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CENTRAL INTELLIGENCE AGENCY
WASHINGTON 25, D. C.

14 MAY 1962

MEMORANDUM FOR: The Director of Central Intelligence

SUBJECT : ARTILLERY COLLECTION: "The Use of Antiradar Mortar Shells to Create Passive Jamming of Enemy Field Artillery Radar Sets"

1. Enclosed is a verbatim translation of an article which appeared in a Soviet Ministry of Defense TOP SECRET publication called Information Collection of the Artillery (Informatsionnyy Sbornik Artillerii).

2. In the interests of protecting our source, this material should be handled on a need-to-know basis within your office. Requests for extra copies of this report or for utilization of any part of this document in any other form should be addressed to the originating office.

[redacted]

Richard Helms
Deputy Director (Plans)

Enclosure

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Original: The Director of Central Intelligence

cc: The Director of Intelligence and Research, Department of State

The Director, Defense Intelligence Agency

The Director for Intelligence, The Joint Staff

The Assistant Chief of Staff for Intelligence, Department of the Army

The Director of Naval Intelligence Department of the Navy

The Assistant Chief of Staff, Intelligence U. S. Air Force

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Following is a verbatim translation of an article entitled "The Use of Antiradar Mortar Shells to Create Passive Jamming of Enemy Field Artillery Radar Sets" which appeared in Issue No. 46, 1958 of the Soviet military publication Information Collection of the Artillery (Informatsionnyy Sbornik Artillerii). This publication is classified TOP SECRET by the Soviets and originates with the Artillery Headquarters of the Ministry of Defense. According to its preface, it is designed for generals and officers from commander of artillery of a corps, commanding officer of an artillery division (commanding officer of an engineer brigade), and higher.

The Use of Antiradar Mortar Shells to Create [redacted]

Jamming of Enemy Field Artillery Radar Sets

Radio electronic equipment considerably increases the capabilities of modern weapons. The rapid introduction into the armed forces of radar, radio communications, radio remote control, radio navigation, and military television is having a considerable influence on the methods of conducting troop combat operations. At the present time, without the use of radio electronic equipment, effective combat operations by aviation, the navy, artillery, especially antiaircraft and missile artillery, and other arms of troops are impossible.

The success of a modern operation depends to a great extent on how accurately and how reliably the complicated radio technical devices for the control of weapons and combat equipment will function. Therefore, to create difficulties for enemy reconnaissance and disorganize the control of his troops, combating enemy radio electronic equipment assumes particular importance. This includes a number of measures collectively known as "radio countermeasures". By radio countermeasures is meant the conducting of a wide range of measures directed toward the destruction (neutralization) or reduction of the effectiveness of enemy use of radio technical equipment such as radar, radio communications, radio remote control and radio navigation.

Among the measures included in radio countermeasures (radioprotivodeystviye), or radio electronic countermeasures (radio elektronnaya mera), as they are called in the Armed Forces of the U.S.A., are the destruction of radio technical equipment, the creation of radio interference (radiopomekha), and antiradar camouflage of troops and installations.

The destruction of radio technical equipment can be accomplished by artillery fire, air strikes, and sabotage groups.

For the destruction of this equipment, depending on circumstances, the importance of the targets, and their distance from the main line of resistance, tube, heavy rocket, and missile artillery may be used.

Radio jamming (radiopomekha) of enemy radio technical sets may be created by jamming transmitters (active interference) or special antiradar reflectors (passive interference).

Antiradar camouflage is achieved with the aid of corner reflectors which create on the screens of radar sets blips of considerably greater intensity than the blips from real targets, and this permits the alteration of the configuration of the radar pattern of the ground in the area of the camouflaged installation and also makes it possible to create false targets on the screens of radar sets and to camouflage the real ones. Antiradar camouflage is employed with the object of concealing from enemy radar intelligence the movement or location of troops and equipment (artillery, tanks, etc), or installations (airfields, railway junctions, bridges, crossings, etc).

