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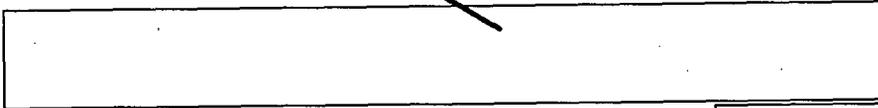
MEMORANDUM FOR: The Director of Central Intelligence
FROM : William W. Wells
Deputy Director for Operations
SUBJECT : MILITARY THOUGHT (USSR): Combat Against
Aircraft and Cruise Missiles at Low Altitudes

1. The enclosed Intelligence Information Special Report is part of a series now in preparation based on the SECRET USSR Ministry of Defense publication Collection of Articles of the Journal 'Military Thought'. This article describes low-altitude tactics of US aircraft and assesses air defense capabilities and difficulties in countering them as experienced in exercises using fighter aviation and surface-to-air missiles. The author explores the possibilities of setting up a low-altitude radar field using various combinations of radars, establishing missile defense lines using different SAM systems in an integrated manner to provide a continuous kill zone, employing aircraft from airfield alert status to intercept targets, and decentralizing control to allow more independent action by air defense means. Problems still to be resolved include increasing radar jamming resistance, restoring disrupted radar fields, and developing an all-altitude aviation system. This article appeared in Issue No. 2 (78) for 1966.

2. Because the source of this report is extremely sensitive, this document should be handled on a strict need-to-know basis within recipient agencies. For ease of reference, reports from this publication have been assigned

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Intelligence Information Special Report

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COUNTRY USSR

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21 December 1976

SUBJECT

MILITARY THOUGHT (USSR): Combat Against Aircraft and Cruise
Missiles at Low Altitudes

SOURCE Documentary

Summary:

The following report is a translation from Russian of an article which appeared in Issue No. 2 (78) for 1966 of the SECRET USSR Ministry of Defense publication Collection of Articles of the Journal 'Military Thought'. The author of this article is General-Mayor of Aviation G. Skorikov. This article describes low-altitude tactics of US aircraft and assesses air defense capabilities and difficulties in countering them as experienced in exercises using fighter aviation and surface-to-air missiles. The author explores the possibilities of setting up a low-altitude radar field using various combinations of radars, establishing missile defense lines using different SAM systems in an integrated manner to provide a continuous kill zone, employing aircraft from airfield alert status to intercept targets, and decentralizing control to allow more independent action by air defense means. Problems still to be resolved include increasing radar jamming resistance, restoring disrupted radar fields, and developing an all-altitude aviation system.

End of Summary

Comment:

General-Leytenant of Aviation Georgiy Petrovich Skorikov is listed as Chief, Main Directorate of Foreign Military Assistance of the General Staff. He was promoted in May 1969. The SECRET version of Military Thought was published three times annually and was distributed down to the level of division commander. It reportedly ceased publication at the end of 1970.

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Combat Against Aircraft and Cruise Missiles at Low Altitudes

by
General-Mayor of Aviation G. Skorikov

Finding methods to combat enemy aircraft and cruise missiles at low altitudes under modern conditions is the most important task of the Air Defense Forces of the Country.

This is due first and foremost to the fact that a distinct tendency has appeared in the actions of attacking aircraft to change over to flights in the low-altitude range, since the negotiating of air defense at medium and high altitudes entails great losses.

In recent years, within the system of combat training of aviation units and subunits of the US, Great Britain, France, and other capitalist states, flying and making approaches to strike targets at low altitudes under cover of intensive jamming have been under mandatory development. In the largest air exercises, up to sixty percent of all aircraft operated at low altitudes and with a variable flight profile.

Analysis of these exercises and of everyday combat training enables us to form an idea of the possible nature of low-altitude operations by both strategic and tactical means of air attack. Thus the flight altitude of strategic bombers under conditions of optical visibility, over fairly regular terrain or over a water surface, may be 100 to 150 meters. At night, however, and under adverse weather conditions, flight altitude is held at about 300 meters above the highest point of the ground surface, within a corridor 18 kilometers wide along the flight route. Upon approaching targets covered by surface-to-air guided missiles, altitude is reduced to the minimum. The flight routes of bombers at low altitudes are chosen with consideration for the aircraft's fuel capacity, the placing of the targets, and whether there are reliable ground reference points.

