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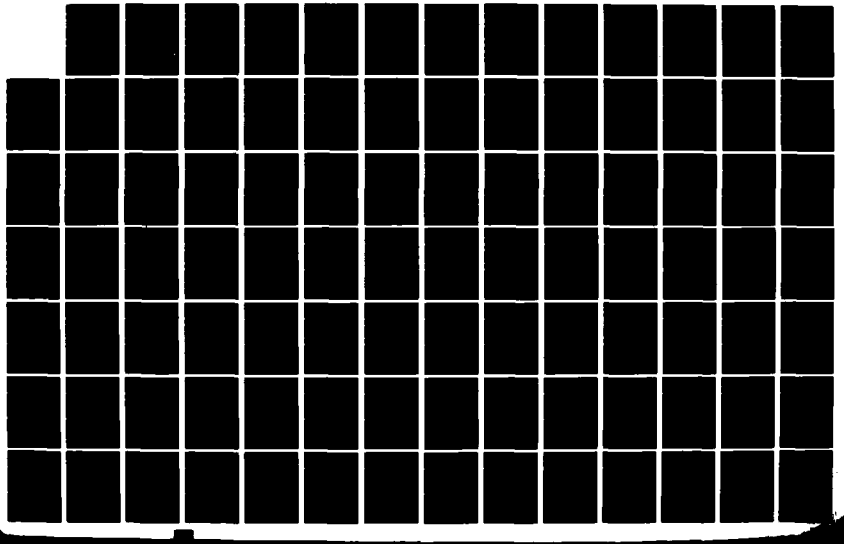

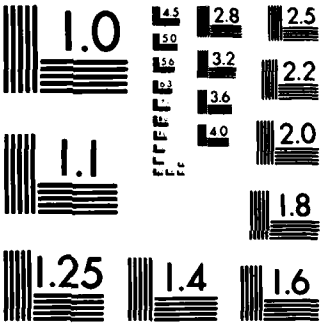

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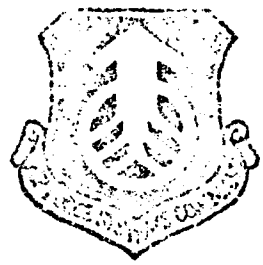
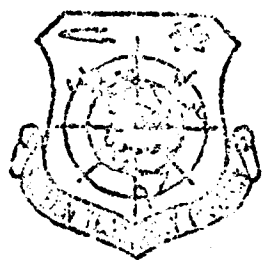


GUIDED ROCKET WEAPON

by

P.V. Morozov



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U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*Ye initially, after vowels, and after ъ, ь; e elsewhere.
When written as ё in Russian, transliterate as yё or ë.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	$\sinh^{-1}$
cos	cos	ch	cosh	arc ch	$\cosh^{-1}$
tg	tan	th	tanh	arc th	$\tanh^{-1}$
ctg	cot	cth	coth	arc cth	$\coth^{-1}$
sec	sec	sch	sech	arc sch	sech^{-1}
cosec	csc	csch	csch	arc csch	csch^{-1}

Russian	English
rot	curl
lg	log

GRAPHICS DISCLAIMER

All figures, graphics, tables, equations, etc. merged into this translation were extracted from the best quality copy available.

GUIDED ROCKET WEAPON.

P. V. Morozov.

In the pamphlet it is told about the new type of weaponry - guided missiles which are at present in different countries accepted for the armament of the army, navy and air force ones it sewed, is given the short historical reference of the development of rockets/missiles, is illuminated the leading role of the Soviet Union in the missile industry.

Pamphlet is intended for the soldiers, the sergeants and the civil/civilian young people, which are interested in rocketry.

Entire actual and assay, placed in the pamphlet, is undertaken from the open Soviet and foreign press, and questions of the prospects for the development of the guided rocket weapon are presented concerning foreign specialists' views.

Page 1.

FROM THE HISTORY OF THE DEVELOPMENT OF ROCKETS

Appearance of the guided missiles (shells) became possible because of the rapid development of mechanics, radio engineering, electronics, automation, chemistry, metallurgy and rocketry.

The missile industry - new branch of technology, although the history of the development of rockets/missiles begins from a deep antiquity. Already from the old times people knew about the possibility of applying reacting force, which appears during the escape of gas or liquid through the aperture in the container. Utilizing this phenomenon, in China more than 1000 years ago for the first time for the military targets began to make powder rockets - "fire arrows" (Fig. 1).

They were the arrows/booms to which were tied the paper cases, filled with powder and incendiary composition. The flying range of such arrows/booms in comparison with the ordinary ones considerably increased, which made it possible during the siege of fortresses to ignite fortress/serf buildings/structures, being located from them at safe distance.

Powder rockets tied also to the knives, to spears and to swords, creating the "flying knives", the "flying spears" and the "flying swords", which exerted strong moral effect on the enemy and deposited on it loss at the relatively larger distances.

Powder rockets long time were located as arms of some armies and before the appearance of threaded/cut artillery successfully competed with the smoothbore artillery.

Further development of rockets/missiles is connected with the advent of the works of K. E. Tsiolkovskiy in which was for the first time scientifically substantiated the tendency of man be detached away from the Earth and to penetrate in the universe.

Page 4.

His first works "Rocket/missile in the outer space" and the "Research of outer space by jet drives" appeared in 1903.

After the great October Socialist Revolution K. E. Tsiolkovskiy based the Soviet school of the amateur scientists, who are occupied by theoretical and practical questions of the missile industry.

In 1910-1912 yr experimental work on the creation of rockets/missiles begins to carry out, also, in other countries. As a result of these experiments appeared different types of illuminating and signal flares, and also rockets/missiles, which work on the liquid propellant, which made it possible to considerably increase velocity, distance and load capacity of rockets/missiles and to utilize them for studying the upper levels of atmosphere and other scientific purposes.

Besides this, were developed/processed the combat missiles. At the beginning of the Great Patriotic War Soviet scientists and the designers developed several types of rockets/missiles, which entered later for the armament of the Army and the Navy.

Famous guards mortars - "Katyusha rocket launcher" (Fig. 2) - during the years of the Great Patriotic War deposited on the Fascist troops/forces heavy losses in manpower and material.

In Germany according to the type of our "Katyusha rocket launchers" were developed the six- and eight-barrel mortars, which were established/installed on the tanks and the armored personnel carriers. These were the rockets/missiles, which work on the solid

propellant.

Furthermore, Germans created the rockets/missiles with the liquid propellant rocket engines, which have the considerably long range of flight, than solid propellant rocket. Such rockets/missiles (V-1 and V-2) Germans launched from the special launchers for the fire of London and other cities of England.

Rocket/missile V-2 (Fig. 3) effectively was applied at a distance to 300 km.

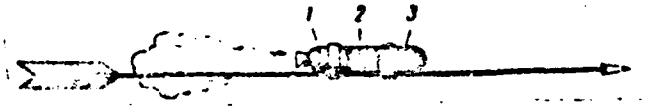

Fig. 1. "fire arrow": 1 - paper case; 2 - powder; 3 - incendiary composition.

Page 5.

It had the powerful/thick charge (to 1000 kg) of conventional explosive and weighed 13 t; the length of rocket/missile was 14 m.

Before the starting/launching of powder rockets to launchers was given the specific position/situation (angle of elevation and direction/axis), after which the engine could deliver rocket/missile to the target. On the powder rockets they had short range and small accuracy of firing. For the hit from the long range the focusing/induction indicated was insufficient; therefore arose the need for rocket control in flight.

Fig. 2. Salvo of rocket mortars ("Katyusha rocket launchers").

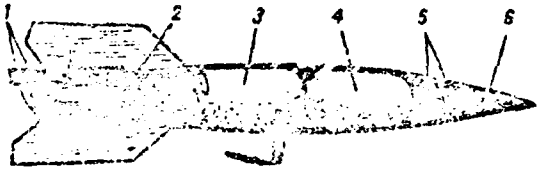

Fig. 3. Rocket/missile of type V-2: 1 - graphite controllers; 2 - rocket engine; 3 - liquid-oxygen tank; 4 - fuel tank; 5 - control instruments; 6 - warhead.

Page 6.

For this purpose for the flight control of rockets/missiles V-1 and V-2 were applied special control instruments which through the power constructions controlled the elevators and direction/axis, holding rocket/missile in the predetermined trajectory.

Thus appeared the first guided missiles.

Toward the end of the Second World War in many countries was developed the series of the guided missiles: some rockets/missiles were controlled on the wires/cables, others had the autonomous gyro mechanisms of the control and even telemetering means/facilities. As the power plants were used different types of powder and liquid-propellant engines. However, the majority of these rockets/missiles remained not launched into the series production.

The experience of the use/application of the guided missiles in the Second World War showed, how is great their value for the military targets, since they made it possible to suddenly destroy enemy from the long range.

In the postwar years in many countries began to be carried out the work for creation and improvement of the guided missiles.

The contemporary guided missile of combat designation/purpose - this is the unmanned flying vehicle with the jet engine, equipped with explosive charge and equipped by special equipment for the control, which makes it possible to automatically control its flight.

At present for the armament of armies and navies of states are accepted the guided missiles of different designation/purpose with different range.

The rockets/missiles equipped with nuclear charges are capable of delivering the charges of enormous destructive force up to the large distances.

Besides the guided missiles of combat designation/purpose, there are experimental (for the final adjustment of the individual elements of rockets/missiles and conducting of flight tests), research (for the upper atmosphere research) and other guided missiles.

The greatest successes in the region of the missile industry achieved the Soviet Union, which for the first time in humanity's history during October 1957 launched into the outer space with the aid of the multistage ballistic carrier rocket the first artificial Earth satellite with a weight of 84 kg.

After this historical event to the elliptic orbit around terrestial globe was brought out the second Soviet artificial satellite with a weight of 508 kg.

Page 7.

During May 1958 into space was launched the third Soviet satellite with a weight of 1327 kg.

In 1959 to the outer space flew three Soviet rockets/missiles with pay load 360, 390 and 435 kg.

These satellites allowed our scientists to investigate outer space near the Earth and Moons, to achieve the Moon, to photograph its concealed/latent before us unit and thereby to open road for further research.

During May 1960 in the Soviet Union was injected into orbit, close to the circular, new satellite whose orbit passed to 320 km from the surface of the Earth. Satellite without the latter/last booster stage weighed 4540 kg.

This satellite in contrast to all previously launched Soviet satellites, which are automatic laboratories, was on its construction the spacecraft, on board which was established/installed pressurized cabin with the cargo, which imitates the weight of man, with entire

necessary equipment for the endurance flight of man in the outer space.

The load capacity of space rockets is considered as the their most important characteristic, one of the main indices of the level of the development of rocketry.

As the another exceptionally important index is considered the accuracy of the output of rocket/missile to trajectory.

For example, so that the rocket/missile would achieve the Moon, it must be derived toward the end of powered flight trajectory (up to the moment/torque of the end of burning of latter/last step/stage) into the strictly defined point of space above the surface of the Earth and to report by it strictly defined according to the value and the direction/axis velocity.

In the case of the deviation of the velocity of rocket/missile at the moment of the cessation/discontinuation of the work of the latter/last step/stage or the engine in all on several meters per second or deflections of the direction/axis of flight in the tenth of degree from the estimated the rocket/missile will not hit to the Moon and will fly by.

Removal to the designated orbit of Soviet artificial Earth satellites, amazing on the accuracy the flights of our rockets/missiles to the Moon and around it clearly show the high degree of the perfection of the surface/ground and adjustable on the rockets/missiles equipment, which ensures their movement along the strictly predetermined trajectory.

For the comparison it is possible to indicate that in the USA in last three years (from 1957 through 1960) there were two ten unsuccessful starting/launching of satellites and space rockets.

Page 8.

The considerable fraction/portion of these failures was explained by malfunctions in the engine installations and the automatic equipment.

The American space rocket, launched during March 1959 (two months after the starting/launching of Soviet space rocket), bore the pay load only of 6 kg, i.e., 60 times less than the first Soviet space rocket.

The extremely high accuracy of the flight of Soviet rockets/missiles was demonstrated, also, during January 1960 during the test launchings of two ballistic missiles into the distant area

of Pacific Ocean.

After covering a distance of 12500 km, these rockets/missiles were dropped/omitted in the assigned area with the deflection from the calculation point of less than 2 km, whereas American ballistic missile "Atlas" to the distance 8000 km has average/mean error at the target of more than 3 km.

During July 1960 entire country flew the new glad news: in the Soviet Union in accordance with the program of conducting the tests of the diverse variants of powerful/thick multistage ballistic rockets for the space research were produced the launchings of such rockets. After passing from the place of start to the target approximately/exemplarily 13000 km, carrier rockets with the remarkable accuracy delivered the mock-ups of latter/last steps/stages into the assigned point/post.

The mock-ups fitted out for the passage through the dense layers of the atmosphere of the terminal stages were given in Pacific Ocean in immediate proximity of the outlined impact point.

It is characteristic that in the series conducted during July of the launchings of rockets into the center section of Pacific Ocean the preestablished size/dimension of dangerous square in the target

area is reduced approximately/exemplarily into two and one-half of times in comparison with the January test series, which again testifies about the perfection of our rockets/missiles, about the high accuracy of their guidance.

During August 1960 the peace/world learned about the new non/without-peridimensional scientific feat of the Soviet scientists, engineers, technicians and workers. In accordance with the plans/layouts with respect to the study of the outer space on 19 August, 1960, in the Soviet Union was realized the starting/launching of the second spacecraft in orbit of Earth satellite. The basic task of starting/launching was further final adjustment of the systems, which ensure the vital activity of man, and also security of his flight and return to the Earth.

Page 9.

The enormous flying shell with a weight of 4600 kg (without considering the weight of latter/last booster stage) was injected into orbit, close to the circular, with the height about 320 km. In the compartment, equipped by all by necessary for the future manned flight, were located experimental animals. After the completion of the study program, calculated for 24 hrs, the satellite vehicle, having special heat shield, on the group from the Earth descended

from its orbit and by unharmed ones it passed the earth's atmosphere. Ship and capsule separated/liberated from it with experimental animals happily landed.

Equipment which was established/installed in the compartment of spacecraft, completely ensured the normal vital activity of animals in flight.

For the first time in humanity's history the living beings completed flight in extent of more than seven hundred thousand kilometers at the height of 320 km and returned to the Earth.

The control system and the arrester of satellite vehicle operated/actuated with the high accuracy: the deflection of touchdown point from the estimated composed only about 10 km.

February of 1961 was marked by the new victories of Soviet science and technology in the assimilation of outer space.

On 4 February in the Soviet Union with the aid of the improved multistage rocket was realized the starting/launching of heavy artificial Earth satellite. The weight of satellite without taking into account the weight of latter/last booster stage was 6483 kg.

On 12 February in accordance with the study program of outer space by the improved multistage rocket was injected into orbit another heavy artificial Earth satellite.

During the same day from this satellite started the guided space rocket, which derived automatic station on the trajectory to the planet Venus. The weight of automatic interplanetary space station was 643.5 kg.

By the basic tasks of this starting/launching were checking the methods of the output of space object to interplanetary tracer, checking hyperdistant radio communication and control space station, refinement of the scale of the solar system and conducting physical research in space.

Greatest event in humanity's history was achieved on 12 April, 1961.

Page 10.

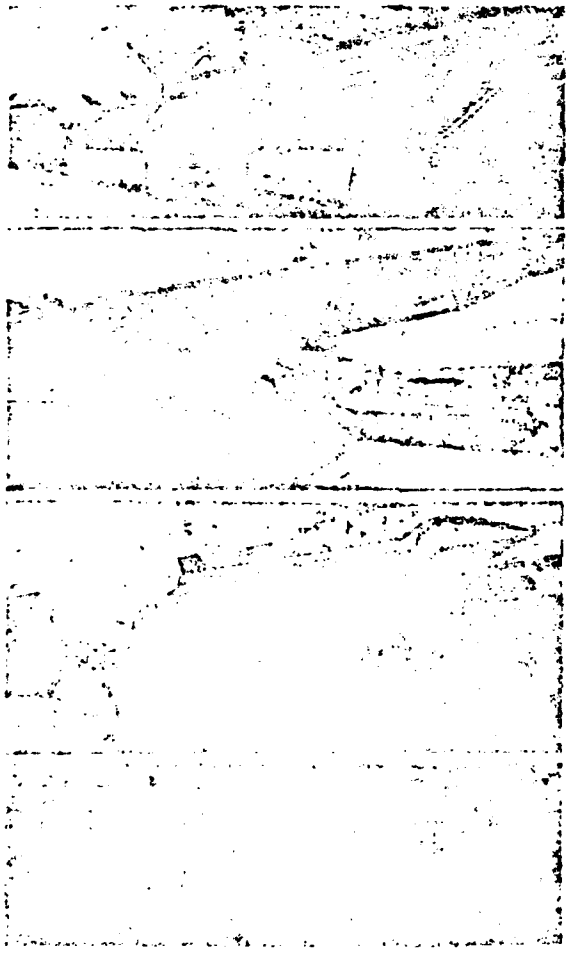

Fig. 4. Soviet combat rocketry, shown on parades over Red Square.

Page 11.

9 Hours 17 minutes on Moscow time space satellite vehicle

"Vostok-1" with the man aboard rose into space and, after completing flight around terrestial globe, 10 hours 55 minutes happily it returned to the Earth, after completing landing in the assigned area of our native land.

The space pilot of space satellite vehicle was citizen of the Soviet Union, Major Yuri Alekseyevich Gagarin.

On 6 August, 1961, in orbit around the Earth was brought out the new space satellite vehicle "Vostok-2", piloted by space pilot Major German Stepanovich Titov.

Space satellite vehicle "Vostok-2" in 25 hours flew more than 17 times around terrestial globe, after covering the distance more than 700 thousand km.

After the completion of the program of scientific research the satellite vehicle happily landed.

By these unprecedented victories of the man over the forces of nature is established beginning to manned flights into the outer space.

The victories of the Soviet subjugators of space are the

remarkable expression of the advantage of socialist order, the result of the greatest achievements of our people in the development of science and technology.

In spite of the enormous successes in the missile industry and the presence in the USSR of the well developed different types of rockets/missiles with the sufficiently precise control system, Soviet government speaks in favor of the unconditional prohibition of th. terrible weaponry.

N. S. Khrushchev in the presentation at the reception of the Soviet journalists in the Kremlin on 14 November, 1959, said: "No one we to frighten desire, but truth we can say, that now is accumulated this quantity of rockets/missiles, this quantity of atomic and hydrogen charges, that if on us they attacked, then we will be able displace from face of the earth/ground of all probable our enemies". Further it indicated: "Having this weaponry, we declare, that are ready all this to drown in sea in the interests of the provision of a peace/world on the earth/ground, in the interests of the future, so that all people and our, and future of generations could live quietly so that they would know that we not only do not want war, but also we do not want to have means/facilities for waging of war. We are ready to annihilate all this weaponry immediately, if follow our example other countries."