In order that radio countermeasures would have maximum effect and would not interfere with the work of our own radio technical* equipment, the planning of radio countermeasures, as a rule, should be done in a centralized manner at front (army) level and carried out in close coordination with the combat actions of all arms of troops participating in the operation.

Some of the problems of reconnoitering enemy ground radar sets and of combating them by artillery fire were dealt with in Artillery Information Collection No. 43, which also gives a description of the features of individual radar stations to which we shall be referring in this article.

This article examines the problems of creating passive radio jamming of enemy field artillery ground radar sets. The main object of these sets is the reconnaissance of mortar (artillery) batteries which are firing and the correction of artillery fire.

The determination of the coordinates of firing positions with the aid of radar sets (Sketch 1) is done, as is known, by means of detecting and tracking the mortar shell (mina) during the ascending sector of the trajectory of its flight with the subsequent extrapolation of the sector located by intersection of the trajectory down to ground level (the assumed location of the mortar that is firing).

In order to deny the enemy the possibility of radar detection of the mortars which are firing, it is necessary to prevent or hamper his detection and intersection of mortar shells during the ascending sector of their trajectory. This task can be fulfilled by setting up passive jamming through the use of antiradar reflectors (chaff or fiberglass) in the zone being reconnoitered by these radar sets.

Chaff or fiberglass can reflect electromagnetic energy in the same way as mortar shells.

The scattering of antiradar reflectors (dipoles) in the area covered by enemy radar reconnaissance sets can be done through the use of aircraft or of special mortar shells filled with these reflectors.

The creation of passive jamming of field artillery radar sets by scattering antiradar reflectors from aircraft entails definite difficulties in connection with the dependence of aircraft flights on meteorological conditions, the difficulty of organizing coordination between these aircraft and the mortar subunits, etc.

Therefore, it is most advantageous to create passive jamming of field artillery radar sets with the aid of antiradar mortar shells.

The maximum reflection of electromagnetic energy from the antiradar reflectors, and, consequently, the most effective interference, will be achieved when the signal strength (uroven signalov) reflected from the antiradar reflectors in the direction of the radar is several times greater than the signal strength reflected from the mortar shell in the same direction.

This is achieved by using a large quantity of reflectors scattered at one point in space. The length of the reflectors (dipoles) must be equal to approximately half the wave length of the enemy radar set which is sweeping and against which the interference is being created.

Under these conditions, the blips from antiradar reflectors attain great intensity and considerable size. Consequently, the observation of the mortar shell on the screens of the radar sets becomes impossible, and the possibility of determining the location of the mortar that is firing is excluded.

Let us examine this problem more closely.

Antiradar reflectors (dipoles) scattered by the mortar shell fly in all directions forming the so-called cloud of reflectors. Thus, for example, the cloud of reflectors at the burst of a 120mm caliber antiradar mortar shell reaches the size of 30 meters in depth and 3 to 6 meters in width. The cloud of reflectors gradually expands because of the action of air currents, descending at the rate of 1 to 2 meters a second and, at the same time, drifting in the direction of the wind.

With a wind speed of 8 to 9 meters a second, the size of the cloud of reflectors reaches the size of 900 meters in width, 500 meters in height, and 30 meters in depth, and 3 minutes later the sizes increase accordingly to 1000, 1500 and 400m.

The quantity of reflectors that must be scattered for the reliable concealment from radar reconnaissance of a mortar shell trajectory is determined by the fact that in the elementary reflecting impulse volume (elementarnyy otrazhayushchiy impulsnyy obyem) the intensity of the signals from the dipoles must be greater than the intensity of the signals from the mortar shell being concealed.

The term elementary reflecting impulse volume means the volume in space which is occupied by the impulse radiated by the radar set, inside which impulse all targets reflect radio waves simultaneously and cannot be observed separately by the radar (Sketch 2).

The quantity of reflectors (N) necessary to create an interference signal, equal in intensity to the signal from a mortar shell when the orientation of the reflectors coincides with the polarization of the electromagnetic waves radiated by the set, can be approximately calculated by the formula:

$$N = \frac{\sigma_m}{\sigma_{osr}} \qquad (1)$$

where

σ_m – maximum effective reflecting surface of the mortar shell (cm^2);

σ_{osr} – mean effective reflecting surface of one dipole reflector (cm^2).