When bombers are operating over a considerable distance, complex flight profiles are employed: beyond the limits of the zone of radar detection, they fly at the most favorable altitude (9,000 to 11,000 meters), and before crossing the detection line they descend to 100 to 400 meters. However, if the distance to the strike targets does not exceed 2,000 kilometers, then strategic bombers can fly at low altitude over the

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full length of the route.

As a rule, tactical aircraft fly to target in the following manner. After take-off, a fighter-bomber climbs to the most favorable altitude and at cruising speed proceeds to a previously designated reference point chosen at a distance of 200 to 250 kilometers from the target to be attacked. Then altitude is decreased sharply to 50 to 150 meters and the fighter-bomber approaches the target area.

During combat training, the F-100, F-101, F-104, and F-105 tactical aviation aircraft in service in the US and other NATO countries are working on flights at altitudes of 50 to 150 meters, the F-105 at supersonic speeds. Their combat radius under these conditions is 600 to 700 kilometers. When flying with a variable profile, the combat radius increases to 1,100 to 1,300 kilometers.

The US Air Force is engaging extensively in combat actions at low altitudes in Vietnam, having been obliged to go over to this practice from the time the air defense of the Democratic Republic of Vietnam acquired surface-to-air missile systems. Prior to that time, American aircraft had flown for the most part at medium altitudes.

Raids by American carrier-based and tactical aircraft are usually carried out by several groups of four to ten aircraft entering the fire zone simultaneously from different directions under cover of jamming. The aircraft groups are echeloned by altitude at 50 to 100 meters, 500 meters, and 2,000 meters. At the same time, diversionary groups operate at altitudes of 2,000 meters and above; under their cover, strikes are delivered by the main forces at low and maximally low altitudes.

Lately bombing has been carried out mainly from a dive after executing a zoom climb or a half-loop with a half-roll. When bombing from a zoom climb, aircraft approach the target area at an altitude of 50 to 300 meters. After crossing the near limit of the kill zone of the surface-to-air missile system at a distance of five to six kilometers from the launching position, the bomber climbs to an altitude of up to 1,500 meters and, changing course by 20 to 30 degrees, goes into a dive.

In order to approach their strike targets undetected, tactical and carrier-based aircraft exploit the local relief extensively, especially river beds and hollows.

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To ensure breaking through the operating zone of surface-to-air missile troops and antiaircraft artillery, US tactical and carrier-based aircraft also use jamming by radiotechnical means. In the majority of instances, this is intermittent response jamming in combination with noise jamming. Jamming affects the combat functioning of operators in the following way. With simplex intermittent response jamming, it is difficult for operators of missile guidance radars to track targets in the manual tracking mode. With switchover to automatic tracking, the coordinate system picks up a false blip which is displaced from the target blip by a distance of 400 to 500 meters. With multiplex intermittent response jamming, three or four false blips are observed on the guidance screens, making it difficult to track the target both in the manual and in the automatic mode.

The need for operating at low altitudes is also taken into account in designing new types of aircraft. Thus the B-111 bomber being produced in the US must be capable, according to the concept of its designers, of carrying out missions at altitudes on the order of 100 meters above the local relief at transonic speed.

From the foregoing it follows that combat against low-flying air targets in a future war will become one of the main forms of combat actions of air defense forces. Therefore reliable covering of the lower range of altitudes by air defense means is an important requirement made on present-day air defense.

However, the fulfilment of this task, for a variety of reasons of a technical and tactical nature, comes up against serious difficulties. Thus as a result of the effect of the ground on the formation of the radiation pattern of radar antennas, the capabilities of the radiotechnical troops to detect and track air targets at low altitudes are considerably less than at medium and high altitudes.

Even such a "low-altitude" radar as the P-15 provides for detection of targets at an altitude of 500 meters only within a radius of 55 to 60 kilometers. When air targets are flying at altitudes of 100 to 200 meters, however, the capabilities of radars are even more limited.

Nevertheless, in order to guide fighter aircraft, it is necessary to have a continuous radar field with a lower limit corresponding to the minimum altitude of the enemy's combat employment of aircraft and cruise missiles. And in order to set up such a field, a large quantity of radars must be deployed, which involves considerable material expenditures.

