AiMT Advances in Military Technology
Vol. 3, No. 1, September 2008

Armament of Combat Helicopters

F. Ludvík[1*]

[1] *Department of Aircrafts and Rockets, University of Defence in Brno*

The manuscript was received on 1 April 2008 and was accepted after revision for publication on 24. June 2008.

Abstract:

The paper deals with the armament of combat helicopters being effective weapons of contemporary air forces in the army's armament. The main attention is paid to the categories of guided anti tank missiles. These missiles are determined for the battle with armoured targets when supporting the land forces.
There are briefly mentioned individual categories of these types of guided missiles. The basic tactical technical requirements are also presented in this paper.

Keywords:

Armament, combat helicopter, guidance system, weapon,

1. Introduction

The combat helicopters are modern and very effective weapons being fielded in the army armament as it flows out from the evaluations carried out by up to date military organs. The combat helicopters armament is represented by board barrel weapons and also rocket weapons.

The utilisation of the rocket weapons, i.e. ***a**nti **t**ank **g**uided r**o**ckets – (ATGR)* is qualified by application of the convenient guidance system, which secures to search out and locate of the target and fire the ATGR [1]. The used guidance systems of the ATGR can be classified as follows:

- *Guidance systems of the 1st generation;*
- *Guidance systems of the 2nd generation;*
- *Guidance systems of the 3rd generation.*

Scheme of the guidance system of the 1st generation is introduced in Fig. 1. Fig. 2 illustrates the guidance system of the 2nd generation [1].

* *Corresponding author: University of Defence, Kounicova 65, Brno,Czech Republic. E-mail: frantisek.ludvik@unob.cz*