The effective reflecting surface of a mortar shell (target) can be measured or calculated by the formula:

$$\sigma = 4\pi r^2 \times \frac{S_{ts}}{S_p}, \qquad (2)$$

where

S_{ts} – the density of electromagnetic energy incidence on the target;

S_p – the density of electromagnetic energy from the target at the receiver input (na vkhode priyemnika).

The effective reflecting surface of the target (mortar shell) depends on its size, shape, and direction from which the target is scanned.

A diagram of the reflection from a mortar shell has a lobe shape (lepestkovyy kharakter) with the maximum radiation being created by its side surfaces. Consequently, the scanning of the mortar shell from the direction of its side surface presents the best condition for its detection and for locating it by intersection on its trajectory.

The mathematical calculation to determine the effective reflecting surface of a mortar shell is extremely complicated, and therefore it is usually determined by experimentation, by comparing the magnitude of the signals reflected from the mortar shell with signals from standard reflectors, the magnitude of whose effective reflecting surface is known. For example, the effective reflecting surface of standard metallized balloons (shar-etalon) put in free flight may be easily calculated and measured with a sufficient degree of accuracy.

When tracking a mortar shell the radar receives a certain averaged magnitude of the scattered electromagnetic field (usrednennoye znacheniye rasseyennogo elektromagnitnogo polya).

When calculating the quantity of reflectors essential for the reliable concealment of a mortar shell in its trajectory, it is essential to give the maximum, and not the average, value to the effective reflecting surface of the shells.

Sizes of maximum effective reflecting surfaces of mortar shells of various calibers are shown in Table 11.

Table 11

Caliber of mortar shell in mm	Maximum magnitude of the effective reflecting surface in cm^2	
	With a wave length of 3 cm	With a wave length of 10 cm
82	1100-1200	800-900
120	7000-8000	6000-6500
160	17,000-20,000	8000-10,000

The effective reflecting surface of one dipole will be at its maximum when its axis is oriented parallel with the vector of polarization of the electromagnetic wave radiated by the radar set. It can be calculated by the formula:

$$\sigma_{otrm} = 0.86\lambda^2 \qquad (3)$$

when

σ_{otrm} – maximum effective reflecting surface of the dipole in m^2;

λ – length of the working wave of the radar.

When the axis of the dipole does not coincide with the polarization of the electromagnetic wave, the effective reflecting surface of the dipole decreases in relation to the absolute size of the angle between its axis and the vector of the field strength.

Thus, when the angle between the axis of the dipole and the vector of the field strength is 90°, the effective reflecting surface of the dipole will be zero.

In determining the quantity of antiradar reflectors necessary to create reliable interference, it is essential to consider the average, and not the maximum, value of the effective reflecting surface of the dipole, which for the case of uniform and equal probability orientation of dipoles in space can be calculated by the formula:

$$\sigma_{osr} = 0.15\lambda^2 \qquad (4)$$

During the burst of a mortar shell, it may happen that part of the dipoles will be damaged or will stick together and part of them will be outside the limits of the reflecting impulse volume of the set.

In consideration of these factors, the quantity of reflectors calculated by formula (1) must be increased by a certain coefficient K. Coefficient K is determined by the formula:

$$K = \frac{K_1}{K_2 \times K_3}$$

where

K_1 — signifies the necessary amount by which the signal strength from the dipoles must exceed the signal strength from the mortar shell;

K_2 — signifies the degree of scattering of the dipoles;

K_3 — the degree of damage to the dipoles.

The value of coefficient K depends on the type of radar set and whether it has equipment for defense against passive interference.

To create reliable jamming of radar sets not fitted with equipment for defense against passive interference, it is sufficient to raise the level of interference signals to double the level of the signals from the target ($K_1 = 2$).