Page 12.

COMBAT CHARACTERISTICS OF THE GUIDED MISSILES AND THEIR CONTROL SYSTEM.

The history of the development of different types of weaponry shows that for the shift/relief to old weaponry comes new, that more advanced and effective.

Under the contemporary conditions as the this weaponry are considered the guided missiles whose combat characteristics differ significantly from the combat characteristics of artillery, torpedo and air weaponry. The guided missiles, especially with the nuclear charges, possess high effectiveness, have high rates, heights/altitudes and flying ranges. Furthermore, they are capable in the short time under any meteorological conditions with the high accuracy of delivering the charges of enormous destructive force virtually into any place on terrestial globe.

Let us examine some data, which testify about the advantage of new weaponry.

According to the data of statistics it is known that in the First World War the average percentage of hits was equal: for the artillery of a heavy caliber - 2.7o/o; for the torpedoes - about 11o/o; for the aerial bombs - about 1o/o; in the Second World War the percentage of incidences/impingements for these types of weaponry was respectively equal to 3.6o/o, about 15o/o and about 7o/o.

The percentage of the incidences/impingements of the guided missiles is considerably higher than in the types of weaponry examined; according to the data of the foreign press, it achieves 45o/o and it is above.

One guided missile with the nuclear charge is capable of causing such harm which in the period of the Second World War caused thousands of aircraft.

Page 13.

The high effectiveness, the large destructive capability of this new type of weaponry indicated the Marshal of the Soviet Union R. Ya. Malinovskiy in the speech at the IV session of Supreme Soviet of the USSR on 14 January, 1960,: "It suffices to say that if within the

period of 1940-1945 the Anglo-American aviation, after completing an enormous quantity of sorties, knew how to discard to the objectives of Germany and those occupied by it the countries of approximately two million tons of bombs, then at present one the strategic missile was capable of delivering of the target the nuclear charge, equivalent according to its power to the total explosive force of the conventional explosive, which is contained in these two million tons of bombs".

Guided missiles - multi-purpose weaponry. They can be used for the destruction of the most varied targets: surface/ground ones, air ones, surface ones and underwater ones.

Another distinctive features of the new type of weaponry lies in the fact that for the launching of rockets are necessary the sufficiently light and simple constructions. This is explained by the fact that during the starting/launching does not occur the recoils as in artillery gun and, therefore, it is not necessary to have complicated devices/appliances for its absorption.

The insignificant effect of meteorological conditions on the possibility of the combat employment of the guided missiles gives to them also the series/row of the advantages over conventional weapons.

Possessing high military characteristics, the guided missiles find ever increasing use.

Depending on the place of start and character of target the guided missiles abroad it is accepted to subdivide into four classes: "surface-to-surface" ("ship-to-ship", "ship-submarine", "submarine-ship", "submarine-to-ground"), intended for the armament of surface/ground units and ships and using for the damage/defeat of surface/ground and waterborne targets; "surface-to-air" ("ship-to-air", "submarine-air"), intended for the armament of surface/ground batteries and ships and using for the damage/defeat of the aerial targets; "air-surface" ("air-to-ship", "air-submarine"), the intended for the armament aviation and using for the damage/defeat of surface/ground and waterborne targets; "air-to-air", intended for the armament of aircraft and which use for the damage/defeat of the aerial targets (Fig. 5).

All enumerated classes of the guided missiles depending on the design features of the body (aerodynamic design) and the types of the engines used are subdivided into the winged missiles and the rockets/missiles (winged and wingless).

Winged missiles have an aerodynamic design of aircraft and engines, dependent on the air medium (as the oxidizer is utilized atmospheric oxygen).

Page 14.

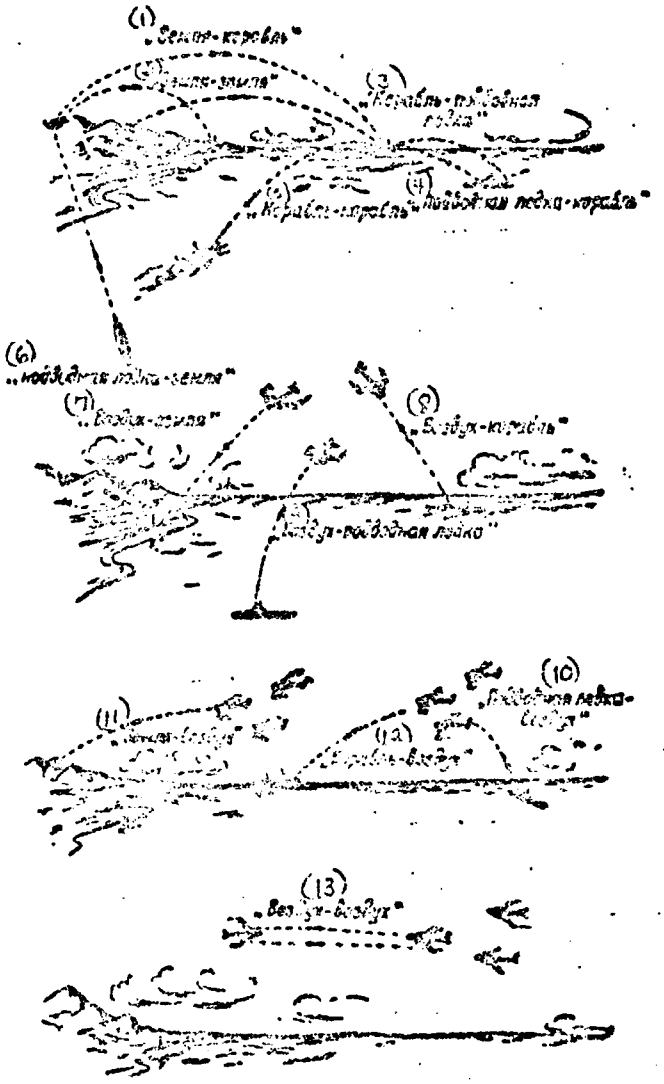

Fig. 5. Classification of guided missiles according to place of start and character of target.

Key: (1). "Surface-ship". (2). "Surface-to-surface". (3). "Ship-submarine". (4). "Submarine-ship". (5). "ship-to-ship". (6). "Submarine-to-ground". (7). "Air-surface". (8). "Air-to-ship". (9). "Air-submarine". (10). "Submarine-air". (11). "Surface-to-air". (12). "Ship-to-air". (13). "Air-air".

Page 15.

Cruise missiles have developed lifting surfaces (wings) and engines, dependent or not dependent on the air medium.

To wingless rockets/missiles are characteristic the oblong cylindrical form with the pointed nose section and the engines, not dependent on the air medium. Wingless rockets/missiles are usually called ballistic missiles or shells, emphasizing by this the character of the trajectory, along which they fly (ballistic trajectory).

The most important military characteristic of the contemporary guided missiles is the long range of activity - from several kilometers to several thousand, what considerably exceeds the range of all existing types of weaponry (range torpedo weaponry - to 10 km,

artillery - to 40 km). On the range the guided missiles are subdivided; into the short-range missiles, intended for target kill at a distance to 300 km; the medium distance, intended for the destruction of targets at a distance of 300-1000 km, and the long-range, intended for the application of strikes/shocks on the objectives, which are found on the removal/distance it is more than 1000 km. The guided missiles with the range of more than 2500 km are called intercontinental rockets/missiles.

Long range ballistic missiles start at the angle of elevation of 90°, i.e., vertically upward (Fig. 6). After achieving the specific height/altitude, they with the aid of the steering devices are inclined to the horizon so that up to the moment/torque of the end of burning slope angle to the horizon would compose approximately/exemplarily 45°, which corresponds to maximum flying distance.

After the cessation/discontinuation of the work of engine ballistic missiles on the inertia fly to the target as ordinary artillery shell.

Winged "surface-to-surface" missiles with the firing to the long range are launched just as long range ballistic missiles, but upon the atmospheric entry they are translated by equipment for the

control in the shallow glide (Fig. 6). Flight in this trajectory considerably increases the range of cruise missiles in comparison with the wingless ones (with the identical characteristics of jet engines).

Winged surface-to-air missiles and "air-to-air" can be launched at different angles to the horizon.

Page 16.

Winged missiles begin takeoff from reclining guides and they fly to the target at the small height/altitude with the constantly operating engine as ordinary aircraft (Fig. 6). On the arrival into the target area the shells convert/transfer into the steep dive at the target or are laid with the aid of the homing systems.

Foreign specialists consider that the ballistic missiles possess the serious advantage over the winged missiles, which have lower speed and flight altitudes, it is difficult to annihilate them during the flight. Therefore they can be intended for the application of surprise strikes/shocks on the important objectives.

With any flying range the guided missiles must have the high probability of hit. This is achieved by applying the control systems

on which completely depends the accuracy of the guidance of rocket/missile to the target.

During the guidance are accomplished two technical missions: the output of rocket/missile to trajectory and the control of its flight in the trajectories which are tightly interlocked.

The accomplishment of the first mission provides the correct orientation of rocket/missile in the space, and on the solution of the second depends the accuracy of the guidance of rocket/missile to the assigned target.

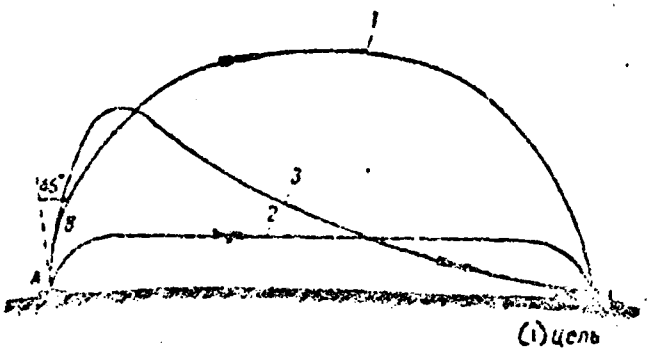

Fig. 6. Flight paths of different types of the guided missiles. 1 - ballistic missile; 2 - winged missile; 3 - winged surface-to-surface missile; AB - the powered flight trajectory of ballistic missile.

Key: (1). Target.

Page 17.

Because of this the process of guided-missile control to the target it consists of two consecutive stages: the first stage - start when the control system is utilized for the imparting to the rocket/missile of the specific position/situation, which makes it possible to derive it on the predetermined trajectory; the second stage - approach in process of which the rocket/missile approaches a target up to the minimum distance for the actuating of warhead and strikes target.

All these problems solves the control system which controls/guides launcher and rocket/missile in the process of preparation/training for the firing and guidance of rocket/missile to the target.

The system of rocket control encompasses: the system of steering devices of the firing which provides the process of firing (target detection, the issue of target designation, the guidance of launcher and the launching of rocket); the system of the instruments of guidance, which ensure the specific position/situation of rocket/missile in the space relative to target and the detachment of the necessary flight path for the destruction of target; the control mechanism which is accommodated on the rocket/missile and is intended for output and retention of rocket/missile to the predetermined trajectory, and also for the execution of the groups of guidance system in the case of deflecting the rocket/missile from the programmed trajectory or if necessary of changing the path of its flight.

Equipment of the control system can be located both on rocket/missile itself and on the objective, from which are conducted the starting/launching of rocket/missile and the control of it or

only the control.

Depending on tactical designation/purpose the rockets/missiles, the conditions of its flight and estimated range of the control system are divided into the systems of preset control, remote control, homing and the combined systems.

During preset control the rocket/missile is guided to the target by means of the instruments, arranged/located on the rocket/missile. The flight program of rocket/missile to steering devices is assigned previously.

This control system can be carried out on the basis of the principles of autopiloting, celestial navigation, inertial systems, etc.

Autopiloting is based on the use of gyro systems, in which in proportion to the deflection of rocket/missile from the programmed trajectory to the autopilot are introduced signal- corrections, which eject rocket/missile to the calculated trajectory.

Preset control is applied mainly for guiding the ballistic medium-range missiles of activity and long-range.

The variety of the system of preset control is considered the astronavigational system as basis of which is assumed the principle of navigation on the celestial bodies, which make it possible to continuously adjust the flight path of rocket/missile.

In this system electro-optical instruments, which are located on the rocket/missile, continuously are laid with the aid of the highly sensitive elements/cells at one or at two celestial bodies, relative to which is previously designed the missile trajectory.

In flight of rocket/missile its actual place is compared with that previously designed. With the noncoincidence of actual position/situation with the estimated operate/wear the corresponding mechanisms of the control system and rocket/missile returns to the predetermined trajectory.

Another variety of the system of preset control is the inertial system, based on the law of mechanics according to which any change of moving the body under the activity of different forces is escorted/tracked by accelerations.

If we measure these accelerations in different directions/axes,

then it is possible to calculate the deflections of the flying body from straight path in the direction/axis, in which was made the measurement.

In the inertial system to the platform stabilized in the horizontal plane place two or three devices (accelerometer), that measure the acceleration in two or three mutually perpendicular planes. Two accelerometers measure the side accelerations and give possibility by means of the special instruments - integrators - to determine the deflection of rocket/missile with respect to the height/altitude and the direction/axis. The third accelerometer measures the accelerations of rocket/missile along the trajectory and makes it possible to determine rate and passed by it route/path. The measured deflections enter the computer which develops the necessary signal- corrections.

The signal, proportional to lateral deflection, after entering to the autopilot, will act on control surfaces and adjust the missile trajectory of relatively given one.

The advantage of inertial system in comparison with the astronavigational lies in the fact that its work does not depend on the condition of cloudiness and time of days.

Abroad they consider that preset control of rocket flight provides the sufficiently high accuracy of incidence/impingement and gives the possibility to strike the large/coarse targets (ports, base, city, etc.), which are found on the large removal/distance from the place of missile takeoff.

The advantage of preset control of flight consists also in the nonsusceptibility to the radio interference, created by enemy. Furthermore, it can be used in flight of rocket/missile to any distance and gives the possibility to launch immediately a series of rockets/missiles, which considerably increases the probability of hit.

Remote control (control at a distance) can be broken into three systems: beam guidance of radar, command and radio navigational.

Beam guidance of radar consists in the fact that the rocket/missile is held in the narrow beam of target-tracking radar, which is simultaneously the station of the observation and control (Fig. 7).

Equipment follows missile heading, without giving to it to move out the cone of the ray/beam, and thereby it lays rocket/missile at the target.

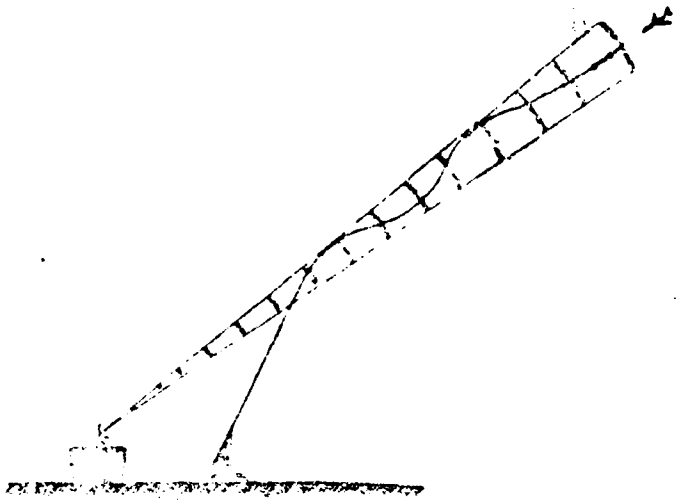

Fig. 7. Guided-missile control on the ray/beam of radar.

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Beam rider guidance system is applied for the rocket control of class "surface-to-air", "air-to-air" and "air-surface", but most widely it is utilized for guiding the AA guided missiles. Furthermore, it can be used for the control of ballistic missiles in the initial sector of their flight.

The range of this guidance system does not depend on meteorological conditions and is estimated distance of the activity of radars.

The advantage of system lies in the fact that in the limits of directing beam of radar it is possible to simultaneously lay several rockets/missiles.

Command guidance system is realized by means of the groups, which enter from the command post to the instruments, which are located on board the rocket/missile. This system is utilized for the missile targeting of near, average/mean and long-range.

In the command guidance systems special equipment or operator, controlling rocket flight and movement of target, transmits by radio or wires/cables of signal-groups which are received as the radio receiver of rocket/missile and through the power mechanisms is activated of rudders, guiding rocket/missile to the target.

To control the relative position of rocket/missile and target is possible visually, with the aid of the optical means/facilities, radiolocations and televisions, moreover the selection of observation facilities is determined by the type of target and by the character of its movement.

There are many varieties of command systems, but for all them is

characteristic the presence of two lines of communications between the command post and the rocket/missile. One line of communications is intended for the observation of the movement of rocket/missile relative to target, another - for the transmission of groups to the rocket/missile in the case, fir tree rocket/missile will be deflected from the calculated trajectory or it will be necessary to change flight path.

Guidance system on the wires/cables is considered as the simplest command system and it is applied abroad in essence in the antitank missiles.

In this system the data about target position and rocket/missile are obtained by visual observation. Rocket/missile is controlled/guided by means of the pulse electrical signals, transmitted by operator with the aid of the command instrument by two thin wires/cables, which are unwound during rocket flight from the revolving coil, adjusted on the rocket/missile under the wings (Fig. 8).

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Are most widely used the radar systems, which depending on a number of radars, entering the system, are subdivided into the

single-ray ones (with one radar) and the double-beam ones (with two radars).

Single-ray systems in turn, are divided into two forms: for the guidance on the moving/driving target and for the guidance on the stationary target.

During the guidance on the moving/driving target one and the same radar simultaneously follows the movement of target and rocket/missile. In this case the rocket/missile moves over the trajectory, which coincides with the line command post - target. The starting/launching of rocket/missile, capture by its ray/beam of radar are conducted almost just as with beam guidance of radar.

The position/situation of rocket/missile relative to target or central axis of the ray/beam of radar is determined on the scope of tracking radar of target and rocket/missile.

Targets Data from tracking radar and rockets/missiles come into the computer, arranged/located on the earth/ground, which determines the errors in the flight path of rocket/missile and develops the appropriate group- signals, transmitted to the rocket/missile by transmitter by the radio link.

This system is utilized in the surface-to-air missiles and "air-to-air".

With the firing at the stationary target the radar operator follows the rocket/missile from the moment/torque of starting/launching to the moment/torque of the cessation/discontinuation of the work of engine, continuously communicating the data about the location of rocket/missile to the computer which compares the flight path of rocket/missile with the program and issues steering commands.

This system can be used for guiding the ballistic missiles in the initial phase of trajectory (Fig. 9).

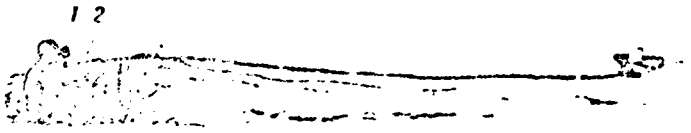

Fig. 8. cable guidance of the antitank guided missile: 1 - optical instrument of observation; 2 - command steering device.

