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AIR INTELLIGENCE INFORMATION REPORT

COUNTRY OR AREA REPORT CONCERNS	DATE OF INFORMATION
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SUBJECT (*Descriptive title. Use individual reports for separate subjects*) STAT

INFORMATION ON THE SOVIET AIR DEFENSE SYSTEM

SUMMARY (*Give summary which highlights the salient factors of narrative report. Begin narrative text on AF Form 112a unless report can be fully stated on AF Form 112. List inclosures, including number of copies*)

Forwarded herewith is a report entitled: "Information On The Soviet Air Defense System", which is based on various Soviet periodical and monographic publications, dating from 1945 - 1957, and Soviet newspapers such as: Krasnaya Zvezda (Red Star), Sovietskaya Aviyatsiya (Soviet Aviation), Pravda (The Truth), Komsomol'skaya Pravda (Komsomol Truth) and others published in the period from 1954 to 1957.

The report represents an attempt to describe the development, basic principles of organization and composition of the Soviet air defense system. It also supplies some information about the methods of combat training and characteristics of the materiel of the Soviet air defense troops and of local air defense formations.

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According to the opinions expressed by the Soviet war leaders and notably by Marshal of the Soviet Union G. K. Zhukov (1), the Soviet doctrine of air defense proceeds from the idea that the next war would be characterized by the mass use of air force, pilotless aircraft, various guided missiles and rocket weapons, and also by such means of mass extermination as atomic, thermonuclear, chemical and bacteriological weapons.

As a result of this idea, asserts Marshal Zhukov, the Soviet armed forces have been radically reorganized since WWII, and qualitatively they have made a great progress from the WWII-time level, particularly in the air force striking power and in air defense.

We learned from the same statement of Marshal Zhukov that the relative strength of the Soviet air force and air defense troops within the composition of the reorganized Soviet armed forces, was considerably increased.

Accordingly, the Soviet air defense forces were raised to the same level as the air forces and obtained special consideration in the whole of Soviet military organization. In nearly every issue of the Soviet military organ Red Star (Krasnaya Zvezda), and in many editorials, special attention was paid to the development of high morale and sense of great responsibility among the air defense troops.

[redacted] strategic air force, a great deal of work was already done in the Soviet Union on the development of modern air defense organization which is now in possession of "supersonic fighter aviation, antiaircraft guided missiles, and other means of antiaircraft defense." He highly praised the successes of the Soviet military engineers and scientists who "on the basis of WWII experiences, and their postwar intensive research, were able to give proper direction for the strengthening of the defense forces of the country."

As far as the territorial [or local] air defense is concerned the Soviet Minister of Defense pointed out that this task was never before as urgent as it is under present conditions. He stressed that "the interest of security of the Soviet people requires further efforts for the organization and improvements in the local air defense, and proper training of the whole population within the framework of special civilian organizations."

These statements reflect the importance of air defense problems in the Soviet military efforts, and also shed light on the present intensive preparation in which are involved large masses of the population. The local air defense organization covers nearly every sizeable Soviet community. The Communist Party [redacted]

As soon as the decisions of the XXth Party Congress were made public, the local party organs organized all over the country special conferences devoted to air defense problems. In the Moscow Military District for instance, the air defense conference was held in the presence of the commanding general of the district [who presided at the conference], two marshals of the Soviet Union, the general deputy chief of the Main Political Administration of the Army, and the

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secretary of the city of Moscow committee of the Communist Party.(2)

As a result of all these efforts, according to one of the Soviet air defense experts, Eng. V. Gremin (3), "the air defense of the USSR disposes besides the most modern fighter aviation, a highly efficient flak artillery and also antiaircraft rocket weapons." These are the main weapons of the Soviet air defense system which strives by the most modern means to make the country impenetrable to air attack.

On March 16, 1957, the Soviet Defense Minister in his speech at the All-Armed Forces Conference of leading soldiers, expressed the opinion that the atomic weapon (if it will be not prohibited), will inevitably appear in the future war as a basic weapon of destructive attack. Therefore, the Soviet armed forces, and particularly the Soviet air defense should be able to combat successfully this weapon, and should know how to inflict on the enemy a crushing blow with atomic arm in response to his attack. The atom arm will be, incorporated into the armed forces on a large scale as a standard weapon.(4)

Since the last reorganization of the Soviet air defense system, the Communist party propaganda was considerably intensified among the air defense troops, as it has been shown at the special conference of the Communist party organizations of the Moskovskiy air defense District (2) and special effort was made to select the most politically reliable and most technically capable element for the air defense troops.

The air defense troops received top priority as far as the selection of the personnel and training facilities is concerned. They are required to meet all the requirements of modern warfare including nuclear and thermo-nuclear weapons. It is said in the Soviet sources that the materiel with which the air defense force is equipped is the most modern and of the highest efficiency.

However, the sources concerning the last reorganization of the Soviet air defense system, especially distribution of troops, services and special means are extremely poor. Therefore, it should be assumed that the data gathered from the available official and monographic publications may not reflect the most recent stage of the Soviet air defense organization, especially in the fields of antiaircraft pilotless means, antiaircraft guided missiles and rockets, and also electronics.

I. DEVELOPMENT, FUNCTIONS AND FORCES

1. Definitions and Composition:

According to the Soviet view the development of the air defense is closely linked with the development of the combat air force which has gradually become a decisive factor in the actual fighting (5).

The Soviet definition of air defense [Protivovozdushnaya Oborona, PVO], formulated by the large Soviet Encyclopedia (7) distinguishes:

(a) Air defense of the troops (Protivovozdushnaya Oborona Voysk)
(b) Air defense of the country (Protivovozdushnaya Oborona Strany)

Air defense of the troops is defined as a special form of combat activity and disposition organized by all formations of the armed forces and by all kinds of arms, and also by the specialized air defense troops, in order to fight against enemy aviation and pilotless means of his air attack (aircraft-missiles, long-

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range rockets and others) and thus defend the troops, (naval units) and important objects in the tactical and strategical zones, as well as in the rear of the [redacted].

The air defense of the country is defined as a combined form of combat activity of the specially designed air defense troops, services and disposition, in order to defend the important economical, political and military objects and centers of the country.

According to the same source [information found in the Soviet Military Text Books] (8), (9), the Soviet air defense system, after the reorganization mentioned by Marshal Zhukov has included the following main components:

(a) Air Defense Command and Command Posts (Komandovaniye PVO i Komandnyye Punkty)

(b) Observation [now including Radio-Detection], Early Warning and Communication Services (Sluzhba Vozdushnogo Nabludeniya, Opoveshcheniya i Svyazi, VNOS)

(c) Air Defense Meteorological Service (Meteorologicheskaya Sluzhba Protivovozdushnoy Oborony, PVO)

(d) Local Air Defense Organization (Organizatsiya Mestnoy Protivovozdushnoy Oborny)

(e) Air Defense Forces and Special Services

Air Defense Forces and Special Services:

Air Defense Forces and Spcial Services include -

1. Air Defense Fighter Aviation (Istrebitel'naya Aviatsiya PVO or IA-PVO)

2. Antiaircraft Artillery and Automatic Weapon (Zenitnaya Artilleriya, ZA,i Zenitnyye Pulemety, ZP)

3. Air Defense of the Naval Forces (Protivovozdushnaya Oborona Voyenno-Morskogo Flota)

4. Antiaircraft Rocket Weapon and Guided Missiles (Zenitnoye Raketnoye Oruzhiye i Zenitnyye Upravlyayemyye Snaryady)

5. Air Defense Radio-Technical Troops and Service (Radio-Tekhnicheskiye Voyska i Radio-Tekhnicheskaya Sluzhba Protivovozdushnoy Oborny)

6. Air Defense Barrage Balloons (Aerostaty Zagrazhdeniya, AZ, PVO)

7. Antiaircraft Searchlights and Radio-Searchlights (Zenitnyye Prozhektory ZPr., i Zenitnyye Radio-Prozhektory)

8. Air Defense Engineering Service for Organization of Antiaircraft Covers and Shelters, and also for: Antiaircraft Concealment, Camouflage and Decoy Installations (Inzhynernaya Sluzba PVO dla Meropriyatiy Ukrytiya i Svetomaskirovki,i Maskirovki) (8) and (9).

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According to several news reports of the Soviet press, to the Air Defense Troop belong also:

- Signal units (voyska svyazi)
- Radio-technical units (radio-tekhnicheskiye chasti)
- Technical and maintenance units (komandy tekhnicheskogo obsluzhivaniya)
- Transport and supply service (transportno-prodovol'stvennaya sluzhba)

2. Command and Control:

According to the sources of information mentioned under reference numbers (7), (8) and (9), the characteristics and tasks of the Command and Control of the Soviet Air Defense System are as follows:

A. Air Defense Command and Command Posts:

Air Defense Command and Command Posts ensure the control of air defense operations of the whole system.

Special technical means of each command post should secure uninterrupted, automatic and rapid control and direction of the air defense operations. Accordingly, the system of command includes:

- Central post of command
- Observation and detection posts
- Early warning and communication network

The Air Defense Command Post which disposes of the aviation and flak artillery means (sredstva avia-zenitnoy oborony) organizes two command posts located together: the Central Command Post of fighter and flak defense (Tsentral'nyy post Aviazenitnoy Oborony, TsEPAZO) and the central command post of local air defense (Central'nyy Post Mestnoy Oborony, TsEPMO).

In the areas defended only by means of local air defense the command post includes only "TsEPMO".

With the command post should be located the central early warning station (Tsentral'naya Stantsiya Opoveshcheniya) linked by a direct line with powerful technical means of warning (alarm sirens, whistles, light signals, radio warnings, etc.)

The central early warning station transmits clearly heard [or visible] over the whole territory of the defended object, or protected area the signals: "air raid alarm" and "all clear" (it is important that the air raid alarm signals should be distinctly different from any other signals which may be used in that area).

B. Observation, Early Warning and Communication Service:

Observation, Early Warning and Communication Service (Sluzhba Vozdushnogo Nabludeniya Opoveshcheniya i Svyazi, VNOS) is organized on the whole territory of USSR and consists of observation and radar detection posts, and also of posts of visual observation of the sky.

The posts of VNOS function uninterruptedly as one vast protective net, in order

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to assure timely detection of the air target and tracking it on the whole of its course. As soon as any invader is spotted, the VNOS posts flash a warning to the defense command centers of PVO.

The observation and reconnaissance is effected by means of radar stations of various types and optical observation instruments.

The VNOS system is based mainly on the radar observation and detection posts. The posts of visual observers are complementary to the radar posts lines and are functioning as auxiliary to the radar reconnaissance.

As the means of early warning communications serve mainly the radio communications and also the telephone.

After the warning of the command centers the antiaircraft radar posts direct the fighter aviation against the spotted air targets and stand by during the fighter attack.

Already in some prewar manuals of air defense it was stressed that the Soviet air defense system requires highly centralized and efficient air reconnaissance [Vozdushnaya razvedka]. The air reconnaissance at present is realized by the VNOS service. (10)

According to this source the VNOS service should secure in peacetime the necessary data about possible air invasion in order to establish the degree of the air threat. In wartime the VNOS should establish on the basis of air reconnaissance data the most threatened directions and conditions of defense of the most important objects and areas.

Also, the VNOS should see to it that the possible airborne landing of enemy forces behind the frontline are detected in time. The VNOS service is mentioned several times in present Soviet publications, but no details on the system of organization of this service could be found in the available sources. According to the authors of the text book on MPVO (10), the local formations of the air defense participate in the early warning system, thus cooperating with the VNOS service. Figures (1) and (2) in the inclosures (1) and (2) present basic principles of the VNOS service.

According to the most recent information in the Soviet publications, it is confirmed that the VNOS service is using on a large scale the most modern radar equipment for reconnaissance and tracking purposes. For instance, the news report of N. Krasnaya Zvezda (Red Star) confirms that in the Bakinskiy [Baku] Air Defense District, the radar observation service is entrusted to the antiaircraft defense radio technical subunit, which maintains the distant radar observation post somewhere in the Caucasian range (11). Also, the Soviet press confirmed the existence of a radar technical station beyond the Polar Circle, (151).

C. Air Defense Meteorological Service:

Soviet air defense system includes special meteorological service. According to L. V. Kravchenko, author of the book entitled: "Meteorology for Pilots". (Letchiku o Meteorologii, Moskva 1955) the Soviet network of meteorological and aerological stations, equipped with the most modern instruments, is steadily increasing (12).

All of these stations regularly carry out observation of the meteorological

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conditions of the atmosphere up to 20-25 km. Special meteorological service of the air force supplies all of the necessary meteorological data for any flying operation.

3. Air Defense Forces and Their Tasks:

A. Air Defense Fighter Aviation:

Air Defense Fighter Aviation (Istrebitel'naya Aviatsiya Voysk Protivovozdushnoy Oborony, in abbr. IA-PVO) is considered to be one of the most maneuverable antiaircraft weapons, which secures air supremacy and covers by day and night, at various altitudes and distances, the troops and naval units, as well as various objects (13), (14).

According to previously mentioned Soviet sources, fighter aviation is still the leading combat force of the Soviet Air Defense, which possesses the qualities of the most modern weapons, and in particular great speed [supersonic], climbing capacity to the highest ceiling and a great fire power (15).

However, quite recently appeared in the Red Star in September 1957, (16) a voice of critique, which without denying the important role of the fighter aviation in the air defense system, points out some tendencies of decline of this weapon for the following reasons: the possibilities of fighter aviation more and more limited, because the speed and altitude of modern bombers approaches those of fighters, and also the maneuverability of fighter aviation, particularly in the stratosphere, is inadequate. The author of this critique, Guards Col. L. Zholuvev, pointed out the necessity to find a solution for an efficient antiaircraft defense in the field of rocket and guided missiles.

(a) Development of Soviet Defense Fighter Aviation-IA PVO:

The IA PVO, being in the beginning a small selected interceptor force [formerly under command of Lt Gen Vasiliy Stalin, and popularly called since that time "Golden Falcons"] was gradually increased and organized as a special fighter command [composed of several fighter corps] within the new command of air defense of the country. The mission of this new air defense fighter command can not be established with certainty. Also, the relation of this command to the high command of the Soviet air force is not known. For instance, on the occasion of the All-Army conference of outstanding soldiers, the air force personnel of the air defense was working with the air force representatives. The photograph of air defense soldiers visiting the Commander-in-Chief of the air defense, airmen, as well as air force officers are missing (see Fig. 3 Inclosure 3). However, operationally the fighter units assigned to the air defense force are receiving orders from the Commander-in-Chief of the Air Defense Force (17), (18).

There is very little news in the Soviet press about the activity of the fighter aviation assigned to the air defense. Even in the Soviet Air Force organ "Soviet Aviation", which dedicated the whole number (No. 22 of Jan 26, 1958) to fighter aviation, the antiaircraft defense fighter units were not mentioned directly.

(b) Cooperation of Fighter Aviation with Antiaircraft Artillery

The Soviet antiaircraft fighter aviation operates in close cooperation with the antiaircraft artillery. This principle is underlined in an official Soviet source such as "The Large Soviet Encyclopedia", (19) which points out: "The IA-POV and the antiaircraft artillery operate in very close contact with

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each other and have the common essential task." An example of realization of this principle in practice is given by N: Illustrated Newspaper (Illustrirovannaya Gazeta) in June, 1956. (20) In the article which describes the joint action of the Soviet Fighter Aviation and Antiaircraft Artillery, the author presents the consecutive action of both arms in photographs. He starts his article by recalling that ..."at the present time, the Soviet air defense has at its disposal, modern supersonic fighters, antiaircraft artillery of the highest qualities, antiaircraft rocket weapons and other means which secure the successful defense of the country." Further, he asserts that the combat coordination of the air defense combined units is achieved in every day joint combat training of all participating arms.

The combat training in a given example proceeds as follows:

(a) The operators of the radar station [from the radio-technical units] spot the air target (see Fig. 4 Inclosure 4)

(b) The data of the air target are transmitted to the command post of the radio-technical unit (see Fig. 5 Inclosure 4)which computes the exact coordinates of the target. The command post of the radio technical unit, which operates over a defined area of air defense, transmits the result of the computation to the following cooperating troops:

-fighter aviation (ground control posts)
-antiaircraft artillery (command posts)
-other antiaircraft defense weapons (command posts)

(c) The fighter interceptors immediately take off on a given signal. Direction of flight, altitude, distance and position of the target are radioed to the fighters by the ground controller. They are guided until the target appears on their radar screen and then they operate independently of the ground control.

(d) In the meantime the antiaircraft artillery batteries are brought into combat readiness and wait the command "fire" (see Fig. 6, Inclosure 5). As soon as the air target appears in the zone of battery fire (zona ognya batarei), the battery commander commands "fire". He signals this command by means of a flag and a flashlight (see Fig. 7, Inclosure 5).

(e) The antiaircraft artillery battery fires the first salvo (see Fig. 8, Inclosure 6). The air target which escaped the fighter interception should have been hit by this first salvo.

The fighter aviation and the antiaircraft artillery are intensively trained by the Soviet Air Defense how to cooperate under difficult and complicated meteorological conditions. For instance, N: Illustrated Newspaper from February 1956, (21) published a news report about the combined fighter interceptors and antiaircraft artillery operation in a winter time on the terrain covered by heavy snow (see Fig. 9, Incl. 7).

B. Antiaircraft Artillery and Antiaircraft Machine guns:

(a) Definition and Development:

According to the available sources, the Antiaircraft Artillery (Zenitnaya Artilleriya, ZA) and the Antiaircraft Machine guns (Zenitnyye Pulemioty, ZPI)

are among the most important means of air defense.

Further, a Soviet source (Great Soviet Encyclopedia of 1955) asserts that this weapon has as an essential task: "to cover the troops and naval units and to defend the important points and objects in the country and in the army rear (operativnyy tyl) against the enemy air attack and air reconnaissance by destroying the enemy aircraft, or by forcing them to give up their attack", (22).

In another Soviet source we find that: "It is an important task of the antiaircraft artillery to break and to disorganize the enemy attacking formations by a concentrated accurate fire, and thus facilitate the counterattack of our own fighter aviation" (23).

According to these sources, the general trend in the development of Soviet antiaircraft artillery may be characterized as follows:

- increase of antiaircraft artillery fire power,
- increase of the rate of fire by further automatization of the firing,
- increase of the accuracy of fire by a greater utilization of the so-called "SON"("Stantsiya Orudiynoy Navodki - radar guidance and detection of the air targets), by automatic fire control (antiaircraft fire director, called in the Soviet antiaircraft artillery: "PUAZO-Pribor Upravleniya Artilleryiyskim Zenitnym Ognem), and by proximity fuzes (radio-vzryvatel'),
- increase of the range of antiaircraft artillery (uvelichit' dosyagayemost')

According to most sources, the Soviet antiaircraft artillery since WWII has made a very substantial progress in quantity as well as in quality.

(b) General Data and Characteristics of Soviet Antiaircraft Artillery:

The Great Soviet Encyclopedia (24) and some individual military authors (25), (26) classified the antiaircraft artillery as follows:

large caliber antiaircraft artillery 100 m/m and up
medium caliber antiaircraft artillery 70 m/m-100 m/m
small caliber antiaircraft artillery 20 m/m-70 m/m

The antiaircraft automatic weapons (in the Soviet terminology) include the antiaircraft machine guns of calibers 7.62 - 20 m/m.

According to its mobility, the antiaircraft artillery may be:

mobile antiaircraft artillery and
stationary antiaircraft artillery.

The mobile antiaircraft artillery is used mainly for the defense of the troops and objects in operational zones, or in frontal areas, and also for the defense of some sectors or points of the frontiers.

The stationary antiaircraft artillery is used to defend the objects and important areas within the territory of the USSR.

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(c) Organizational Principles of the Antiaircraft Artillery:

The antiaircraft artillery assigned to the air defense of the country is under a unified command within the air defense forces of the country. The largest units mentioned in the available Soviet sources are the air defense artillery divisions (soyedineniya zenitnoy artillerii protivovozdushnoy oborony), which consist of antiaircraft artillery regiments (polki i chasti zenitnoy artillerii) and of some units of antiaircraft machine guns (27), (28).

The antiaircraft artillery regiment consists of several battalions (divisiony zenitnoy artillerii). The antiaircraft artillery battalion as a tactical unit is composed of 3 to 4 batteries which are the basic firing units.

The antiaircraft artillery battery, depending on the caliber, is composed of 4 to 12 guns. As an example of small firing units, the Soviet sources mention platoons composed of 2 or more guns. (29)

(d) The Role of Antiaircraft Artillery:

In spite of some critical opinions which were recently spreading among the Soviet air defense experts, that the antiaircraft artillery may be insufficient against the modern high speed and high altitude attacking aviation, and in particular, that the antiaircraft artillery salvo can not guarantee a hit from the first burst except by accident, it holds still a very important role in the Soviet air defense system. (30)

According to Large Soviet Encyclopedia, WWII has proven that against a massed air attack the concentrated fire of massed antiaircraft artillery may be very successful. (31)

In another Soviet source (32) a historical example was cited that during WWII, of the 7,500 German aircraft destroyed by the Soviet air defense, 3,500 are credited to the antiaircraft artillery.

Judging from the number of editorials devoted in the Soviet military press to the problems of antiaircraft artillery, it may be assumed that this weapon still holds a very important role in the Soviet air defense system. Never-the-less, the voices of critics of antiaircraft artillery still appear in the Soviet press, and among them one of the most recent was the criticism expressed by Hero of the Soviet Union, Guards Col L. Zholudev (33) who said: ..."The weak point of antiaircraft artillery is the insufficient range of this weapon in altitude and also the small efficiency of its fire in combat against low flying targets." "Therefore", asserted Guards Col L. Zholudev, [who is an air force officer,]" pilotless means of antiaircraft defense, such as pilotless aircraft and rockets with various systems of homing, and target tracking devices have assumed greater importance. Their basic advantages: high speed of flight, sufficient radius of action, and possibility to utilize a great warhead with a powerful charge. However, all of these air defense means, as well as the means of radio-control and radio-detection, are extremely sensitive to radar and radio interference."

"The conclusion drawn from this is that the factor of surprise in the action of bombers depends in many respects on the degree of possibility to paralyze the radar means of the enemy air defense."

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(e) Types of Antiaircraft Artillery Guns:

The Soviet air defense has at its disposal a large variety of antiaircraft artillery guns of small, medium and large calibers. The standard type of antiaircraft artillery gun is often described in the Soviet sources, for instance, Col V. Chekhovich and Eng. Col S. Temkin published a detailed technical description, with the nomenclatures of each part, of an antiaircraft artillery gun. They also described the methods of operation of such gun and its characteristics. (34) The modern type of Soviet antiaircraft artillery guns are adapted for synchronous automatic control.

(f) Antiaircraft Artillery Guns of Small Caliber:

The small caliber antiaircraft automatic cannons which can be often seen in the Soviet sources is presented in Fig. 10, Incl. 8 (Turkestanskiy Military District). Self-propelled small caliber antiaircraft artillery gun is presented in Fig. 11, Incl. 8. More modern small caliber antiaircraft artillery guns (for instance, self-propelled antiaircraft artillery gun of small caliber, probably 57 mm. with no visible radar installation was shown at the parade on Nov 7, 1957), appear often in the Soviet sources, but without any technical description.

The naval antiaircraft automatic cannons of small caliber are presented in the chapter which describes the naval antiaircraft defense. Eng Col V. G. Sadovskiy in his textbook (35) supplied a detailed technical description of the basic type of automatic cannons, and also describes the basic characteristics of this weapon.

(g) Antiaircraft Artillery Guns of Medium and Large Caliber:

According to Eng Col Sadovskiy, there are in use 76 mm. antiaircraft guns (Model 1942) and 85 mm. (Models 1939 and later). The antiaircraft gun 85 mm. has a semi-automatic breechblock of mechanical type. Eng Col Sadovskiy gives in his textbook (36) a detailed technical description of this mechanism.

The antiaircraft artillery guns of medium caliber which are in current use in the Soviet air defense are presented in Figures 12 through 19, Inclosures 9 through 13 . Some of these guns are used also by the satellite countries' air defenses (for instance in Czechoslovakia). According to numerous descriptions which appeared in the Soviet publications, the guns of these calibers are mostly adapted to automatic synchronous control. The antiaircraft artillery guns of larger caliber, from 105 mm. up, were mentioned in the Soviet sources; however, without technical description or illustrations.