Coefficient K_2 is assumed to be 0.3; and coefficient K_3 is assumed to be 0.2. Under these conditions K = 33.4.

Taking coefficient K into consideration, formula (1) will assume the form:

$$N = K \frac{\sigma_m}{\sigma_{osr}}.$$

It has been established by experiment that to create effective passive jamming of radar sets not fitted with an attachment (pristavka) to select moving targets, it is sufficient to scatter on the trajectory one quarter of a standard package of chaff (fiberglass).

When creating passive jamming of radar sets fitted with attachments for defense against interference, the necessary quantity of reflectors is increased in proportion to the weakening of the interference signal by the defensive equipment (apparatura zashchity).

The nomenclature of chaff and fiberglass and also their dimensions, quantity and weight are given in Table 12.

Table 12

	Chaff strips No.4 for creating jamming of sets in 10cm band.	Fiberglass	
		DOS-50 to create jamming of sets in 10cm band	DOS-15 to create jamming of sets in 3cm band
Length of chaff strip (Fiberglass) in mm	50	50	15
Width of chaff strip in mm	2	-	-
Quantity in a package	20,000	50,000	800,000
Weight of a package, in grams	440	50	90

Concealment of a mortar shell trajectory from enemy radar reconnaissance will be most effective when the operator of the radar set is unable to observe the signal from the mortar shell against the background of signals from the antiradar reflectors, i.e., when the interference will appear on the screen of the set as one solid blip (odna sploshnaya otmetka).

The mutual distance of two or more bursts of antiradar shells, ensuring the creation of a solid blip on the screen of the radar set, depends on the resolution (razreshayushchaya sposobnost) of the set and its distance from the mortar being concealed.

The most probable angles of displacement of the plane of observation of the enemy radar sets in relation to the plane of fire during radar reconnaissance of mortar firing positions under practicable conditions, should be considered to be angles on the order of 45° to 85°. Therefore, for complete illumination (sploshnoy zasvet) of the screen of the enemy radar set, it is essential that the distance between the bursts of antiradar shells should not exceed the magnitude of the bearing resolution of the set, at the given distance of the set from the plane of fire of the mortar.

The bearing resolution of a radar (Sketch 3), as is known, depends on the width of the antenna radiation pattern and can be calculated by the formula:

$$\Delta \ell = R \frac{\Delta \beta}{57.3} \qquad (6)$$

where

R — distance between the radar and the target (in meters);

$\Delta \beta$ — width of the radiation pattern of the radar antenna (in degrees).

Table 13 gives numerical values for the distances between bursts of antiradar shells ($\Delta \ell_{\sigma}$) ensuring the creation of effective jamming of the American AN/MPQ-10 set to conceal a firing mortar, under varying distances of the sets from the target (R).

Table 13

R in km	5	6	7	8	9	10
$\Delta \ell_{\sigma} = \Delta \ell$ in meters	435	520	600	690	760	870

To conceal the trajectory of a mortar shell from radar reconnaissance by the British FA No.1 Mk1 set, which has an antenna radiation pattern 1.5° wide, the distance between bursts of antiradar shells must be approximately those shown in Table 14.

Table 14

R in km	5	6	7	8
$\Delta \ell_{\sigma} = \Delta \ell$ in meters	130	156	182	208

In concealing the trajectory of a mortar shell, when radar reconnaissance is conducted in the direction coinciding or almost coinciding with the plane of mortar fire, the distance between the bursts of antiradar mortar shells also must not exceed the bearing resolution of the radar. Moreover, in this case the deviation of the cloud of reflectors from the trajectory of the concealed mortar shell in the plane of fire must not exceed the range resolution of the set at a range of (Δr), which is mainly determined by the pulse duration of the radar (Sketch 4) and may be approximately determined by the formula:

$$\Delta r = \frac{c\tau}{2}, \qquad (7)$$

where

C – the speed of radio waves (assumed to equal the speed of light - 300,000 km a sec);

τ – pulse duration of the radar set, in microseconds (mksek).

