drum.

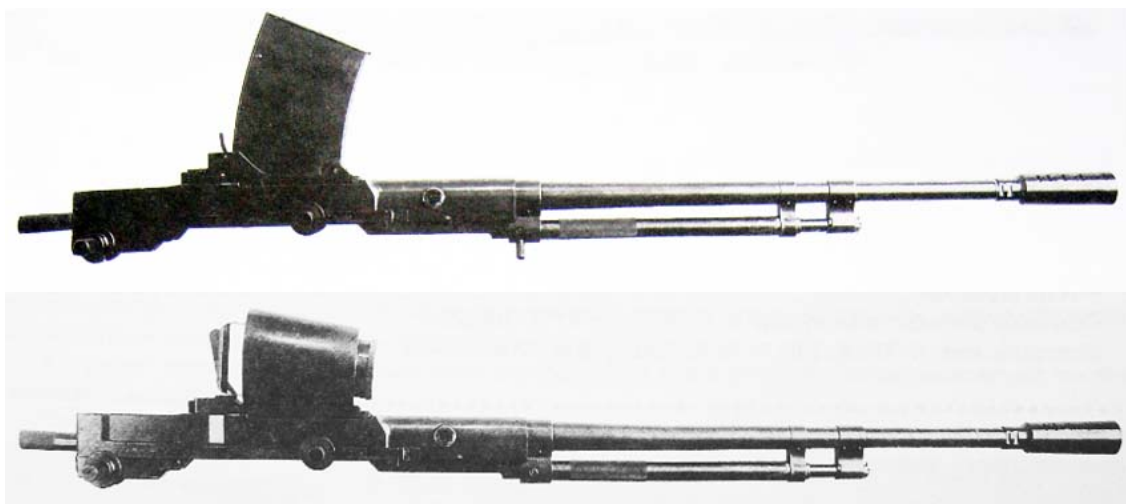
Data on this "Sample 3-4" system unfortunately did not survive. In view of the complexity of the work and the lack of work on the cartridge, by the end of 1933 the work on the 25-mm gun was curtailed in favor of lighter 20-mm systems.



25-mm experimental Degtyarev's cannon "Sample 3-4"

At that time in many countries the concept of a 20-mm universal machine gun, suitable for anti-aircraft, tank, anti-tank and aircraft use, was very popular. Light, compact and quick-firing 20-mm machine guns in the early 30's were effective against almost any target.

Work on the development of such a system started in KB-2 in 1932, and was entrusted to an experienced engineer: Jan Atslega, a Latvian by nationality. Originally, it was planned to develop a purpose-designed cartridge, but in August of the same year the Red Army Air Force offered to use the powerful German cartridge for the Rheinmetall 2 cm FlaK 30 AA gun, now popularly known as the "Long Solothurn" (20x138B), for which the USSR planned to purchase the production line from Germany. This somewhat simplified the task, as the cartridge was well developed in production, possessed excellent ballistics and was quite common in the world.