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In the ballistic missiles the computer not only issues steering commands, but also determines the moment/torque of the cessation/discontinuation of the work of engine that it is very important for the provision of a precise incidence/impingement of rocket/missile into the target.

In the double-beam system are utilized two radars: one tracks a target, another - after the rocket/missile.

According to the data of station the computer determines rate, height/altitude and direction of the motion of target and develops signal- groups for the rocket control (Fig. 10).

This system makes it possible to guide to the target only one rocket/missile, which to a considerable extent decreases the kill probability of target.

Double-beam system is utilized for guiding the "surface-to-air" missiles ("ship-to-air").

Monitoring/checking of the movement of rocket/missile relative to target can be realized by aid of television equipment, and rocket control on the radio links.

In this guidance system are a construction, which transmits to the command post the image of target and of its surrounding terrain, and construction, reproducing image on the television screen.

Operator, controlling target on the screen and sending to the rocket/missile of a signal-group, lays it at the target.

This system is applied for the guided-missile control of different classes on the targets whose location is changed or accurately unknown.

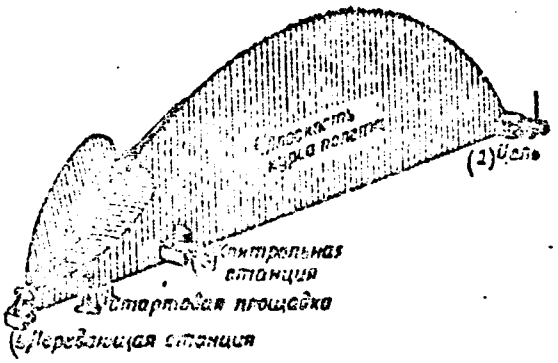

Fig. 9. Schematic of beam riding missile guidance in the initial trajectory phase.

Key: (1). Plane of direction of flight. (2). Target. (3). Control station. (4). Launch pad. (5). Transmitting station.

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The dependence of the work of television system on the weather conditions and illumination, and also the low range decrease the effectiveness of its use/application.

As the overall deficiency/lack in all command systems is considered the absence of concealment and susceptibility (except wire system) to the effect of the radio- and radar clutter, created by enemy.

Radio-navigation system also makes it possible to control/guide rocket/missile at a distance, moreover rocket/missile is guided to the target in accordance with the predetermined program and on the signals of radio navigational guidance stations.

In this system several of ground stations transmit signals, and the receivers of rocket/missile with the automatic guidance equipment measure the difference in the time between the receptions of the signals of these stations and convert findings rockets/missiles into the data about the position/situation. Then these data are compared by automatic equipment of rocket/missile with the estimated ones and the manufactured signal- corrections give rocket/missile to the predetermined trajectory.

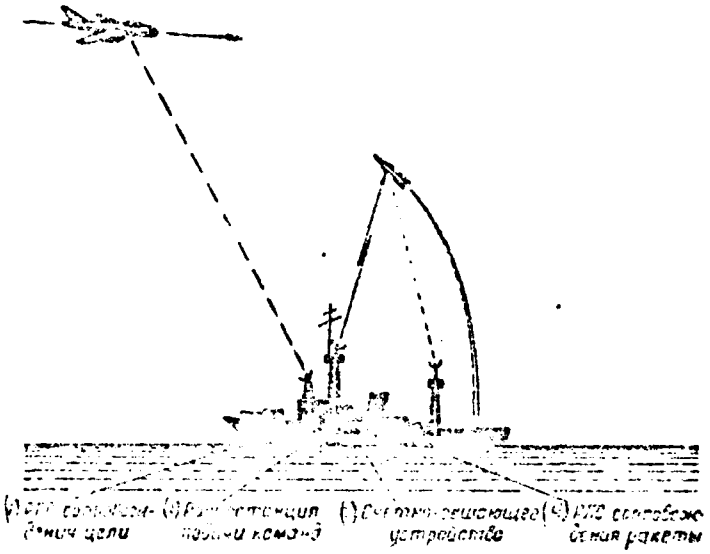

Fig. 10. Command double-beam guidance system of the guided missile.

Key: (1). Target-tracking radar. (2). Radio set of delivery of commands. (3). Computer. (4). Missile-tracking radar.

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Radio-navigation system can be used for the guided-missile control of long-range.

Homing usually is utilized in the final phase of flight of rocket/missile for an increase in the probability of hit and it makes it possible to fire/shoot at the low and maneuvering targets.

Homing is provided by special construction - the homing device (Fig. 11), arranged/located in the rocket/missile which works on the thermal, the radar, the optical or any by friend principle.

At present are distinguished three methods of the homing: passive, active and semi-active.

The passive method of homing is based on the principle of perception with sensing element of the homing device of the rocket/missile of one or the other physical field of the target: thermal, electromagnetic (radio waves), light, etc.

The instruments of homing fix/record the bearings/angles between the directions of the motion of rocket/missile and target, and by means of the control surfaces rocket/missile is guided to the target - the radiation test of physical field.

Active method is based on the use of a radiolocation.

Rocket/missile has miniature radar which emits radio waves into the specific sector/arc of space in front of the rocket/missile.

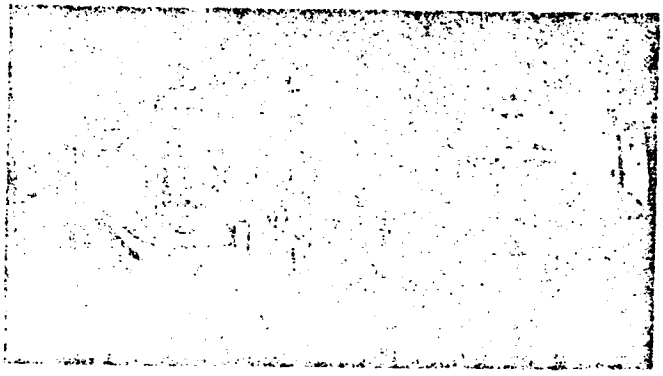

Fig. 11. The general view of radar homing device. Is to the left visible antenna deflector.

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Upon the appearance of a target in this sector/arc the pulse reflected from it is received as the receiver of station and, acting on control surfaces, it lays rocket/missile at the target (Fig. 12).

Semi-active method is also based on the use/application of a radiolocation, but rocket/missile does not have a station. On it is located only the receiver. However, target is irradiated by radar, arranged/located on the earth/ground.

The pulse reflected from the target is received as the receiver of homing device that it leads to the operation of control surfaces

and the guidance of rocket/missile to the target.

For the provision of sufficient probability of hit at the long range of firing are applied the combined control systems.

The combined control system encompasses different systems, for example: preset control and homing, remote control and homing, etc.

Preset control in combination with the homing more frequently is applied in the guided surface-to-surface missiles, remote control with the homing - in the "surface-to-air" missiles and "air-surface".

The use of the combined control systems makes it possible to obtain the high accuracy of incidence/impingement with the firing at the small size and moving/driving targets.

From the combat characteristics of the guided missiles examined it is evident that the effectiveness of the damage/defeat of surface/ground, air and waterborne targets by the guided missiles can be very high, in this case the distance of their activity considerably exceeds the ranges of the existing artillery, torpedo and air weaponry.

For this reason to the improvement and creation of the guided missiles is at present paid very considerable attention.

Fig. 12. Diagram of active homing.

CONTEMPORARY GUIDED [illegible]MISSILE.

In spite of the immense diversity of the guided missiles, created at the present time, they all have general/common/total structural elements/cells.

Construction/design and technical characteristics of elements/cells depend on the tactical designation/purpose of rocket/missile, in this case their location in the missile body can be different. The guided missile it consists of the body (glider/airframe of the specific aerodynamic design), warhead with the fuses, airborne guidance system, supplies of power and engine installation (Fig. 13).

All elements/cells of the guided missile must perform strictly in concord, accomplishing the task assigned to the rocket/missile.

As the critical element/cell of the guided missile is considered the guidance system, on accuracy and reliability of work of which depends the effectiveness of the use of a rocket/missile.

The body is load-bearing element and is intended for positioning/arranging of warhead, steering devices and guidance and jet engine. It is done such form that the air resistance in flight would be smallest and rocket/missile was controlled/guided well. The construction/design of the body must be durable and light.

Aerodynamic design of the guided missile is driven out/selected taking into account the designation/purpose of rocket/missile, flight conditions and forces acting in flight.

The guided cruise missiles have a glider/airframe which consists of fuselage (body), wings (lifting surfaces), rudders and stabilizers.

Stabilizers are otherwise called rocket fin. Wings in some rockets/missiles are made with rotary ones, which also makes it possible to control/guide rocket flight.

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Rocket flight, which has the aircraft configuration of construction, is determined by the presence of the lift of wing. With an increase in the velocity of flight when rocket/missile flies in essence due to the energy acquired from the engine, there is no need

for to supply with its large and heavy wings, which create lift. Therefore with an increase in the velocities the sizes/dimensions of wings decrease, and in ballistic missiles wings generally are absent.

The mutual disposition of rudders and wings and their quantity can be different. In cruise missiles more frequently is utilized the cruciform four-wing general-arrangement diagram, which encompasses four mutually perpendicular wing and four mutually perpendicular planes of the tail unit.

Depending on by what surfaces is controlled/guided rocket/missile and in what place they are arranged/located, are distinguished three aerodynamic designs of the guided missiles (Fig. 14): diagram the "guided tail assembly", or the normal aerodynamic design where the wings are arranged/located in front of the rudders; the diagram of "canard", in which the rudders are arranged/located in front of the wings; diagram the "guided wing", where the wings and rudders perform the role of control and lifting surfaces, i.e., they are combined.

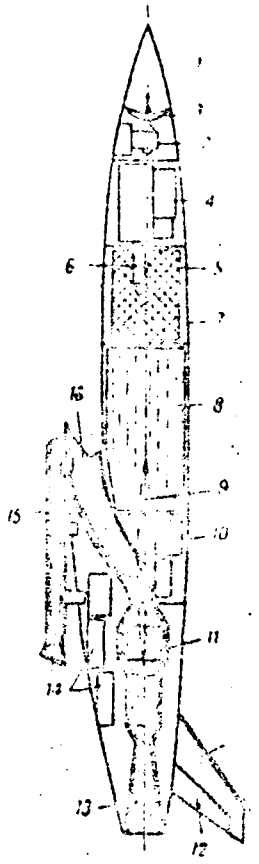

Fig. 13. The exemplary/approximate schematic of the layout of the guided winged missile "Regulus II": 1 - radar fairing; 2 - equipment of homing system; 3 - antenna deflector of homing system; 4 and 10 - equipment for the control; 5 - warhead (explosive charge); 6 - fuse; 7 - fuselage (body); 8 - fuel tank; 9 - wing; 11 - march turbojet engine; 12 - rudder; 13 - jet; 14 - the auxiliary mechanisms of engine; 15 - booster engine; 16 - air intake.

The diagrams examined can be used both in of the aircraft and in the cruciform schematics guided missiles, with it has its advantages and deficiencies/lacks.

The rocket/missile of cruciform diagram is controlled/guided in two mutually perpendicular planes, moreover the control in each plane been independent. In order to turn the rocket/missile, which has aircraft configuration, necessary to simultaneously and in concord turn it around the longitudinal axis (to incline), and only after this it is possible to change the direction/axis of flight in the required plane, which considerably complicates rocket control at high velocities of flight.

Aircraft configurations more frequently are utilized for the "surface-to-surface" missiles ("ship-to-ship").

Cruciform diagram allows for the guided missiles at the high velocities to accomplish rapid maneuvers in the horizontal and vertical planes, in connection with which this diagram most extensively it is used in the "surface-to-air" missiles, "air-surface"

and "air-to-air".

Foreign specialists indicate that in the accuracy of the control the cruciform and aircraft configurations barely differ.

Ballistic missiles do not require for their flight of support in air; therefore they do not have wings.

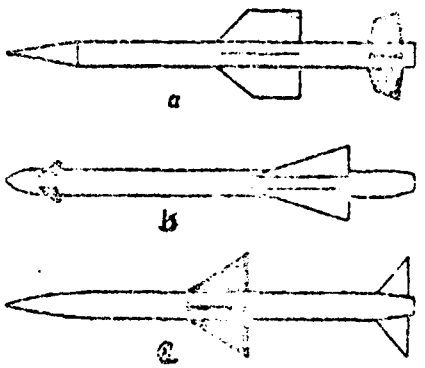

Fig. 14. Aerodynamic designs of the guided missiles: a) the "guided tail assembly"; b) "canard"; c) the "guided wing".

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The majority of their trajectory they fly as ordinary artillery shell, and wings would only impede their movement.

This is why ballistic missiles have the extended cylindrical body with the pointed nose section and sometimes small tail unit for the stabilization of flight (Fig. 27).

Ballistic missiles are controlled/guided by air or vanes, and also by a change in the position/situation of engine relative to axis of rocket, for which the engines are established/installed in the special gimbal suspensions. Vanes are arranged/located in the gas jet

of engine.

Furthermore, for the rotation of rockets/missiles can be used the rotary chambers/cameras of the booster engines which accommodate on each side of rocket/missile. After the rotation of rocket/missile rotary chambers/cameras are dropped.

The warhead of the rocket/missile with the fuses is intended for the execution of basic combat mission - the destruction of target. Warheads can be basic and auxiliary designation/purpose.

The warheads of the basic designation/purpose include the warheads of high-explosive, fragmentation, armor-piercing and cumulative effect, etc., to the auxiliary ones - illuminating, smoke, agitational, etc.

The guided missiles, intended for the damage/defeat of surface/ground, surface and underwater targets, bear the warheads mainly of high-explosive effect with the charges of conventional explosive or with the nuclear charges. Furthermore, can be used warheads of the armor-piercing, chemical and cumulative effect.

In the guided "air-to-surface" missiles, "surface-to-air" and "air-to-air" are utilized fragmentation, HE fragmentation,

fragmentation incendiary or nuclear warheads.

Ballistic missiles in essence have high-explosive warheads with the ordinary or nuclear charges.

The warheads of high-explosive effect strike targets with the shock wave, which is formed during the burst. They consist of the steel body, the explosive/bursting explosive charge, fuses and booster charges, which use for the reliability of the activity of warhead (Fig. 15).

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The warheads of AA guided missiles, intended for the damage/defeat of the aerial targets, during the burst give a large number of lethal fragments whose kinetic energy depends on their weight and velocity of rendezvous with the target (Fig. 15).

Warheads of the cumulative effect are based on the use of the directional effect of burst. In the explosive charge of warhead notched, covered with the metallic facing which during the burst forms the metallic jet, which moves at a velocity more than 10000 m/s. Because of the high kinetic energy the jet breaks through the heavy armor.

Such warheads are commonly used in the rockets/missiles for the destruction of the armored targets.

Warheads with the atomic charges are based on the self-developing fission chain reaction of the atomic nuclei of some elements/cells.

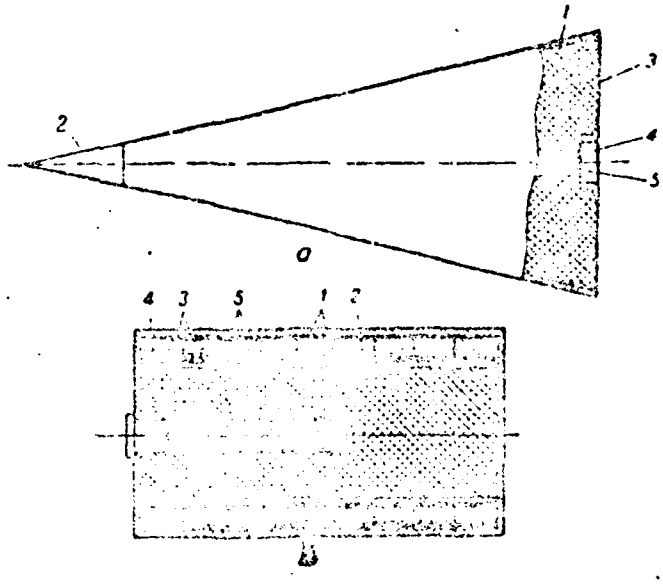

Fig. 15. The exemplary/approximate diagrams of the warheads: a) ballistic missile (V-2): 1 - body; 2 - point detonating fuze; 3 - explosive charge; 4 - base fuze; 5 - supplementary fuse; b) the surface-to-air missile: 1 - body; 2 - explosive charge; 3 - finished fragments; 4 - eyepiece for the fuse; 5 - the booster charges.

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As can be seen from communications/reports to the foreign press, as the explosive atomic substance (atomic fuel) abroad are applied uranium-235, uranium-233 and plutonium 239.

In order to produce burst, is necessary atomic substance with the specific critical mass (Fig. 16), i.e., such quantity of fissionable material with which the nuclear reaction becomes self-sustaining.

In the warhead at certain distance from each other places two masses of atomic substance, each of which is less than the critical, but in the sum they give the critical mass (it is more precise, somewhat more than critical).

With the rapid combination of these masses occurs the burst. The process of burst proceeds virtually instantly (for the milliseconds).

The energy, which is isolated during the atomic explosion, into hundreds of thousands and millions of times exceeds energy isolating

during the burst of the conventional explosives, undertaken in the same quantity. Atomic explosion is escorted/tracked by powerful/thick shock wave, intense luminous radiation and penetrating radiation. The remainders/residues of the products of burst are the radioactive materials, which biologically affect the human organism.

Besides the warheads with the atomic charges, there are warheads with the thermonuclear charges.

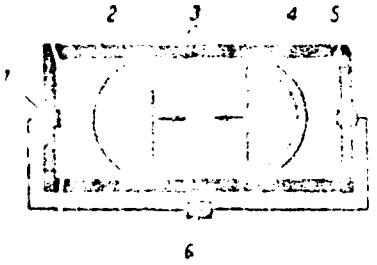

Fig. 16. The exemplary/approximate schematic of the construction of the atomic bomb: 1 - detonator; 2 - charge of conventional explosive; 3 - atomic charge; 4 - neutron reflector; 5 - shell; 6 - destructor mechanism of detonators.

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Such charges include the hydrogen charge during burst of which nuclear energy is freed as a result of the nucleation of helium from the hydrogen isotopes. This reaction can occur only at very high temperatures (several million degrees).

Basic nuclear substance can be the mixture of deuterium with tritium. The nuclear reaction of mixture is caused by the temperature in several million degrees, that is formed during the burst of the ordinary atomic charge, which is in this case detonator for the hydrogen charge.

As the basic nuclear substance in the hydrogen charges can be used also hydride of lithium (the chemical compound of heavy hydrogen

- deuterium with lithium) whose thermonuclear fusion appears at a temperature of 30-40 mln. degrees.

The power of atomic charges is determined by a quantity of intranuclear energy, which is freed during the atomic explosion. This power they estimate by the TNT equivalent, i.e., compare the power of atomic explosion with the power of trotyl, undertaken in the same quantity.

