

Farmer's Notes on the AK-47 designer(s)
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Who designed the AK-47?

The Soviet archives aren't open. Thus we're left with reverse logic. Rather than trying to “find” the designer we're left with the reverse.

Do you have a basic familiarity with radar? Send out a signal. Plane returns signal. “There you are.” What about stealth? Doesn't return signal. So paint the sky with signals. The part that doesn't return one is it. Reverse logic at work – don't look for it. Look for the reverse. “Gather all the suspects in a room and don't try overly hard to find the right one. Work at eliminating the wrong ones. The one left standing is him.”

Adding to the circus nature of this, I'm not even going to do any significant research. Caveat Emptor.

For those unfamiliar with the topic, the answer is “Mikhail Kalashnikov.” For those aware of the circumstances, Hugo Schmeisser is offered. Myself I don't think it was either. The basis is what follows.

Gun Designers.

Gun designers are made, not born. The most unlikely of people have a knack for it and others, who logically should, do not. Andrew Burgess was an interesting man. Burgess joined Mathew Brady, the celebrated photographer, in 1855 as an assistant. In 1863 he became a full partner and, in 1872 when the firm folded, Burgess ended up with an incredible collection of negatives from the operation. His widow donated them to a university after Burgess passed away after the turn of the century. “Eighty five.” The number of patents a reasonably good search will turn up assigned to Burgess. The first was awarded in 1871 and the last was filed in 1904; quite the run. Every single one of them for improvements in firearms. While Burgess designed firearms of many types, it was his patents for lever action rifles which really stirred things up. Enough where Winchester's dominance in those was threatened. Winchester did the only thing possible – get another gun designer to restore their ability to compete. John Moses Browning of course. “One hundred and thirty five.” The number of patents a reasonably good search will turn up assigned to Browning. The first was granted in 1871 and the last was filed in 1928 – after Browning had died.

Winchester had access to Browning. They also had local talent of course. Frank F. Burton filed a string of patents from 1904 to 1939. Let's call it 48 patents. Thomas C. Johnson of Winchester has

about 80 from 1896 to 1925. Perhaps, at 33 from 1952 to 1987, that makes Eugene Stoner a lightweight.

The interesting thing about gun designers is they design guns. Rarely one gun. Just let the number of guns that Browning designed flow through your head and that becomes clear. Burgess, Johnson, Mauser, etc., They design guns. Browning, a good example, is responsible for an auto-loading shotgun and a pistol. John D. Pederson is also responsible for a series of shotguns and a pistol. Mauser is famous for the rifles but the pistol they made saw wide service. Hugo Schmeisser clearly was a gun designer and even took the time to file 10 patents in the United States. Which is the same number as Andreas Schwarzlose who, interestingly enough, filed his first ones while residing in Suhl at the same time as Schmeisser. Christopher Spencer, of Spencer carbine fame, is also the inventor of the pump shotgun.

Production Engineers.

Gun designers design guns. Typically they spent their lives inventing them. What gun designers rarely do is production engineering. Production engineers take a design, in this case a gun, and redesign it for production. Typically that means reviewing the design in hopes of simplifying it. A production engineer, generally a trained engineer, also looks for engineering mistakes. An obvious mistake is a 90 degree angle under stress; that is where fractures occur. The Krag-Jorgensen in American service had a 90 degree angle in the receiver where the barrel butted against it. That was removed after receiver fractures in screwing in barrels. The M1 rifle, “the Garand,” had a 90 degree angle in the operating rod and it, as expected, fractured at that location. A production engineer takes a gun design and redesigns it for production. The design gets simplified. Known engineering mistakes are addressed.

A good example of a gun design and a production engineered gun design is the Krag-Jorgensen in American service. The Krag-Jorgensen was placed into production with no production engineering. From April of 1894 to April of 1896 they managed to make about 30,000 of the guns. The Krag was “re-engineered” with the Model of 1898 and that made it easier to produce. It didn’t get a complete re-engineering but the Model of 1898 wasn’t an “improvement” of the earlier models – it was an attempt to re-engineer it for production. Another example is the M-1941 Johnson rifle. After he’d completed the design, the designer took the gun to Taft-Peirce. Taft-Peirce, a company in Rhode Island at the time, specialized in production engineering. As did Pratt & Whitney. One last example of a gun getting production engineering after the fact is the M-1903 rifle. During WW2 that rifle was re-engineered for production. The M-1903A3 was the result.