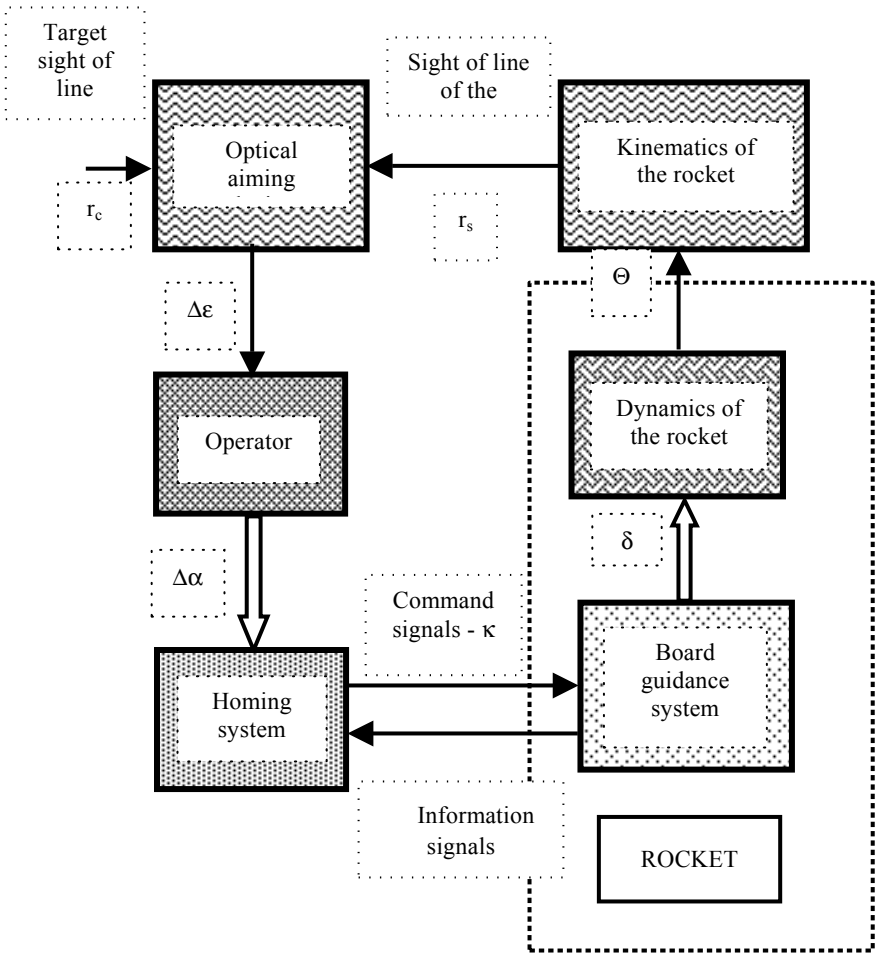


Fig. 1 Scheme of antitank guided rocket guidance system of the 1st generation

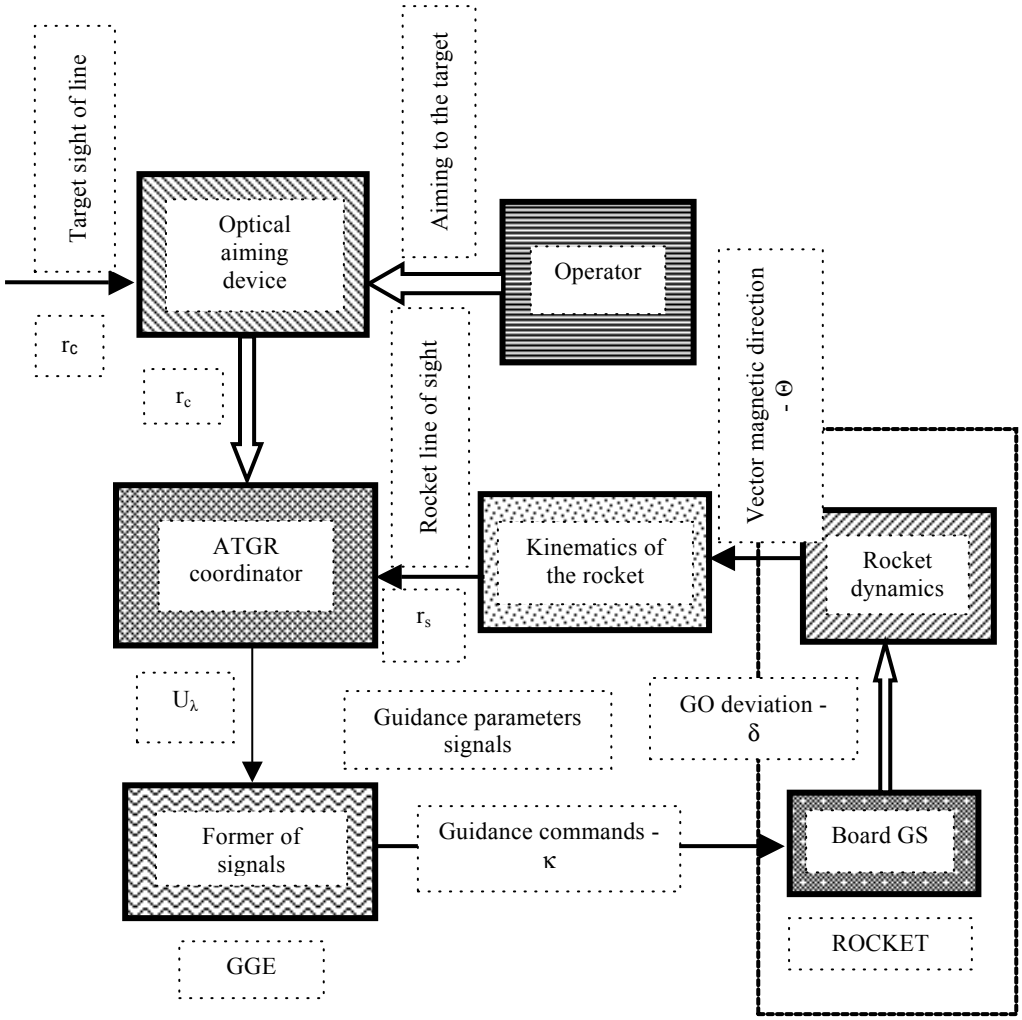


Fig. 2 Guidance system of the rocket of the 2nd generation

The ATGR scheme of a coordinator is evident in Fig. 3 [1].

The propulsion unit of the ATGR is illustrated in Fig. 4 [2].