(h) Special Characteristics Required of the Antiaircraft Guns:

Eng Col Sadovskiy points out in his book (37) the following characteristics required of the antiaircraft guns: -

1. Great height of trajectory and great range
2. Great initial velocity in order to reduce the time of flight of projectile
3. Great vertical field of fire (angle of maximum elevation not less than 85 degrees, angle of minimum elevation 5-10 degrees)
4. Horizontal field of fire - 360 degrees
5. Great maximum rate of fire (for antiaircraft guns of small caliber - full automatic recharging)

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6. Automatization of the sighting operations
7. Speed in laying of the gun for elevation and for azimuth, with small effort in operating of the handwheels; use of two speeds in laying operation (so-called rough laying and fine laying), adoption of power elevation and traverse mechanisms

8. Great compactness and accuracy of fire
9. Adaptability of the gun for firing against the tanks and other ground targets. Adaptability for self-defense

10. Reliable functioning of all mechanisms under any angle of elevation

11. Ease of operation of the mechanisms despite their necessary complexity

12. Availability of the shield assembly
13. Speed in preparing for action

(a) Antiaircraft Machine Guns (Zenitnyye Pulemety)

According to the Soviet sources (38, 39 and 40) the main tasks of the antiaircraft machine gun troops are:-

-to destroy the attacking aircraft, the landing airborne troops and parachutists,

-to destroy the illuminating air-bombs and other illuminating flying devices,

-to hamper the enemy air reconnaissance and his aerial spotting operations,

According to the numerous descriptions of the Soviet antiaircraft machine guns there exists the following types of these weapons:-

(a) Special and adapted for antiaircraft fire machine guns of the caliber 7.62 (the same models as standard infantry weapons equipped with special sighting devices and mounts),

(b) Antiaircraft machine guns of large caliber (for instance - 20 mm. special antiaircraft machine gun),

(c) Light infantry machine guns and sub-machine guns on special mounts, with special sighting devices adapted for antiaircraft fire.

In the same Soviet sources we find the following firing characteristics of the antiaircraft machine guns:-

-effective range in horizontal firing 3,000 m (maximum range in this type of firing depends on the type of bullets, which may be of Model 1908 or 1930, or tracer or armor piercing bullets; (machine gun Model Goryunov, 43, may attain a maximum range in horizontal firing up to 5,000 m),

-effective range in flak firing - 2,000 m (maximum range 2,400 m),

-combat rate of fire 300-350 rounds per minute (maximum 600 r/m) for a single machine gun; the rate of fire of twin and multi-machine guns may amount

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to 2,[illegible] m.

The various types of Soviet special antiaircraft machine guns are shown in the following: (Fig. 20, Inclosure 14) - special heavy antiaircraft machine gun protecting the tank, (Fig. 21, Inclosure 14) - special heavy antiaircraft machine gun protecting the self-propelled artillery gun. (Fig. 22, Inclosure 15) - heavy antiaircraft machine gun of large caliber on a special mount, (Fig. 23, Inclosure 16) - four-barreled small caliber antiaircraft machine gun. (Fig. 24, Inclosure 16)- coaxial, twin, small caliber antiaircraft machine gun with ring-type sight.

The problem of utilization of standard weapons of rifle units against the air targets is very often discussed in the Soviet military publications. For instance, in November 1956 in the P: Voyennyye Znaniya (Military Science), No. 11, was published an article in which the author outlined the basic principle of use of infantry weapons against air targets (airplanes and helicopters and also descending parachutists). The article illustrated by sketches and photographs supplied some technical information about the use of infantry weapons in antiaircraft fire. (41)

The types of mounts used in antiaircraft fire of standard infantry sub-machine guns, and also the method of grouping of these weapons in combat are shown in (Fig. 25-26, Inclosure 17).

The Soviet antiaircraft machine guns acting together with the antiaircraft artillery, or separately are capable of covering successfully the combat order of ground troops in battle as well as in their movements. (42)

(j) Technical Possibility of Antiaircraft Artillery in Combat:

Defended objects and areas adjacent to them approximately 30-40 sq km can be covered at combat altitude by an antiaircraft artillery battalion [division] of 3 batteries, which should be able to meet the enemy aircraft in proper time from any direction it may approach. (43)

The distance from the defended point to the exterior limit of the zone of antiaircraft artillery fire, in case of cooperation with the fighter aviation, may be calculated to be approximately 30 to 35 km; in case of absence of fighter aviation this distance may be calculated to be approximately 12 to 15 km. The relation of the limits of the zones of antiaircraft artillery fire to the approaching course (to the defended object) of the enemy bomber is explained in the diagrams (Fig. 27-28, Inclosure 18).

(k) Zones of Antiaircraft Artillery Fire Seen by Approaching Bomber Pilot:

According to a recent Soviet source (44), which analyzes the antiaircraft artillery fire from the point of view of a bomber pilot approaching the target on a bombing mission, the effectiveness of this fire is characterized by the time during which the bomber will remain in the zone of firing. If the defended objects on the larger sector of the front are covered equally by antiaircraft artillery batteries whose firing positions are organized approximately 3 km from the forward edge (for the antiaircraft machine guns - 800-1000 m), then the bombers approaching the front at medium altitudes will be under fire from 8 - 10 km.

The bomber approaching the target at an angle of 90 degrees in relation to the front line will reduce the time of its flight under antiaircraft fire to the possible minimum.

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In the operational zone, the antiaircraft artillery is utilized for the defense of such objects as airfields, ports, railway and industrial objects, etc. The number of antiaircraft firing weapons depends on the importance of the object, its configuration, dimensions and the possibilities of air attack.

The firing positions of the batteries are organized around the defended object at equal intervals. More important directions are reinforced by an additional number of the batteries. Objects of special importance may be covered by the fire of antiaircraft guided missiles.

The author of the article suggests that the bomber pilots attack an object which is located in a large area protected by the antiaircraft artillery, only from one direction, thus reducing the possibilities of effective fire to the number of batteries which are located along the axis of flight of the bomber or formation of bombers at a distance equal to the plane zone of fire for a given altitude of flying. The author explains this in a diagram (Fig. 28, Incl. 18), (44).

(l) Technical Characteristics:

A Soviet source (45), (46) supply the following additional technical details concerning the antiaircraft artillery and antiaircraft machine guns:

The antiaircraft artillery gun possesses a vertical field of fire up to 90 degrees; horizontal field of fire - unlimited; initial velocity - 800-900 m/sec, and more. The rate of fire for the large and medium caliber 20-25 rounds/min. for the small calibers 180-250 rounds/min. The rate of fire of the antiaircraft machine gun: Models Degtyarev and Shpagin, caliber 12.7 - 550-600 rounds/min. Model Maxim 31 caliber 7.62 - on the quadruple gun mount - 2400 rounds/min.

(m) Range of Fire of Antiaircraft Artillery Guns

The antiaircraft guns of large caliber [100 m/m and more]:

- horizontal range about 16-18 km (6)
- Altitude range about 9 - 12 km (6)

The antiaircraft guns medium calibers [70-100 m/m[]:

- horizontal range about 9 - 14 km (6)
- altitude range about 5 - 8 km (6) [in the source (6b) - the altitude range of medium caliber antiaircraft artillery is 7-8km]

The antiaircraft guns of small calibers [20-70 m/m]:

- altitude range about 1500-2000 km (6) and 3,000 km.

(n) Soviet Antiaircraft Artillery and Machine Gun Fire Control Systems:

The Soviet antiaircraft artillery of large and medium caliber [and also some type of antiaircraft artillery of small caliber] are supplied with the following fire control and sighting equipment: (46), (47)

a. Combined height and range finder used when visibility is good.
b. Antiaircraft artillery Director, called in the Soviet artillery : PUAZO - Pribor upravleniya Artilleriyskim Zenitnym Ognem, see Fig. 29, Inclosure 19, (48).

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c. Antiaircraft artillery radar station called in the Soviet artillery: SON (Stantsiya Orudiynoy Navodki), see (Fig. 30, 31, Inclosure 19). (48)

The principles of operation of these instruments for controlling the anti-aircraft artillery fire are presented in the (Inclosure 20, Fig. 32 and 33).(48) In the commentaries of these illustrations the author explains:

The radar operators uninterruptedly watch the screens of the electron-beam tubes. At some distance from the defended antiaircraft defense object enemy airplanes approach. The radar operators spot the image of these airplanes in a form of small triangles (impulses) (see Fig. 31, Incl. 20). The coordinates established by SON are continuously transmitted to PUAZO automatically by cable. This instrument computes and resolves the mathematical problem of the lead and determines the point of encounter of the artillery shell with the air target (see Fig. 32, Incl. 20).

Electrically powered, synchronous data transmission mechanism (elektricheskaya sinchronnaya peredacha) transmits automatically through the junction boxes the signals to the guns. By these signals the guns are laid in azimuth and in elevation. The detailed functioning of this mechanism is shown in the diagram, (Fig. 34, Incl. 21). (49) More detailed description of Soviet methods of radar control of antiaircraft artillery fire is presented in Chapter "3", Section "E" "Antiaircraft Radio-Technical Service" in this report.

(o) Automatic Sighting Mechanism for Antiaircraft Fire:

According to Eng Col Sadovskiy's manual "Fundamentals of Artillery Materiel"(81) the automatic sighting devices designed for direct pointing are used in the Soviet antiaircraft artillery of small caliber.

The automatic sighting device determines the position of the aircraft in the air at the moment of its encounter withthe projectile (so-called point of impact) and automatically establishes the angles of sighting. For automatic sights the predicted dead time is equal to the time from the moment of fire to the moment of encounter of the projectile with the aircraft, (it is assumed that during this time the aircraft flys with the same speed and in the same direction, and in obsolete sights it also was assumed that the altitude does not change).

The automatic sighting devices are used without preliminary computation. The necessary data to use these sights are: speed of the air target, its course, angle of diving or pitching, slant range or altitude. All of these elements are determined on the sight scales. Their magnitude is established by sight or by means of course calculator, speedometer and range finder.

The principle of the automatic sighting device used in antiaircraft fire is presented in the diagram (Fig. 50, Incl.28).

(p) Ring Type Sights for Antiaircraft Fire:

According to the above mentioned source (49) and the information supplied by Eng Col Zaytsev (50) the most simple mechanical sight of this type (largely used for antiaircraft machine guns) consists of diopter and concentric, graduated rings, which automatically determine the lead of the air target for its most characteristic speeds.

The principle of sighting consists in leading the target toward the center of

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the graduated concentric rings. The changes of angles of sighting and angles of site, according to the changes in distance, are obtained by appropriately shifting the graduated rings along the linear rule. (49)

The models of these sighting devices, called also foreshortening sights, are widely used in the Soviet antiaircraft machine gun units. For instance, Professor Tsukerman's foreshortening sighting device, (Model 43) for the DShK machine gun, and the foreshortening sighting device (Model 44), for the Goryunov 43 machine gun and also optical types of these sights (called also collimator sights). (50)

(r) Examples of the Soviet Antiaircraft Artillery Methods of Operation:

As an example of the methods of operation of the Soviet antiaircraft artillery of a larger caliber may serve the following report, published in one of Soviet military periodicals(51), which describes a combat firing of antiaircraft artillery battery in the Privolzhskiy military district. The photographs of this battery in action are shown in (Fig. 36 through 39, Inclosure 23 through 25).

The battery command post signalled to the firing platoons the appearance of "enemy" aircraft. The commanders of the gun crews commanded "action Station", (k boyu). The gunners rushed to their combat posts. In the meantime the power cable of the guns was laid down, (see Fig. 36, Incl. 23). The gunner-scout at the battery command post took his observation post and watched the sky. (see Fig. 36, Incl.24)

At the radar station the antenna began scanning the sky. The radar operator (with the badge of distinction of "outstanding antiaircraft defense soldier," - otlichnik PVO), attentively surveyed the radar screen. (see Fig. 37. Incl. 29). Suddenly on the screen appeared sharp impulses indicating the target. The radar operator, (considered as an expert in radio-location) transmitted the target data to the plotting board operator of the battery command post. The plotting board operator skillfully fixed on the board elements received on the target flight. At this time, the sergeant commander of the telephone section worked as a plotting board operator,[according to principle of so-called "interchangeability", some members of the antiaircraft defense personnel are trained, besides their organic functions, also in other specialities].

In the photograph (Fig. 38, Inclosure 24) the plotting board operator is shown working under the supervision of the battery commander. When the line plotting the "enemy" aircraft course was approaching the zone of battery fire, the gun commanders received the target data: azimuth, angle of site, range. Automatically the barrels of the guns followed the course of the invisible target. Ammunition bearers swiftly carried the rounds. The gunner operating the elevation mechanism laid the gun. All of the guns reported readiness for fire. Their commanders raised the red flags - signal to fire, (see Fig. 39, Inclosure 25). Then followed the command "fire". The gunner-loader pressed the trigger bar. "In such a way", said the author of the report, "the antiaircraft artillery personnel is trained in acquiring the skill of accurate fire, struggling for each second of time." The firing battery was a subunit of the antiaircraft artillery of the Privolzhskiy Military District.

Generally, the firing positions of Soviet antiaircraft artillery are organized without gun emplacements, and with little cover for the crews as it was in the above described combat firing. However, some Soviet antiaircraft batteries in fixed positions have very well elaborated gun emplacements with trenches for ammunition and shelters for the crew, as can be seen in the (Fig. 56, Incl. 32).

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C. Soviet Naval Antiaircraft Defense Forces:

According to the "Manual for Navy Seamanship" by R. D. Kartashev, (53) the Antiaircraft Defense Troops of the Navy (Voyska Protivovozdushnoy Oborony Flota) are used as observation and warning force against the enemy air attack and for frustrating this attack.

The Soviet Naval Antiaircraft Defense Forces organize the Sky-Watch through a well developed network of observation posts equipped with sound-locators, searchlights and other technical means [certainly also with radar stations] which enable detection of the enemy airplanes. To repulse an attack of these airplanes is the task of the naval antiaircraft aviation and antiaircraft artillery. (53) p. 19.

Besides these weapons the naval antiaircraft defense has at its disposal also various antiaircraft rockets and guided missiles* which are combined with the conventional naval antiaircraft artillery.**

The naval antiaircraft defense forces are divided between the operational fleet and coast defense. It is possible that the system of antiaircraft defense in the coastal zones, being directly under naval authorities, operationally are transferred to antiaircraft defense command.

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*In the German XXXX Periodical: "World of Flying" (Flugwelt), No. 1, Vol. VI, Jan 1954, edited in Koln, appeared an article by Volursus (pp 14-15), which supplies the following information on the Soviet naval antiaircraft defense rocket weapon:..."Swedish observations in the Baltic Sea in January 1953 were confirmed by the representatives of the British Admiralty on June 10, 1953, that the cruiser "Sverdlov" (whose water displacement is officially given as 12.800 tons, (but which actually is 15.000 - 16.000 tons), has but a few conventional antiaircraft defense guns. The most important antiaircraft defense weapons on this modern warship are antiaircraft defense rocket batteries." Further, the author of the article asserts that:..."the other warships of the Soviet Navy were also equipped with such antiaircraft defense rocket batteries as in the case of cruiser "Sverdlov" proved."

**The Soviet author Maj Eng V. Kruchinin also mentioned this matter in his article in Red Star No. 57, 1956, (54) asserting that the naval ships may carry antiaircraft rocket weapons.

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(a) Soviet Naval Fighter Aviation:

According to the "Manual for Navy Seamanship" by R. D. Kartashev, the Fighter Aviation of the Navy (Istrebitel'naya Aviatsiya Voyenno Morskogo Flota, IA-VMF) covers the warships, bases and other objects against the attack of the enemy aviation and secures combat operations of own naval aviation. (55)*

We also find a general description of the Soviet naval fighter aviation in the article of Guards Maj B. Shukakov, which appeared in the Illustrated Newspaper (Illustrirovannaya Gazeta) in August 1955. (56)

According to Major Shukakov, the Soviet Naval Fighter Aviation is equipped with the Soviet-built modern jet-airplanes of the highest speed, great climbing capacity and powerful armament. This aviation is capable of [redacted] at any time of the day and under any weather conditions.

High performance data and the most modern instrument equipment enable the Soviet naval fighter aviation to cover successfully the maritime regions of the country, formations of naval units and the naval bases against any surprise attack of the enemy aviation or other "provocation".

The Guards Fighter Regiment of the Naval Aviation had trained many masters of aerial combat and sniping, who still soundly study the theoretical and practical problems of aerial combat and modern aviation technique.

In (Fig. 41, Incl. 27) are presented the types of Soviet naval jet-fighter airplanes flying in combat formation. In (Fig. 42, Incl. 28) are photographed the Soviet naval air force technical personnel and mechanics watching the flight of the aircraft, and in the photograph (Fig. 43) are presented the Soviet naval fighter pilots being instructed by the Guards Col N. Gurin [apparently naval engineer] about the characteristics of the destroyer which they have to cover (the model of destroyer is in the photograph). Fig. 44 presents an additional suspension fuel tank being carried to a fighter airplane before the flight over the high sea, and (Fig. 45) shows the weapons mechanics of the fighter aviation loading the aerial automatic weapon. (56)

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*According to the British source of information (RAF Flying Review November 1957), 65-70 squadrons of fighters previously belonging to the naval air arm were subordinated to the command of antiaircraft defense of the country.

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(b) Naval Antiaircraft Artillery:

The Naval antiaircraft artillery comprises the coastal antiaircraft artillery and seaborne antiaircraft artillery and automatic weapons. (57), (58) According to the same source the seaborne antiaircraft artillery is designed to combat the enemy air attack against the naval units at sea. For this purpose, the warships carry, according to their importance various antiaircraft artillery and automatic weapons. For instance, the battleship [lineynyy korabl', or linkor] may be equipped with about 150 antiaircraft automatic guns of calibers up to 65 m/m [see the type of such guns in Fig. 46, Incl. 29]. The aircraft carrier may be armed for antiaircraft defense with about 100 pieces of antiaircraft defense guns of lesser caliber. (59)

Also, a large number of antiaircraft defense guns of small caliber are placed on cruisers, monitors, destroyers and other naval vessels. Examples of the types of Soviet antiaircraft naval artillery guns are presented in the following illustrations:

In the (Fig. 47, Incl. 30) is presented the naval antiaircraft artillery of small caliber on the Soviet cruiser: "Mikhail Kutuzov". The photograph was taken at the moment when the commander of these guns ordered "action station". (60)

(In Fig. 48, Incl 31) is presented the naval antiaircraft batteries on the cruiser "Molotovsk" while firing a salvo. (61)

The naval antiaircraft batteries with automatic guns combined with other types of naval artillery on the cruiser N. are presented in (Fig. 49, Incl. 32), and the antiaircraft artillery commander of this cruiser is presented in the photograph in (Fig. 50, Incl. 33). (62)

Also the Soviet river monitors are armed with antiaircraft automatic cannons [generally on a twin-mount] and searchlights for the night firing. Such weapons on one of the monitors on the river Amur are presented in (Fig. 51, 52, Incl. 34). (63)

In (Fig. 52a, Incl. 34) is shown the sighting device of these cannons.

D. Antiaircraft Rockets and Guided Missiles:

The antiaircraft rocket weapons and antiaircraft guided missiles are comparatively the youngest weapons in the Soviet air defense system. They are treated separately from the conventional antiaircraft artillery (zenitnaya artilleriya i zenitnoye raketnoye oruzhiye i zenitnyye upravlyayemyye snaryady).

The first official news about the incorporation of these weapons into the Soviet air defense system came from Marshal Grigoriy Zhukov, during his speech at the XXth Party Congress. In the later years, several Soviet authors, and among them Marshal Rodion Malinovskiy, the Defense Minister, and Marshal Sergey Biryuzov, Commander-in-Chief of the air defense of the country mentioned the important role of the rockets and guided missiles in the Soviet air defense system.

In general, there is no available Soviet publication which gives a complete picture of the Soviet antiaircraft rockets and guided missiles. However, some information published in the German source on the basis of Soviet publications

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("Flugwelt", World of Flying, No. 1, 1954) supplies indirectly the data, supported by the photographs, which deserve to be taken into consideration as a general characteristic of the development of Soviet antiaircraft rocket weapons.

Some of these rockets appeared also in the Soviet illustrations and were generally described by the Soviet authors, however, without revealing whether they are actually used in the Soviet air defense system.

According to the above mentioned German source, the early Soviet types of antiaircraft rocket weapons were largely based on the German models, however, because of the very intensive research work in this field, there was created a large variety of new types of antiaircraft rockets and guided missiles. Since that time the Soviet press is constantly publishing articles discussing the problems connected with the use of the antiaircraft rockets and guided missiles.

(a) Soviet Authors About the Rocket Weapons:

The above German information about the Soviet antiaircraft rockets is confirmed indirectly by the following Soviet authors:

Eng Maj V. Kruchinin in his article "Antiaircraft Guided Missiles" (64) published in March 1956 disclosed some Soviet ideas on the matter.

According to Eng Maj Kruchinin, the high velocity and ceiling of the modern combat aircraft make impossible to create a reliable antiaircraft defense, based only on fighter aviation and antiaircraft artillery. Thus, many countries attach now much importance to the development of antiaircraft guided missiles.

"The speed of the antiaircraft rockets", says the author, "may be many times superior to that of sound, and their ceiling may be considerably higher than the ceiling of the modern bombers or flying airplane-missiles." "They possess guiding devices which if adequately conceived and were properly functioning, may secure effective destruction of the target."

According to the author, the probability of hitting for some rockets reaches 65 per cent. "But", says the author, "there is no doubt the antiaircraft guided missiles can not entirely replace all other means of antiaircraft defense, but must be used conjointly with the antiaircraft artillery, fighter planes, and radar devices." Further, the author characterized the antiaircraft guided missiles in a following way:

Basically, these missiles are distinguished by their range, ceiling weight and explosive they are carrying. The body of these missiles usually is made of light alloys in a form of finely sharpened pencil, or that of a thin spindel. They are provided with wings and empennage and contain a system of guiding mechanism, and explosive charge with a firing device, a propelling motor, and a supply of fuel. The missiles with a range of 30-50 km, as a rule are propelled by liquid fuel, or solid fuel motors. The long range missiles[100 km and more] are usually propelled by a ram-jet motor, which uses relatively less fuel.

The majority of the modern antiaircraft guided missiles are provided with an auxiliary propelling device, which assists the launching of the missiles. These propelling device which use solid fuel, accelerate the missile, until it reaches a speed close to that of sound, and then it is discarded in flight.

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The most complicated and expensive part of the guided missiles is its guidance system. "The complex of the mechanism guiding the missile toward the target," says the author of the article, "may consist of two or more independent systems working on different principles and serving different purposes." One part of this mechanism may serve to conduct the missile toward the target, directing it from the ground, while the other part may guide it automatically to the target.

The prevailing new systems of directing an antiaircraft missile on the first leg of its course are those of command guidance system and beam-rider guidance system.

The command guidance system is shown on the left side of the sketch (Fig. 53, Inclosure 35) which accompanied the article of Eng Maj Kruchinin. This system comprises:

1. Separate radar direction finder which tracks the target
2. A separate radar guiding the missile
3. An automatic computer which links both radars and "works out" the tracking data necessary for adjusting the course of the missile -

thus making sure that the missile will meet the target. The data combined in the computer are transmitted to the missile [as steering signals]. A schematic design of one type of antiaircraft missile launcher is shown in the sketch under (4).

In the lower right corner of the same sketch (5) an outline of the beam-rider guidance system is presented. The narrow tracking-radar beam [from the ground station] is surrounded by a cone of a larger beam necessary initially to bring the missile into the right direction. The corresponding equipment in the body of the missile may consist of four receiving antennas placed at 90° degree angles. As long as the missile follows the axis of the beam, all four antennas receive identical signals, but in case of deviation the intensity of the signals received by various antennas will differ.

Eng Maj Kruchinin asserts that according to the foreign press information, both above described guidance systems have their defects. First of all, they limit the range of the missile. Then, their proper functioning may be disturbed by the radio interferences, and their guiding is not precise enough. Besides that, the command guidance system requires complicated ground installations.

On the last part of its trajectory an antiaircraft guided missile is directed by an automatic guiding device of the so-called homing system. The homing system may be of active, semi-active, or passive type. In the active homing guidance system all of its parts [i.e. the source which illuminates the target and the receiver which receives the echoes] are carried within the missile. The advantage of this system is its greater range and independence of the ground installation. But on the other hand, the active homing guidance system is heavy and requires consequently a larger and heavier missile.

In the semi-active homing system the receiver in the missile works on radiations from the target, which has been illuminated by a source from the ground. In the passive homing guidance system the receiver in the missile utilizes natural radiation from the target [electromagnetic, heat or light]. According to the foreign press, says Eng Maj Kruchinin, "best developed now are the homing system "working on heat (infrared) rays." The range of the passive homing system is inferior to that of the other two types, but it is less influenced by exterior interferences.

