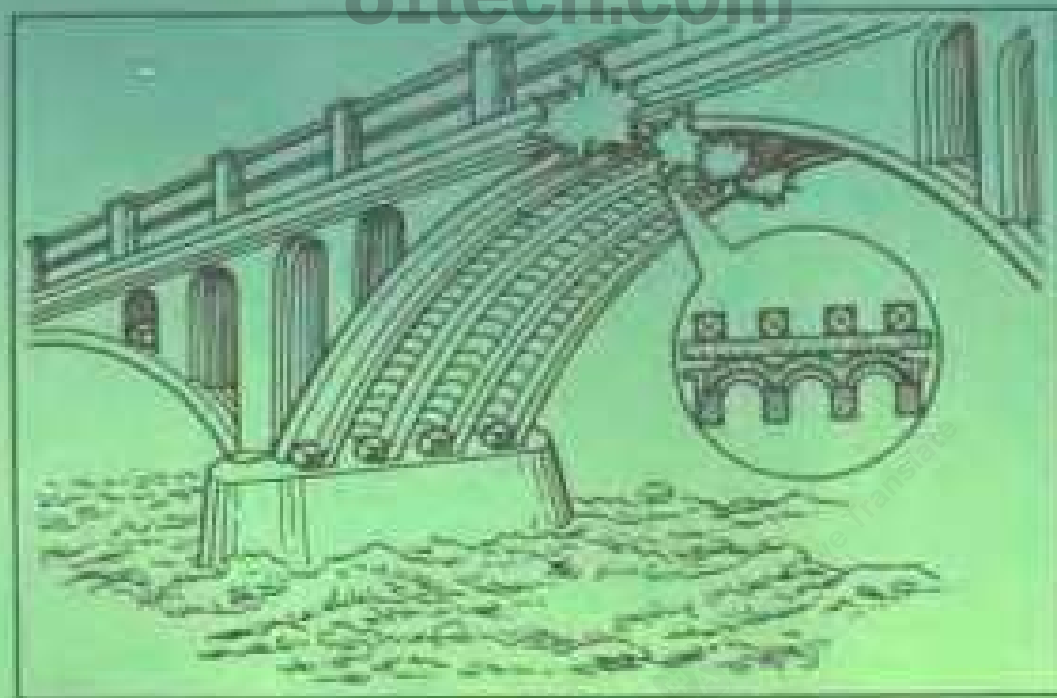


军用爆破教范

中国人民解放军总参谋部兵种部

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Military Demolition Manual

People's Republic of China Huijiao Army
General Staff Department

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Military Affairs
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通 知

委托工程兵指挥学院审修的《军用爆破教范》，经有关专家审定，现予颁发施行。1978年9月颁发的《爆破教范》即行废止。

本教范是全军军用爆破专业教育训练和军用爆破技术运用的依据。各单位应结合实际灵活运用本教范，并注意不断总结经验，提出改进意见，以便再版时补充和修正。

总参谋部兵种部

1998年5月

The "Manual on Military Demolition" reviewed and revised by the Academy of Engineering Commanders, approved by relevant experts, is hereby promulgated for implementation. The "Manual on Demolition" promulgated in September 1978 shall be abolished.

This manual serves as the basis for the education, training, and application of military explosive engineering technology throughout the armed forces. All units should apply this manual flexibly in accordance with their specific circumstances, continuously summarize experience, and submit suggestions for improvement so that it can be revised and reissued as needed.

Chief of Staff
Department of
Armies

May 1998

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第一章 总 则

第一条 为了规范爆破训练，在总结作战、训练、施工经验和原《爆破教范》的基础上，依据有关条令、条例、国家军用标准等，制定本教范。

第二条 本教范适用于全军工程兵部队、院校及其他担负爆破任务的部队；是组织爆破专业训练和技术运用的基本依据。

第三条 爆破是利用炸药的爆炸作用，达到预期目的的一门技术。军用爆破是爆破技术在军事上的运用，其目的是破坏军事目标、杀伤敌有生力量、加速工程作业、完成作战工程保障任务。

第四条 为确保爆破效果，实施爆破必须遵守以下原则：

(一) 实施工程侦察。受领爆破任务后，应首先对目标实施工程侦察，以查明：

1. 爆破目标的数量、位置、类型、性质、结构、有关尺寸和破坏部位。
 2. 敌人对该目标的警戒情况。
 3. 爆破目标附近的地质、地形条件及其他有关建筑物的情况。
 4. 目标附近可供利用的简便器材数量、种类。
 5. 准备作业的地点、存放炸药和爆破器材的野战仓库、点火站和警戒的位置。
 6. 需要重点保护的目标及地物、地貌。
 7. 其他与作业有关的事项。
- 侦察所获情况应标绘在侦察要图上。

— 1 —

Chapter 1 General Provisions

Article 1: To standardize blasting training, this manual is formulated based on the overall combat, training, and construction experience, and the original "Blasting Manual," in accordance with relevant regulations, rules, and national military standards.

Article 2: This manual applies to all engineering troops, schools, and other units assigned explosive demolition tasks; it serves as the basic basis for organizing professional training in explosives and the application of technical skills.

Article 3: Blasting is a technology that achieves expected objectives through the explosive action of explosives. Military blasting is the application of blasting technology in military operations, with the purpose of destroying military targets, inflicting casualties on enemy personnel, accelerating engineering operations, and completing combat engineering support tasks.

Article 4: To ensure blasting effects, blasting operations must adhere to the following principles: (1) Conduct engineering reconnaissance. After receiving the blasting task, engineering reconnaissance of the target must be carried out first to ascertain:

1. Quantity, location, type, nature, structure, and relevant dimensions of blasting targets and the damaged area.
 2. Enemy surveillance of the target.
 3. Geological, topographical conditions and information on other relevant structures near the blasting target.
 4. The number and types of available equipment near the target.
 5. Prepare the location for the operation, the field warehouse for stored explosives and blasting materials, the ignition station, and the positions for security.
 6. Targets and features, as well as landforms, that require special protection.
- ed, other matters related to the assignment.
- 侦察所获情况应标绘在侦察要图上。

— 1 —

(二) 周密组织计划。根据上级赋予的任务和侦察获得的资料, 制定爆破计划。爆破计划内容应包括:

1. 爆破方法、装药配置、装药量计算和起爆方法, 并绘制要图加以标示。
2. 炸药、火具和作业器材数量 (炸药、火具应增加预备量)。
3. 作业人员的编组和任务区分。
4. 作业准备、器材存放和点火站的位置。
5. 警戒、掩护位置; 安全距离的计算; 破片预计飞散区域及人员隐蔽位置。
6. 预计准备作业开始和完成时间。
7. 与有关部 (分) 队的协同, 各种信 (记) 号的规定。
8. 可能发生的意外情况及处理方法。

根据上级批准的爆破计划, 组织各项准备, 并适时展开作业。

(三) 准确可靠起爆。实施爆破作业时, 必须在指定时间内完成起爆前各项准备工作, 并按上级命令或预定方案准确可靠起爆。

为保证爆破效果, 除了敷设基本起爆线路外, 还应敷设预备起爆线路。起爆线路敷设完毕至起爆前, 应不间断地加以检查和维护, 随时排除故障。爆破重要目标时, 除构筑基本点火站外, 还应构筑预备点火站。同时还要派出预备队, 携带炸药、火具和起爆器材、防护器材, 配备运输工具, 配置在隐蔽安全、便于接近目标的待机地域, 随时准备执行强行爆破任务。

在有敌情顾虑的情况下执行爆破任务时, 指挥员应随时注意敌情变化, 加强本分队的警戒和战斗准备, 并与友邻密切协同, 规定互相支援的方法和联络信号, 以防敌人的突然袭击。

爆破后, 应立即检查爆破效果并向上级报告。报告内容包括:

— 2 —

(2) Carefully organize and plan. Based on the tasks assigned by higher authorities and intelligence gathered through reconnaissance, formulate a demolition plan. The demolition plan shall include:

1. Blasting method, charge configuration, charge quantity calculation, and initiation method, and draw the required diagram to indicate them.
2. Quantity of explosives, pyrotechnic tools, and working equipment (explosives and pyrotechnic tools should include a reserve)
3. Grouping of workers and division of tasks
4. Preparation of work, storage of equipment, and location of the ignition station.
- 5 Warning, cover position: Calculation of safe distance: Fragment dispersion area and personnel concealment position.
6. Estimate the start and completion times for the preparation work.
7. Coordination with relevant departments (units) and regulations for various signal (record) types.
8. Possible unexpected situations and their handling methods.

Based on the blasting plan approved by higher authorities, organize all necessary preparations and carry out operations at appropriate times.

(三) 准确可靠起爆。实施爆破作业时, 必须在指定时间内完成起爆前各项准备工作, 并按上级命令或预定方案准确可靠起爆。

Complete all preparatory work prior to detonation and proceed with a reliable detonation in accordance with superior orders or the planned scheme.

To ensure effective blasting, in addition to laying the main detonation circuit, a reserve detonation circuit should also be laid. Before detonation, the detonation circuits must be inspected and maintained continuously, with faults eliminated at all times. When blasting important targets, in addition to constructing the main firing station, a reserve firing station should also be built. A reserve team should also be dispatched, carrying explosives, ignition devices, detonation equipment, and protective gear, equipped with transportation tools, and stationed in concealed and safe areas close to the target, ready at all times to carry out forced blasting operations.

When conducting demolition operations under conditions of enemy threat, the commander must constantly monitor changes in the enemy situation, strengthen the guard and combat readiness of his own squad, and coordinate closely with friendly units by establishing methods for mutual support and communication signals to prevent surprise attacks by the enemy. After the demolition,

Check the blasting effect and report to the superior

Report
Content
Package

1. 起爆时间及爆破效果。
2. 炸药、火具及其它器材的消耗情况。
3. 作业分队伤亡情况。
4. 其他与爆破有关的事项。

(四) 保障作业安全。实施爆破作业，必须遵守下列安全规则。

1. 作业人员必须熟悉炸药、火具的性能及使用方法，明确自己的职责，熟知作业程序。两人以上共同作业时，必须指定负责人。

2. 炸药、火具应分开保管，并注意警戒。在捆包装药和制作点火管时应远离建筑物。保管、运输和使用炸药、火具时要严禁烟火。

3. 禁止非作业人员进入作业现场。对预计破片飞散区域要派出警戒。起爆时禁止己方一切人员进入危险区。

4. 用点火管或延期电雷管起爆装药时，若点火后未能按时爆炸，应等 15 分钟后，方可派人进入现场检查、排除。

5. 爆破完毕，指挥员（或指定人员）应对爆破现场进行检查。若发现拒爆装药应组织排除；情况紧急无法排除时，应设置明显标志。对未爆的炸药、火具，应就地销毁或带走，爆破现场不得遗留任何炸药、火具。

1. Timing of detonation and blasting effect

果。

2. Consumption of explosives, pyrotechnic tools, and other equipment

具。

3. Injury and work loss situation of the work squad

况。

4. Other matters related to blasting

页。

(4) Ensure safety during operations. When conducting blasting operations, the following safety regulations must be observed:

1. Personnel must be familiar with the characteristics and usage methods of explosives and ignition tools, clearly understand their responsibilities, and thoroughly know the operating procedures. When two or more people work together, a person in charge must be designated.

2. Explosives and pyrotechnic articles shall be stored separately, and vigilance shall be maintained. When bundling and packaging explosives and preparing

When installing the ignition pipe, keep it away from buildings. When storing, transporting, and using explosives and pyrotechnic devices, be strict

3. Non-operating personnel are prohibited from entering the work site. A security cordon must be established in the area where fragments are expected to scatter. During detonation, all personnel of our side are prohibited from entering the danger zone.

4. When detonating the charge with a fuse or a delay fuse, if it fails to explode on time after ignition, wait 15 minutes before sending personnel to enter the site for inspection and troubleshooting.

5. After blasting is complete, the commander (or designated personnel) shall inspect the blasting site. If any unfired charges are found, they shall be organized for disposal; in case of emergency where disposal is not possible, obvious markers shall be set. Unexploded explosives and ignition devices shall be destroyed on site or removed; no explosives or ignition devices shall be left behind at the blasting site.