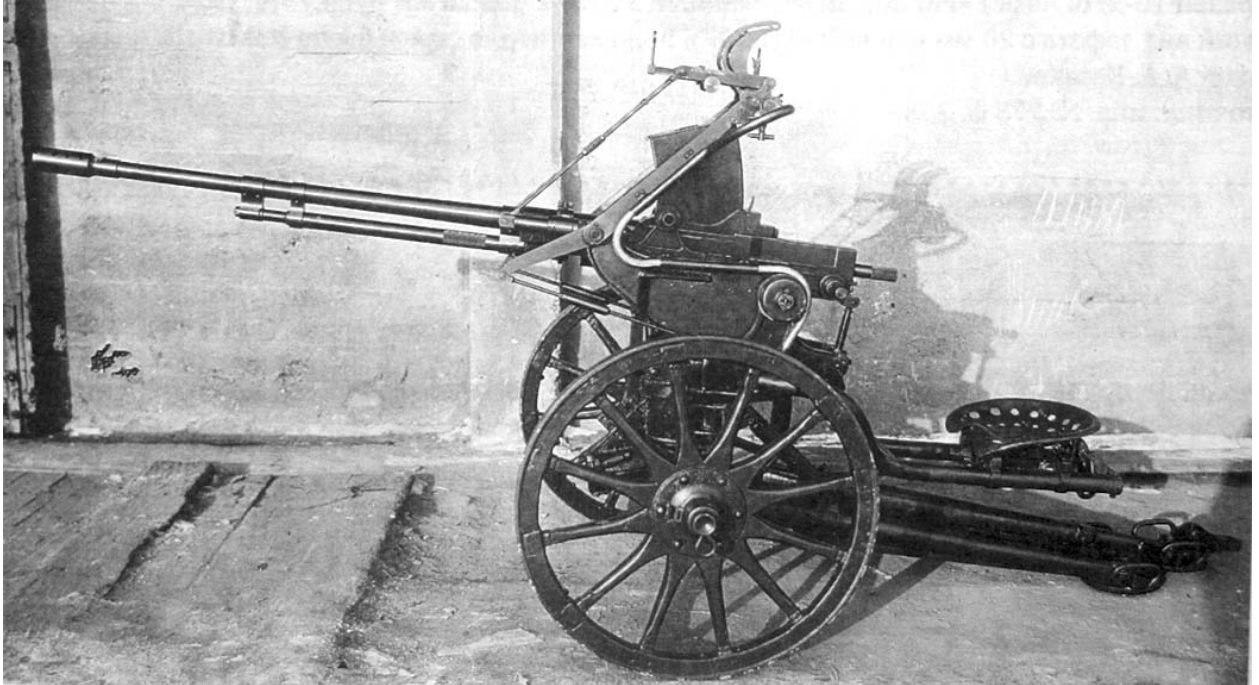


20 mm cannon AP-20 mod 34 with box and drum magazines

In February 1933 Atslega's preliminary gun design was considered and approved for the production of a prototype. In 1934, two guns were manufactured, for box and drum magazines for 12 cartridges, which received the designation AP-20, 1934 year model. The gun used a gas-operated system, which at that time became the corporate style of the national weapons school. It

fired from the open bolt, both single shots and bursts with a cyclic rate of fire up to 250-300 rpm. The powerful cartridge generated a muzzle velocity of 880 m/s. The barrel was 1,520 mm long with 8 right-hand rifling grooves with a pitch of 720 mm.

The gun had an original device for activating an additional spring to help with cartridge feeding when firing at high elevation, when the effectiveness of the magazine spring was reduced.

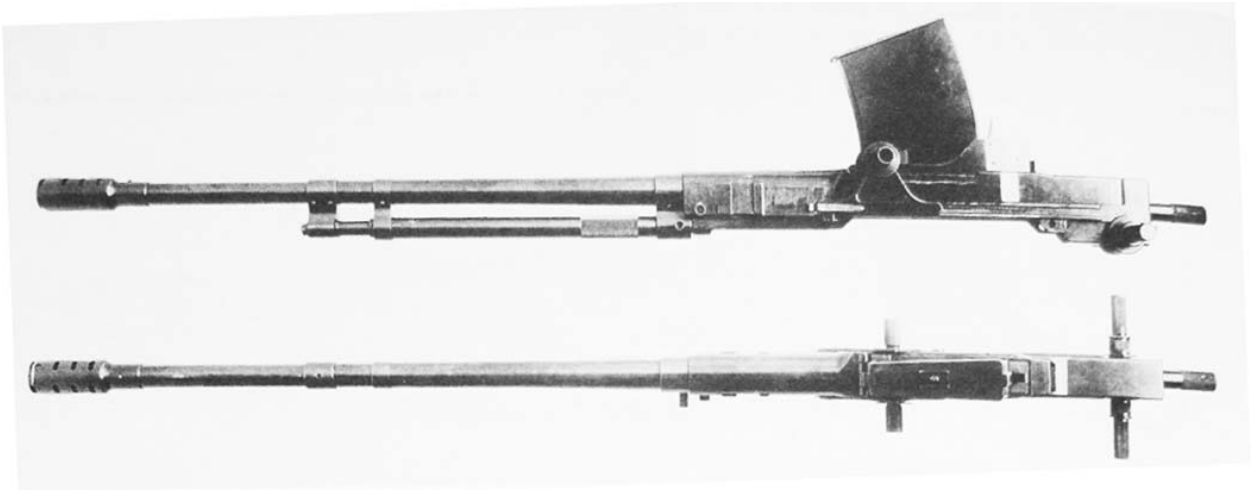


20 mm cannon AP-20 mod 34 on carriage

Tests of prototypes conducted during the period from 1935 to early 1936 revealed an inadequate rate of fire, making it unsuitable for aircraft use.