If the power of ordinary atomic charge is equal to the explosive force of tens and hundreds of thousands of tons of trotyl, then the power of thermonuclear charge is equated the power of several million tons of trotyl.

From the communications/reports to the foreign press it is evident that the guided "surface-to-surface" missiles near activity have warhead by the weight of 300-700 kg (antitank 3-5 kg), average/mean and long-ranges - to 1000 kg and more than, these of class "surface-to-air" - 20-150 kg; "air-to-air" - 10-30 kg.

For the blasting/detriment of the warhead of the rocket/missile at required point in the trajectory or upon the encounter with obstacle serve the fuses.

Using the method of activity in target the fuses are subdivided into the strike ones, the remote/distance ones and the noncontact ones; on the point of connection with the warhead - to the head ones, the bottom ones and the lateral ones.

Impact fuzes operate/wear with the impact against obstacle, remote/distance - at a given moment in time or at the assigned distance of rocket/missile from the places of start, noncontact - are automatic during the approach of rocket/missile with the target.

Proximity fuses according to the operating principle are divided into the radar ones, the optical ones, the acoustic ones, the magnetic ones, etc.

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For the combat guided-missile units most frequently are applied radar proximity fuses (VT fuzes) (Fig. 17).

The operating principle of the radar fuse is the same as the operating principle of radar. In the fuze body are installed the miniature transmitting and radio receiving stations with the power supply. Usually stations have one antenna, which is simultaneously transmitting and receiving.

During the starting/launching of rocket/missile (or on the group from the instrument board) is actuated the supply of power of fuse and radio wave they begin to be emitted into the surrounding space.

Upon the appearance in the zone of action of the fuse of target the signal echo from it is recorded the signal, which is amplified in proportion to the approximation/approach of target.

At the designed moment/torque when the rocket/missile flies near the target, signal achieves this force, which activates of fuse and, therefore, the burst of charge.

The activity of photoelectric proximity fuzes is based on the use of thermal (infrared) target emanation (Fig. 17).

Fuses of such type consist of the lens, transparent for the infrared rays, the photocell, arranged/located in the focus of lens, amplifier circuit and squib.

During the approach of rocket/missile with the target the latter comes into view of fuse, the intensity of the radiation/emission, which strikes by the photocell, sharply is changed, in the circuit of

amplifier appears the impulse/momentum/pulse of photocurrent, which activates of squib and blasting/detriment of charge.

All guided missiles have the airborne guidance system, which uses for the retention of rocket/missile in the predetermined trajectory and the rocket control on the groups, which come from guidance system. Furthermore, it provides in flight stability and maneuverability of rocket/missile.

Between the control mechanism and the guidance system must be communications/connection, since on their work depends the accuracy of the guidance of rocket/missile to the target.

Airborne guidance system according to the operating principle relates to the automatic control systems, since it automatically controls/guides the position/situation of missile body in flight.

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Onboard equipment consists of antenna, construction for the reception/method of groups and onboard radio transmitter, which is transceiver. Furthermore, into onboard equipment enter measuring (sensing), amplifier-converter and executive-power elements, which use for the direct control of rocket flight.

Sensing elements (gyroscopes, accelerometers, etc.) determine the real position/situation of rocket/missile and issue the signals, necessary for processing the control commands.

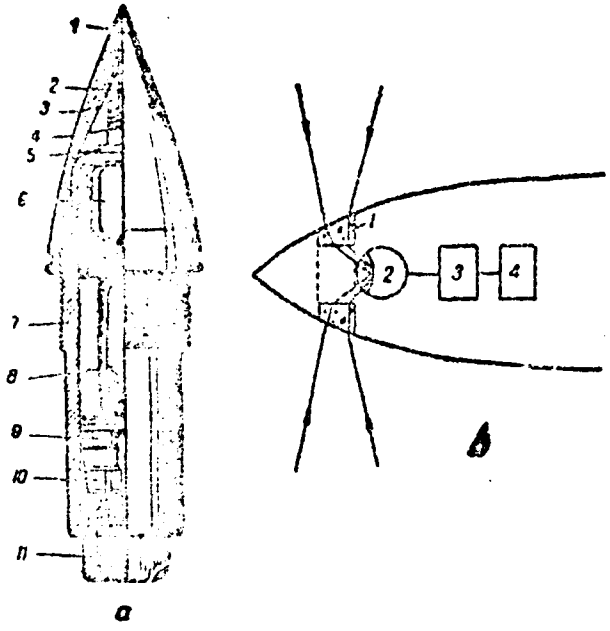

Fig. 17. The proximity fuses: a) the diagram of an English VT fuze of

the type V-T: 1 - antenna; 2 - wax filling; 3 - plastic head; 4 and 5 - coil of antenna; 6 - radio transmitter and receiver; 7 - dry battery; 8 - cylinder with electrolyte; 9 - safety device/fuse; 10 - self-destructor; 11 - detonator; b) the schematic of the photoelectric proximity fuze: 1 - lens; 2 - photocell; 3 - amplifier; 4 - squib.

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These signals, intensified and converted, through the actuating elements act on rudders so that after the rotation of rocket/missile the error signal disappears and rocket/missile moves in the assigned direction/axis.

The thrust, necessary for the realization of rocket flight, creates engines.

Basic parts of any rocket engine are combustion chambers and jet (Fig. 18 and 19). Combustion chamber serves for the creation of the conditions for the effective combustion of fuel/propellant, i.e., the transformation of chemical energy of fuel/propellant into thermal energy of gas. Combustion gases are expanded in the nozzle channel and ensue/escape/flow out into the environment at a high speed, causing the reaction force (thrust) of engine.

Jet engines in contrast to other heat engines are the engines of forward reaction, since they directly create reaction force by the rejection of the mass of substance (gases).

With the combustion of fuel/propellant in the combustion chamber is formed a large quantity of gases, heated to high temperatures (3000-3500°), the gas pressure within the chamber/camera in this case rises. As a result of pressure difference in the combustion chamber and in the environment occurs the outflow of gases behind the jet.

According to the law of conservation of energy with an increase in the rate of flow the pressure in the flow decreases. Therefore in those places where the rate will be more, pressure will prove to be less, and vice versa.

Net force, which appears due to the nonuniformity of the distribution of pressure on the internal surfaces of the combustion chamber and jet, and will be reaction force. The amount of this force proves to be the greater, the greater the gas flow per unit time and the greater the exhaust gas velocity.

Consequently, jet engine - this is the heat engine in which the

chemical energy of fuel/propellant with its combustion in the chamber/camera is converted into thermal energy of gases, and the latter - into the kinetic energy of the outflow of gas jet behind the jet, due to what is created the reaction force.

By fuel/propellant is understood any substance, which is the energy source, which can be converted into the thermal. Is at present applied mainly the chemical fuel/propellant, which exhibits its thermal properties during the usual chemical reactions - during the burning.

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Besides this, for the rocket engines are developed/processed the projects of the use/application as the fuel/propellant of the atomic fuels/propellants, in which is utilized the heat of thermonuclear fusions.

Chemical fuel/propellant consists of one or two units - components. Each of the components can be uniform or consist of the mixture of the substances, which play identical role in the reaction. In bipropellants one component - combustible; by another - oxidizer; in the monopropellant (for example, powder) combustible and oxidizer they are located in one substance.

Oxidizer is called the chemical substance, which contains in itself a sufficient quantity of active oxygen or another any oxidizing element/cell, necessary for combusting the fuel.

Fuel/propellant can be both the solid and liquid.

According to the form of fuel/propellant the rocket engines of the guided missiles are divided into the workers into the solid propellant (RDTT [solid-propellant rocket engine], powder - PRD) and the liquid ones (ZhRD [liquid propellant rocket engine]).

The engines of the guided missiles can be independent of the air medium (rocket) and dependent (air-breathing).

Rocket engines work on the fuel/propellant, which contains in itself the reserve of fuel and oxidizer on board the rocket/missile; therefore they reliably perform in the rarefied layers of the atmosphere. Jet engines obtain oxygen necessary for the fuel combustion from the surrounding air, in connection with which they cannot effectively work at the high altitudes.

During the selection of engines for the guided missiles they

proceed from the conditions for the provision of the necessary distance, rate and flight altitude.

As the simplest by the construction/design are considered the solid propellant rocket engines which appeared earlier than all existing rocket engines.

In the engines, which work on the solid propellant, entire fuel reserve is accommodated in the combustion chamber; fuel/propellant is ignited with the aid of electric primer (Fig. 16).

With the combustion of solid propellant (for example, powder) in the chamber/camera are formed the gases, which have temperature 2000-2500° C and creating pressure 50-250 atm. and more, which determines the high rate of their outflow behind the jet (2000 m/s and more).

Solid propellant is safe in the inversion, conveniently in the operation can be stored long time.

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The advantage of solid propellant engines is the high value of the ratio of reaction force to the initial weight of engine. This

engine is capable to report to flight vehicle for the short time the necessary acceleration. Besides this, the solid propellant engines are reliable and can perform in the vacuum and under water.

To deficiencies/lacks in the solid propellant engines are carried low efficiency/cost-effectiveness due to the low colorific value of a fuel, short operating time, difficulty of regulating the thrust level in the time according to the assigned law and dependence of the engine power rating on the initial temperature of powder charge.

The engines, which work on the solid propellant, are applied both as the booster engines, necessary for the reduction of launching phase and rapid dispersal/acceleration of rocket/missile to the normal march speed at which basic jet engine can independently increase rate to the normal value and as the sustainer engines.

After the framing of necessary velocity booster engine, or booster, is separated/liberated from the guided missile.

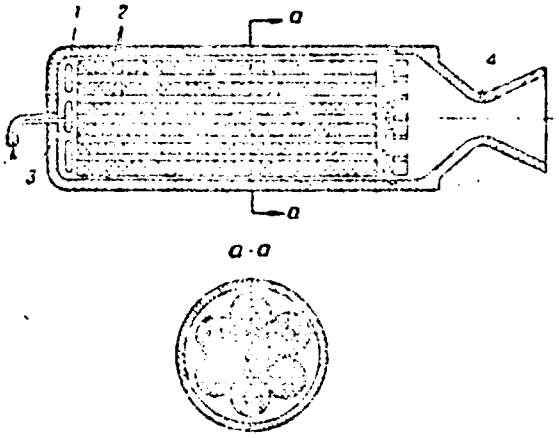

Fig. 18. The schematic diagram of the solid propellant rocket engine: 1 - combustion chamber casing; 2 - the powder cups; 3 - electric primer; 4 - jet.

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Liquid propellant rocket engines can create the thrust to several hundred tons, which ensures rocket flight up to the large distances with the enormous velocity, which reaches several ten thousand kilometers an hour.

Liquid propellant rocket engines depending on the fuel feed system into the combustion chamber are divided into two groups (Fig. 19): engines with the turbopump fuel feed system (fuel/propellant is

supplied with the aid of the pumps) and engines with the pressure fuel feed system (fuel/propellant is extruded from the tanks by compressed gas).

Work liquid-propellant engines on the same principle, as on the solid propellant. Difference consists only in the fact that in the combustion chamber burns the fuel/propellant, which consists of the liquid combustible and liquid oxidizer which continuously are supplied from the tanks through the special injectors. Liquid propellant rocket engines allow more accurately than powder, to change thrust according to the assigned law have greater operating time.

Main disadvantage in all liquid propellant rocket engines is their low efficiency/cost-effectiveness, i.e., they expend/consume a large quantity of fuel/propellant per unit of the developed thrust.

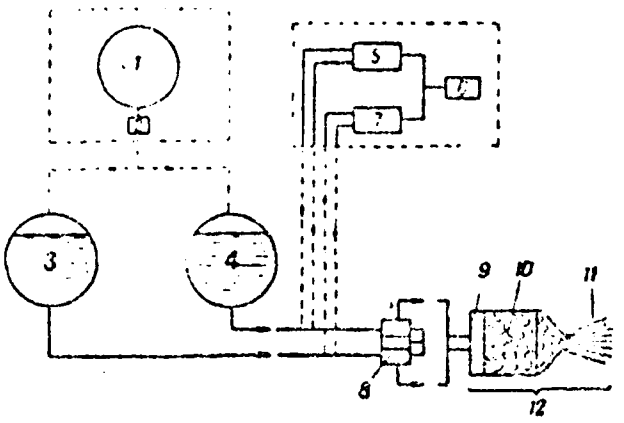

Fig. 19. The schematic diagram of rocket engine on the liquid propellant: 1 - cylinder with the compressed gas; 2 - pressure reducer; 3 - oxidizer tank; 4 - fuel tank; 5 - fuel pump; 6 - pump drive; 7 - oxidizer pump; 8 - valves, which control the supply of fuel/propellant; 9 - injector; 10 - combustion chamber; 11 - jet; 12 - rocket engine.

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The liquid propellant rocket engines examined and to engines, since they can work at any height/altitude and under water.

There is another type of liquid propellant rocket engines - nonautonomous. They include jet engines (VRD), in which one of the components of propellant (oxygen) is taken from the atmosphere;

therefore these engines cannot work out of the atmosphere.

Thrust in jet engines is created due to a difference in the velocities of entering the engine air in flight and the flow of hot gases escape/ensuing from it.

Combustion chamber pressure of VRD higher than atmospheric; therefore for the feed into the chamber/camera of air it must be preliminarily pressed.

The constructions, which ensure air compression, can be the diffusers where air is compressed due to braking of incident to the engine relative wind, or the compressors.

The engines, equipped with diffuser, are called compressorless, and in the presence of compressors - compressor. There are compound engines, which combine the qualities of compressorless and compressor engines.

Compressorless engines depending on the combustion conditions of fuel/propellant are subdivided into the direct-flow/ramjet ones (PVRD), Fig. 20) and fluctuating (pulsejet engines).

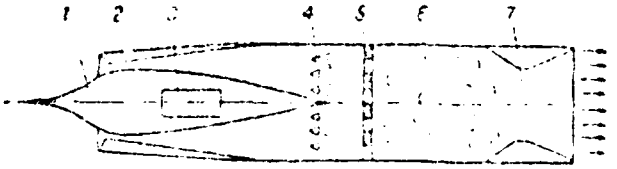

Fig. 20. Schematic of the ramjet engine, which works on the liquid propellant. 1 - central cone; 2 - air intake and diffuser; 3 - tank and power-supply system by fuel; 4 - injector; 5 - flame holder; 6 - combustion chamber; 7 - jet.

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In the ramjet engines air, which enters the combustion chamber, is preliminarily compressed by velocity head in flight of rocket/missile whose velocity is more than 500 km/h and fuel/propellant burns in the chamber/camera at a constant pressure. In the fluctuating engines the precompression of air is conducted by jerks/impulses.

The compressor engines include turbojet engines (TRD), whose compressor works from the gas turbine.

Turbojet engines most frequently are applied in the winged missiles and work on entire route/path of the flight of shell.

Ballistic missiles engines work only on the unit of the trajectory (powered phase).

For an increase in the flying range of their rockets/missiles they make with multistage ones.

Each step/stage has its fuel/propellant and engine. On the measure the expenditure of the fuel/propellant of step/stage are separated/liberated from the basic rocket/missile and the engine of latter/last step/stage ejects rocket/missile to the target.

On the guided missiles for operational provisions of different constructions and instruments, besides the basic sources of energy (starting and sustainer engines), are auxiliary sources: mechanical, electromechanical and electrochemical.

In the mechanical energy sources working medium/propellant is the compressed gas (air, nitrogen) or any chemical substance, which uses for obtaining the gas, which rotates turbine. In electromechanical sources the shaft of gas turbine is connected with the electric generator. The electrochemical energy source are small/miniature storage batteries/accumulators (silver-zinc and mercury batteries).

Each class of the guided missiles has its launchers which must provide the launching of rockets so that they reliably would strike into the sphere of influence of guidance system.

Launchers are used with the constant and variable angle of elevation. Installations with the variable angle of elevation can be those laying in the horizontal plane or nonguiding.

For the long range ballistic missiles are applied the launchers (launching platforms) with the constant angle of elevation of 90°.

The launchers of the short-range missiles and medium range usually have the variable angle of elevation, depending on firing distance.

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For the firing at the moving targets are applied launchers with the variable angle of elevation, which are laid in the horizontal plane. The bearings/angles of focusing/indication of these installations are calculated by the computer of the system of steering devices of firing on the basis of the data about the position/situation and movement of target.

For the above-ground launchers there are unlimited possibilities in the creation of durable and convenient constructions/designs. However, ship installations must satisfy the specific ship conditions: provide launch opportunity in motion and on the tossing, have a minimum weight and overall sizes.

Especially complicated for the starting/launching of the guided missiles are launchers on the submarines and on the aircraft.

On the submarines the starting/launching of the guided missiles can be conducted both in the surface and in the underwater position/situation.

During the starting/launching in the surface position/situation the rockets/missiles are accommodated in the special containers, arranged/located on the hull of the submarine from behind of room/house or before it (Fig. 25).

During the starting/launching in the underwater position/situation the launchers are arranged/located in the center section of the boat in the below-deck magazine where can be located 10 guided missiles and more (Fig. 26).

Launchers on the aircraft differ from surface/ground and ship

installations, first of all, in terms of the absence of the mechanisms of guidance. The necessary line of fire is assigned by the rotation of aircraft.

Airborne launchers usually are arranged/located under the wings or the fuselage of aircraft and have a length of guides, several times less than surface/ground installations.

Work for creation and improvement of the guided missiles at present is conducted in many capitalist countries. The greatest spread/scope they acquired in the USA, England and France. Let us examine designation/purpose, construction and activity of the most characteristic guided missiles, developed and developed/processed in these countries.

Guided "surface-to-surface" missiles ("ship-to-ship").

Depending on the fulfilled problems the "surface-to-surface" missiles are divided into three groups: tactical, operational and strategic.

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The tactical missiles include the rockets/missiles with the firing distance to 150 km. They perform on the field of battle directly in the combat formations of the troops/forces.

The rockets/missiles of operational designation/purpose are utilized in the interests of large/coarse troop formations at the distances 150-1000 km.

The strategic missiles include the rockets/missiles with the range of more than 1000 km, including intercontinental.

These groups have both the winged missiles and ballistic missiles.

Winged missiles have any one of the autonomous control systems. Sometimes in the initial sector is utilized beam rider guidance system of radar or command system; in the sector of approach - inertial or astronavigational system. In the final trajectory usually is utilized active or passive homing.

Ballistic missiles in the powered flight trajectory are controlled/guided one of the forms of preset control. In the final phase of flight of rockets/missiles in the principle can be used the homing.

Guided winged short-range missiles. The most typical guided short-range missiles are antitank missiles.

In the USA for dealing with the tanks is developed the guided missile "Dart" (Fig. 21). Rocket/missile has cruciform arranged/located wings and rudders. Is controlled/guided rocket/missile on the wires/cables on the basis of data, obtained during the observation of it into the optical sight.