第二章 炸药与火具

第一节 炸 药

第五条 凡在适当的外界能量作用下能发生爆炸的化学物质都称为炸药。

第六条 炸药爆炸具有下列特性。

(一) 反应速度极快。常用炸药的爆速为 3000 ~ 9100 米/秒, 能在极短时间内完成爆炸反应, 将爆炸能量传给周围物质。

(二) 产生大量热量。1 千克常用炸药爆炸后, 可放出 1600 ~ 6300 千焦耳的热量, 其爆温可达 1500 ~ 4500℃。放出的热量不仅使炸药爆炸反应进行到底, 而且也是产生破坏作用的能源。

(三) 产生大量气体。1 千克常用炸药爆炸后, 可生成 600 ~ 1000 升气体 (标准状态下)。这种含有大量热量的气体在瞬间急剧膨胀并对外做功, 因而对周围物质产生巨大压力。

第七条 炸药在外界作用下发生爆炸的难易程度称为炸药的感度。容易爆炸的称为感度大或敏感, 不容易爆炸的称为感度小或钝感。不同的炸药有不同的感度; 同一种炸药的不同感度有大有小。炸药的感度越大, 所需的起爆能越小。

能够引起炸药爆炸变化的能量, 称为起爆能。起爆能的形式有:

- (一) 热能 (火焰、火花)。
- (二) 电能 (电热、电火花)。
- (三) 机械能 (冲击、摩擦、刺扎)。
- (四) 化学能 (化学反应产生的热)。

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Chapter 2: Explosives and Firearms

Section 1 Explosives

Article 5: Chemical substances that can undergo explosion under appropriate external energy are collectively referred to as explosives.

Article 6: Explosions of explosives have the following characteristics:

(1) Extremely fast reaction speed. The detonation velocity of common explosives is 3000 ~ 9100 meters/second,

Complete the explosion reaction in a very short time Transfer explosive energy to surrounding matter

(2) Generates a large amount of heat. After 1 kilogram of common explosive detonates, it can release 1600 ~ 6300 kilojoules of heat, with a peak temperature of up to 1500~4500%. The released heat

Not only does it ensure that the explosive reaction proceeds to completion, but it also serves as the energy source that produces the destructive effect.

(3) Produces a large amount of gas. After 1 kg of common explosive detonates, it can generate 600 ~

1000 liters of gas (at standard conditions). This highly energetic gas expands rapidly and suddenly, performing work on the surroundings, thereby exerting tremendous pressure on surrounding matter.

Article 7: The ease with which an explosive detonates under external influences is called the explosive's

sensitivity. Explosives that are easily detonated are said to have high sensitivity or be sensitive, while those that are not easily detonated are said to have low sensitivity or be insensitive. Different explosives have different sensitivities; the same type of explosive can have varying degrees of sensitivity. The greater the sensitivity of an explosive, the less initiation energy it requires.

The energy capable of initiating an explosive detonation is called initiating energy. The forms of initiating energy include:

(1) Thermal energy (flame, sparks).

(2) Electrical energy (electrical heating, electrical spark).

(3) Mechanical energy (impact, friction, puncture). (4) Chemical energy (heat generated by chemical reactions).

(五) 它种炸药(雷管、扩爆药或炸药)的爆炸能。

第八条 炸药爆炸时粉碎与其接触的介质或物体的能力称为炸药的猛度。炸药的猛度主要与炸药的爆速和装药密度有关,爆速和装药密度越大,猛度也越大。

第九条 炸药爆炸时对周围介质或物体作功的能力称为炸药的威力。作功能力的大小取决于炸药爆炸时所产生的气体和热量的多少。

第十条 炸药的稳定爆炸称为爆轰。炸药爆炸时,爆轰波在炸药中的传播速度称为炸药的爆速。爆速越大则破坏力越大。由于炸药成份和性质的不同,其爆速各不相同;同样的炸药其爆速大小则主要取决于下列因素。

(一) 起爆能:为使炸药爆炸达到最高速度,必须给予足够的起爆能。起爆能不足,则不能引起炸药的爆轰。

(二) 炸药密度:增大炸药密度,能提高其爆速,同时要求起爆能相应增大。当起爆能一定时,各种炸药都具有最佳密度。当炸药的密度大于或小于最佳密度时,都有可能使炸药爆速降低甚至拒爆。

(三) 炸药的包壳:坚固的包壳能提高炸药的爆速,特别对于低级炸药更为明显。对于起爆药,包壳对爆速的影响极小。

(四) 炸药湿度:炸药湿度小,爆速大;湿度增大,爆速就会降低;而湿度过大,炸药则不爆炸,甚至不能燃烧。硝酸炸药、黑火药等受湿度影响更大。

第十一条 炸药按性能和用途分为起爆药、猛炸药和火药三类。

(一) 起爆药:起爆药对冲击、摩擦和热的感度灵敏,通常用于装填雷管和火帽。常用的起爆药有雷汞、氮化铅、斯蒂酚酸铅和 D·S 共晶等。

1. 雷汞:白色或灰白色针状结晶体。有毒,难溶于水;受潮后爆炸能力减弱,当含水 10% 时只能燃烧不能爆炸;含水

(5) The explosive energy of other explosives (detonators, booster charges, or explosives).

The ability of an explosive to pulverize media or objects in contact with it upon detonation is called

Explosive power. The intensity of an explosive is mainly related to its detonation velocity and charge density, and

The greater the velocity and charge density, the greater the degree.

Article 9: The ability of an explosive to do work on the surrounding medium or objects upon detonation is called the power of the explosive. The magnitude of this work depends on the amount of gas and heat generated during the explosion.

Article 10: The stable detonation of explosives is called detonation. The speed at which the detonation wave propagates through an explosive during its explosion is called the detonation velocity of the explosive. The greater the detonation velocity, the greater the destructive power. Due to differences in the composition and properties of explosives, their detonation velocities vary; for the same explosive, the detonation velocity

Depends on the following factors. (1) Initiating energy: To ensure the explosive detonates at maximum velocity, sufficient

Insufficient initiation energy then it cannot cause detonation of the explosive

(2) Explosive density: Increasing explosive density can increase its detonation velocity, but it also requires a corresponding increase in initiation energy. When the initiation energy is fixed, all types of explosives have an optimal density. If the density of the explosive is greater than or less than the optimal density, the detonation velocity may decrease, even to the point of failure to detonate.

(3) Explosive casing: A sturdy casing can increase the detonation velocity of explosives, especially for

More pronounced in low explosives. For initiating explosives, the casing has a negligible effect on detonation velocity.

(4) Explosive moisture: Low moisture in explosives results in higher detonation velocity; as moisture increases, detonation velocity decreases.

will decrease; if the moisture content is too high, the explosive will not explode, and may even fail to ignite. Ammonium nitrate explosives and black powder are more affected by moisture.

Article 11: Explosives are classified into three categories: initiating explosives, high explosives, and propellants, based on their performance and application.

(1) Initiating explosives: Initiating explosives are highly sensitive to impact, friction, and heat, and are typically

Used for priming detonators and fuses. Common initiating charges include mercury fulminate, lead azide, lead styphnate, and D·S eutectic.

1, Mercury fulminate: white or grayish-white needle-shaped crystals. Toxic, insoluble in water; after exposure to moisture, its explosive power decreases; when containing 10% water, it can only burn and cannot explode; when containing

30%时, 则不能燃烧。在起爆药中, 雷汞的机械感度最大, 火焰感度也较敏感, 遇到轻微的冲击、摩擦和火星等影响, 就会引起爆炸。爆发点为 170 ~ 180℃。当密度为 3.3 克/厘米³ 时, 爆速为 4500 米/秒。雷汞能腐蚀铝, 所以装有雷汞的雷管用铜作外壳。

2. 氮化铅: 白色粉末结晶体。不溶于水。对冲击、摩擦和热的感度比雷汞迟钝, 但起爆能力大于雷汞。爆发点为 305 ~ 405℃。当密度为 3.8 克/厘米³ 时, 爆速为 4500 米/秒。氮化铅与铜起化学反应, 生成感度灵敏的氮化铜, 所以装有氮化铅的雷管用铝作外壳。

为便于使用, 通常在氮化铅中加入糊精, 制备成糊精氮化铅。

3. 斯蒂酚酸铅: 深黄色细粒结晶体。不溶于水。对冲击、摩擦的感度比氮化铅迟钝, 但对火焰的感度比雷汞灵敏。爆发点约为 270℃。爆速为 5000 米/秒。斯蒂酚酸铅与金属不起化学作用。它主要用于装有氮化铅的雷管中, 以保证引爆氮化铅。

4. D·S 共晶: 为氮化铅—斯蒂酚酸铅二元化合物共沉淀起爆药。火焰感度不低于斯蒂酚酸铅, 起爆能力不低于氮化铅。

(二) 猛炸药: 猛炸药爆炸威力大, 对冲击、摩擦和热感度较为迟钝, 便于使用和保管。

猛炸药分为高级炸药、中级炸药和低级炸药。

高级炸药有黑索金、太安、特屈儿和塑性炸药等。主要用于作扩爆药、装填炮(炸)弹和雷管, 或制作导爆索、导爆管。

中级炸药有梯恩梯、黑梯炸药等。主要用于破坏作业, 装填炮(炸)弹和地雷。

低级炸药有硝铵炸药等。主要用于土壤、岩石等的内部爆破, 也可装填地雷。

1. 爆索金: 白色结晶体。无臭无味, 不吸湿, 难溶于水。对冲击、摩擦的感度比特屈儿灵敏。枪弹贯穿会爆炸。遇火燃

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At 30%, it cannot burn. Among priming agents, mercury fulminate has the highest mechanical sensitivity and is also relatively sensitive to flame; even slight impacts, friction, or sparks can cause it to explode. The ignition temperature is 170~180°C. When the density is 3.3 g/cm³, the detonation velocity is 4500 m/s. Mercury fulminate can corrode aluminum, so detonators containing mercury fulminate are made with copper casings.

2 Lead azide: white powder crystals. Insoluble in water. Less sensitive to shock, friction, and heat than mercury fulminate, but has greater detonating power. Detonation temperature is 305~405°C. At a density of 3.8 g/cm³, the detonation velocity is 4500 m/s. Lead azide reacts chemically with copper to form highly sensitive lead azide copper, so lead pipes containing lead azide are sheathed in lead.

For ease of use, dextrin is usually added to lead nitrate to prepare dextrin lead nitrate.

on 3. Lead stibogluconate: deep yellow fine-grained crystals. Insoluble in water. Less sensitive to impact and friction than lead azide, but more sensitive to flame than mercury fulminate. The detonation point is approximately 270°C. The detonation velocity is 5000 m/s. Lead stibogluconate does not react chemically with metals. It is mainly used in lead azide-filled detonators to ensure the initiation of lead azide.

4. D-S eutectic: a primary explosive consisting of a co-precipitated binary compound of lead nitrate and lead stibate.

Flame sensitivity not lower than lead stibate

Initiation capability not lower than lead azide

(II) High explosives: High explosives

High explosive power, high sensitivity to shock, friction, and heat.

Relatively slow, easy to use and store.

High explosives are classified into high-grade explosives, medium-grade explosives, and low-grade explosives.

High explosives include RDX, HMX, TATB, and plastic explosives. They are mainly used as initiating charges, for loading artillery shells and grenades, or for making detonating cords and detonating tubes.

Intermediate explosives include TNT and black powder, primarily used for demolition operations, loading artillery shells and grenades, and landmines.

Low-grade explosives include ammonium nitrate explosives and are mainly used for internal blasting in soil and rock, and can also be loaded into landmines.

1. Dynamite Gold: White crystalline. Odorless and tasteless, non-absorbent, and difficult to dissolve in water. Impact resistant.

The sensitivity to friction is more sensitive than a fart.

Bullet penetration will explode

烧,冒浓烟,可由燃烧转为爆炸。爆发点为 230℃。当密度为 1.76 克/厘米³ 时,爆速为 8660 米/秒。

2. 太安:白色结晶体。不吸湿,不溶于水。对冲击、摩擦的感度比黑索金灵敏。枪弹贯穿会爆炸,遇火燃烧,在密闭容器中,即使数量少,也会由燃烧转为爆炸。爆发点为 225℃。当密度为 1.77 克/厘米³ 时,爆速为 8600 米/秒。

3. 特屈儿:淡黄色结晶体。无臭,味咸,难溶于水。对冲击、摩擦的感度较迟钝。遇火迅速燃烧,可由燃烧转为爆炸。爆发点为 195~220℃。当密度为 1.7 克/厘米³ 时,爆速为 7860 米/秒。

4. 奥克托金:无色结晶体。无臭无味,不吸湿,不溶于水。对冲击、摩擦的感度比特屈儿灵敏。枪弹贯穿会爆炸。遇火燃烧,冒浓烟,可由燃烧转为爆炸。爆发点为 298℃。当密度为 1.88 克/厘米³ 时,爆速为 9010 米/秒。

5. 塑性炸药:为柔软可塑的固体。主要成份是黑索金。常用的有塑—1、塑—4 等炸药。

塑—1 炸药呈白色或微黄色。吸湿性小。在 -10~+60℃ 之间保持可塑性,可根据需要做成各种形状。对冲击、摩擦的感度比梯恩梯灵敏。用 8 号雷管起爆。威力为梯恩梯的 1.23 倍。枪弹贯穿不燃烧也不爆炸。当密度为 1.64 克/厘米³ 时,爆速为 8280 米/秒。

塑—1 炸药可用于装填地雷、碎甲弹及复杂弹体等,可染成各种颜色供特工人员爆破使用。

塑—4 炸药呈白色或微黄色。吸湿性小。可塑性好,在 -40℃ 时仍有良好的可塑性。威力为梯恩梯的 1.23 倍。对冲击、摩擦的感度比塑—1 炸药灵敏。用 8 号雷管起爆。当密度为 1.66 克/厘米³ 时,爆速为 8204 米/秒。其用途同塑—1 炸药。

6. 梯恩梯:淡黄色或黄褐色结晶体,味苦有毒。阳光照射后颜色变暗,感度增大,但不影响爆炸性能。

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Burning, emitting thick smoke, can transition from combustion to explosion. The ignition temperature is 230°C. At a density of 1.76 g/cm³, the detonation velocity is 8660 m/s.

