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CENTRAL INTELLIGENCE AGENCY
WASHINGTON 25, D. C.

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27 JUL 1962

MEMORANDUM FOR: The Director of Central Intelligence

SUBJECT : Chapter IX of SECRET Soviet Manual on Atomic Weapons and Antiatomic Protection

1. Enclosed is a verbatim translation of Chapter IX of a Soviet SECRET document entitled "A Guide to the Combat Characteristics of Atomic Weapons and to the Means of Antiatomic Protection". It was published in 1957 by the Ministry of Defense, USSR.

2. For convenience of reference by USIB agencies, the codeword IRONBARK has been assigned to this series of TOP SECRET CSDB reports containing documentary Soviet material. The word IRONBARK is classified CONFIDENTIAL and is to be used only among persons authorized to read and handle this material.

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Richard Helms

Richard Helms
Deputy Director (Plans)

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Enclosure

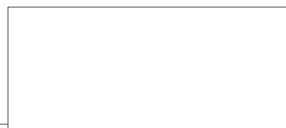
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cc: The Director of Intelligence and Research,
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COUNTRY : USSR

SUBJECT : Soviet Manual on Atomic Weapons and
Antiatomic Protection (Chapter IX)

DATE OF INFO : 1957

APPRAISAL OF
CONTENT : Documentary

SOURCE : A reliable source (B).

Following is a verbatim translation of Chapter IX of a Soviet SECRET document titled "A Guide to the Combat Characteristics of Atomic Weapons and to the Means of Antiatomic Protection." This manual was published in 1957 by the USSR Ministry of Defense as a replacement for a similar 1954 manual (CSDB-35586), and is referenced in the Information Collection of the Artillery (cf. CSDB-3/649,649). It had not been superseded as of late 1961. A similar, more general document was also published by the 6th Directorate of the Ministry of Defense in 1959 (CSDB-3/649,686).



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Chapter IX

Engineer Means of Protection from Atomic Weapons

32. Requirements for the Construction of InstallationsWhich Will Ensure Protection from Atomic Weapons

Defensive installations, constructed for protection of personnel, weapons, materiel and equipment, must ensure protection both from ordinary means of destruction (aerial bombs and projectiles) and from atomic weapons.

All the construction elements of the installations (barrier works, entrances, apertures and the like) must be of uniform strength and capable of bearing the load exerted on them by a given pressure in front of the shock wave of an atomic burst.

The external elements of the installations must not catch fire from the impingement of thermal radiation. The protective thickness of installations is chosen on the basis of the requirements for the protection of personnel in the installations from injury from penetrating radiation at those distances from the place of an atomic burst at which they are protected from the shock wave.

The construction of entrances, gun ports, and filter-ventilation systems must preclude the possibility of the shock wave or radioactive materials penetrating into the installation.

33. Structural Strength and Protective Properties of DefenseInstallations Trenches, Dugouts and Connecting Trenches

The simplest installations - trenches, connecting trenches and dugouts (Figure 118) - possess significant protective properties: they protect against thermal radiation, reduce the shock wave pressure, and attenuate the penetrating radiation dose.

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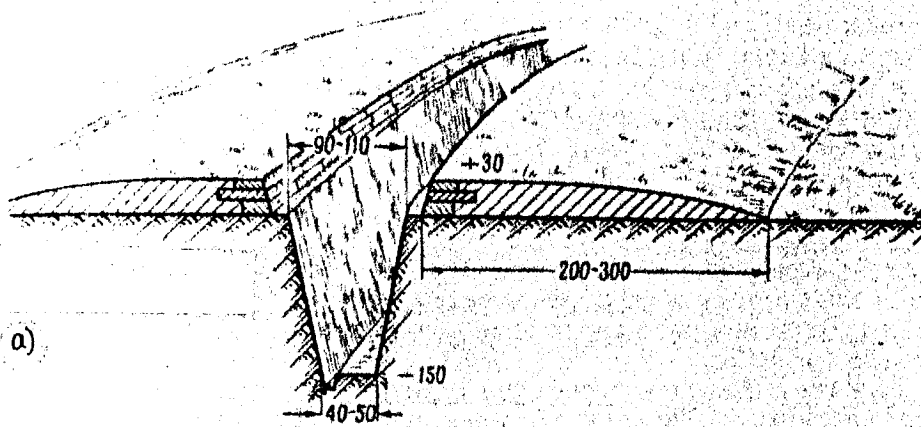
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Trenches, connecting trenches and dugouts are fully covered at the first opportunity. Trenches and connecting trenches must have smooth outlines in the design.

In unstable soils (sand, fine sand, and sandy loam) the simplest shelters are made, as a rule, with revetments of poles, brush, slabs, boards, canes and other materials. Special attention is given to the strength of support fastenings. Supports are driven into the ground to a depth of not less than 0.5 meter. In soft ground, and also in cases where supports cannot be driven to the desired depth, cross bars are placed flush with the ground between them. The upper ends of the supports are fastened with guy wires attached to anchor pickets located 2.5 to 3 meters from the top of the revetment.



a). Trench without revetted slopes

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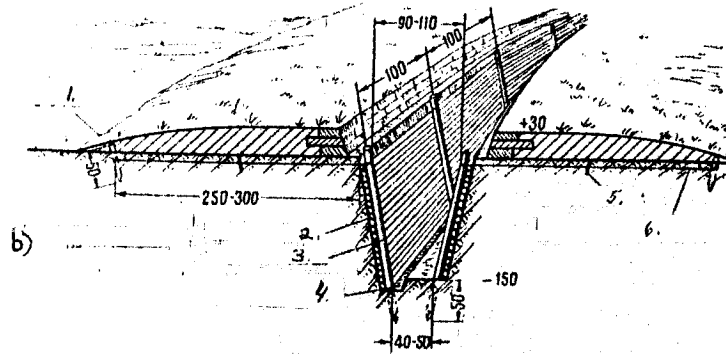
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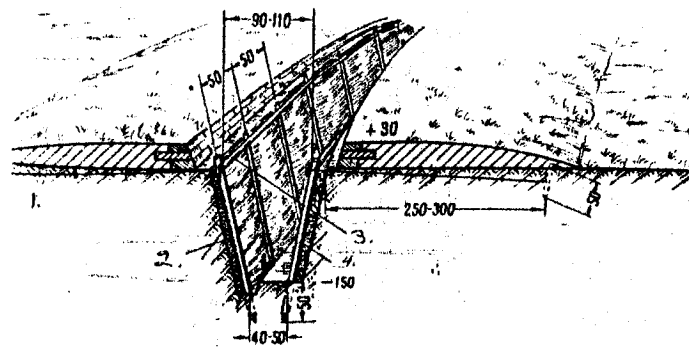
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b). Trench with revetted slopes made of poles

1. Anchor picket, $d = 5$ to 7cm
2. Poles, $d = 5$ to 7cm
3. Picket, $d = 8$ to 10cm
4. Drain-off channel
5. Clamp
6. Guy wires, $d \geq 3$ to 4mm in two strands



c.

FIG. 118

c). Trench with revetted slopes made of brushwood, canes

1. Guy wires, $d = 3$ to 4mm in two strands over 100cm
2. Brushwood, canes
3. Pressure pole
4. Picket, $d = 8$ to 10cm

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Figure 118. Trenches

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In order to increase the fire resistance of the revetted slopes of trenches and connecting trenches, especially at points of contact with the covered installation, they are covered with earth. Antifire gaps 1 to 2 meters wide and spaced every 40 to 50 meters are left in revetted slopes of great length.

Trenches and connecting trenches without revetted slopes, constructed in average soil, do not sustain damage at distances from the center (ground zero) of an atomic burst where the shock wave pressure, at the surface of the earth, is 0.3kg/cm^2 or less. At pressures of 0.3 to 0.5kg/cm^2 such trenches sustain slight damage, that is, damage which has practically no effect on their further military use.

Trenches with revetted slopes survive pressures of less than 0.5kg/cm^2 ; they sustain slight damage at pressures of 0.5 to 1.2kg/cm^2 .

Trenches and connecting trenches, as well as dugouts, when situated perpendicularly to the direction of shock wave movement, ensure protection from the impact of the shock wave pressure head, and from the direct impact of thermal radiation, and they reduce the penetrating radiation dose in an atomic air burst by 5 to 15 times.

The minimum distances from the center (ground zero) of a burst at which trenches (dugouts, connecting trenches) can ensure protection of personnel, are:

- with bursts of low yield warheads - about 0.9km;
- with bursts of medium yield warheads - about 1.4km.

Covered Sectors of Trenches (Connecting Trenches)

and Covered Slit Trenches

Covered sectors of trenches, connecting trenches and slit trenches may be made of logs, fascines, and may also have the form of wattle, earthen arches or arches of elongated sand bags (Figure 119). The slopes of the covered sectors of trenches, dug in soft or average soil, must be covered.

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In winter time the covered sectors of trenches, connecting trenches and slit trenches may be made of snow, ice or frozen ground over a form made of wattle or fascines.

The covered sectors of trenches do not suffer damage at distances from the center (ground zero) of an atomic burst where the shock wave pressure, at the earth's surface, is less than 0.8 kg/cm^2 . At pressures of 0.8 to 1.2 kg/cm^2 they sustain slight damage.

Covered slit trenches do not suffer damage at pressures less than 1.0 kg/cm^2 , but they sustain slight damage at pressures of 1 to 1.5 kg/cm^2 .

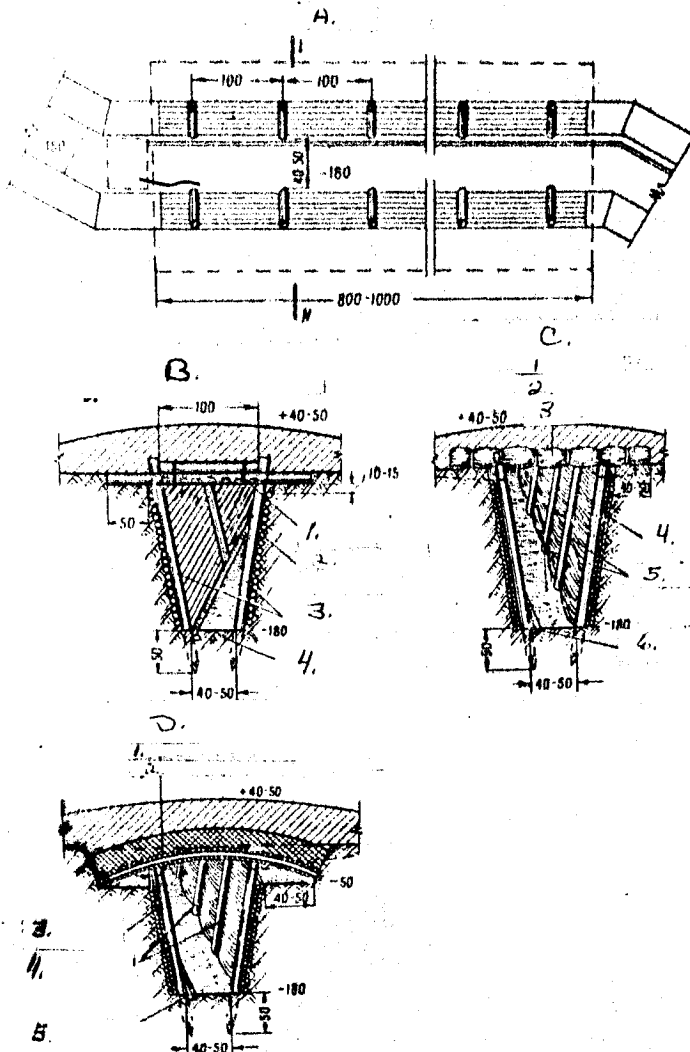


Figure 119. Covered Portions of Trenches

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Description of Figure 119. Covered Portions of Trenches

- A. Top view
- B. Cross-section with cover of logs
 - 1. Flat wooden ceiling, d = 12 to 14cm
 - 2. Poles, d = 5 to 7cm
 - 3. Stakes, d = 10 to 12cm at intervals of 100cm
 - 4. Cross tie (in soft soil)
- C. Cross-section with cover of fascines
 - 1. Earth
 - 2. Fascines, d = 25 to 30cm
 - 3. Brushwood, canes
 - 4. Brushwood, canes
 - 5. Stakes, d = 10 to 12cm at intervals of 100cm
 - 6. Drain-off channel
- D. Cross-section with earth cover
 - 1. Earth
 - 2. Arch for earth, 20 to 25cm thick, on wattles
 - 3. Brushwood, canes
 - 4. Stakes, d = 10 to 12cm at intervals of 50cm
 - 5. Drain-off channel

Covered portions of trenches and covered slit trenches completely protect personnel from thermal radiation and reduce the penetrating radiation dose by 25 to 50 times.

The minimum distances from the center (ground zero) of a burst, at which the covered portions of trenches (connecting trenches) and covered slit trenches ensure protection of personnel, are:

- with bursts of small yield warheads - about 0.7km;
- with bursts of medium yield warheads - about 1.2km.

Dugout Shelters

Dugout shelters are usually constructed for 4 to 8 men. Dugout frames are made of logs, poles, slabs, and also of reinforced concrete sections (blocks) or sections of corrugated steel (Figures 120 to 123).