What has become clear in history is gun designers design guns. It’s a knack as much as anything. Those with the talent design multiple guns. Production engineers re-design guns. Typically they’re educated engineers. They take a design and make it easier and cheaper to produce. Removing known engineering flaws in that effort.

Production Engineering as Redesign.

In 1934 the Germans adopted the MG34 machine gun. It’s been claimed that the MG42, a “designed replacement” for the MG34, was due to the battlefield conditions varying from the desert of North Africa to the mud of Russia. The problem with that theory was the effort to replace, or supplement, the MG34 with something cheaper and easier to make was started before Poland was

invaded. In fact it was in 1937. We know this as the first patents on the “redo” effort were filed in 1937.

The MG34 was a complex, expensive, and hard to produce item. Complexity, cost, and reduced volume production generally go together. Reviewing the MG34, the powers that be took it to a company specializing in manufacturing items from stamped metal – instead of milled. Milling takes a lot longer than stamping and thus slows production and wastes metal. The major “improvement” in the M-1903A3 over the earlier M-1903 is also noticed in stamped metal parts. With as many items made via stamping today it could be believed that stamping metal parts is easy, and it is today, but in the 1940s it was an advanced manufacturing technique.

The MG34 “replacement” bid was sent to three companies: Metall und Lackierwarenfabrik Johannes Großfuß AG of Döbeln, Rheinmetall-Borsig of Sömmerda, and Stübgen of Erfurt. Rheinmetall-Borsig made weapons, mainly cannon, but they also had an advanced manufacturing ability. Großfuß specialized in stamped metal lanterns. Note that the “normal” small arms companies are absent? They weren’t after a “new” design but a production engineered MG34.

German patent DE1037926B. “Barrel exchange a direction for machine rifles.” Filed on May 12th of 1938, the inventors are Dr-Ing Werner Gruner and Kurt Horn. Assigned to Großfuß. Not “Dipl-Ing” but “Dr-Ing.” Werner Gruner held a doctorate in engineering. Typically people in the trades were Dipl-Ing or, roughly, a Master’s degree. Kurt Horn isn’t listed as having a degree. “A production engineer of considerable note and a gun designer working together.” Seems clear. “A production engineer of considerable note in a firm specializing in metal stamping and a “hired gun” to handle the gun design aspects.” Seems clear. What the powers that be likely didn’t expect is that the MG34 wasn’t just “production engineered” to a simpler form, as the M-1903 to M-1903A3 was, but Großfuß redesigned the mechanism to using roller locking. Basically it was a new design. Gun designer at Großfuß? Kurt Horn. He did the unexpected.

Sheet metal enters the mix.

The Remington Model 8 rifle was introduced in 1906. Using the same basic designs as Browning’s shotgun, the Model 8 was a semi-automatic rifle. The most interesting part of the Model 8, for our purposes, is the barrel locked into the barrel – not receiver. In a typical military rifle of the era, the M-1903 or M1 apply, the barrel screws into a solid receiver and the bolt locks, via lugs, into that receiver. The receiver itself, given it holds the bolt lugs, must be strong. With the Model 8 Browning placed a “collar” on the barrel and had the bolt lock into that instead; this meant the receiver itself didn’t need great strength. The Model 8, when fired, uses the recoil to drive the locked barrel/bolt assembly back until they unlock – at which time the bolt continues its journey to the rear. The bolt/barrel assembly are returned by a large spring which is located around the barrel.

What Kurt Horn and Dr-Ing Werner Gruner at Großfuß did was very similar. In the MG42 the bolt/barrel are locked together and driven back by recoil. The barrel/bolt assembly are “held together” via rollers. As the barrel/bolt travels back the rollers move out of the way and that permits the bolt to continue its’ movement to the rear. Functionally this is really no different from the Model 8. Many guns used it – notably the first “squad automatic rifle” - the French Chauchat.

Just before WW2, with the Johnson M-1941, Melvin Johnson “evolved” the Model 8 with a couple of improvements. The big improvement was the bolt locking lugs; instead of two lugs on the side Johnson determined that multiple lugs provided more locking surface and, being smaller, permitted the bolt to lock and unlock with less rotation. Whereas Browning had placed the “return spring” around the barrel Johnson placed it in the stock. Johnson also used a two-piece bolt – a bolt and a bolt carrier.