2. TATAN: Self-crystallizing. Non-absorbent, insoluble in water. More sensitive to impact and friction than RDX. Penetration by bullets causes explosion; it burns upon contact with fire. In a sealed container, even a small quantity can transition from burning to explosion. The detonation temperature is 225°C. At a density of 1.77 g/cm³, the detonation velocity is 8600 m/s.

3. Triacetin: pale yellow crystals. No melting point, salty taste, difficult to dissolve in water. Relatively insensitive to impact and friction. Burns rapidly upon exposure to fire and can transition from combustion to explosion. The detonation temperature is 195~220°C. At a density of 1.7 g/cm³, the detonation velocity is 7860 m/s.

4. Octogold: Colorless crystalline substance. Odorless and tasteless, non-hygroscopic, insoluble in water. More sensitive to impact and friction than TNT. Gunshot penetration causes explosion. Flammable, emits dense smoke, can transition from burning to detonation. Explosion point is 298°C. At a density of 1.88 g/cm³, the detonation velocity is 9010 m/s.

5. Plastic explosive: A soft, malleable solid. The main component is RDX. Common types include plastic explosive No. 1 and plastic explosive No. 4.

Plastic-1 explosive is white or slightly yellow. It has low hygroscopicity and retains plasticity between 10~+60°C, allowing it to be molded into various shapes as needed. Its sensitivity to impact and friction is higher than that of TNT. It is detonated with an 8 mm fuse. Its power is 1.23 times that of TNT. It does not burn or explode when penetrated by a bullet. At a density of 1.64 g/cm³, its detonation velocity is 8280 m/s.

Plastic explosive 1 can be used to fill landmines, armor-piercing shells, and complex casings, and can be dyed various colors for use by agents in explosions.

Plastic explosive 4 is white or slightly yellow in color. It has low hygroscopicity and good plasticity, retaining good plasticity even at -40°C. Its power is 1.23 times that of TNT. Its sensitivity to impact and friction is higher than that of Plastic explosive 1. It is detonated by No. 8 detonators. When the density is 1.66 g/cm³

Explosion speed is 8204 meters/second

Its use is the same as plastic explosive No. 1.

6. TNT: pale yellow or yellow-brown crystals, bitter taste and toxic. After exposure to sunlight, the color darkens and sensitivity increases, but the explosive performance is not affected.

梯恩梯炸药吸湿性小，难溶于水。压（铸）制的块状梯恩梯炸药可直接用于水中爆破，使用鳞片状梯恩梯炸药时要采取防水措施。

梯恩梯炸药对冲击、摩擦感度迟钝，枪弹贯穿不爆炸也不燃烧。在空气中点燃时冒浓烟，但不爆炸，如数量很大并堆积在一起或在密闭的容器中燃烧则可能由燃烧转为爆炸。

常用的梯恩梯炸药有鳞片状和块状两种。鳞片状梯恩梯炸药的密度为 $0.75 \sim 0.85$ 克/厘米³；块状梯恩梯炸药有压制与铸制两种，密度约为 1.6 克/厘米³。梯恩梯炸药的熔点约为 80.2°C 。

鳞片状梯恩梯炸药和压制的梯恩梯药块，可用8号雷管起爆；铸制的梯恩梯药块起爆感度迟钝，用8号雷管不能起爆，需用压制的梯恩梯药块作扩爆药。

当密度为 1.6 克/厘米³ 时, 梯恩梯炸药的爆速约为 7000 米/秒。

梯恩梯是爆破作业中使用的主要炸药，适用于各种材料、目标的爆破和装填炮（炸）弹以及地雷。爆破时产生大量有毒气体，不适用于坑道掘进作业。

7. 黑梯：由黑索金和梯恩梯组成的不同配比的混合炸药。常用的有黑梯 50/50、黑梯 40/60 等。呈黄色或淡黄色，吸湿性小。对冲击、摩擦感度大于梯恩梯而小于黑索金，枪弹贯穿通常不爆炸也不燃烧。用 8 号雷管起爆。当密度为 1.69 克/厘米³时，黑梯 50/50 混合炸药的爆速为 7752 米/秒。

黑梯炸药主要用于装填各种弹药和地雷。

8. 硝铵类炸药：以硝酸铵为主要成份的混合炸药。硝铵炸药的颜色因所含成份不同而有差别，通常为浅黄色或灰白色。爆速为 3500 ~ 5000 米/秒。对冲击、摩擦和热的感度迟钝，遇火焰、火星不易点燃。

硝铵炸药吸湿性强。吸湿后将影响对雷管起爆的感度，当含水量超过 3% 时，则不能爆炸。潮湿的硝铵炸药，应在干燥的天

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RDX has low hygroscopicity and is difficult to dissolve in water. Cast or molded blocks of RDX explosives can be directly detonated in dry water, but when using flaky RDX explosives, waterproofing measures must be taken.

TNT is insensitive to impact and friction; bullets passing through it do not cause explosion or ignition. When ignited in air, it produces thick smoke but does not explode. However, if a large quantity is piled together or burned in a closed container, the combustion may transition to explosion.

Common types of TNT explosives are flake and cast. The density of flake TNT is 0.75~0.85 g/cm³; cast TNT comes in two types: pressed and molded.

Density is approximately [6 grams/cm³ The melting point of TNT is approximately 80.

Scale-shaped TNT and pressed TNT blocks can be detonated with No. 8 fuses; cast TNT blocks have a slow detonation sensitivity and cannot be detonated with No. 8 fuses, requiring

Use TNT blocks as explosives. ch.Gom When the density is 1.6 grams per cubic centimeter, the detonation velocity of TNT is approximately 7000 meters per second,

TNT is the primary explosive used in blasting operations, suitable for blasting various materials, targets, loading shells and bombs, and landmines. It produces large amounts of toxic gases during blasting and is not suitable for tunneling operations.

7. Black Dynamite: A mixed explosive composed of black powder and TNT in varying proportions.

[illegible]

The color of the drug varies depending on its ingredients, typically being light yellow or grayish-white. The detonation velocity is 3500 ~ 5000 m/s. It is insensitive to impact, friction, and heat, and is not easily ignited by flame or sparks.

Ammonium nitrate explosives have strong hygroscopicity. After absorbing moisture, it will affect the sensitivity to detonation of detonators. When the water content exceeds 3%

then it cannot explode	Damp ammonium nitrate explosive	should be on a dry day
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气，将其放置在阴凉通风处，使之干燥。

长期存放的硝酸铵炸药，受温度变化以及受潮后水份又蒸发等影响，易结成硬块。结块的硝酸铵炸药对雷管起爆的感度降低，使用前应揉成粉末状。

硝酸铵炸药能腐蚀铵、铜等金属。当雷管插入硝酸铵炸药内超过1昼夜时，雷管外壳应加以防护。

硝酸铵炸药的密度为0.95~1.05克/厘米³，用8号雷管起爆。

硝酸铵炸药通常包装成直径31~35毫米的圆柱形药卷，每卷重100克、150克和200克。

硝酸铵炸药有效保存期为6个月。

常用硝酸铵炸药的性能见表2—1。

表 2—1 常用硝酸铵炸药性能

名 称	成 份 (%)			爆速 (m/s)	威力 (ml)	猛度 (mm)
	硝酸铵	梯恩梯	木粉			
1 号岩石炸药	82	14	4	4000	350	13
2 号岩石炸药	85	11	4	3800	320	12
新 2 号岩石炸药	87	7	4	3100	320	12
1 号露天炸药	82	10	8	3600	300	11
2 号露天炸药	86	5	9	3525	250	8
说 明	新 2 号岩石炸药另含 2% 的柴油。					

9. 液体炸药：分为单质液体炸药（硝基甲烷、四硝基甲烷）和混合液体炸药（硝酸—硝基苯、胍类）两大类。液体炸药流动性好，输送、装药方便。通常对金属具有腐蚀性，有毒。可用于装填航弹、地雷，也可用于扫雷、构筑工事。

10. 燃料空气炸药：由燃料与空气构成的一种混合炸药。常用的燃料有环氧乙烷、环氧丙烷（常温常压下为液体）等。燃料

Qi, place it in a cool, ventilated area to dry.

Long-term stored ammonium nitrate explosives, affected by temperature changes and moisture evaporation after dampness, tend to form hard lumps. Ammonium nitrate explosives that have formed lumps have reduced sensitivity to detonator initiation; therefore, they should be crushed into powder before use.

Ammonium nitrate explosives can corrode metals such as ammonium and copper. When a detonator is inserted into ammonium nitrate explosives for more than one night, the detonator casing should be protected.

The density of ammonium nitrate explosives is 0.95 ~ 1.05 g/cm³, detonated by No. 8 detonators.

Ammonium nitrate explosives are typically packaged as cylindrical cartridges with a diameter of 31 ~ 35 mm, with each cartridge weighing 100 g, 150 g, or 200 g.

The effective shelf life of ammonium nitrate explosive is 6 months.

常用硝酸铵炸药性能表 2-1

Table 2--1 Common Performance of Ammonium Nitrate Explosives

	成 份 (%)			爆速 (m/s)	威力 (rvg)	猛度 (mm)
	硝酸铵	梯恩梯	木粉			
No. 1 Rock Explosive	82	14	4	4000	350	13
No. 2 Rock Explosive	85	11	4	3800	320	12
New No. 2 Rock Explosive	87	7	4	3100	320	12
No. 1 Open-Face Explosive	82	10	8	3600	300	11
No. 2 open-air explosive	86	5	9	3525	250	8
New No. 2 rock explosive also contains 2 % diesel						

9. 液体炸药：分为单质液体炸药（硝基甲烷、四硝基甲烷）和混合液体炸药（硝酸—硝基苯、胍类）两大类。液体炸药流动性好，输送、装药方便。通常对金属具有腐蚀性，有毒。可用于装填航弹、地雷，也可用于扫雷、构筑工事。

10. Fuel-Air Explosive: A mixed explosive composed of fuel and air. Often The fuels used include ethylene oxide, propylene oxide (liquid at room temperature and pressure), etc. Fuel

通过第一次爆炸被均匀地抛散并与空气中氧气充分混合，经第二次起爆即产生爆炸。其爆炸威力与破坏范围均大于梯恩梯数倍，可摧毁一般弹药不易摧毁的目标，并对人员具有较大的杀伤作用和一定的窒息作用。通常用于摧毁坚固目标和扫雷。

(三) 火药：火药可分为有烟火药和无烟火药。常用的有黑火药、发射药和烟火剂。

1. 黑火药：属有烟火药。通常由硝酸钾 75%、硫磺 10%、木炭 15% 混合制成，有粉状和颗粒状两种。良好的粉状黑火药为均一的灰黑色粉末；粒状的为具有光泽的灰黑或黑色颗粒。

黑火药遇火焰、火花很容易引燃。遇雷电打击、枪弹贯穿都会立即引起爆炸。少量黑火药在点燃时只会燃烧，在密闭条件下或数量大时，则会由燃烧转为爆炸。爆发点为 300℃。

黑火药的吸湿性强，允许最大含水量为 1%，当含水量超过 2% 时，则失去引燃能力。潮湿的黑火药干燥后，析出硝酸钾，其爆炸威力减弱。

黑火药可用火花点燃。其燃速取决于火药成份、外部压力及火药密度等。随着外部压力的升高，黑火药的燃烧速度会增快。若将黑火药装在坚硬的外壳或填塞良好的药孔中，用雷管或扩爆药起爆，可增大破坏作用。

黑火药主要用于制作导火索和弹药内的点火药、抛射药及延期药盘等，也用于内部装药爆破土壤或岩石、装填地雷。

2. 发射药：属无烟火药。主要由硝化棉、硝化甘油及化学溶剂混合加工而成。分为单基火药、双基火药和多基火药。主要用作枪弹、炮弹的发射药和火箭推进剂。

发射药是外观稍为透明的固体物质。其颜色因附加成份不同而有差别，通常是灰黑色和棕色。火箭用发射药一般为柱状，有无孔药柱、单孔药柱、多孔药柱和星形药柱等。其密度一般在 1.57~1.70 克/厘米³ 之间。

发射药的火焰感度灵敏，接触明火立即燃烧。

— 10 —

Uniformly dispersed and thoroughly mixed with oxygen in the air by the first explosion, the second detonation produces an explosion. Its explosive power and area of destruction are several times greater than that of TNT, capable of destroying targets that are difficult to destroy with conventional munitions, and it has significant lethal effects on personnel and a certain smoke-suppressing effect. It is typically used to destroy fortified targets and for mine clearance.