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Further, the same author points out that a number of countries have developed anti-aircraft guided missiles of various types and already have them in their armament.*) Some of these missiles are designed for the protection of important administrative and industrial centers. They are of the guided rocket types provided with a liquid fuel jet engine. Their length is about 6.3 m, diameter 0.3 m, range 30-40 km, combat ceiling 18-23 km, and the weight of the warhead (boyevaya chast') - 140 kg.

Such missiles are launched with the help of a powerful powder launching device at an angle of almost 90 degrees. On the first part of their trajectory they are directed by the command guidance system, and on the last part by a semi-active homing system.

He also points out that the antiaircraft guided missiles may also be used as armament on the naval ships. One model of such naval missiles has two powder propelled motors (one basic and one for launching purpose). Its length is about 4.5 m. diameter 0.3 m. The launching motor separates from the main body of the missile a few seconds after the launching. The missile is directed by the beam-rider system provided by the ship's radar station. Its combat range is 16-18 km.

The same Soviet author assures that there was also developed an antiaircraft guided missile, which can be launched without any auxiliary launching device. The missile is equipped with only one (basic) motor, working on nitric acid (as oxidizer) and kerosene (as fuel). The motor functions for 30 seconds and at the end of this time the missile reaches the velocity of 550 m/Sec. The length of this type of missile is 6 m, maximum diameter of the body - 0.4 m, weight at takeoff - 350 kg. The missile is provided with crosslike triangular wings and with an empennage. The wings can move along the body of the missile in response to the shifts of the location of the center of gravity of the missile during the flight.

Present trends to perfect the antiaircraft guided missiles are aiming at: more precision in guidance system, increase of the range and ceiling. Besides that, a more effective warhead is also being developed, as well as more efficient methods in the use of this missile.

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*) Eng Maj Kruchinin asserts for instance that American antiaircraft guided missiles battalions consist of four batteries, each battery of four launchers. All the ground installations of American battalions are movable and can be transported by airplanes. Around many American cities permanent launching positions are built, provided with underground munition depots, elevators, etc.

The author of the article believes that greater effectiveness in the antiaircraft guided missile may be obtained by providing the missile with an atomic warhead. He asserts that according to the already published date, the antiaircraft guided missile with an atomic warhead was tested in the beginning of the year 1955. This missile with an atomic warhead was supposedly used against aerial targets flying at the high altitude in order to avoid any damage to the objects and ground installations. According to Maj Kruchinin, the sphere of complete destruction of aerial targets by atomic warhead will have a radius of several hundred meters.

Further the author points out that effective use of antiaircraft guided missiles requires a high degree of coordination in the functioning of all the different parts of the system, and particularly proper functioning of the detecting and tracking elements, furnishing the necessary data and guiding the interception.

Eng Maj Kruchinin ends his article by citing Marshal Zhukov's statement at the XXth Party Congress, that the Soviet Union possesses now for its air defense, besides other weapons, also rockets and guided missiles. "Mastering the new antiaircraft defense materiel", says the author, "is the next step in rendering the USSR still more secure."

Engineer V. Grenin About Antiaircraft Guided Missiles:

A year later, after the above cited article, another Soviet author, Engineer V. Grenin published a very similar article in the Soviet Aviation (Sovetskaya Aviatsiya) (65), in which, however, are presented different data in regard to the antiaircraft guided missiles.

Engr V. Grenin, in the beginning of his article asserts that the present development and perfection of the strategic bombers and of long-range jet guided missiles capable of carrying atomic and thermo-nuclear charges considerably increased the importance and responsibility of the antiaircraft defense of all vital industrial and administrative centers of the country.

In connection with this fact, a great scientific research work and testing constructional endeavours are going on in the Soviet Union in order to meet all the requirements of the modern air defense of the country.

Among the means assigned to that task, apart from all-weather fighter-interceptors, possessing high flying and combat characteristics, are also the antiaircraft guided missiles. These missiles in a series of cases may appear as a reliable weapon against the enemy guided missiles.

The antiaircraft guided missiles are not designed primarily to combat only the enemy bombers and airplane-missiles flying at subsonic speed, but they may be also used against air targets of supersonic speed, at various altitudes as well as for interception of these targets at a long distance from the defended objects. They are also designed to combat the enemy guided missiles. Further, Engr V. Grenin characterizes the following problems connected with the antiaircraft guided missiles:

(a) Guidance Systems

The author asserts that for some type of antiaircraft guided missiles the probability of hitting is over 65 percent. The effectiveness of antiaircraft guided missiles depends on the correctly chosen aero-dynamic form, type of launching mount, size of the warhead, and in particular on the reliability and

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accuracy of the guidance system.

The author asserts that among the various guidance systems applied to the anti-aircraft guided missiles the most wide-spread are the so-called command guidance and beam-rider systems. Further, the author gives detailed description of the guidance system, which in general are similar to those mentioned by the Soviet author, Eng Maj Kruchinin. (64)

(b) Utilization of Antiaircraft Guided Missiles

According to Engr V. Grenin, the antiaircraft guided missiles are designed to destroy the enemy air targets at altitudes which are unattainable by the conventional flak artillery or fighter interceptors.

External look of the antiaircraft guided missile reminds one of the guided rocket with the cross-like triangle shaped wings and steering elements placed on the front part of the missile.

The starting weight of one of the missiles of this type amounts to 1000 kg, the length - 6 m, the maximum velocity about 700 m/sec, combat ceiling 20-23 km, slant range 30-40 km.

This type of missile is equipped with a liquid fuel jet motor. The fuel consists of concentrated nitrous acid with some admixture of nitric oxidizing agents, and also of gasoline, which is used in the turbo-jet engines. To launch this missile, a powder jet-motor is used, (see Fig. 54 on the right, in the Inclosure 36) which detaches itself from the body of the missile after the supply of its solid fuel is exhausted. The firing of the antiaircraft guided missiles is effected from special launchers [launching mounts].

The interception of aerial targets at a low altitude presents a series of difficulties caused primarily by the influence of the various objects in the environment of the launching site on the guidance system. At the low altitude appear additional reflected waves, echoed by the local hills, buildings, sea waves and clouds. All of that forms some background which interferes with, or strongly hinders the detection of moving aerial targets.

The author of the article believes that the most important problem in developing antiaircraft guided missiles, designated to combat low flying targets, is the creation of adequate, reliably working guidance system.

For this purpose, (says the author) (according to the press information), there are under construction missiles powered by a liquid fuel jet-engine, with a range up to 80 km. Further, he asserts that the antiaircraft guided missiles of long range, as a rule, are powered by the ram-jet engine, which has comparatively low fuel consumption and can secure a velocity surpassing 4 times that of sound, and a combat range of up to 30-35 km. in height. Such missiles are equipped with the wings, thus resembling conventional jet-aircraft.

From its outward appearance, one of this type of guided missiles (see Fig. 54, Incl. 36) on the left, is an all-metal aircraft monoplane with triangle-shaped wings and with a similar empennage. It is equipped with two ram-jet engines, placed on two pylons.

For the acceleration of the missile in flight, an auxiliary liquid fuel jet-engine is placed in the missile's tail part. The length of this type of missile reaches 11 m, maximum velocity 3200 km/h, maximum range 320-400 km.

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The author says, that it seems that the guiding of the missile to the target is effected by means of a combined guidance system, but at the end part of its trajectory the missile is directed by the homing guidance system.

(c) Antiaircraft Defense and Rocket Weapons

Engr V. Grenin believes that the utilization of the antiaircraft rocket weapons on a large scale should sharply raise the effectiveness of the antiaircraft defense of the country. There is the reason why greater efforts to perfect and to raise the efficiency of the antiaircraft guided missiles should be made. One of the means by which this goal may be achieved is considered to be the atomic charge in the antiaircraft guided missile's warhead.

The use of the atomic warhead will certainly sharply increase the probability of hitting the aerial targets, and also the probability of destruction of a group of aircraft by one missile.

According to the press news (says the author) such warheads with the atomic charge for antiaircraft defense purposes are already under development. Concluding this article, Engr V. Grenin said that in fulfillment of the Defense Minister's statement at the XXth Party Congress, much work has been done in the USSR in the field of air defense organization.

As a result, the Soviet Union antiaircraft defense has now at its disposal not only a modern fighter aviation and highly efficient flak artillery, but also antiaircraft rocket weapons.*)

(d) Guided Missiles for Antiaircraft Defense and Aerial Combat:

In September, 1956 in the P: Herald of the Air Fleet (66), appeared an article written by the Bachelor of Science, Eng Lt Col V. N. Glukhov, in which he describes the types of guided missiles used for antiaircraft defense purpose.

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*) The growing interest of the Soviet antiaircraft command in the utilization of rocket weapons and guided missiles for the antiaircraft defense purpose is also confirmed by a series of articles popularizing these problems in the Soviet military and para-military press. Particularly, descriptions of foreign achievements in this field are often given. For instance the P: Military Science (67), published in December 1956, a significant article by P. Marudin who supplies quite detailed information about the USA antiaircraft defense missiles (pp. 14-15). Maj General G. I. Pokrovskiy in his manual on the same subject (68) also describes the USA antiaircraft defense rockets and guided missiles (pp. 51-55).

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According to the author, the antiaircraft guided missiles may be divided into two groups:

(a) Flak guided missiles [surface-to-air guided missiles, described in Russian as: Zenitnyye upravlyayemyye reaktivnyye snaryady - ZURS]

(b) Aerial combat guided missiles, designed as a weapon of the fighter-interceptors [air-to-air guided missiles, described in Russian as: upravlyayemyye snaryady vozdushnogo boya]

The flak jet-powered guided missiles are (says the author), winged, and as a rule, two-stage rockets. In the first stage the missile is usually launched by a solid-propellant rocket launching charge. In the second stage the missile is powered by a liquid fuel jet engine, or ram-jet engine. Such construction of the motive power secures for the missile the speed necessary to intercept the aerial target.

Further, the author cites some performance data of these missiles; one of the models of these missiles has a range of about 32 km (the maximum effective combat range in altitude - 16 km), maximum velocity of 650 m/sec, weight of 1500 kg., length of 15 m. Its launching and basic motors are powered by solid fuel. After the propellant burns out (in 3 sec.), the starting motor detaches itself from the missile. During the flight the missile is guided by the movement of the wings; the tails assembly is immovable and serves only for the stabilization of the flight. The guidance of the missiles to the target is effected by means of a radar beam from surface or shipboard radar station.

The other model of this type of missile is also a two-staged rocket of 10 m overall length. The first stage of this missile is a 4 m long starting engine [the author calls it also a "booster" - uskoritel' and in another case "starting engine" - startovoy dvigatel'].

The second stage is formed by the missile proper. The diameter of the starting engine is 0.45 m, and of the missile proper - 0.3 m. The weight of the missile at the start is 1000 kg, 550 kg of which belongs to the starting engine. The starting engine works on solid fuel; the missile's proper engine uses liquid fuel, (zhidkostnyy reaktivnyy dvigatel' - ZhRD).

The aerodynamic design adopted for this missile is of the "duck" type, (utka). The steering assembly is located in the head part of the missile. The maximum effective altitude range is 18 km, the maximum slant range is 27 km, the minimum range of combat use is about 6 km, the maximum velocity is 670 m/sec. The probability of hitting is 65 percent (without taking into account the interferences).

The missile is guided to the target by a radar station, and on the final part of its flight by the homing system located in its head.

The author concluded this part of his article by the statement that the flak guided missile are designed to hit the aircraft maneuvering at the high altitude, under conditions in which the fire of the conventional flak artillery is ineffective. The types of the Soviet ground-to-air guided missiles and new rockets are presented in Fig. 55-56, Inclosures 37, 38. (77), (78)

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(e) Jet-powered Missiles in Aerial Combat

The same author, Eng Lt Col Glukhov (69) made the following remarks about the jet-powered missiles in aerial combat:

The increase of altitude and speed of bomber aviation has substantially reduced the possibility of attack of fighter-interceptors and made the aerial combat more rapidly moving.

On the other hand, thanks to the considerable gross weight of bomber aircraft, which enables effective artillery protection against the fighter attack in the rear hemisphere, the chances of a fighter-interceptor to approach the bomber sufficiently close are much reduced. Consequently, the fighter-interceptor is forced to open the fire from great distances, thus reducing the effectiveness of his attack.

The analysis of the development of fighter aviation has shown that the effectiveness of its attacks was increased, thanks to better sighting system, and also, thanks to the increase of the caliber of aerial guns. However, the increase of the calibers of aerial artillery encounters a substantial difficulty, because the recoil of more heavy guns affects the aircraft.

Also, fighters equipped only with unguided jet-propelled missiles can not fully solve the problem of effective combat against an aerial enemy. Therefore, concludes the author, only guided jet-powered missiles which contain huge destructive power and great accuracy of hitting, present great possibility of increasing the effectiveness of fighter attack.

That is the reason why during the last decade so much attention is paid to this weapon in many countries, says the author.

Particularly intensive effort was made to develop the guided missiles for aerial combat in connection with the appearance of atom and thermo-nuclear weapons, when necessity for the destruction of all enemy bomber aircraft heading toward the target arose.

Up to the present time (asserts Eng Lt Col [redacted]), a great number of various guided missiles for aerial combat was worked out which vary in weight, dimensions, aerodynamic features, types of engines, system of guidance, and in the characteristics of the warhead.

After giving the detailed characteristics of systems of guidance of these missiles, the author expresses the following opinion about them:

"The guided, jet-powered missiles for aerial combat, which combine high accuracy of fire with the powerful charge of warhead, present very effective means of combating the aerial enemy. No doubt, they will have a very substantial influence on the methods of conduct of combat operations."

E. Air Defense Radio-Technical Service:

(a) Development:

According to Maj Gen N. I. Gapich, the Soviet military radio service was already playing a very important role before World War II. At that time the

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radio service was incorporated into the Signal Troops. (70)

According to Marshal of the Signal Troops I. T. Peresypkin, the importance of the radio-technical service was immensely increased during and after World War II. In his book published in 1948 (71), Marshal Peresypkin pointed out that the radio service, thanks to the development of new radio-technical means, such as radio-location, received a new, still more important role in the air navigation and antiaircraft defense. In particular, he asserted that radio location became one of the most decisive factors in aerial and naval operations and greatly increased the effectiveness of the antiaircraft fire.*

(b) Radio Technical Troops:

Thus, the Soviet Signal Troops (Voyska Svyazi) have developed new formations called Radio Technical Troops (Radio-Tekhnicheskiye Voyska), assigned for combat cooperation with all the main arms, and in particular with the antiaircraft defense troops. The important role of these troops in the antiaircraft defense was described in general terms in one of the Red Star editorials in June 1957 (73). Detailed description of the activity of the radio technical troops and principles in the use of radar equipment in antiaircraft defense appeared in the Soviet publications quite often.

(c) Radar in Antiaircraft Defense Service:

In 1954, Candidate of Technical Science, Docent V. S. Nelepts and Eng G. B. Byelotserkovskiy published their text book: "Fundamentals of Radar" (74), in which they have described the task of radar stations in antiaircraft defense in the following way:

..."Radar helps to detect the aircraft (or warships). A radar station may be installed on the ground in aircraft or ship. Usually the range of such station is within 50 to 200 km. At such distances the accuracy of location is less important, and the slant range determined according to the indicator, is assumed as horizontal. Some radar stations are equipped with an altitude indicator."

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*(In his next book, edited in 1955, Marshal Peresypkin analyzed the role of military radio operator in peace and in wartime. In this book Marshal Peresypkin emphasized the great importance of mass training of radio and radar specialists for the defense of the country, notably within the framework of DOSAAF organizations. (72)

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"In order to assure the right approach of the fighter to the enemy airplanes, the antiaircraft defense utilizes the fighter direction stations. These stations, watching the enemy airplanes, determine the coordinates of the targets and communicate them to the fighter. When the fighter pilots approach the air targets, they switch on their short range interception radar stations."

"The radar stations which establish the target actual data are utilized also for direction of the antiaircraft artillery fire. The target actual data determined by the radar station [antiaircraft artillery director] are transmitted to the computing device which established the ballistic elements for the antiaircraft fire."

"In case of necessity to illuminate the enemy airplane by searchlight, usually to the searchlight is added a radar station, which constantly sights the searchlight at the target without light beam. At a determined range, the searchlight is switched on and the beam illuminates the airplanes after that are switched on the auxiliary searchlight and the guiding searchlight [again switched off] may continue the target search."

(d) Description of the Antiaircraft Radiotechnical Means:

The Large Soviet Encyclopedia, Vol 35, published in 1955 describes the utilization of radio-location for the air defense purpose in the following way. (75):

"The radio-location station for detection of air targets may be of stationary or mobile type with various ranges of operation. The stationary stations which are utilized in the air defense system, have the range of action against heavy bombers amounting to 400-450 km and more at the altitude of the bomber flight of 12 to 15 km. The range of action of the mobile radio-location station is 200-350 km."

"While detecting the air target at a great distance the radio-location station does not need precise data about the altitude, but with the approaching air target, accurate determination of the altitude becomes indispensable, in order to guide the fighters interception, or to direct the antiaircraft artillery fire."

For this purpose besides the radio-location station is mounted a station indicating the altitude of target. This altitude indicating station may have the same range of action as the main detecting station, or smaller, and at times it may amount to 120-150 km. Constructionally, both stations may be combined. Such combined station, if it is serving the fighter aviation, is called the station of detection and ground control of interception, and if it is serving the antiaircraft artillery, it is called the air targets detection station [radar plot] which supplies the data to the antiaircraft fire control stations. Such station may guide the fighter to the air target with accuracy up to several km (in daytime). In the night, or in a complex meteorological condition in daytime, the search of a single aircraft only on the basis of radar detector data is extremely difficult, and in many cases impossible."

"For this reason, modern fighters (fighter-interceptors), designed to act in complex meteorological conditions at day and night, are equipped with a special interception and sighting radar. This radar secures for the fighter an accurate approach to the target and controls the fire at night, and in the clouds, without visual reference to the target. The fighter-interceptor after being guided toward the target by the radar ground control, determines

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more precisely the position of the target, independently of the ground station by means of his own board interception and sighting radar. While approaching the target, this board radar automatically tracks the target and transmits the position data to a computing device, which supplies the sighting elements for an aerial fire.

"In the antiaircraft artillery antiaircraft fire control radars are utilized, (SON)* which work two ways: search and tracking. While searching, this [illegible] target it determines the coordinates of the target with great accuracy, about 10-20 m in range and 3-5 minutes of the arc (i.e. one graduation of azimuth scale) of angular coordinates."

"All the coordinates of the target determined by SON are transmitted automatically and continuously to the antiaircraft fire director (PUAZO**) which computes the lead elements of fighting for the guns and directs the fire."

"In order to increase the probability of hit, the antiaircraft artillery projectiles are provided with homing device-fuzes. The same kind of homing device is utilized also for the antiaircraft guided missiles."

The Large Soviet Encyclopedia (76) presents various types of radar stations and reproduces their photographs.

The types of Soviet antiaircraft artillery and fighter aviation radar equipment in the current use and also the photographs of the Soviet radar personnel are presented in (Inclosures 39, see Fig. 57, (79), Fig. 58, (80) and Fig. 59 (81). Fig. 60, Inclosure 40 shows the most commonly used type of radar station for detection of air targets. (82)

(e) Radar for Control of Antiaircraft Artillery Fire:

More detailed description of the Soviet methods of use of radar for control of antiaircraft artillery fire was published by Eng Maj Candidate of the Technical Sciences, M. Katkhanov. (83). Here are the excerpts of his article [see also the Chapter: "Soviet Antiaircraft Artillery and Automatic Fire Control Systems".

"The scheme of the gun controlling installation with the power tracking drive consists of (see diagram, Fig. 61, Inclosure 41) -

(1) command control transmitting unit, located at the command post

(2) electric synchronous transmission line

(3) measuring device

(4) directing unit

(5) servomotor

(6) independent power supply unit

*) SON - Stantsiya Orudiynoy Navodki - antiaircraft fire control radar.
**)PUAZO - Pribor Upravleniya Artilleriyskim Zenitnym Ognem - antiaircraft fire director.

"The servo-motor is mechanically coupled with the aiming mechanism of a gun. The measuring device (3) is linked with the command post and the motor shaft (5). The measuring device compares the angle of the tracking drive transmitter with the position of the axis of the bore, and depending upon the difference between those angles, originates and electric signal which is transferred to the director [directing unit] where it is amplified. Then, that signal is supplied to a servomotor. The gun is turned by the motor until the gun angle and the angle of the sender in the tracking device coincide. When the gun is turned to the preset angle, the voltage supplied by the measuring device becomes equal to zero and its action upon the director is interrupted, and the gun stops."

"Besides this, the antiaircraft fire is controlled by a set of special devices. As soon as an airplane appears in the zone of fire the gunners determine its actual coordinates. When the target is directly seen, an optical sight, or range finders are adopted. At night and in fog the detection of the aircraft and determination of its coordinates is effected by means of a radar station. The combined use of both systems secures the effective search of the air target and determination of its coordinate at anytime or any weather.

(f) Antiaircraft Fire Controlling Radar and Director:

Further, Eng Maj Katkhanov describes the process of antiaircraft fire control in a following way:

"The target coordinates are automatically transferred from the transmitters of the radar tracking device along the synchronous data transmission line to the central computing device called antiaircraft artillery fire director (PUAZO-Pribor Upravleniya Artilleriyskim Zenitnym Ognem). The modern PUAZO consists of assembly of complex electro-mechanical and electrical devices, which according to received data, determines the coordinates of the point of the target lead and directs the setting of the guns. PUAZO solves the problem of the target encounter point automatically by the electric tracking systems, without human interference. Gun setting data are sent from PUAZO continuously through the synchronous transmission line to the antiaircraft battery located at some distance from the commadd post . The radar station, synchro-drives electric elements of PUAZO and also servomotors of the guns are supplied by a powerful current source." (88)

(g) Radio Technical Troops in Air Defense:

Radio technical troops of air defense (Radio-tekhnich-eskiye voyska protivo-vozdushnoy oborony) and description of their activities appeared in the Soviet available publications quite often. Also were given several times the characteristics of the radio and radar personnel and their equipment, [the radio and radar operators are popularly called in the Soviet sources as "radiomen"- radisty].

According to these publications[which will be cited later, together with the example of radio technical units in operation and training], the radio technical troops form the most important components of the VNOS service and radio meteorological service (Radiometeorologicheskaya sluzhba). They appeared alsoas an organic component of antiaircraft fighter aviation and antiaircraft artillery. (84)

However, on the basis of available sources it is difficult to determine the interdependence of radio technical troops and signal troops (voyska svyazi)

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and the organization of radio technical troops on the level higher than regiment (radio-tekhnicheskaya chast').

The smallest unit of radio technical troops is the crew of a radio or radar station. In the available sources, also radio technical company and battalion appeared. Radio technical troops serving the aviation division, or antiaircraft artillery division are organized as a large radio technical unit [some Soviet sources mentioned this unit as a regiment], which serves as an administrative and training base for the radio technical personnel. This was confirmed, for instance, by the news item which appeared in N: Soviet Aviation (Sovetskaya Aviatsiya) in December 1956, (85) in connection with the "divisional competitions for radio and radio technical personnel, serving in N-aviation division."

According to Marshal Biryuzov, Commander-in-Chief of the Soviet Troops of Antiaircraft Defense of the Country. (84), the personnel of radar stations belongs to one of the leading specialities of the antiaircraft defense forces. Together with the fighter pilots and antiaircraft artillerymen, radar operators participate directly in combat against the air enemy, and are responsible for his destruction. (85)

(h) Air Defense Radar Operations:

Descriptions of air defense radar operations and characteristics of radar personnel, called in the Soviet army: "soldiers of the radar stations" (voiny raschetov radio-lokatsionnykh stantsiy), or simply "radarists" (lokatorshchiki) are quite numerous in the Soviet press. For instance, in October 1956 appeared in N: Red Star (Krasnaya Zvezda) a report of a military correspondent from Bakinskiy [Baku] Air Defense District in which he describes the activities of the soldiers of radiotechnical subunits, serving various radar posts (voiny radio-tekhnicheskikh podrazdeleniy okruga PVO)

There is also information about a radar technical station in the Pribaltiyskiy Military District, which obtained good results in tracking the air targets in its zone of observation. (86)

(i) Radar Stations Serving Fighter Aviation:

Another description of the operation at the Soviet radar station appeared in the Red Star (Krasnaya Zvezda) in August 1956. (87):

"The radar station commanded by Sergeant Kirichek was ready for the antiaircraft defense exercise. The crew of the station was waiting for the command to start the search of the target. Soon came the command. The radar aerial started to turn. On the indicator screen appeared an impulse, reflecting an aircraft in the air. Judging from the rapid displacement of the impulse and its form, the operator concluded that the spotted target was a single, high-speed airplane. Further checking confirmed that it was an "enemy" airplane. The fighter interceptor took off and the radar operations attentively tracked the (enemy) airplane." "Suddenly, the impulse disappeared from the radar indicator; apparently the 'enemy' used radio interference, which was swiftly eliminated by the commander of the radar station. Despite this action, (the 'enemy' airplane changed the course and made a sharp descent), it could not escape the direct attack of the fighter pilot."