Rifles, sub-machine guns, and assault rifles.

Rifle cartridges are very powerful whereas pistol cartridges aren't. Understanding that pistol cartridges weren't very powerful, a wide variety of "sub-machine guns" were made in the 20th century. Most used simple blow-back operation like a pistol. This is possible as the cartridge itself isn't very powerful. With blow-back operation the bolt simply moves to the rear – driven by the recoil force of the cartridge going off. The bolt must be heavy for this to work (for each reaction there is an equal opposite reaction). *A submachine gun has a fixed barrel and only the bolt is driven back by the recoil.* If one built a submachine gun using simply blow-back operation, and fired a rifle cartridge, the bolt would need to be massive; it's simply not possible. Thus the Model 8, Johnson M-1941, and MG42 (among others) use the mass of the barrel and bolt to off-set the recoil.

If one scales down the rifle cartridge to an "intermediate size" round is it possible to use simply blow-back like a sub-machine gun?

Tactical imperative.

Let's take a simple WW2 German rifle unit. The unit has an MG42 which requires a "crew" of three: gunner, assistant gunner, and ammunition carrier. Typically the squad also has a squad leader and 7 other infantrymen for a total of 10 infantrymen and 1 squad leader. The weapon's complement is 1 MG42, one sub-machine gun (squad leader) and 9 K98k rifles. What the Soviets figured out, pretty early on, is the MG42 must be dealt with. Once the MG42 is removed from the mix, assuming the crew survives, it's 11 Germans with a single sub-machine gun and 9 bolt-action rifles. What a review of German accounts is clear is the Soviets figured that out. Soviet tank losses were massive. T-34s would attack, generally unaccompanied by infantry (poor tactics) and take out the MG42. With the MG42 removed the Soviet troops would attack – armed with sub-machine guns. Soviet troops armed with sub-machine guns were deadly against Germans with bolt-action rifles. The Soviets lost a lot of T-34s as the infantry should protect the tanks (see my tank paper) but that rarely was done. Regardless, what the Soviets figured out was it was tactically imperative to take out the MG42 first. Mortars, tanks, etc.,

German tank tactics, post-Kursk, were designed to take out Soviet tanks at range. The Soviets had figured out that the Tiger and Panther were better "tank against tank" tanks than the T-34 but, if you get in close, that advantage was lost. At Kursk the T-34s got in close with the German tanks and destroyed them wholesale. Numbers matter. Range matters. Along the same lines the Germans figured out the Soviets were using that "take out the MG42 and then attack the Germans with guys having sub-machine guns" method. The Germans could have responded by arming their own troops with sub-machine guns but, as with tanks, that is more of an "equalizer" than anything. What was wanted was a gun which was about the size of a rifle but had range greater than the sub-machine gun.

An American infantry squad was equipped with semi-automatic rifles and a Browning Automatic Rifle. The riflemen were armed with a repeater.

A German infantry squad was equipped with bolt-action rifles and an MG42.

A Soviet infantry squad was armed with short-range sub-machine guns.

I mention the previous as, in the case of the Americans, no real tactical imperative is created if the BAR is lost as the riflemen have respectable firepower. With the Soviets the same really holds true as they're armed with fully automatic weapons; albeit close range ones. The Germans were the ones with a tactical imperative to find a better solution as the mix they had suffered the fatal flaw of the squad being under-armed when the machine gun was taken out.

The German Assault Rifles.

Having encountered the Soviets with sub-machine guns, and Americans with semi-automatic rifles, the Germans responded with a desire to arm their men with something better than a bolt-action rifle. End result? Gewehr 43 and MP44. It was the addition of Kurt Horn that resulted in the MG42 being “more than expected” in the engineering of the MG34 to something cheaper. *The Germans had decided to move from bolt action rifles to a semi-automatic rifle; not an assault rifle.* Over 400,000 Gewehr 43 rifles were made. This, not an assault rifle, was the designed replacement for the K98k. The StG43, redesignated MP44, was revolutionary and not what the power that be wanted or desired.

A hamburger today.

Let’s get back to that time-frame and review the need. It’s a tactical imperative to provide riflemen with a rifle that is better than a sub-machine gun as that’s what the Soviets have. This eliminates sub-machine guns. The Germans had multiple factories all equipped to produce the K98k rifle. Those factories could be leveraged to make semi-automatic rifles. The semi-automatic rifle used the same cartridge as the machine gun. It solved the tactical imperative and did so using existing factories.