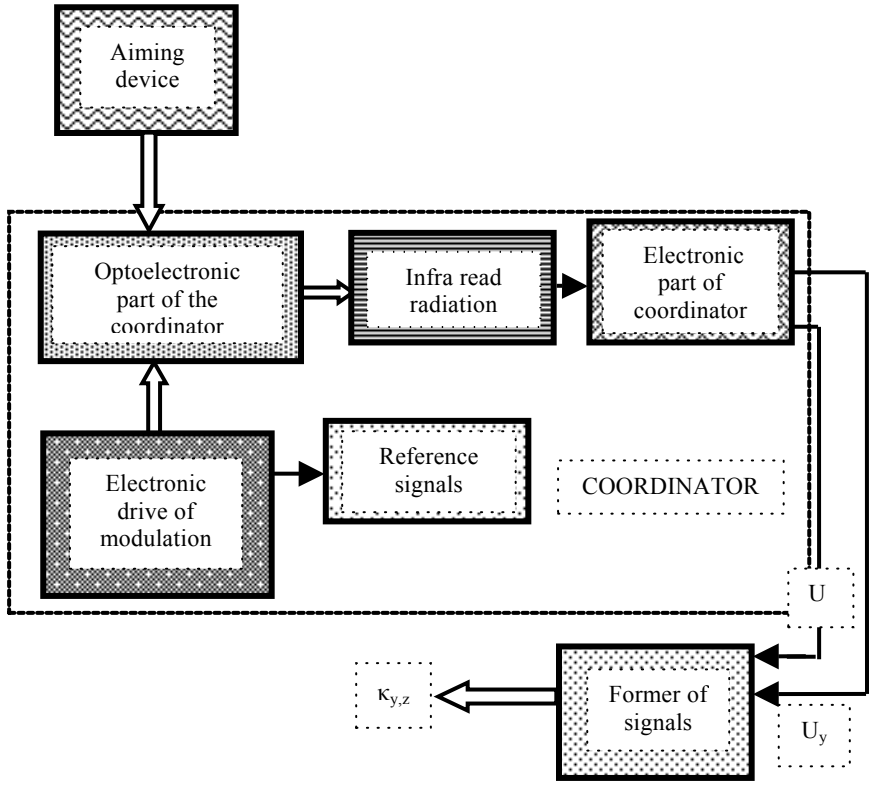


Fig. 3 Scheme of the 2nd generation coordinator of the ATGR

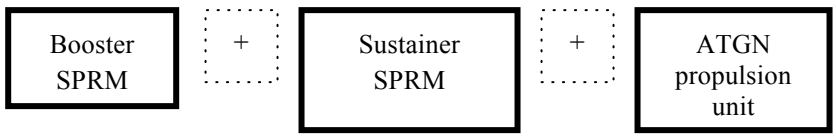


Fig. 4 Scheme of Anti-tank Guided Rocket propulsion unit

Remark: all introduced propulsion systems of the ATGR have to secure the required thrust program, i.e. the dependence F = F (t) – see Fig. 8 [3].

The construction arrangements are shown in Fig. 5, Fig. 6 and Fig. 7.

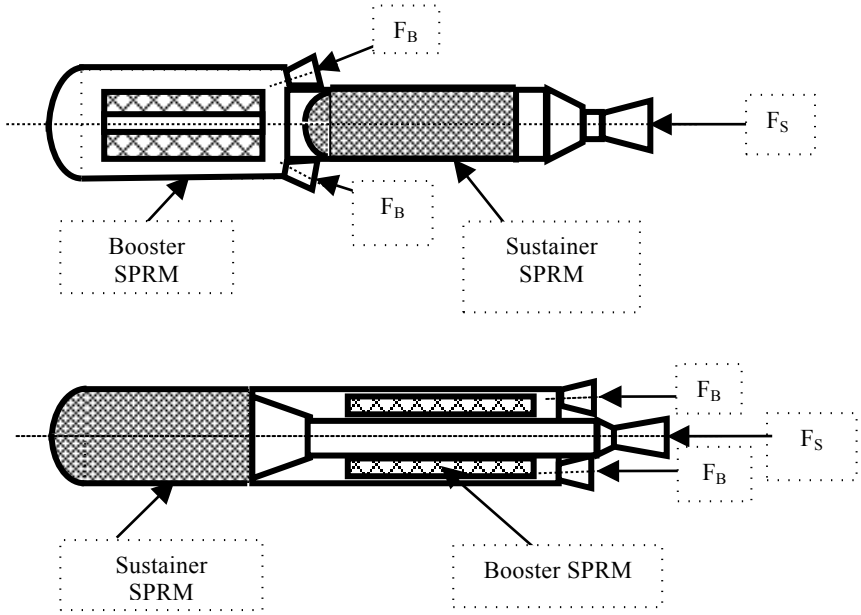


Fig. 5 Principle of two chamber propulsion unit of the ATGR

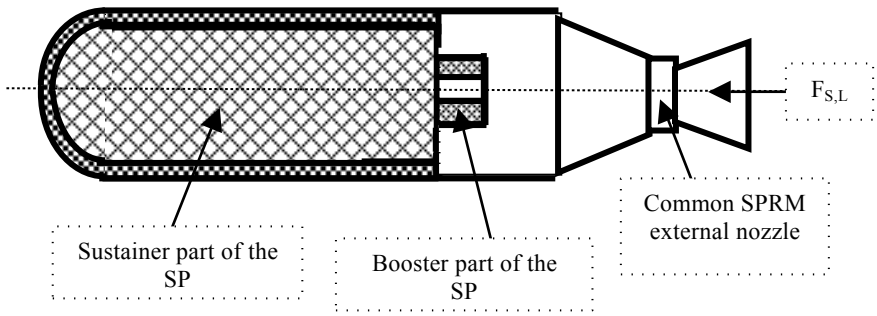


Fig. 6 Principle of single chamber propulsion unit of the ATGR

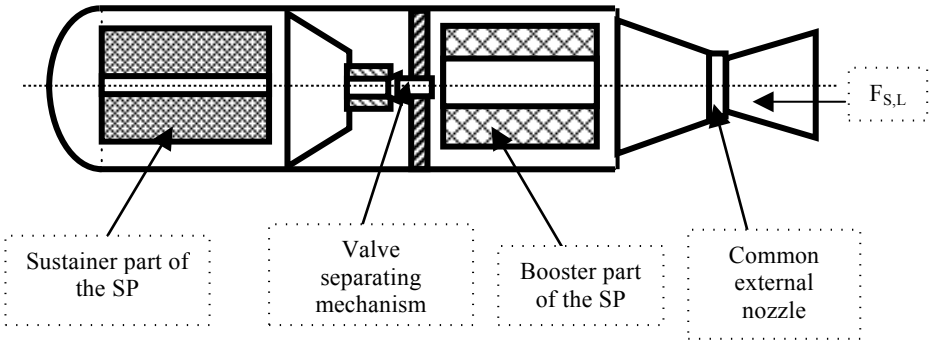


Fig. 7 Principle of the ATGR propulsion unit with two dependently working combustion chambers