"Thus, the operators of Sergeant Kiricheks radar crew successfully completed their mission and performed with high combat skill."

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(j) Radar Station Serving Antiaircraft Artillery:

The other example of antiaircraft radar stations in operation on behalf of an antiaircraft artillery battery supplied the Red Star (Krasnaya Zvezda) in May 1955: (88)

..."at the preset time all the guns of the battery were pointed towards the sky. A monotonous, steady humming of the radar station was heard from the hill. The antenna of the radar stood out against the bright sky with a shining small lamp located in the very center of the grid disc. From the command post came the order for search. At that moment the operator was looking at the orange screen of the plan position indicator, exactly at the bright radial line on its surface. By a smooth rotation of the control wheel he sets the scanning at the desired sector. It means that the antenna had turned its "eye" toward that part of the sky from which the target was to appear.

"The operator was attentively observing the indicator and suddenly noticed a new, brighter and thinner traverse trace on the screen. He reported: 'Target detected, azimuth forty seven.'

"The target image approached the prefixed boundary line and the second operator reported this fact to the operator number one. Two round indicators flicked before him. A traverse trace was seen on the right half of the indicator screen. It was the target. At that very time the target image also appeared on the screen of the precision aiming indicator. Here, the pulses coming from the space, produced a luminous cloud and developed the target image in the form of a bubbling drop, moving quickly anticlockwise on the screen. The operator number two, after a quick look at the green light, reported: 'Data Received'.

"The exact position of the target was automatically transmitted to the computing unit every second through the complex system of the station. With the use of tables, the operators quickly determined the meteorological and ballistic corrections, and by pushing special knobs, supplied them to the computor. Wind, weight of the projectile and its trajectory were taken into account and translated into figures by that ingenious and rapid machine. (88)

(k) Radio Day in USSR

The importance of the radio and radiotechnical service in the Soviet armed forces was emphasized by instituting the Radio Day Celebration, May 7th. On this occasion the editorial of the Red Star on May 7, 1955 stressed the particular importance of radiolocation for the military purpose, and especially for antiaircraft defense. (89)

In the same number of the N: Red Star (Krasnaya Zvezda) on the occasion of the Radio Day were reproduced the photographs of the outstanding soldiers of the radar service (See Fig. 62 through 65, Inclosur 42).

(l) Antiaircraft Searchlights

Col A. Borodin in his article published in P: Military Science (Voyennyye Znaniya) in April 1956, described among other means of antiaircraft defense, also the antiaircraft searchlights. (91)

Antiaircraft Searchlights (Zenitnyye prozhektory), according to Col Borodin, are designed to illuminate the air target in order to enable the fighter aviation, antiaircraft artillery and antiaircraft machine guns to find and

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to destroy the air target. *)

According to Col Borodin, the modern searchlight has great candle power amounting up to two billion candles. Its maximum range is 40-50 km. The searchlights are used in a group of two or three projectors acting simultaneously. The types of searchlights used in the Soviet air defense and also in the satellite countries are shown in (Fig. 67-69, Inclosures 44-45. (92)

Because the search for enemy airplanes at night with conventional searchlights, presents considerable difficulty, for usually radar is used with the searchlights and this combination is called in the Soviet army "radio-projector."

(m) Searchlight-Control Radar

Lt Col M. Meshcheryakov in the Illustrated Newspaper (Illustrirovannaya Gazeta), in February 1956, describes the operation of searchlight-control radar in the following way. (93)

"In the distant air approaches to the [defended] object an 'enemy' airplane flying at a high altitude and with great speed was detected. At the radar-searchlight station, a command was received 'illuminate the target'. Commander of the station, Lt Belyayev swiftly prepared the station and the combat crew for action. The crew completed all the preparatory work at the station in the shortest time possible. Sen Operator, Sergeant P. Drozdov quickly found on the indicator screen of his radar the target and reported - 'target bearing-range 25'. The fighter-inceptor guided to the target, reported 'see the target-attack'.

"The crew of Lt Belayayev's radar-searchlight station received only excellent and good marks for combat and political preparation. All radio operators of the station are graded specialists.

"Right now, the radar-searchlight station received a group of new young soldiers who successfully acquire the complex skill of radio-searchlight's technique and prepare themselves to become expert-masters in their military profession."

*) The problem of servicing the fighter aviation in aerial night gunnery by lighting the targets in the sky was examined by Eng Col S. Sheludchenko in his article, published in P: Herald of the Air Fleet (Vestnik Vozdushnogo Flota) in January 1955.

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chlight-control radar

The photograph accompanying the articles shows
and its crew in operation (see Fig. 69, Inclosure 45).

The personnel serving in the antiaircraft searchlight or radio-searchlight
units are called generally in the Soviet Army, [redacted]
Their dependence on the radio technical units can not be confirmed in the available sources, however, it is logical to assume that they form a part of these units. Their assignment to the antiaircraft fighter aviation or anti-aircraft artillery was confirmed on several occasions. However, it is not certain whether they are attached permanently, or according to the missions.

II. GENERAL CHARACTERISTICS OF THE SOVIET AIR DEFENSE TROOPS:

Marshal of the Soviet Union, S. S. Biryuzov was called for the first time in the press "Commander-in-Chief of the troops of air defense of the country" (Glavnokomanduyushchyy voyskami protivovozdushnoy oborony strany), on the occasion of the All-Army Conference of leading soldiers which took place in Moscow in March 1957. (95)

At the same time his photograph was published in the N: Krasnaya Zvezda (Red Star), in which he appeared in the company of Marshal of Artillery Yakovlev (apparently the high commander of the air defense artillery) and leading soldiers of air defense troops, all of them in artillerymen uniforms, (see Fig. 3, Inclosure 3).

However, it was known long before this event that the organization of the air defense of the country was entrusted to Marshal Biryuzov, and that in this capacity he published in August 1956, an article describing the general characteristics of the air defense troops. (96)

Here are the most essential points of his article on this subject:-

1. Growing Importance of Air Defense Troops in Modern Warfare

Marshal Biryuzov pointed out that after the last war the importance of air defense troops had increased enormously. He then quoted the statement of the former Soviet Defense Minister, Marshal of the Soviet Union, G. K. Zhukov, [at the XXth Party Congress], who asserted that the future war, if launched by the "aggressive imperialistic forces" will be characterized by the mass utilization of the air force, of various rocket weapons and other means of mass destruction such as atomic, thermo-nuclear, chemical and other weapons.

Military specialists of the "bourgeois countries" assert that these powerful means of destruction will be delivered on enemy territory, most probably by the air force, or various pilotless means.

In the light of this, (said Marshal Biryuzov) it is clear why "aggressive circles" of the United States strive to develop in every possible way their strategic aviation, and enlarge the network of the air bases around the Soviet Union and countries of the Peoples's Democracies. It is known that there is a considerable number of these air bases designed mostly for strategic aviation.

"The Soviet people", continued Marshal Biryuzov, "occupied with peaceful, constructive work, cannot ignore the serious menace to the Soviet state represented by this plotting of the enemy of Peace".

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Marshal Biryuzov then asserted that the Communist Party and the Soviet government had taken all necessary measures to strengthen the defensive power of the country, and in particular, to assure that the air defense will be organized in accordance with the latest achievements of modern military technology and science. Thanks to the constant care of the Party and government the whole organization and preparedness of the Soviet armed forces in the period after the last war were accomplished in conformance with the most modern combat techniques.

Accordingly, the effectiveness of the air force and air defense troops was considerably increased.

Here again, Marshal Biryuzov quoted a statement of the former Soviet Defense Minister, Marshal Zhukov, at the XXth Party Congress, who said, ..."taking into account the real menace from the air, especially from long-range rockets and jet-propelled strategic aviation, the great task of organizing the air defense was already accomplished in the country."

"At present, the antiaircraft defense possesses supersonic modern fighter aviation, high quality antiaircraft artillery, antiaircraft rocket weapons, and other means which secure the antiaircraft defense of the country."

2. The Morale of Soviet Air Defense Personnel

According to Marshal Biryuzov, the soldiers and officers of the air defense, like all soldiers of the Soviet armed forces, fully realize the great responsibility which the Soviet nation had entrusted to them in the defense of the Fatherland, and that they should make a great effort in mastering the combat technique and weapons, and persistently strive to acquire the skill to use these weapons most effectively.

It is known, (said the Marshal) - that the rapid growth of speed and ceiling in modern aviation and of its radius of action greatly increased the importance of surprise of an air attack. Jet-propelled bomber aircraft carrying the atom, or thermo-nuclear weapon is able to cover great distances rapidly, and appearing suddenly in the enemy's deep rear, may strike a powerful blow against important administrative, industrial and military centers. To repulse such an attack, to destroy in time the enemy bombers, or to force them to give up their mission are the tasks of air defense troops. Thus, it is clear how important it is that air defense personnel maintain a constant high combat readiness. Unfailing vigilance, the ability to rise into air combat at any moment, and to hit the enemy with a decisive blow are the requirements which must be met by the air defense personnel.

Despite the difficulties of the task, Marshal Biryuzov assured that the soldiers of the Soviet antiaircraft defense are always ready to accomplish it successfully.

3. Characteristics of Air Defense Operations

Asserting anew that the Soviet air defense troops are equipped with first class modern combat means to cope with any combat task regardless of its complexity, Marshal Biryuzov thus described the methods of operation of air defense:

A. Fighter Aviation:

(a) Air Reconnaissance - First it is necessary to detect the approach of the enemy airplane, or his pilotless means of attack. The earlier the warning, the more successful the preparation of the combat mission by the antiaircraft personnel.

Quite recently (recalled Marshal Biryuzov) the task of the air reconnaissance (during the "Great Fatherland War") was entrusted to air observation posts of the VNOS service [air observation, warning and communication service, sluzhba vozdushnogo nablyudeniya, opoveshcheniya i svyazi]. At that time, the detection of enemy aircraft was effected visually in observation sectors which determine the type of aircraft, their course and approximative altitude. Experienced observers at that time were able to cope successfully with their complex task, because the speed and ceiling of their air targets were low when compared with modern aircraft. However, their task became very complicated in bad meteorological conditions [solid cloudiness] and at night.

Today, this task is accomplished by accurate technical means such as radar, which detect the air target at a distance of several hundred kilometers, determine whose airplane it is, and also provide other indispensable data.

(b) Ground-controlled Interception

Continuing, Marshal Biryuzov described the principles of ground-controlled interception. According to the radar data, the fighter interceptors of the air defense take off. The ground control keeps in constant touch with the fighter pilots and directs them to the target. At this stage of operation, the fighter pilots rely entirely upon the guidance of the ground-controller. The ground controller using the radar data controls the situation in the air, and like an orchestra conductor, guides the fighter pilots intercepting the air targets.

When the air enemy is near, the fighter pilot does not need the ground controller's prompting because he can "see" the enemy bomber on the screen of his airborne radar, and can sight at it the powerful weapons of his airplane. But, at that stage the mission is far from completed. Modern bomber aircraft are in reality flying fortresses. Their most important vital parts are protected by solid armor. They carry on board powerful cannons, and like fighter aircraft, radar equipment. To approach such air enemy unnoticed, and to shoot it down from short-range is not so simple. Moreover, modern bombers are now powered by jet engines, which enable them to fly at great speeds, and to climb rapidly to high altitudes. To conduct an air combat under such conditions is extremely difficult.

B. Antiaircraft Artillery:

Marshal Biryuzov pointed out in his interview that the Soviet antiaircraft artillery, equipped with first class combat materiel, is a powerful defense against the enemy air attack.

The modern antiaircraft artillery, equipped with radar antiaircraft fire control stations (SON)*), is able to hit the air target with accurate fire

*) SON - Stantsiya Orudiynoy Navodki, Gun-laying Radar Station.

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even under cover of darkness or cloudiness, or at high altitudes. The use of radar considerably increased the operational capacity of antiaircraft artillery, and the effectiveness of its fire.

Detection of targets is entrusted to the crews of the so-called plan-position indicator stations whose main task is distant air reconnaissance. For the accurate location of the air target and determination of its coordinates, the antiaircraft artillery has the already mentioned radar antiaircraft fire control stations (SON), which can determine the air target coordinates with great precision, although not at very great distances.

(a) Tracking the Air Target

The method of tracking of the air target is described as follows by Marshal Biryuzov. Using the data of radar detecting stations, the operators of the radar antiaircraft fire control station (SON) catch the air target while it approaches the antiaircraft artillery zone of action and track it uninterruptedly, transmitting its exact coordinates to the antiaircraft fire director (PUAZO). These data are transmitted automatically. PUAZO is a complicated and "clever" device capable of solving the most difficult mathematical problems, and also of determining points at which the fired projectiles will meet the air target. The data computed by the PUAZO are transmitted uninterruptedly as electrical impulses through a synchronous line to the guns.

(b) Characteristics of Soviet Antiaircraft Guns

Marshal Biryuzov praises the Soviet antiaircraft guns - products of the national artillery industry. According to his statement, these guns are complicated in construction and possess high tactical and technical characteristics. Their most important qualities are:

1. Accuracy of fire
2. Maximum rate of fire
3. Maximum effective range
4. Great initial projectile velocity
5. Great blast power of projectile

"Operating such guns in combat places great responsibility upon the antiaircraft artillery men," said Marshal Biryuzov.

Characteristics of Antiaircraft Artillery Specialties

The antiaircraft artilleryman should possess a great deal of knowledge in the field of theory dealing with the antiaircraft fire and should be an expert in artillery materiel. But even that is not sufficient.

The antiaircraft artillery personnel must be well prepared for the performance of their duties, must be in good physical condition, be hardened and possess great endurance. These requirements concern particularly such specialists among the gun crews as loaders.

Antiaircraft combat is a rapidly moving action. The enemy bomber may remain in the zone of antiaircraft battery fire only a few seconds, i.e. that the antiaircraft personnel would then have very little time to prepare the fire, to open the fire and to hit the air target. Evidently, under such conditions the accuracy of the first salvo decides the success. It follows that if the first salvo is a miss, the enemy pilot seeing the bursting shells around him

will hasten to use the antiflak fire maneuver and will escape the zone of effective fire.

If the antiaircraft artillery salvo is repeated, it is rarely successful, because correction introduced in the firing error may result in the failure of the combat mission.

Marshal Biryuzov asserted that the problem of a hit by the first salvo is of paramount importance to the antiaircraft artillery personnel. In order to solve this problem successfully, the antiaircraft artillery personnel should maintain their combat materiel in an excellent working condition, and should learn with all thoroughness how to prepare it for firing. Moreover, they should strive to operate their guns and antiaircraft fire instruments faultlessly.

4. Specialties of Soviet Air Defense Personnel

Marshal Biryuzov stated that the Soviet air defense requires a great variety of military specialists. The leading specialties are: - fighter pilots, antiaircraft artillerymen and radar personnel. They participate directly in the destruction of the air enemy. But, of course, they cannot fulfill their combat mission without the auxiliary service personnel.

Marshal Biryuzov next pointed out the large variety of military specialties in antiaircraft artillery, which are indispensable for the successful action of this weapon. First, there are the gunners who execute various functions in the gun squad, and on whose skill the successful result of firing depends. In addition to the gunners, and equally responsible for effective firing are operators of the radar stations and of antiaircraft fire directors. Everyone of them assures the accuracy of fire and is responsible for the success or failure of firing.

Similarly important and responsible work is entrusted in the antiaircraft batteries to the artillery armorers, who take care of the combat equipment and artillery materiel, and to the electricians responsible for the power supply and to the drivers responsible for the artillery prime movers.

"Finally," said Marshal Biryuzov, "in order to secure the most successful cooperation and coordination of all these various military specialists of the antiaircraft defense troops, there are specialists at the antiaircraft defense command posts on a higher level of command who have a complete picture of the combat situation."

5. Air Defense Command Posts

According to Marshal Biryuzov, the decision of selecting the air target and proper weapon to attack it, belongs to the commander of air defense. This is possible only if the commander has accurate data and complete picture of the general situation of the aerial combat in a large air space.

The air defense commander receives the positions of enemy airplanes and own fighters from the radar stations, but the data received from plan-position indicators are very relative, and not clear enough. Therefore, they are transformed by means of special devices into a more complete picture, in order to give the commander a clear picture of the combat situation so he can make proper decisions.

When the decision is taken the commander's orders are transferred to the radio and telephone operators. They maintain communication with the firing position of the antiaircraft artillery, with fighter aviation in the air, and acting on behalf of the commander they transmit to them the necessary orders. They also receive reports from the units and subunits subordinate to the commander. It is obvious how very responsible is the role of communication specialists in air defense. The slightest inaccuracy in their action may endanger the execution of the commander's entire plan.

Marshal Biryuzov concluded by saying that the whole system of antiaircraft defense of the country is strong, thanks to well coordinated work and close cooperation of the troops which form the component parts of this defense. That is the reason why "the soldier of each military specialty, acting in the air defense, should realize his high personal responsibility, and should striving by firm and diligent effort to prepare himself to complete his combat task, regardless of its complexity." (96)

III. ORGANIZATION OF AIR DEFENSE:

1. General Principles:

The general pattern of the Soviet present air defense organization was developed shortly after World War II. The standard air defense organization which existed during the war was modified and adapted, according to Marshal Sergey Biryuzov, Commander-in-Chief of the air defense of the country, to the new exigencies created by the unprecedented development of jet powered aviation, electronics and rocket weapons.

No comprehensive source of information as to the Soviet present air defense organization is available. However, according to such sources as the Soviet textbook for local air defense, manuals for various components of the air defense system and daily press information, the general framework of the Soviet present-day air defense organization may be presented in a following way:

The whole Soviet air defense system comprises three branches:

(a) Air defense of the country with specially allotted troops and means for the whole territory of the USSR [and some adjacent areas] under a single Commander-in-Chief (Marshal S. Biryuzov).

(b) Air defense of the armed forces and on the theaters of operation with special naval antiaircraft defense, under the command of respective commanders of the main arms.

(c) Local air defense under single main administration subordinated to the Ministry of Interior.

The responsibility for the air defense as a whole and for proper organization of all forces and means assigned to this defense is entrusted to the Minister of Defense.

The territorial organization of the Soviet air defense in peacetime is based on the so-called "threatened zones" (organizatsiya ptotivovozdushnoy oborony na territorii strany v ugrozhayemykh polosakh).

The system of air defense of the armed forces and on the theater of operation is mentioned several times in the Soviet military press which describes the combat training of antiaircraft defense troops, however, without any substantial information as to the organization and materiel.

For this reason, this report deals mainly with the air defense of the whole country, including local air defense. The general idea of the Soviet air defense system is presented in the organizational chart in (Fig. 70, Incl. 46).

2. Territorial Subdivision

According to the previously mentioned Soviet sources, the Soviet territorial subdivision of the air defense system comprises:-

1. Special air defense districts
2. Air defense on the territory of military districts
3. Areas of specially defended objects

Subdivision of the territory into zones according to the degree of possibility of an air attack was mentioned in the Soviet press, however, without a definition as to the character and extent of the zones. No substantial information was available as to the so-called "exterior" or "outer" zones (vnesnyaya ugrozhayemaya polosa). The existence of the so-called "interior" zone, which covers the territory along the frontiers was confirmed in the Soviet press, particularly in regard to the VNOS service (Observation, early warning and communication service). For instance, descriptions of the radar observation and detection posts beyond the polar circle and along the eastern and southern frontiers, appeared several times in the Soviet press, periodicals and even monographic publications.*)

From such fragmentary information a conclusion may be drawn that the so-called "interior" zone stretches along the whole USSR frontiers, behind the "outer" zone, and encircles the Soviet territory completely.

The zone of air defense of vital centers, or as it is called in the Soviet terminology "objects", covers the most vulnerable areas of the country with important political, military and industrial centers. Around the most important such centers were formed special air defense districts (Okrugi protivovozdushnoy oborony), provided with adequate air defense troops and services.

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*) Recently, N: Sovetskiy Flot (Soviet Fleet), No. 88, April 13, 1958 published news report about the radar observation post on the Island Kheys, Franz Joseph Archipelago (Zemlya Frantsa Iosifa).

Available sources up to now have confirmed the existence of such districts: around Moscow (Moskovskiy Air Defense District, Moskovskiy okrug PVO) and around Baku (Bakinskiy Air Defense District, Bakinskiy okrug PVO). The air defense of vital objects on the territory of military districts, according to the press information describing the combat training operations of the antiaircraft defense units, is the responsibility of district commanders. The antiaircraft defense forces are scattered all over the country, predominantly around the important centers (see the map in Fig. 71, Incl. 47), on which are marked antiaircraft defense units and subunits mentioned on various occasions in the Soviet publications). (97)

3. Assignment of Air Space Areas

According to a previously mentioned source and articles in the Herald of the Air Fleet, (98) the air space over Air Defense Districts is divided into special zones for action by antiaircraft artillery, fighter aviation, and at highest altitudes, antiaircraft rockets and guided missiles.

The air space reserved for fighter aviation is subdivided according to the flying capacity of the aircraft and type of its armament. Some Soviet authors assert that fighter-interceptors equipped with aerial rockets or jet-propelled missiles proved to be very effective in combat at high speed and highest altitude.

4. Airfields of the Soviet Air Defense Organization

(a) Airfields

On the basis of numerous descriptions of antiaircraft fighter operations, which appeared in the Soviet press, it is very probable that Soviet Air Defense Districts have at their disposal a considerable number of small airfields, adapted for fighter aviation, particularly around the important centers and objects of air defense. However, as a rule, in the available sources the description and photographs of airfields are given without indication of their location or assignment. They are generally marked "N-airfield". Their typical general view and their controlling installations are presented on the photograph (Fig. 72, Incl. 48. (99). According to Red Star (March 1957) some of these airfields have the most modern technical airfield installation. (100)

However, from photographs of these airfields (see Fig. 73 (101) and Fig. 74 (102), Inclosure 49) it appears that they have a few conventional airfield installations and these installations are mostly mobile [for instance mobile radar control post]. This is justified by the great concern of the Soviet antiaircraft defense command for decentralization and dispersion, because of the possibility of atomic bombardment.

(b) Anti-atomic Precautions on Airfields

The problem of an air atomic attack against airfields is often discussed in the Soviet press. In 1954 there appeared an article of Lt Col A. Gnedin (103) under the title: "Radiation Reconnaissance and Warning System in the Airfield Area" (Radiatsionnaya Razvedka i Opoveshcheniye v Rayone Aerodroma) in which he describes this problem as follows:

"In present combat conditions, with application of atomic weapons, it may be assumed that airfields will be the first objects of an atomic bombardment by the enemy, who will seek to demolish them, destroy aircraft on the ground and exterminate the personnel of the defender. To prevent such a destruction is the main task of any air force commander.

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"The success of defense will depend on timely measures of protection and for interception and destruction of enemy aircraft. If the enemy uses atomic weapons, everything possible must be done to reduce their striking effects to a minimum. Therefore, air force units and subunits located on the airfield, or in the area of an atomic explosion, must be ready ahead of time to supply defensive measures. This may be achieved by a good organization of the anti-atomic defense of the airfield, skillful protection of the personnel and combat equipment against the effects of the shock wave, heat and lethal radiation." (103) Another author, Eng Lt Col Pavlov, in his article published in 1957 in Soviet Aviation (Sovetskaya Aviatsiya) (104), suggested that in order to enable the aviation to operate under atomic warfare conditions, each subunit (composed at least of 8 aircraft) should be able to act independently, from the technical and operational point of view. According to the author, such maximum dispersion of aviation units will reduce somewhat the danger of atomic air attack against Soviet airfields.

5. Participation of Civil Authorities in the Soviet: Air Defense Organization:

Civil authorities (and also Communist Party Organs) participate in the organization of air defense of the country, particularly in the defense against an air attack on administrative and industrial centers, railway transport, various communal and municipal structures, institutions and population. Also, civil authorities may be entrusted with the defense of areas less exposed to air attacks. In general, the antiaircraft defense entrusted to civil authorities and social organizations is called "Local Air Defense" [Mestnaya Protivovozdushnaya Oborona, MPVO]. Organization of the air defense organized by civil authorities in peacetime as well as in wartime is guided generally and controlled by military authorities [Ministry of Defense]. (105) Participation of Communist Party organs in the air defense of the country is more in the nature of a morale building and propaganda character.

