

Can a tank ‘umbrella’ protect the turret of a main battle tank?

Jaime A. Teixeira da Silva 

Independent researcher,
e-mail: jaimetex@yahoo.com

INFORMATION

Article history:

Submitted: 27 January 2023

Accepted: 14 October 2023

Published: 30 December 2023

ABSTRACT

In response to the destruction of the hatch of main battle tanks, as has been evidenced in the on-going Russo-Ukrainian War, when a bomb or other explosive device is dropped onto the tank or its turret from above, a protective structure that deflects the device from causing harm to the turret – and thus the tankers – is desirable. This concept paper discusses one possibility: a tank ‘umbrella’, which offers, at least in theory, protection to the turret and tankers.

KEYWORDS

anti-tank guided missile, turret, turret hatch, turret ring, unmanned aerial vehicle



© 2023 by Author(s). This is an open access article under the Creative Commons Attribution International License (CC BY). <http://creativecommons.org/licenses/by/4.0/>

In the ongoing Russo-Ukrainian war, it is not uncommon to observe instances where the turret of main battle tanks (MBTs) were literally blasted off the main body of the tank, often following an attack by an anti-tank guided missile (ATGM), or due to bombs dropped by loitering munition such as unmanned aerial vehicles (UAVs) or drones. In some cases, a bomb, dropped from above, was observed to fall into the driver’s hatch or into the turret hatch (or cupola), with the power of the explosion within the tank in some cases itself ejecting the entire turret, even more so for the T-72 tanks with a “jack-in-the-box” flaw [1]. This might also be possible if an ATGM strikes the turret ring, i.e., the gap that exists between the revolving turret and the main body of the tank itself, or the turret-hull connection. Images have surfaced of steel contraptions,

seemingly made of steel, that are inserted above the turret, often welded onto the turret itself, presumably to protect it from attacks by ATGMs and UAVs, for example metal grids on T-72B1 or T72B3M tanks [2].

A theoretically ideal passive protective cover would: 1) withstand a blow from an ATGM or a bomb dropped from a UAV; 2) use resistant material that could deflect an incoming projectile rather than absorb its explosive impact; 3) be sufficiently agile to cover enough angles to make it a suitable deflective surface; 4) be easily replaced if damaged; 5) be able to deflect attacks from the flanks in a 360° direction (horizontal attack on turret or turret ring) or from above in a 180° direction (vertical attack on turret or turret / driver's hatch); 6) be a cost-effective structure whose cost would be substantially less to replace than a new turret; 7) be sufficiently aerodynamic to withstand high wind speeds or the speed of a travelling tank. Ultimately, the aim of such a cover would be to reduce the costs caused by the loss of human lives and damage to the turret and tank. Such a cover would likely fall into the "soft kill" category [3].

Here, I propose a conceptual structure, a 'tank umbrella', not unlike a regular umbrella (Fig. 1), welded onto the turret itself, that could offer some level

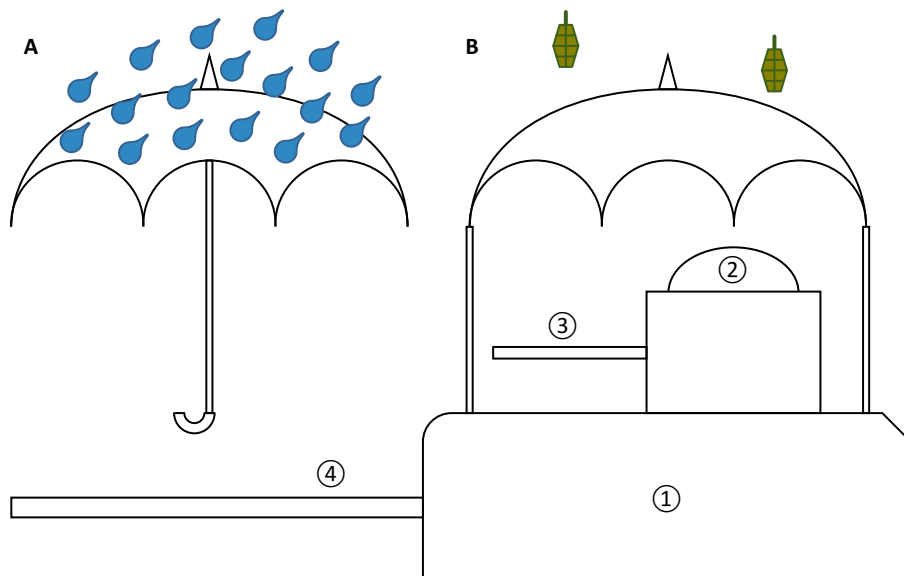


Fig. 1. A diagram showing partial or full protection from rain by an umbrella (A) or protection of a tank turret from vertically dropped munition by a 'tank umbrella' (B). The 'tank umbrella' is affixed to the hull of the turret to allow the turret to be swivelled 360°, i.e., the 'tank umbrella' should not impede the functioning or rotation of the machine gun. Key: ① turret; ② turret hatch; ③ commander's machine gun; ④ tank's main machine gun
Source: Author's own elaboration.