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Numerous difficulties are also encountered in the combat employment of surface-to-air missile troops. Radar stations for reconnoitering targets and guiding missiles of surface-to-air missile units and large units also have a very limited range of detection of low-flying targets. In addition, reflections from local terrain features appear on indicator screens at low altitude, making it difficult to track targets and determine their coordinates. Under these conditions, the accuracy of missile guidance is reduced and the danger arises of premature activation of the missile's radar proximity fuze by signals reflected not from the target but from local terrain features.

Fighter aviation actions to intercept and destroy low-flying targets are adversely affected first and foremost by the worsening of conditions for the use of onboard radar sights and by the great expenditure of fuel. The latter circumstance leads to a significant reduction in the duration, and thus in the practical range, of fighter flights at low altitudes.

Great difficulties are involved in searching for low-flying air targets and also in maneuvering and attacking by fighters. Moreover, the use of fighters is adversely affected by the short effective ranges of the ground radars and radio communications means used to guide fighter aircraft.

True, some of the enumerated difficulties are gradually being overcome thanks to the improvement of the combat equipment models already in service and to the production of new models better adapted for operations at the lower altitude limit. Thus, in the surface-to-air missile troops, through modernization of existing weapons systems, success has been achieved in significantly broadening the capabilities for destruction of aircraft and cruise missiles at low altitudes, since the lower limit of the kill zone of medium-range systems has been lowered from one to three kilometers down to 300 meters and that of low-altitude systems from 200 down to 100 meters.

Experimental exercises have shown that surface-to-air missile troops can destroy low-altitude air targets not only over flat terrain but also in mountainous terrain. At an exercise conducted in the Baku Air Defense District under conditions of mountainous terrain, the average values for the range of detection and automatic tracking of targets by missile guidance radars at altitudes less than 1,000 meters approximate the values obtained under conditions of flat terrain and allow for preparing initial data and firing upon targets with small reflecting surfaces (of the tactical fighter type) within the kill zones as recommended by the firing rules.

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Also verified through actual practice was the possibility of employing low-altitude systems and medium-range systems to destroy air targets at low and maximally low altitudes when they are carrying out complicated types of maneuver (pitching upward at angles of 45 to 110 degrees, chandelle with dive, half-loop, and loop).

The destruction of targets before they begin to maneuver can be accomplished by a medium-range system at 300 meters and by a low-altitude system at 200 meters or more. To destroy targets attacking installations at altitudes of 100 to 200 meters and employing maneuvers, it is necessary to use specially modified systems.

Medium-range and low-altitude surface-to-air missile systems, as experimental exercises have shown, can even attack aerial bombs dropped from horizontal flight at altitudes of 3,000 meters and higher, as well as when pitching up at angles of 90 to 110 degrees. There has also been a substantial increase recently in the capabilities of fighter aviation. If a few years ago only one type of fighter-interceptor could destroy air targets at altitudes on the order of 200 to 300 meters above the local relief, today other types of fighters as well are capable of conducting combat against the air enemy at low altitudes.

For example, thanks to technical modifications we have succeeded in lowering the limits of combat employment of the fighter-interceptors with radar sights, which are the most widely distributed in the Air Defense Forces of the Country, from 5,000 to 1,500 meters, and down to 500 meters in the "fixed beam" firing mode; the lower limit for employing twin-engine interceptors of the latest models has been lowered from 500 to 300 meters.

Modifications are being carried out which make it possible to use jet interceptors for destroying low-flying targets observed by onboard radar sights against the background of the earth. They will be able to intercept and destroy air targets at maximally low altitudes.

In order to study the capabilities of fighter aircraft for combat against the air enemy at low altitudes, a special exercise was conducted in 1965.

Using production-line fighter-interceptors with the latest modifications, 65 experimental intercepts were made during daylight with optical visibility, and eight radio-guided target aircraft were shot down by missiles with infrared homing heads at altitudes of 50 to 100 meters. Guidance of an interceptor to target was carried out on the basis of data

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from a low-altitude radar field, and target lock-on and missile launch -- by collimator.