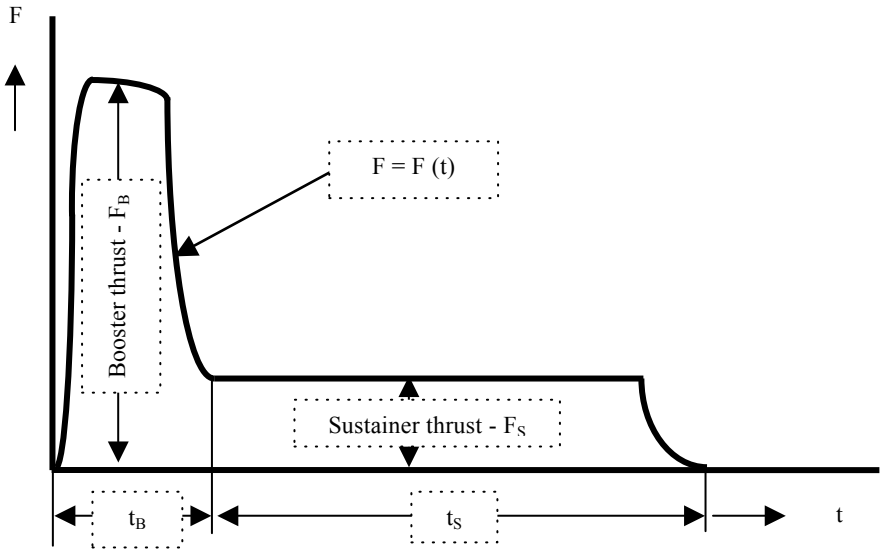


Fig. 8 Dual thrust rocket motor principle

2. Modern Rocket Armament of Combat Helicopters

According to performed analyses it is evident that the prospective means of ATGR being the armament of combat helicopters are e.g. *BGM – 71 TOW, MILAN, AGM-114 HELFIRE* and also the ATGR marked as *Long Range TRIGAT*. The type "*TRIGAT*"is assumed as very prospective one because it represents the weapon system with low vulnerability, with simple control in dynamically varying environment and clever to damage all types of tanks. The system is able to act in the distance (500 ÷ 5000) m, during the day and the night and also during the lowered visibility. Some types of modern combat helicopters as e.g. *APACHE* provided by the system *LONGBOW* can reach outstanding improvement regarding "*survival*" and "*vulnerability"*.

The utilisation of the ATGR of the type *MILAN* or *TOW* equipped with the semiactive command system of aiming are of the need of equipment which allows the detection of the flying ATGR deviation from its trajectory [2].

Contemporary means for the battle with armoured targets belonging to the different development generations usually use for the identification and guidance the different sensors as e.g. *infrared, radio, radar and lasers*. These can be *active* or *passive*.

The convenient methods of the guidance are as a rule the methods as *"proportional guidance"* and also the methods which use passive infrared surveillance of the target.

Contemporary but mainly the future types of the ATGR being used on the combat helicopters should fulfil the next requirements, i.e. prolongation of the range of firing and provided with the system F*ire and* F*orget – (FF)* as well as with the higher destructive effect and processing of signals needed for the ATGR guidance.

It is evident that from till now mentioned the all types of ATGR aren't convenient as the combat helicopters armament. These types of the ATGR which require the transfer of information's by the help of wires (micro cables).

Therefore the modern combat helicopters armament (ATGR) introduces the table 1 [2].

Tab. 1 Armament of Combat Helicopters by ATGE

TYPE OF ATGR	COUNTRY	L (m)	m (kg)	D (m)	guida-nce	X (km)
AT - 6 SPIRAL	Russia	1.83	35.0	0.13	RC	5
AT - 9 VIKHR	Russia	1.20	17.0	0.13	L	4
SWATER AT-29M 17Skorpion	Russia	1.16	30.0	0.13	RC	4
AGM 114 A HELLFIRE	USA	1.63	46.0	0.18	SARH	8
AGM 114 B/C HELLFIRE	USA	1.73	48.0	0.18	SARH, IIR RF,IR	8
TOW BGM - 71 A/B	USA	1.17	19.0	0.15	wire	4
TOW BGM 71/C, I – TOW	USA	1.45	19.0	0.15	wire	4
TOW BGM 71 D, TOW 2	USA	1.55	22.0	0.15	wire	4
HOT - 1	Euro missile	1.27	24.0	0.14	wire	4
HOT - 2/3	Euro missile	1.30	30.0	0.15	wire	4
HJ - 8A	China	0.88	11.0	0.12	wire	3
SWIFT ZT - 3	South Africa	1.35	19.0	0.13	L	4
TRIGAT ATGW - 3LR	Europe	1.50	21.0	0.13	IIR	4

Legend: *AL – active laser, AP – autopilot, A/P – active/passive radar, ARH – active radar surveillance, IR – infrared, L – laser, LR – laser radar, PR – passive radar, RC – radio command, RF – radio frequency, SARH – semiactive radar homing, TV – television, I - inertial, IIR – inertial infrared.*

It is evident from the table 1 that the rocket weapon systems using the wires i.e. micro cables for the transmission of the information are for up to date and mainly for the future types of combat helicopters *unusable* nevertheless that the jamming of these weapons is more difficult. On the other hand the combat helicopter has higher risk for enemy air defence action. The reason is the time of this ATGR flight lying within the range 20 s ÷ 30 s i.e. during the ATHR guidance the helicopter has to be in the position *"hang"* and therefore it is convenient target for the air defence.