(3) Gunpowder: Gunpowder can be classified into smoking and non-smoking gunpowders. Common types include black powder, propellant, and pyrotechnic agents.

1. Black powder: Belongs to pyrotechnic compositions. Usually made by mixing 75% potassium nitrate, 10% sulfur, and 15% charcoal, available in powder and granule forms. High-quality black powder in powder form is a uniform gray-black powder; granular form consists of lustrous gray-black or black granules.

Black powder ignites easily upon contact with flame or sparks. It explodes immediately upon being struck by lightning or penetrated by a bullet. A small amount of black powder will only burn when ignited, but under sealed conditions or in large quantities,

Then it will turn from combustion to explosion. The ignition point is 300°C.

Black powder is hygroscopic, allowing a maximum moisture content of 1%. When the moisture content exceeds 2%, it loses its ability to ignite. Dried black powder that was previously moist will exude potassium nitrate, resulting in reduced explosive power.

Black powder can be ignited by a spark. Its burning rate depends on the composition of the powder, external pressure, and powder density, among other factors. As external pressure increases, the burning rate of black powder increases. Black powder can be placed in a hard casing or packed tightly into a well-formed borehole and detonated with a detonator or explosive booster to increase its destructive effect.

Black powder is mainly used to make fuse, priming, propelling, and delay charges in ammunition, and is also used for blasting soil or rocks with internal charges and for filling landmines.

2, Propellant: Belongs to smokeless powder. It is mainly produced by mixing and processing nitrocellulose, nitroglycerin, and chemical solvents. It is classified into single-base propellant, double-base propellant, and multi-base propellant. It is primarily used as a propellant for cartridges and shells, and as rocket propellant.

Propellant is a solid substance that is slightly transparent. Its color varies depending on the additives and is typically gray-black or brown. Rocket propellants are generally cylindrical and may be solid, single-hole, multi-hole, or star-shaped. Their density generally ranges between 1.57~1.70 g/cm³.

The flame sensitivity of the propellant is high; it ignites immediately upon contact with an open flame.

— 10 —

发射药的机械感度比梯恩梯灵敏，起爆感度比梯恩梯迟钝，用8号雷管不能引起爆轰，用扩爆药可以引起爆轰，爆速约为6000米/秒。

3. 烟火剂：烟火剂是由氧化剂、可燃物及其它物质组成的混合物。按其产生烟火效应的特征可分为照明剂、信号剂、燃烧剂、发烟剂和声光剂等。烟火剂爆炸变化的主要形式是燃烧，其火焰感度和摩擦感度比猛炸药灵敏。

烟火剂主要用于装填弹药和地雷。

第二节 火 具

第十二条 火具用于点火和起爆炸药。常用的火具有火雷管、电雷管、导火索、拉火管、导爆索和导爆管等。

第十三条 火雷管用于导火索点火时起爆炸药或导爆索等。常用的为8号火雷管。外壳由铜或铝制成。内装加强帽、绸垫、起爆药和高级炸药，全长45毫米，外径6.8毫米（图2—1）。

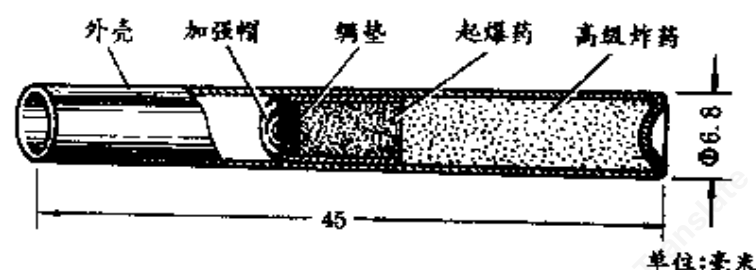


图 2—1 火雷管

火雷管遇冲击、摩擦、加热或火花，都可能引起爆炸。受潮后容易失效。

为了避免拒爆和发生意外，凡雷管有裂口、压损不能插入导火索，内壁沾有起爆药粉或管体生锈等现象都不宜使用。

在导爆管传爆法中，为使同一起爆线路中多个装药逐次起

The mechanical sensitivity of the propellant is higher than that of TNT, while its initiating sensitivity is lower than that of TNT. It cannot be detonated by an No. 8 detonator, but can be detonated with a booster explosive. The detonation velocity is approximately 6000 m/s.

3. Pyrotechnic composition: A pyrotechnic composition is a mixture composed of an oxidizer, a combustible, and other substances. According to the characteristics of the pyrotechnic effect produced, they can be classified into illuminators, signal agents, burning agents, smoke generators, and sound-and-light agents. The main form of explosive change in pyrotechnic compositions is combustion, and their flame sensitivity and friction sensitivity are more sensitive than high explosives.

Pyrotechnic agents are mainly used to load ammunition and landmines.

Section 2•Fire•Tool

Article 12 Fireworks are used for ignition and initiating explosives. Common types of fireworks include fire fuses, electric detonators, fuse cords, detonating cords, and detonating tubes.

Article 13: Fire detonators are used to initiate the explosion of explosives or detonating cords when igniting fuse wire. The commonly used type is No. 8 fire detonator. The casing is made of copper or aluminum. It contains a booster, silk pad, initiating explosive, and high-grade explosive. The total length is 45 mm, and the outer diameter is 6.8 mm (Figure 2-1).

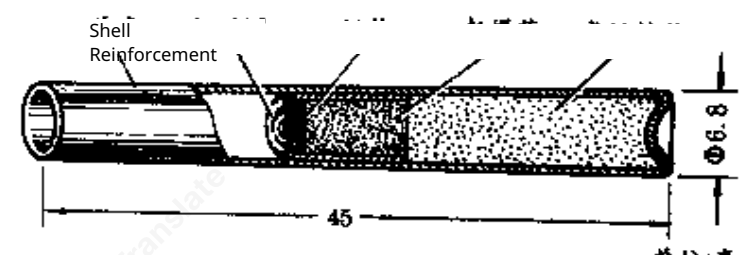


Figure 2-1 Fire Fuse

Fire detonators can be ignited by impact, friction, heating, or sparks, and may fail to detonate after exposure to moisture.

To prevent accidental detonation and accidents, all detonators with cracks or damage that prevent insertion of the fuse shall not be used.

Inner walls contaminated with detonator powder or rusted casings are not suitable for use.
。 In the detonating tube initiation method, to ensure sequential initiation of multiple charges in the same firing line,

爆，还使用毫秒延期火雷管和秒延期火雷管（图 2—2），其延期时间见表 2—2。



图 2—2 毫秒延期火雷管

表 2—2 延期火雷管的延期时间

段 别	延 期 时 间 (s)			
	毫秒延期雷管	半秒延期雷管	秒延期雷管 (延期体式)	秒延期雷管 (导火索式)
1	0	0	0	1.5
2	0.025	0.5	1	2.5
3	0.050	1.0	2	4.0
4	0.075	1.5	3	6.0
5	0.110	2.0	4	8.0
6	0.150	2.5	5	10.0
7	0.200	3.0	6	
8	0.250	3.5	7	
9	0.310	4.0	8	
10	0.380	4.5	9	
11	0.460			
12	0.550			

Explosive, also using millisecond-delayed and second-delayed fuse detonators (Figure 2-2), with delay times shown in Table 2-2.

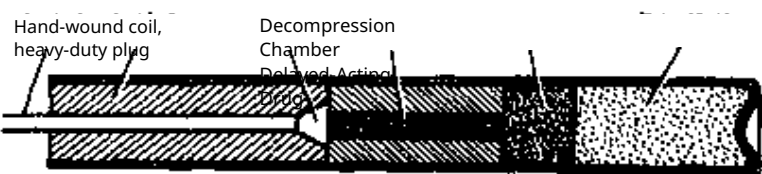


Figure 22 millisecond delay fuse

Table 2—2 延期火雷管的延期时间

8 days duration om

	Wall second delay drilling pipe	Half-second delayed egg tube	Second-delay detonator (Deferred Style)	Second Delay Steroid Tube (Picnic-style)
1				- -

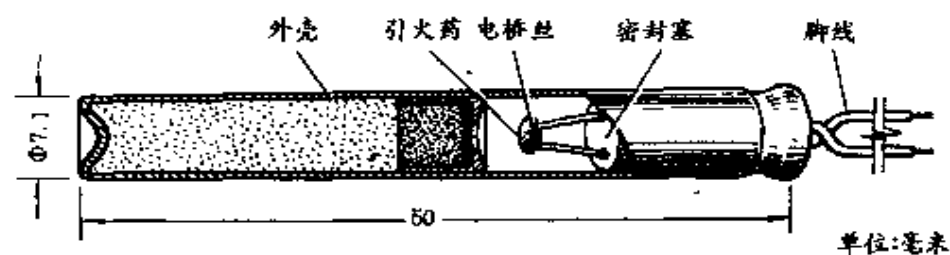


图 2—3 瞬发电雷管

毫秒延期电雷管由火雷管、延期药、电引火头和密封塞等构成（图 2—4），用于在同一起爆线路中以毫秒级时间间隔逐次起爆装药。毫秒延期电雷管延期时间分为 4 个系列 30 个段别，其延期时间见表 2—4。

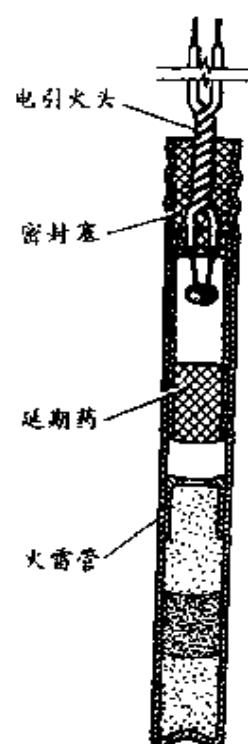


图 2—4
毫秒延期电雷管

表 2—4 毫秒延期电雷管的延期时间系列

段别	延期时间 (ms)			
	1 系列	2 系列	3 系列	4 系列
1	0	0	0	0
2	25	25	25	25
3	50	50	50	45
4	75	75	76	65
5	110	100	100	85
6	150		128	105
7	200		157	125
8	250		190	145
9	310		230	165
10	380		280	185
11	460		340	205

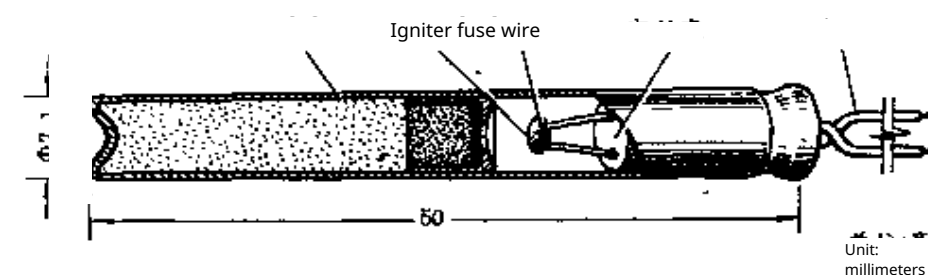


Figure 2-3 瞬发电雷管

Pen-second delay electric detonators, instant detonators, delay charges, electric primers, and sealing plugs constitute (Fig. 2-4), used to sequentially detonate charges in the same blasting circuit at millisecond intervals. Millisecond delay electric detonators have four series with 30 segments each; their delay times are shown in Table 2-4.