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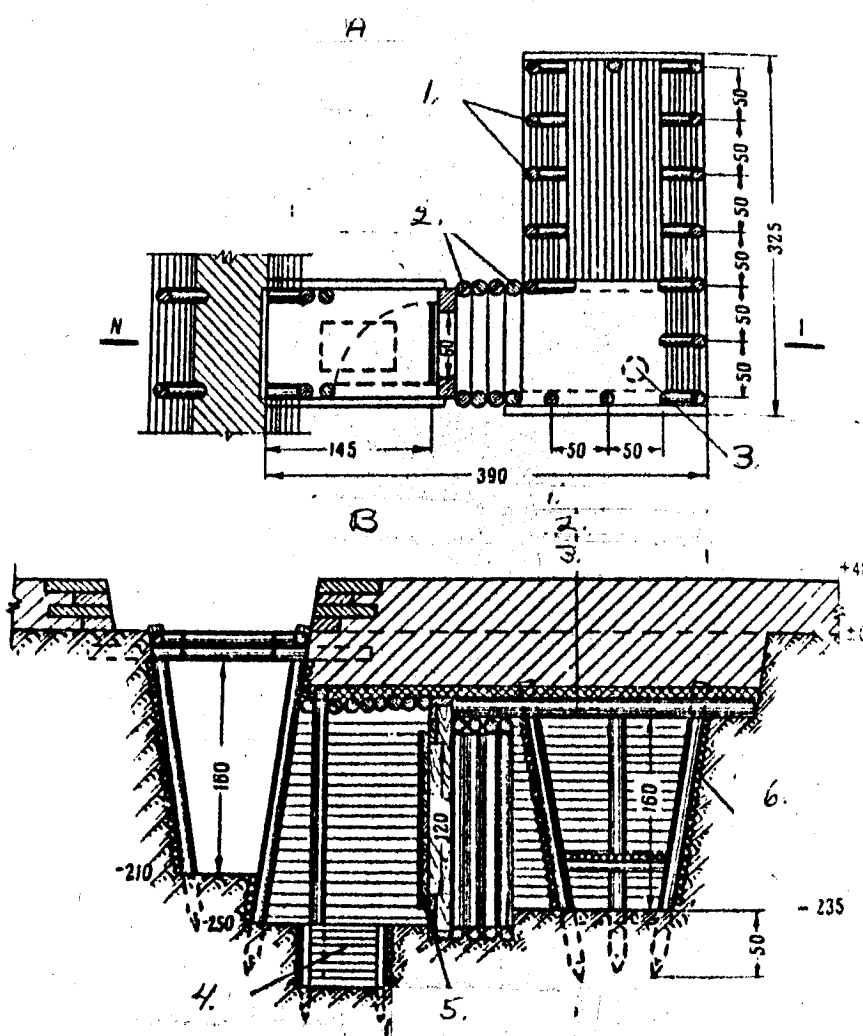


Figure 120. Dugout with Slopes Revetted with Poles and Covered with Boards

A. Top View

1. Posts, $d = 12\text{cm}$
2. Board frames, $d = 14$ to 16cm
3. Place for stove

B. Longitudinal Section

1. Earth - 90cm
2. Clay - 10cm
3. Log, $d = 16\text{cm}$
4. Drainage pit
5. Light-type protective door
6. Poles, $d = 5$ to 7cm

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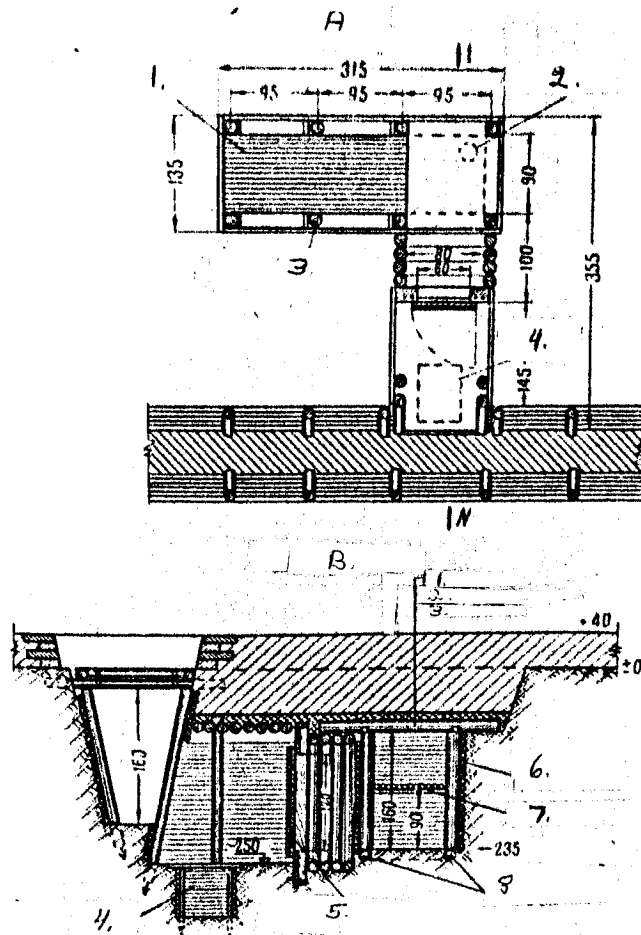


Figure 121. Dugout with Crossbar Frames

A. Top View

1. Removable plank bed
2. Place for stove
3. Board frame, $d = 14$ to 16 cm
4. Drainage pit

B. Longitudinal Section

1. Earth - 90cm
2. Clay - 10cm
3. Log, $d = 16$ cm
4. Drainage pit
5. Light type protective door
6. Poles, $d = 5$ to 7 cm
7. Removable plank bed
8. Crossbars, $d = 12$ cm

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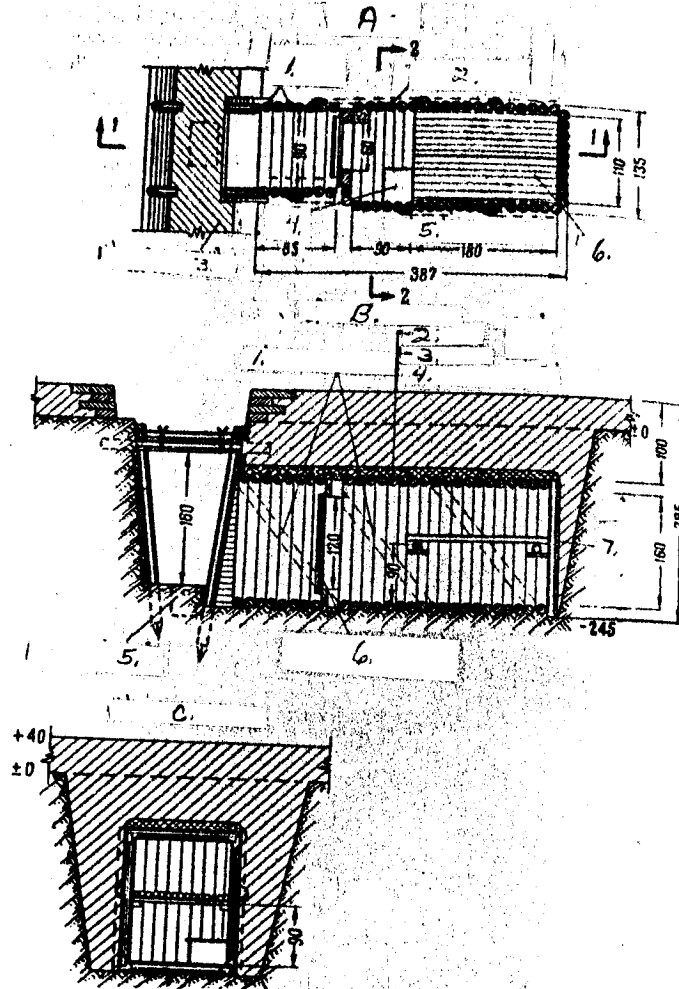


Figure 122. Dugout of Log Frames

A. Top View

1. Log frames, $d = 12$ to 14 cm
2. Log frames, $d = 12$ to 14 cm
3. Open connecting trench
4. Place for stove
5. Supports, $d = 12/2$ cm
6. Bed made of poles

B. Longitudinal Section

1. Passages, $d = 12/2$ cm
2. Earth
3. Clay - 10 cm
4. Frame of installation
5. Drainage pit
6. Light-type protective door
7. Log, $d = 12$ cm

C. Cross-Section

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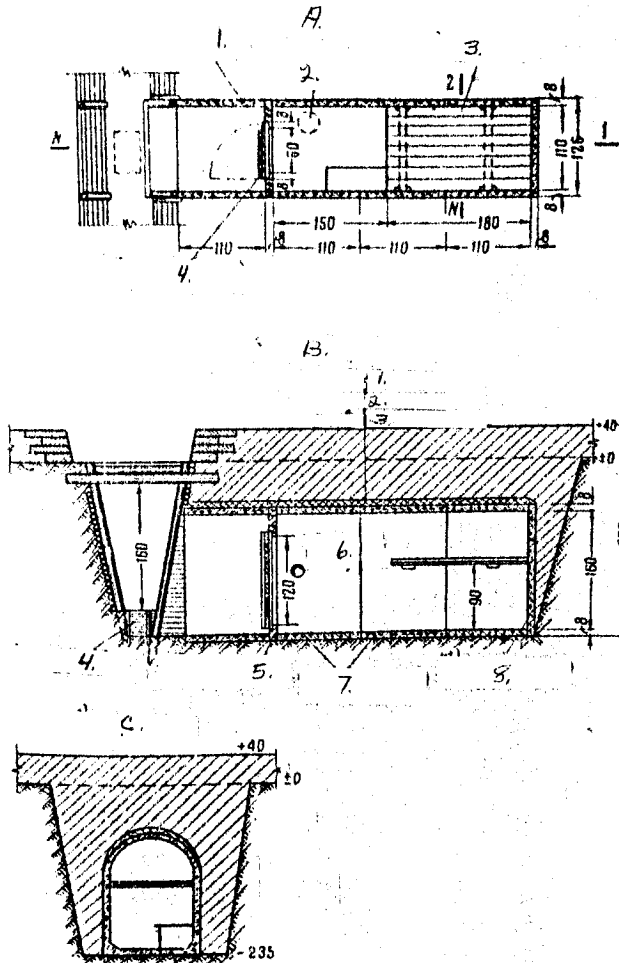


Figure 123. Dugout of Reinforced Concrete Sections

A. Top View

- 1. Reinforced concrete section B-1
- 2. Place for stove
- 3. Plank bed
- 4. Light-type protective door

B. Longitudinal Section

- 1. Earth
- 2. Clay - 10cm
- 3. Frame of shelter
- 4. Drainage pit
- 5. Reinforced concrete section B-2
- 6. Opening for stove pipe
- 7. Reinforced concrete section B-1
- 8. Reinforced concrete section B-3

C. Cross-Section

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The protective soil cover over dugouts must be not less than 100cm deep to ensure reduction of the penetrating radiation dose by 200 to 400 times. The entrances to dugouts are equipped with light-type protective doors.

The structurally strongest dugouts are made of reinforced concrete sections and corrugated steel; the least strong with revetted slopes made of poles and a cover made of logs. On the average, dugouts do not suffer damage from shock wave pressures at ground level less than $1.2\text{kg}/\text{cm}^2$. They sustain light damage from pressures of 1.2 to $2\text{kg}/\text{cm}^2$.

Dugouts of the construction cited above ensure protection of personnel at a distance of about 0.5km from ground zero of the burst of a low-yield atomic bomb and at a distance of about 0.8km from ground zero of the burst of a medium-yield bomb.

Light-Type Shelters

The light-type shelter is usually constructed by means of excavation. The frames of pit shelters are made of timbered elements in the form of frames, panels and blocks, and of reinforced concrete sections and corrugated steel sections (Figures 124, 125).

The soil thickness covering a light-type pit shelter must be no less than 160cm to ensure a 2000 to 3000 times reduction in the penetrating radiation dose. Entrances to the shelter are equipped with heavy-type protective doors, air intake openings and chimneys with anti-blast valves or gravel shock absorbers; chimney openings are fitted with hermetic valves closed by hand.

The structurally strongest shelter is made of frame blocks and reinforced concrete sections; the least strong shelter is made with frames in the form of a disjointed contour (v vide nezamknutogo kontura) (from sloping revetments made of poles).

The following data describe the average structural strength of light-type shelters. The installations do not suffer damage at shock wave pressures less than $1.0\text{kg}/\text{cm}^2$ at ground level, but at pressures of 1.0 to $3.0\text{kg}/\text{cm}^2$ they suffer light damage.

Light-type shelters of the construction given above protect personnel at a distance of 0.4km from the center of a surface or from ground zero of a low air burst of a low-yield atomic bomb and at a distance of 0.6km with a burst of a medium-yield bomb.

Troops can remain in hermetically sealed shelters equipped with filter-ventilating systems when the terrain and air are contaminated with toxic and radioactive materials.

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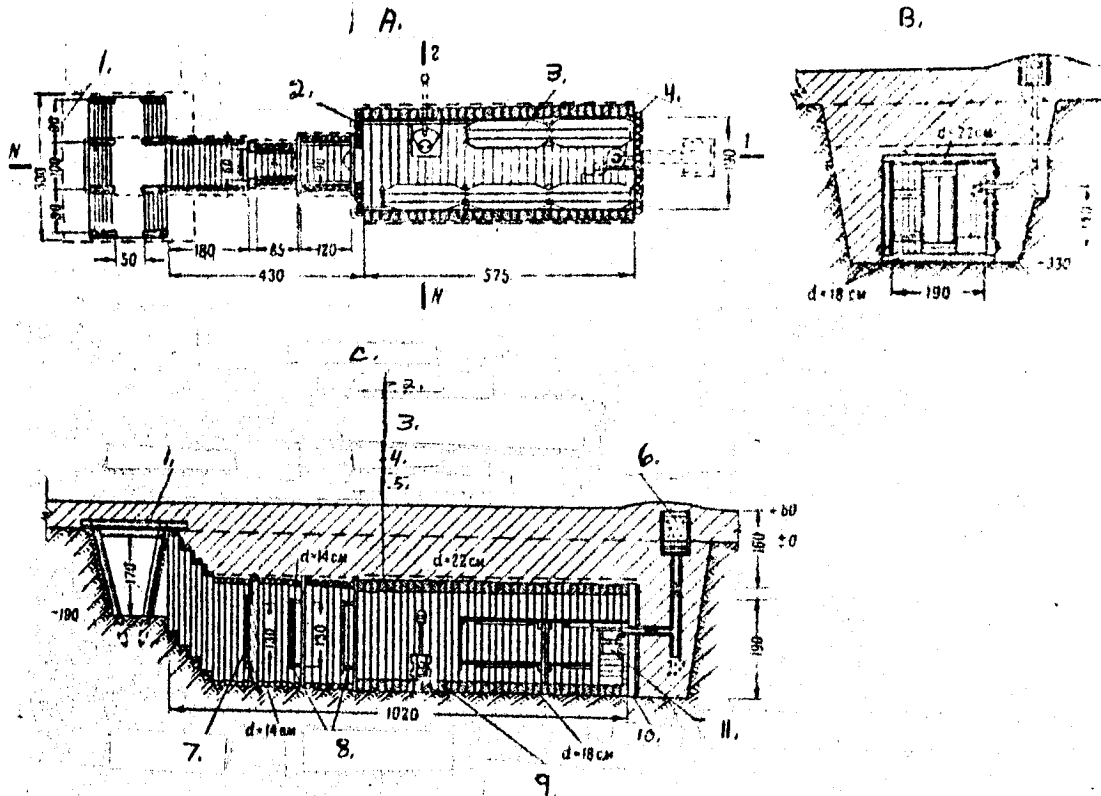