It is obvious that the diameter of the effect of the head part is (0.12 ÷ 0.15) m of the homogeneous armour piercing device.

The ATGR of the type HOT – 1 is illustrated in Fig. 9 [2].

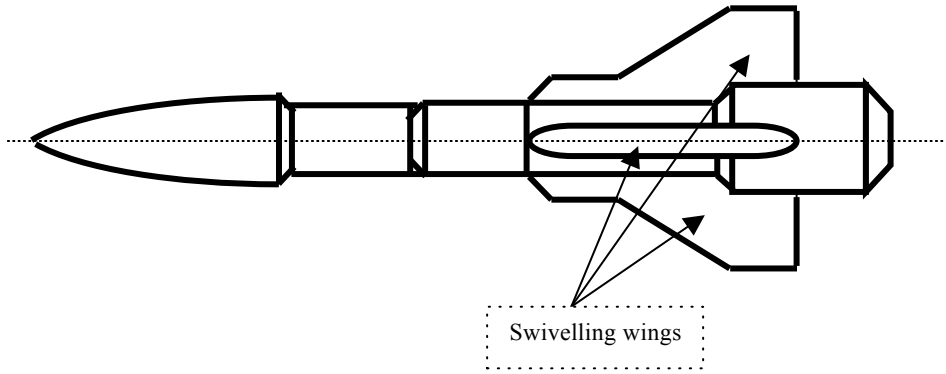
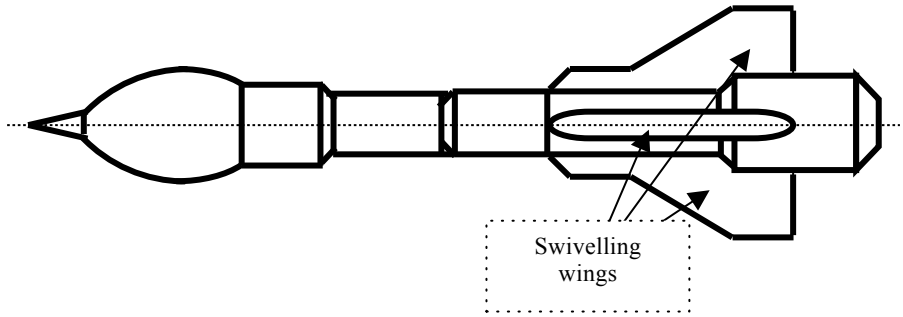


Fig. 9 Silhouette of antitank guided rocket HOT-1

The silhouette of the version *HOT-2* is in Fig. 10.



Fia. 10 Silhouette of the antitank auided rocket HOT-2

The ATGR *BGM 71 TOW* is launched from the tube launching equipment and has the optical location of the target and command guiding system with the transfer of the signal by the help of wires. In the year 1991 had been modernised by the infrared homing system with the possibility to lock the target before it's launching.

Remark: similarly is solved the ATGR ZT 3 SWIFT from South Africa Republic as well as the Romanian ATGR placed on the helicopter PUMA.

The all versions of ATGR *TOW* are placed on combat helicopters in hermetically closed rocket blocks. The silhouettes of some *TOW* versions are in Fig. 11. a, b, c. The guidance system of basic versions of the *TOW* is a command type with the transfer of signals by the help of the wires. The propulsion is secured by the ejecting SPRM (with very short time of the SPRM operation in order that the SP will be burned inside of the rocket launcher). The sustainer velocity is secured by the sustainer SPRM.