6. Organization of Central Control: High Command of Air Defense of the Country:

According to the statement made by the Soviet Defense Minister at the Party Congress (106), the forces of air defense of the country received a status equal with that of the army, aviation and navy. Their Commander-in-Chief (Glavnokomanduyushchyy Voyskami Protivo vozdushnoy Oborony Strany) is directly responsible to the Defense Minister, who is in charge of the whole air defense system of the USSR. (107) and (108) The air defense command, which according to some Yugoslav source of information (109), was formerly in the hands of the Soviet air force command [before the reorganization of the air defense forces],*) now it is independent and includes the branches of: - air defense fighter aviation, antiaircraft artillery and automatic weapons, antiaircraft rockets (Zenitnoye Raketnoye Oruzhiye), and antiaircraft guided missiles (Zenitnyye Upravpyayemye Reaktivnyye Snaryady. (ZURS)

*) After the reorganization the common name for "Central M. V. Frunze's House of the Soviet Aviation and Antiaircraft Defense" was still maintained (Tsentral'nyy Dom Aviatsii i Protivovozdushnoy Oborony - PVO imieni M. V. Frunze. (118)

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It is also likely that the signal and radio-technical services and the various auxiliary technical services, about which the Commander-in-Chief of the Soviet Antiaircraft Defense, Marshal Biryuzow spoke in his interview (108), are also represented in the high command of the air defense of the country.

The headquarters of the high command of the troops of antiaircraft defense was called in 1956: "Main Administration of the High Command of Forces of Anti-aircraft Defense of the Country" (Glavnoye Upravleniye Komanduyushchego Voyskami Protivovozdushnoy Oborony Strany). (110)

7. Organization of the Air Defense Territorial Control:

As mentioned previously, the existence of special air defense districts was confirmed by the available sources only with regard to Moscow and Baku. The Moskovskiy Air Defense District (Moskovskiy Okrug PVO) was mentioned in the Soviet sources on various occasions, (2), (111), (112), (113), (150)

The commander of the troops of the Moskovskiy Air Defense District (Komanduyushchiy voyskami PVO okruga), Col Gen P. F. Batitskiy, was interviewed by the Red Star (Krasnaya Zvezda) reporter, from which the following characteristics of the district may be established. (150)

Besides the command of the district, there is also a Military Soviet of the district (Voyennyy Soviet Okruga PVO). The functions of this soviet was not determined. However, the commander of the district in his interview mentioned that his soviet was participating in the selection of outstanding soldiers among the air defense troops for the All-Army conference, in organization of party-political education and in so-called "grading classification for air defense specialists", (on this occasion the commander of the district asserted that among his troops there are many highly qualified, graded specialist in the air defense).

Among the various military specialists included in the Moskovskiy Air Defense District, the General mentioned: aviators, antiaircraft artillerymen, radio-technical troopers, signalmen, aviation technical specialists, aviation armament technical specialists, aviation oxygen equipment specialists and others. Further, the district commander mentioned that on one of the air-fields of the antiaircraft defense fighter aviation there is a motor-tractor platoon, which keeps the airfield and all access roads in good working order and free of snow regardless of weather conditions.

According to Col General Batitskiy, one of the peculiarities of the air defense troops is the fact that their success in operation depends upon the irreproachable action of all numerous component teams of the whole air defense system. Strict execution of the mission by every member of the fighter-airplane crew, by every member of the antiaircraft gun crew, or by every operator of the radar station is a most indispensable condition of their combat efficiency. For this reason it is important that not only the leading soldiers become highly qualified specialists, but all soldiers, sergeants, and officers, without exception know their specialties perfectly; the Moskovskiy District of Air Defense in preparation for combat mission of its personnel is striving not only for individual perfection, but for high efficiency of all air force squadrons, artillery batteries and companies.

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The Moskovskiy Antiaircraft Defense District has many subunits in which every soldier may be considered a leading specialist, asserts the General. The Bakinskiy Air Defense District, (Bakinskiy Okrug Protivovozdushnoy Oborony) was described less frequently in the Soviet press. (114), (115), (116)

The Commanding General of the Troops of Bakinskiy Air Defense District (Komanduyushchyy Voyskami Bakinskogo Okruga Protivovozdushnoy Oborony), Col General V. D. Ivanov was not interviewed by the Soviet press [in the available sources], except for his appeal to military editors and correspondents for better cooperation in the training of his troops. (117)

Little is known about the composition of forces of the district and activity of its troops except routine training and parades.

Besides special air defense districts of Moscow and Baku there are some indications that special territorial air defense subdivisions were formed in the areas of Leningrad, Riga, Vladivostok and Magadan [on the Okhotskoye Sea]. It is said that in the Leningrad area the air defense is the responsibility of Admiral Baykov, Commander of the Leningrad Naval Region.*)

8. Organization of the Air Defense of an Object:

According to the previously mentioned Soviet sources, organization and system of control of the air defense of an object is established in peacetime. If the defended object includes civil institutions or civil population, then the civil head of the local air defense of the object is incorporated into the military command of the object, and the formations and services of the local air defense cooperate with the corresponding military organs. The diagram of a combat organization of air defense of an object is shown in (Fig. 75, Incl. 50); however, this system was developed long before an atomic warfare came into being, and does not include an anti-atomic service.

*) The French press published in Paris information gathered from the Estonian and Latvian refugee circles that the whole Baltic shores from the Finland Gulf to Klaipeda, including the naval base Liepaia (Libava), was organized as a special air defense area. In particular, a persistent rumor was circulating that the Soviet Air Defense Command of the Baltic area had turned the Estonian Islands, Hiuumaa (Dago) and Saaremaa (Oesel) into a base for launching antiaircraft rockets and guided missiles. Also, considerable fighter aviation forces were installed along these shores; the civil population from the islands under military authorities was evacuated to the mainland.

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system that the means of warning are correctly distributed, that they assure good audibility on the whole territory of the inhabited area, that duplicate warning signals are provided and that the entire warning system is controlled from a central point.

Air Defense Preparation of the Population

The air defense preparation of the civil population on the territory of the USSR is conducted by the DOSAAF organization* and by organizations of the Union of Red Cross and Red Crescent Associations, (Soyuz Obshchestv Krasnogo Kresta i Krasnogo Polumesyatsa).

The tasks of this preparation are:

(a) To instruct the population how to behave and how to maintain their dwelling houses under conditions of atomic attack and also in case of utilization by the enemy of bacteriological, chemical and other special weapons.

(b) to train the population in the use of individual and collective means of protection, in the organization of protection in contaminated areas (by radioactive elements, by war gas and by other lethal means), in methods of decontamination of the grounds, dwelling houses, equipment, private property, clothes etc.,

(c) to train the population in removing the effects of an air attack, and in particular to assure: medical help for the victims of attack, putting out fires, repair of technical breakdowns in communications, transports and electrical power systems and destruction of unexploded air projectiles.

The removal of the effects of an air attack is the responsibility of the organizations and subunits of MPVO. In an emergency, all ablebodied citizens may be drafted for this work.

4. Organization of Central and Territorial Control of Local Air Defense

Local air defense and all preparations for civil air defense are the responsibility of the Ministry of Interior.

Central control is executed by the "Main Administration of the Local Air Defense Service of Ministry of Interior" (Glavnoye Upravleniye Sluzhby Mestnoy Protivovozdushnoy Oborony Ministerstva Vnutrennikh Del SSSR), in close cooperation with the military authority, (118).

As a rule, the air defense of the protected points and of special areas of the country is realized by both active and passive means of defense i.e. by aviation and flak units, and local organization of air defense; however in some cases the air defense may be prepared only by local air defense.

The deployment of all air defense means starts with the announcement of mobilization, or by special order of the military command or by sudden air attack of the enemy air force.

*DOSAAF - All Union Voluntary Association for the Promotion of the Army, Aviation and Navy (Vsesoyuznoye Dobrovol'noye Obshchestvo Sodeystviya Armii, Aviatsii i Flotu).

Local air defense organizations start their combat activity from the moment of enemy air attack, directing their efforts to liquidate the consequences of this attack. Before the local air defense units are able to start their operations, members of the primary air defense organization from the civil population, (so-called first echelons), are responsible for the liquidation of the effects of an air attack. They are acting under control of the commanders of the local primary formations of air defense.

5. Local Air Defense of a City or Rayon

The local antiaircraft defense of cities or rayons is carried out by the City or Rayon Executive Committees of the Soviets /Councils/ of Working Population (Ispolkom Sovietov Deputatov Trudyashchikhsya). The chairmen of these soviets are heads of the city or rayon local air defense. They are responsible for organization of the local air defense and protection of the population against the effects of air attacks and also for proper preparation of the forces and means of local air defense.

The head of the local air defense of the city or rayon directs the operations through his working team called: "Headquarters and Services of the Local Air Defense" (Shtab i Sluzhby Mestnoy Protivovozdushnoy Oborony-MPVO.

The services of the City Local Air Defense are organized in order to combat and liquidate the effects of an enemy air attack.

There are the following services:

(a) Anti-fire Service,

(b) Emergency Technical Service,

(c) Medical Service,

(d) Decontamination Services for People, Clothes, Buildings and Territory,

(e) Protection and Public Order Service,

(f) Early Warning and Communications Service,

(g) Protection Shelters and Covers Service,

(h) Light Discipline Service,

(i) Veterinary Service and others (119).

Emergency rescue squads of the city (rayon) are composed of members of existing building and construction organization.

A diagram of a city local antiaircraft defense organization is shown in the Fig. 76, Incl. 51, (119).

6. Local Air Defense of Objects of Vital National Importance

Local air defense of objects of national importance is realized in order to:

- prepare these objects to function under conditions created by an air attack,

- protect the personnel of these objects,

- reduce material damages,

- liquidate the effects of an air attack.

The responsibility for the defense of objects such as industrial centers, railway junctions, stations, sea and river ports, power plants, communication centers and other, remains with the chiefs local antiaircraft organizations.

The most important objects are classified as "objects of special category". The head of the local antiaircraft defense of the object directs the protective operations through his headquarters and the specialized services of the local antiaircraft defense of the object. He also uses for this purpose the technical, industrial and administrative personnel of the defended object.

The specialized services of the local air defense of the object, their character and tasks are the same as those of the speciallized services of the city or rayon. They are headed by the chiefs of the corresponding departments or subdivisions of the object. For example, chief engineer, chief mechanic, chief doctor, supervisor of the general protection etc.

All the chiefs of the local air defense services are subordinated to the head of the local air defense of the objects, who directs them personally or through his headquarters.

The removal of the effect of air raids is the task of special party teams, detachments and other units recruited from the members of the various services of MPVO. For example, medical teams are formed from medical service bodies; larger units include several medical groups and teams.

The removal of air attack effects from small objects is performed by units composed of members of various services. The MPVO units are composed of personnel (men and women) of the defended objects, (119).

7. Air Defense of Educational Institutions, Kolkhozes, Sovkhozes and Dwelling Houses. Self-Defense Groups.

The chiefs, directors and commandants of institutions such as educational centers, kolkhozes, sovkhozes, motor tractor stations and other, are responsible for the local air defense of these objects.

In peacetime, their responsibility in this field is limited to the preparation and training of local air defense personnel for their objects, to the acquisition of indispensable means and equipment and organization of preventive measures against effects of an air attack. Small institutions, schools, and dwelling houses have primary party teams, so-called "groups of self-defense". These groups are subordinated to the head of the local antiaircraft defense of the object and operate according to his instructions.

The self-denfense groups supervise the execution of all preventive and fire-fighting measures of their objects and participate in the organization and preparation of protective shelters and covers and also assure their maintenance and proper use.

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In dwellings and institutions assigned to them, the selfdefense group supervises, in wartime, blackout and light control regulations and see to it that orders and instructions of the executive committees of the city (or rayon) are carried out properly.

Upon the sounding of the air alarm signal the personnel of the selfdense group must timely warn the tenants of dwellings of educational institutions, or collective farms about the air attack and should assure them the proper cover and refuge in pre-arrenged shelters. Selfdefense groups act immediately in areas hit or contaminated by air attack assuring premedical help to the victims and protecting the property of the state, community and of private persons. They participate in rescue work and cooperate with specialized units of MPVO.

Selfdenfense groups are recruited from the inhabitants of dwelling quarters, employees of the institutions and students. Citizens of both sexes aged 16 and up may be enrolled.

A selfdefense group includes:

- the head of the group,
- assistant of the head for political matters,
- manager of supplies, and equipment,
- chief of communications,
- 6 party teams: public order and observation, fire prevention, decontamination, emergency-rescue, medical and protective shelters and covers.

On farms with live-stock a veterinary team may also be formed. Earch team of the selfdefense group consists of 5-8 members and 2 alternates.

Training and preparation of selfdefense personnel is assured by the local committees of DOSAAF. The preparation of particular teams may be delegated to the specialized services of MPVO, and the preparation of medical teams to the Union of Associations of the Red Cross and Red Crescent; in educational institutions the leaders and members of selfdefense groups are trained by the managing personnel of these institutions.

8. The Rules of Behavior of Populations According to the Signals of MPVO

Upon declaration of a "State of Emergency" (Ugrozhayemoye Polozheniye) the system of local air defense of the inhabited areas and objects is placed in combat readiness.

A "State of Emergency" means that the territory on which it was declared is in the zone of a possible enemy air attack, /Threatened Zone/. The "State of Emergency" may be introduced by order of the head of MPVO of a Republic (or of Oblast', Region /Kray/, or City).

In case of a declaration of an "Emergency State", the competence and responsibility of the administration and guiding personnel of educational institutions, other institutions of a general character and dwelling quarters are decided locally in accordance with the resolutions of Executive Committees of the Soviets /Councils/ of Deputies of Working People of the given areas. The same

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executive committees decide the order in which the protective shelters and covers should be put into combat readiness and also direct the behavior of the population, in accordance with the MPVO signals.

As soon as the order of a "State of Emergency" is brought to the knowledge of the population in the given area, members of the MPVO units are called for instructions; subunits are formed and an adequate number of MPVO posts are fixed in the area., (anti-fire post, public order, observation). A 24 hour tour of duty of responsible personnel is established in various institutions and dwelling quarters.

Protective shelters and refuges occupied for other purposes are cleared by orders of the executive committees and put into combat readiness; simultaneously covers of the simplest type (slit trench, dugout) are built.

Individual antichemical protection means and fire fighting equipment are put into full readiness and special preventive anti-fire measures are taken.

In order to reduce the number of possible fires resulting from an air attack, the inhabitants are ordered to clear their premises from rubbish (particularly of inflammable character) and also not to leave the heating devices, burning appliances, and electrical installations without supervision.

All the work required by the blackout regulations in industrial, administrative and dwelling quarters and in transport carriers should be completed before dark. All adults should be alert and cooperate with the security and public order services, in order to discover an render harmless hostile element which may become active after the "State of Emergency" is declared. All radio receivers should be permanently switched on, because after a declaration of a "State of Emergency" is made, all MPVO signals, orders and instructions are transmitted by radio.

The citizens should acquire out of their own funds the antigas equipment (gas masks and antigas capes). They should also keep their food supplies in special protective containers and water in closed receptacles, (119), (120).

9. Signals of the MPVO: (120), (121)

(a) Air Alarm

Upon approach of an enemy plane the population of the area is warned by the signal: "Air Alarm" (Vozdushnaya Trevoga), which at the same time serves as a warning against an atomic attack.

The signal "Air Alarm" is transmitted through a radio net-work in these words: "Citizens! The Air Alarm is Declared" (Grazhdane! Ob'yavlyayetsya Vozdushnaya Trevoga). This warning is accompanied by sirens and whistles of plants, factories, locomotives, ships, etc. during 2-3 minutes.

On this signal, members of selfdefense groups head for assembly points and the working people are directed by their superiors to protective shelters and covers. The MPVO posts are reinforced and, if the air alarm is given during the night, the blackout regulations are checked. The personnel of the MPVO units assembles in its alarm places and acts according to the orders of the MPVO heads.

After the "Air Alarm" signal, fires in stoves of dwelling houses and other buildings should be extinguished, other heating appliances and burners switched off, and the gas supply cut off.

People on streets and roads are directed towards shelters and covers, and, if they are not available in the vicinity or are overcrowded, to places where the contours of the terrain or ditches offer some cover.

After an "Air Alarm" signal the people in houses or other buildings, before making for shelters, should complete their fire prevention precautions, close the windows and draw the blinds. The indispensable food and water supply should be taken to shelters or covers. The city transport will be stopped at once and the passengers will be directed to the nearest shelters.

(b) Atomic Attack (121)

During the "Air Alarm" the enemy may use the atomic weapons. If an atom bomb explodes, citizens in shelters and covers (except persons in special anti-chemical shelters) should put on their gas masks and protective capes. The people on the streets and roads should take any nearest cover, such as ditches, ravines, trenches, under stone bridges, in tunnels, or any other natural covers in the terrain. There should be no running. If there is no cover, people in the open should lie down prone, with legs directed toward the explosion, covered by a protective cape, and should remain motionless for 15-20 seconds. It is important in such a case to act rapidly, resolutely, without panic and strictly according to the MPVO instructions issued beforehand.

(c) Chemical Attack (121), (122)

In case of contamination of the territory with radioactive elements, or other chemical or bacteriological substances, the headquarters of the MPVO will give the signal: "Chemical Attack". This alarm may concern only a part of the area or the territory of the entire city. In this case the signal transmitted through a radio net-work will be "Citizens! Chemical Attack". It will be repeated by sound signals (striking of a suspended rail, gongs or other loud sounding metal objects). A local chemical alarm will be signalled by frequently repeated sound signals. If the signal is given by radio (in case of an atomic explosion or bacteriological attack), the character of contamination and the limits of contaminated areas also may be indicated.

Upon hearing the signal "Chemical Attack" all persons who are not in the special antichemical protective shelters must put on their own individual protective means.

(d) "All Clear" Signal (122)

As soon as the danger of an air attack is past, the MPVO headquarters transmits through the radio network the signal "All Clear", or "Citizens! The Danger of Air Attack is past. All Clear." After an atomic air attack, the signal "All Clear" is transmitted only beyond the area of attack, but not on the territory on which the atomic explosion occurred. In that case, all persons may leave the shelters and covers only by orders of the operating personnel of the MPVO, strictly observing the regulations of behavior in the contaminated area.

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All able-bodied citizens must participate in emergency rescue work, according to orders and instructions issued by the headquarters of the local air defense.

10. General Tasks of DOSAAF and Union of the Red Cross and Red Crescent Associations in the Local Air Defense (119), (120), (121), (122)

The All-Union Voluntary Society for the Promotion of the Army, Aviation and Navy (Vsesoyuznoye Dobrovol'noye Obshchestvo Sodeystviya Armii, Aviatsii i Flotu SSSR, DOSAAF, SSSR) has been given an important task in the field of defense of the country. This society together with Red Cross and Red Crescent Associations (Soyuz Obshchestv Krasnogo Kresta i Krasnogo Polumesyataa, SOKK I KP) prepare and train the command personnel and the population in local air defense.

In particular, DOSAAF, the Red Cross and Red Crescent Associations are active in the training of self-defense groups, in supplying programs and training aids and other means to the local air defense organizations. DOSAAF and the associated organizations prepare and publish books, educational posters, educational films, etc., which instruct the population how to protect itself during an air attack and in particular against atomic and bacteriological weapons.

Special attention is paid to the preparation of the whole population against the effects of atomic warfare.

11. Anti-Atomic Protection, [PAZ] (121), (122)

(a) Tasks

The DOSAAF and its associated organizations form among the working population so-called PAZ Circles (Kruzhki Protivoatomnoy Zashchity). Each "Kruzhok PAZ" comprises 20-25 members. Training is conducted 1-2 times per week. Each class lasts 2 hours.

Training and school hours are decided by committees of the primary DOSAAF organizations in coordination with administrations of institutions, enterprises, plants, educational centers, sovhozes, kolkhozes and dwelling quarters managements.

The training is conducted in the "Kruzhki PAZ" by voluntary instructors of PAZ and the medical personnel assigned by the primary DOSAAF organizations and Red Cross and Red Crescent Associations, which also supply the necessary means of education and training aids (in cooperation with the management of institutions concerned and other social organizations). The basic training aid for the study of PAZ problems is the book-let entitled: "Instructions for the Population in Atomic Defense" (Pamyatka Naseleniyu po Zashchite ot Atomnogo Oruzhiya).

The PAZ instructors and medical personnel carry out their work in preparing the population in antiatomic defense as a social duty [probably without special salaries and beyond their regular duties, what is called in Russian: "vesti rabotu v obshchestvennom poryadke" i.e. to do the work as a social obligation].

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The population is trained and instructed in anti-atomic defense (PAZ) according to the program called "Program of Training the Population in Anti-atomic Defense in Circles of Primary Organizations of DOSAAF" (Programma Zanyatiy s Naseleniyem po Protivoatomnoy Zashchite v Kruzhkakh Pervichnykh Organizatsiy DOSAAF). This program includes the following subjects:

- familiarity with the atomic weapon,
- study of individual and collective means of anti-atomic defense,
- study of first aid methods to victims of an atomic attack,
- study of the rules of behavior of the population according to the MFVO signals.

In the final stage of the training the PAZ instructor (or leader of the PAZ circle) calls a conference of committees of DOSAAF primary organizations and of Union of Red Cross and Red Crescent Associations. During the final stage of training the trainees are given an examination of the subjects comprised in the program and of their skill in using the anti-atomic defensive means. The results of training and the marks received by the trainees are registered in a formal document. These results are noted also in the membership cards of the DOSAAF organization. The record of completed anti-atomic training states the date of training and its character. Citizens who are not members of DOSAAF organizations are issued certificates of completion of anti-atomic training. Persons who complete the training with unsatisfactory results are obliged to repeat the course.

Statistics of citizens who completed anti-atomic training are kept in the records of primary organizations of DOSAAF and in regional committees of DOSAAF. The anti-atomic defense training in DOSAAF circles is combined with propaganda among the working population for joining the organization.

(b) PAZ Instructing Personnel (119) pp. 59-60.

The basic role in the anti-atomic preparation of the population belongs to volunteer PAZ instructors. For this reason the DOSAAF committees select the candidates for PAZ instructor posts with special care.

Volunteer PAZ instructors (leaders of PAZ circles) are selected by the city or rayon DOSAAF committees from among the most active DOSAAF members, from among instructors of Air and Antichemical Defense (Protivovozdushnaya i Protivokhimicheskaya Dborona - PVKhO), engineers, technicians, chemists, teachers, medical personnel, reserve officers, and retired officers.

The instructors are trained in DOSAAF Air Defense Schools and also at courses organized by the city (or rayon) committees of DOSAAF or by the committees of large primary organizations of DOSAAF.

The training is conducted according to the program: "Preparation of Volunteer Instructors of DOSAAF for Anti-atomic Defense" (Podgotovka Obshchestvennykh Instructorov DOSAAF po Protivoatomnoy Zashchite (PAZ)). Citizens who complete this training and successfully pass an examination, receive a certificate and by the decision of the city (rayon) committee of DOSAAF also the title of "Volunteer DOSAAF Instructor for Anti-atomic Defense" (Obshchestvennyy Instruktor DOSAAF po Protivoatomnoy Zashchite).

Instructors who complete the training of more than 250 trainees in PAZ circles are given the highest award, a medal "For Active Work" (Vysshaya Nagrada Obshchestva - Znak: 'Za Aktivnuyu Rabotu')

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PAZ instructors are supervised and assisted by the city (rayon) committees of DOSAAF, which organize the methodical instructive training and seminars. In order to increase the skill and knowledge of PAZ instructors DOSAAF committees invite members of the All-Union Society for the Promotion of Political and General Sciences to organize lectures and scientific reports on atomic weapons and anti-atomic defense, for PAZ instructors.

12. The Role of the Union of Red Cross and Red Crescent Associations in Organization of the Medical Service (119) pp. 60-61

(a) Medical Service Formations

The Republican, Regional, Oblast' and City Committees of the Union of Red Cross and Red Crescent Associations, work in close cooperation with DOSAAF committees and the Ministry of Public Health and organize and train units for the Medical Service of local air defense organizations. These units are:

- personnel of medical posts,
- medical squads,
- rescue and casualty sorting parties,
- rescue and medical transport detachments.

The Medical Post is formed from especially trained personnel, entitled to wear a badge "GSO" /probably: "Ready for Medical Defense" - Gotov k Sanitarnoy Oborone/. The medical post comprises: 4 persons and medical equipment (first aid bag, medical chest, stretcher and gas masks). Medical posts are created in welling quarters, schools, educational institutions, various enterprises, kolkhozes and sovkhozes.