During the winter of 1936-37, KB-2 also developed a more powerful 20x110 cartridge, using a 128-gram armor-piercing shell. The final model 1937 version of the AP-20 used this cartridge. The operating system and gun dimensions remained unchanged, but the weight of the system was reduced and the firing rate raised to 600 rpm. The capacity of the box magazine grew to 15 rounds.

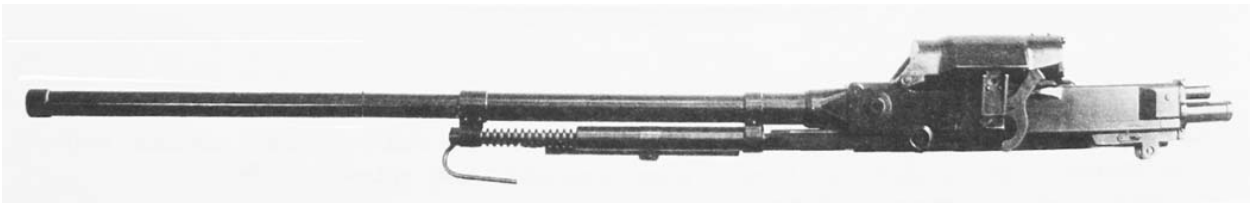
During 1937 about a dozen AP-20 cannons were produced and installed on the RM-20, a universal wheel/track carriage. On July 31, 1937, the main developer of the gun, Jan Atslega, the head of the KB-2 machine tools and installations section, was arrested in accordance with the standard indictment of that time and several months later was shot as an “enemy of the people”. Soon all the work on the AP-20 was canceled.



20 mm cannon AP-20 mod 37

However, attempts to use a powerful 20x110 cartridge were made until the early 1940s. In 1937, the pair of Degtyarev and Shpagin, using the aviation version of their DShK heavy machine gun (HMG) as the basis (about which more below), presented for testing their 20 mm DShAK aircraft gun. In general, the DShAK (Degtyarev-Shpagin Aviation large-caliber) repeated the classical Degtyarev design - the gas operated principle, the locking of the barrel by two pivoting flaps and a drum mechanism which could feed the metal belt from either side.

During the tests, the DShAK gun showed a very good rate of fire of about 600 rpm. While this was less than the frenzied rate of the ShVAK, the gun was considerably easier and cheaper to make and, most importantly, had better ballistics and effective range thanks to its more powerful cartridge.



20 mm experimental Degtyarev and Shpagin aircraft cannon DShAK

The DShAK was designed mainly for installation in the wing. Perhaps, further plans of the developers envisaged the creation of modifications for motor or synchronous versions.

The throne of the "king of aviation weapons" in the 1930s was firmly occupied by Boris Shpitalny, Stalin's favourite. Shpitalny did not tolerate competitors and until the beginning of the war no one was allowed to compete with him. As a result, Soviet aircraft were saddled with the weak, expensive and unsatisfactory ShVAK before the war. Those who dared to criticise it, even high-ranking Red Army Air Force officers, lost their lives.

Degtyarev, who was also respected by Stalin, survived but was not permitted to become involved with aviation weapons.

Before the war, attempts to develop 20-mm aircraft guns for the 20x110 cartridge, capable of competing with the ShVAK, were undertaken by Tula engineers from TsKB-14. Mikhail Berezin

introduced in 1941 a scaled-up version of his UB-20 machine gun, originally developed for this powerful 20x110 cartridge. Alexander Volkov and Sergey Yartsev combined to develop a 20-mm TKB-180 gun also, apparently, assuming the use of this cartridge. Both of these projects continued in different forms. TKB-180 was later reworked for a 23-mm caliber, becoming the VYa-23, one of the most successful Russian aircraft guns, and at the end of the war the UB-20 gun became the B-20, but using the standard ShVAK cartridge - in the conditions of wartime was not practical to produce two types of 20-mm ammunition.