The advantage of an assault rifle is it can be fired fully automatic like a sub-machine gun but has greater range. The disadvantages are it uses a unique cartridge, not common with the machine-gun, and doesn’t leverage existing tooling. It’s been said, rightly, that Hitler was against the assault rifle. The reasons are obvious. The semi-automatic rifle solved the problem and did so with existing plant.

Let’s review that tactical imperative again. The Soviets had discovered that taking out the machine-gun left the German squad at a great disadvantage. The German riflemen were armed with bolt-action rifles and the squad leader with a sub-machine gun. The rifles could be replaced via semi-automatic rifles but that left the sub-machine guns. The Stg43, now called the “MP44,” was paraded as a replacement for the sub-machine guns.

Cannon fodder with automatics.

The German army, having the MG42s and Gewehr 43, was provided for. The MG42 was already sufficient, the K98k was to be replaced by the Gewehr 43, and the MPs would be replaced by the MP44. Cartridge commonality for the MP44 didn’t matter as it wasn’t designated as a rifle replacement and the early MPs didn’t use rifle cartridges either. Not terribly different from the M1 carbine.

With the enemy threatening Germany itself a much larger arming than had been previously envisioned was clear. “When we arm the people, the Volkssturm, we’ll need to do so on a much wider basis than the army.” That was clear. The existing factories were making rifles for the army. New factories could be brought in and, given it was from scratch, the stamped metal construction of the MP44 was easier to make given the lack of tooling; a reverse of what had been seen in rifle production.

In 1944 it was obvious that many more weapons were needed than could be produced. The following is what was seen:

- 1) Mauser was asked to design an even better MP (assault rifle cartridge) for the army. They elected to use a “roller locked” design – not a roller delayed design as the MG42 had.
- 2) Großfuß was asked to design an MP (assault rifle cartridge) using blow-back.
- 3) Gustloff-Werke was asked to design a cheap assault rifle for the Volkssturm using blow-back also. This was to also use the assault rifle cartridge. This gun was to be semi-automatic.
- 4) The factories making the rifles were asked to submit designs for “emergency production” arms.

#1 and #2 are regular army efforts whereas #3 and #4 were centered on the Volkssturm via the “primitive weapons program.”

Alles Kaputt.

Germany ended the war with the MP44 (Hugo Schmeisser), the Mauser designed roller-delayed assault rifle, the Gustloff-Werke assault rifle, using blow-back and only being a semi-automatic, and the Großfuß assault rifle, also being blow-back but being fully automatic. Both the Gustloff-Werke and Großfuß designs had used blow-back but, in both, interesting designs had been used as it proven that it wasn't possible to fire that cartridge with a simple blow-back action. Both Gustloff-Werke and Großfuß had succeeded but, again, they weren't able to do so with simple blow-back.

Those involved at Gustloff-Werke (MP44 production and Gustloff-Werke assault rifle design) were Karl Barnitzke, and Otto Schink.

Those involved at Großfuß were the same two from the MG42 effort: Werner Gruner (production engineer) and Kurt Horn.

Those involved at Haenel were under Hugo Schmeisser.

I'll skip the Mauser staff.

When the war ended three of the four German centers of assault rifle design were in the Soviet zone (Gustloff-Werke, Großfuß, and Haenel) with one being in West Germany (Mauser). Immediately after the war the designers from Gustloff-Werke, Großfuß, and Haenel were sent to the Soviet Union and remained there until the early 1950s.

John Garand took his time.

In American lore John Garand was a great gun designer. There is no doubting that the M1 rifle is an incredible thing. Adopted in 1936 it provided the American forces with a semi-automatic rifle for WW2. Looked at another way, the M1 rifle, when adopted, used a gas trap design. It also suffered from failure to feed issues. The operating rod tended to break. In other words, *twenty years after he started, Garand's rifle design still wasn't working.* This in spite of having worked along side John Pedersen – a true gun designer. Right before America entered the war there was a “fierce battle” between the M1 rifle and Johnson's M-1941 rifle. The M-1941 was heavily based on Browning's Model 8 design. That “battle” was due to shortcomings in the M1 rifle.

Gun design is hard. Browning's BAR was found to be defective during WW1 and wasn't fielded in any numbers due to the defects (see Farmer's Notes, Volume 6, Part 2). Browning, perhaps the best gun designer in history, wasn't an assured win on design.