These results testify that fighter-interceptors of the indicated types can be employed successfully during daylight in favorable weather conditions to destroy low-flying air targets at maximally low altitudes. But in order to exploit these capabilities on axes of probable operations of low-altitude targets, there must be a continuous radar field with a lower limit on the order of 50 to 100 meters.

However, despite the successes achieved, a number of questions on combat against aircraft and cruise missiles at low altitudes still require operational-tactical or technical resolution.

We shall consider some of these questions, touching mainly on the desirable utilization of existing air defense means.

One of the most important conditions for establishing an effective air defense at low altitudes is an efficient disposition of the grouping of air defense forces and means capable -- according to their tactical-technical specifications -- of conducting combat against low-flying targets.

First and foremost it is necessary to determine the main directions from which enemy air attacks at low altitudes are possible, and to what depth.

Obviously such attacks are the most probable from the sea, but also over flat terrain on axes leading the attacking aircraft by the shortest route to main targets (troop groupings, industrial-economic areas, and key administrative-political centers). The possible depth of penetration of enemy aircraft at low altitudes will be determined by the flight ranges, under these conditions, of the various types of bombers, taking into account their need to return to their bases.

Naturally, in air defense formations and large units deployed on these axes it is necessary first of all to set up a continuous low-altitude radar field and groupings of active air defense means capable of conducting combat against the air enemy at low altitudes and also to provide for keeping them in a state of increased combat readiness.

A continuous low-altitude radar field can be set up by using P-15 low-altitude radars with the new UNZHA-2 feeder antenna device on a 30-meter mast, used in combination with the PRV-9 height-finding radar.

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Good results are also provided by combined use of P-35 radars and P-15 radars synchronized with each other.

Another effective means of detecting low-flying targets is the PRV-11 height-finding radar prepared for operation in the circular scanning mode and possessing about the same capabilities as the P-15 radar with the mast-mounted UNZHA-2 antenna.

Perceptible results can also be obtained by placing modernized P-35 and PRV-10 radar sites on elevations, which contributes to a considerable widening of the radar horizon when the two-frequency radar operation is being used. To set up a radar field at low altitudes in mountainous terrain, the P-35 low-altitude site with the PRV-11 built-in coherent height-finding radar can be used. Placing these sites on coastal elevations 300 to 500 meters high, as experience shows, makes it possible to double the range of detection of air targets coming from the sea.

The number of low-altitude radar posts and their placement on the terrain must ensure reliable detection and tracking of low-flying targets as well as their interception and destruction by fighter aircraft and surface-to-air missile troops.

The VOZDUKH-1 automated control system must be based on a low-altitude radar field set up by radars on tall supports. This will make it possible to support the combat actions of fighter aviation and surface-to-air missile troops in the lower altitude range with sufficiently high effectiveness.

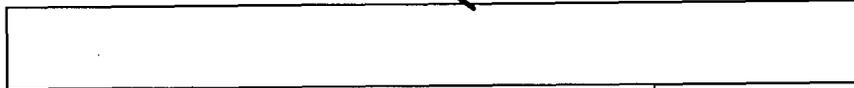
To increase the depth of the radar field and establish warning zones on the most dangerous axes, radar picket aircraft may be used.

On coastal axes, navy reconnaissance means should also be used for these purposes in accord with a unified plan: reconnaissance aviation, radar picket ships, and other naval means, right down to visual shipboard posts. During a period of threat, a sufficient number of ships having shipboard fighter aviation guidance posts must be put out on these axes. They are responsible for controlling fighters operating over water at ranges exceeding the capabilities of shore-based guidance posts.

A grouping of surface-to-air missile troops must be established with consideration for the importance of the installations to be covered, their location relative to each other, and the overall significance of the axis to be defended, and in such a way that the grouping reflects the zones and

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installations. A grouping of surface-to-air missile troops must be based on integrated use of fire means of different systems: low-altitude in combination with medium-range and long-range systems. Some installations may be covered by individual surface-to-air missile units or systems.