Figure 124. Light-Type Shelter of Frame-Block Construction

A. Top View

1. Outline of cover
2. Panel
3. Plank beds
4. Panel

B. Cross-Section

C. Longitudinal Section

1. Log, $d = 12\text{cm}$
2. Earth
3. Insulating material (clay, etc)
4. Earth
5. Frame of shelter
6. Gravel shock absorber
7. Protective door
8. Hermetic doors
9. Heating unit
10. Panel
11. Filter-ventilation unit

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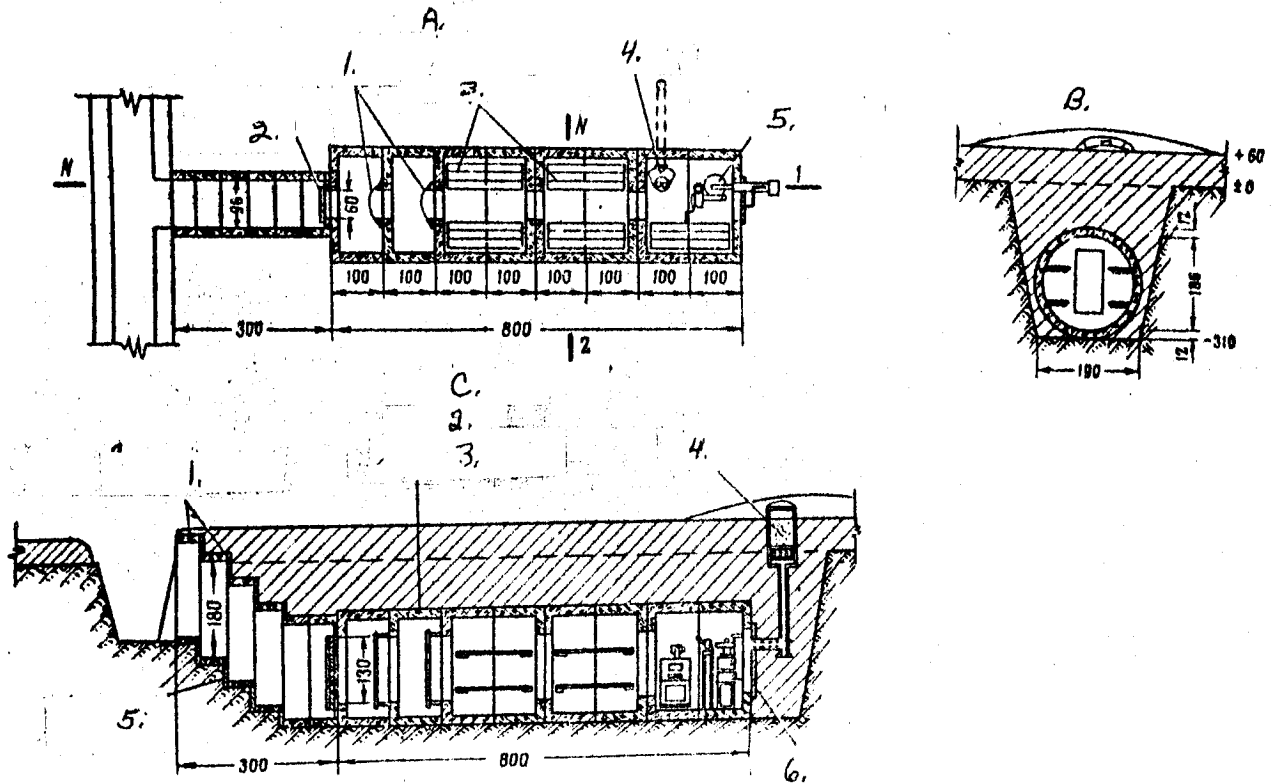


Figure 125. Light-Type Shelter of Reinforced Concrete Sections

A. Top View

1. Hermetic doors
2. Protective door
3. Plank beds
4. Heating unit
5. Filter-ventilation unit

B. Cross Section

C. Longitudinal Section

1. Reinforced concrete section "V-4"
2. Earth
3. Reinforced concrete section "T-2M"
4. Gravel shock absorber
5. Boards 5cm thick
6. Boards 5cm thick

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Covered Machine Gun and Observation Works of the Field Type

Covered machine gun and observation works are constructed with timber and earth, of reinforced concrete sections and with armored end pieces (covers).

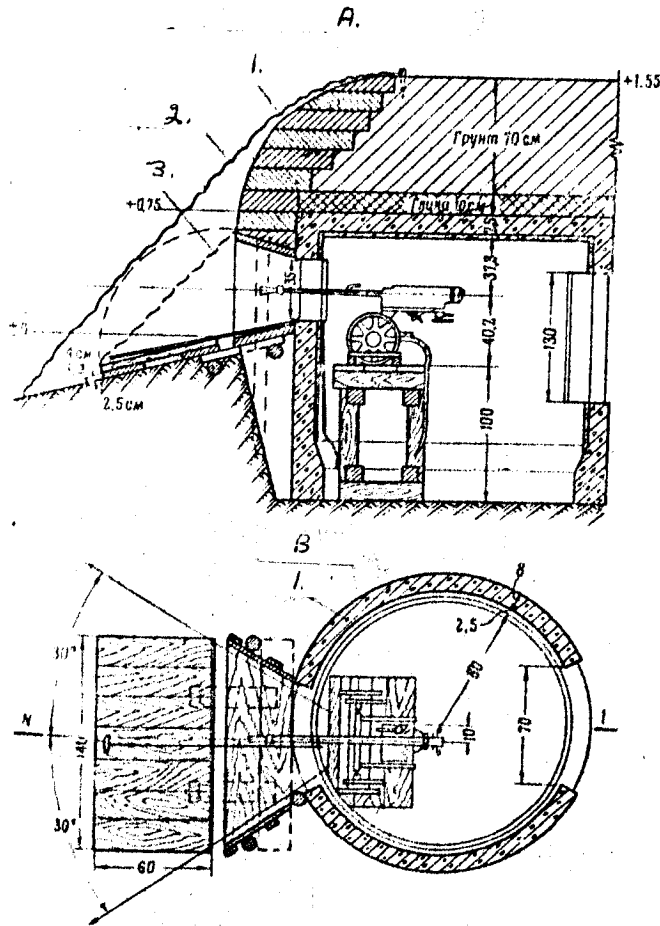


Figure 126. Covered Machine Gun Emplacement Made of "T-1" Reinforced Concrete Sections

- A. Cross-Section
 - 1. Fixed camouflage cover
 - 2. Wire brace
 - 3. Camouflage cover attached to movable panel
- B. Top View
 - 1. "T-1" section

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When constructing machine gun and observation works the following requirements are met:

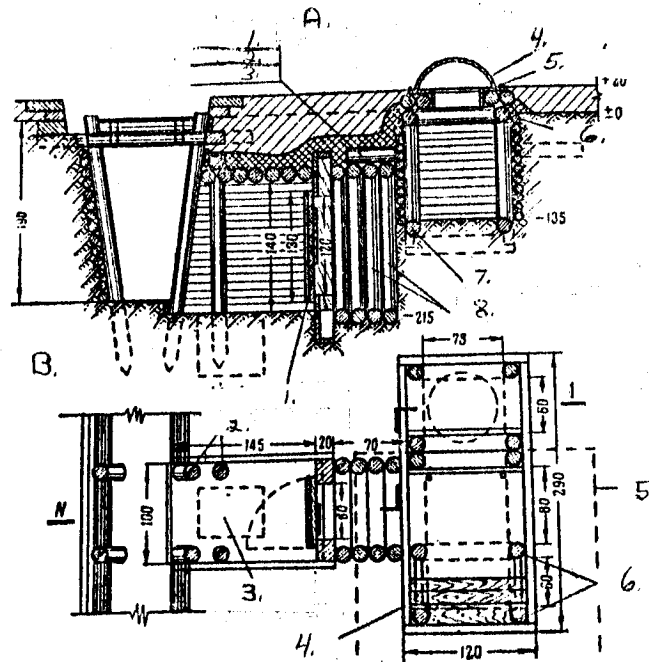
-- entrances to the works are equipped with protective doors and the gun ports and observation slits are fitted with protective devices (of the panel and flap type) in order to prevent the shock wave from penetrating into the installation;

-- alongside the casemates (especially in works with armored covers), where possible, shelters are built for the protection of the crew from penetrating radiation.

During construction special attention is given to the secure attachment of the covers (ogolovok) to the frame of the installation.

The construction of the machine gun installation from "T-1" reinforced concrete sections is shown in Figure 126; the construction of an observation installation with armored cover is shown in Figure 127.

The structural strength of covered machine gun and observation installations and their protective properties are described by the data presented in Tables 132 and 133.



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Figure 127. Observation Post with Armored Cover, Type TNP

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Figure 127. (continued)

A. Longitudinal Section

1. Earth
2. Clay, 10cm
3. Log, d=16cm
4. Observation slit
5. Spike
6. Support frame
7. Cross bar, d=16cm
8. Log frames

B. Top View

1. Light type protective door
2. Supports, d=12cm
3. Drainage pit
4. Poles
5. Limit log ceiling
6. Log frames, d=16cm

Table 132

Structural Strength of Covered Machine Gun andObservation Works of the Field Type

Type of Structure	Pressure Δp_f in kg/cm ² at which the installation sustains		
	Total de-struction	Moderate damage	Slight damage
Timber-earth machine gun works of crown (venchataya) construction	1.1	0.8	0.6
Timber-earth observation works of frame construction	0.8	0.6	0.4
Machine gun and observation works with reinforced concrete domes	2.5	1.6	0.8
Observation works with armored covers on wood foundations	1.1	0.6	0.5

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Table 133

Protective Properties of Covered MachineGun and Observation Works

Type of structure	Distance in km at which the installation ensures protection of personnel	
	From atomic bursts of low yield	From atomic bursts of medium yield
Timber-earth and reinforced concrete machine gun works	0.75	1.0
Timber-earth observation structures	0.8	1.2
Observation structures with reinforced concrete domes and armored covers: with observers under the dome (armored cover)	1.0	1.3
with observers in covered position	0.5	0.8

The best protective properties are possessed by installations with periscopic observation. Such installations, depending on their importance, may be constructed as dugouts or light-type shelters.

Dugouts and Shelters for Guns and Mortars

Shelters of the pit type are constructed for guns with calibers up to 100mm intended for direct fire.

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The shelter is made in the form of a pit connected to the gun site by a ramp. If materials and time are available the position is made with a cover of logs. The entrance to the shelter is covered with joined panels made of beams (logs).

Shelters are constructed for guns firing from concealed positions so that the gun is covered to the upper edge of the shield.

Dugouts for antiaircraft guns, recoilless weapons and mortars are dug to a depth which does not interfere with firing.

Dugouts are built for the concealment of crews.

The location of dugouts relative to gun sites depends on the protective properties of the terrain and the expenditure of the minimum amount of time for occupying them on receipt of the warning signal of the danger of an atomic attack.

Slit trenches with recesses are built for ammunition. Sectors of slit trenches with recesses are covered (and if time permits, the whole slit trench is covered).

Trenches for guns, rocket launchers and mortars are shown in Figures 128 to 132.

	Dimensions in cm				
	R	a	b	-c	-d
57mm gun	350	300	200	-110	-40
85mm gun	500	400	300	-120	-30
100mm gun	500	400	300	-120	-30

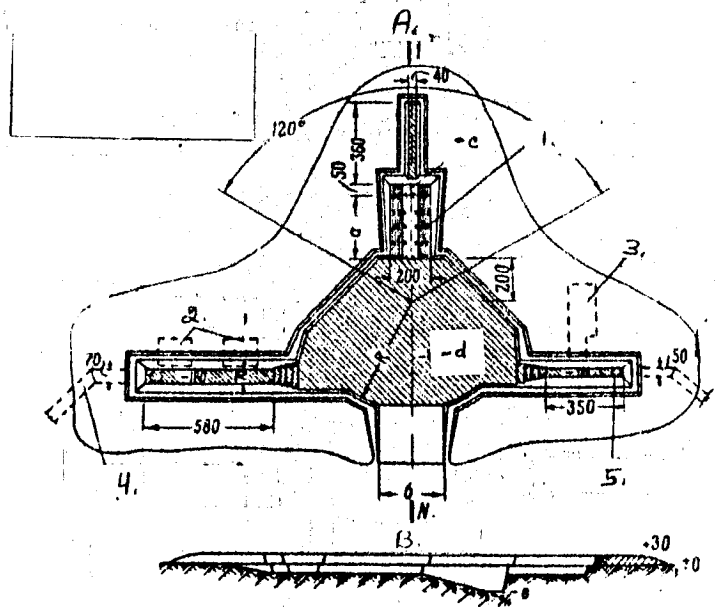


Figure 128. Trench with a Wide Field of Fire for 57mm, 85mm and 100mm Guns.