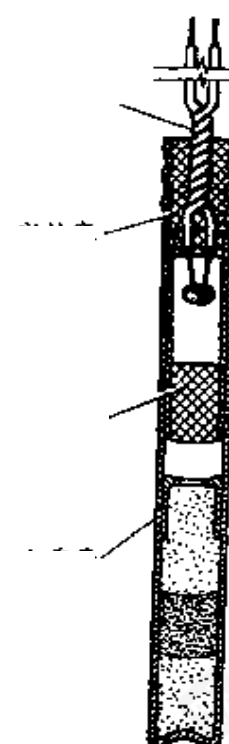


Figure 2—4
millisecond delay
electric detonator

Delay time series of millisecond-delay electric detonators

Delay time (ms)

段别	延期时间 (ms)			
	1 系列	2 系列	3 系列	4 系列
1	0	0	0	0
2	25	25	25	25
3	50	50	50	45
4	75	75	76	65
5	110	100	100	85
6	150		128	105
7	200		157	125
8	250		190	145
9	310		230	165
10	380		280	185
11	460		340	205

续 表

段 别	延期时间 (ms)				段 别	延期时间 (ms)			
	1 系列	2 系列	3 系列	4 系列		1 系列	2 系列	3 系列	4 系列
12	550		410	225	22			1225	550
13	650		480	250	23			1350	590
14	760		550	275	24			1500	630
15	880		625	300	25			1675	670
16	1120		700	330	26			1875	710
17	1200		780	360	27			2075	750
18	1400		860	395	28			2300	800
19	1700		945	430	29			2550	850
20	2000		1035	470	30			2800	900
21			1125	510					

秒延期电雷管由火雷管、导火索、电引火头、排烟孔和密封塞等构成（图 2—5），用于在同一起爆线路中逐次起爆装药。延期时间分为 4、6、8、10、12 秒等，在包装盒上有说明。

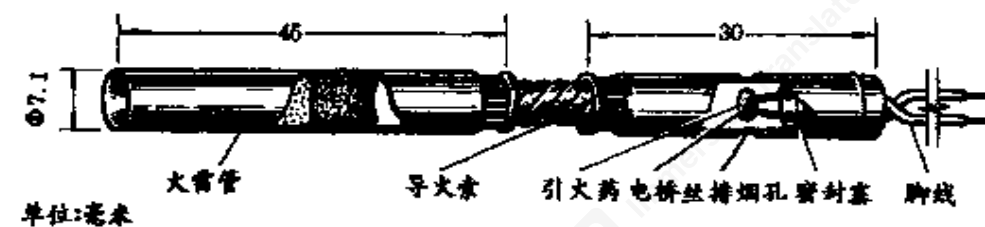
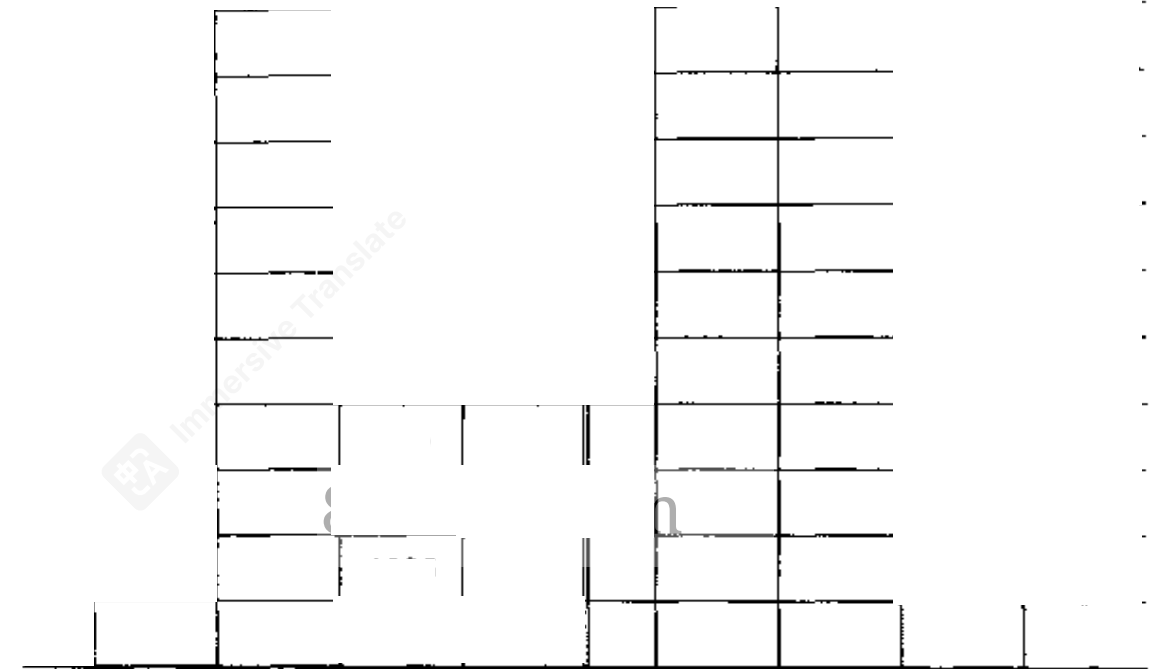


图 2—5 秒延期电雷管

电雷管在使用前需用欧姆表检查能否通电，如不通则不能使用。用欧姆表可精确地测量并选择电阻，检查方法见第四十三条。

Delay (ms)

Delay time (ms)



Delay electric detonators consist of a fire detonator, fuse, electric igniter, smoke vent, and sealing plug (Fig. 2-5) and are used for sequential detonation of charges in the same blasting circuit. The delay times are 4, 6, 8, 10, 12 seconds, etc., and are indicated on the packaging box.

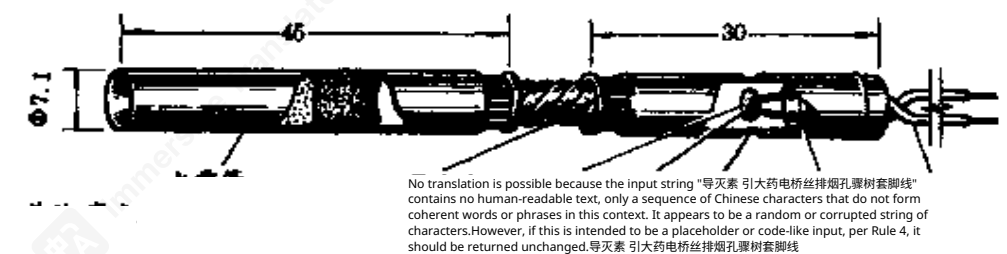


Figure 2-5 Delayed Electric Fuse

Before use, electric detonators must be tested with an ohmmeter to verify electrical continuity; if no continuity is detected, they cannot be used. An ohmmeter can be used to precisely measure and select resistance; the testing method is described in Article 43.

检查时,应将电雷管放置于防护物的后面或埋入地下 10~15 厘米,以防危险。

第十五条 导火索用于引爆火雷管或黑火药。由芯线、芯药(黑火药)及数层棉线和纸包缠而制成(图 2—6)。常用导火索表皮为白色,外径 5.2~5.8 毫米,每卷 50 米。

导火索燃速约为 1 厘米/秒。防水性能良好,两端密封,放置于 1 米深的常温静水中,经 5 小时不失去燃烧性能。芯药受潮即失效。

导火索在使用前应仔细检查,如发现有折断、松散、油浸、沥青渗出、受潮(芯药潮湿、表皮发霉)等现象均不能使用。经外观检查合格的导火索还应检查其燃烧性能,可切取 60 厘米做试验,其燃烧时间应在 60~75 秒内为正常,水中使用时燃速稍快。

第十六条 拉火管主要用于点燃导火索。由管体(纸或塑料)、倒刺(塑料管体无倒刺)、摩擦药、火帽、拉柄等组成(图 2—7)。

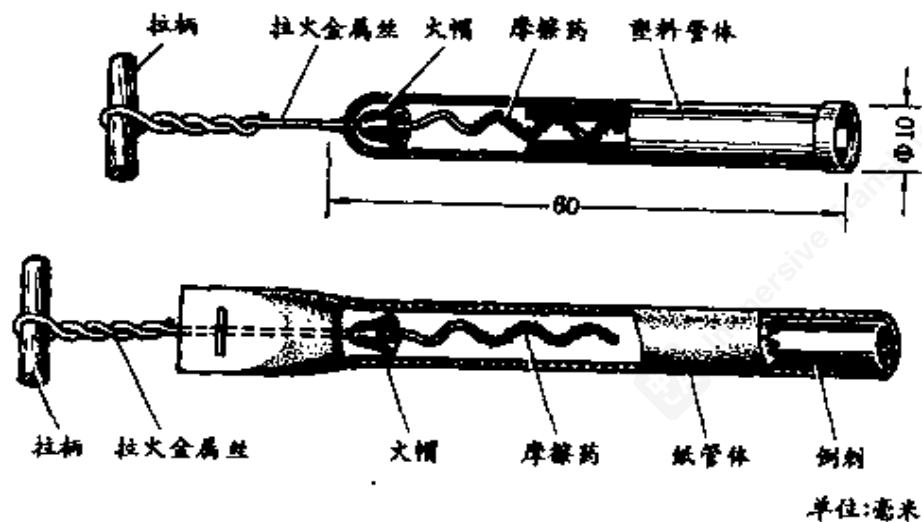


图 2—6 导火索

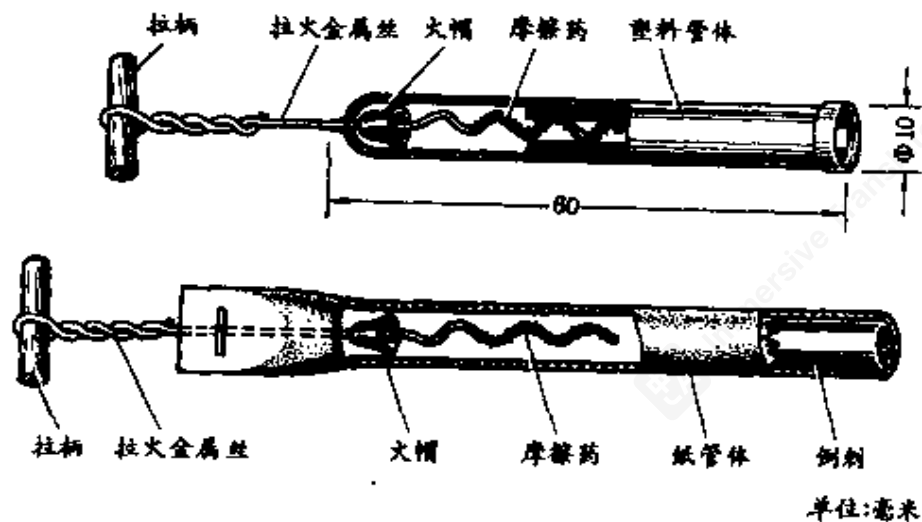


图 2—7 拉火管

When checking, place the electric detonator behind a protective shield or bury it underground 10~15 cm to prevent danger.

Article 5: The fuse is used to detonate fire fuses or black powder. It is made from a core wire, core powder (black powder), and several layers of cotton and paper wrapping (Figure 2-6). The common fuse has a white outer coating, an outer diameter of 5.2~5.8 mm, and each

卷 50 米 1

Burning rate of the fuse is approximately 1 cm/s. Waterproofing performance

Good, sealed at both ends, placed in a static environment at room temperature for 1 meter deep. In water, it retains its burning properties for 5 hours. The core agent becomes ineffective when damp.

The fuse must be carefully inspected before use; if any of the following conditions are found—breakage, looseness, oil immersion, asphalt leakage, or moisture absorption (damp core or moldy outer surface)—it shall not be used. Fuses that pass the visual inspection must also have their burning performance checked. A 60 cm sample may be cut for testing; the burning time should be within 60~75 seconds for normal performance. When used in water, the burning rate will be slightly faster.

Article 16: The striker tube is mainly used to ignite the fuse. It consists of a tube body (paper or plastic), a burr (no burr on plastic tube bodies), friction compound, primer, and a pulling handle (Figure 21-7).

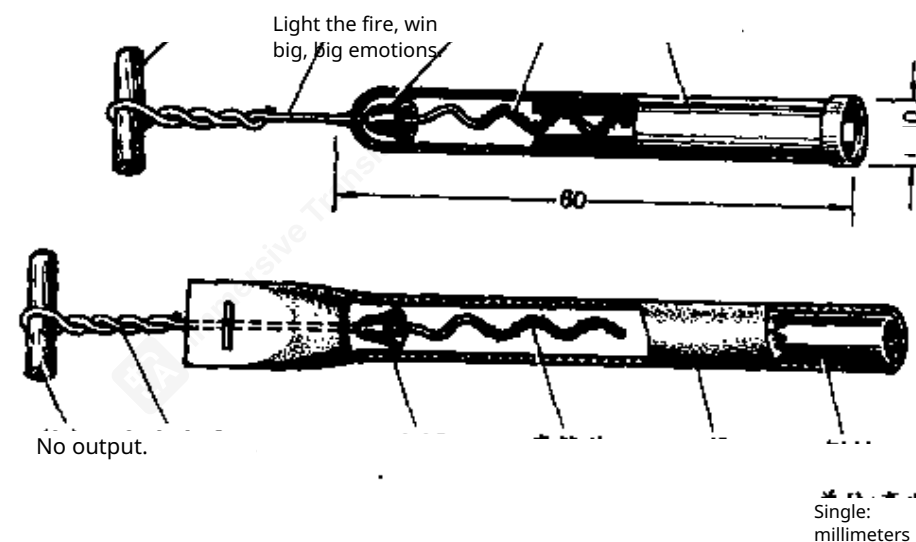


Figure 2-7: Pulling the fuse

拉火管受潮后失效，应特别注意防潮。

第十七条 导爆索主要用于同时起爆数个装药。由芯线、芯药（药量为 16 克/米黑索金或 12 克/米太安）及数层棉线和纸包缠而制成（图 2—8）。其表皮为红色，以区别于导火索。外径 5.2~6.0 毫米，每卷 50 米。

导爆索用雷管起爆，爆速不小于 6500 米/秒。导爆索受到摩擦、撞击、枪弹贯穿和燃烧时，都易引起爆炸。防潮性能良好，两端密封，放量于 0.5 米深的常温静水中，经 24 小时不失去爆炸性能。

使用前须检查外表有无破裂、折断、受潮等现象，并切取一段进行试爆，传爆良好即可使用。

第十八条 导爆管主要用于传递稳定的爆轰波，通过起爆火雷管而同时起爆数个装药。其空心塑料软管内壁涂有以奥克托金（或黑索金）为主的薄层炸药粉末（图 2—9），药量为 16 毫克/米。外径约 3 毫米，内径约 1.4 毫米。

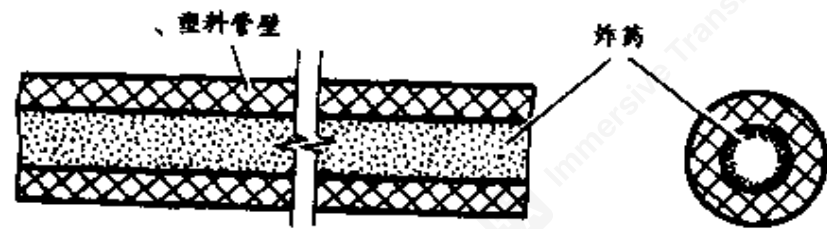


图 2—8 导爆索

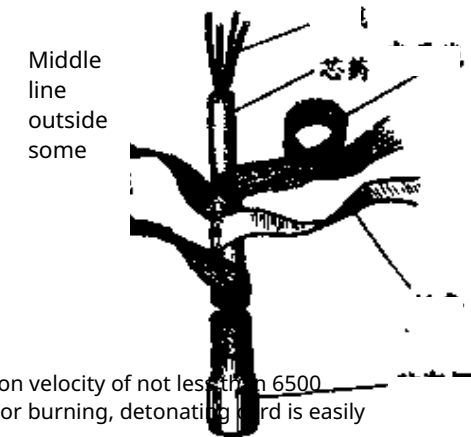
图 2—9 导爆管

导爆管用雷管或专用起爆器起爆，爆速为 1950 米/秒（芯药为奥克托金）或 1650 米/秒（芯药为黑索金）。导爆管两端密封

The flintlock tube becomes ineffective when damp and should be kept especially dry.