In establishing lines of surface-to-air missile defense consisting of sites of different systems, the distance between adjacent sites of the same system, and also the proportion between the number of sites of different systems, are determined by their designed ground ranges. In order to ensure reliable coordination of fire among sites of the same system, the distance between adjacent sites should not exceed the magnitude of the two designed ground ranges (for low-altitude missile sites -- 20 kilometers, and for medium-range missile sites -- 34 to 46 kilometers, depending on the type of missiles to be employed). Consequently, on individual key axes, the proportion between the number of medium-range and low-altitude missile sites in the grouping to be established must be 1:2.

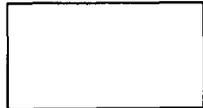
It is also very important to determine the best way of echeloning fire means and the optimal distances in depth between the launching positions of the sites of the different systems. The following conditions must be fulfilled here:

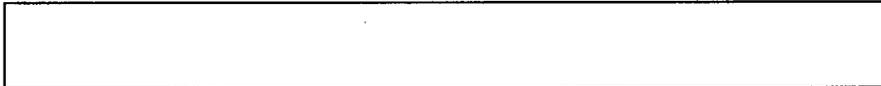
- a continuous kill zone is created over the full range of altitudes, with coordination of fire between adjacent sites;
- the survivability of the grouping is ensured under conditions of enemy employment of weapons of mass destruction;
- provision is made for defense of adjacent sites of different systems against enemy air strikes directly on their launching positions as well as for fulfilment of the task of covering installations.

This can best be achieved when there are low-altitude sites in the first line and medium-range sites in the second.

The first-line fire means are responsible for destroying an air enemy attacking at low altitudes and also for covering, against low-altitude strikes, the launching positions of medium-range surface-to-air missile sites deployed in the second line.

The second-line fire means, covering the defended installations over the full range of altitudes, will also provide cover for the launching positions of low-altitude sites at long ranges. In order to do this, as calculations show, the low-altitude sites must be located at a distance up to ten kilometers in front of the medium-range sites.





If there are not enough sites on the individual most threatened axes, particularly from the sea, special lines must be established consisting only of low-altitude surface-to-air missile systems.

The effectiveness of the combat actions of surface-to-air missile troops against low-altitude targets depends to a large extent on the depth of warning and the timeliness of the information obtained from the radar means of the radiotechnical troops. Therefore, on the most important axes it is desirable to have a radar field (or the lines of a field) at these altitudes and, in order to reduce data transmission time, to use automated control systems or direct communications lines from the radar companies of radiotechnical troops directly to the stations for target indication and guidance of surface-to-air guided missiles.

The correct selection of launching positions and their preparation are also very important. An attempt must always be made to have the minimum clearance angle at the center of the launching position close to zero degrees. This is achieved by setting up an SNR-75 "P" van on natural or man-made elevations, by deploying SNR-125 control and guidance posts on special metal towers, and also by clearing firing sectors in wooded terrain.

The grouping of fighter aircraft is set up in such a way that the fighter-interceptors having the greatest capabilities to intercept low-flying targets are in the first echelon.

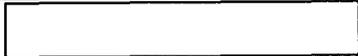
In doing so, the basing of the fighters must provide for intercepting and destroying low-altitude aircraft and cruise missiles at the maximum distance from the installations to be defended and for conducting combat against them in the intervals between surface-to-air missile zones.

The methods for combat employment of fighter aviation to repel enemy air strikes at low altitudes are determined with consideration for the depth of the radar field.

Interception of the air enemy from the "airfield alert" status is possible only if the depth of the radar field ensures timely warning of fighter aircraft and guidance of fighters to the air targets.

Since guidance based on data from local radars is very difficult, or even impossible if target speeds are high, fighter-interceptors must be put into the air and guided, from "airfield alert" status, based on data from adjacent radar companies. However, if even these data come in irregularly,





then the fighters can be put into the air immediately and sent to a waiting zone on the probable fight axis of the low-altitude target. In this case the fighters are guided at first from a guidance board, and after entering the radar zone -- from a plan position indicator.

If there is no continuous radar field at low altitudes, it is advisable to carry out an independent search by a target interceptor in the sector of possible axes of the target's movement. The interceptor flies on a logarithmic curve. A necessary condition for employing this method is that the speed of the interceptor exceed that of the target.