Range of rocket/missile - to 4.8 km, the engine of powder.

In the nose section of rocket is placed the charge of cumulative effect, in the tail - tracers for the best observation of its flight.

Rocket/missile is launched from the installation, installed on the motor vehicle.

In francium for dealing with the tanks is created the guided missile "Nord-5200" (Fig. 22). Rocket/missile has the short cylindrical body with the pointed nose section and the large cruciform arranged/located wings in the tail section.

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It is controlled/guided on two wires/c[illegible]s, wound around the coils which are arranged/located in the missile body. Flight speed of rocket/missile - about 85 m/s.

In the nose section of the rocket/missile is located the charge of cumulative effect, capable of opening armor in thickness to 400 mm.

Rocket/missile is launched from the installation, installed on the motor vehicle or arranged/located on the earth/ground. Rocket/missile is accepted for the armament not only in France, but also in England, USA, Italy, Israel and Western Germany. During the aggression in Egypt the Israeli troops/forces employed these rockets/missiles against the Egyptian tanks.

The variety of rocket/missile "Nord-5200" is the more advanced rocket/missile "Nord-5210" which also is launched from the launcher,

installed on the motor vehicle.

"Nord-5210" - multipurpose rocket/missile, it it is possible to utilize and as that guided of "air-to-surface" missile and "air-to-air".

The guided short-range missiles include American rocket/missile "Lacrosse" (Fig. 23), intended for the tactical fire support of ground forces and marines.

Fig. 21. Antitank guided missile "Dart" on the installation for the starting/launching, installed on the motor vehicle.

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Into the system "Lacrosse" enter rocket/missile itself, installation for the starting/launching, installed on the motor vehicle, and guidance equipment which ensures the high accuracy of incidence/impingement into the pinpoint targets.

Range of rocket/missile - to 30 km, flight speed 360 m/s.

At present in the capitalist countries is paid considerable attention to the creation of the guided short-range missiles.

In France, for example, are developed several guided short-range

missiles which are intended for the damage/defeat of surface/ground and waterborne targets at a distance to 250 km.

Guided winged missiles of the medium range. One of the first guided medium-range missiles of activity in the USA was winged missile "Matador" (Fig. 24), by whom are now armed many units and subunits of the guided missiles, which are based in Europe and in the Far East.

Winged missile is carried out on the aircraft configuration. The length of shell is 11.9 m, the diameter of the body 1.37 m, the span of wings 7.9 m.

Fig. 22. Anti-tank guided missile "Nord-5200" on the launcher, installed on the motor vehicle.

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Starting and sustainer engines provide to winged missile the velocity more than 300 m/s and the gain of altitude of more than 12000 m. Missile operational range - to 900 km.

Launching weight of shell 6250 kg, shell can bear atomic charge.

Is launched winged missile from the mobile launcher at angle of 45° to the plane of the horizon/level with the aid of the booster engine. Launcher with the shell is easily transported by transport aircraft, which gives the possibility to rapidly relocate units and the subunits of the guided winged missiles "Matador".

In flight the winged missile copes with the surface/ground point/post, equipped with radar for the monitoring/checking of its flight and for finding the target.

At present in the USA there are several modifications of this winged missile which possess best performance data in comparison with the first models.

The organizational unit of units and subunits, armed by rockets/missiles "Matador", is squadron.

[illegible] 17. Guided missile "Larosse" on the installation for the [illegible], installed on the motor vehicle.

Page [illegible]6.

[illegible] "[illegible] II", [illegible] from the [illegible], the [illegible] ships and [illegible] installations. In appearance shell [illegible] the "Matador".

[illegible] is equipped with the [illegible] and is possible to deliver it with [illegible] to the distance of [illegible]00 km.

AD-A149 061 GUIDED ROCKET WEAPON(U) FOREIGN TECHNOLOGY DIV 2/2
WRIGHT-PATTERSON AFB OH P V MOROZOV 11 JUN 82
FTD-ID(RS)T-0527-82

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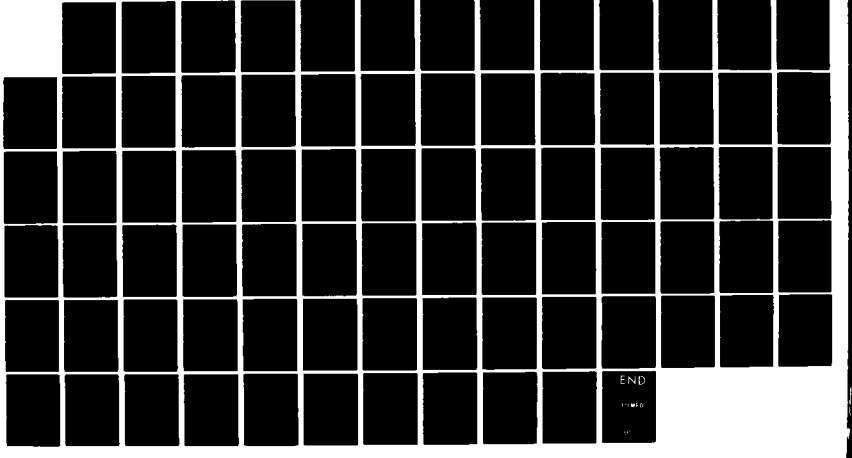

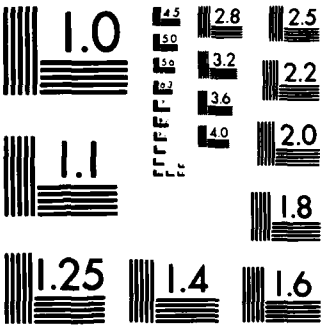

Launching weight of shell - about 5600 kg, is laid shell on the predetermined course with the aid of the installed on it electronic device, which accepts steering commands.

On the submarine the shells with the folded wings are accommodated in the cylindrical sealed/pressurized hangar behind the room/house (Fig. 25).

According to the communication/report for the foreign press, for the surfacing of boat, the starting/launching of shell and submerging/dive of boat are required about 5 min.

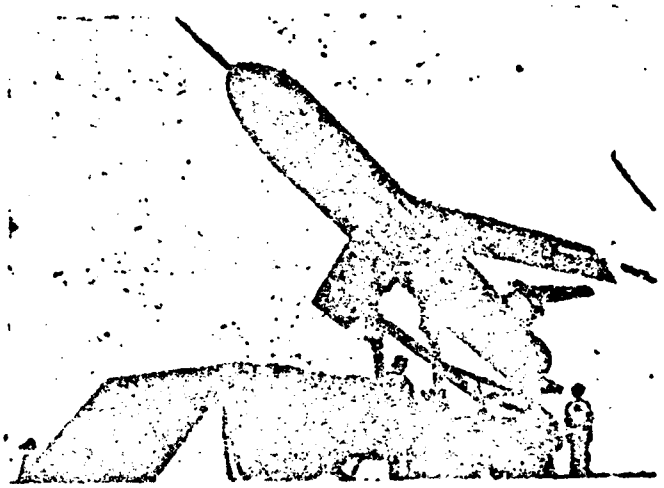

Fig. 24. Guided winged missile "Matador" on the mobile launcher.

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Guided winged missiles of long-range. At present in the USA are developed several types of winged missiles and long range ballistic missiles which consist as arms of army, navy and Air Force. The winged missiles of long-range include "Regulus II", "Snark" and "Navaho", moreover "Snark" and "Navaho" are intercontinental shells.

Winged missile "Regulus II" is the modification of shell "Regulus I", but has the considerably greater flying range - to 1600 km - and velocity to 515 m/s.

Shell is launched with the aid of two booster engines and is controlled/guided by radio commands.

The winged missile "Snark" (Fig. 26) has the march turbojet engine, which ensures cruising speed, close to the speed of sound. Missile operational range - to 8000 km, ceiling - somewhat more than 18300 m.

The length of shell is 22.5 m, the span of wings 14.6 m.

In the forward fuselage section they are accommodated the charge which can be ordinary, atomic or thermonuclear, and the station of the creation of electronic jammings of enemy.

In the middle part of the fuselage are located tanks with the fuel/propellant both the equipment for the system for the control and the guidance.

Fig. 25. Conclusion/derivation of the guided winged missile "Regulus I" from the hangar of the submarine.

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Is launched shell with the aid of two booster engines and is laid with the aid of the astronavigational and inertial control systems winged missile "Navaho" it can bear nuclear charge it possesses the range of approximately 8000 km. Ceiling 30000 m, flight speed - somewhat more than 1000 m/s.

Is controlled/guided shell by astronavigational system.

As the most terrible weaponry of our time are considered the ballistic missiles, which have enormous velocities, distances and flight altitudes. Equipped with nuclear charges, they can apply to enemy surprise strike/shock at any distance from the place of start.

Foreign military specialists assert that with the use of ballistic missiles the defense of any country becomes improbably difficult task.

The USA began to conduct works on the creation of the ballistic missiles of different range since 1946. Within this time were created several types of rockets/missiles.

Like winged missiles, ballistic missiles are subdivided into the rockets/missiles of near, average/mean and long-range.

Fig. 26. Starting/launching of the guided winged missile "Snark".

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Ballistic short-range missiles. The most widely used short-range missile in the USA is rocket/missile "Corporal" with the range to 120 km (Fig. 27).

Rockets/missiles is long cylinder with the cone-shaped nose section, where they are accommodated charge - ordinary or nuclear. After the warhead is arranged/located the equipment bay for guidance.

The flight control of shell "Corporal" in the initial trajectory

phase is realized with the aid of the guide of the radio beam of radar of the control. After engine cutoff the shell moves over the ballistic trajectory on the inertia.

Rocket/missile has the powerful/thick liquid-propellant engine, which works on the bipropellant.

The flight speed of rocket/missile several times exceeds the speed of sound.

Meteorological conditions do not affect the use/application of a rocket/missile.

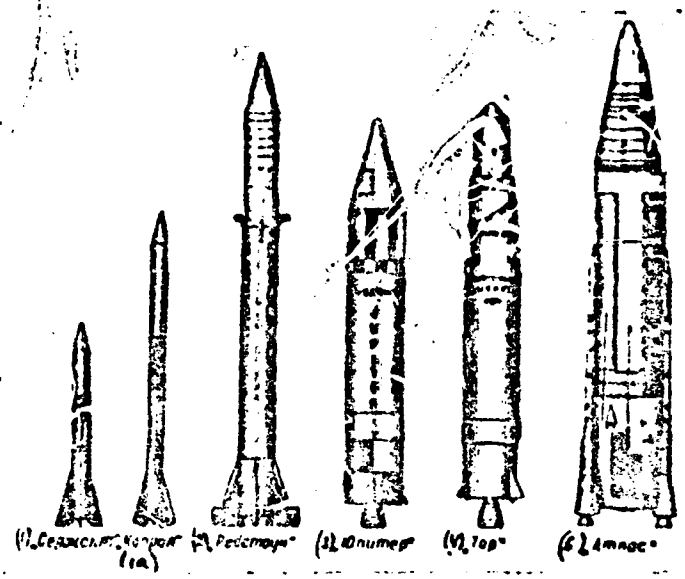

Fig. 27. Ballistic missiles.

Key: (1). "Sergeant". (1a). "Corporal". (2). Redstone". (3). "Jupiter". (4). "Thor". (5). "Atlas".

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Into system "Corporal" enter: rocket/missile itself, mobile launcher and radar equipment for the remote control by rocket/missile.

Launcher consists of self-propelled trolley/cart with the construction for the transportation of rocket/missile and starting

platform. Trolley/cart is equipped by bulldozer for the alignment/levelling of soil under the starting platform.

The rocket/missile, fastened to the carrier beam of trolley/cart, is established/installed on the starting platform in the vertical position with the aid of hydraulic jacks. For the prelaunch examination/inspection and the missile preparation for the launching/starting is a special motor vehicle with the long hinged arrow/boom which concludes with small area/site for positioning/arranging the service personnel. Area/site can be raised to any height/altitude of missile body.

There are the modification of rocket/missile "Corporal" - "Corporal E" and "Corporal F", the characterized by mainly the larger range (to 240 km).

The units, armed by rockets/missiles "Corporal", are brought to the battalions each of which consists of four batteries: administrative-headquarters, by technical, the batteries of the starting/launching of the rockets/missiles and control by them. Battalion has 10 launchers.

On the base of rocket/missile "Corporal" in the USA is created the short-range missile "Sergeant" (Fig. 27), that possesses greater

accuracy and smaller sizes/dimensions.

Ballistic medium-range missiles. To this group of ballistic missiles can be attributed American rocket/missile "Redstone" (Fig. 27), intended for maintaining ground forces while conducting of offensive and defensive operations.

Range of rocket/missile - to 320 km.

Rocket/missile has the long cylindrical body from the aluminum alloy with the liquid propellant rocket engine, which works on alcohol and liquid oxygen.

The characteristic feature of rocket/missile "Redstone" lies in the fact that its conical nose section in which is accommodated ordinary or nuclear charge, can be separated/liberated.

After separation from the missile body nose section is guided to the target with the aid of the small governors.

Rocket control is autonomous, with the use of an inertial system.

Organizational unit is the battalion, which consists of two batteries. Each battery has on one construction for the launching of rockets.

Long range ballistic missiles. These rockets/missiles are intended for the accomplishment of strategic objectives for the purpose of the damage/defeat of the deep rears of enemy by nuclear charges.

In the USA at present is conducted extensive work on the creation of long range ballistic missiles for the army, the navy and the Air Force.

As the most known long-range missiles are considered "Atlas", "Jupiter", "Thor", "Polaris" and "Titan", in this case the "Atlas" and "Titan" relate to the intercontinental rockets/missiles.

Ballistic two-stage missile "Atlas" (Fig. 27) is developed to order of Air Force. It is the cylindrical body with the extended conical nose section, where is accommodated atomic or thermonuclear charge in weight about 1360 kg.

In the tail section of the rocket/missile on the gimbal suspensions are secured three liquid propellant rocket engines, that use for the rocket control by changing the direction/axis of the axes of engine relative to axis of rocket. These deflections of engines are developed by the radar control system.

Two engines (first stage) are arranged/located on each side of missile body. the third engine (second step/stage) - along the axis of rocket/missile. As the fuel is utilized special composition, as oxidizer serves liquid oxygen. During the starting/launching work all three engines, after 180 s the work of first-stage engines ceases and they are separated/liberated from the rocket/missile.

The length of rocket/missile is 26.4 m, the diameter of the body 3.05 m, launching weight of 115-118 t. Range of rocket/missile - to 10190 km, the maximum speed of flight 7100 m/s (27750 km/h).

Ballistic missile "Titan" is also two-stage. First stage is the cylinder in which are located the tanks with special liquid combustible and liquid oxygen. In the second step/stage, which has smaller diameter, are accommodated fuel tanks and liquid oxygen, charge (ordinary or nuclear) both the system of control and guidance.

Second-stage engine begins to work after the squad of first stage. Engines of both steps/stages are installed in the gimbal suspensions, which makes it possible to control/guide rocket flight with the aid of the gas jet.

Is controlled/guided rocket/missile by inertial system.

The length of rocket/missile is 27.6 m, the diameter of the body of first stage 3.05 m, the second - 2.44 m, launching weight of 93-99 t. Estimated range of rocket/missile - to 10,190 km, the maximum flight velocity of 7100 m/s (25750 km/h).

Ballistic missile "Jupiter" (Fig. 27) is developed to order of the army of the USA on the base of rocket/missile "Redstone". They assume that the units, armed by rocket/missile "Jupiter", possess the mobility, which makes it possible for them to be moved together with the field army.

Rocket/missile "Jupiter" - single-stage with the liquid

propellant rocket engine, attached in the gimbal suspension.

The nose section of the rocket/missile is conical, which is separated/liberated before the entry in the atmosphere in the descending trajectory phase.

In order to avoid the combustion of nose section, it they cover/coat with several layers of thermoresistant plastic, which partially burns from the friction against air.

The system of rocket control is inertial.

Range of rocket/missile - to 2780 km, flight speed 3500 m/s (16100 km/h), the maximum altitude of trajectory - about 600 km.

For the Navy in the USA on the base of rocket/missile "Jupiter" is developed two-stage rocket/missile "Polaris".

On the rocket/missile is utilized the engine, which works on the solid propellant. Combustion products escape from the special high-pressure receiver through four turned jets which provide to rocket/missile rotary motion. Therefore rises its stability in flight.

The use/application of a solid propellant not only simplifies inversion with the rockets/missiles on the submarines, but also it makes it possible to decrease the sizes/dimensions of rocket/missile.

In the nose section of the rocket/missile can be arranged/located ordinary or atomic charge whose weight is more than 450 kg.

The system of rocket control is inertial.

The length of rocket/missile is 8.5 m, the diameter of 1.37 m, launching weight of 12.7 t, the range 2400 km, flight speed 3450 m/s.

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Rockets/missiles can be launched both from the submarines, which are located in the underwater position/situation, and from the surface ships and from coast installations.

The carriers of ballistic missiles "Polaris" are the nuclear powered submarines of the type "George of Washington" (Fig. 28).

Launchers on this boat are carried out in the form of the stationary stand pipes, placed in the rocket compartment of boat in

two series/rows, along eight pipes/tubes in each. Pipes/tubes have an airconditioning system for maintaining the necessary temperature of solid propellant. For this purpose in the walls of pipes/tubes are made the channels, through which is pumped through hot or cold water. From above the pipe/tube they are closed by durable hinged/reversible watertight covers. Rockets/missiles within the pipes/tubes with the aid of the numerous cables are constantly, up to the moment/torque of starting/launching, connected to the monitoring instruments and the instruments of prelaunch servicing procedure.

For the launching of rocket it is necessary to calculate the path of its flight. This task fulfills control station of firing.

Ship inertial navigation system constantly transmits into the special geo-ballistic computer the data about the place of boat. Computer calculates the position/situation of the boat of the relatively previously chosen ground target.

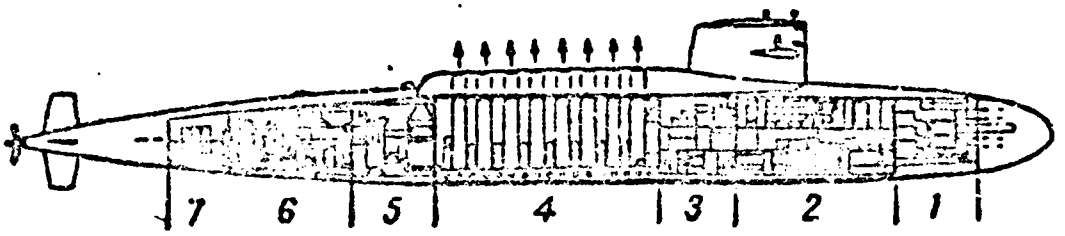

Fig. 28. American nuclear powered submarine "George of Washington" - the carrier of ballistic missiles "Polaris": 1 - forward torpedo compartment; 2 - crew quarters and central station; 3 - control station of rocket firing; 4 - rocket compartment with the starting devices of rockets/missiles "Polaris"; 5 - reactor compartment; 6 and 7 - engine compartments.