Article 7: Initiating powder is primarily used to detonate multiple charges simultaneously. It is manufactured by winding cotton threads and paper around a core wire and core charge (the core charge consists of 16 grams per meter of black powder or 12 grams per meter of TATP) (Figure 2-8). Its outer surface is red, to distinguish it from fuse wire. The outer diameter is 5.2~6.0 millimeters, and each roll is 50 meters long.

Detonating cord is initiated by a detonator, with a detonation velocity of not less than 6500 m/s. When subjected to friction, impact, projectile penetration, or burning, detonating cord is easily ignited.



Explosive. Good moisture resistance. Sealed at both ends.

Figure 2—8 Detonating Cord

5 meters deep in still water at room temperature

Does not lose explosive performance over time.

Before use, inspect the exterior for cracks, breaks, or signs of moisture, and cut a sample for trial detonation; if the detonation is satisfactory, it may be used.

Article 18: Detonating tubes are mainly used to transmit stable detonation waves and simultaneously initiate several charges through initiating detonators. Their hollow plastic soft pipes are coated on the inner wall with a thin layer of explosive powder powder mainly composed of octogen (or RDX) (Figure 2-9), with a charge of 16 milligrams per meter. The outer diameter is approximately 3 millimeters.

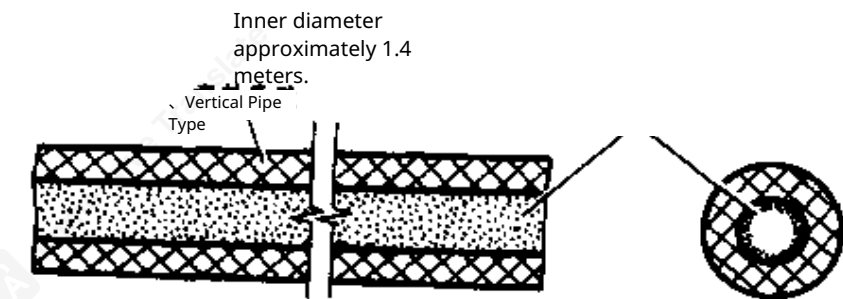


Figure 2-9
Detonating Tube

Detonating tubes are initiated by detonators or dedicated initiators, with a detonation velocity of 1950 m/s (core charge is octolite) or 1650 m/s (core charge is RDX). Both ends of the detonating tube are sealed.

后防水性能良好，明火点燃只能平稳地燃烧；抗静电性能良好。

使用前须检查管壁有无破裂、拉细、折损，管壁内有无水珠或异物，并切取一段进行试爆，传爆良好即可使用。

第三节 炸药、火具的保管、搬运与销毁

第十九条 炸药、火具的保管既要确保安全，又要使其质量不受影响。保管时应注意以下事项。

(一) 炸药、火具仓库的位置应选择在荫蔽、干燥、通风良好的地方。要避开营房、居民地和重要建筑物，安全距离按第一百八十一条计算。

因一处炸药偶然爆炸而引起其他炸药的爆炸，称为殉爆。为防止殉爆，各炸药存放点之间应有一定的安全距离。殉爆安全距离可按下式计算：

1. 雷管对于炸药的殉爆安全距离：

$$r = 0.06 \sqrt{n}$$

式中：r——殉爆安全距离（米）

n——雷管数量（发）

2. 炸药之间的殉爆安全距离：

$$r = K \sqrt{C}$$

式中：r——殉爆安全距离（米）

K——由炸药种类和存放条件决定的系数，见表 2—5。

C——主发炸药数量（千克）

两个炸药（雷管）库可互为主发装药，计算殉爆安全距离时，应以存放量最大的为准。

Good water resistance, only burns steadily when ignited with an open flame; good anti-static performance

Before use, inspect the pipe wall for cracks, thinning, or damage, check for water droplets or foreign objects inside the pipe wall, and cut a section for a test explosion; it may be used only if the detonation is successful.

Section 3: Storage, Transport, and Destruction of Explosives and Fireworks

Article 19: The storage of explosives and fire tools must ensure safety while preventing any impact on their quality. The following precautions should be observed during storage.

(一) The location of explosive and pyrotechnic stores should be chosen in a shaded, dry, and well-ventilated area. It should avoid barracks, residential areas, and important buildings. The safe distance shall be calculated according to Article 81 of the 81tech.com. An explosion of one explosive causing the explosion of other explosives is called a secondary explosion. To prevent secondary explosions, there should be a certain safe distance between each explosive storage point. The secondary explosion safe distance can be calculated as follows:

1. Safety distance for detonator殉explosion of explosives: $I = 0.06 n$

In which: "One殉爆 safety distance (meters)"

n. Number of detonators (rounds)

2. Safety distance for殉爆 between explosives: VC

In which: r—explosive safety distance (meters)

K1—Coefficient determined by the type of explosive and storage conditions, see Table 2-1

C—Main charge quantity (grams)

Two explosive (initiator) magazines can serve as main charge magazines for each other; when calculating the safe distance for殉爆 (殉爆), The one with the largest effective quantity shall prevail.

表 2—5 系数 K 值

K 值 主发装药		被发装药		梯恩梯炸药		高级炸药	
		裸	埋	裸	埋	裸	埋
梯恩梯炸药	裸露的	0.25	0.15	0.40	0.30	0.70	0.55
	埋藏的	0.15	0.10	0.30	0.20	0.55	0.40
高级炸药	裸露的	0.80	0.60	1.20	0.90	2.10	1.60
	埋藏的	0.60	0.40	0.90	0.50	1.60	1.20
说明	裸露的	2.00	1.20	3.20	2.40	5.50	4.40
	埋藏的	1.20	0.80	2.40	1.60	4.40	3.20

1. 裸露放置的炸药，适用于贮存炸药的一般建筑物和裸露堆积的炸药。
2. 埋藏的炸药，适用于炸药放置在防护墙内的情况。

(二) 炸药、火具要分开存放，不同的炸药也要分开放置。要注意防潮、防震、防热、防火和防雷击，并要经常进行检查，发现问题及时处理。

(三) 炸药、火具存放地点应派警戒，严禁烟火和存放易燃品，无关人员不准接近。

第二十条 炸药、火具的搬运应遵守以下规则。

(一) 由人工搬运炸药、火具时：

1. 炸药、火具要分开搬运。
2. 雷管、电雷管须装入雷管盒或原包装内搬运到作业地点，禁止揣在衣袋中。
3. 搬运炸药、火具的人员，应彼此相距 5~10 米，禁止携带火柴、打火机等引火物品。在搬运途中，不准在非指定地点休息或逗留。

(二) 用车辆运输炸药、火具时：

Table 25 Coefficient
K value

K value		TNT Explosive		TNT Explosive		TNT Explosive	
		裸	埋	裸	埋	裸	埋
TNT Explosive	裸露的	0.25	0.15	0.40	0.30	0.70	0.55
	埋藏的	0.15	0.10	0.30	0.20	0.55	0.40
TNT Explosive	裸露的	0.80	0.60	1.20	0.90	2.10	1.60
	埋藏的	0.60	0.40	0.90	0.50	1.60	1.20
TNT Explosive	裸露的	2.00	1.20	3.20	2.40	5.50	4.40
	埋藏的	1.20	0.80	2.40	1.60	4.40	3.20

1. Explosives stored openly, suitable for general storage buildings and open stockpiles of explosives. ecnc

2. Buried explosives, suitable for situations where explosives are placed inside a protective wall.

(2) Explosives and detonators must be stored separately, and different types of explosives must also be kept apart. Pay attention to moisture protection, shock protection, heat protection, fire prevention, and lightning protection, and conduct regular inspections.

Address issues promptly upon discovery.

(Lan) Locations for storing explosives and pyrotechnic devices must be guarded; smoking and fire are strictly prohibited, and flammable materials must not be stored. Irrelevant personnel are not allowed to approach.

Article 20: The transportation of explosives and pyrotechnic devices shall comply with the following rules.

(1) When transporting explosives and firework tools manually:

1. Explosives and pyrotechnic devices must be transported separately.
2. Detonators and electric detonators must be transported to the work site in detonator boxes or their original packaging.

Forbidden in pockets.

3. Personnel transporting explosives or ignition devices shall maintain a distance of 5~10 meters from each other and are prohibited from carrying matches, lighters, or other fire-starting items. During transport, no resting or lingering is permitted except at designated locations.

(2) When transporting explosives and pyrotechnic articles by vehicle:

1. 装、卸车时要谨慎小心，轻抬轻放。炸药、火具在车上要用绳索固定牢固，避免碰撞。

2. 炸药、火具禁止在同一车、船上运输。在特殊情况下，经上级批准，炸药与起爆器材可以同车、船运输，其数量不得超过：炸药 1000 千克，雷管 1000 发，导爆索 2000 米，导火索 2000 米；雷管必须装在内壁衬有软垫的专用保险箱里并紧固于车、船前部；炸药不得放在雷管箱上。

3. 车辆在行驶中应保持一定的距离。在平坦道路上行驶时，相距不小于 50 米；在山地道路上行驶时，相距不小于 300 米。

4. 途中休息时，要注意检查和警戒，停车地点要离开居民点和桥梁等重要建筑物 200 米以上。

5. 运输炸药、火具的车辆，除警卫人员外，不得搭乘其他人员。

第二十一条 炸药、火具的销毁应遵守以下规则。

(一) 炸药可采用爆炸、燃烧和溶解等方法销毁。

1. 条件允许时，应选择远离居民区、建筑物的空旷地形，将待销毁的炸药堆放在一起，将梯恩梯药块直接设置在炸药上起爆销毁。若数量较大时可分成数堆（每堆数量视安全距离而定，但不超过 20 千克）销毁，堆与堆之间距离以互不影响为准。销毁场地四周的易燃物、杂草和碎石应清除干净。安全距离按第一百八十一条计算确定。

2. 采用燃烧的方法销毁炸药时，应将炸药在地面铺成宽度不大于 30 厘米、厚度不大于 5 厘米的长条形燃烧带，并在下风处点燃。当一次销毁数量较大时，应将炸药铺成数条燃烧带，带距不小于 5 米，一次点燃不超过 3 条燃烧带。

采用燃烧的方法销毁炸药只适应于梯恩梯、硝铵及黑火药等；起爆药及黑索金等感度较高的炸药不得使用此法销毁。

3. 硝铵炸药、黑火药等，可投入水中与水充分混合，使之失效。条件允许时，可投入流水中冲走。

1. When loading and unloading, proceed with caution, lifting and placing gently. Explosives and ignition tools on the vehicle

Use ropes to secure it and avoid collisions.

2. Explosives and pyrotechnic devices are prohibited from being transported on the same vehicle or vessel. In special circumstances, with approval from higher authorities, explosives and detonating devices may be transported on the same vehicle or vessel, but their quantities must not exceed: 1000 kg of explosives, 1000 detonators, 2000 meters of detonating cord, and 2000 meters of fuse; detonators must be placed in a special safe with a soft lining on the inner wall and securely fastened to the front of the vehicle or vessel; explosives must not be placed on the detonator box.