In the case of concealing a mortar shell trajectory from reconnaissance by an AN/MPQ-10 radar set (τ=0.8 microseconds), the distance between the plane of fire and the cloud of reflectors must not exceed 300 meters; and in the case of concealment from a FA No. 1 Mk1 radar set, this distance must not exceed 40 meters.

The length of the interval between bursts, and the number of bursts of antiradar shells on the ascending sector of trajectory which are needed for reliable concealment of the firing position of a firing mortar, will depend on the range of fire and on the minimum section of the trajectory of the mortar shell necessary for the radar to determine the coordinates of the firing position.

The minimum length of sector of the trajectory of the mortar shell ($\ell_{observation}$)*, from which a radar set can determine the coordinates of the firing position, is determined by the operating time of the computer and the speed of flight of the mortar shell.

* ($\ell_{\underline{nabl}}$) in original

The operating time of the computers of modern radar sets is approximately 3 or 4 seconds. When the speed of flight of a mortar shell is 150 to 180 meters a second, the minimal sector of the trajectory required to get a fix on a firing mortar will be 450 to 540 meters.

To prolong the time that the cloud of antiradar reflectors will remain large enough to ensure concealment, it is necessary to displace the point of burst of the antiradar mortar shell upward and in the direction opposite to the direction of the wind, in relation to the flight trajectory of the mortar shell being concealed. The amount of this displacement will depend on the speed of the wind, the rate of descent of the dipoles, and on the bearing resolution of the radar against which the concealment is carried out.

The burst of antiradar mortar shells must be carried out at such a distance from the flight trajectory of the mortar shell being concealed which would not exceed the magnitude of the bearing resolution of the enemy radar.

The lateral displacement of the cloud of reflectors in relation to the concealed plane of fire may be calculated by the formula:

$$S_{\underline{b}} = \Delta \ell + t_{\underline{u}} W \sin \Phi, \qquad (8)$$

where

$\Delta \ell$ — the bearing resolution of the radar (in meters);

$t_{\underline{u}}$ — the lead time of burst of antiradar mortar shells (in seconds) (includes the time of flight of the mortar shell being concealed up to the cloud of reflectors and the time needed for the formation of the cloud itself);

W — wind speed (meters a second);

Φ — the direction of the wind relative to the plane of fire (in degrees).

The vertical displacement of the cloud of reflectors in the plane of fire being concealed may be calculated according to the formula:

$$S_v = \Delta\ell + V_{ov} t_u \qquad (9)$$

where

$\Delta\ell$ — the bearing resolution of the radar (in meters);

V_{ov} — the rate of descent of the antiradar reflectors (in meters per second);

t_u — lead time of the burst of antiradar mortar shells (in seconds).

For example, if the distance of an AN/MPQ-10 set from the mortar that is firing is 6 kilometers, $\Delta\ell = 520$ meters, the rate of descent of the dipoles $V_{ov} = 2.0$ meters a second, the wind speed $W = 15$ meters a second, and $\Phi = 90$, then the bursts of antiradar mortar shells should occur $t_u = 20$ seconds before the mortar shells being concealed are fired (rate of fire, 10 seconds), with displacement: in direction $S_b = 280$ meters: in height $S_v = 560$ meters.

Because the rate of descent of the cloud of reflectors is considerably lower than the speed at which it is displaced by air currents, the duration of effectiveness of passive jamming of the radar set will also basically depend on the wind speed. This time may be calculated approximately by the following formula:

$$t_p = \frac{2\Delta\ell}{W \sin\Phi} + t_u. \qquad (10)$$

For example, when $\Delta\ell = 520$ meters, $W = 10$ meters a second, and $\Phi = 90^\circ$, the duration of interference, $t_p = 2$ minutes; and if $\Phi = 45^\circ$, $t_p = 160$ seconds.

Therefore, the rate of fire with antiradar mortar shells will be determined first of all by the duration of passive jamming of the enemy radar set.

Passive jamming of enemy field artillery radar [redacted], created with the aid of antiradar mortar shells may be "point" (tochechnyy), random (raspredelennyy), or grouped (obyemnyy).