If the radar field is of inadequate depth, fighter aircraft must be committed to combat at low altitudes from the "airborne alert" status. This method ensures the highest readiness of the fighters and is very effective. It is not economical, however, since it requires a large and not always justified expenditure of fighters. For this reason, it must be used only on the most threatened axes at the most crucial moments of combat actions.

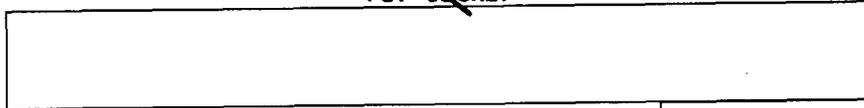
Control of air defense forces and means during combat against an air enemy at low altitudes is implemented from command posts of the units of the branch arms and from joint command posts of the tactical level. A characteristic feature of this type of control will be broad decentralization -- allocation of the authority for the decision on destruction of low-flying targets to be made directly by the unit commander, and in some instances -- by subunit commanders and even by individual fighter crews. In a situation in which timely warning of the active means is not ensured, independent actions by individual subunits and missile sites may be desirable.

From control posts of all levels, first and foremost from command posts of tactical levels, extremely efficient and well coordinated work and a continuous information exchange with adjacent elements regarding the air situation and the actions of subunits (units) will be required.

The main method of cooperation between fighters and surface-to-air missile units under these conditions will obviously be joint actions by them in a single zone -- a zone of the surface-to-air missile troops.

In conclusion, it should be emphasized that combat against the air enemy at low altitudes will often be combined with the intercept and destruction of his aircraft at medium and high altitudes. Consequently success in this combat will be predetermined by correct distribution of the





efforts of fighters and surface-to-air missile units in accordance with their combat capabilities. An important role here will be played by the timely and decisive maneuvering of air defense forces and means capable of combating low-flying targets onto those axes where the enemy is operating predominately at low altitudes.

In order to further increase the effectiveness of air defense in the low-altitude range, it is necessary to continue to improve the combat equipment.

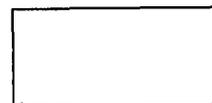
A no less important problem which must be resolved in the immediate future is that of ensuring that the radars of radiotechnical troops have high jamming resistance. It can be resolved, in our view, by using radars with various frequency bands, location by triangulation, equipment for suppressing side lobes, and devices increasing the quality of compensation for passive jamming; by employing direction-finding and correlation methods; and also through technical improvements.

Reductions in the time needed for processing, putting out, and transmitting radar information on low-altitude targets can be achieved if extensive use is made of special low-altitude posts which automate the processing and transmission of information being received from low-altitude radar companies.

It also makes a great difference whether there are mobile and adequately effective means for building up and rapidly restoring a radar field which has been disrupted or completely put out of operation by enemy nuclear strikes. One of the possible courses for resolution of this problem is to develop aircraft and helicopter versions of radars capable of detecting low-altitude targets against the background of reflections from the surface of the earth. ✓

A further increase in the effectiveness of surface-to-air missile troops at low altitudes can be achieved by improving the jamming resistance of missile guidance radars and by lowering the lower limit for combat employment of medium-range and long-range missile systems to 100 meters and of low-altitude systems to 50 meters.

In fighter aviation, one of the most urgent tasks is to work out aviation systems which can combat small high-speed air targets at both high and low altitudes. We consider that the systems must be composed of all-altitude interceptors which can be put into the air quickly and which have jamming-resistant onboard equipment capable of operating against



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supersonic targets at altitudes on the order of 50 meters. The radar sight of such an interceptor obviously must detect and lock onto a low-flying target against the background of the earth. The effectiveness of air-launched missiles can be increased by installing combined homing heads on them (radar and infrared) and also by equipping the missiles with special warheads, including warheads for operating against low-altitude targets.

A complex problem encountered when conducting fighter aviation combat actions at low altitudes is maintaining reliable communications between command posts and fighters. In order to provide such communications, we should use airborne and ground retransmitters and also widely adopt automated control systems based on the use of jamming-resistant communications means with great operating ranges.

The matters raised in this article do not exhaust the full volume of problems which must be resolved when organizing air defense at the lower altitude limit. There are considerably more of them, and they require further theoretical working out and practical resolution in the troops. It would be useful to draw the attention of wide circles of generals and officers to these problems.

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