Boris Shpitalny also attempted to correct the problem of the weak 20x99R cartridge. However, to use the Degtyarev's 20x110 rimless cartridge while maintaining its original revolving feeding scheme was impossible. As a result, a new 20x110R rimmed cartridge (using the same 128-gram projectile as Degtyarev's 20x110 round) was developed for use in an experimental automatic cannon based on the mechanics of the ShVAK, which was carried out by a group of designers at the Tula TsKB-14 with the index TsKBSV-75 (length 2,200 mm, weight 65 kg, MV 940 m/s, rate of fire 500 rpm). But this cannon proved too heavy as well as preserving all the shortcomings of the ShVAK, so was of little use in an aircraft and remained as a prototype.



20 mm experimental ShVAK-type cannon TsKBSV-75



Russian cannon cartridges of the 30's - 20x99R ShVAK, 20x110, 20x110R (the 3d model)

In the early 1930s the development of aircraft HMGs was accorded less importance in the USSR than automatic cannon, as indeed was the case in most other countries.

In the USSR, the first attempt to use a heavy machine gun in aviation was noted in the autumn of 1926 when a water cooled .5" Vickers HMG purchased in Britain was installed in a synchronised installation on the R-1 reconnaissance plane (a licensed copy of the British DH-4). At the same time, the possibility of buying a licence for the production of Vickers machine guns was considered. However, the parties did not reach an agreement.

In addition to Britain, technical assistance to the USSR in the development of weapons was provided by Weimar Germany, in particular the firm Dreise – Bergmann Industrierwerke. Using the Dreise LMG as a basis, a scaled-up version of this weapon was developed in Tula in 1927-28 by a team under the leadership of Ivan Pastukhov. This used a short-recoil mechanism and the same belt links as the the .5 Vickers cartridge, and received the designation 5.P – “5-line machine gun” (the line - an old measure of length in Russia is equal to 0.1 inches). At the end of 1927, work was begun on the creation of a domestic large-caliber cartridge based on the British 12.7x81SR with an elongated case to improve the ballistics.

Starting in 1929, the 5.P machine gun was redesigned for a new cartridge, known as the 12.7x108. The new version of the HMG received the designation 5.P-II, repeating the previous design. However, at that time a serious competitor appeared from Tula; the Kovrov KB-2. As a result all work on the 5.P family was cancelled.



12.7 mm experimental machine gun 5.P-II

(from the collection of St.Petersburg Artillery museum)

Degtyarev's first HMG project, designed with gas operation and feeding from rigid clips, was in general similar to the DP LMG.

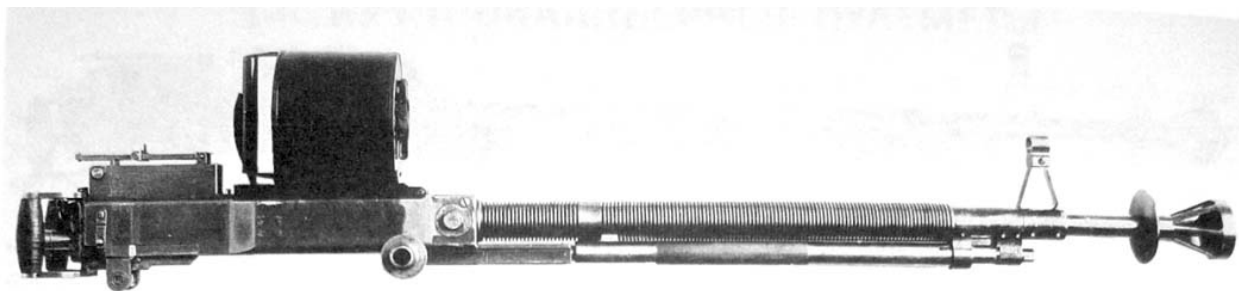
In May 1931, a modified sample of a machine gun with Shpagin's receiver for use with a fabric ammunition belt feed was presented for testing.

On February 9, 1931, a government decree initiated a program for an aviation version of an HMG, stipulating the use of the new 12.7x108 cartridge.

