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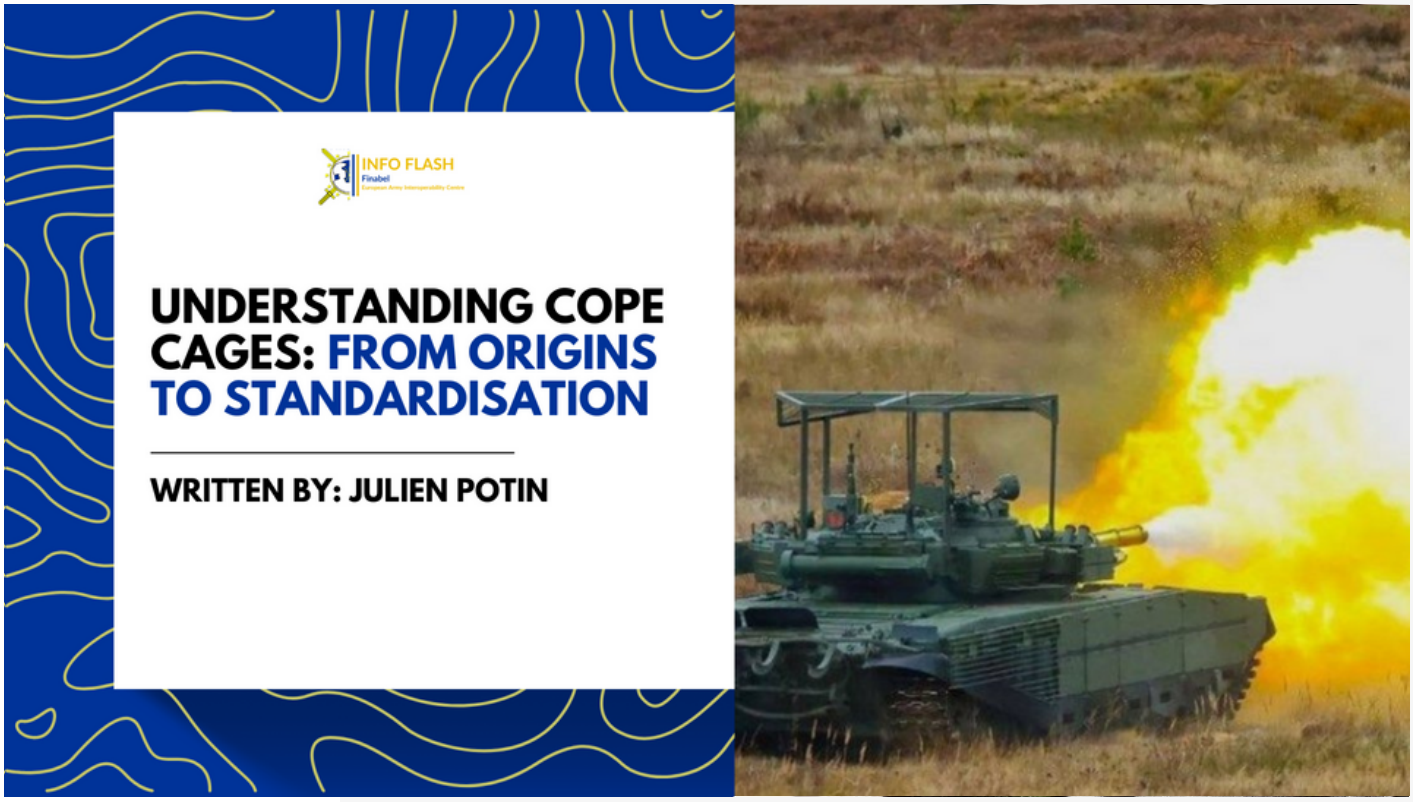