The three evolved.

Should the M2 carbine be considered an “assault rifle?” The M1 carbine is semi-automatic and fires a cartridge which isn't a pistol and isn't a rifle cartridge. The M2 edition, produced during WW2, was fully automatic. The bolt is essentially similar to the bolt in the M1 rifle. So neither fish nor fowl. After WW2, not having the tactical imperative the Germans had faced, the American army stuck with the M1 rifle evolved; the M14. The M1 and M2 carbine were secondary arms as they had been during the war.

Winding back to 1941, the M1 rifle and the Johnson M-1941 had had a fierce battle with the Johnson losing. Post-war the USAF was armed with M2 carbines. Fairchild Corporation (aviation) started a small arms division and, logically, started designing weapons for the USAF. Eugene Stoner was employed and began designing an assault rifle. A review of the AR-10 design shows an incredible similarity to the Johnson M-1941 and that's not surprising as Melvin Johnson was brought in to help. Scaled down to a smaller cartridge, the AR-15, they licensed the design to Colt. The M-16 was initially purchased by the USAF to replace the M2 carbines. Thus the American assault rifle really is the Browning designed Model 8, via the Johnson rifle, to the M16. It can be said that the Johnson, updated (M16), finally won over the M1, updated (M14) but again it was a battle.

The Mauser roller locked assault rifle was developed after the war into the CEAM Modele 1950 in France and then the CETME in Spain. Returning to Germany, the designers joined forces with former Mauser employees Edmund Heckler and Theodor Koch (Hekler and Koch) and produced the G3.

What we're lead to believe is in Russia Mikhail Kalashnikov, a man with no real gun design experience of note, designed the AK-47. After that design he was involved in the design of a machine gun based heavily on that design and nothing else of note.

What of the other three German assault rifles? The design teams for all three were in Russia at their design center. In Russian lore perhaps they were sewing socks or gun covers. When the Germans are mentioned Russians, and Russophiles, invariably play the "you're claiming the Russians are barbarians and cannot design modern items" card. What they don't address is those German assault rifle designers in Russia while the AK-47 was designed. The first AK-47 was made from sheet metal – a specialty of Werner Gruner.

The AK-47 design.

To anyone with their eye's open the German assault weapon designers were behind the AK-47. Was Kalishnikov involved? No doubt. "Local peasant boy makes good, designs assault rifle" makes for good Soviet propaganda. Again, one cannot ignore the German designers there. Of the four groups in Russia at that time three had designed assault rifles:

Hugo Schmeisser: MP44.

Karl Barnitzke, and Otto Schink: Gusloff-Werke Assault Rifle.

Kurt Horn and Werner Gruner: Großfuß Assault Rifle.

Mikhail Kalashnikov: None.

Yet we're to believe that Kalashnikov was the designer? The beggers belief. "The AK-47 isn't a copy of the MP44" is often advanced. "Neither were the Mauser, Gusloff-Werke, nor Großfuß assault rifles." It's been observed that action of the AK-47 isn't the same as the MP44 but it should be noted that the MG42, Gustloff-Werke, and Großfuß assault rifles all used unique actions.

Russian designers and tactical imperative.

Simonov, Fyodorov, Tokarev, and Shpagin. Russian gun designers. Good gun designers. Tokarev was ahead of the game with his SVTs. Simonov was probably more talented than Tovarev even. In 1945 the Russians fielded the SKS. The SKS, like the Gewehr 43, leveraged existing plant. It was traditional. The Russians didn't have the same tactical imperative as the German in the German's production of an assault rifle. The SKS, like the M1 carbine, is neither fish nor fowl. Regardless, the Russians adopted the SKS while those German designers were in Russia. In 1947 the first AK was produced. The Germans had moved from the Gewehr 43 to the MP44 for some basic reasons. The

Americans ended up moving from the M1 to the M16 for the same basic reasons. The Russians ended up moving from the SKS to the AK-47 for much the same reason. John Garand wasn't involved with the M16. Sergei Simonov wasn't involved with the AK. Instead it was a young "gun designer" with no production weapon to his credit assigned with Germans from three different teams which had produced assault rifles. One question why the two Russians with experience in the field, Simonov and Tokarev, were not involved unless one understands men with more experience in assault rifle design were available.

Schmeisser is outclassed.