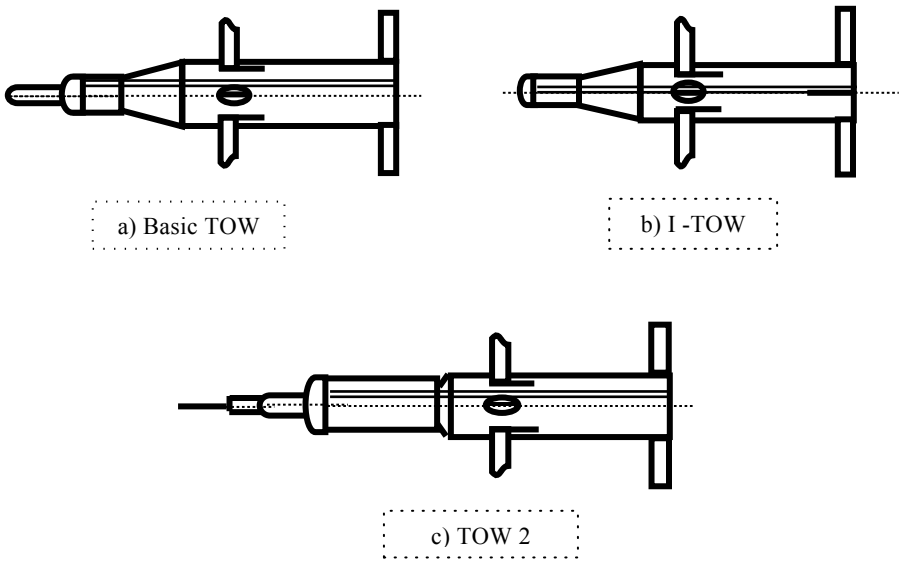


Fig. 11 Silhouettes of the antitank guided rocket TOW

The further ATGR is *AGM 114 HELLFIRE*, provided with the active laser guidance system of the type F*ire and* F*orget* – (*FF*). These ATGRs were developed at the beginning of the year 1985. The version *AGM 114 B* (for the US Navy forces) with the lowered amount of the smoke during their function and safety initiation mechanism and three optional homing equipment which uses the infrared visual display unit *(IIR)*, or semiactive laser system *(SAL)* and radio frequency system (*RF/IR*). The version *AGM 114 C* being developed for the US army is similar to the version *AGM 114 B*, but without the safety initiation mechanism. The antitank system *HELLFIRE* is determined for the combat helicopters *AH - 64 Apache, OH – 85 G Miosa, UH – 60 Black Hawk, Lynx, AH 1J Sea Cobra a AH – 1W Super Cobra.*

AGM 114 HELLFIRE has 4 swivel fins in the nose part of the rocket and 4 stabilizing fins completed by 4 swivelling control areas located in the trailing edge of the stabilizing fin – see Fig. 12. Hellfire is the most important rocket on up-to-date helicopters of US army including the combat helicopter *AH-64 Apache.*

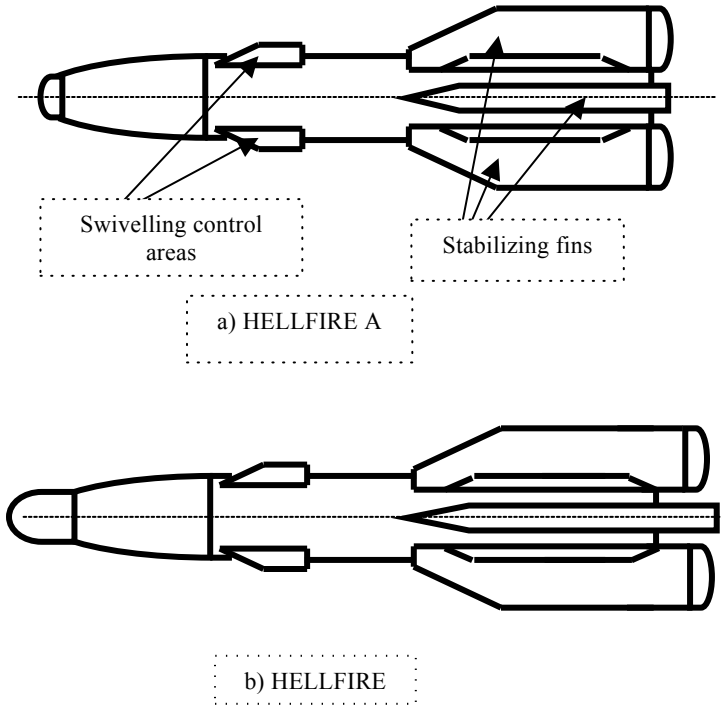


Fig. 12 Silhouette of antitank guided rocket HELLFIRE

The rocket *AGM-114* was developed during the years 1963-66. Adjustment of the ATGR *AGM 114 HELLFIRE* is evident in Fig. 13 [2].

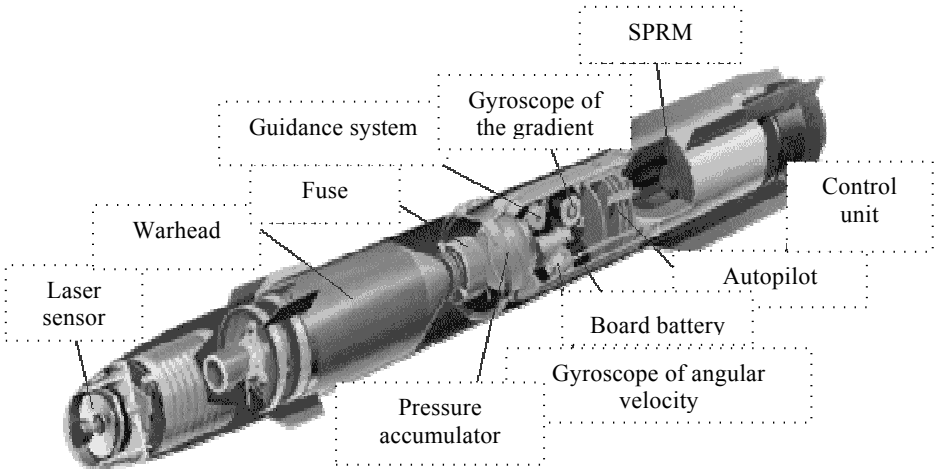


Fig. 13 Main construction parts of the antitank guided rocket HELLFIRE

In the future the rockets ***HELLFIRE*** will be provided with the warhead with tandem HEAT charge effect with the maximum distance of firing up to 10 000 m.