"Point" interference may be created by means of periodic bursts of antiradar mortar shells at one point on the ascending phases (vetv) of the trajectories of not more than one or two firing mortars. This interference is most effective when the mortars are firing at ranges at which the heights of the trajectories do not exceed 1000 to 1200 meters. In this case, passive interference does not hinder the detection of mortar shells in their trajectory; but it also does not allow the possibility of determining the coordinates of the firing positions of the mortars that are firing, because the automatic tracking of the mortar shells during their flight in the ascending phase of the trajectory is precluded.

For example, when firing with single mortars in order to save antiradar mortar shells, the intervals between bursts of these mortar shells may be permitted to be twice the magnitude of the bearing resolution of the radar set.

In this case the blips from the mortar shells may be observed on the screen of the radar set in the intervals between the blips from passive interference created by the clouds of antiradar reflectors. However, the tracking of the mortar shell and the determination of the coordinates of the firing position of the mortar that is firing with the aid of the radar set becomes impossible.

When creating "point" interference, the cloud of reflectors made by the burst of an antiradar mortar shell takes place in the middle of the ascending sector of the flight trajectory of the mortar shell being concealed, as observed by the radar.

The sectors of the trajectory below and above the cloud of reflectors are not sufficient to determine the coordinates of the firing position of the mortar that is firing, because the working time of the computer of a radar set is limited.

To conceal the firing position of 82mm or 120mm caliber mortars that are firing, the heights of burst of antiradar mortar shells should be approximately 700 to 800 meters; and for 160mm caliber mortars, approximately 1000 meters.

The fixing of firing mortars by AN/MPQ-10 type radar sets, in the presence of "point" interference, becomes possible if the cloud of reflectors is located more than 200 meters away in range, and not less than 0 -- 60 in direction, from the trajectory of the mortar shell being concealed. If the cloud of reflectors is located at shorter distances from the trajectory of the mortar shell being concealed, then the above-mentioned radar sets, after starting to track the mortar shell, will, as a rule, lose the mortar shell as it passes near the cloud of reflectors and will lock on to the signal from the passive interference.

The detection of firing mortars with the aid of the above-mentioned radar sets, under standard conditions (pri tablichnykh usloviyakh) of fire, becomes possible approximately 1 to 2 minutes after the creation of passive interference, and the determination of the coordinates of the firing position of the firing mortar in 2.5 to 3 minutes.

When the trajectory of the mortar shell is more than 600 meters above the cloud of reflectors, it is possible to track it by radar and to determine the coordinates of the firing position of the mortar, In this case, however, the errors in determining the coordinates are increased by approximately 40 to 50 meters owing to insufficient accuracy in extrapolation of the initial sector of the trajectory by the set's instruments.

To create "point" interference during a wind with an average speed of 15 to 20 meters per second, it is necessary to create a cloud of reflectors approximately every 2 to 3 minutes, for which a rate of fire of 30 seconds is assigned, firing antiradar mortar shells after each five or six conventional mortar shells.

To create the most effective "point" passive radio interference, it is advisable to fire the antiradar mortar shells from the mortar whose trajectory is being concealed.

The effectiveness of "point" interference is considerably reduced when the crew operating the radar set has had experience in working under conditions of interference, particularly when tracking manually.

Random interference is created by a burst of antiradar mortar shells at several points along the ascending sector of the trajectory. In this case the distance between bursts must not exceed the magnitude of the bearing resolution of the radar.

The lower cloud of reflectors should be positioned at a height of about 500 to 600 meters. The height of the upper cloud is determined by the height of the flight trajectory of the mortar shell being concealed. Therefore, the total number of intermediate bursts depends on the height of the trajectory. When the height of the trajectory exceeds 1000 meters, it is necessary to create radio interference at two or three points along the ascending sector of the trajectory.

The duration of radio interference and, consequently, the rate of fire with antiradar mortar shells, is determined, as in the case of "point" interference, chiefly by the speed and the direction of the wind. With a wind speed of 9 meters a second and its direction 50° to 60° to the plane of fire, the rate of fire should be approximately 20 to 30 seconds. With an increase in the wind speed, the rate of fire should also increase.