When Hugo Schmeisser's presence in the Russian design center when the AK-47 was being designed the Russians and Russophiles all lose their cookies. On the other side many claim Schmeisser was likely the designer. From what I can see neither was. It ignores the presence of Kurt Horn and Karl Barnitzke. Kurt Horn is the designer behind the MG42 – a weapon more significant than any Schmeisser designed.

Schmeisser. Was ill and, from Soviet records, uncooperative. They kept reducing his pay due to non-cooperation. Unlikely he was the designer.

Kalishnikov. Had no significant design success before or after. This rules him out. Those wishing to hang on to the idea that Kalishnikov was responsible need to ignore the German designers being there. That simply isn't possible. German teams behind 3 of the 4 German assault rifle designs were there. One team being the designers of the MG42. For those insisting on Kalishnikov the question is "what do you think those Germans were doing?" No answer is generally available. They weren't sewing socks. It's not denegrating the Russian skills. Simonov was likely the most talented at the time and his SKS-45 was the "main chance" gun adopted while those Germans were brought in, independently, after Germany's defeat. Simonov, and the SKS, bear a similarity to the Germans and the Gewehr 43 in so many ways. Russia had no tactical imperative for an assault rifle. The SKS used existing plant. The Russians weren't as advanced in metal stamping (the first AK-47s suffered from that lack of capability). "Why design a gun to use metal stamping when you clearly do not have the ability to make it?" Does one believe Kalashnikov made that decision or Werner Gruner – a doctorate level engineer specializing in metal stamping?

The Germans are gone.

The Germans left in the early 1950s – after the design of the AK-47 had been perfected and bugs worked out. Schmeisser went back to Suhl and died shortly thereafter. I cannot find Karl Barnitzke's subsequent activity. His assistant at Gustloff-Werke, Otto Schink, went back to the company (it was Simson company before the Nazis took it from the Jewish owners) and designed motorcycles as weapons design was no longer an option there. Werner Gruner returned to East Germany and specialized in metal stamping application in agriculture machinery.

Kurt Horn made it to West Germany. 4336743 is a German patent assigned to Heckler & Koch. Filed 10 January, 1980, the main inventor is listed as "Kurt Horn." The designer behind the MG42 and, in my opinion, the main designer of the AK-47.

Wrapping it up.

Guns using rifle cartridges either use gas to unlock the bolt, late in the firing cycle, to avoid the full recoil from operating on the bolt. The other method used is to use the mass of the barrel and bolt to tackle the recoil. Guns using pistol cartridges can use the bolt but it does demand a heavier bolt. With the “assault rifle” cartridges the first fielded design, the StG43, used gas to unlock the bolt. No different from the M1 carbine. The Germans desired simpler designs and both Großfuß and Gustloff-Werke managed it. While they managed it they had “walked the walk” in learning the difficulties of that problem. What both of them discovered is, while it can technically be done, effectively it cannot. The StG43 is the first generation of assault rifles. The three German assault rifles (two blow-back and one roller locked) were the second. The AK-47 is the third. The designers behind it are pretty clear from anyone looking at the issue. Werner von Braun was brought to the United States after the war. A rocket engineer of note what did the Americans wish from him? “Sewing socks.” Rocket design. Brunolf Baade was an airplane designer at Junkers during the war. After the war he was taken to Russia. Why? “Sewing socks.” Not really – the Russians were very interested in the JU-287 and there was a strong desire to have one finished for the 1947 Aviation Day at Tushino airfield. Baade was provided with a team of German engineers to complete the work. Helmut Gröttrup was a German engineer on the V-2 rocket program. From 1946-1953 he was in the Soviet Union. Doing what? “Sewing socks.” Working on rockets. Werner Gruner was a German engineer at Großfuß. From 1945 to 1952 he was in the Soviet Union at their small arms design facility. Doing what? “Sewing socks.” As were Hugo Schmeisser, Kurt Horn, Karl Barnitzke, and Otto Schink. They were all sewing socks.

9 pages with no graphics, headings, cites, or anything else. Written in an hour. Written pretty quickly so if there are nits with something feel free to send them. If you’re more interested in an argument don’t bother. Reasoned debate is good but emotional argument is pretty pointless.

This isn’t an “academic paper” or a book for sale so I’ll not bother with the footnotes and such. It was written rather quickly and is simply a paper to illuminate some of the aspects of AK-47 design and the usual arguments.

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