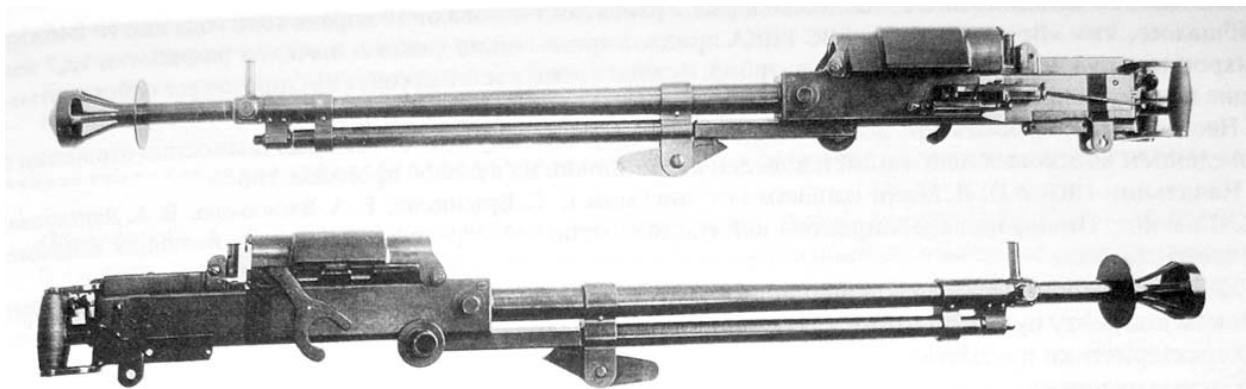
In 1932 the HMG was formally adopted for service with the designation DK-32. At the same time, the aviation version, DAK-32, was delivered for testing.

The military tests of the DK in 1934 showed that the machine gun was not suitable for engaging fast-moving targets because of the low rate of fire. Although the cyclic rate of 360-400 rpm was acceptable, the practical rate (including magazine changes) did not exceed 200 rds / min.

There were a lot of experiments with different carriages and types of magazine.