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Introduction

Tank warfare remains a favourite among online aficionados due to the enduring cultural fascination with heavy armour. Events from the Russo-Ukrainian War, particularly the recent incident involving the apparent disabling of a Russian T-90M tank by two Ukrainian-operated US-supplied Bradley infantry fighting vehicles (IFVs) have reignited interest in armoured combat. The ongoing debate surrounding the effectiveness of various tank designs continues to resonate across social media platforms and official channels. However, the emergence of distinct netting structures above tank turrets and other armoured vehicles has garnered significant attention since their increased use in the Russo-Ukrainian War as well as the more recent Israeli-Hamas War (Parker et al., 2022; Axe, 2023). Considered a form of improvised cage armour, these humorously labelled 'cope cages' remain relatively prevalent despite increasing scepticism of their utility. This study provides an overview of these improvised armour structures, analysing their origin and current standardisation and assessing their perceived impact.

Cage Armour and Modern Anti-Tank (AT) Threats

Cope cages are a form of cage armour, usually in the form of an improvised roof above a metal frame welded into place. These are top-mounted, therefore above the turret, and often involve either metal grilles or loose netting. Appearing as a clumsy sunroof, they act as an extra barrier of protection meant to prematurely detonate chemical rounds and limit the damage received by the crew, main armour, or external modules. Unlike previous forms of cage armour involving metal slats, bars, and grilles placed on a vehicle's sides or above modules such as radiators, 'cope cage' designs seem to have been specifically improvised to deal with threats coming from directly above. With the vulnerable thinly armoured turret roof of modern main battle tanks (MBTs) increasingly targeted, threats coming at a vertical or steep angle have received greater attention.

Earlier forms of cage armour were developed as a response to the increasing prevalence of chemical munitions like high-explosive anti-tank (HEAT) shaped charges. These munitions comprise a hollow charge internally coated with a liner usually made of metal, glass, or ceramic (Walters, 1990). When the charge detonates, the liner forms a high-velocity jet concentrated at the point of impact (Ruys, 2023). With penetrative abilities great enough to render rolled steel armour obsolete, countries sought to develop new forms of protection. Despite the development of armour capable of withstanding HEAT warheads, they remain in use in rocket-propelled grenades (RPGs) and anti-tank guided missiles (ATGMs). While modern MBTs have employed other armour systems such as Explosive Reactive Armour (ERA) pads to counter shape charges, lighter vehicles such as armoured personnel carriers (APCs) and infantry fighting vehicles (IFVs) employ cage armour variants for their chassis. These structures, therefore, aim to detonate the HEAT round prematurely to significantly diminish the penetrative power of the jet (Coghe, 2022). While the measure is of limited reliability, it remains a relatively inexpensive gamble to increase crew and tank survivability (Newdick, 2023).

An Increasingly Common Practice

While HEAT munitions are no longer the sole reason for the use of cope-cages in Ukraine or Gaza, the rationale behind their development stems from the experiences of and later Russian tank crew against RPGs during the 1994-1995 Battle of Grozny in Chechnya. Inadequate Russian armoured doctrine and their inability to conduct urban operations allowed Chechen anti-tank (AT) teams to target tank turrets from elevated positions (Grau, 2004). In the Second Nagorno-Karabakh War (2020), similar conclusions were reached on the inadequacy of MBTs against drones, stirring speculation on whether tanks had been reduced to ducks sitting in an open field (Postma, 2021; Bateman, 2020).

The idea of a threat from above was later epitomised in 2022 by the en masse delivery of FGM-148 Javelin weapon systems to Ukraine to halt the armour-heavy advance of Russian troops following the invasion (Garamone, 2023). Armour will likely still perform a crucial role in present and future combat but its vulnerability to vertical threats requires addressing. While the mounting of cages on the turret of the tank was advertised as a solution to counter these guided missiles, the improvised armour's virtually inexistent effectiveness against the American-made ATGM is what won its pejorative denomination (MIC News, 2021; Newdick, 2021; Parker et al., 2022). The employment by tank crews of a top-mounted improvised metal grille cage armour is portrayed as a coping mechanism, given its employment against Javelins is futile. The term gained mass popularity on the internet and later also came into use amongst analysts and politicians (Parker et al., 2022).