of protection to the turret of an MBT, and thus to ammunition and tankers' lives, and that – if sufficiently tested [4] – could satisfy the seven ideal aspects envisioned above. Olsson focuses specifically on protective measures associated with the front of the turret and not the top of the tank [4]. In the case of bombs or grenades that explode upon impact, the 'umbrella' would surely be damaged, but not the turret, and in the case of a bomb or grenade with a time fuse, the 'umbrella' would deflect the bomb or grenade, or cause it to explode some distance from the tank itself (Fig. 2). The surface of the 'umbrella' could be made or coated with material that either reduces the impact of a blast, or that enhances deflection, i.e., that allows a grenade, bomb or improvised explosive device (IED) to slip off the surface easily. Several possibilities include carbon fiber reinforced plastic [5], bullet-proof glass, transparent ceramics, wave-transmitting composite materials [6, 7], or titanium [8]. Welding would also need to take into account the heterogeneity of materials [9].

The concept of the tank 'umbrella' appears to have first been suggested in the media at the end of 2021, prior to the Russo-Ukrainian War [10].

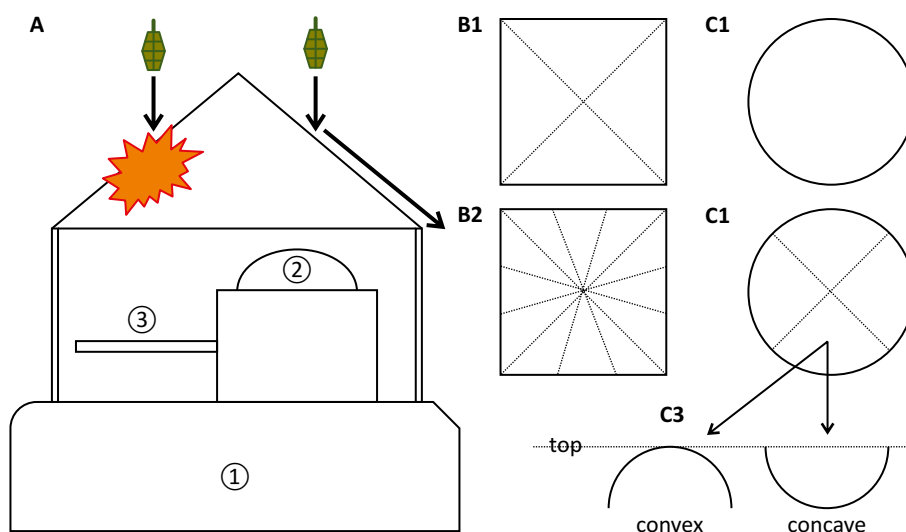


Fig. 2. A diagram showing how the 'tank umbrella' could either cause a bomb or grenade that explodes upon impact to damage the 'umbrella' itself (left side), or be deflected by the 'umbrella' to the side of the tank (right side) (A). The 'umbrella' could take on a square (B) or circular (C) shape, as observed from the top view, in either case supported by four supports or rods that are welded onto the turret itself. The surface of a square 'umbrella' could have four (B1) or multiple sides (B2), or in the case of a circular umbrella, have a fully smooth surface (C1), or a surface with four sides (C2) that could either be convex or concave (C3). Key: ① turret; ② turret hatch; ③ commander's machine gun

Source: Author's own elaboration.

Would the real-time application of a non-flammable coating such as wax or Vaseline increase the ability of a surface to deflect a bomb? Would a material such as Perspex, despite being flammable, but that has high light transmission and flexibility, be a candidate for testing?

The disadvantages and limitations of this proposal include the following: the gunner's field of view, especially the aerial view, would be reduced; if the length of the barrel of the commander's machine gun exceeds the diameter of the turret, it will collide with the support structures or rods of the 'tank umbrella', so this would only be possible for tanks with a gun with a short barrel, or for turrets without a gun; an additional cost would be needed to create and attach the 'tank umbrella', so a benefit: cost analysis would be needed. The proposal in this paper is merely a prototype, and testing of materials, angle of inclination of the 'umbrella' surface, reliability in different weather conditions, especially extreme conditions such as strong wind, etc. Common sense (i.e., keeping the turret hatch closed at all times) is also advised.