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The data about position/situation and course of boat, speed of its running, pitch angles and the like enter the computer which issues to the autonomous inertial system of rocket control trajectory elements, passing through the target.

Rocket/missile is launched at the previously designed point of ocean theater during the movement of the submarine with the specific course and the velocity at the depth of 25-30 m.

Before the starting/launching are equalized the pressure in the starting pipe/tube and outboard pressure. Then is opened/disclosed the durable cover cap of pipe/tube, from this point on, rocket/missile from bauds will separate/liberate only thin diaphragm from the special plastized resins. During the starting/launching the rocket/missile, ejected of the pipe/tube by inert gas, will break through diaphragm and will move out into the water.

So that the gas would not burst open between the walls of pipe/tube and the rocket/missile, on the rocket/missile there is an obturator/shutter, while nozzle holes are closed with general/common/total wooden cover/cap. On the output/yield of rocket/missile from the pipe/tube this cover/cap is dropped.

After the rocket/missile will move out to the surface and on the inertia will reach the altitude to 25 m, is included first-stage engine. The engine firing time is regulated by the mechanism of time and by the middle line.

Using the communication/report to the foreign press, the possibility of this starting/launching of the rocket/missile "Polaris" already repeatedly was inspected/checked in the mock-ups and allegedly were obtained satisfactory results.

At present to the creation of the rockets/missiles, launched from the sea depths, is paid considerable attention. To these targets in the USA are released enormous budgetary appropriations.

By assignment of Air Force in the USA is developed ballistic missile "Thor". Rocket/missile has a body of the cylindrical form where are arranged/located tanks with kerosene and liquid oxygen, equipment for the control and engine.

Engine is installed on the gimbal suspension, which provides rocket control.

The system of rocket control is inertial.

The head cone of the rocket/missile in which is accommodated ordinary or nuclear charge in weight to 680 kg, has counterradar coating, which considerably impedes operation of search system.

The length of rocket/missile is 19.8 m, the greatest diameter of 2.4 m, laurching weight of 49.9 t.

Range of rocket/missile 2780 km, flight speed 3500 m/s (16100 km/h), the maximum altitude of trajectory - about 600 km.

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Guided "ground-to-air" missiles ("ship - air").

The guided missiles of this class began widely to be developed/processed after the Second World War, which was caused by the need of conducting the struggle with the carriers of nuclear weaponry, capable of causing colossal decomposition.

Special antiaircraft shells were projected/designed in many countries already in the period of the Second World War. First these were the unguided rockets/missiles which could only rapidly report to the target large charges and with the aid of the radar fuses explode them in immediate proximity of it. Then appeared the surface-to-air mechanically controlled missiles, which began to call the AA guided missiles (ZUR).

AA guided missiles enter into the so-called anti-aircraft complexes of the rocket weapon which, besides the rockets/missiles, connect the control systems, necessary for the flight control of rockets/missiles, launchers and different infrared equipment.

AA guided missiles are the shells of cigar-shaped form with good aerodynamic properties, which makes it possible for them to develop

high flight velocities.

The electronic equipment for homing provides a precise guidance of rocket/missile to the target, and proximity fuses provide the automatic explosion/burst of charge during the approach of rocket/missile to the target.

AA guided missiles are launched both from the above-ground launchers and from the ship ones. The launchers have guides, on which during the start it moves shell in the assigned direction/axis, construction of feed and loading, mechanisms of guidance in the horizontal and vertical planes.

System of the control of ZUR combined: remote control with the homing.

Currently, in many capitalist countries several specimens each of anit-aircraft guided missile has been developed which are capable of resolving various air-defense problems.

In the USA for the armament of air defense units is accepted the rocket/missile "Nike-Ajax" (Fig. 29) with the range to 40 km and the ceiling 18 km. Flight speed of rocket/missile 850 m/s.

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The overall length of rocket/missile together with the booster 10.4 m, the maximum/overall diameter of 0.3 m.

Is controlled/guided rocket/missile by radio commands.

Organizationally the "Nike-Ajax" are brought to the battalions each of which has 16 launchers.

The variety of this rocket/missile is the rocket/missile "Nike-Hercules" which according to the sizes/dimensions is larger/coarser than the "Nike-Ajax".

Rocket/missile possesses larger firing distance (to 130 km), velocity (1127 m/s) and flight altitude (to 30 km) and is capable of bearing the atomic charge which, in the opinion of the American specialists, makes it possible to deliver strikes/shocks in aircraft fleet in air.

Rockets/missiles "Nike Hercules" are launched from the special launching sites.

For the Navy of the USA are created several types of AA guided missiles. According to the communication/report to the foreign press, most successful of them are the "Terrier" and "Talos" (Figs. 30 and 31).

With these rockets/missiles are armed aircraft carriers, cruiser, the destroyers and special antiaircraft ships intended for the protection of a convoy of ships on the sea passage.

Fig. 28. AA guided missiles "Nike-Ajax" on the launchers.

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Slant range of rocket/missile "Terrier 1" 25-30 km, ceiling - about 16 km, flight speed 680 m/s.

Rocket/missile "Talos" has the slant range of more than 100 km, ceiling 21-25 km, flight speed 850 m/s.

It can bear atomic charge and is utilized not only for the damage/defeat of the aerial targets, but also for the application of strikes/shocks on the ground and large/coarse surface targets.

There are modifications of the rockets/missiles indicated:

"Terrier II", "Talos-W" and "Talos-L", which possess larger flying range.

These rockets/missiles are guided to the target on the ray/beam of radar with the use in the final stage of the flight of semi-active homing device. This control system makes it possible to launch rocket singly and by groups in rate/tempo two rocket/missile per minute with one guide.

Rocket/missile "Terrier" is launched from the special installations, which are the low cylindrical stones, fastened to the deck. From above the stone is established/installed the step bearing on which is located the head turned on 360° with the pins/journals protruding from two sides. To the pins/journals are fastened the guides for the launching of rockets.

In the stone and the head are accommodated the drives and rotating mechanisms of head and guides. By the rotation of head is conducted the laying for direction of guides, while by the rotation of guides on the pins/journals - laying for elevation. Maximum angle of elevation of guides of 90°.

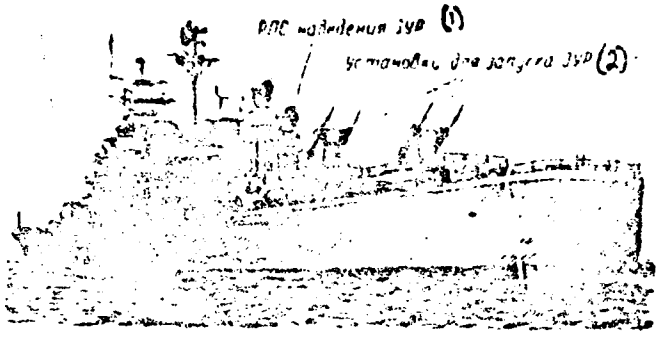

Fig. 30. Cruiser "Boston" with the launchers for the starting/launching ZUR "Terrier".

Key: (1). RPS of guidance of ZUR. (2). Installations for starting/launching ZUR.

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Aboard the ships the AA guided missiles are stored in the cellars, whence they are supplied to the launchers with special constructions.

To order of Air Force in the USA is developed the rocket/missile "Bomarc", made on the aircraft configuration (Fig. 32).

Rocket/missile has two direct-flow/ramjet VRD, arranged/located

under the wings and which ensure the range to 460 km. The flight speed of rocket/missile 860 m/s, ceiling - are more than 20 km. The length of rocket/missile is 20 m, the span of wings 6 m, total launching weight of 6860 kg.

In the forward fuselage are accommodated ordinary or atomic charge and remote-control devices and homing, which is realized by an active radar head.

Rocket/missile is launched vertically with the aid of the starting solid propellant engine.

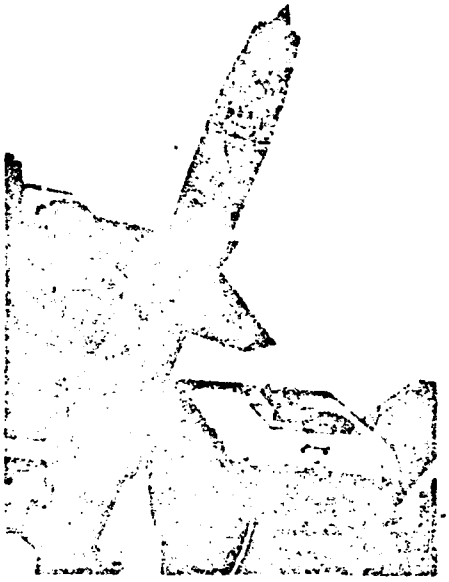

Fig. 31. AA guided missile "Talos" on the sea-going launcher.

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In view of the presence in the rocket/missile of constructions for boarding it can be applied as the pilotless fighter-interceptor of repeated use.

Together with the works on an increase in the combat attainability AA guided missiles on the height/altitude abroad they are conducted the work on the creation of the surface-to-air

missiles, low-flying for dealing with the low-flying air attack weapons.

Thus, in the USA to order of army is created AA guided missile "Hawk" (Fig. 33). It is characterized by simplicity of construction and small sizes/dimensions. Rocket/missile has an engine, which works on the solid propellant and which ensures the range to 35 km, flight speed 680 m/s, ceiling to 18 km. In view of short range the rocket/missile has only a homing system.

Length of rocket/missile - about 5 m, greatest diameter of 0.36 m.

Installation for the launching of such rockets is installed on the caterpillar tractor.

In England for the armament of ships entered the small/miniature AA guided missile "Sea Cat" (Fig. 34), intended for the damage/defeat of the aerial targets, which fly at the heights/altitudes to 6 km.

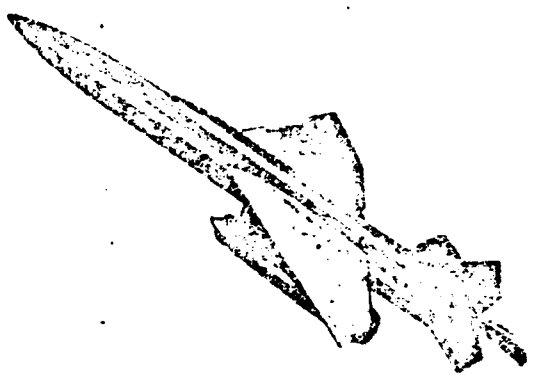

Fig. 32. Surface-to-air winged missile "Bomarc".

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Rocket/missile has the march and booster engines, which work on the powder.

The length of rocket/missile 1.47 m, the span of wings 0.63 m, rocket/missile are guided to the target with the aid of the steering commands.

On the launcher are accommodated four rockets/missiles "Sea Cat"; however, to launch and to lay them at the target is possible only alternately.

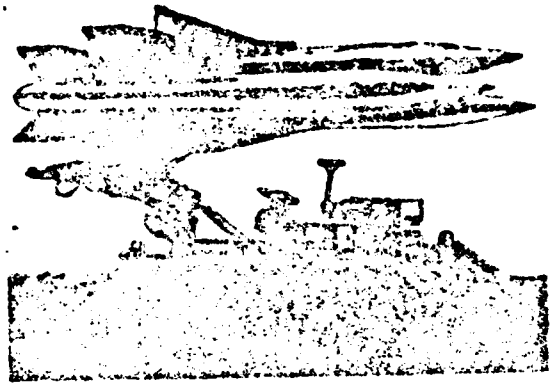

Fig. 33.

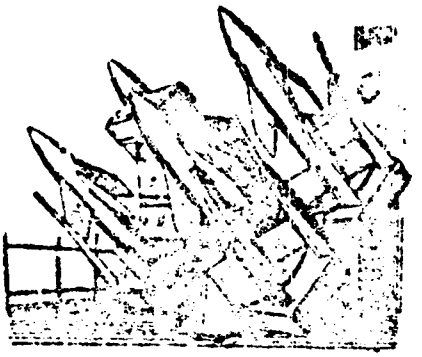

Fig. 34.

Fig. 33. Small/miniature AA guided missile "Hawk" on triplex mobile unit, installed on tracked personnel carrier.

Fig. 34. Small/miniature AA guided missile "Sea Cat" on quadrupled starting/launching ship installation.

Furthermore, the low service range of aiming/sighting these rockets/missiles permits implemention of on the contemporary high-speed aircraft not more than two launchings/startings, which considerably limits the possibility of their use.

The AA guided missiles examined by us are created in essence for dealing with the manned air attack weapons, which have subsonic or somewhat higher flight velocities.

For dealing with the intercontinental ballistic missiles and the winged missiles, which possess long range, by velocities and by flight altitudes, are required new technical equipment.

As the basic means of the annihilation of ballistic missiles in the USA it is proposed to apply the special multistage guided missiles - antimissile missile (antimissile missile) with the high tactical flight characteristics: by velocity, distance and by operational altitude.

From the communications/reports to the foreign press it is evident that the provision of distance of the powered flight of antimissile missile only in 137 km it is necessary that its latter/last step/stage would weigh 45 kg, and jet engine developed thrust during 60 s. In this case the construction/design of antimissile missile must maintain/withstand hundredfold g-force with the radius of turn 38 km and velocity of turn 9.2 deg/s.

In antimissile missile they plan to apply atomic charges with the TNT equivalent 20 kt. This charge, in the opinion of the foreign

specialists, will be capable is capable to strike rocket/missile by shock wave, if antimissile missile is torn 300 m of it. Thermonuclear charge of 20 Mt will be able to annihilate ballistic missile in the radius of 3 km, but due to the limited size/dimension and the weight of the latter/last step/stage of antimissile missile the use/application of these charges is highly improbable.

To a number of developed/processed in the USA antimissile missiles relate "Nike-Zeus" and "Wizard".

Antimissile missile "Nike-Zeus" (Fig. 35) is further improvement of ZUR "Nike Hercules". Antimissile missile has the rocket engine, which works on the solid propellant (there are versions, also, with ZhRD [liquid propellant rocket engine]), which ensures the range to 320 km, flight speed is more than 2300 m/s, ceiling is more than 30 km.

It can have ordinary or atomic charge. The guidance system of antimissile missile command; is intended to apply infrared homer, since the ballistic missiles, which virtually fly beyond the limits of the atmosphere, are contrast thermal target against the surrounding background.

Is launched antimissile missile from the special stationary starting devices.

Antimissile missile "Wizard" is single-stage rocket with the engine, which works on the solid propellant. Flying range - about 1600 km, flight speed 6700 m/s.

On the antimissile missile is assumed the use/application of a booster that allegedly it will make possible to intercept long range ballistic missiles at the heights/altitudes of 400-800 km.

Antimissile missile "Wizard", apparently, will be equipped with inertial guidance system and with infrared head for the homing in the

tinite segment.

Guided "air-to-surface" missiles ("air-to-ship").

The guided missiles of this class relate to aircraft rockets/missiles.

The "air-to-surface" missiles for the first time appeared during the years of the Second World War.

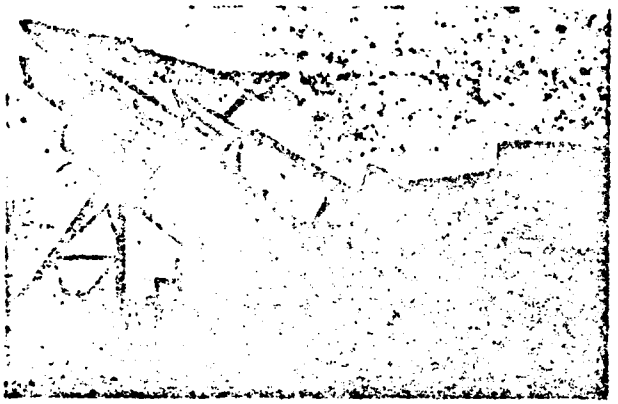

Fig. 35. Antimissile missile "Nike-Zeus" on the launcher.

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They were the unguided powder rockets, which were utilized for the firing both at the surface/ground ones and at the waterborne targets.

In the final stage of the Second World War in the USA they attempted to create the guided aricraft missiles. In such rockets/missiles they were placed by electro- and radio equipment with the aid of which the pilot of carrier aircraft controlled/guided the flight path of rocket/missile after its starting/launching, and the tracers, which facilitate observation of rocket flight.

In the USA at present developed several types of "air-to-surface" missiles.

For the activities at the long range there is a powder rocket "Bullpup" (Fig. 36), which copes by radio commands with carrier aircraft. The length of rocket/missile is 3.35 m, the diameter of 0.3 m, the range - to 5 km, flight speed 617 m/s.

The variety of this rocket/missile is considered the rocket/missile "Bulldog", which twice exceeds "Bullpup" to the distance and has greater flight speed. The rockets/missiles of this class include the rocket/missile "Rascal" intended for the damage/defeat of the ground targets.

Rocket/missile is launched from the aircraft at the height/altitude of approximately 15000 m and at a distance of 160 km from the target. Further with the aid of its engine it heaves to greater height/altitude (here the control autonomous) and already from this height/altitude dive to the target (remote control) in speed about 900 m/s.

In the tail section of the rocket/missile is placed three-chamber ZhRD (combustible - kerosene, oxidizer - nitric acid), in the nose section - equipment for the control and the warhead with the ordinary or atomic charge.
Total weight of rocket/missile 5600 kg.

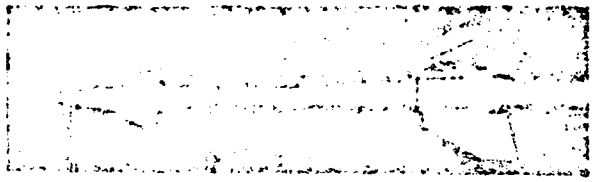

Fig. 36. Guided missile "Bullpup".

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For The Navy in the USA is developed the guided winged missile "Petrel" (Fig. 37), intended for the annihilation of the submerged submarines. It can be used also for the damage/defeat of surface ships.

Shell is the combination of winged missile and homing antisubmarine torpedo.

Flying range of shell in air - about 36 km (remote control from the carrier).

With the entry into the water the torpedo is separated/liberated from the winged missile and certain unit of the route/path to the target it goes under water, being controlled/guided by homing system.

Weight of shell 1720 kg, flight speed 240 m/s.

Guided "air-to-air" missiles.

The rockets/missiles of this class relate to the air short-range missiles and are intended for dealing with the attacking aviation. Their development was begun at the end of the Second World War.

The guided "air-to-air" missile is the air torpedo, guided to the target from the carrier aircraft. In view of the low range (to 10 km) the majority of contemporary "air-to-air" missiles have only one system of control - homing.