While the alleged ATGM's success story did enhance the ridicule of using scrap metal as a first line of defence, the continued use of cope cages should not be directly associated with the weapon system. Though there was a mediatic love for the Javelin success story, artillery remains the most effective weapons system on the battlefields of Ukraine (Clarke et al., 2024). Yet, while cage armour is arguably ineffective against high-calibre artillery shells, it has served some use as improvised protection against drone-dropped improvised explosive devices (IEDs) employed by infantry units. Drone footage of grenades being dropped into open tank hatches or destroying external modules such as radiators suggests how improvised cage armour could increase crew survivability. This is also perhaps the reason that Israeli Merkava tank crews have similarly fit top-mounted slat armour to their vehicles in the stages before the invasion of Gaza in 2023 (Mizokami, 2023).

Despite scepticism, the continued use of this add-on-armour and experimentation with top-mounted structures by countries such as Israel, India, and China somewhat suggest an institutionalisation of the practice (Malyasov, 2023; Malyasov, 2024). Production-line designs appeared at the Russian International Military-Technical Forum in 2023, with complete sets of V-shaped slat roofs and nettings on display (Newdick, 2022). V-shape slat armours better account for vertical impact angles, allowing premature detonation of projectiles from a wide set of angles (Coghe, 2022). While this design is not new, its presentation at official expos further implies a standardisation of the practice.

Assessing Effectiveness

At this stage, there is a general lack of quantitative data regarding the effectiveness of cope cages. Open-source intelligence databases such as Oryx document visually confirmed Russian and Ukrainian equipment losses and showed numerous vehicles with top-mounted armour (Oryx, 2022). While determining the cause for a vehicle's destruction is no easy feat, the sheer number of destroyed vehicles mounting top cages indicates how improvised add-on armour is unsurprisingly not a game changer in Ukraine. Given this context, the following considerations should be taken into account when evaluating the impact and effectiveness of cage armour.

Protection against AT threats

As discussed, Russian cage armour remains ineffective against advanced top-attack ATGMs employed by Ukrainian forces. Geometrical studies and tests of various types of cage armour, such as slat, bar, and net armour variants, however, suggest varied levels of effectiveness against lighter RPGs, specifically the widely available anti-tank RPG-7 anti-tank (Coghe, 2022). However, this is not particularly innovative considering modern MBTs employ other means, such as ERA, to counter such AT threats (Held, 2004). For this precise reason, most vehicles employing large amounts of cage armour variants tend to be less protected APCs or IFVs and other such vehicle types (Coghe, 2022).

Visibility and Crew Mobility

The most apparent element of cage-armour-equipped Russian and Ukrainian tanks is the increased profile of the vehicle. A taller and more visible vehicle is more easily spotted and targeted by AT weapons. This largely defeats the rationale behind Soviet and Russian MBTs being smaller and more compact than the significantly larger Western models (Cranny-Evans & Kaushal, 2022).

Moreover, installing a structure directly above the turret impedes the crew's mobility and fighting ability. The cage structure limits the rotation of top-mounted machine guns and, in theory, the vehicle's ability to fulfil some infantry support roles. In addition, depending on how the cope cage is installed, the crew's ability to exit and escape the tank may be hampered, decreasing its survivability.

Drone Protection

Both the Russo-Ukrainian War and the Israel-Hamas have seen considerable use of cheap or commercially available quadcopter drones. Used to drop IEDs or as a kamikaze weapon, these are the main reasons behind the continued use of top-mounted cope cages (Axe, 2023). While modern MBTs are designed primarily to fight with closed hatches, crews will most likely be 'unbuttoned' when in low-risk operations, on the move, or when operating turret-mounted secondary weapons.