Random radio interference renders it impossible for the radar sets not only to determine the coordinates of the firing positions of mortars that are firing but also to detect the mortar shells in trajectory. Thus, random interference is much more effective than "point" interference and may be used more successfully to conceal the fire of mortar batteries.

Grouped radio interference may be used to conceal the fire of a group of mortars.

In firing with a group of mortars in one direction, the necessary dimensions of the volume of space (depth, height, and width along the front) to be concealed from enemy radar reconnaissance may be selected beforehand, depending on the conditions for firing, the relative disposition of the mortars and the enemy radar sets, and also on the speed and the direction of the wind in relation to the plane of fire. This type of interference may also be created during adjustment of fire by mortars on several targets at different ranges.

When creating grouped interference, the bursts of antiradar mortar shells must be distributed by range, width, and height. The distance between the bursts must be approximately equal to the bearing resolution of those enemy radar sets from whose reconnaissance the fire positions are being concealed.

The number of mortars employed to create grouped interference is determined first of all by the magnitude of space to be concealed.

The "interfering" mortars and the mortars being concealed are, as a rule, located at a single firing position.

The duration of grouped interference is somewhat longer than that of the types of interference described above, and lasts approximately 2.5 to 3 minutes. At the expiration of this period it is necessary to supplement the cloud of reflectors in the space being concealed.

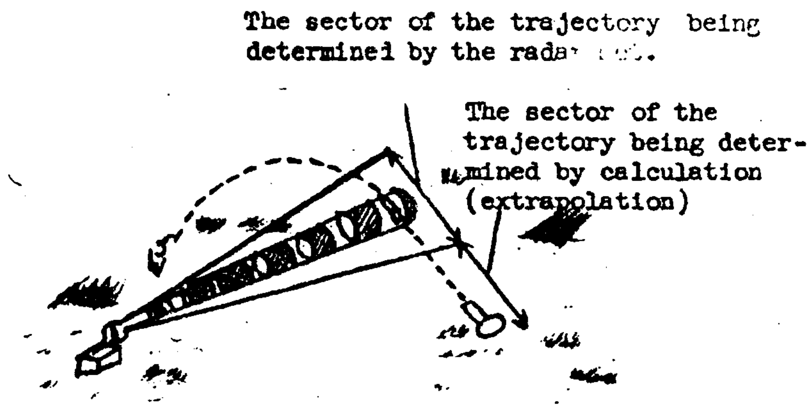
Ordinary leaflet mortar shells filled with antiradar reflectors may also be used, besides the special antiradar mortar shells, to create passive radio interference.

To make enemy radar reconnaissance of firing positions of firing mortars more difficult, various organizational measures may be carried out in addition to the destruction (neutralization) of the reconnaissance radar sets by artillery fire and the creation of active and passive radio jamming of them. Among such measures are fire of roving mortars from decoy positions, salvo firing by mortar batteries, and many others.