ATGW 3LR TRIGAT is the antitank weapon system of the 3rd generation. According to available information this ATGR should be produced in 3 versions, i.e. with the medium firing range for the land troops (***ATGW 3MR***), with the long range from the land launchers and very long range for the combat helicopters (***ATGW 3LR***). The requirement regarding the rocket development flows out of the need to replace ATGR as e.g. ***MILAN, HOT, TOW*** and ***SWINGFIRE***. The system ***ATGW 3 LR*** can be applied for the combat helicopter armament (***EUROCOPTER TIGER***, ***AH 64A Apache*** and ***Augusta A 12)*** as well as for the tank system of the land troops. The silhouettes of the ATGW 3LR - see Fig. 14.

The ATGR ***ZT-3 SWIFT*** is the weapon system developed in South Africa Republic probably at the beginning of the year 1990. It has been developed mainly for the combat helicopter ***ROOIVALK***, another version has been developed for the tank destroyer ***RATEL*** and the third one for the tank system of the land forces [2].

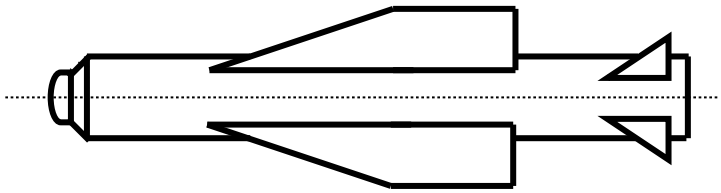


Fig. 14 Silhouette of the antitank guided rocket ATGW 3LR TRIGAT

ZT – 3 Swift regarding its construction is similar as ATGR *BGM 71 TOW*. It has *4 swivelling fins* of rectangular shape in the central part of the ATGR body and *4 swivelling wings* for the ATGR control flight in the rear part of the ATGR – see Fig. 15.

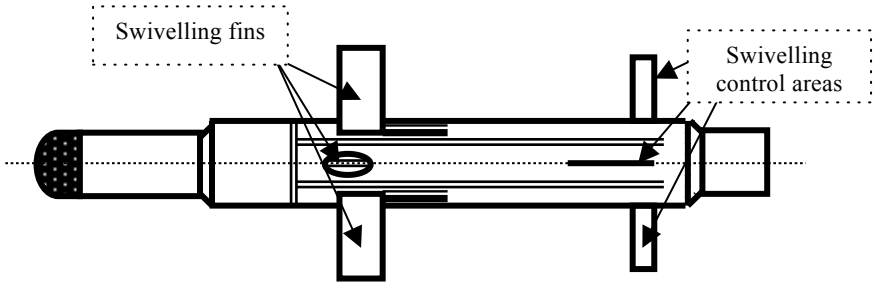


Fig. 15 Silhouette of the antitank guided rocket ZT – 3 SWIFT

ZT – 3 has the laser command system *SACLOS* (**S***emi-***A***utomatic* **C***ommand to* **L***ine* **O***f* **S***ight*), which uses the infrared source for the target homing. ATGR is provided with the warhead of the type *HEAT*, which is initiated by the impact fuse. The rocket is ejected from the launching tube by ejecting rocket motor and after leaving the tube is accelerated to the cruising velocity ≈ 330 ms^{-1}. This secures the time of flight ≈ 18 s and the firing range 4 km.

The ATGR produced in Russian federation can be characterised as follows. The 1st ATGR is the rocket named as *AT-SWATER (9M 17 SCORPION)*. Its utilisation is possible for minimum distance X_{MIN} = 1000 m and maximum firing range X_{MAX} = 4000 m. The guidance system is semiautonomous (but also with the handy command system). The utilisation of this ATGR is possible when the combat helicopter velocity is about (80 ÷ 260) km/h and the flight in altitude (20 ÷ 200) m. The total number of the ATGR at the helicopter board (*Mi 24-D*) is 4 rockets. The silhouette of the ATGR *AT-SWATER (9M 17 SCORPION)* is in Fig. 16.