Thus, being vulnerable to the relatively stealthy drone-dropped grenades or suicide drones, cope cages can save the vehicle and crew. However, evidence of their effectiveness risks being distorted by the information war and propaganda employed by the belligerents (Atherton, 2022). Selective biases are likely to prevent Ukrainian media channels from showcasing an ineffective drone attack on Russian vehicles, though such instances can be found on Russian social media accounts (Eureka News, 2024). This reinforces that, despite the pejorative term, cope cages are still being used and increasingly adopted by ground forces outside of the Russo-Ukrainian War (Malyasov, 2023; Malyasov, 2024).

Morale Booster

Behind the improvised and non-standardised look of cope-cages on the Ukrainian battlefield are the individual tank crews that weld them together. Despite the practice becoming increasingly common, the construction of what these tankmen call 'sunroofs' also acts as a placebo (Epstein, 2023). While ineffective against AT threats, having a coping cage may reassure crewmen who ultimately do not have alternative solutions. US tank crews in WWII also improvised add-on-armour by putting sandbags on their vehicles to soften AT munitions: a notoriously ineffective practice.

Cost and Modularity

As mentioned above, the cost and requirements to set up top-mounted cage armour are relatively low, if not negligible, when compared to an MBT's production cost. It can be set up as easily as it can also be removed, making it a largely modular piece of equipment. Similarly, the addition of ERA plates on top of the cage is indicative of how this improvised armour is evolving according to needs (Payne, 2023).

Conclusions and Future Applications

Images of a UK-donated Challenger 2 tank with a top-mounted metal mesh stand out as an indication of the institutionalization of the cope cage on the Ukrainian battlefield. (Nikolov, 2023). While cope cages were quickly dismissed in the early stages of the war, their perseverance as a piece of add-on armour raises questions on what the future holds for armoured warfare. There are several factors to consider that could influence whether NATO countries themselves will adopt such structures. Would a cope cage still exist in a better integrated combined arms operation? Is Western armoured doctrine better suited against the threats faced by Russian, Ukrainian, and Israeli tank crews? Both the increased use of commercially available drones and tactical inadequacy have characterized the standardization of cope cages. As anti-drone countermeasures and electronic warfare evolve, cope cages might ultimately disappear from the battlefields of Ukraine as well. What will certainly remain is the human tendency to improvise and work around challenges, whether this brings actual advantages or simply calms the psyche.

Bibliography

Atherton, K. D. (2022, May 26). How drones in Ukraine help fuel propaganda and shape perception. Center for Public Integrity. https://publicintegrity.org/national-security/ukraine-in-crisis/how-drones-in-ukraine-help-fuel-propaganda-and-shape-perception/

Axe, D. (2023, October 16). Cope Cages Come to Israel as IDF Tanks Get Extra Drone Armor. Forbes. https://www.forbes.com/sites/davidaxe/2023/10/16/cope-cages-come-to-israel-as-idf-tanks-get-extra-drone-armor/?sh=75fc95cfaab8

Bateman, R. (2020, October 15). No, Drones Haven't Made Tanks Obsolete. Foreign Policy. https://foreignpolicy.com/2020/10/15/drones-tanks-obsolete-nagorno-karabakh-azerbaijan-armenia/

Clarke, E., Oltei, A., & Potin, J. (2024, January 18). Artillery in Ukraine – a Critical Evaluation. Finabel. https://finabel.org/artillery-in-ukraine-a-critical-evaluation/

Cranny-Evans, S., & Kaushal, S. (2022, April 27). Technical Reflections on Russia's Armoured Fighting Vehicles. Royal United Services Institute. https://rusi.org/explore-our-research/publications/commentary/technical-reflections-russias-armoured-fighting-vehicles

Coghe, F. (2022) Efficiency of Different Cage Armour Systems. Applied Sciences, 12(10), 5064, 1-34. https://doi.org/10.3390/app12105064

Epstein, J. (2023, July 18). Photos capture the crude cages Russian and Ukrainian crews are welding on their tanks and armor as a last-ditch defense. Business Insider. https://www.businessinsider.com/russia-ukraine-welding-crude-cages-tanks-last-ditch-defense-effort-2023-7