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Figure 128 (continued with its description)

- A. Top View
 - B. Cross-Section
1. Concealment for gun
 2. Ammunition niches
 3. Dugout
 4. Possible connecting trench
 5. Drainage pit

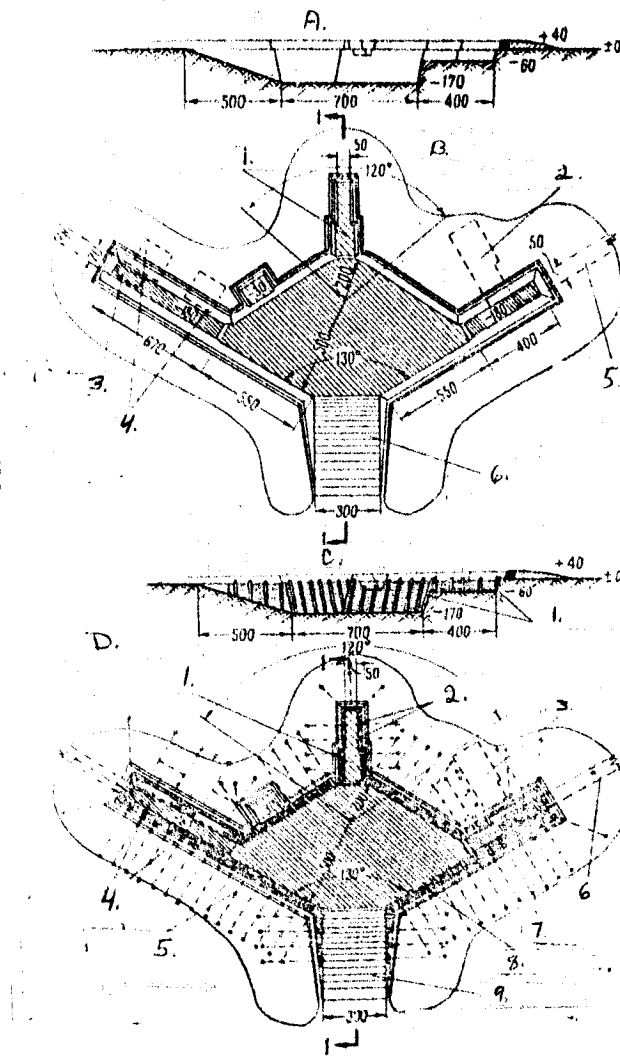


Figure 129. Excavated Emplacement with Wide Field of Fire for 122mm Gun, 122mm and 152mm Howitzers and 152mm Gun - Howitzer (A and B without revetted slopes, C and D with slopes revetted with poles)

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Figure 129 (continued with its description)

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| <p>A. Cross-Section</p> <p>B. Top View</p> <ol style="list-style-type: none"> 1. Excavation for tube 2. Dugout 3. Drainage pit 4. Ammunition niches 5. Possible connecting trench 6. Ramp <p>C. Cross-Section</p> <ol style="list-style-type: none"> 1. Poles, d = 5 to 7cm | <p>D. Top View</p> <ol style="list-style-type: none"> 1. Excavation for tube 2. Stakes, d = 7cm 3. Dugout 4. Ammunition niches 5. Guywires, d = 3 to 4mm 6. Possible connecting trench 7. Drainage pit 8. Supports, d = 10 to 12cm, every 0.9 to 1.0cm 9. Ramp |
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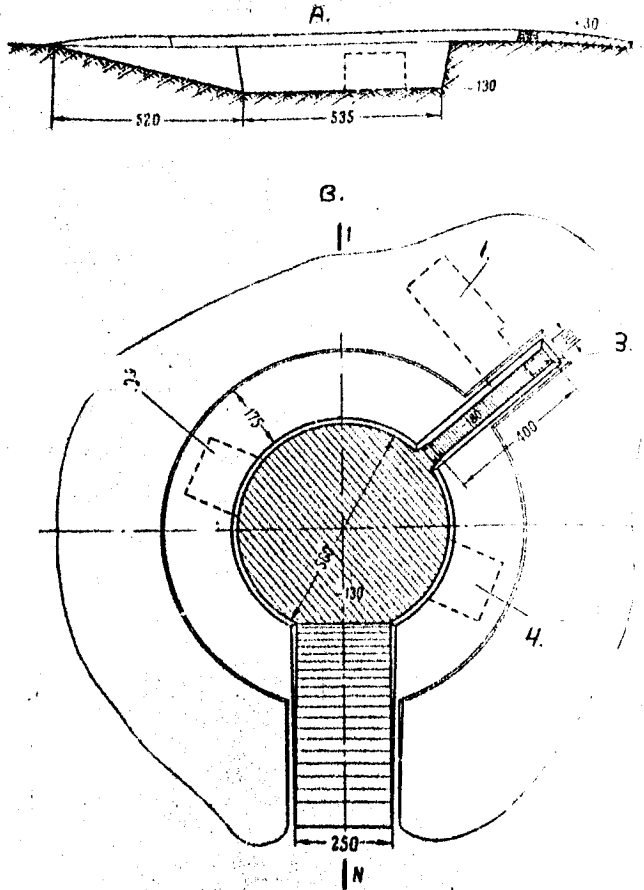


Figure 130. Emplacement for 85mm Antiaircraft Gun.

- | | |
|-------------------------|--|
| <p>A. Cross-Section</p> | <p>B. Top View</p> <ol style="list-style-type: none"> 1. Dugout 2. Ammunition niche 3. Drainage pit 4. Ammunition niches |
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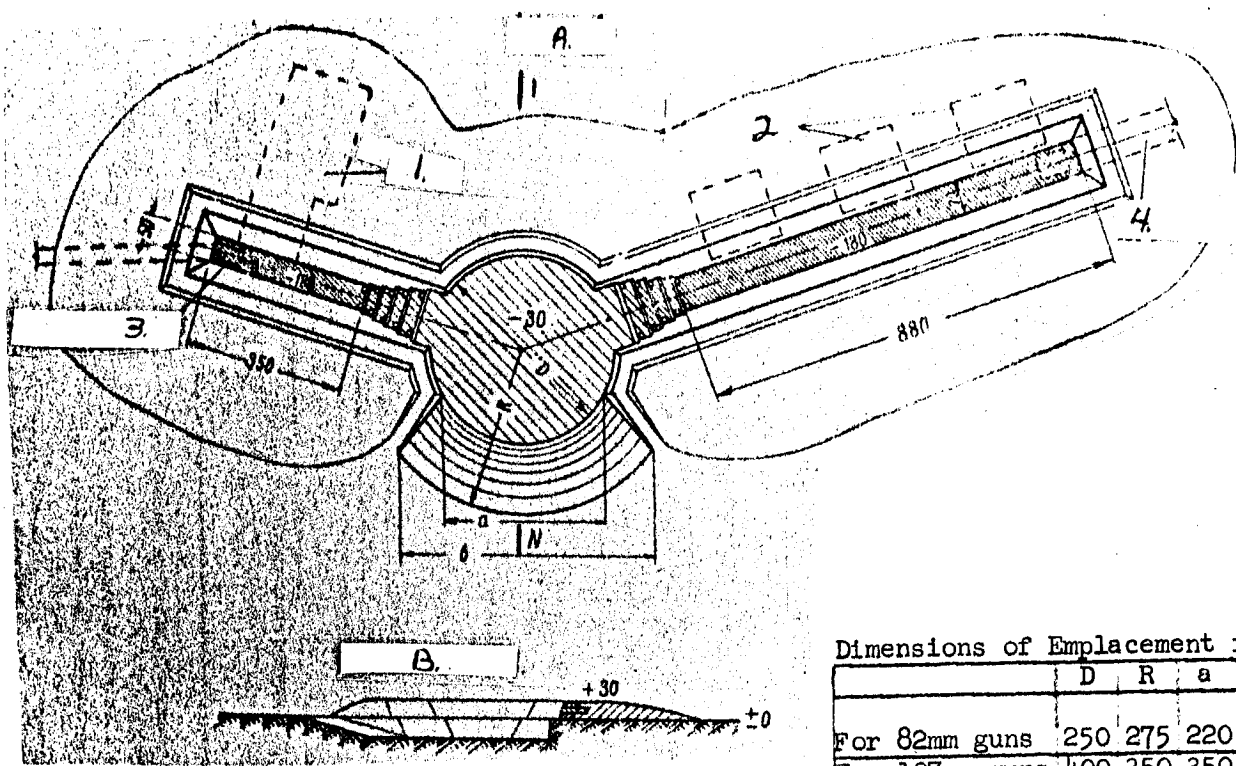
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Dimensions of Emplacement in cm

	D	R	a	b
For 82mm guns	250	275	220	420
For 107mm guns	400	350	350	550

2 ammunition niches are made for 82mm gun

Figure 131. Emplacement for 82mm and 107mm Recoilless Guns

A. Top View

1. Dugout
2. Ammunition niches
3. Drainage pit
4. Possible connecting trench

B. Cross-Section

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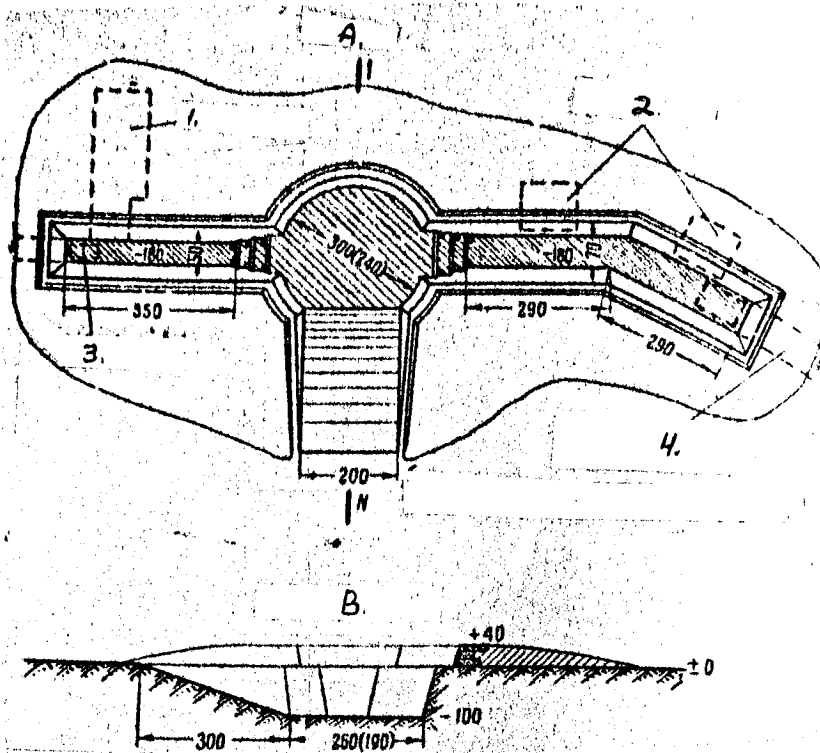


Figure 132. Emplacement with Circular Field of Fire for the 120mm (82mm) Mortar

A. Top View

B. Cross-Section

- 1. Dugout
- 2. Ammunition niches (for mortar shell)
- 3. Drainage pit
- 4. Possible connecting trench

Note: Dimensions in parentheses are for the 82mm mortar

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The protective properties of gun emplacements and shelters are given in Table 134.

Table 134

Protective Properties of Gun Emplacements Shelters		
Type of Installation	Distances in km at which installations ensure protection of guns and mortars	
	From atomic bursts of low yield	From atomic bursts of medium yield
Excavated gun and mortar emplacements	0.5	0.75
Emplacements with cover for weapons: with guns located on the platform	0.7	1.0
with guns located in the shelters	0.5	0.75

Emplacements and Shelters for Tanks, Assault Guns and Armored Personnel Carriers

Emplacements with circular or limited fields of fire are constructed for tanks and assault guns. In cases where firing is not anticipated, shelters are constructed for tanks and assault guns. Shelters, as a rule, are constructed for armored personnel carriers. The construction of emplacements and shelters is shown in Figures 133-134.

Slit trenches or dugouts are constructed near the emplacements (shelters) for the protection of the crew.

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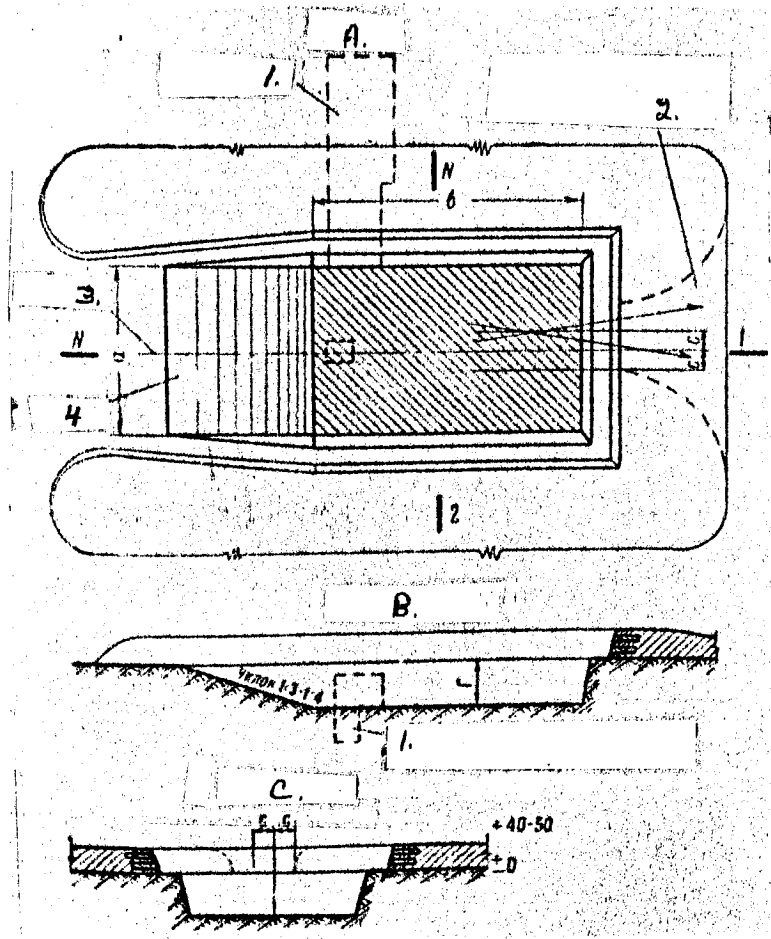