In 1950-1952 for the Air Force in the USA was developed and tested the rocket/missile "Firebird" (Fig. 38)which was intended for firing at the intercepted aircraft or UAV.

Rocket/missile is accommodated under the wings of aircraft. In its nose section are located the charge and radar fuse.

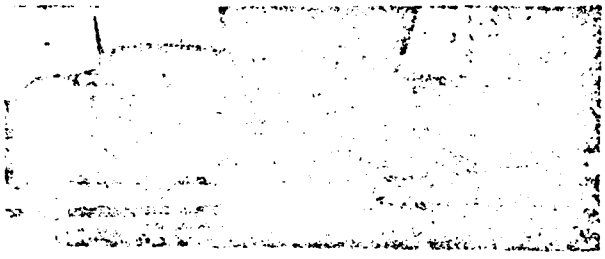

Fig. 37. Guided missile "Petrel".

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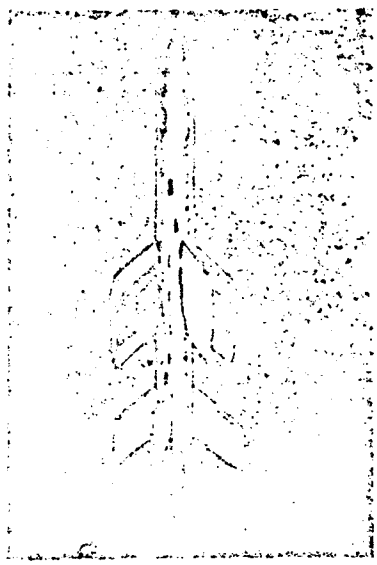

Fig. 38.

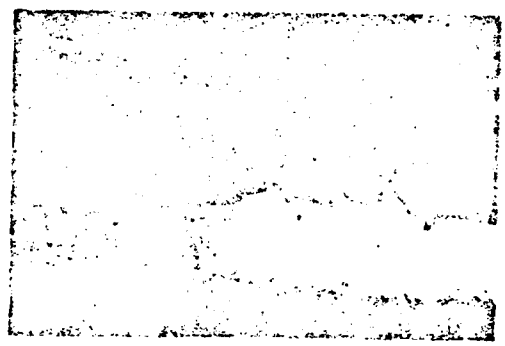

Fig. 39.

Fig. 38. Guided missile "Firebird".

Fig. 39. Guided missile "Sparrow I", suspended/hung under wing of fighter airplane.

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In the beginning of rocket flight is guided to the target of radio from the carrier aircraft, and then by homing system.

The engine of rocket/missile works on the solid propellant. Distance of its flight - to 3.6 km, the velocity of 740 m/s.

The length of rocket/missile is 2.3 m, the diameter of 0.15 m, launching weight of 270 kg.

More advanced is the rocket/missile "Sparrow I" (Fig. 39), that has solid propellant engine, range 8 km and flight speed 960 m/s.

On the rocket/missile is used the beam rider guidance system of airborne radar with the march/passage for the semi-active homing in the final approach phase of rocket/missile with the target.

The length of rocket/missile is 3.8 m, the diameter of 0.15 m, launching weight of 134 kg.

There are modifications of this rocket/missile - "Sparrow II" and "Sparrow III", that possess greater distance, velocity and accuracy of flight.

The rockets/missiles of this class include also the rocket/missile "Falcon" (Fig. 40). It has the small sizes/dimensions (length of 1.8 m) and a weight (50 kg), an engine, which works on the solid propellant, the range to 3 km and the velocity of 1000 m/s.

With rocket/missile "Falcon" are armed aircraft-interceptors of different types.

Before the launching/starting from the fighter airplane the rocket/missile obtains from airborne radar data of target designation, which makes it possible for rocket/missile to intercept precisely that target which must be struck.

Homing system holds rocket/missile in the predetermined trajectory and maximally draws together it with the target, in spite of any maneuvers of target.

Rocket/missile has a series/row of modifications, which are characterized by in essence homing devices. The use/application of rockets/missiles with the combined heads (thermal and radar, etc.) can ensure, in the opinion of the American specialists, the probability of hit to 90o/o.

In 1954 in the USA for the armament of all-weather fighter-interceptors was accepted the guided missile "Genie" (Fig. 41), having remote control and equipped with atomic warhead with the TNT equivalent 1.5 kt.

The effective casualty radius of this rocket/missile 1800-2000 m, which makes it possible to destroy the group of the aircraft, which go in the close formation.

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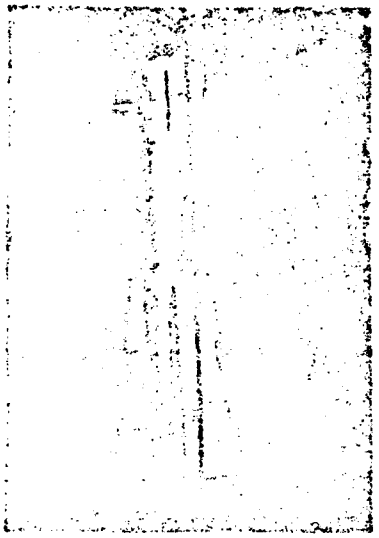

Fig. 40.

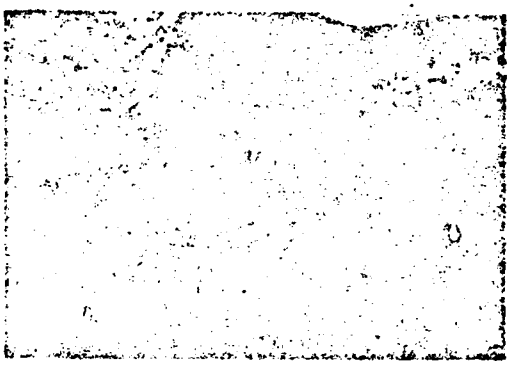

Fig. 41.

Fig. 40. Guided missile "Falcon".

Fig. 41. Guided missile "Genie" established/installed on fighter airplane PVO.

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Launching weight of rocket/missile 450 kg, the length of 2.7 m, the range 3.2 km, flight speed 515 m/s. Engine works on the solid propellant.

"Air-to-air" missiles are also in other countries, in particular in France and England.

Basic performance data of the guided missiles examined are given in the table, placed at the end of the pamphlet.

Besides the rockets/missiles, intended for the damage/defeat of objectives, in the foreign armies and the navies are guided missiles of special designation/purpose. Considerable attention is paid to the use of the guided missiles for air intelligence. Such rockets/missiles are made on the aircraft configuration and possess supersonic flight speeds. On board the reconnaissance rockets/missiles, besides airborne guidance system, is established/installed the automatic reconnaissance equipment for the aerial photography, fitted out for daytime and night photography, detection equipment of radars of enemy and setting up of radio interference in the necessary areas.

Abroad they also consider that the guided missiles can be used as the transport means for the transportation of military cargoes and as the guided targets which are utilized for training of troops/forces and evaluation of the effectiveness of the combat

devices of struggle with the high-speed/high-velocity high-altitude targets.

Targets are the flight vehicles, which have aircraft configuration or schematic of cruise missile. Such targets cope with the command post, arranged/located on the earth/ground, aircraft or ship.

Surface/ground and onboard equipment makes it possible to control/guide the flight of targets to several hundred kilometers and it provides on the group from the command post their landing to the earth in the necessary area with the aid of the brake and landing parachutes.

Targets can be used also for air intelligence. For this purpose in them are established/installed reconnaissance equipment and photo-armament.

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Use[illegible] of the guided missiles in an army, in the fleet and in the aviation.

(On foreign military specialists' views).

The guided missiles are at present accepted for the armament in many countries and are considered as the terrible weaponry, capable of delivering to large distances accurately into the assigned place the charges of enormous destructive force, and also to considerably reinforce anti-aircraft and antitank defense.

The role of rocket weapon under the contemporary conditions strongly increased. With its appearance changed the character of the use of individual forms of the armed forces and conduct of military activities as a whole. To such changes, first of all, is carried the possibility of delivering by the guided missiles of surprise powerful/thick strikes/shocks on the objectives, which are located on any distance from the front line. These objectives can be individual dugouts, ships, tanks, aircraft, industrial centers and naval bases.

The creation of intercontinental ballistic missiles, as consider

American specialists, made actually useless contemporary air defense and decreased the value of different military bases.

New weaponry considerably accelerates conducting operations/processes, are made them simpler and requires less forces than during the use/application of ordinary types of weaponry.

The use/application of the guided missiles in the combat operations on dry land produces increase in the depth of operational zone and dispersal of the combat formations of the troops/forces and materiel. Besides of this, the use new weaponry decreases the dependence of combat operations on the meteorological conditions and the time of days.

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In the period of offensive the guided "surface-to-surface" missiles can be used for the direct fire support of their troops/forces, for isolation of the area of penetration from the adequate/approaching reserves of the enemy by the creation of the zone of radioactive contamination, and also for the application of strikes/shocks on the places of the troop concentration and their communications.

In the defense the guided surface-to-surface missiles it is proposed to employ by the concentration areas of the attacking troops/forces. Besides this, the guided missiles will increase the possibilities of the defense of coast from the strikes/shocks from sea and landings. The batteries, armed by the guided missiles with the flying range, equal to the flying range of a rocket/missile of the type "Regulus", with the aid of the external control posts can destroy any ships of the enemy at a distance of several hundred kilometers from the coast. In this case batteries themselves will be less vulnerable to the strikes/shocks of ship-launch vehicles of the enemy.

The long range of the activity of the guided"surface-to-surface" missiles are allowed for the troops/forces, equipped with the guided missiles, to accomplish a large-scale maneuver by fire/light along the front and to concentrate it on the decisive directions/axes.

American specialists consider that surface-to-surface missiles to more expediently employ massed. For this they recommend launchers to reduce to the tactical units, which create the high concentration of fire/light on the target, which has important value for the success of conducting operations/processes in entire theater operations.

The use/application of the guided surface-to-surface missiles ("ship-to-ship") from the surface and undervater ships will increase the effectiveness of the damage/defeat of single waterborne targets and targets, which go in the dispersed formation/order.

Furthermore, ships can deliver strikes/shocks on the coastal targets, exert fire support to landing forces, destroy and render inoperable large/coarse industrial centers and naval bases.

Special importance in the capitalist countries is given to the activities of the submarines - the carriers of the guided missiles. In the opinion of the American military specialists, these activities will be split off from the concealed output/yield of boats into the assigned area at the removal/distance to 800 km from the assault objectives, from the refinement by the submarines of the places of surfacing and rocket launching on the assigned targets.

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During the use of the submarines, equipped with the guided missiles of the type "Regulus", against the surface ships it is considered that first their aircraft or submarines of guidance reconnoiter the combat or route formation of the enemy and are established/installed his course and velocity. These data are

transmitted to the attacking submarines which will realize firing into set forward point.

Besides this version of attack, in the American fleet is mastered such version with which the control of the released rockets/missiles is transmitted to aircraft or submarines of guidance.

During the actions against convoys the submarines can be drawn together with the enemy for refining his elements of movement, and then, after falling back from it to safe distance, to float and eject shells (Fig. 42).

The guided "surface-to-air" missiles ("ship-to-air") increased the possibility of air defense in the struggle with the air enemy both on dry land and at sea.

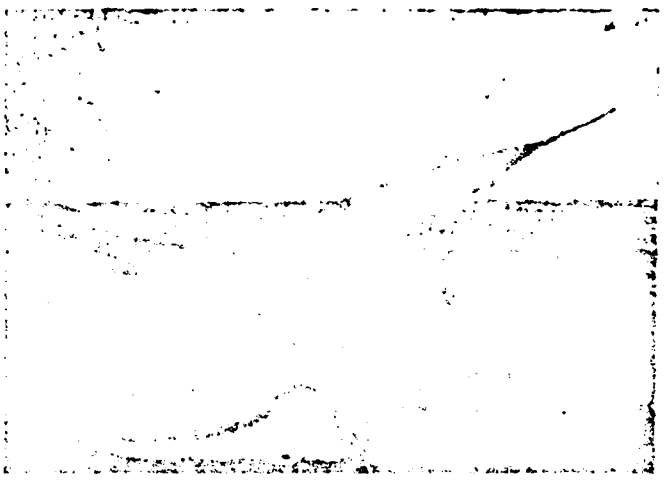

Fig. 42. Starting/launching of the guided winged missile "Regulus II" from the submarine.

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On height/altitude and range, and also in the value of charge the AA guided missiles to a considerable extent exceed antiaircraft artillery, but the electronic equipment for guidance to the target and the high flight speeds give the possibility to destroy not only aircraft, but also the guided missiles.

The use of AA guided missiles made it necessary to reexamine the tactical receptions/methods of the activity of aviation.

As the lowest subunit, where enter AA guided missiles, are considered the batteries which are established/installed around the military areas and the objectives.

Batteries can be mobile and stationary and consist of the positions of the group of the radar control and the firing position.

Mobile batteries have several trailer launching platforms, radar equipment of remote control, placed on the trailers, and the

necessary transport for the transportation of rockets/missiles and fuel/propellant.

Launchers are accommodated around the vans with radar and other armament, and the service personnel is located in the dugouts at the safe removal/distance from the launchers. Such installations can be easily transported and rapidly established/installed in any point/post.

Stationary batteries have positions well equipped in engineering sense.

The position of the group of the radar control is located at a distance of 1-6 km from the firing position and consists of the search radars (survey station), of tracking it and missile targeting to it. The firing position has launch pads, under which are located underground depots/dumps for storing the rockets/missiles, assemblies of electric power supply, depots/dumps of fuel/propellant and quarters/premises for the assembly of rockets/missiles.

Launch pads are arranged/located one from another at a distance to 350 m (Fig. 43). Each launch pad has four launchers which in pairs can be retracted into the underground concrete bunkers.

To the launchers the rockets/missiles are supplied with hydraulic elevators, and they are launched by means of remote-control gear of start.

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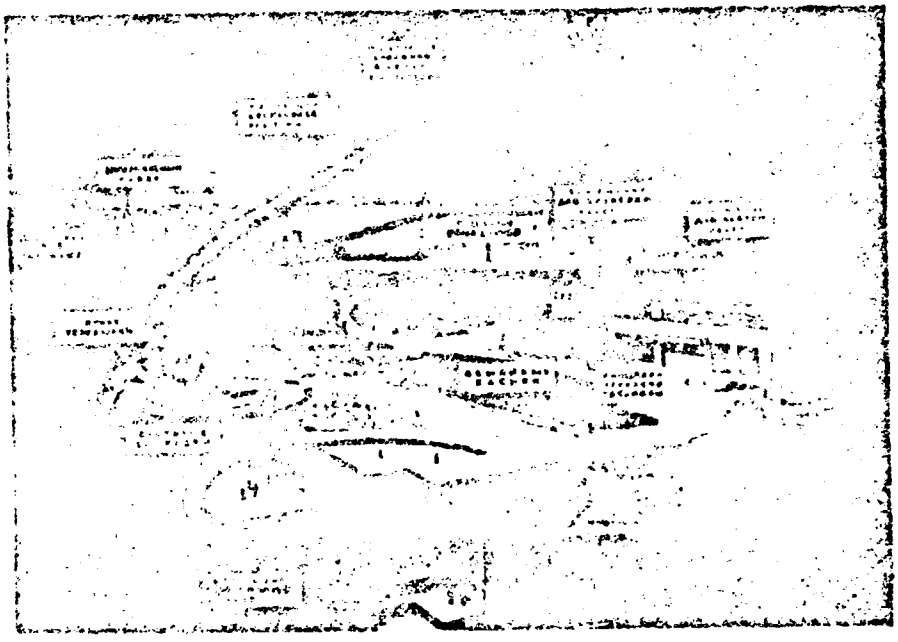

Fig. 43. Schematic of battery of AA guided missiles of type "Nike".

Key: (1). Target - tracking radar. (2). Missile - tracking radar. (3). Covered area. (4). Premises for checking missiles. (5). Administration and residential presises. (6). Missile-assembly premises. (7). Surveillance radar. (8). Control post. (9). Dirt embankment. (10). Refuelling area. (11). Launchers. (12). Lift and storage of missiles.

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As soon as the battery of rockets/missiles will obtain from the net/system of the points/posts of early detection or survey station signal about the fact that the aircraft of enemy approach the area, defended by battery, radar of the tracking of the group of the control traps/catches target and automatically it follows it.

In this stage the rockets/missiles are trained/prepared to the activity and are led to the position/situation for the start. As soon as target it will enter into the zone of action of rockets/missiles, is conducted their launching/starting. Are laid rockets/missiles by instrument board of flight. In the final stage of flight operates/wears the homing system (Fig. 44).

By the means/facilities of this battery it is possible to intercept and to annihilate only the one aircraft (guided missile).

Fig. 44. Destruction of aircraft by AA guided missile. The instruments of homing lay rocket/missile at the target, rocket/missile converges with the target, near the target the VT fuze produces the burst of rocket/missile.

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For the annihilation of the aerial targets utilize supplementary constructions - control system by the combat operations of the means of the air defense which provide the timely detection of several targets, their recognition, assign for the annihilation of one or the

other aerial target the specific weapons of destruction.

Control system by the combat operations of the air defense weapons of capitalist states has different scales of the use/application: from fire control of the subunits of rockets/missiles, located in one area, to fire control the air defense weapons of several areas and even countries.

The AA guided missiles of ships are intended for dealing with the air enemy upon transfer of ships by sea, also, in the bases. Usually screening ships are constructed around the protected ships and are formed the zones of distant and near defense.

In the zone of distant defense the fighter-interceptors and AA guided missiles annihilate air enemy to his output/yield into the attack; in the zone of near defense surface-to-air missiles are utilized together with the antiaircraft artillery of ships.

For dealing with the intercontinental ballistic missiles, which possess greater distances, heights/altitudes and flight speeds, in the USA, as has already been indicated above, they are developed/processed are special antimissile missiles.

The use of antimissile missiles requires reliable distant

observation. The stations of detection and antimissile missile must possess such performance data, which would allow at the enormous distance (1500 km and more) to detect the ballistic missiles of enemy, which fly with speed to 7 km/s at the heights/altitudes to 1000 km, and to destroy them.

Search systems it is proposed to apply complexly with the computers which must calculate the trajectory of ballistic missile and the point of its incidence/drop. Calculated data will be transmitted at the guidance station of antimissile missiles. Most thoroughly are monitored/controled latter/last 700-800 km of the flight of ballistic missile, since in this sector are possible the random and predetermined deflections. This distance is considered as the outer edge of the zone of the interception of ballistic missile (Fig. 45).

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The internal boundary of the interception is determined by minimum range and as height/altitude, with which thermonuclear head can be undermined in air without the damage/defeat of the protected objective, and is received the equal not less than 80 km from the detachment, that the effective distance of the damage/defeat of head 30-32 km, but this requires, count the foreign military specialists,

the ranges of antimissile missiles not less than 120-160 km.