Eureka News. (2024, March 2). The invincible tanks of the 5th Brigade advance and assault the AFU stronghold city of Krasnogorovka. X. https://twitter.com/Eureka_News_ENG/status/1763891261251952675

Garamone, J. (2023, March 3). U.S. Sends Ukraine $400 Million in Military Equipment. US Department of Defense. https://www.defense.gov/News/News-Stories/Article/Article/3318508/us-sends-ukraine-400-million-in-military-equipment/

Held, M. (2004) Dynamic Plate Thickness of ERA Sandwiches against Shaped Charge Jets. Propellants, Explosives, Pyrotechnics, 29(4), 244-246. https://doi.org/10.1002/prep.200400051

Malyasov, D. (2023, October 17). Indian T-90 tanks appear with 'cope cage' defense on top. Defence Blog. https://defence-blog.com/indian-t-90-tanks-appear-with-cope-cage-defense-on-top/

Malyasov, D. (2024, March 23). Chinese combat vehicles get 'cope cage' armor. Defence Blog. https://defence-blog.com/chinese-combat-vehicles-get-cope-cage-armor/

Mizokami, K. (2023, October 24). Everything you need to know about Israel's 'Cope Cage' Armor on Tanks. Popular Mechanics. https://www.popularmechanics.com/military/weapons/a45561784/israel-cope-cage-armor/

MIC News. (2021, July 7). На российские танки начали устанавливать импровизированную защиту от Javelin и БПЛА. MIC News. https://vpk.name/news/521682_na_rossiiskie_tanki_nachali_ustanavlivat_improvizirovannuyu_zashitu_ot_javelin_i_bpla.html

Newdick, T. (2021, December 23). Ukrainian Troops Test Javelin Missile Against Russian Cage-Style Improvised Tank Armor. The Warzone. https://www.twz.com/43648/ukrainian-troops-test-javelin-missile-against-russian-cage-style-improvised-tank-armor

Newdick, T. (2023, August 14). 'Cope Cages' go mainstream at Russia's Arms Bazaar. The Warzone. https://www.twz.com/cope-cages-go-mainstream-at-russias-arms-bazaar

Nikolov, B. (2023, November 16). Challenger 2 tank spotted with DIY cope cage of the turret. Bulgarianmilitary.com. https://bulgarianmilitary.com/2023/08/16/challenger-2-tank-was-spotted-with-diy-cope-cage-of-the-turret/

Oryx. (2022, February 24). Attack On Europe: Documenting Russian Equipment Losses During The Russian Invasion Of Ukraine. Oryx. https://www.oryxspioenkop.com/2022/02/attack-on-europe-documenting-equipment.html

Parker, C., Horton, A., & Neff, W. (2022, March 12). What to know about the role Javelin antitank missiles could play in Ukraine's fight against Russia. The Washington Post. https://www.washingtonpost.com/world/2022/03/12/javelins-ukraine-russia/

Payne, S. (2023, May 6). Russian Tank With 'Cope Cage' Covered In Explosive Reactive Armor Emerges. The Warzone. https://www.twz.com/russian-tank-debuts-cope-cage-covered-in-explosive-reactive-armor

Postma, J. (2021). Drones over Nagorno-Karabakh: A glimpse at the future of war? Atlantisch Perspectief, 45(2), 15–20. https://www.jstor.org/stable/48638213

Ruys, A. J. (2023). Silicon Carbide Ceramics: Structure, Properties, and Manufacturing. Elsevier Series in Advanced Ceramic Materials, 435-489. https://doi.org/10.1016/B978-0-323-89869-0.00005-8

Walters, W. P. (1990). Technical Report BRL-TR-3142: The Shaped Charge Concept, Part I. Introduction. Defence Technical Information Centre. https://apps.dtic.mil/sti/pdfs/ADA226401.pdf