The best alternative to war is no war. However, where war is unavoidable, where tanks are used, and where grenades, bombs or IEDs might be dropped from UAVs onto tanks, additional reflection on how to protect the lives of skilled machine-gunners and tankers, as well as the tanks themselves, is needed. The 'tank umbrella' is a non-active (i.e., passive) protection system, and unlike perforated plates [11] or cage armour [12] to reduce ballistic penetration, its theoretical objective would be for ballistic deflection.

References

1. Westfall S, Neff W. *How the 'jack-in-the-box' flaw dooms some Russian tanks*. Washington Post. 2022;30 April, [online]. Available at: <https://www.washingtonpost.com/world/2022/04/30/russian-tank-turret-blast-jack-in-the-box/> [Accessed: 27 January 2023].
2. Ukrainian Military Center. *Russia is installing metal grids on its T-72B1 in Crimea*. 2021, [online]. Available at: <https://mil.in.ua/en/news/russia-is-installing-metal-grids-on-its-t-72b1-in-crimea/> [Accessed: 27 January 2023].
3. Kunz A. *Development trends in armored weaponry*. Scientific Journal of the Military University of Land Forces. 2020;196(2):339-51. <https://doi.org/10.5604/01.3001.0014.2537>
4. Olsson P. *Measuring quality of military equipment*. Defence and Peace Economics. 2022;33(1):93-107. <https://doi.org/10.1080/10242694.2020.1851474>
5. Piancastelli L, Cassani S. *Next generation main battle tank. Part III: An air transportable, upgradable and flexible weapon system integrated in the future warfare*. ARPN Journal of Engineering and Applied Sciences. 2020;15(15):1687-94.

6. Madhu V, Bhat T. *Armour protection and affordable protection for futuristic combat vehicles*. Defence Science Journal. 2011;61(4):394-402. <https://doi.org/10.14429/dsj.61.365>
7. Zhang Z-Y, Liu Q-A, Zhang P-D. *Analysis on armor protection requirements of the top of self-propelled antiaircraft gun*. In: Long S, Dhillon BS. (eds.). *Man-Machine-Environment System Engineering*. MMESE 2020. Lecture Notes in Electrical Engineering. Springer. Singapore. 2020;645:307-12. https://doi.org/10.1007/978-981-15-6978-4_37
8. Montgomery JS, Wells MGH, Roopchand B, Ogilvy JW. *Low-cost titanium armors for combat vehicles*. JOM. 1997;49:45-7. <https://doi.org/10.1007/BF02914684>
9. Karthick K, Malarvizhi S, Balasubramanian V. *Mechanical properties and microstructural characteristics of rotary friction welded dissimilar joints of rolled homogeneous armor steel and medium carbon steel*. Journal of the Mechanical Behavior of Materials. 2021;30(1):171-8. <https://doi.org/10.1515/jmbm-2021-0017>
10. *Russian tanks massing near Ukraine sport mods against drones, Javelin missiles*. Forbes. 2021;29 November, [online]. Available at: <https://www.forbes.com/sites/sebastienroblin/2021/11/29/russian-tanks-massing-near-ukraine-sport-mods-against-drones-javelin-missiles/?sh=3ef4b1d965e9> [Accessed: 27 January 2023].
11. Balos S, Howard D, Brezulianu A, Labus Zlatanović D. *Perforated plate for ballistic protection – a review*. Metals. 2021;11:526. <https://doi.org/10.3390/met11040526>
12. Coghe F. *Efficiency of different cage armour systems*. Applied Sciences. 2022;12(10):5064. <https://doi.org/10.3390/app12105064>

Czy czołgowy „parasol” może chronić wieżę czołgu podstawowego?

STRESZCZENIE Tocząca się wojna rosyjsko-ukraińska udowodniła potrzebę wynalezienia konstrukcji chroniącej czołg podstawowy, zwłaszcza jego wieżę, przed zniszczeniem przez bombę albo inny ładunek wybuchowy zrzucony z góry. Niniejszy komunikat z badań opisuje jeden z możliwych pomysłów – czołgowy „parasol”, który zapewnia, przynajmniej w teorii, ochronę wieży czołgu i czołgistów.

SŁOWA KLUCZOWE przeciwpancerny pocisk kierowany, wieża, właz wieży, pierścień wieży, bezzałogowy statek powietrzny

Biographical note

Jaime A. Teixeira da Silva – a biologist by profession, but takes an interest in a wide range of topics. More background at the social network site: <https://www.researchgate.net/profile/Jaime-Teixeira-Da-Silva>.

ORCID

Jaime A. Teixeira da Silva  <https://orcid.org/0000-0003-3299-2772>

Jaime A. Teixeira da Silva

Acknowledgement

No acknowledgement and potential funding was reported by the author.

Conflict of interests

The author declared no conflict of interests.

Author contributions

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

Ethical statement

The research complies with all national and international ethical requirements.