Figure 133. Emplacement for Tanks and Assault Guns

A. Top View

1. Dugout
2. Breastwork not made in assault gun field of fire
3. Longitudinal axis
4. Ramp

B. Longitudinal Section

1. Drainage pit (constructed when there is not slit trench for crew)

C. Cross-Section

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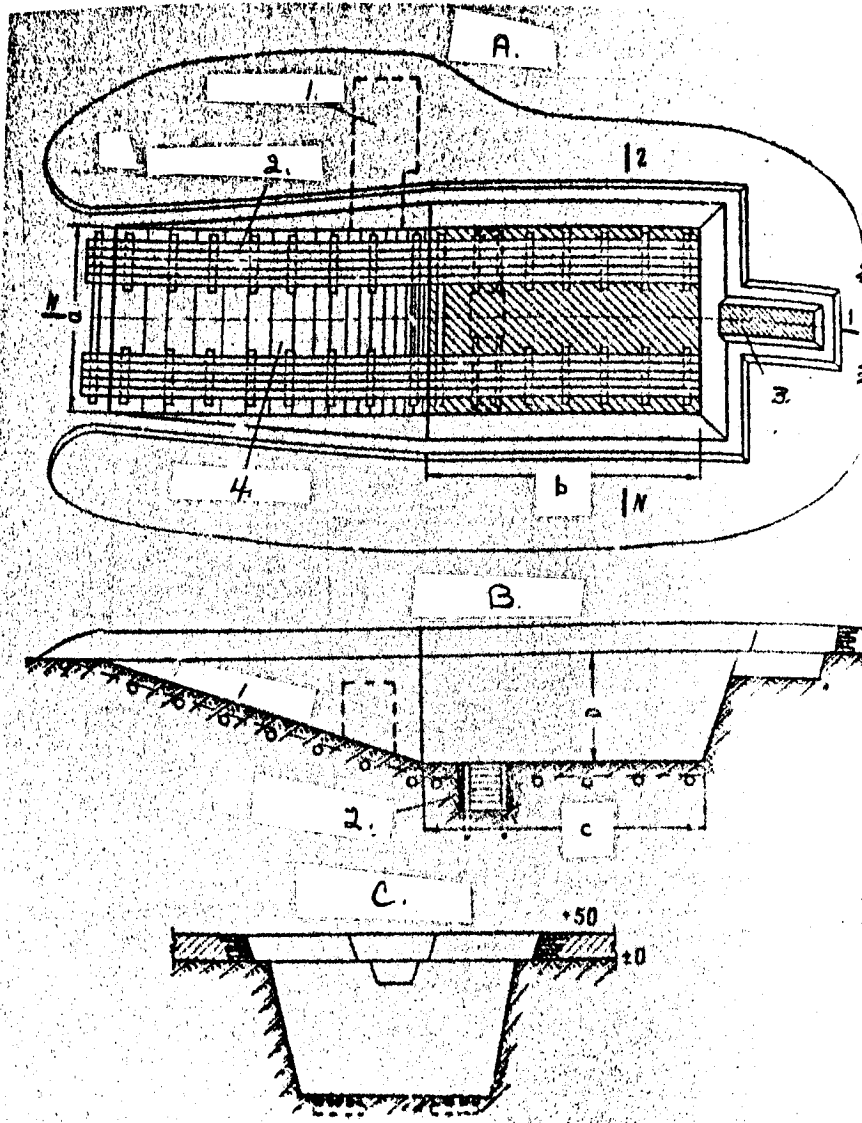


Figure 134. Enplanement for Tanks, Assault Guns and Armored Personnel Carriers

A. Top View

- 1. Dugout
- 2. Tracks constructed if earth is soft
- 3. Slot for gun tube
- 4. Ramp

B. Longitudinal Section

- 1. Grade 1:3 or 1:4
- 2. Drainage pit

C. Cross-Section

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Emplacement and Shelter dimensions are given in Table 135.

Table 135

Emplacement and Shelter Dimensions		
Features	Legend	Dimensions
Emplacement and shelter width along the bottom	a	For emplacements- width of vehicle + 50cm; for shelter- width of vehicle + 100cm
Length of pit of emplacement and shelter along the bottom	b,c	For emplacements- length of vehicle + 50cm; for shelters- length of vehicle + 50cm
Emplacement depth	d	According to location (must permit firing). Usually 90 to 100cm without breastwork
Shelter depth	e	Height of vehicle
Height of trench for the tube in a shelter	-	Height of the zero line of the gun minus 40cm
Length of trench for the tube in a shelter	-	Tube length + 30cm
Incline of the revetment of the emplacements and shelters	-	Not more than 45 to 60°
Height of breastwork	-	40 to 50cm

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Tanks, assault guns and APC's in shelters are not tossed about by the shock wave, as a result of which the radius of the zones of severe and moderate damage to vehicles is diminished. Emplacements protect armored equipment to a lesser degree, since damage to the turret and gun is not prevented.

The protective properties of emplacements and shelters are described by the data given in Table 136.

Table 136

Protective Properties of Emplacements and Shelters

Type of equipment protected	Distance in km at which the protected equipment retains its combat effectiveness	
	During atomic bursts of low yield	During atomic bursts of medium yield
Heavy and medium tanks and assault guns:		
in shelters	0.25	0.40
in emplacements	0.3	0.45
Light tanks, assault guns and armored personnel carriers in shelters	0.4	0.6
Light tanks and assault guns in emplacements	0.5	0.8

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Note: The radii of the zones of slight damage (damage to external equipment) of tanks and assault guns in emplacements and shelters are significantly greater than given in the table. They are approximately equal to the radii of the zones of slight damage to vehicles situated in the open.

Concealed Positions for Tractors, Special-Purpose
Vehicles and Engineer Vehicles

Concealed positions of the pit type with ramps for entrance and exit are constructed for tractors, special-purpose vehicles and engineer vehicles (Figure 135). Dimensions for such concealed positions are given in Table 137.

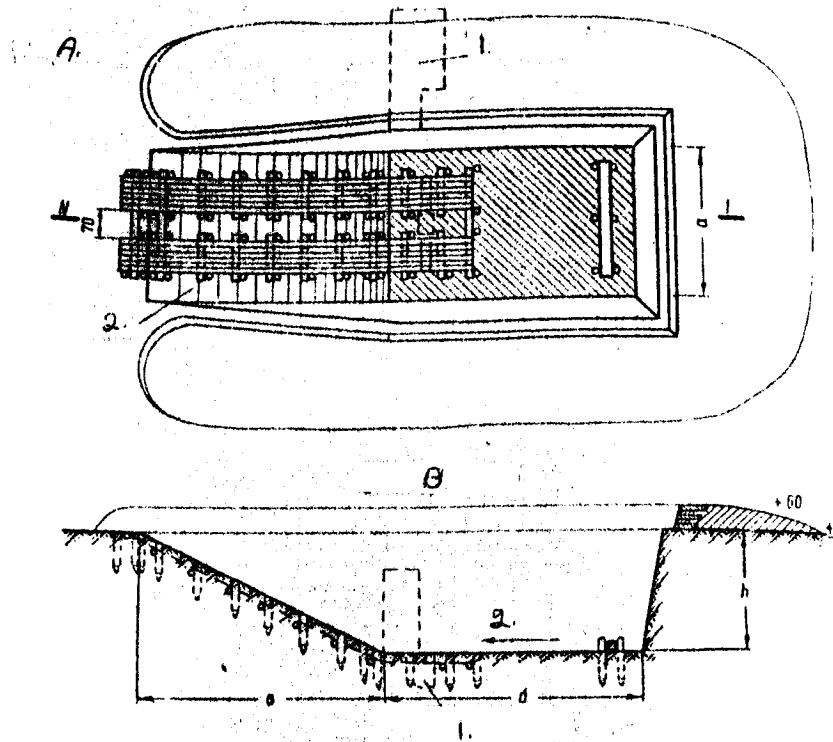


Figure 135. Emplacement for Tractors, Special-Purpose Vehicles, Engineer Vehicles and

- A. Top View
1. Dugout
2. Ramp

- B. Longitudinal Section
1. Drainage pit
2. Grade

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Table 137

Basic Dimensions of Concealed Positions for Tractors,
Engineer Vehicles and Special-Purpose Vehicles

Kind of vehicle	Dimensions in m				Volume of excavated earth in m ³
	a	b	c	h	
<u>Transport Vehicles</u>					
GAZ - 69	2.5	3.9	5.6	1.5	30
GAZ - 63, GAZ - 51	3.0	5.6	8.2	2.2	75
ZIS - 150, ZIS - 151	3.2	6.9	8.2	2.2	90
<u>Special Vehicles</u>					
Amphibious tracked transporter K-61	4.6	9.5	8.2	2.2	150
Amphibious vehicle BAV	3.9	9.5	4.9	1.3	65
Amphibious vehicle MAV	3.2	5.2	3.7	1.0	25
Vehicle with pontoon section	3.2	10.0	10.9	2.9	170
Tank truck ARS-12D	3.2	7.0	8.0	2.8	130
Decontamination vehicle ADM-48D and disinfection-shower vehicle DDA-53	3.5	5.6	5.5	2.8	100

Table 137 continued on next page

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Table 137 continued

Power unit APG	1.5	2.5	5.2	1.4	13
Power unit SPO (SPL)	3.5	6.0	8.5	2.3	95
Power unit 1-AP-1.5	2.5	3.3	7.1	1.9	40
Radiotechnical station	4.5	7.5	8.5	2.3	135
Radar station	3.0	6.5	3.0	0.8	20
<u>Tractor-Prime Movers and Engineer Vehicles</u>					
Tractor S-80	3.3	4.3	10.5	2.8	105
Prime Mover M-2	3.6	5.0	9.3	2.5	100
Light prime mover	3.0	5.2	8.2	2.2	70
Medium prime mover	3.4	5.9	9.7	2.6	110
Heavy prime mover	4.0	7.0	10.8	2.9	165
Excavator E-255	4.2	4.3	13.0	3.5	185
Excavator KG-65	4.3	9.4	14.5	3.9	330
Bulldozer D-271	4.5	5.4	10.5	2.7	145
Grader D-144	4.2	8.6	13.8	3.7	280

Concealed positions for combat, special and transport vehicles and tractors are completely destroyed at pressures greater than $0.8\text{kg}/\text{cm}^2$; they sustain moderate damage at pressures of $0.5\text{kg}/\text{cm}^2$ and slight damage at pressures of $0.35\text{kg}/\text{cm}^2$.

The protective properties of concealed positions are described by the data given in Table 138.

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Table 138

Protective Properties of Concealed Positions

Kind of Equipment	Distance in km at which a concealed position protects equipment	
	From atomic bursts of low yield	From atomic bursts of medium yield
Transport and special vehicles	0.85	1.3
Tractors and combat engineer vehicles	0.6	0.9

Concealed Positions for Ammunition, Fuel,Lubricants and Rear Area Equipment

Concealed positions for the preservation of ammunition, fuel, lubricants and rear area equipment are built if there are no natural shelters (ravines, pits, depressions).

Vaults (Figure 136) or pit-type shelters (Figure 137) are excavated for storing ammunition.

Pits are excavated for storing fuel and lubricants in containers, barrels and cans. When materials are available, the pits are covered.

It is recommended that large containers with fuel be buried and covered with a layer of earth. It is necessary to construct wooden

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frames over the filler neck (gorlovina) of the tanks, which, at the level of the top of the fill, is covered with a wooden lid whose upper surface is covered with iron.

Semi-excavated storage areas or shelters of the dugout type are constructed for the preservation of clothing, rations and forage.

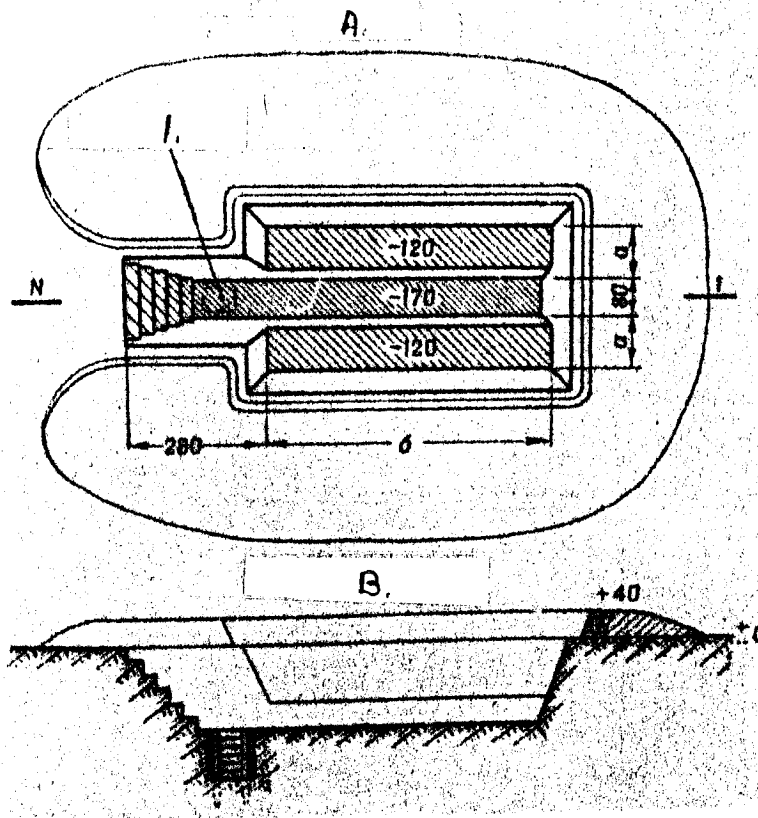


Figure 136. Vault for Ammunition Storage

- A. Top View
- B. Longitudinal Section
- 1. Drainage pit

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Basic Dimensions

Type of Artillery	Vault dimensions in <u>m</u>		Volume of excavated earth in <u>m³</u>
	a	b	
57mm gun	1.2	2.0	16
85mm gun	1.2	3.5	22
100mm gun	1.0	5.0	27
122mm howitzer	1.0	3.0	19
122mm gun	1.0	5.0	27
152mm howitzer	1.0	4.5	25
152mm gun-howitzer	1.0	5.5	29
203mm howitzer	1.0	4.5	25
82mm mortar	1.0	2.0	14
120mm mortar	1.0	2.5	17
160mm mortar	1.0	4.0	22

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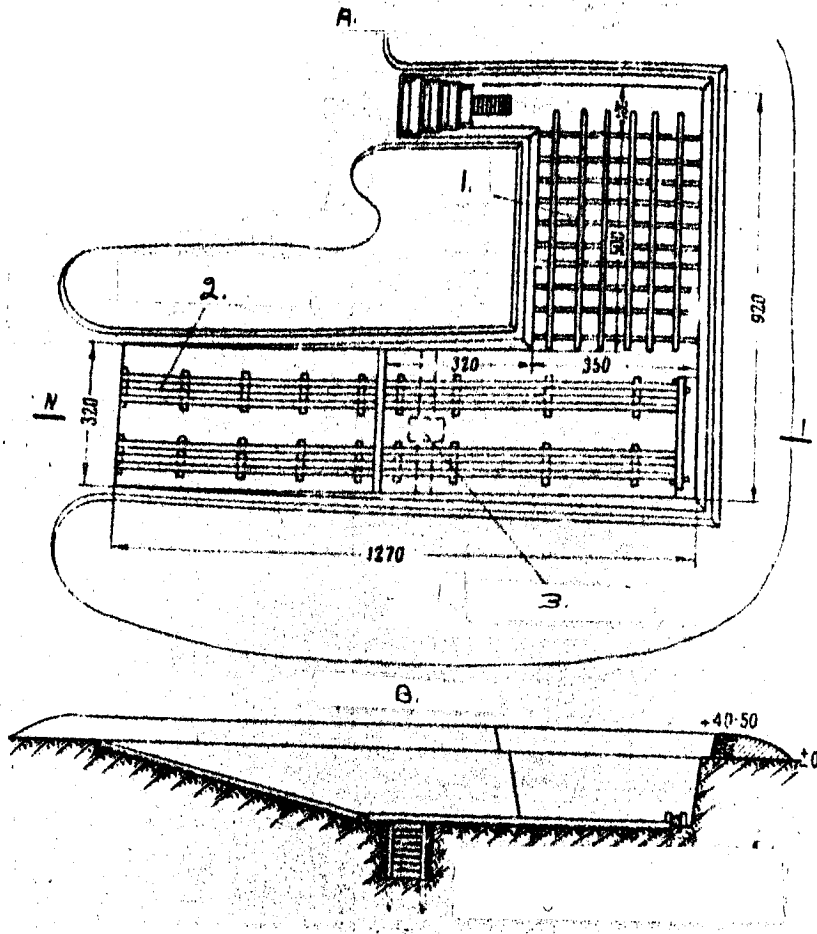


Figure 137. Pit-type Emplacement for Ammunition Storage

A. Top View

- 1. Floor made of poles, $d = 6$ to 8 cm
- 2. Tracks made of planks, $d = 20/2$
- 3. Drainage pit, 40×60 cm

B. Longitudinal Section

Note: Volume of earth excavated - $90m^3$.
 Construction time (including construction of tracks and floors)
 -- 24.5 man-days.