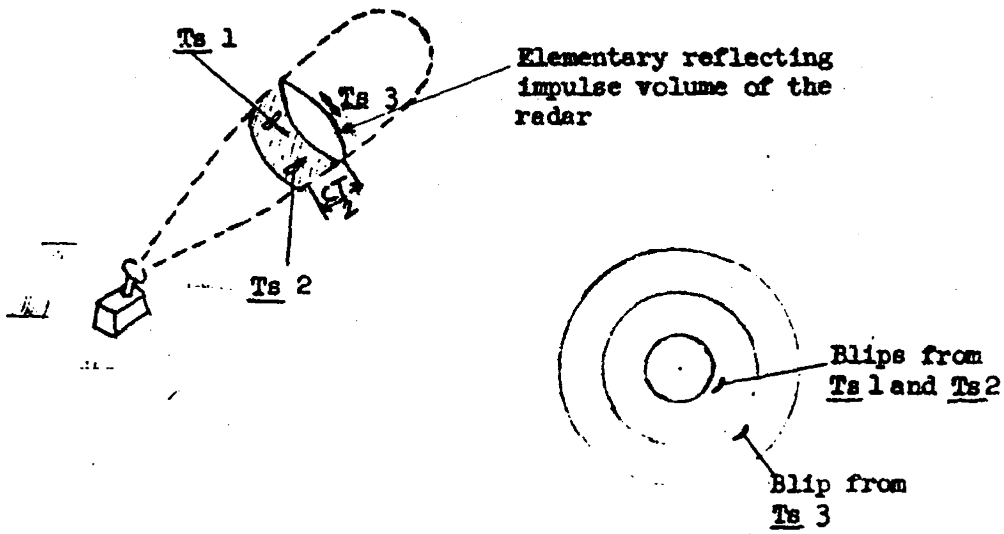
* * * * * * *

This article contains some preliminary considerations on the creation of passive jamming of radar sets engaged in reconnaissance of firing mortars (guns).

The suggested methods of creating passive interference require testing in practice by troops and further development.

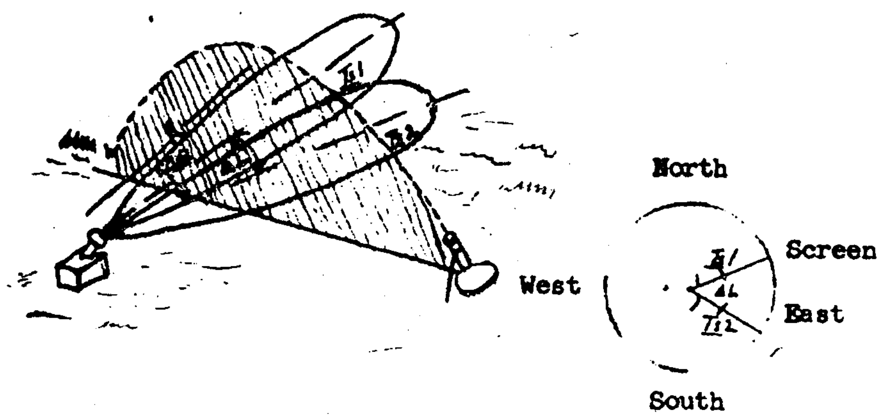


Sketch 1: The use of a radar set to determine the firing position of a mortar that is firing.

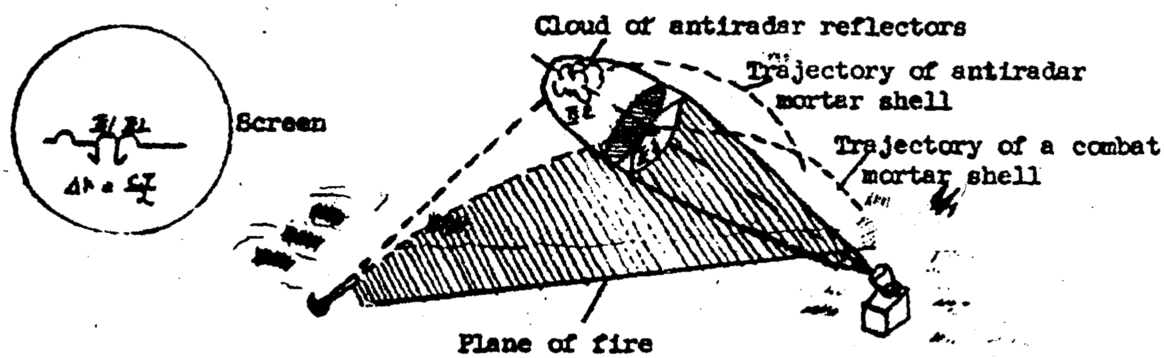


SKETCH 2: The possibility of observing separate targets on the screen of a radar set

Editors comment: Ts stands for Russian word Tsel - target.



SKETCH 3: Bearing resolution of a radar set (Δl)



SKETCH 4: Range resolution of a radar set (Δr)