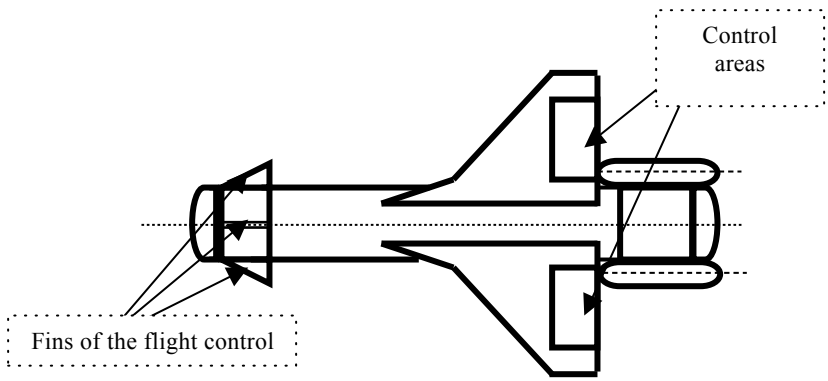


Fig. 16 Silhouette of the antitank guided rocket SKORPION

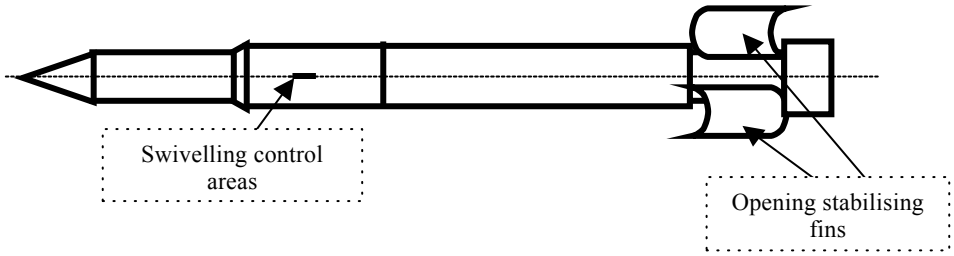


Fig. 17 Silhouette of the antitank guided rocket AT - 6 SPIRAL (SHTURM)

The Russian army uses further on the ATGR named as *AT-6 SPIRAL (9M 114 SHTURM), AT-9 VIKHR* or *AT-12 VIKHR M*. The introduced ATGR types can be characterised as follows.

AT-6 SPIRAL is the ATGR of the 3rd generation and its development had been started in seventeen years and was fielded in the year 1980. The air forces of the Russian federation (*RF*) use this type of ATGR on combat helicopters *Mi-24E/F, Mi-28* and *KA-29*. The utilisation of this ATGR also assumes the combat helicopter *PZL-Swidnik W-3 Sokól*. It is launched from the closed launching tube and is provided by swivelling control areas of rectangular shape and 4 profiled opening stabilising fins – see Fig. 17. Its length is 1.83 m, calibre 0.13 m and the weight is 35 kg (including the launching tube ≈ 46.5 kg). The ATGR was provided at the beginning with the radio command guiding system by the operator by the help of infrared homing system and also was provided with semiactive laser terminal homing system.

AT-9 VIKHR is the ATGR which was firstly presented on the exhibition in Dubai in the year 1991. According to available information it can be used on the airplane *S-25* (8 rockets under the plane wings), further on it can be the armament of the combat helicopters *Mi-24, Mi-28* and *Ka-50*. The outer shape of the ATGR is similar to the rocket *AT-6 SPIRAL* with the difference that the warhead is protected by the ballistic shield. The ATGR is located in the circular launching tube. The stabilising fins and control areas are of swivelling type (aerodynamic arrangement of the rocket is of canard type) – see Fig. 18.

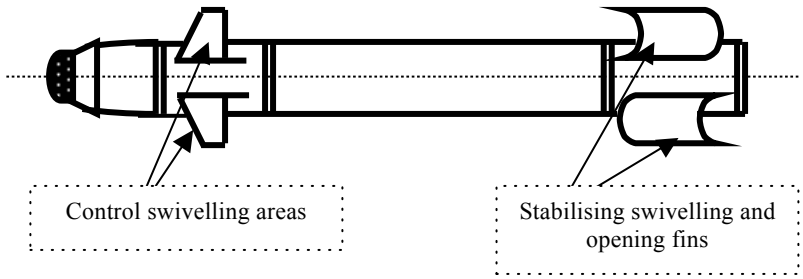


Fig. 18 Silhouette of the antitank guided rocket AT - 9 VIKHR

According to the available information it is further evident that the ATGR *AT-12 VIKHR* can also be used as the missile of the type *"air-to-air"* against the enemy's combat helicopters or also against the small surface navy vessels having on the board the rocket equipment.

3. Conclusion

The paper introduces the main types of the rocket armament of the combat helicopters being fielded in the contemporary armies of the world. Main attention is paid to the systems of the 2nd or 3rd generation. The rocket armament of the combat helicopters represents the effective weapon systems carrying out the actions against armoured land targets, against the enemy's combat helicopters or small surface navy vessels having on the board the rocket equipment.

The discussed problems are the main ones, but it is necessary to point out, that the mentioned content should be corrected regarding the new developed types of the ATGR, because the development continuously advances.

References

[1] LUDVÍK, F. Raketová technika – část II (Úvod do předmětu). Rocket Technique – Part II (Introduction to the Subject). Printed lectures of MA in Brno, S-883/II, Brno 2003.

[2] LUDVÍK, F. Raketová výzbroj vrtulníků (In Czech), Rocket Equipment of Helicopters. Rukopis pro připravovanou reedici knihy *Střelecká a raketová výzbroj letadel* (Manuscript for the reelaborated edition of the book "*Gunnery and rocket Equipment of Airplanes"* – Naše vojsko, Prague, 1st Edition, 1997.

[3] LUDVÍK, F. and KONEČNÝ, P. Rakety – část I. (Rockets – Part I). Textbook of MA in Brno, U1153/I, Brno 1998.