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The protective properties of these shelters are described by the data given in Table 139.

Table 139

Protective Properties of Concealed Positions

Type of equipment and means of storage	Distance in km at which protection of equipment is ensured	
	From bursts of low-yield atomic weapons	From bursts of medium-yield atomic weapons
Fuels and lubricants in metallic drums in pit-type shelters (trenches)	0.4	0.6
Lubricants in wooden containers in pit-type shelters (trenches)	0.5	0.8
Fuel in underground reservoirs	0.3	0.45
Rear area supplies (clothing, rations and forage) in storage vaults of upright, pit-type construction	0.65	1.0

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Shelters at Water Supply Points

At water supply points shelters are constructed:

- for wells, shafts and pump gear;
- for materials used for purification and storage of water;
- for personnel and means of transporting water.

Shelters for well shafts and pumps are shown in Figure 138. Pits, niches and covered slit trenches ensure the protection of well shafts, drilled wells, and pumping gear mounted on them from bursts of atomic weapons of medium yield at distances of 0.4 to 0.6km, and from small-yield weapons at distances of 0.25 to 0.4km.

The protection of drilled wells, set up in dugouts, is ensured from bursts of atomic weapons of medium yield at distances of 0.3 to 0.35km and from weapons of low yield at distances of about 0.2km.

Water purification facilities, mounted on vehicles, are placed in shelters of the pit type and portable facilities are placed in trenches or covered slit trenches.

Pits are prepared for the cover of authorized water storage equipment.

It is necessary to cover water tanks (type RYe-6000) with canvas in order to avoid radioactive fallout.


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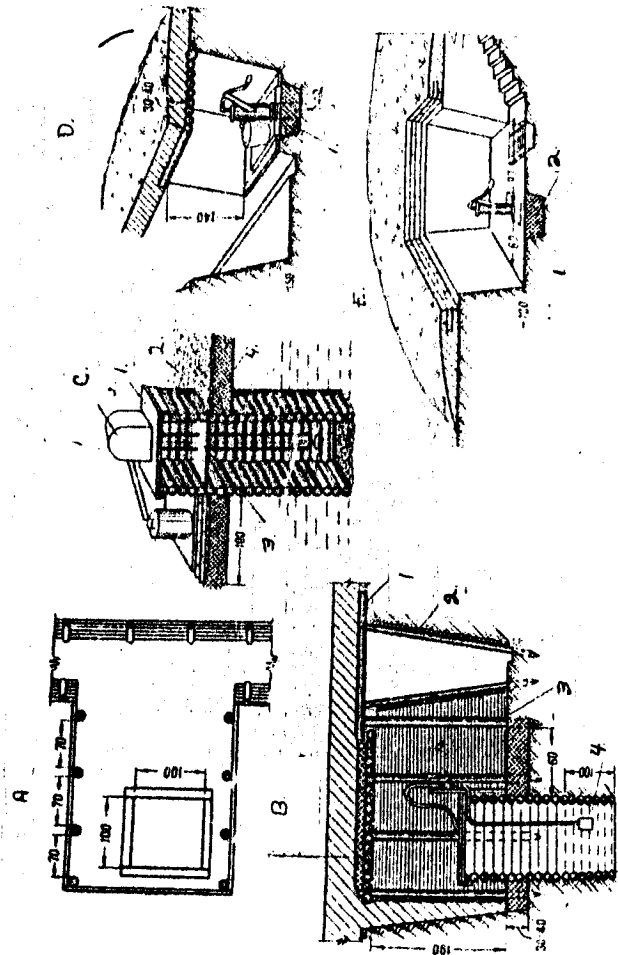


Figure 138. Emplacements for Water Pumps

- | | |
|--|--|
| <p>A. Top View</p> <p>B. Longitudinal Section of A
 Earth - 40 to 60cm
 Clay - 8 to 10cm
 Ceiling, $d = 12$ to 14cm
 $l = 270$cm</p> <ol style="list-style-type: none"> 1. Ceiling, $d = 12$ to 14cm 2. Poles, $d = 5$ to 7cm 3. Post, $d = 10$ to 12cm
$l = 240$cm 4. Water Table | <p>C. Bucket-chain Pump</p> <ol style="list-style-type: none"> 1. Wooden cover 2. Stone covering 3. Intermediate protective covering 4. Clay barrier <p>D. Hand Pump</p> <ol style="list-style-type: none"> 1. Clay barrier 2. Well pipe <p>E. Hand Pump</p> <ol style="list-style-type: none"> 1. Clay barrier 2. Well pipe |
|--|--|

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The construction of shelters and the disposition of storage tanks within them is shown in Figure 139.

Pit type shelters will protect authorized storage tanks from bursts of atomic weapons of medium yield at distances of about 1.2km, and from small-yield bursts at distances of about 0.8km.

For the shelter of personnel serving a water supply point and for those coming for water, dugouts or covered slit trenches are constructed and pit type shelters are constructed for water transport gear.

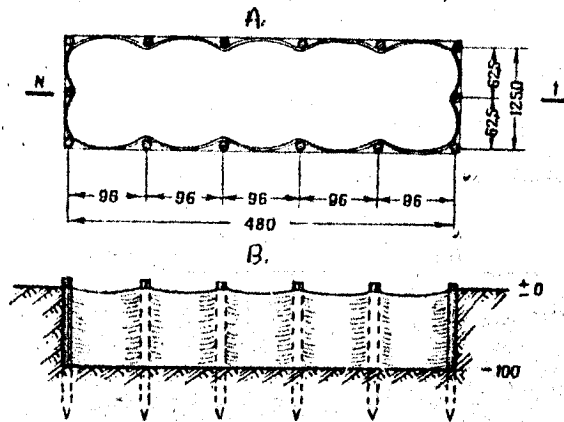


Figure 139. Emplacement for Reservoirs (RYe-6000)

- A. Top View
 Volume of earth excavated - $6m^3$
 Construction time - 15 man-days
- B. Longitudinal Section

34. Protective Measures Against Shock Wave Penetration into Installations*

Shock Wave Penetration into installations through doors, air vents, gun ports, and other apertures may lead to destruction of the garrison and damage to the internal equipment of field defense installations even at distances from the center (ground zero) of an atomic burst where the protective features of the installations do not suffer real damage. Therefore special attention must be paid to the protection of apertures through which the shock wave may penetrate.

Note: * The protection of installations against the penetration of radioactive materials is ensured by measures carried out by antichemical defense and is not considered in this Guide.

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Protection of Entrances and Gun Ports

Protective doors are used (in dugouts, shelters, covered machine gun and observation installations) for the protection of field defense installations against the penetration of the shock wave through entrances. Detachable panels are used in covered trenches.

Depending on the construction of the installation, the type of entrance and the availability of materials, protective doors may be made of wood, metal, or reinforced concrete. Metal or reinforced concrete doors are used in especially important underground or reinforced concrete installations. In addition, metal doors may be used in installations made of assembled reinforced concrete sections. Wooden doors are used in the majority of field defense installations (Figures 140, 141).

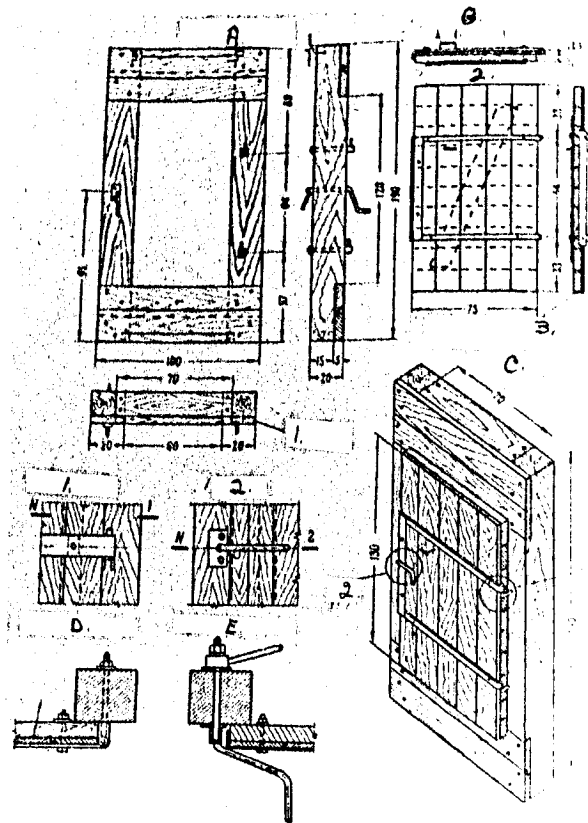


Figure 140. Light-Type Protective Door

- | | |
|--|--------------------------------|
| A. Door Frame | C. Overall View |
| 1. Boards, 5cm thick | 1. Assembly A |
| B. Door Panel | 2. Assembly B |
| 1. Door clamp | D. Cross Section of Assembly A |
| 2. Metal hinge | E. Cross Section of Assembly B |
| 3. Oiled papers between layers of boards | |

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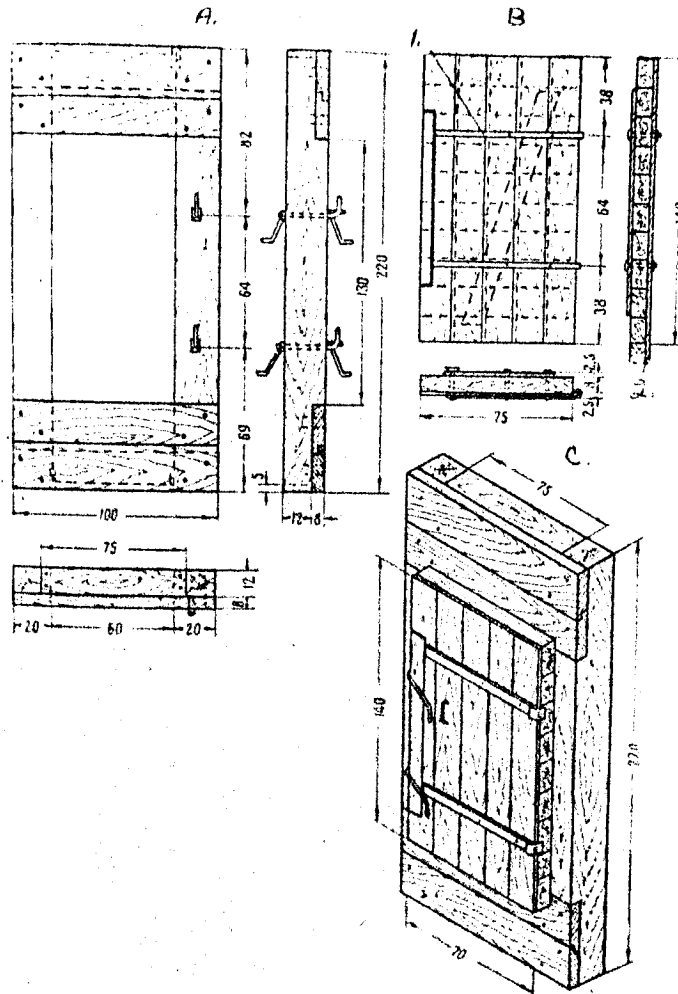


Figure 141. Heavy-Type Protective Door

- A. Door Frame
- B. Door Panel
 - 1. Metal hinge
 - 2. Oiled paper between layers of boards
- C. Overall View

Various types of hinged panels, flaps and plugs are used to protect the interior compartments of installations against the penetration of the shock wave through gun ports and observation slits.

In reinforced concrete fire positions permanent type gun ports are protected with special protective armor devices.

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Protection of Ventilation Apertures and Chimneys

In order to protect ventilation apertures and chimneys against shock wave penetration the following are used:

- gravel filter-shock absorber;
- filter-shock absorbers combined with valve cut-off for the shock wave;
- antiblast valves with by-pass channels;
- hermetic valves closed manually; and
- electromechanical antiblast devices.