12.7 mm DK-32

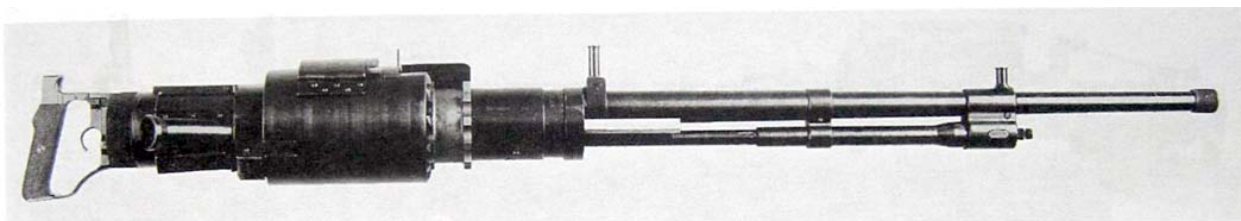


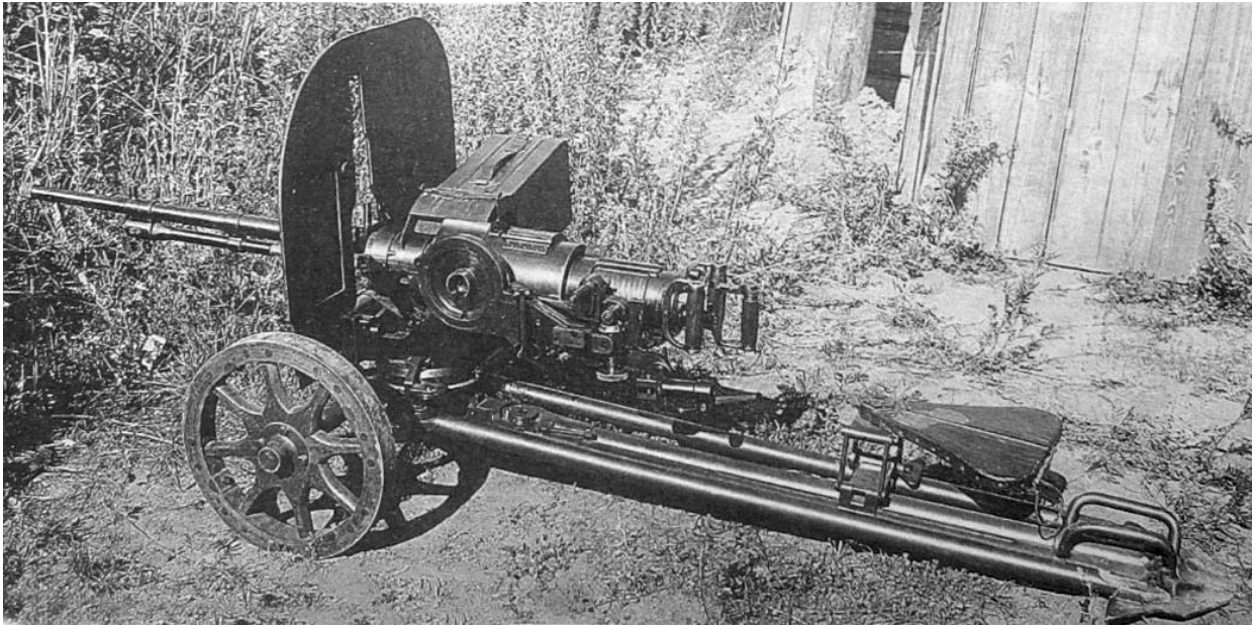
12.7-mm aircraft "wing" DAK-32

The DAK-32 aircraft version, intended for fixed wings and turrets, repeated the shortcomings of the DK "land" version, the main one of which was the unacceptably low rate of fire of about 300 rpm; it was also heavy at 35.5 kg .

At this period appears the first mention of the ShVAK 12.7mm machine gun, the prototype of which was completed on May 28, 1932.

In 1934 the production of the DK was suspended, and in 1935 it was stopped. To a considerable extent, the work on the improvement of Degtyarev's heavy machine gun was facilitated by Shpitalny, who promised Stalin a heavy machine gun with the best characteristics both for "land" and air versions. However, the 12.7-mm ShVAK proved unsuccessful: partly because of the complexity of the design inherited from the 7.62mm ShKAS, partly because of the inability to use in the ShVAK the standard rimless 12.7x108 cartridge. As a result, in parallel with the Degtyarev's cartridge, appeared an almost identical rimmed cartridge, the ShVAK 12.7x108R. The ShVAK-12.7 was not accepted by either the aviation nor ground forces and, after the release of about a hundred guns in 1937, its production was canceled.



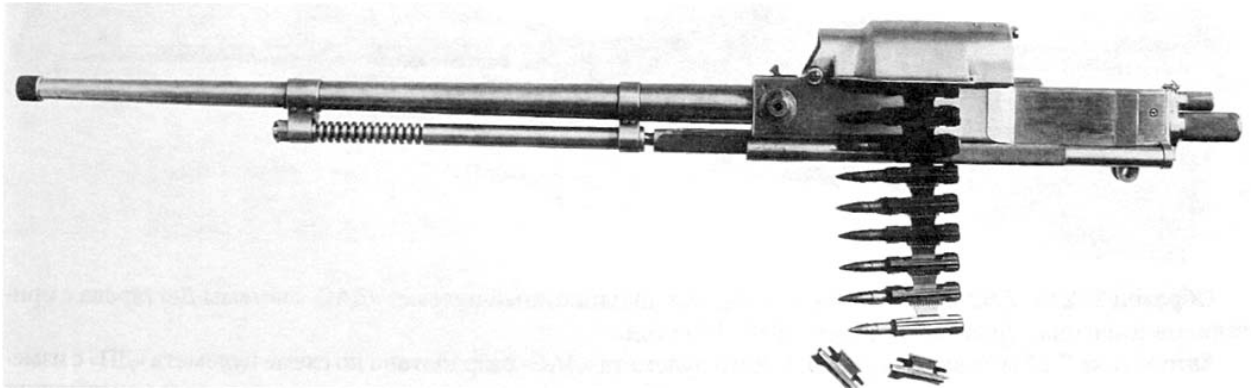


ShVAK-12.7 on air and ground versions

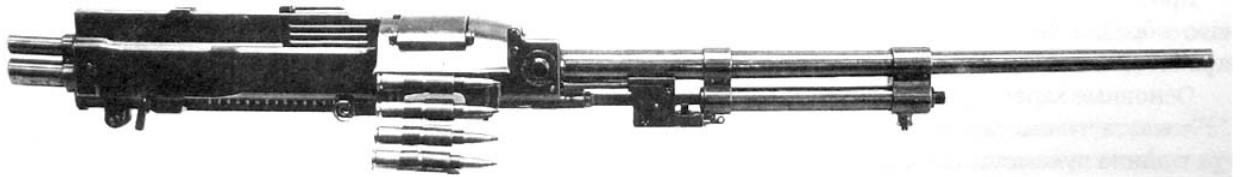
Meanwhile, the need for a universal HMG was still very obvious. Fortunately, in 1935 - 1936 Degtyarev managed to achieve acceptable characteristics for his design. In 1938, it was adopted with the designation "12.7-mm machine gun of the 1938 model of the DShK" (Degtyarev-Shpagin large-caliber). In parallel, experimental versions of the type of magazine were developed, and options were tested for the SHVAK 12.7x108R cartridge.