3. While driving, maintain a safe distance. When driving on flat roads at least 50 meters; on mountain roads, at least 300 meters.

4. During rest stops, pay attention to inspecting and monitoring the vehicle; parking locations must be at least 200 meters away from residential areas, bridges, and other important buildings.

5. Vehicles transporting explosives or pyrotechnic devices may not carry other passengers except for security personnel.

Article 31. The destruction of explosives and pyrotechnic devices shall comply with the following rules.

(1) Explosives may be destroyed by methods such as explosion, combustion, and dissolution.

1. When conditions permit, select an open terrain far from residential areas and buildings, pile the explosives to be destroyed together, and detonate and destroy them by directly placing TNT blocks on the explosives. If the quantity is large, divide them into several piles (the number of items per pile depends on the safe distance, but shall not exceed 20 kilograms); the distance between piles shall be sufficient so that they do not affect each other. All flammable materials, weeds, and rubble around the destruction site shall be cleared. The safe distance shall be calculated and determined in accordance with Article 181.

2. When destroying explosives by burning, the explosives should be spread on the ground in a long strip with a width not exceeding 30 cm and a thickness not exceeding 5 cm, and ignited at the downwind end. When the quantity to be destroyed in one operation is large, the explosives should be spread in several burning strips, with a distance between strips of not less than 5 m, and no more than three strips should be ignited at one time.

The method of destruction by burning is only suitable for explosives such as TNT, ammonium nitrate, and black powder; high-sensitivity explosives such as initiators and RDX shall not be destroyed by this method.

3. Ammonium nitrate explosives, black powder, etc., can be thrown into water and thoroughly mixed with it to render them ineffective. If conditions permit, they can be thrown into flowing water to be washed away.

(二) 火具的销毁应分别类型采取相应的办法。

1. 各种雷管、导爆索等通常采用爆炸的方法销毁，严禁使用燃烧的方法销毁。

2. 导火索、导爆管、拉火管等可采用燃烧的方法销毁。

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(2) The destruction of fire tools shall be carried out according to appropriate measures for each type.

1. Detonators, detonating cords, and similar items are usually destroyed by explosion; burning methods are strictly prohibited.

2. Fuses, detonating tubes, and pull tubes, etc., may be destroyed by burning.

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第三章 起爆与传爆法

第二十二条 起爆装药通常采用点火管起爆法、导爆索传爆法、导爆管传爆法、电起爆法和遥控起爆法。起爆与传爆法是爆破作业的基础之一，是准确可靠地完成爆破任务的重要环节。

第一节 点火管起爆法

第二十三条 点火管起爆法是用点火管起爆装药的一种方法。所需器材少，作业简便，在爆破作业中运用广泛，但不能同时起爆多个装药。

第二十四条 点火管由导火索和火雷管制成。点火管的制作应按以下步骤和方法实施。

(一) 检查火雷管和导火索是否良好。

(二) 切取导火索。导火索插入火雷管的一端要切平；切取的长度应保证点火手能在导火索燃烧的时间内退至安全地点，一般不小于 10 厘米。

(三) 将导火索谨慎地插入火雷管内（图 3—1），直到与加强帽接触为止。插入时不准挤压和转动。

(四) 用雷管钳将火雷管固定在导火索上。固定时，应使雷管钳的侧面与雷管口相平（图 3—2），慢慢夹紧；使用其他工具时，可在距雷管口 5 毫米处夹紧。夹紧时不可用力过猛，以免损伤芯药，影响传火。当点火管的导火索较短时，应在雷管和导火索的接续部位用胶布包缠，以防拉火管口喷出的火焰由缝隙直接射入雷管内而发生误爆。点火管制作好后如不立即使用或在潮湿

Chapter 3 起爆与传爆法

Article 22: Blasting charges are typically detonated using the detonator tube method, blasting cord transmission method, suspended intelligent transmission method, electric blasting method, or remote control blasting method. The detonation and transmission methods form the foundation of blasting operations and are a critical link in accurately and reliably completing blasting tasks.

First-stage detonation tube initiation method

81tech.com **第二十三条** 点火起爆法是用点火管起爆装药的种方, few devices, simple operation, widely used in blasting operations, but cannot detonate multiple charges simultaneously.

Article 14: The ignition pipe shall be made of fuse and firework materials. The manufacture of the ignition pipe shall be carried out according to the following steps and methods:

(1) Check the safety of the fire fuse and fuse cord.

(-2) Pull the fuse: The end of the fuse inserted into the fuse detonator must be cut flat; cut out

The length is guaranteed to allow the ignition hand to retreat to a safe location within the time the fuse burns.

not less than 10
centimeters.

() Carefully insert the fuse into the fuse tube (Fig. 3-1) until it contacts the booster cap. Do not push, squeeze, or rotate during insertion.

(4) Use a detonator pliers to secure the detonator to the fuse. When securing, align the side of the pliers with the mouth of the detonator (Figure 3-2) and tighten slowly; when using other tools, tighten at a distance of 5 mm from the mouth of the detonator. Do not apply excessive force during tightening to avoid damaging the core powder and affecting ignition. When the fuse on the ignition pipe is short, wrap the junction between the detonator and the fuse with tape to prevent the flame ejected from the mouth of the ignition pipe from entering the detonator through gaps and causing accidental detonation. After the ignition pipe is manufactured, if it is not used immediately or in humid conditions,

地区作业，也应缠以胶布，以防受潮。

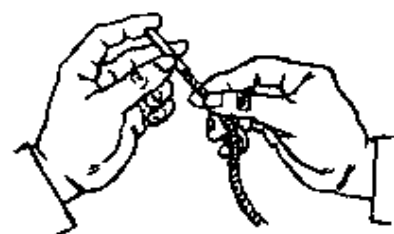


图 3—1
将导火索插入火雷管内



图 3—2 夹紧雷管口

第二十五条 点火管必须牢固、确实地固定在装药上。先将点火管插入装药的雷管孔内，然后用细绳加以捆扎，对非携带式装药还可使用木片谨慎地塞入雷管与雷管孔的间隙内，将其卡紧。固定时，应使雷管确实插到雷管孔底。

第二十六条 点火管通常用拉火管、火柴或雷管钳上的打火机点燃。

(一) 用拉火管点燃时，应先将点火管导火索端部切平。使用塑料拉火管时，应将导火索插入管内 20~25 毫米；使用纸拉火管时，应将导火索插过倒刺，以防脱落。拉火时，一手握紧拉火管，一手用力拉出拉火丝，看见冒烟并听到导火索点燃后的喷火声时，即已点燃（图 3—3）。



图 3—3
用拉火管点燃导火索

(二) 用火柴点燃时，应先将点火管导火索端部斜切，使火柴头紧贴芯药（图 3—4），然后擦火，当看到导火索喷出火星时，方可松手。

(三) 用雷管钳上的打火机点燃时，应先将点火管导火索端部切平，插入打火机的圆孔内，然后打火（图 3—5）。

Regional work should also be wrapped in tape to prevent moisture absorption.

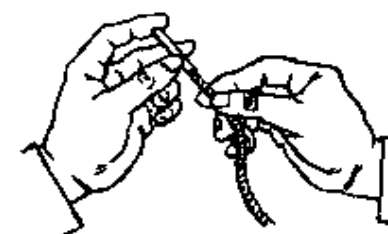


Figure 3-1
Insert the fuse into the fuse tube.



Figure 3-2 Clamping the detonator mouth

Article 25. The igniter tube must be firmly and securely fixed to the charge. First, insert the igniter tube into the detonator hole of the charge, then tie it tightly with a thin cord. For non-portable charges, carefully wedge a piece of wood into the gap between the detonator and the detonator hole to secure it. When fixing, ensure the detonator is firmly inserted to the bottom of the detonator hole.

Article 26 The ignition pipe is usually ignited using a striker, a match, or a lighter from a blasting cap holder.

(一) When lighting with a flint striker, first light the
Cut the end of the primer tube flat. Use a plastic striker tube.
At this time, the fuse should be inserted into the pipe 20~25 millimeters;
When using a paper pull-fire tube, insert the fuse through
the spike to prevent it from falling out. When pulling the
fuse, hold the pull-fire firmly with one hand.
tube, pull the fuse with one hand, and ignite
when you see the stacked smoke and hear the
sound of the fuse igniting (Fig. 3-3).



Ignite the fuse with a
striker rod.

(二) When lighting with a match, first cut the end of the fuse of the striker obliquely so that the match head is tightly pressed against the primer (Fig. 3-4), then strike it. Only release your hand when sparks are seen shooting out from the fuse.

(3) When lighting with a lighter from the blasting cap holder, first ignite the fuse at the detonator end.
Push the lighter into the round hole, then light it (Figure 3)



图 3—4
用火柴点燃导火索

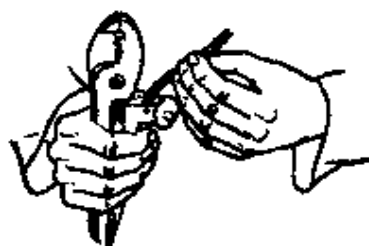


图 3—5
用七寸管钳点燃导火索

此外，还可燃着的导火索、香火、电石灯等点燃。

第二十七条 采用点火管起爆法时应注意以下事项。

(一) 当一次起爆两个以上装药时，应以最后一个被点燃的点火管的导火索长度作为计算安全撤离时间的依据。

(二) 当两人以上同时作业时，应指定一人负责，明确起爆顺序，规定撤离路线，保证安全。

(三) 在含有瓦斯、沼气、粉尘等具有爆炸危险的场合禁止使用点火管起爆法。

第二节 导爆索传爆法

第二十八条 导爆索传爆法是利用点火管或电雷管起爆导爆索线路，使其在瞬间同时传爆多个装药的方法。

第二十九条 用导爆索同时起爆数个装药时，常用串联、并联和混联三种基本形式构成导爆索线路（图 3—6）。

第三十条 导爆索需要接长时，可将两根导爆索的一端并在一起，用细绳或胶布捆扎起来，接续部的长度应不小于 10 厘米；也可用对钩结接续。如果将支路上的导爆索接到干线上，可用云雀结接续（图 3—7）。对钩结和云雀结的结扣要抽紧，以防松脱而影响传爆。

第三十一条 导爆索与装药连结时，应在导爆索插入装药的



Figure 3-4
Light the fuse with a match



Use a seven-inch pipe wrench to light the fuse.

In addition, it can also be ignited using a burning fuse, incense, or an acetylene lamp.

Article 27 When using the detonation method with a firing tube, the following precautions should be observed.

(1) When more than one charge is detonated in a single operation, the length of the fuse of the last ignited fuse tube shall be used as the basis for calculating the safe evacuation time.

(2) When two or more persons work simultaneously, one person shall be designated in charge, the blasting sequence shall be clearly defined, evacuation routes shall be specified, and safety shall be ensured.

(3) Prohibited in areas containing gas, biogas, dust, and other explosive hazards.

Use the detonation method with a firing tube.

Section 2: Detonation Cord Initiation Method

Article 28. The detonating cord initiation method uses a firing tube or electric detonator to initiate the detonating cord.

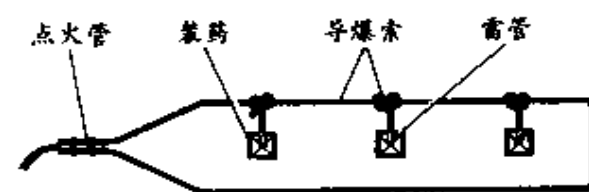
method of connecting a fuse line to detonate multiple charges simultaneously in an instant 去。

Article 29 When using detonating cord to simultaneously initiate several charges, series and parallel connections are commonly used.

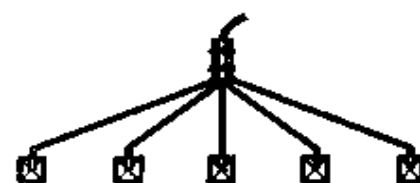
The three basic forms of series, parallel, and mixed configurations constitute the detonating cord circuit (Figure 3-6).

Article 30: When extending detonating cords, the two ends of two detonating cords may be joined together and tied with a thin rope or adhesive tape; the length of the joint shall not be less than 10 cm. Alternatively, a double hook knot may be used for joining. If a detonating cord on a branch line is connected to the main line, it may be joined using a crow's foot knot (Figure 3-17). The knots of the double hook knot and the crow's foot knot must be tightened to prevent loosening and affecting detonation transmission.