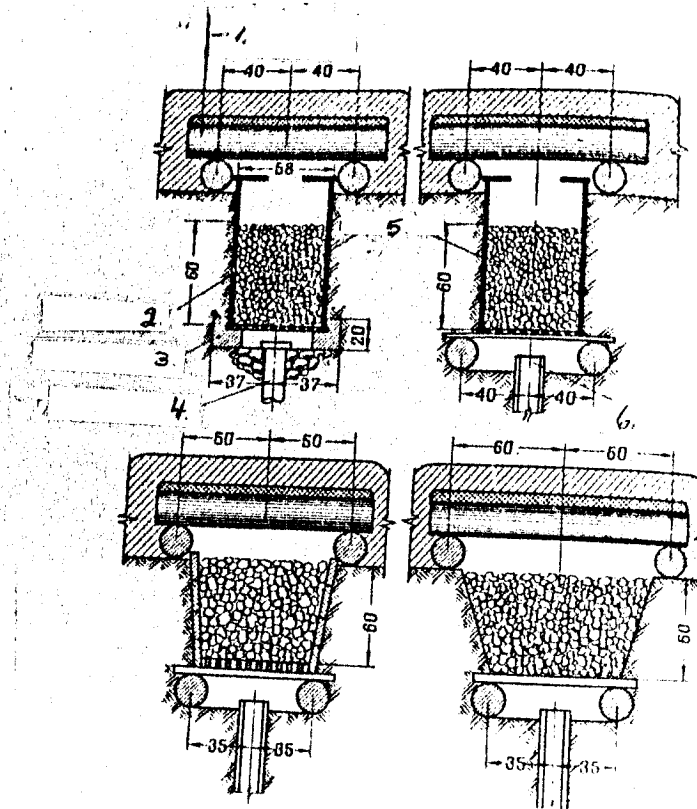


Figure 142. Construction of Gravel Filter-Shock Absorbers From Materials at Hand

- | | |
|---|----------------------------------|
| 1. Earth - 15cm
Clay - 5cm
Logs, d = 18 to 20cm | 4. Air intake pipe,
d = 100mm |
| 2. Metal barrel | 5. Gravel, d = 3 to 4cm |
| 3. Wooden support | 6. Wooden housing
10 x 10cm |

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Gravel Filter-Shock Absorber (Figure 142) is the simplest and a sufficiently effective means of damping a shock wave. The damping coefficient (the ratio of the shock wave pressure at the entrance to the shock wave pressure at the exit) depends on the magnitude of the pressure at the entrance, the thickness of the gravel layer and its density. With a layer of gravel 60cm thick the damping coefficient fluctuates within the limits of 5 to 10.

The coarseness and thickness of the layers of gravel are selected on the basis of the resistance to the flow of the air collected by the ventilator, which may be equal to a 15 to 20mm water column with manual, and a 25 to 30mm water column with mechanical operation of the ventilator.

A gravel shock absorber does not completely damp the shock wave of an atomic burst, therefore besides filter-shock absorbers, manually operated hermetic valves are installed on water lines and stove pipes in field installations.

Gravel filter-shock absorbers are used mainly for the protection of chimneys.

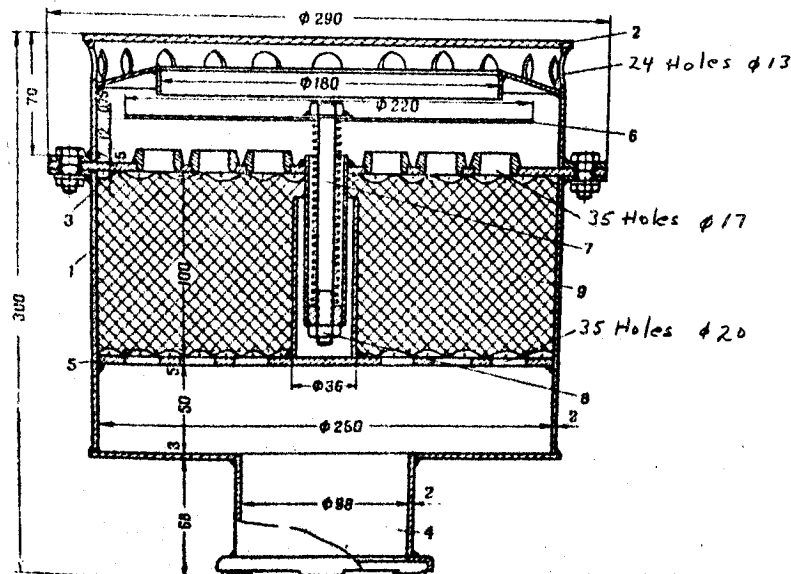


Figure 143. Filter-Shock Absorber Combined with Shock Wave Cut-off

- | | |
|---|--|
| 1. Body | 6. Valve cut-off disc |
| 2. Lid | 7. Valve cut-off return spring |
| 3. Base plate of the cut-off valve | 8. Adjustment nut |
| 4. Connecting sleeve to air intake or chimney | 9. Shock absorber filler-- metal shavings or coils |
| 5. Base plate of shock absorber | |

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Filter Shock Absorber (Figure 143), combined with shock wave cut-off is a more improved device for damping the shock wave of an atomic burst. The cut-off reduces the shock wave action time in the shock absorber as a result of the closure* of the air intake aperture by the disc-cutoff located in the upper horizontal partition of the shock absorber, as a consequence of which such a shock absorber reduces the pressure approximately 20 times. The filter-shock absorber combined with a cutoff is used in light-type installations for the protection of ventilation apertures and chimneys.

Antiblast valves with bypass channel (Figure 144), at the moment of a burst, automatically close the ventilation or exhaust apertures by means of a piston displaced by the impact of the shock wave. The presence of a bypass channel ensures closure of the aperture before the shock wave reaches it through the bypass channel.

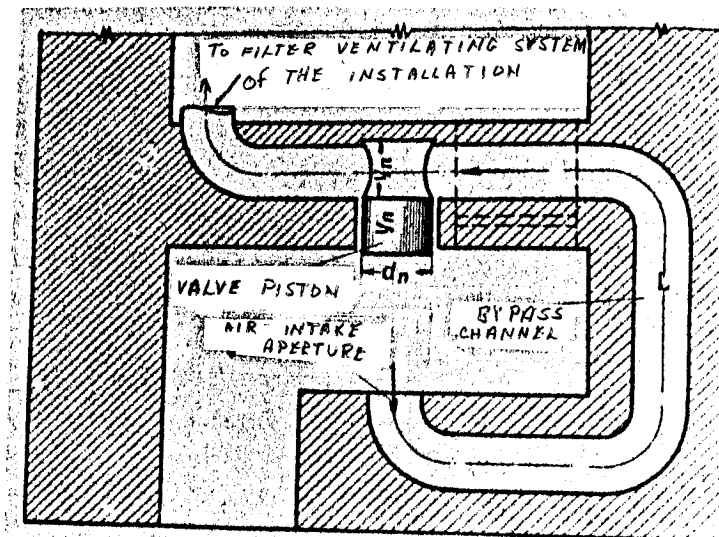


Figure 144. Basic Diagram of an Antiblast Valve with Bypass Channel

Closure time for the disc of the filter-shock absorber placed in a filter ventilation system equipped with filters FP-50, must be not more than $1m/sec$ where $\Delta p_{exit}^ = 0.2kg/cm^2$ and the computed pressure at entrance $\Delta p_{entrance}^{**} = 5kg/cm^2$. *-vykh **vkh

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The PVK-100 valve (Figure 145) consists of three concentrically arranged steel tubes with diameters of 100, 150, and 200mm. A piston moves in the center tube; it has a series of apertures on its side. In the initial position of the piston these apertures coincide with the apertures in the central tube, and air enters the installation along the lines indicated by the arrows. Under the impact of the shock wave the piston is shifted and the lateral walls close the apertures.

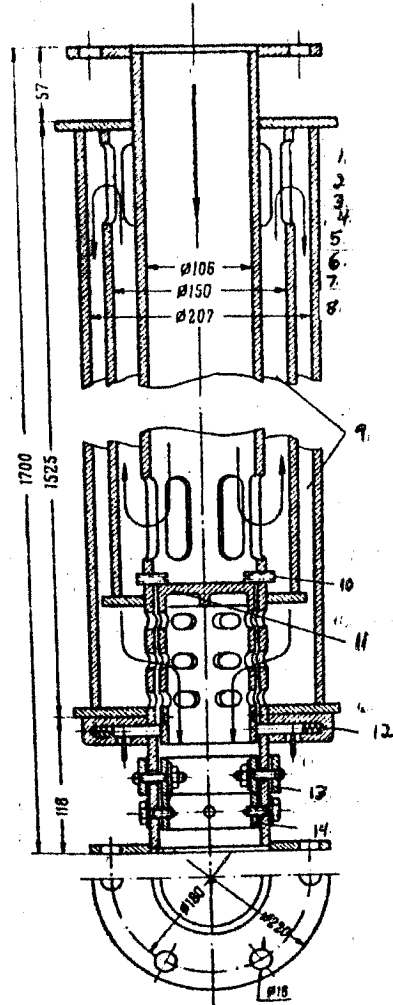


Figure 145. Antiblast Valve with Bypass Channel Type PVK-100

- | | |
|-------------------------------|-------------------------|
| 1. Basic Data | 8. Resistance - 17mm |
| 2. Size - ϕ 220 x 1700 | column of water |
| 3. Weight \sim 100kg | 9. Bypass channel of |
| 4. Bypass channel length | the valve |
| $L = 2.5m$ | 10. Stop pin |
| 5. Piston weight $G = 0.5kg$ | 11. Valve piston |
| 6. Piston stroke $Y = 17.5mm$ | 12. Retaining mechanism |
| 7. Piston area $S = 89.8cm^2$ | 13. Return mechanism |
| | 14. Base ring |

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An antiblast valve of different construction, also designed for the protection of apertures with a diameter of 100mm, is shown in Figure 146. The bypass channel of this valve is in the form of an elbow of a tube with a diameter of 100mm. The sealing gaskets ensure a tighter seal of the air duct with a valve of this type.

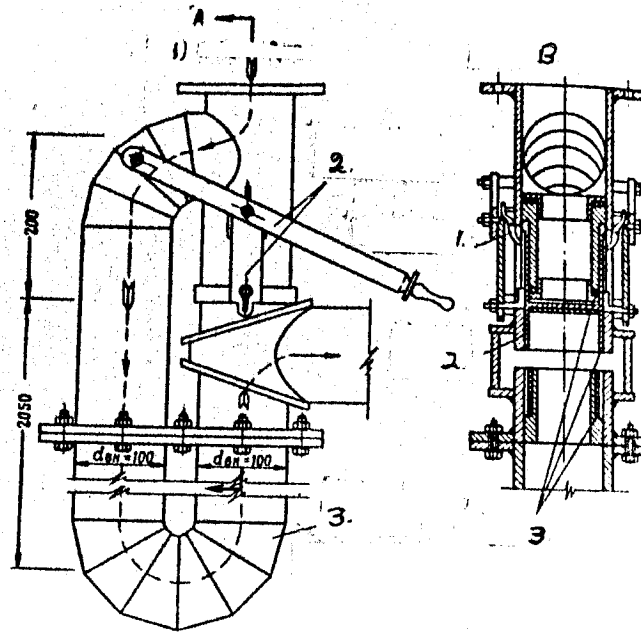


Figure 146. Antiblast Valve with Bypass Channel and Sealing Gaskets

A. Side View

1. Air intake
2. Valve closing device
3. Bypass channel

B. Longitudinal Section

1. Retaining mechanism
2. Valve piston
3. Sealing gasket

Basic Data: size - 2300 x 250 x 120mm; weight - 60kg; length of bypass channel - $L = 3.6m$; piston weight - $G = 0.5kg$; piston stroke - $Y = 80mm$; piston area - $S = 78cm^2$; resistance - 12mm column of water.

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The valve, shown in Figure 147, consists of two separate elements: the valve itself and the bypass channel in the form of an elbow chamber made of steel tubes. This allows the chamber to be installed in the protective features of the installation during its construction and the valve to be installed during the equipment assembly.

Antiblast valves with bypass channels are intended principally for the protection of apertures in heavy-type defense installations.

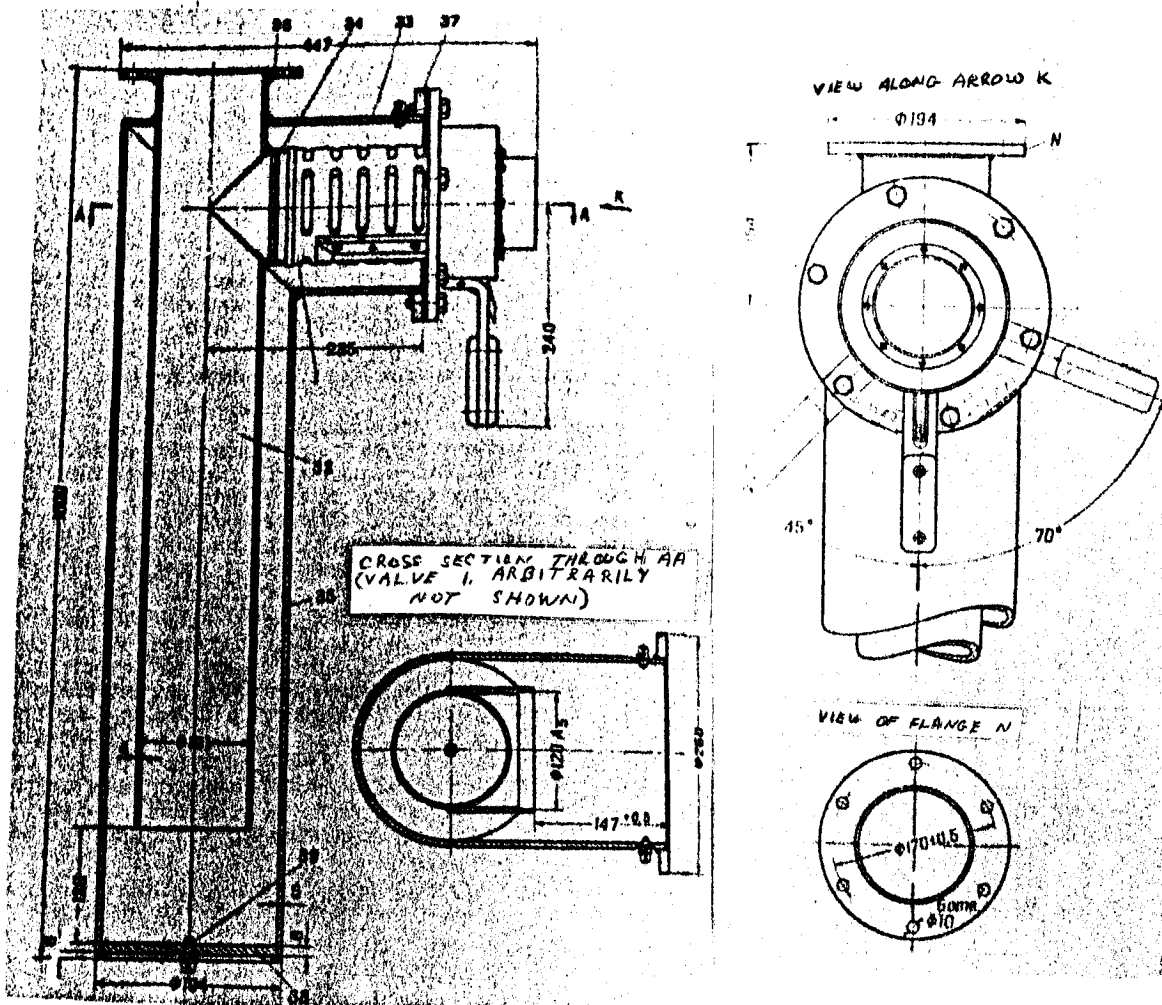


Figure 147. Antiblast Valve with Bypass Channel in the Form of an Elbow Chamber of Steel Tubes

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In Figure 148 a PVK-300 valve is shown installed in a reinforced concrete installation for the protection of a ventilation aperture with a diameter of 300mm. The 2.5 meter long bypass channel of the valve is situated in the thick protective wall of the installation. The route of air movement in the installation is indicated by arrows on the sketch.