The tasks of medical posts are:

- first aid to victims /of an air attack/,
- transportion of victims from the area affected by an air attack,
- medical and anti-epidemic arrangements in shelters and places where people gather.

(b) Medical Squads and First Aid Detachments (OPM) (119) pp. 61-62

Medical squads are organized in enterprises, institutions, educational institutions, kolkhozes and sovkhozes, from among the most active members of the Red Cross and Red Crescent Associations, who had medical training according to a special program.

A medical squad /or detachment/ comprises usually five teams with the following medical equipment: first aid bag for squad commanders, first aid kit for members of the squad, one stretcher for each team, gas masks and protective overalls for all squad members. They administer first aid in areas of air attacks, organize the transportation of victims to places of safety,and guide the work of stretcher bearer teams.

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Medical squads included in Medical First Aid Detachments (Otryad Pervoy Meditsinskoy Pomoshchi - OPM) carry out their work according to the instructions of the commander of the detachment and assist the medical personnel of the detachment.

Medical squads may be used also to combat the threat of an epidemic. They are then called Medical Anti-Epidemic Squads (Sanitarno-protivoepidemicheskiye druzhiny).

(c) Search and Segregation Groups

A First Aid Medical Detachment comprises also a Search and Segregation Group (Poiskovo-sortirovachnaya Gruppa, PSG) composed of specially trained nurses. This group comprises: chief of the group, (medical practitioner) and 11 nurses. Each nurse is equipped with a first aid kit, individual anti-gas package, protective cloth, flashlight and water container. The task of the group is to give first premedical help to victims of an air attack in the area of destruction and ruins. In this task the group cooperates with the technical-rescue subunits and directs the work of medical posts and squads, and, in particular, organizes the first segregation of victims and arranges for their transportation.

The Detachments of Search and Victim Removal (Otryady rozyska and vynosa postradavshikh, ORVP) work under the guidance of the Search and Segregation Group. After completion of their work in destruction areas, the nurses of the Search and Segregation Groups may be engaged to work with the stationary medical units of the Medical Service of Local Antiaircraft Defense.

(d) Detachments of Search and Victim Removal (ORVP)

Members of the OVRP are formed by order of the directors of the given educational institutions and trained according to the special programs. Each ORVP comprises 5 squads, a total of 125 members. In case of air attack the ORVP is directed to the destruction areas to search for victims, whom they carry out after the necessary pre-medical first aid is given.

Training aids and necessary equipment are allotted to the OVRP according to the tables of equipment allowances for a given educational institution, (119).

(e) Circles of Volunteers "Ready for Medical Defense"

In addition to the formations of the Local Air Defense mentioned above, organizations of the Red Cross and Red Crescent conduct the training of medical sections of Selfdefense Groups and also organize a mass training of the population in the circles of volunteers called "Ready for Medical Defense" (Gotov k Sanitarnoy Oborone, GSO) and "Be Ready for Medical Defense" (Bud' Gotov k Sanitarnoy Oborone, BGSO), which are probably special formations for young volunteers.

The training of all the above mentioned mass formations of Local Air Defense, conducted by DOSAAF and the Union of Red Cross and Red Crescent Associations, reinforces the local air defense of the USSR (119).

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13. Antiatomic Defense Squads of MPVO, (124)

In the daily Soviet Patriot (June 1956) appeared an article signed by a certain G. Taranenko, concerning the decontamination of installations after an atomic blast.

According to the article, special groups of Local Air Defense squads (komandy), provided with dosimetrical equipment are selected to inspect the damage area, to determine the degree of contamination of different regions, and to mark the region boundaries.

After determining the extent of radioactive contamination, they proceed to decontaminate the area and to weaken the effects of radioactive substances used by the enemy.

The author of the article suggested the following safety norms in contaminated areas:

(a) the ground is considered "contaminated", if the degree of gamma radiation exceeds 0.1 Roentgen per hour,

(b) the ground is considered "highly contaminated", if the gamma radiation exceeds 5 Roentgens per hour,

(c) the ground is considered "dangerously contaminated" if the gamma radiation exceeds 100 Roentgens per hour.

As to the safety precautions for the MPVO antiatomic personnel, a dosage of 50 Roentgens in a single exposure is considered safe. If exposures are repeated, the safety norms (per exposure) are reduced to 10 Roentgens, but the total dosage should not exceed 100 Roentgens a year. In continuous and systematic exposure, the safety norm for antiatomic personnel is reduced to 0.1 Roentgen per hour.

The article also discussed the problem of decontamination of dwelling quarters [approaches to the houses, houses, and household furniture].

V. AIR DEFENSE TRAINING PROBLEMS AND SCHOOLS

1. Defense Minister about the Study of Modern Air Defense Weapons

On Nov. 27, 1957, N: Pravda reported a speech of Soviet Defense Minister, Marshal R. Malinovskiy, delivered at the Kremlin to Military Academy graduates, on the subject of improving the study of new weapons and in particular of modern air defense weapons in military academies.

Marshal Malinovskiy pointed out that Soviet officers had not fully mastered all the problems concerning the use of the latest weapons and most modern military equipment.

The defense minister stressed that further great efforts were required to solve the problem of efficient air defense weapons and in particular of anti-missile weapons.

Soviet officers (continued the minister) in addition to their study of new weapons, have been trained in modern methods of anti-atomic defense, as well as in anti-gas and anti-chemical defense.

The minister mentioned in his speech that there is a shortage of laboratory and training equipment in Soviet military schools, but he denied that the Soviet armed forces technically were insufficiently prepared. On the contrary, he said, "our forces are equipped with all the most modern weapons, including nuclear and thermo-nuclear and missiles weapons".

Among the listeners of Marshal Malinovskiy's speech were generals and high ranking officers who had completed the courses for high command officers at the Lenin Higher Military Academy and the Frunze General Staff Academy. He mentioned that 70 percent of graduates were participants of World War II, and among them 59 hold the title of "Hero of the Soviet Union".

Apparently these courses, organized on the highest level, were designated to further modernization of the Soviet armed forces with particular stress on the air defense latest weapons, (125).

2. Air Defense Schools and Training Centers

Information concerning Soviet air defense schools and training centers is comparatively scarce. The promotion of air defense force to the equal status with main arms caused considerable increase in the air defense schools and training centers.

Some information in the Soviet sources indicate that the training of air defense NCO-s was organized in special training battalions.

Education of air defense officers follows the general pattern of Soviet military education for officers which includes:

(a) Scientific research and special training centers (Nauchno-issledovatel'-nyye i spetsializiruyushchyye uchrezhdeniya)
(b) Institutions of higher military education, which are also called "military academies" (Vysshiye-voyenno-uchebnyye zavedeniya i akademii)*

*) It is said that Dzerzhinskiy Artillery Academy in Moscow had developed a special training center for high ranking antiaircraft defense officers.

(c) Military schools of secondary education or so-called "officers schools" (srediye voyenno-uchebnyye zavedeniya),
(d) Special correspondence courses of higher military educational establishments (Zaochnyye vysshiye voyenno-uchebnyye zavedeniya), (126).

It is probable that Soviet special air defense schools exist on all the above mentioned levels of the Soviet military educational system, although most of the air defense schools mentioned in available sources are on the level of secondary military educational institutions. Special air defense schools for aviation personnel were not found in available sources.

One of the first air defense schools mentioned in the Soviet sources was the Sevastopol Antiaircraft Artillery School, (127). Then, in 1946 in the N: Komsomol'skaya Pravda, appeared the announcement of the Commander of air defense of the country about the opening of registration of candidates for the following military schools:

1. School of Instrumental Reconnaissance (Uchilishche instrumental'noy razvedki), in the city of Pushkin (Leningradskaya Oblast'),
2. Antiaircraft Artillery School, Order of Fatherland War in the city of Gor'kiy (Gor'kovskoye Ordena Otechestvennoy Voyny uchilishche zenitnoy artillerii),
3. The Sevastopol' Antiaircraft Artillery School Order of the Red Banner in the city of Zhitomir

Also, the conditions of training in these schools were specified:
Duration of courses in these schools - 3 years,
Educational requirements - 10 grades of high school,
Age of candidates - 18 - 24, (110).

In 1954, the Red Star published a news item about the Antiaircraft Artillery School Order of the Red Star in the city of Tomsk (Tomskoye Ordena Krasnoy Zvezdy zenitno-artilleriyskoye uchilishche) in the Sibirskiy Military District (128).

More recently, on March 23,1955, N: Pravda (The Truth) supplied the information about the Govorov L.A.Artillery-Radiotechnical Academy in the city of Kharkov (Khar'kovskaya Artilleriyskaya Radiotechnicheskaya Akademiya Sovetskoy Armii imeni L.A. Govorova), (129). On October 5, 1955, the N: Red Star (Krasnaya Zveda), No. 236, mentioned the Zhitomir Antiaircraft Artillery School (Zhitomirskoye Zenitno-Artilleriyskoye Uchilishche).

On May 30, 1957, the N: Red Star (Krasnaya Zveda), No. 126, reported the existence of the Leningrad Antiaircraft Technical Artillery School (Leningradskoye Zenitno-Artilleriyskoye Tekhnicheskoye Uchilishche) and on June 20, 1957, No. 144, the same newspaper published a news report about Chkalovsk, G.K. Ordzhonikidze Antiaircraft Artillery School (Chkalovskoye imeni G.K. Ordzhonikidze Zenitno-Artilleriyskoye Uchilishche) in Yuzhnouralskiy (South Ural) Military District, (147). This news report described night combat firing of one training battery formed among the students of the school under the command of Maj. Posyagin.

On November 15, 1957, in N: Red Star (Krasnaya Zveda), No. 269, appeared a news report about the Odessa Antiaircraft Artillery School (Odesskoye Zenitno-Artilleriyskoye Uchilishche) in the Odesskiy Military District. While describing the training in the school, the news report mentioned the following training personell: Lt. Col. Gavryushev, instructor of tactics, Lt. Col. Shumilov,

senior instructor of communication service and communication materiel, Lt. Col. Baldykin, senior instructor of military topography.

The training and study of the air defense problems on the highest level is assured by special courses at the Lenin Higher Military Academy and at the Frunze General Staff Academy, as it was mentioned in N: Pravda on Nov. 27, 1957, (125).

3. Maj. Gen. of the Air Force A.I. Pokryshkin about the Training in Aerial Combat

A three-time Hero of the Soviet Union, Guards Maj. General of the Air Force, A.I. Pokryshkin, published in the Herald of the Air Fleet (130) an article in which he characterized the combat possibilities of fighter aviation as follows:

The speed of flight and climbing capacity of a fighter airplane play an important role in the interception of enemy bombers at a long distance. Moreover, if the fighter airplane has to overtake his target before the combat, then the speed of flight is directly proportional to the distance of interception from the zone of intended enemy attack. For instance, if we assume that the speed of an enemy aircraft to be overtaken is 720 km/h, and the speed of a fighter flying at the distance of 12 km is 900 km/h, then the time necessary to overtake it will be 4 minutes. During that time the enemy will cover a distance of 48 km. But, if the speed of fighter is 1080 km/h, it will overtake the enemy in 2 minutes, during which time the enemy aircraft may fly only 24 km.

The superiority of the fighter in fire power and the fact that his aircraft presents a smaller target area give him a better chance in an aerial combat with an enemy bomber.

The armament of a modern fighter aircraft is characterized by great fire power, hitting capacity and accuracy of sighting mechanism. At present, fighter aircraft are armed mostly with artillery weapons. However, the development of aviation requires even greater use of aerial rocket weapons and also guided and homing-guided rockets. Adoption of homing-guided rockets will not only increase the firing power of the fighter airplane, but will also enable the fighter pilot to hit hostile supersonic airplanes and pilotless means of attack, intercepted on their approaching courses. General Pokryshkin believes that in the future the interception of enemy air targets on their approaching courses will play a still more important role in aerial combats.

Further, General Pokryshkin pointed out that in the combat training of fighter aviation personnel the study of enemy air tactics, familiarity with the enemy aviation materiel and also with the combat-technical characteristics of the enemy aircraft plays a very important role. At the same time, fighter pilots should constantly try to improve their own air tactics and methods of interception. The tactical ratio of forces in aerial combat has substantial influence on the result of the operation. Numerical superiority of force creates favorable conditions for the destruction of an enemy formation in a short period of time. Depending on the character of the enemy formation, the superior fighter forces may be introduced into combat simultaneously or from various assault positions. Also the numerical superiority may be obtained by attacking only one part of the enemy formation by a concentrated large fighter force.

However, said Pokryshkin, it would be an error to consider only numerical superiority as a decisive factor of success and to forget the correlation in fire power between the enemy and the attacking fighter force. He ends his suggestions by

saying that the necessary combat readiness of the Soviet Fighter Force which defends the air frontier of the USSR, depends on high moral and combat qualities and political preparation of the Soviet fighter aviation personnel(130).

In order to increase the skill in aerial firing of the Soviet fighters, the training units are equipped with the most modern training aids. The fighter pilots are trained in aerial snipping on the ground and in the air. Each firing is thoroughly examined. If the fighter pilot used for training firing, the camera-gun, the results are studied on the special screens. (see Fig. 77, Incl. 52).

4. Antiaircraft Artillery and Antiaircraft Machinegun Training

An editorial of the Red Star, published in January 1955, pointed out the following principles for the training of antiaircraft artillery personnel, (131):

..." In the system of antiaircraft defense of the armed forces as well as of the country, the antiaircraft artillery plays a most important role. The experience of World War II unquestionably proved the enormous potentialities of this weapon. Soviet antiaircraft artillery together with fighter aviation provided a reliable umbrella for Soviet ground and sea formations in all operations of the Soviet armed forces, and warded off mass raids of enemy aircraft on Soviet seaports, lines of communication, large cities and industrial centers.

"The further development of aviation technique presents even more pressing demands on the combat skill of antiaircraft artillery units and subunits and on the combat morale of the personnel. High speed and high ceilings, as well as a considerable increase of the range of operations of modern aircraft, all this could not but affect the qualitative changes of the antiaircraft artillery and machineguns or the combat preparedness of the antiaircraft artillery personnel.

"Antiaircraft artillery, like the other arms and services, [illegible] to the care of the Communist Party and Soviet government is supplied with first class mechanical equipment produced by Soviet industry, equipment that meets all the demands imposed by present day air combat. It is our duty, says the editorial, to take care that the personnel of our antiaircraft artillery further improve their skill in handling weapons and technical equipment and achieve precision, good teamwork and perfection in operations, conducted under most complex conditions.

"Thanks to persistent training antiaircraft artillerymen achieved an improvement in their combat preparedness last year. In All-Army Fire and Tactics competitions several antiaircraft artillery batteries of the Army and Navy won challenge prizes and certificates.

"Continuing the exercises in winter time, commanders of antiaircraft artillery units and subunits instruct and train their subordinates in new developments of military science and technique. Performing these important tasks the commanders should pay a particular attention to the further development of vigilance and constant combat preparedness of their subordinates.

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"Vigilance is the most important combat quality of Soviet soldiers. To be vigilant means to be ready at the first signal to open fire, to put in action all the complicated technical devices, including radar stations which enable observers to determine air target location at the longest possible range. Vigilance of an antiaircraft artilleryman is supposed to include his personal responsibility for the performance of his duty in operating the guns and instruments and also for his high discipline, good teamwork, and strict compliance with the provisions of antiaircraft artillery service regulations.

..."The crews of radar stations are particularly responsible for the improvement of combat preparedness of antiaircraft artillery units and subunits. The dependable functioning of modern radar equipment and its successful use, depend upon their skill and training. It is well known, that even a brief interruption of its functions may lead to the loss of the target and this means that the whole subunit will be put in the most difficult situation. Therefore, it is important to improve constantly the technical knowledge of the personnel, to instruct members of the crew how to locate precisely at a moment's notice the target's position, how to tune and regulate the radar installation and to operate them under heavy radar interferences.

"While training their subordinates the commanders have to keep in mind that the combat training of antiaircraft artillerymen should always be carried out in conditions closely resembling actual combat without excuses or simplifications.

"...The personnel are conditioned to fight a strong, technically well armed enemy, possessing modern aircraft.

"...Unfortunately some inadmissible practices are tolerated in the combat training of antiaircraft artillery personnel; for instance artillerymen know in advance where the target will come from at the next exercise... Such a practice has nothing in common with actual combat conditions.

..."The requirements in training of the troops in what is indispensable for real war, especially emphasize the pressing necessity of improving the combat qualifications of antiaircraft gunners. Performing their duty at the guns and at antiaircraft fire directors, they must realize and feel the tenseness of modern actual combat and its complexity.

..."There are also some other deficiencies in the training methods of antiaircraft gunners. Thus, some commanders do not pay due attention to the fortifications of gun emplacements. This is very detrimental for the combat training of the personnel. It is well known that the combat activity of antiaircraft gunners is subject to enemy air attack. Therefore, it is self-understood that the fortification of the fire positions has an enormous importance.

..."It is always necessary to instruct and train antiaircraft gunners in the construction of fortified gun emplacements.

"Also a proper organization of daily training in the supply of material is very important for assuring smooth teamwork in subunits. Further, the commanders [illegible] automatization in artillerymen action. They should direct their action to the main task: to locate the target in due time, no matter from which direction it appears and shoot it down.

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..."Another important factor in combat training is the necessity to improve artillery marksmanship of the officers. They must know perfectly the artillery weapons, their potentialities and proper use against maneuvering enemy aircraft.

..."Antiaircraft artillery plays an important role in modern war. But to play such a role its personnel must strive for a steadfast improvement in knowledge and skill, and use their initiative in the combat against a strong and technically well equipped air enemy, (131).

5. The Role of All-Army Artillery Competitions in Training of Antiaircraft Artillery Personnel

In December 1956 there appeared in the Red Star and article of Artillery Lt. General N. K. Vasil'kov, demanding still higher achievements in the combat preparedness of the Soviet antiaircraft artillery, (132).

The author asserts that in view of constant and rapid perfection of the aerial attack the role and the task of air defense troops have become still more important, particularly in the last few years. The actual combat requires of the flak personnel the ability to repulse an attack of supersonic aircraft, flying at various altitudes, from the highest to the lowest.

Combat against such aerial targets, Vasil'kov writes, presents great difficulties.

Peculiar feature of this combat is the extremely limited time during which the aerial target finds itself in the zone of fire. In many cases the flak personnel will have only a few seconds for firing against aerial targets. Nevertheless, they should hit the target or at least force the enemy to abandon the attack.

The author points out that in atomic warfare even a single enemy aircraft, carrying nuclear bomb, may cause irreparable damages if the air defense is unable to stop it.

In view of this possibility, the flak personnel should constantly strive to improve their combat skill, in order to be able to detect the target in time, to determine its position accurately, its coordinates, (koordinaty), and to conduct the fire at the highest rate, fully utilizing the entire combat technique put at their disposal.

Until quite recently, there existed a widespread opinion among flak artillery officers that a salvo scoring a hit on the first burst is rather a matter of accident. Some officers even tried to prove theoretically that it is impossible to score a hit by the first computed salvo. Practical firing also seemed to confirm that opinion, because hits, particularly by the first salvo, were very rare in the past. Suffice it to say that even batteries selected for previous firing records with very small exceptions, seldom hit the target by the first burst.

In the year 1955 intensive efforts were devoted to perfecting the training methods and to raising the firing skill of the flak artillery personnel. The efforts of officers to understand better and to utilize more fully the combat technical equipment of their batteries was not without results.

The All-Army Flak Artillery Competitions in the following year 1956 proved that the skill of the flak artillery personnel was considerably improved. The results obtained at the contests were excellent. For instance, one battery in four, out of five firing salvos, obtained the mean point of bursts in the circle 0-02 of lateral and vertical dispersion and plus-minus 20 m in range.

Also very high results during these competitions were demonstrated by other batteries. When two batteries fired three salvos, each of them scored a hit, but only one of them scored a hit with the first salvo.

These results convinced even the greatest sceptics who asserted that a salvo which scores a hit is just a lucky accident.

The experience of outstanding flak artillery specialists proves that the effectiveness of Soviet Flak Artillery can be considerably improved by perfecting the training methods of flak artillery personnel and the combat technique.

The flak artillery commanders of all grades should at the present time concentrate their attention on obtaining better results in these tasks (132), concluded Gen. Vasil'kov.

In November 1957, Marshal of Artillery V. I. Kazakov, Hero of the Soviet Union, on the occasion of the Soviet Artillery Day Nov. 17 , published an article in which he stated:

> "...In the regiments and divisions of Soviet Artillery, there are quite a few antiaircraft artillery commanders who achieved great successes in the training of their subunits.
>
> "This was proven by the results obtained at the recently completed district artillery competitions in firing and tactical operations. In these competitions, batteries of antiaircraft artillery of air defense of the troops (Batarei voyskovoy zenitnoy artillerii) had shown increased combat skill, high team-work and good special and technical preparedness.
>
> "...An equally high degree of combat skill was shown by the artillery personnel of the troops of air defense of the country. Possessing excellent combat technique, they skillfully fired against air targets. For instance, in recent competitions the antiaircraft artillery battery under the command of Officer P. Tyapichkin achieved 4 hits out of five salvos. That is an execellent result$, (133).

6. Examples of Antiaircraft Artillery Combat Training (134)

The antiaircraft artillery battery of Capt. F. Shevelev received the signal of an air alarm (trevoga). After a few seconds the electric generators were switched on. The screens of the radar station were illuminated and the gunners rushed to their battle positions (see Fig. 78, Incl. 53).

At the battery command post, Capt. Shevelev supervised the preparation of the fire. Data on the air situation were supplied to him by the plotter, Sergeant V. Khludeyev, and members of his squad (see Fig. 79, Incl. 54). The radar operators "caught" the target on the radar screen at maximum range. The gunner scout watched the sky carefully (see Fig. 80, Incl. 54). Finally the

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gun barrel began to move. The loader skillfully prepared the gun for fire (see Fig. 81, Incl. 54). At the very moment when the "enemy" aircraft entered the zone of effective battery fire, the signal "fire" was sounded. The loader pressed the trigger handle. After the first well synchronized battery salvo, followed the second and the third. The battery did not miss a single "enemy" aircraft. The higher commander commended the battery personnel for execellent firing.

Another example of antiaircraft artillery battery combat training is supplied by Capt. Shaposhnikov, commander of the antiaircraft artillery battery which won the first place and the challenge prize at the Artillery Firing Competitions of the District (135).

Capt. Shaposhnikov asserted that the high achievement of the battery is a result of persistent and strenuous efforts of the whole personnel of the battery. At every combat training exercise, the instructing personnel tried to approach the actual combat conditions as closely as possible. The gunners made especial efforts to master the guns and instruments perfectly (see Fig. 82, through 87, Incl. 55-56). The gunner-scouts and radar operator secured a high accuracy of fire and received specially high commendation from the battery commander.

Capt. Shaposhnikov asserted that the high achievements in battery combat training and in perfect maintenance of the materiel should be credited in the first place to his gun commanders, majority of whom are members of the Komsomol organization.

The total strength of the gun squads assembled in the firing position is shown in Fig. 88, Incl. 57, together with the guns in combat readiness.

7. Special Antiaircraft Artillery Training Device and Training Aids

The problem of training antiaircraft artillery personnel in firing at high speed air targets without aircraft appeared several times in the available Soviet sources. In March 1957, in the Red Star, appeared a news item (136) from which we learn that when the former Defense Minister inspected Soviet occupation troops in East Germany (Gruppa Sovetskikh Voysk v Germanii), a special device was shown in the camp of air defense units, designed to train antiaircraft artillery gunners in firing against high speed air targets, without an airplane.

This device, already adopted for training in Capt. Sergeyev's antiaircraft battery was constructed by a group of innovators and rationalizers, under the direction of Capt. Sazonov. This device, original in its construction, facilitates antiaircraft artillery training without actual targets in the air.

Marshal Zhukov was informed that some valuable training aids, built by innovators and rationalizers of the occupation forces in Germany, were sent to Prikarpatskiy, Odesskiy and other military districts for exploitation*.

* An original plotting board device, useful to antiaircraft defense units, was published in the Military Herald, in June 1957 - (137).

8. Training of Antiaircraft Machine gun Subunits

Col. S. Chubarov published in October 1954 in P: "Military Herald" Voyennyy Vestnik, (138) the following remarks on the antiaircraft machinegun training:

Col. Chubarov recalled that during WW II Soviet antiaircraft machinegun units destroyed 2,296 enemy aircraft, or more than 10 per cent of all enemy aircraft destroyed by ground troops of the Soviet antiaircraft defense.

According to Col. Chubarov, the antiaircraft machinegun subunits together with antiaircraft artillery are capable of covering successfully the combat order of troops in battle. The main task of the machinegun subunits is:

(a) to destroy the attacking airplanes, airborne troops and illuminating bombs,

(b) to frustrate air reconnaissance and aerial spotting operations.