The analysis of the characteristics of the contemporary ballistic missiles, which are or which enter the armament in different countries, shows that the starting/launching and the guidance of antimissile missiles must occur during one minute, otherwise shoot down ballistic missile will be impossible.

In the USA are developed/processed several systems of antimissile missiles. Basic is considered the system "Nike-Zeus", intended for the antimissile defense of surface/ground objectives.

Into this system enter radars of three types (long-range, recognition and escort/tracking) and battery for the starting/launching of antimissile missiles (Fig. 46). Long-range radar, after obtaining signal about the possible attack, continuously follows the directions/axes of attack from the distance of 1600 km.

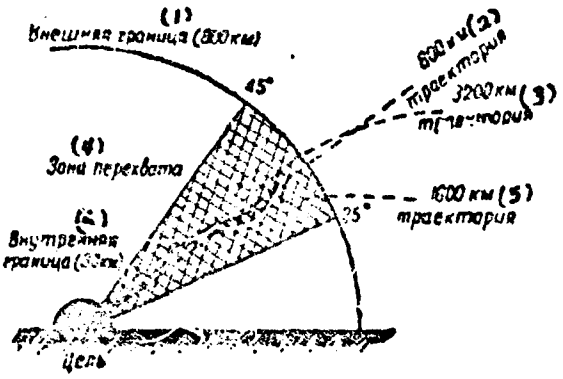

Fig. 45. Zones of the possible interception of long range ballistic missiles.

Key: (1). Outer edge (800 km). (2). 800 km trajectory. (3). 3200 km trajectory. (4). Zone of interception. (5). 1600 km trajectory. (6). Internal boundary (80 km).

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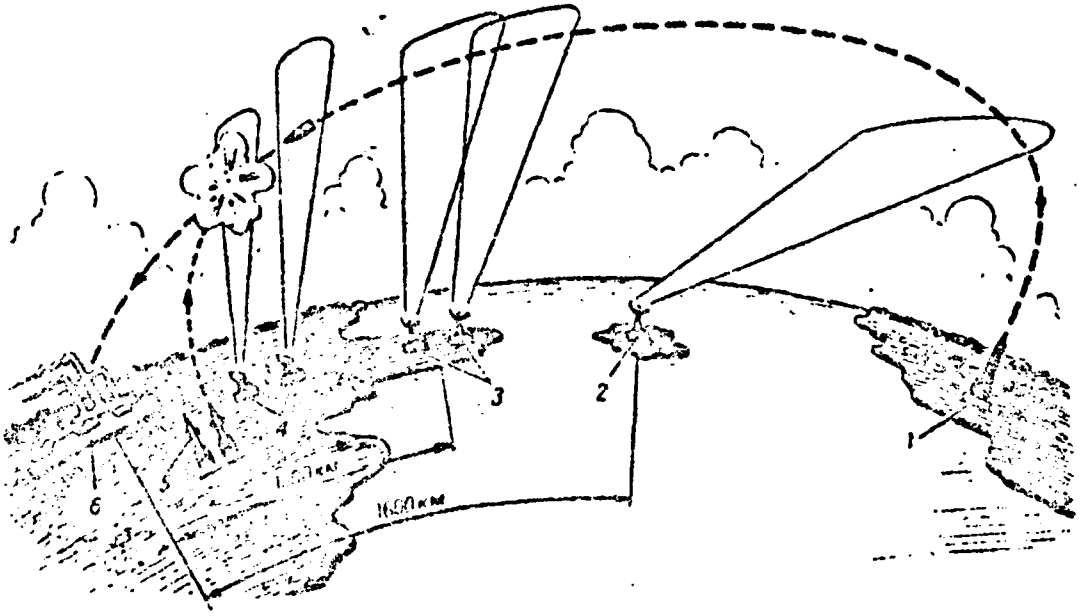

Fig. 46. Exemplary/approximate schematic of detection, interception and annihilation of intercontinental ballistic missiles: 1 - place of start of ballistic missile; 2 - long-range radar; 3 - radars of tracking and recognition; 4 - tracking radar of ballistic missile and antimissile missile; 5 - battery of antimissile missiles; 6 - defended objective.

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After the target will be discovered by long-range radar, two

stations of recognition pick up the functions of tracking and recognition. They also determine the target coordinates and the character of flight path.

Range of stations - to 1000 km.

One station of recognition works with four batteries of antimissile missiles "Nike-Zeus" and with the tracking stations attached by it.

To each battery of antimissile missiles are given two tracking stations the range of which to 320 km. One station escorts/tracks the approaching rocket/misrile, another - the antimissile missile "Nike-Zeus", released for the interception of the rocket/missile of the enemy.

Both stations continuously supply the data about the position/situation of rocket/missile and antimissile missile into the computer, which issues groups for guiding the antimissile missile.

To the prelaunch servicing procedure it is devoted little time; therefore antimissile missiles on the batteries must constantly be located ready for action.

In the defense of objectives a number of batteries depends on the character of objective.

The batteries of antimissile missiles under the conditions of attack must be constructed so that the people and the armament could perform even with the complete annihilation by the enemy of the surrounding defense area. This is possible if the batteries of antimissile missiles will be placed deeply underground.

In the foreign press it was communicated about the development of another antimissile missile - "Wizard", which allegedly will have some advanteges in comparison with the system "Nike-Zeus", since it is created for dealing with the maneuvering ballistic missiles.

It is thought to also create system for the defense of individual objectives under the field conditions, the assemblies of system will be installed on the trailers.

American specialists consider that the probability of hit of antimissile missiles "Nike-Zeus" and "Wizard" composes 25o/o; therefore for the damage/defeat of one ballistic missile will be required at least 10-20 antimissile missiles.

With the use/application of the guided air-to-surface missiles

increased the effectiveness of damage/defeat by the aviation of surface/ground and waterborne targets. Aircraft obtained the possibility to destroy ships and surface/ground objectives from the long range and with the high accuracy. In this case the carrier aircraft, striking target, can be located out of the attainability of the activities of the anti-aircraft weapons of the objective, on which will be deposited the strike/shock.

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The activities of carrier aircraft URS differ from the activities of bombers and torpedos. They, as assume/set foreign specialists, will be of the concealed approach of aircraft fleet to the point of deployment on the heights/altitudes, which impede detection by their radars, in the separation at this point into the groups, the gain of necessary altitude and of the exercise the striking forces of initial positions for launching/starting and guidance of rockets/missiles to the target.

Because of the high probability of the incidence/impingement of the guided missiles and a larger quantity of explosive in them for the annihilation of the specific target will be required considerably less aircraft than it would be required bombers and torpedos.

Thus, the equipment of aviation with the guided weaponry will allow it to annihilate targets from the long range and by a smaller quantity of aircraft.

Of all forms of the armament of fighter-interceptors with the most efficient weaponry are counted the guided "air-to-air" missiles. Having flying ranges to 10 km, high velocities and powerful/thick charges up to the atomic ones, these rockets/missiles give possibility to fighter airplanes, without entering into the zone of action of the defensive weaponry of bombers, to destroy them. AA guided missiles in combination with the fighter-interceptors, equipped with "air-to-air" missiles, are capable of destroying air enemy on the far routes of approach of the defended objective to his output/yield to the assault position.

The spread/scope of experimental works on creation and use of the guided missiles in the capitalist countries and the rates/tempos of their introduction by the armed forces testify about the high value of this new type of weaponry. The communications/reports of foreign press about the new achievements of rocketry indicate, that now the primary attention is paid to increase in the distance, height/altitude, flight speed and effectiveness of the use/application of the guided missiles, and also to creation of the multipurpose guided missiles.

An increase in the range in essence is characteristic for the guided "ground-to-air" missiles, "air - the earth/ground" and "air - air". The range of these rockets/missiles is limited at present by the small limits of the work of the remote-control devices and homing, whereas power constructions (engines) can ensure considerably long range.

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Therefore an increase in the range of remote control and homing will make it possible to increase the range of rockets/missiles themselves.

Work on an increase in the operational altitude is conducted for the "ground-to-air" missiles ("ship - air"), which will considerably enlarge the region of their use/application. Especially this is important for the antimissile missiles which must intercept and destroy intercontinental ballistic missiles at the heights/altitudes into several hundred kilometers.

Abroad is conducted also the work on the creation of the small/miniature AA guided missiles with which are armed the ships and

mobile above-ground launchers for dealing with the low-flying air attack weapons.

Work on an increase in the velocity of flight is conducted for all classes of the guided missiles, with exception of the long range ballistic missiles, which have velocities to 8 km/s, since the rockets/missiles, which have the velocities more than 8 km/s, actually are converted into the artificial Earth satellites.

It is very important to increase the flight speed of "surface-to-air" missiles and "air-to-air", since they are considered as the basic means of struggle with the air enemy.

The effectiveness of the use/application of the guided missiles rises by an increase in the range, accuracy of guidance, freedom from interference and reliability of the activity of the control systems, and also by an increase in the degree of effect on the target due to the creation of the more powerful/thicker explosive charges of warheads.

Thus, in the opinion of the American specialists, atomic charges with the TNT equivalent 800-5000 t it is expedient to apply in the AA guided missiles and the "air-to-air" missiles, which can allegedly strike the whole formation of the bombers, which go even in the

dispersed formation/order.

Recently abroad is conducted wide work on the creation of the multipurpose (multi-purpose) rockets/missiles which it is thought to utilize from different carriers for the destruction of diverse targets. Great possibilities in this respect have the guided "air-to-air" missiles, "surface-to-air", "air-surface" and partially "surface-to-surface".

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So, the guided missile "Talos", which has atomic charge, can be used both from the ships and from the above-ground launchers for the damage/defeat of aerial targets and application of strikes/shocks on the ground and large/coarse surface targets.

The French guided missile "Nord-5210" can be utilized as "surface-to-surface" missile and "air-surface" (from the aircraft and the helicopters).

Ballistic missile "Polaris" attracts attention of the specialists not only navy of USA, but also Air Force which are intended to utilize it from the land bases.

As the large special feature/peculiarity of further works on the improvement of the guided missiles is considered the use/application for them of plastics and solid propellants. Plastics will make it possible to considerably improve tactical-technical characteristics of the guided missiles: to lower weight, to increase heat resistance, to worsen/impair the radar observability of the enemy, etc., and solid propellant will simplify storage and missile preparation for the starting/launching.

The aggressive circles of NATO alliance countries lay large hopes for the guided rocket weapon. They openly declare, that the guided missiles with the nuclear charges are intended first of all for the decomposition of military objectives and administrative centers of the socialist countries. Therefore Soviet soldiers must attentively follow all achievements of military-technological thought and, in particular, study new rocket weapon, methods of its application in the combat operations on dry land, in air and at sea.

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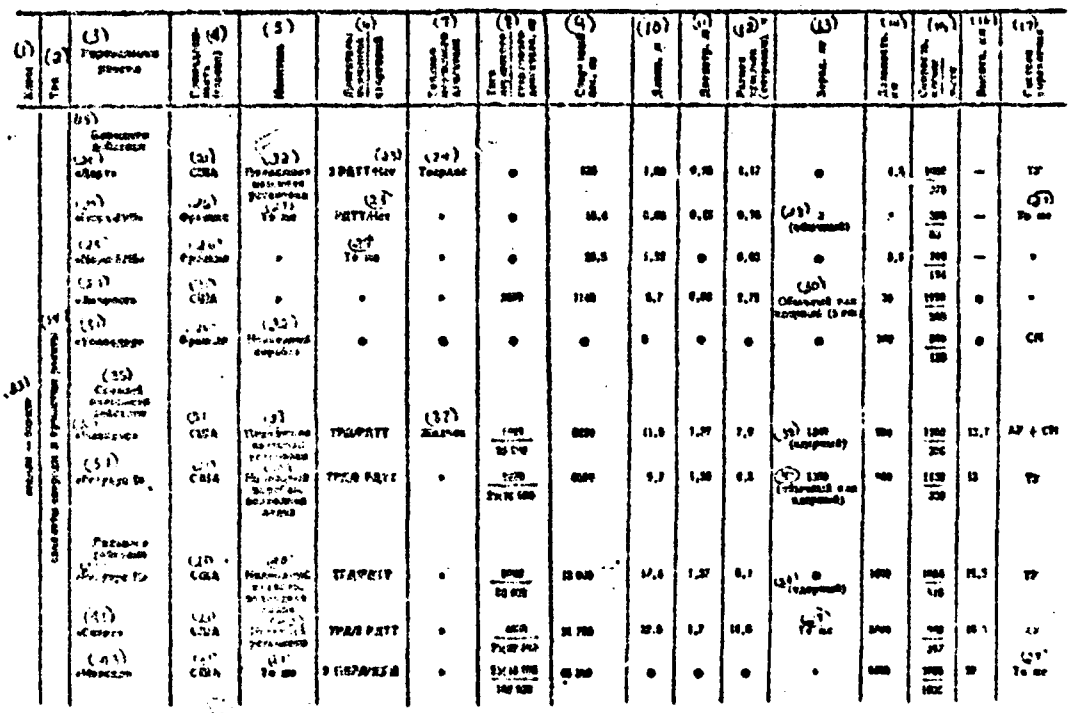
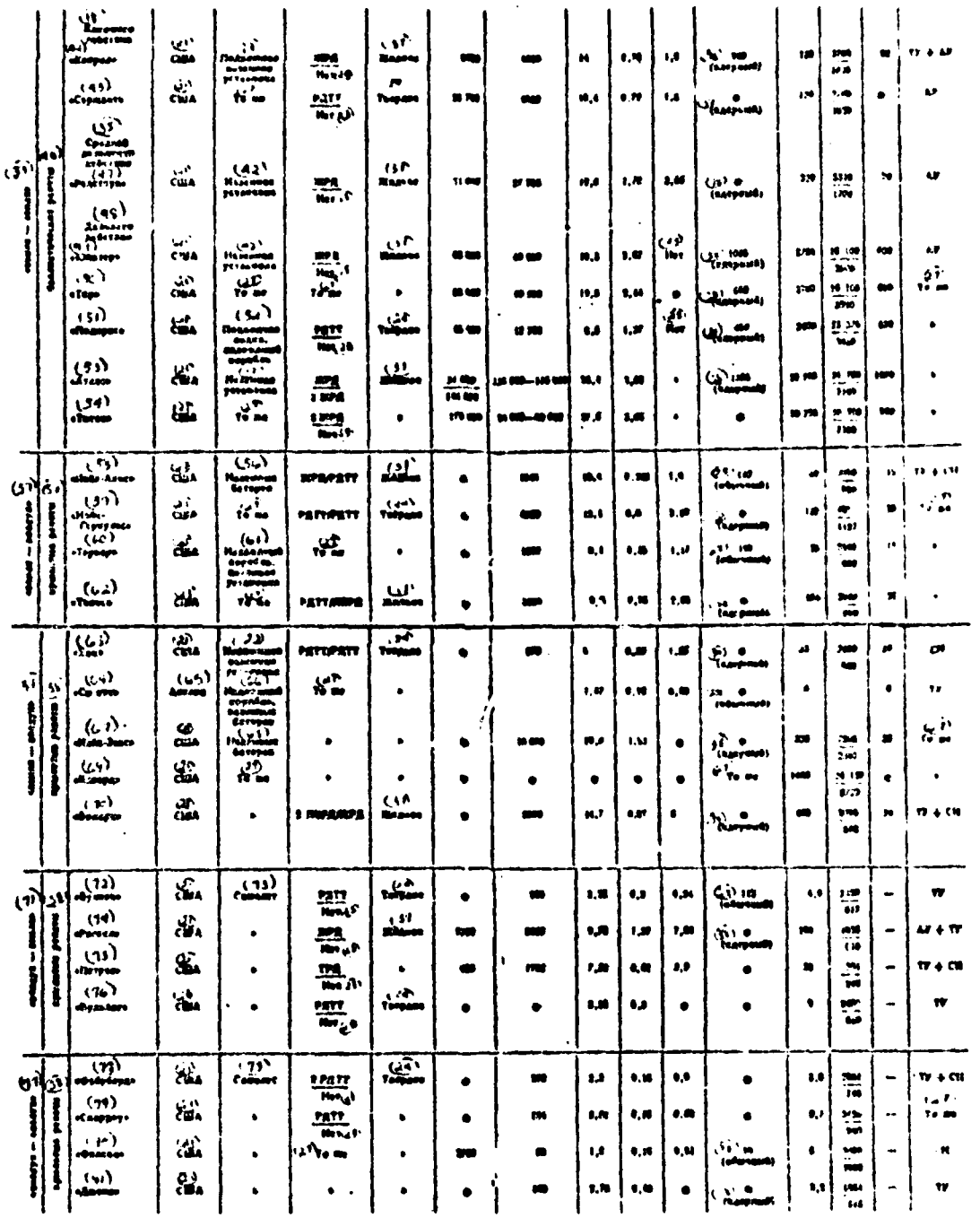
Table. Basic performance data of guided missiles.





Designations: point (...) - data are absent; TU - remote control; SN - homing; AU - preset control.

Key: (1). Class. (2). Type. (3). Guided missiles. (4). Identity/accessory equipment (country). (5). Carrier. (6). Engine: march / starting. (7). Fuel/propellant of sustainer engine. (8). Thrust of march / booster engine, kg. (9). Launching weight, kg. (10). Length, m. (11). Diameter, m. (12). Span of wings (tail assembly), m. (13). Charge, kg. (14). Distance, km. (15). Velocity, kilometers per hour / meters per second. (16). Height/altitude, km. (17). Control system. (18). Short-range. (19). No key. (20). Dart. (21). USA. (22). Mobile surface/ground installation. (23). No. (24). Solid. (25). Nord-. (26). France. (27). The same. (28). ordinary. (29). Lacrosse. (30). Ordinary or nuclear. (31). Tornador. (32). Surface ship. (33). surface-to-surface. (34). winged missiles and cruise missiles. (35). Medium range. (36). Matador. (37). Liquid. (38). nuclear. (39). Regulus. (40). Surface ship, submarine. (41). Snark. (42). Surface/ground installation. (43). Navaho. (44). Corporal. (45). Sergeant. (46). ballistic missiles. (47). Redstone. (48). Long-range. (49). Jupiter. (50). Thor. (51). Polaris. (52). Submarine, surface ship. (53). Atlas. (54). Titan. (55). Nike-Ajax. (56). Surface/ground batteries. (57). surface-to-air. (58). cruise missiles. (59). Nike-Hercules. (60). Terrier. (61). Surface ship,

surface/ground installation. (62). Talos. (63). Hawk. (64). Sea Cat. (65). England. (66). Surface ship, surface/ground batteries. (67). Nike-Zeus. (68). Surface/ground batteries. (69). Wizard. (70). Bomarc. (71). air-surface. (72). Bullpup. (73). Aircraft. (74). Rascal. (75). Petrel. (76). Bulldog. (77). air-to-air. (78). Firebird. (79). Sparrow. (80). Falcon. (81). Genie.

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