If necessary the air duct may be closed by valve and by hand.

Electromechanical antiblast devices. The automatic antiblast device APU-100 may serve as an example. It is activated by the impingement of gamma rays at the moment of an atomic burst, that is, before the arrival of the shock wave. The device consists of a gamma ray receiver (pick up), trigger circuit (control panel), activating mechanism (two valves with electromagnets) and packing box for cables, pick-up and battery.

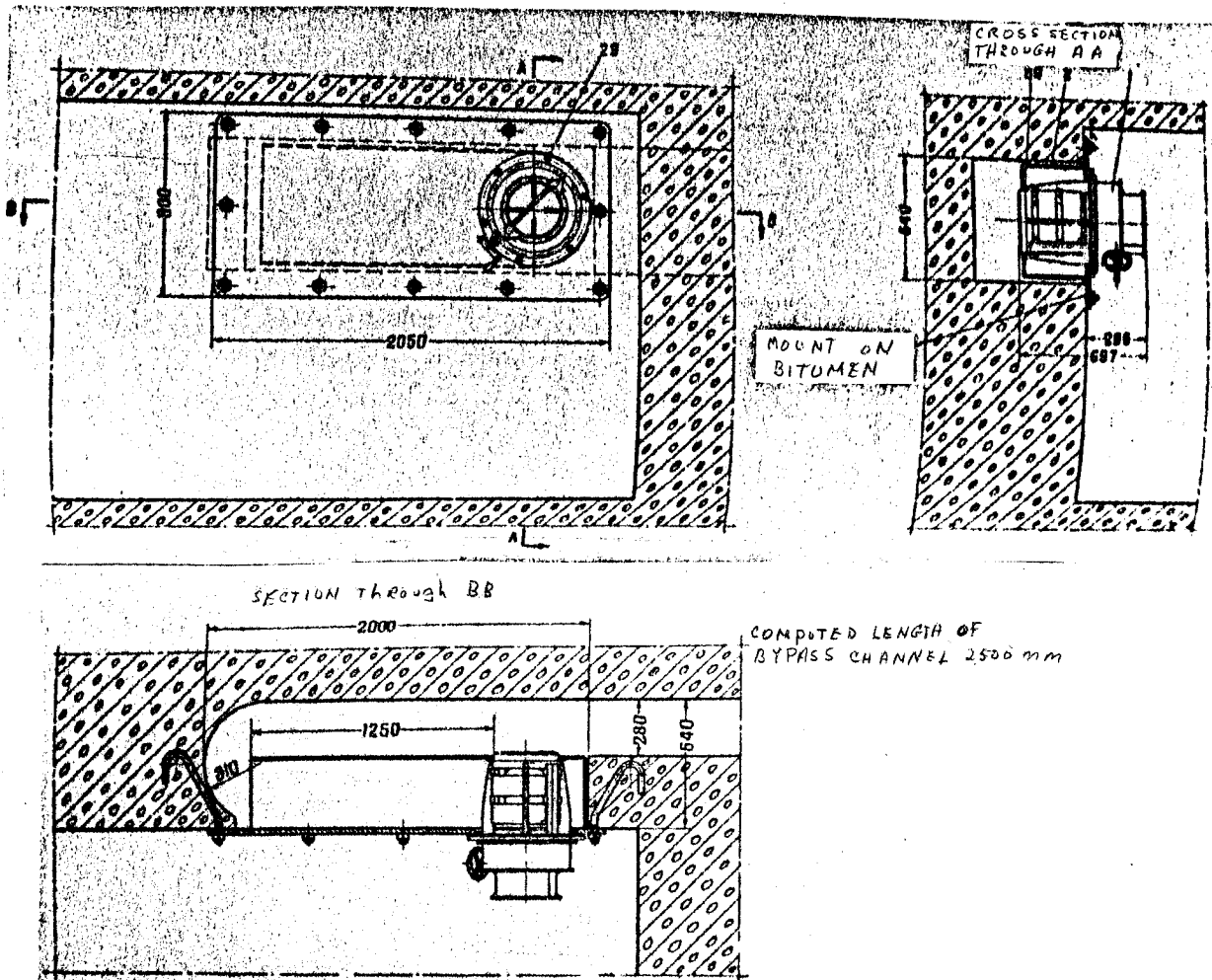


Figure 148. Antiblast Valve Type PVK-300 Installed in a Reinforced Concrete Installation

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The main electrical circuit of the APU-100 is shown in Figure 149. Gamma rays impinge on the pick-up, inducing an electric current in the pick-up circuit which causes a voltage drop in the resistor R producing ignition of the three-electrode gas discharge tube L. When a discharge is induced in tube L it becomes conductive and closes the power circuit to relay P. The relay discharge, and with its contacts 1 - 2 and 3 - 4 connects battery B_3 to the closing electromagnets of both activating mechanisms (Figure 150). The electromagnets retract the plunger (serdechnik) connected to a movable plate which, on moving, covers the apertures of the lattice.

Following activation of the closing electromagnets the battery is cut off.

Power for the pickup is furnished by battery B_3 (see Figure 149) and for relay P - from battery B_2 .

The device permits closing and opening of the valve by buttons (two-way switches).

Power for the electrical circuit of the device is provided from direct current sources (from dry batteries and storage batteries) or from alternating current grids through selenium rectifiers.

During an atomic burst, the automatic antiblast device operates at those distances where the pressure in the shock wave front changes from 12 to 0.1 kg/cm². At these distances the mechanical stability of all its elements is ensured.

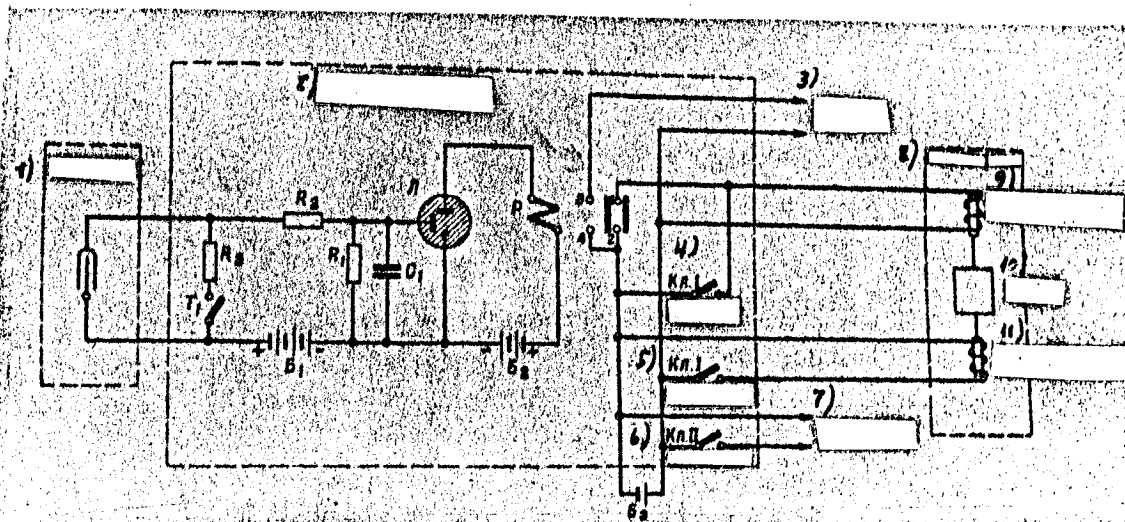


Figure 149. Electrical Circuit of Antiblast Device APU-100

- | | |
|-------------------------------|-------------------------------|
| 1. Pick-up | 7. To activating equipment II |
| 2. Control panel | 8. Activating equipment I |
| 3. To activating equipment II | 9. Closing electromagnet |
| 4. Valve I -- closed | 10. Valve |
| 5. Valve I -- open | 11. Opening electromagnet |
| 6. Valve II -- open | |

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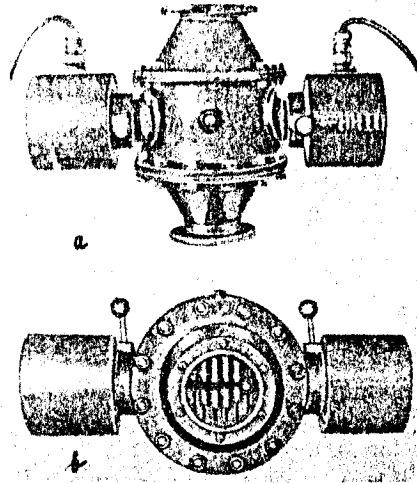


Figure 150. Activating Mechanism of Antiblast Device APU-100

- a. Valve with connecting cables from the control panel
- b. Valve with open aperture

The pick-up (Figure 151) is installed outside the installation in the ground at a depth of 30 to 40cm. It is constructed of a steel tube inside of which a gas counter, type STS-5, is placed. Basic dimensions of the pick-up: diameter - 6.5cm; length - 26.5cm; and weight - 5.5kg.

The pick-up is connected by flexible cable to the overall circuit of the device. By its sensitivity, the pick-up ensures dependable activation of the APU circuit with a *gamma* ray dose rate of 0.1r/hr.

The control panel ensures: prompt automatic activation of two valves installed in the air intake channel and chimney; closure and opening of these by two-way switches; detection of radioactive contamination inside the shelter and filter-absorbers at a radiation level of 0.1r/hr and higher.

The control panel is installed inside the shelter.

Overall activation time of the valve does not exceed 0.1 second.

The automatic antiblast device APU-100 ensures dependable protection of the filter-ventilation plant and heating system from the shock wave of an atomic burst and is designed for long-term utilization in important field defense installations.

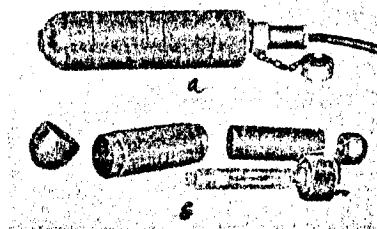


Figure 151. Pick-up of Antiblast Device APU-100

- a. General view;
- b. View of disassembled parts

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One method of placing an automatic antiblast device in a field-type installation is given in Figure 152.

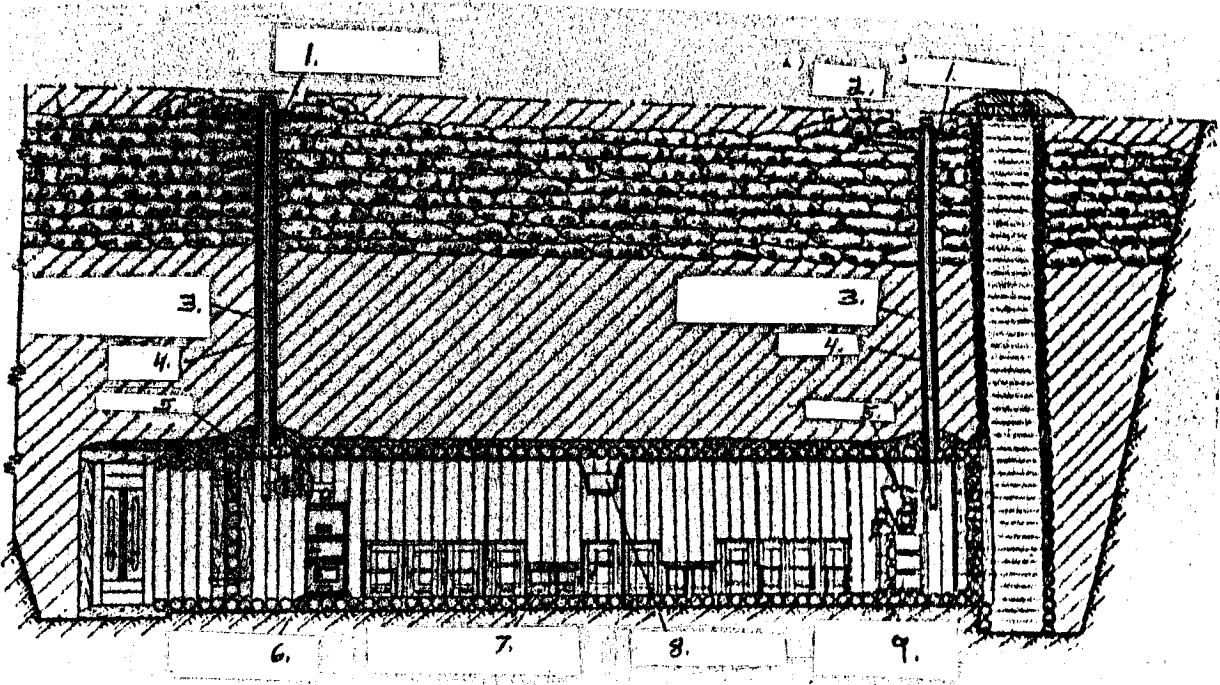


Figure 152. One Method of Placing an Automatic Antiblast Device in a Shelter

- | | |
|--|---|
| 1. Clay seal | 6. Heating system |
| 2. Pick-up | 7. Packing boxes with storage batteries |
| 3. Wooden housing, internal dimensions 250 x 250mm | 8. Control panel |
| 4. Sand | 9. Filter-ventilating system |
| 5. Valve | |

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