Modern high speed airplanes are capable of attacking ground targets unexpectedly in a very short period of time. Therefore, the antiaircraft machinegun subunits must be trained in opening the fire against attacking airplanes as rapidly as possible. The machinegun squads also must be trained to know perfectly the antiaircraft machinegun materiel and to be able to use it effectively against air and ground targets.

The effectiveness of the antiaircraft machinegun fire depends on the accurate execution of the assigned task by all members of the machinegun squad. Therefore the commander of antiaircraft machinegun subunit must select members of machinegun squads carefully and train them in the technique of operating antiaircraft machineguns.

Each member of the squad must be well trained not only in the correct execution of the assigned operation, but also in coordinated teamwork. For example, the training of a machinegunner in firing an airplane, by the use of accompanying fire includes:

(a) adjustment of the seat,

(b) proper setting of the sighting device,

(c) knowledge of the sighting mechanism,

(d) comparison of the collimator's reticle with the mobile and stationary dummy airplane at various course angles,

(e) accurate execution of the all firing commands.

The instructor starts the training with a correct adjustment of the seat in order to assure the best observation of aerial targets at any angular height and then proceeds to show how to operate the pointing mechanism. For this purpose dummy airplanes are used, placed 20-50 m before firing position at various angles of approach (under various foreshortenings). In the beginning of training it is expedient to use the dummy airplanes moving with the speed of 0.5 m/sec and gradually to increase this speed up to 4 m/sec.

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In this period of training the instructor watches that the gunner can:

(a) point the antiaircraft machinegun at the indicated target correctly,

(b) coincide the collimator's reticle with the target uninterruptedly and

(c) press the trigger mechanism accurately.

The gunner operating the sighting mechanism must gain the necessary experience in determining airplane speed, flight course and range.

During tactical training exercises the antiaircraft machinegun squads are trained in combined operations as a battery. They include organization and change of firing positions and firing against aerial and ground targets.

Chubarov then points out that the tactical training of antiaircraft machinegun subunits must be organized on the field with trenches and marked sectors of antipersonnel and antitank obstacles (138).

9. New Mounting Devices for Antiaircraft Machineguns

Writing in the Soviet monthly "Military Herald" Voyennyy Vestnik (August 1957), Lt. Col. N. Antonov proposed the following mounting device for twin-barreled antiaircraft machineguns already sed in his military district during firing exercises from standard twin-barreled heavy antiaircraft machineguns (Zenitno-Pulemetnaya Ustanovka, ZPU), utilizing the 7.62 mm ammunition.

Antonov invented a special mount which is fastened above the standard twin-barreled heavy machinegun. In this installation two infantry sub-machineguns (RPD) are fixed for firing 7.62 mm ammunition, but a standard antiaircraft machinegun sighting device, trigger and pointing mechanisms have to be used with them. Thus modified, the standard antiaircraft machinegun mount makes it possible to train in antiaircraft fire not only on the special antiaircraft firing ground but also on the rifle range with a firing range of up to 800 m. It may be also utilized for tactical training for firing blank cartridges. The modified installation does not prevent the use of standard antiaircraft mounts for combat firing., [Antonov's article is illustrated by diagrams and sketches of the proposed device],*(139).

* The theoretical rules for firing from Soviet standard antiaircraft machinegun mounts are presented in detail by Lt. Col. D. Kozlov in the P: Military Herald, No. 7, July 1957, pp. 59-68, (140).

VI. PROBLEMS OF AIR DEFENSE AGAINST INTERCONTINENTAL BALLISTIC ROCKETS AND OF AUTOMATIC FIGHTER INTERCEPTORS

Articles discussing problems of intercontinental ballistic rockets appeared in several Soviet publications since 1956. Major General of Eng.-Technical Service G. I. Pokrovskiy [Dr. of Technical Science and Professor in his booklet entitled: "Science and Technics in Modern Wars" pointed out that intercontinental ballistic missiles present a great possibility for a sudden attack because of their enormous destructive power and also because it would be difficult to discover their launching sites, dispersed in a strongly fortified and camouflaged terrain. These launching sites, said Pokrovskiy may be secretly prepared in peace time and used with complete surprise for the enemy, (141).

However, in his description of intercontinental and long range ballistic and guided missiles General Pokrovskiy failed to discuss the problem of defense against such weapons.

This problem was treated later [in April 1957] in the Soviet Aviation press, from a scientific point of view, by Eng. Major V. Kriksunov, (142).

The concepts presented by the author may be described as follows:

1. Problem of Detection of Intercontinental Ballistic Rockets (ICBR)

Intercontinental Ballistic Rocket will fly at an altitudes tens times that of the maximum ceiling of modern bombers or guided pilotless aircrafts*. The velocity of intercontinental ballistic rockets will approach 6-7 km/sec.** Thus, the difficulty of the problems of detection, interception and destruction of this weapon are readily apparent.

It is known that the existing radar stations can detect the flying targets at a distance of 500 km. The trajectory of flight of the air target may be determined in a few seconds with the aid of electronic computing machines, which calculate on the basis of the coordinates of the target, established by the radiolocator [radar].

The radar stations make possible constant tracking of the rocket's position on its trajectory and thus predict the area on which the rocket will fall.

General Pokrovskiy in his already mentioned pamphlet asserts that in principle the accuracy of ICBR in hitting the target may be substantially higher than that of artillery fire, and, at any rate, its lateral deviation will be considerably smaller than that of artillery fire.

* According to General Pokrovskiy this altitude, i.e. the height attained by ICBR at top of its climb, amounts approximately to one fourth part of the distance of firing, (143).

** The maximum velocity of a multistage ICBR, according to General Pokrovskiy may be 8-11 km/sec (144).

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If an ICBR carrying nuclear or thermo-nuclear charge is fired for a distance of several thousand km, it may be assumed, said General Pokrovskiy, that dispersion of points of hits will not exceed the limits of the hitting zone, as it sometimes happen in artillery fire or aviation bombardment. Therefore, by using the rockets for long distances a successful firing may be achieved (at least in principle) also by a single shot. Each rocket may be launched from a separate launcher (puskovaya ploshchadka), which may be constructed quickly in a hiding place, difficult to detect, (at least more difficult to detect than an airfield on enemy territory). That is the reason why any preventive action against the launching of ICBR will be very difficult. Because of the high speed and high altitude of flight, the detection of ICBR also will be extremely difficult. Even if the enemy succeds in detecting by radar means an ICBR in flight, he will only have several tens of seconds for sounding an alarm and alerting the people before the burst occurs, i.e. too late.

Thus, says Pokrovskiy, long distance rockets assure practically a surprise hit of distant targets on enemy territory. Particularly effective may be a mass rockets attack, directed against an aggressor. The launching sites of these rockets may be prepared secretly in peacetime without the possibility (for an aggressor) of detecting and destroying them. All of this proves that long distance rockets are the most modern means of combat, which substantially increase the importance of surprise in modern war (145).

Detection of intercontinental ballistic rockets and determination of their coordinates may be considerably simplified and the range of detection increased, because the heat developed by friction on the surface of the rocket in the atmosphere causes dissociation of gases in the air. The ionized particles of the gases form a cover around the flying rocket which reflects better the radar impulses. But, of course, this will occur only on that part of trajectory which is in the atmosphere, with sufficient air strata to form such a cover, i.e. at an altitude considerably lower than the maximum height of the intercontinental ballistic rocket flight (142).

2. Interception and Destruction of Intercontinental Ballsitic Rockets (ICBR)

The radius of the defense hemisphere, at the boundary line of which the ICBR should be destroyed, is obtained as a sum of the effective radius of action of the anti-ICBR missile's warhead charge, plus the distance of safety to the defended object. According to foreign press estimates (says Eng. Maj. V. Kriksunov), such a radius should amount to no less than 80 km.

From the moment of detection of the ICBR to the moment it reaches a point on the perimeter 80 km from the defended object (target of ICBR) elapsed time is only 70-80 seconds. During that time the defense should determine the trajectory of the ICBR and the coordinates of the point of its encounter with the anti-ICBR missile. Also, during that time the command "fire" should be transmitted to the anti-ICBR battery.

In order to intercept the ICBR at the boundary line of the zone of destruction, it is necessary to open fire against it while it is 270 km from the defended object. Thus, for the whole operation of interception (computing trajectory and point of encounter, transmitting the command and opening of fire) about 25-30 seconds will remain.

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However (says Kriksunov), interception within this short period is quite possible, taking into consideration all modern technical means of interception (automatization of the operation and electronic computing devices). Nevertheless for a more reliable interception it would be more expedient to possess a radar detecting station able to detect an ICBR at a distance of 1300-1600 km. In that case, the zone of interception will be extended up to 800 km (see the diagram, Fig. 89, Incl. 58), and consequently the time for solving the problem of interception will be also increased (142).

3. Operation of Interception of Intercontinental Ballistic Rockets (ICBR)

In the same article Eng. Maj. Kriksunov states that detection, identification, interception and destruction of the flying ICBR may proceed as follows:

Just 15 minutes earlier, somewhere 8000 km away an intercontinental ballistic rocket was launched, starting, for instance, from an underground launcher (see sketch, Fig. 90, Incl. 58).

The ICBR starts vertically, then the longitudinal axis of the rocket body turns 43 degrees toward the horizon. After the starting flight at a velocity corresponding to the firing range, the second stage rocket motor is switched off. Now, the ICBR follows its trajectory to the highest point, at an altitude of 1270 km. From this highest point of its elliptic trajectory the ICBR begins to fall to the earth. A few minutes later it crosses the boundary of the anti-ICBR radar detection zone, at a distance of some 500 km from the defended object.

From that moment on, the radar station of the air defense begins to track the ICBR flight. It was matter of several seconds to compute the approximate trajectory of the ICBR. The system of distant radar detection transmits two groups of data: (a) to the launching position of the anti-ICBR missiles battery, (b) to the launching positions of its own ICBRs, already in combat readiness to attack ICBR bases on enemy territory.

The electronic computing device supplies the corrections to the calculated ICBR trajectory and the coordinates of the point of encounter. All these data are uninterruptedly transmitted to the anti-ICBR missiles battery, already in combat rediness and waiting for the signal "fire".

At a proper moment, the electronic computing device transmits the signal from the central post of fire control to the anti-ICBR missiles battery. Of course, the author adds, the above description of a hypothetical interception operation reflects only the basic principles of a future system of ICBR interception.

Further, he points out that according to the press informations it is considered possible that if the detection range of the radar station is 1600 km, the accuracy in determining the distance to the flying ICBR (margin of error) will not exceed one per cent of the radar range i.e. 16 km. It follows that if the initial data are inaccurate the coordinates of encounter point computed by electronic device, will be also inaccurate.

Connected with this fact is the problem what means should be used to blow up the ICBR (141).

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4. Problem of Anti-ICBR Missiles

The article of Eng. Maj. Kriksunow does not provide much technical information about anti-ICBR missiles. The author cited an opinion which suggests that to assure the effectiveness of anti-ICBR missiles, their warhead should be charged with a small atom charge, corresponding in power to 20 kilotons of TNT. This atom charge may affect the ICBR by a shock wave, light and nuclear radiation.

However, in order to obtain an effective shock wave, it is necessary that the encounter point of ICBR and anti-ICBR missile be determined with an accuracy of no less than 300 m. It is also necessary to take into consideration the fact that if the encounter point is determined at a great altitude, where the air density is rarefied, the effect of the shock wave will be considerably reduced. Thus in determining the encounter point at high altitude the accuracy should be still greater.

In order that the anti-ICBR missile may carry a warhead with a charge of considerable weight and with the necessary speed, it is indispensable that its own weight and initial thrust approach the starting weight and thrust of the ICBR.

Theoretical calculations of possible variants of the anti-ICBR three-stage missile show that in order to carry the weight of the thrid stage of 450 kg during 30 seconds of active flight, the initial weight of this missile should be 45.4 tons, and its thrust 140,000 kg.

As to the simpler means of interception of ICBR, some military specialists believe that a considerable increase of the accuracy of the anti-rockets missiles is necessary. This may be obtained in two ways:

(a) by interception of ICBR at distances closer to the target [defended object]

(b) by installation of a special radar homing system in the anti-rocket missile.

Some experts assume that the intensive thermal radiation of ICBR in flight may be utilized for the homing system of an anti-ICBR missile. In that case the anti-ICBR missile's homing system will contain elements sensitive to thermal radiation, which will direct it to the ICBR.

Further, Maj. Kriksunow pointed out that while the development of an ICBR with a powerful warhead is believed to be of great importance, many foreign military specialists, however, do not consider this rocket as an "absolute weapon", because the creation of a strong defense system is, from a technical point of view, fully feasible.

The problem of intercontinental ballistic rockets and the creation of an efficient defense system against them, is widely discussed in the Soviet press after the successful launching of the earth satellites.

In particular, in N: Soviet Aviation several articles appeared dedicated to the problems of efficiency of the rocket weapons. In one of the articles of some interest are the remarks of three Soviet rocket experts: Maj. Gen. of Eng. Tech. Service, V. Pugachov, Prof. and Dr. of Technical Sciences, Engr. Lt. Col. V. Glukhov, Candidate of Technical Sciences, Engr. Lt. Col. V. Marisov, Candidate of Technical Sciences, published in Soviet Aviation, No. 271, Nov. 17, 1957.

The authors state that foreign rocket specialists believe that it is possible to deliver to any point on the globe a load of 1.5-2 tons by means of a rocket which launched into the orbit the Soviet artificial satellite "Sputnik" II. Thus, (said the authors) the action of modern guided missiles with rocket propulsion has no distance limits on the surface of the earth and that is the greatest advantage of rocket weapons in relation to other types of weapon.

The other advantage, according to the authors, is that the accuracy of rocket weapon is increasing. It is believed (said the authors) that creation of the system guiding the rockets during the flight, in principle, solves the problem of accurate hitting. Some types of existing antiaircraft jet guided missiles are designed to achieve a direct hit. The guiding system of intercontinental ballistic rocket, according to published data, secures accuracy of hitting with admissible error which does not exceed two thousandths of the firing distance, i.e. that if such distance is 10,000 km, the error in hitting will not surpass 20 km [according to Gen. Pokrovskiy the magnitude of this error may be considerably smaller]. The authors consider that even with such error of hitting the rocket which carry nuclear or thermo-nuclear charge can effectively destroy the ground target on a considerably large area.

Further, the authors assert that at present the strategic bomber aviation, despite its long range of action, great destructive power of its nuclear and thermo-nuclear bombs and accuracy of hitting, can not be considered as a unique effective weapon, because modern bombers flying at an altitude of 20 km are vlunerable to antiaircraft defense fire, and because the strategic aircraft raid can be detected well in advance before it reaches the target, thus the whole antiaircraft defense system of the attacked area can be put into combat readiness.

The cosmic altitudes at which the ballistic rocket flies on the major part of its trajectory, and also the tremendous speed with which the rocket approaches its ground target, eliminate the possibility of the effective defense of the object of attack.

Practically, assert the authors, in contradiction to the previously cited Soviet rocket expert, Eng. Maj. V. Kriksunov, long distance rockets are not vulnerable to the air defense means.

Summing up, the authors consider the jet guided missiles, which combine so many important combat qualities, to be an extremely effective modern weapon. According to the authors, these qualities are:

- great range of action,

- great accuracy in hitting,

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- tremendous destructive effect,

- invulnerability to the action of air defense.

Some of the types of the Soviet latest rocket weapons are shown in the Incl. 38, Fig. 56, (147).

5. Problem of Automatic Fighter Interceptors

The problem of automatic fighter interceptors was discussed in the Soviet press several times. Theoretically, automatic fighter interception is considered by some Soviet authors as one of the basic methods of air defense in the next few years. However, no information is available about the practical adoption of this principle.

On this subject there has appeared in the Red Star in August 1957 a significant article of Eng. Col. K. Malyutin, who, quoting some foreign sources, presented the following remarks, (148):

(a) Automatic fighter airplanes may fly under conditions unattainable for conventional airplanes as to the maximum of "G" force.

(b) Consequently, the automatic fighter airplane may be launched from a launching installation without a starting run and airfields.

(c) The process of transmitting control signals and their execution by the automatic fighter interceptor is instantaneous.

(d) The automatic fighter interceptor may attain a speed of 2,000 to 3,000 km/h and an altitude of 18,000 to 20,000 km .

(e) The system of guidance of the automatic fighter interceptor under conditions of aerial combat should be double, i.e. the aircraft should be guided by radar from the ground and also by a homing system located on board. In both cases, however, a special installation should eliminate the possibility of radio-interferences by the enemy.

(f) Besides the radar homing system on board the aircraft, there may be developed a system of thermic, infra-red homing, which reacts to a temperature of 50 to 70 degrees [C] above the temperature of the surrounding area, at a distance of 35 km. In some cases a thermic homing system is more reliable than radar system, however, it may be hindered by fog or cloudiness.

(g) The automatic fighter interceptor may be armed with guided missiles launched automatically according to radar ground control signals or by a homing system on board the automatic aircraft.

(h) Operation of the pilotless fighter interceptor may be executed in the following stages: 1. launching the interceptor and guiding it into the area of air target by radio and radar directing station, 2. independent flight of interceptor guided by a homing device on board, 3. search of the target, atta ck (firing) and return to the air base, accomplished by homing system, and 4. landing approach, and landing controlled by the radar ground station.

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The author believes that the creation of a reliably functioning automatic fighter interceptor is a complex task, and, according to the foreign press, no such aircraft exists in a production stage (here the author describes the testing of a model of the automatic fighter interceptor in France).

However, concludes the author, "it is necessary to take into consideration that with the aid of the present scientific achievements such automatic airplanes may be created in any technically well advanced country (148).

CONCLUDING REMARKS

According to the statements expressed on several occasions by the former Defense Minister, Marshal G. Zhukov, and the present Defense Minister Marshal R. Malinovskiy, and also in the light of opinions published by such Soviet authors as: Marshal V. Sokolovskiy, Marshal P. Rotmistrov, General P. Kurochkin, General Baykov, General Shatilov and General Professor Pokrovskiy, the Soviet Union is prepared to fight the most modern war which has required revision of the whole military setup. This also vitally concerns the air defense system which has been radically modernized and already possesses highly developed branches of nuclear and thermo-nuclear defense, and also anti-chemical and anti-bacteriological defense.

The same Soviet authors state that tremendous preparations have been made in civil defense, thus making the whole nation ready to resist successfully any air invasion, until, as the authors said: "our own forces deliver a crushing-decisive blow to the enemy vital centers".

In order to forestall the possibility of air aggression, the Soviet air defense system has developed a very extensive radar observation and detection network in close cooperation with the countries of the so-called "democratic bloc".

The total strength of the forces engaged at present in the Soviet air defense system is unknown (according to some Western estimates it might amount to over 200,000 men, about 12,000 guns and missile launchers and 1,500 latest Soviet fighter airplanes).

The Soviet air defense spreads a network of bases throughout the country, but their exact location is not known. The Soviet source which supplies information about the air defense activity, as a rule, mentions the bases and airfields with the conventional mark "N". Some of the air defense bases are located in the "forbidden zones". The news reports do not contain any indications as to their military ditricts, but only general descriptions, for instance: "radar-technical subunit somewhere beyond the polar circle" (gde-to v Zapolyarii). With the exception of the Baku and Moscow air defense district and some air defense training centers, the exact location of air defense commands and units is not known.

However, on the basis of various news reports and press information on the routine training, parades, sport achievements, etc., it was possible to establish that the air defense units and services are located within the areas of all military districts and are close to the important and vital administrative and economic centers.

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They are marked on the appended to this report map, which is a photostatic copy of the Soviet map published in P: Illustrirovannaya Gazeta (Illustrirovannaya Gazeta) in Feb. 1956, showing the vital economic areas according to the Party directive for the new Five Years Plan, (see Fig. 71, Incl. 47).

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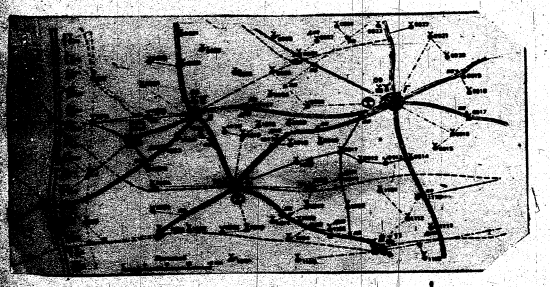

Fig. 1 - Diagram of the ring-type observation of the VNOS Service (Early Warning, Observation and Communication Service)

The observation posts are numbered counter-clockwise from the North. The first two-digit figure indicates the number of the main post, the following two-digit that of the post itself. For example, the figure 0175 shows the number 01, as that of the main post, the number 75 that of the observation post.

Disposition of the observation posts in relation to their density is shown on the diagram only for orientation. The scale of the diagram is valid only in relation to the distances.

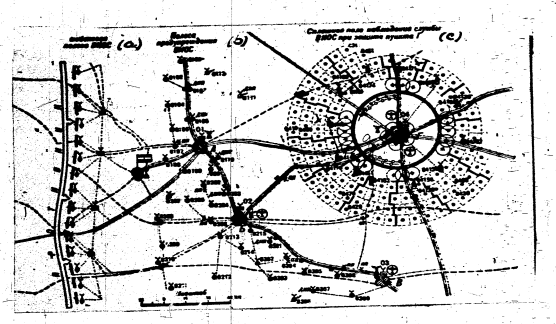

Fig. 2 - Diagram of organization of the VNOS Service according to the principle of Continuous Observation.

(a) Army Zone of the VNOS Service

(b) Zone of Warning of the VNOS Service

(c) Zone of Continuous Observation of the VNOS Service, for defense of point "G"

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Fig. 3 - Commander-in-Chief of the Soviet Air Defense, Marshal S. S. Biryuzov, with Artillery Marshal N. D. Yakovlev and leading soldiers of the Air Defense Forces

Fig. 4 - Radar Operator detected the air target

Fig. 5 - Plotting board at the command post of radio technical unit

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Fig. 6 - Antiaircraft artillery battery is being prepared for firing.

Fig. 7 - Commander of the firing unit commands: "FIRE", (using signal - flag and flashlight)

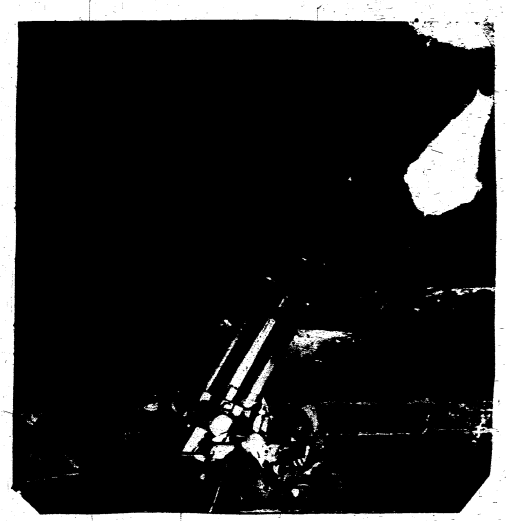

Fig. 8 - Antiaircraft artillery battery fires a salvo

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Fig. 9 - Antiaircraft artillery battery in state of alert.

Fig. 10 - Small caliber antiaircraft automatic cannon.

Fig. 11 - Small caliber antiaircraft self-propelled gun.

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Fig. 12 - Medium caliber antiaircraft artillery gun

Fig. 13 - Battery of antiaircraft artillery guns of medium caliber in firing position

Fig. 14 - Antiaircraft artillery platoon of medium caliber in firing position.

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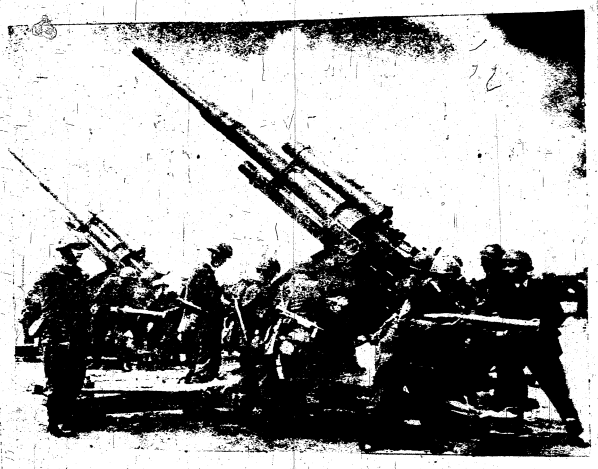

Fig. 15 - Antiaircraft artillery gun of medium caliber of the Czechoslovakian Air Defense

Fig. 16 - Sighting telescope of antiaircraft gun of medium caliber.