At the turn of 1937-38, an aircraft version of the "land" DShK (factory designation TsKB-2-3835) was developed in two versions: for wing mounting the DShKA with a belt feed, and for turret mounting DShTA (DShAT) with a 30-round drum magazine designed by Kladov. These were structurally identical to each other and also in large part with the "land" DShK. The difference consisted in a higher rate of fire - 750-800 rpm, due to the lever accelerator and the use of disintegrated metal belt with a smaller pitch between the links - 34 mm instead of 39 mm in the non-disintegrating one on the DShK. Characteristically Degtyarev also covered the options, having developed versions both for the standard 12.7x108 cartridge and for the ShVAK's 12.7x108R.

The final version of Degtyarev's aircraft machine gun was the DNK version 1938 year model, designed by Nikiforov. This was intended for both wing and synchronised installations. Also tested were versions for the 12.7x108R ShVAK cartridge. Unlike the DShK, its aviation versions featured a quick barrel change. The barrel length of 1,070 mm (with 8 right-hand rifling grooves) and the gas operation system were the same as the DShK except for the breech part, in which a bayonet connection with the receiver was provided.



12.7-mm aircraft "wing" DShKA-38



12.7-mm aircraft DNK

The weight of aviation machine guns in different designs ranged from 24-27 kg with a length of about one and a half metres. Thus, at the end of the 1930s, the Degtyarev-Shpagin aircraft gun was at least as good as the famous American Browning M2 and it could well compete with it as a universal machine gun for all purposes.

By the way, in the late 30's the question of copying the .50 Browning M1921 was seriously considered. An example of the American machine gun was purchased and tested under the designation "KB-2" (Colt-Browning). In 1938 the designers Salishchev and Galkin from TsKB-14 Tula developed the TKB-138 HMG based of the Browning design (12.7x108), but this remained a single prototype, and later the TKB-138 was scaled up to 23 mm caliber (TKB-198 or SG-23) and in the early 1940s participated in the competition for a 23-mm aircraft gun.

But then fate intervened to prevent the adoption of the DNK. In the autumn of 1938, a series of tests took place of a "BK" aircraft HMG designed by a young and practically unknown designer, Mikhail Berezin from Tula TsKB-14. This weapon showed exceptionally good characteristics: it had a higher rate of fire (using the same disintegrating metal belt), was lighter, easier to make, and more reliable than the DNK.

There is a legend that at the beginning of 1939, during a meeting in the Kremlin at which prospective types of weapons were considered, the question arose of a new aircraft heavy machine gun. Joseph Stalin, puffing his pipe and looking in the eyes of Degtyarev, asked: "So which machine gun is better, yours or comrade Berezin?" To which Degtyarev, without hesitation, replied "Berezin's machine gun is better."

The result is well known: the Russian Air Force received the UB - in its class, one of the best aircraft HMGs in the world. Degtyarev did at least secure the "land" niche. His DShK was in

service in the USSR in various versions for many decades. And now it can be found all over the world.



HMG cartridges: .5 inch Vickers Export (12.7x81SR), 12.7x108 DShK, 12.7x108R ShVAK

model	Fyodorov	DAS	AP-20 mod 34	AP-20 mod 37	TsKBSV- 75	DShAK	DAK-32	DShKA	DNK	5.P
automatic	Short recoil	Gas operated								Short recoil
cartridge	Arisaka 6.5x50SR	7.62x54 R	20x138B	20x110	20x110R	20x110	12.7x108	12.7x108	12.7x108	12.7x81SR 12.7x108
Length, mm	1055	1110	2130	2200	2200	1770	1590	1520	1550	1632
Barrel length, mm	520	605	1520	1520	?	1050	?	1070	1070	1003
Weight, kg	4,4 (body) 7,3 (with mag.)	10.0	60	56	65	33.3	35.5	24.3	27.6	28
MV, m/s	660-770	840	880	940	940	930	850-870	850-870	850-870	
ROF	600	1200	250-300	600	500	600	300	700-800	850	450-500