Fig. 17 - Elevation mechanism of antiaircraft gun of medium caliber.

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Fig. 18 - Undercarriage of antiaircraft artillery gun of medium caliber.

Fig. 19 - Spade of antiaircraft artillery gun of medium caliber.

Fig. 20 - Special antiaircraft machinegun of large caliber protecting a tank.

Fig. 21 - Special antiaircraft machinegun of large caliber protecting self-propelled

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Fig. 22 - Antiaircraft machinegun of large caliber on special mount fires at illuminated sleeve-target.

Fig. 23 - Four-barreled antiaircraft machinegun of small caliber.

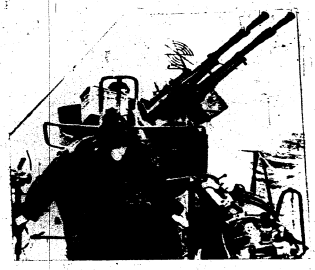

Fig. 24 - Twin-barreled antiaircraft machinegun of small caliber.

Fig. 25 - Rifle units submachinegun used for antiaircraft fire from special mounts (Odesskiy military district)

Fig. 26 - New type of mount for standard submachinegun for antiaircraft fire.

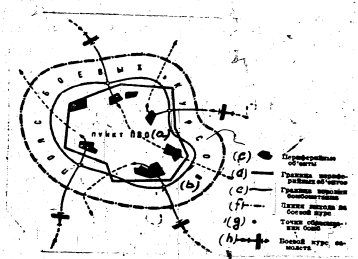

Fig. 27 - Zones of bombing approach around an antiaircraft defense point

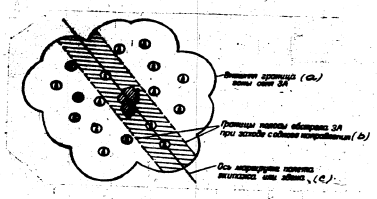

Fig. 23 - Various bombing approaches to the target from one direction. The target is strongly defended by antiaircraft artillery fire which covers a large area.

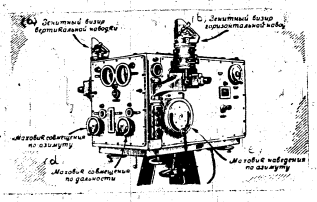

Fig. 29 - Antiaircraft artillery fire director (SNAG)
(a) Elevation sight, (b) Azimuth sight (c) Azimuth control-handwheel (d) Range control handwheel. (e) Azimuth sighting handwheel.

Fig. 30 - General view of the antiaircraft artillery radar station (SON)

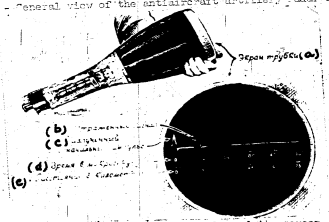

Fig. 31 - Electron-beam tube and its screen.
(a) Screen of electron beam tube; (b) Reflected signal; (c) Initial pulse; (d) Time in micro-sec.; (e) Distance in km.

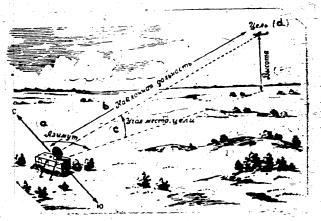

Fig. 32 - Determination of target coordinates
(a) Azimuth (b) Slant range (c) Target's site angle (d) Target (e) Altitude

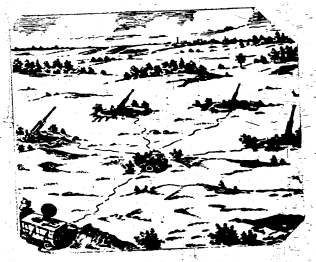

Fig. 33 - General view of antiaircraft artillery battery while firing against airplanes.

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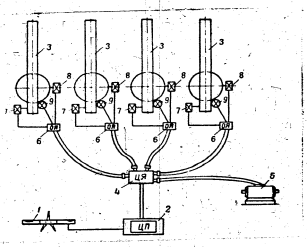

Fig. 3. Diagram of the antiaircraft artillery fire control

1. Range finder (height finder)
2. AA director ("PUAZO" - Tsentral'nyy Pribor Upravleniya Zenitnym ognem, computes the commands for the guns)
3. Battery guns
4. Main junction box of the data transmission mechanism
5. Power plant of the data transmission mechanism
6. Gun junction boxes of the data transmission mechanism
7. Elevation mechanism
8. Azimuth mechanism
9. Fuse setting mechanism

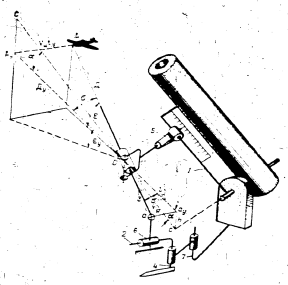

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Fig. 36 - Antiaircraft artillery squad received command "action station", and the cable to the gun has been laid down. (Antiaircraft artillery unit in Privolzhskiy Military District)

Fig. 37 - Scout-gunner at the battery telescopic sight.

Fig. 37a- Radar operator watches the impulses on radar screen.

Fig. 38 - Battery commander watches the work of plotting board operator (who is at the same time commander of the battery signal section).

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Fig. 39 - The crew of five prepares the gun for fire: (Privolzhskiy Military District antiaircraft defense unit).

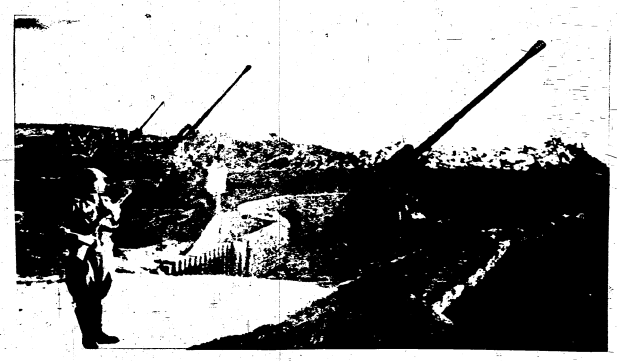

Fig. 40 - Soviet antiaircraft artillery battery on prearranged firing positions on the sea coast.

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Fig. 41 - Soviet naval jet fighters cover a destroyer.

Fig. 42 - Naval aviation mechanics watch prepared by them jet fighters in flight.

Fig. 43 - Naval fighter pilots being instructed about technical characteristics of destroyer, which they have to cover. Instructing officer - Guards Lt. Colonel N. Gurin.

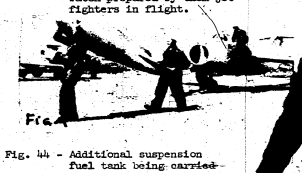

Fig. 44 - Additional suspension fuel tank being carried to jet-fighter, before it takes off over high sea.

Fig. 45 - Naval aviation weapon mechanics loading jet fighter airplane before combat flight.

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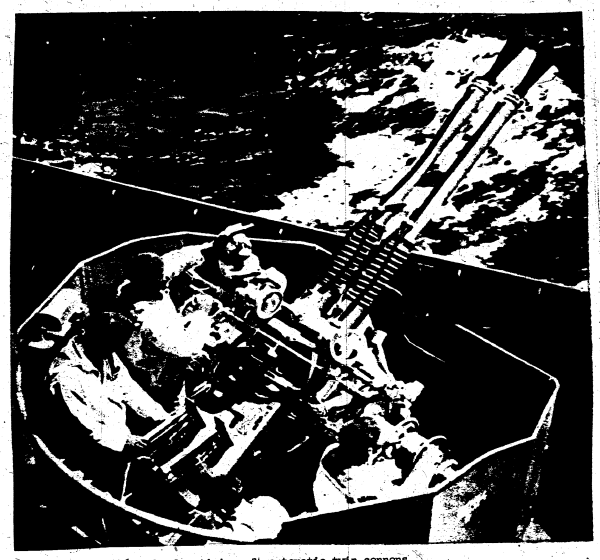

Fig. 46 - Naval antiaircraft automatic twin cannons.

Fig. 47 - Naval antiaircraft artillery battery of the cruiser " Mikhail Kutuzov".

Fig. 48 - Naval antiaircraft artillery battery of the cruiser "Molotovsk" fires a salvo.

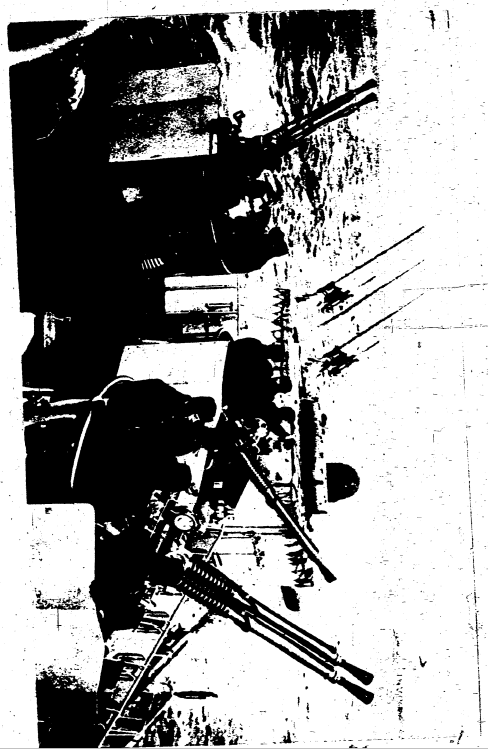

Fig. 49 - Batteries of the naval antiaircraft automatic guns of the cruiser in readiness to fire.

Fig. 50 - Naval antiaircraft artillery commander of the cruiser M at observation post. The cruiser's main battery fires a salvo.

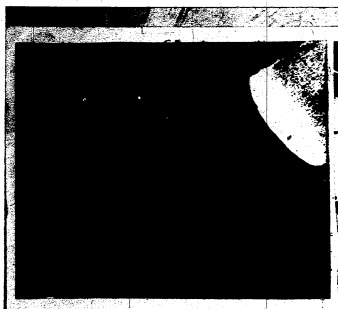

Fig. 51 - Naval antiaircraft searchlight (Soviet Monitor on the river Amur).

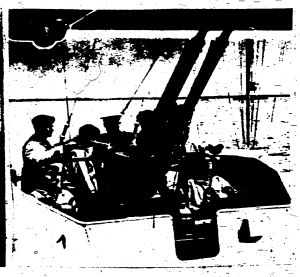

Fig. 52 - Naval antiaircraft automatic twin cannons (Soviet Monitor on the river Amur).

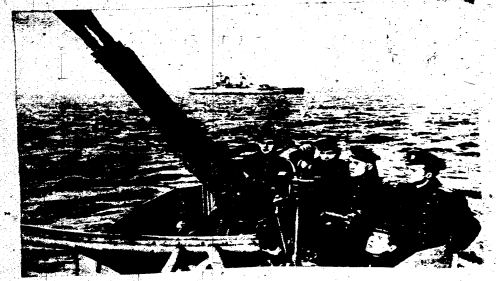

Fig. 52 a. Naval antiaircraft automatic twin cannons with sighting device.

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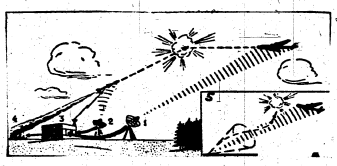

Fig. 53 - Sketch of the Soviet concept of an antiaircraft guided rocket.

(1) Radar direction finder

(2) Radar guiding the missile

(3) Antiaircraft fire automatic computor

(4) Antiaircraft guided missile launcher

(5) Principle of the "guiding beam" system

Fig. 54 - Antiaircraft guided missile at the moment of start and in flight.

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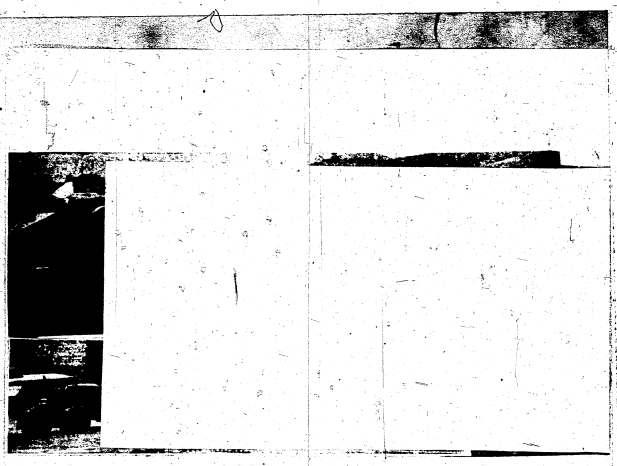

Fig. 55 - Types of Soviet ground-to-air guided missiles.

Fig. 56 - New types of Soviet rockets.

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Fig. 57 - Antiaircraft artillery battery radar station in

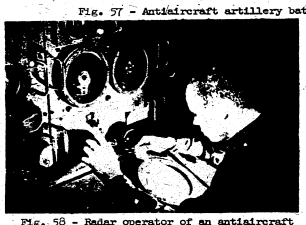

Fig. 58 - Radar operator of an antiaircraft artillery subunit, watches the radar screen.

Fig. 59 - Senior radar operator of an antiaircraft subunit works at radar station.

Fig. 60 - Soviet radar operator (graded specialist first class) watches the impulses on the circular raddr screen.

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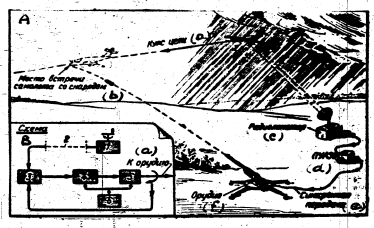

Fig. 61 - Diagram of radar controlled antiaircraft artillery fire

Sketch A:
(a) Course of the target
(b) Point of encounter: airplane - missile
(c) Radar station
(d) Antiaircraft artillery fire director
(e) Synchronous data transmission line
(f) Gun

Sketch B:
(1) Command and control unit
(2) Electric synchronous data transmission system
(3) Measuring devices
(4) Directing unit
(5) Servo motor
(6) Independent electric power supply unit
(a) To the gun

Fig. 62 - Radar station and control post of the fighter unit

Fig. 63 - Radar station of the antiaircraft artillery unit

Fig. 64 - Naval radar operator (1st class) at the post.

Fig. 65 - At naval radar station operators at work

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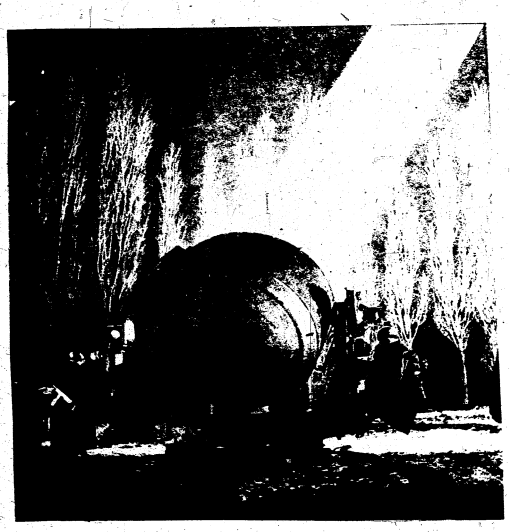

Fig. 66 - Antiaircraft artillery searchlight of Czechoslovakian Army.

Fig. 67 - Searchlight operator checks direction of the beam.

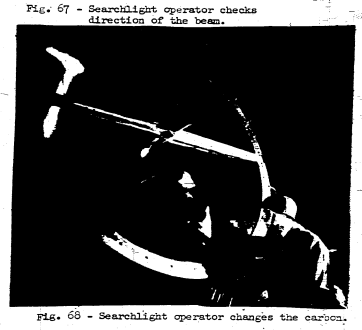

Fig. 68 - Searchlight operator changes the carbon.

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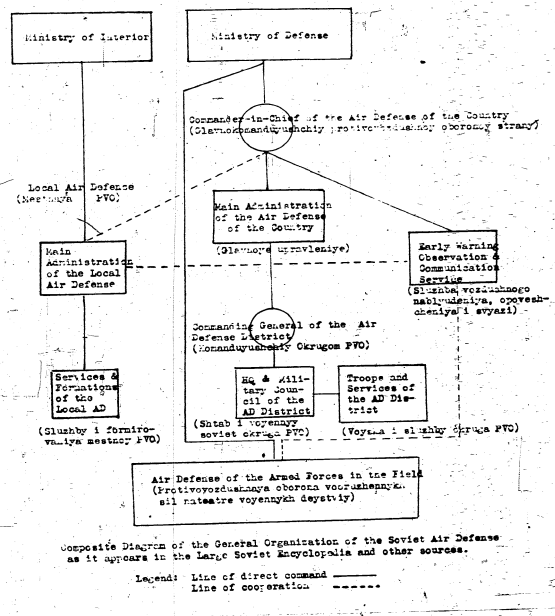
Fig. 69 - Searchlight-control radar in operation.



Composite Diagram of the General Organization of the Soviet Air Defense as it appears in the Large Soviet Encyclopedia and other sources.

Legend: Line of direct command ———
Line of cooperation - - - - - -

Fig. 70 - General organization of the Soviet air defense.

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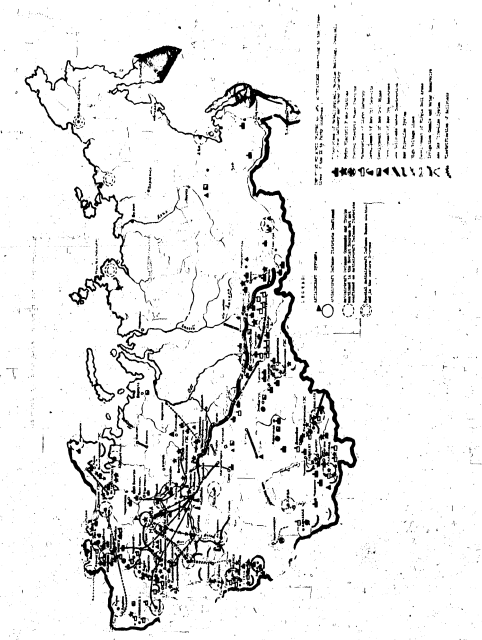

Fig. 71 - Map of approximate location of the Soviet air defense forces.

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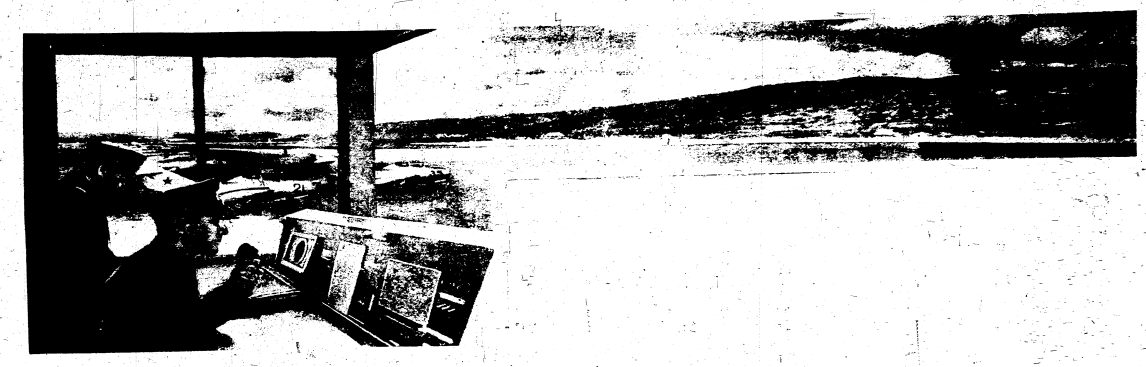

Fig. 72 - General view of an air field of N fighter regiment. At the command post flight supervisor and ground controller direct the takeoff of fighters.

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Fig. 73 - Mobile radar control post at the airfield of fighter aviation. Hero of the Soviet Union Col. B. Zavoryzgin controls the flight.

Fig. 74 - Mobile refueling station on the airfield of N-regiment of fighter aviation.

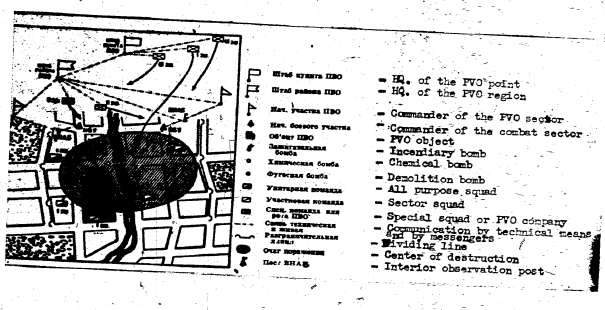

Fig. 75 - Diagram of combat organization of an aircraft defense object.

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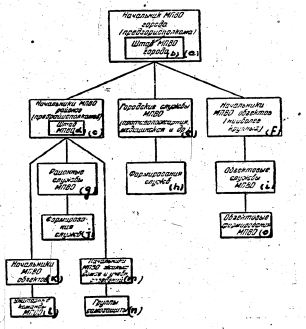

Fig. 76 - Organizational chart of the local antiaircraft defence of a city (Skhema organizatsii MPVO goroda)

(a) Head of MPVO of a city (chairman of city executive committee)
(b) Headquarters of MPVO of a city
(c) Head of MPVO in an area (chairman of area executive committee)
(d) Headquarters of MPVO of an area
(e) MPVO services of a city (anti-fire service, medical and others)
(f) Heads of MPVO of objects (of large objects)
(g) MPVO services of areas
(h) Formations of MPVO of a city
(i) MPVO services of objects
(j) Formations of MPVO of areas
(k) Heads of MPVO of objects
(l) MPVO squads of standard composition
(m) Heads of MPVO of dwelling quarters and educational insitutions
(n) Self-defense groups
(o) Formations of MPVO objects

Fig. 77 - Fighter pilots study on special screens the films of combat duels, which show the results of their firing.

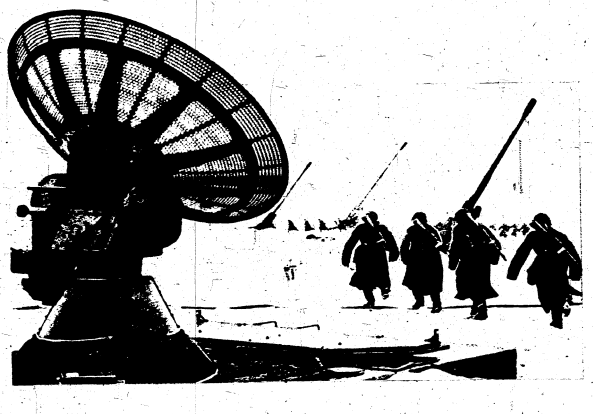

Fig. 76 - Capt. F. Shevelev's antiaircraft artillery battery after "air alarm."

Fig. 79 - Capt. Chevelev, battery commander at the command post, assisted by plotting board operator.

Fig. 80 - Gunner-scout watches the sky with the battery telescopic sight.

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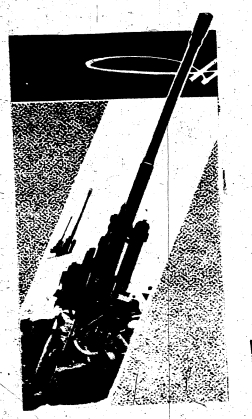

Fig. 82 - The guns of Capt. Shapoynikov's battery (probably 85 mm).

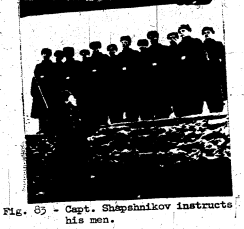

Fig. 83 - Capt. Shapshnikov instructs his men.

Fig. 84 - Battery plotting board operators at work.

Fig. 85 - The gunner operates elevation mechanism of a gun.

Fig. 86 - Gun crew commander instructs the gunners.

Fig. 87 - The loader prepares the round.

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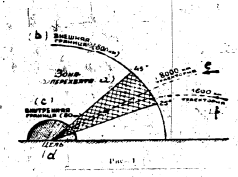
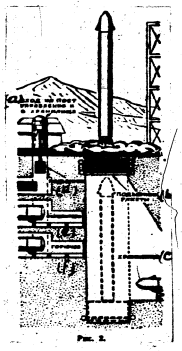
Fig. 88 - Capt. Shapshnikov's battery personnel and the guns in firing position



(a) Zone of interception
(b) Exterior limit
(c) Interior limit
(d) Target
(e) Trajectory 6000 km
(f) Trajectory 1500 km

Fig. 89 - Diagram of zone of interception of intercontinental ballistic rocket



(a) Entry to the command post and storage place
(b) Elevator of the rocket
(c) Storage place for rockets
(d) Elevator at the command post
(e) Oxidizer
(f) Fuel

Fig. 90 - Sketch of intercontinental ballistic rocket launching position

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