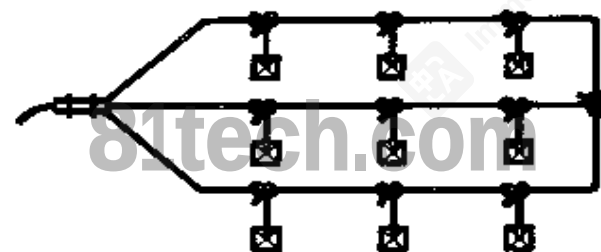
Article 31 When connecting detonating cord to the charge, the detonating cord shall be inserted into the charge at



(一) 串联线路

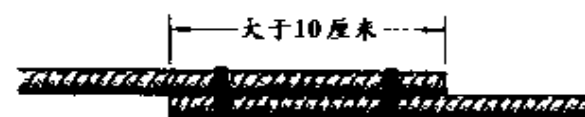


(二) 并联线路



(三) 混联线路

图 3—6 导爆索线路



(一) 用细绳捆扎



(二) 对钩结



(三) 云雀结

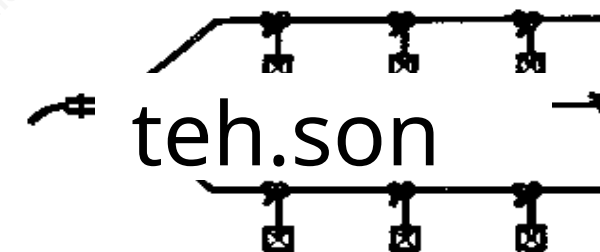
图 3—7 导爆索的接续



(I) Series circuit

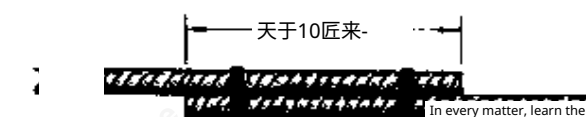


(II) Parallel Lines



(3) Hybrid Domain Road

Figure 3—6 detonating cord line



(一)



(II) Checkpoint T



(3) Lark Station

Figure 3-7 Splicing of detonating cord

一端装上 1 发火雷管；也可不装火雷管而将导爆索在药块上紧密缠绕 4~5 圈。起爆粉状装药时，可将导爆索折叠 2~4 股扎紧或打数个结扣放入装药中（图 3—8）。

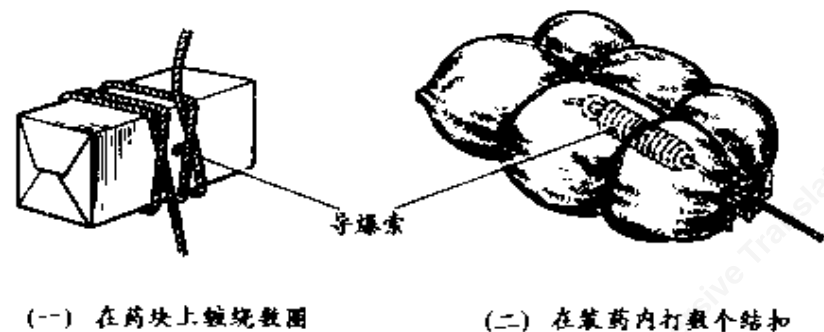


图 3—8 导爆索与装药的连结

第三十二条 导爆索
线路的敷设应按设置装药、敷设干线网路、用支线连接装药与干线的顺序实施。

第三十三条 导爆索
线路必须用点火管或电雷管起爆。1 发雷管起爆 1~6 根导爆索；当导爆索超过 6 根时，可将导爆索捆在药块上，然后用点火管或电雷管起爆药块（图 3—9）。

导爆索与雷管或药块的连结部分，应用胶布或细绳扎紧。

第三十四条 敷设导爆索线路应注意以下事项。

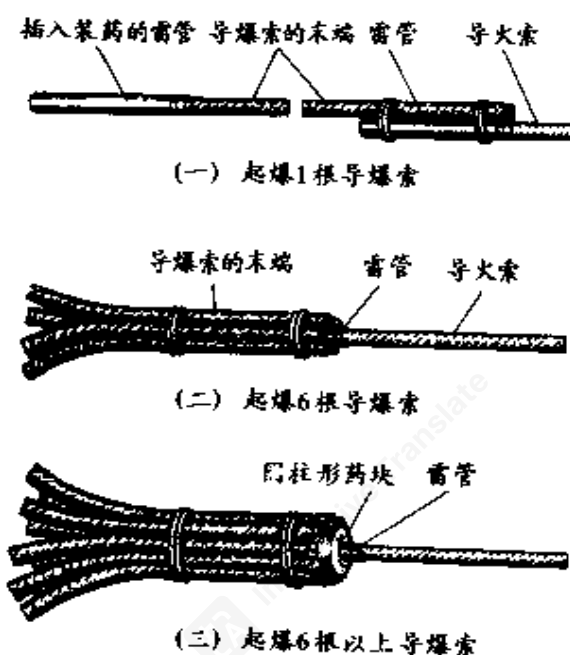


图 3—9 导爆索的起爆

Install one detonator on the end; alternatively, do not install a detonator and tightly wind the detonating cord around the explosive charge 4~5 times. When initiating powder charges, the detonating cord may be folded into 2~4 strands and tied tightly or knotted several times before being placed in the charge (Figure 3-8).

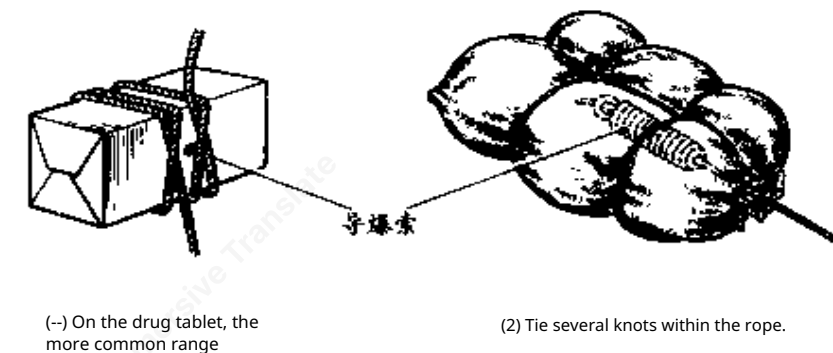


Figure 3-8 Connection of the detonator and the charge

The laying of detonating cord lines shall be implemented in the sequence of setting up the charge, laying the network, and connecting the charge to the line with branch lines.

Article 33 Detonating Cord. The detonating cord circuit must be initiated by a firing fuse or an electric detonator. One detonator can initiate 1~6 detonating cords; when the number of detonating cords exceeds 6, the detonating cords may be bundled onto a charge block and then initiated by a firing fuse or an electric detonator (Figure 3-9).

The connection between the detonating cord and the detonator or explosive block shall be tightly bound with tape or a thin cord.

Article 34. When laying explosive wire lines, the following precautions should be observed.

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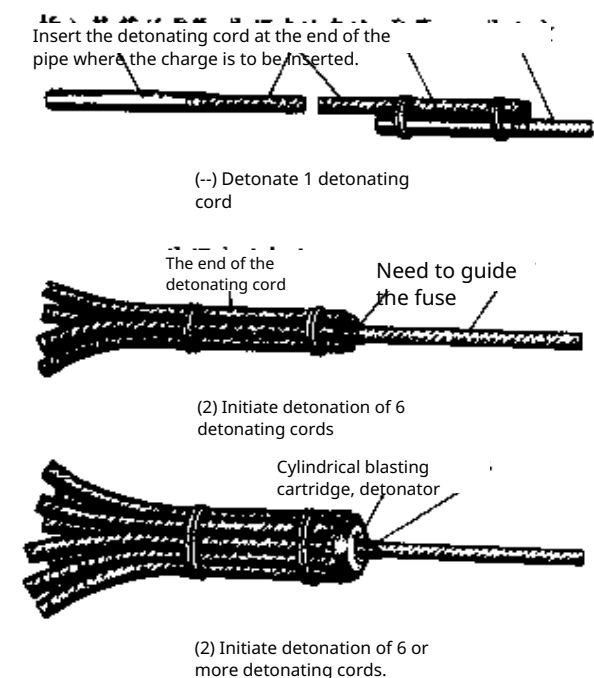


Figure 3—Initiation of detonating cord 9

(一) 在潮湿天气或水中使用导爆索时, 其末端必须用胶布裹紧并浸以防潮剂。

(二) 为了使串联或混联线路中所有装药可靠起爆, 应将线路闭合起来。

(三) 用点火管或电雷管同时起爆数根导爆索时, 各导爆索的传爆方向要一致, 以免与传爆方向相反的导爆索可能被炸断 (图 3—10), 造成传爆中断。



图 3—10 导爆索的传爆方向

(四) 线路中的导爆索不得互相接触, 也不得与相邻的装药接触; 不要过分拉紧, 也不得形成环圈。

(五) 导爆索必须用雷管钳或快刀切取。切取时, 应先将整卷的导爆索展开一部分, 使截取处至未展开处的长度不小于 10 米。

(六) 导爆索不应在烈日下长时间暴晒; 经烈日暴晒过的导爆索, 应就地销毁, 不得收回库存。

第三节 导爆管传爆法

第三十五条 导爆管传爆法是利用专用起爆器或点火管、电雷管起爆导爆管线路, 使其在瞬间同时传爆多个装药的方法。

第三十六条 用导爆管同时起爆数个装药时, 常用串联、并

(一) When using detonating cord in damp weather or water, its ends must be covered with tape.

Wrap tightly and immerse in a moisture-proofing agent.

(二) (1) To ensure reliable detonation of all charges in series or parallel circuits, the wire should be closed.

The road is closed.

(三) (1) When detonating multiple detonating cords simultaneously with a firing fuse or electric detonator, the direction of detonation for each cord must be consistent to prevent the possibility of a cord detonating in the opposite direction and breaking (Fig. 3-10), which could interrupt the detonation sequence.

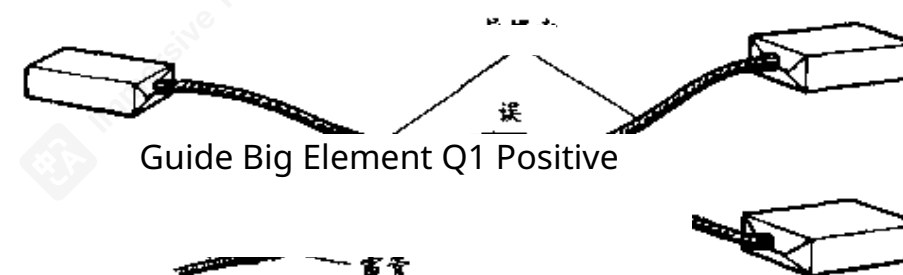


Figure 3-10 Direction of detonation transmission of detonating cord

(四) 线路中的导爆索不得互相接触, 也不得与相邻的装药接触; 不要过分拉紧, 也不得形成环圈。

(五) 导爆索必须用雷管钳或快刀切取。切取时, 应先将整卷的导爆索展开一部分, 使截取处至未展开处的长度不小于 10 米。

(六) Explosive fuse shall not be exposed to direct sunlight for prolonged periods; explosive fuses that have been exposed to direct sunlight must be destroyed on-site and shall not be returned to inventory.

Section 3: Detonation Tube Initiation Method

Article 35 The detonating tube initiation method utilizes a dedicated initiator or a firing tube with electric detonators to initiate the detonating tube circuit.

A method to detonate multiple charges simultaneously in an instant.
Article 36 When detonating multiple charges simultaneously using detonating tubes, it is common

联和混联三种基本形式构成导爆管线路（图 3—11、图 3—12 和图 3—13）。

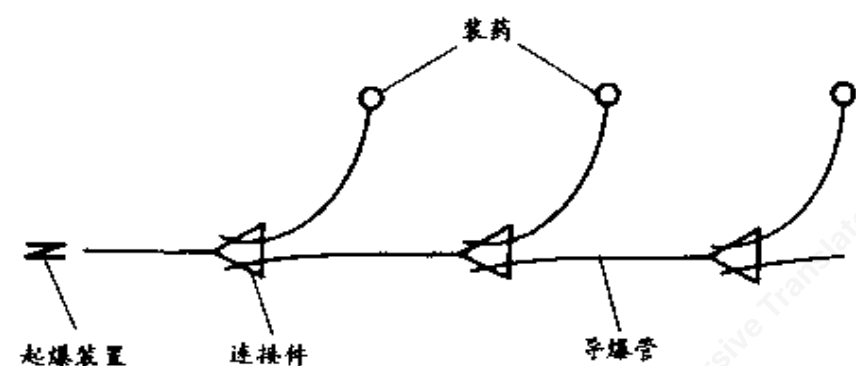


图 3—11 导爆管串联线路

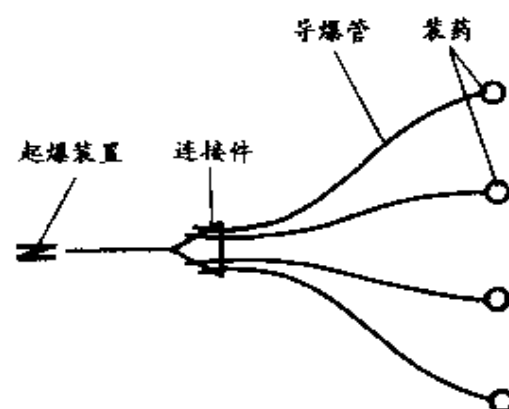


图 3—12 导爆管并联线路

第三十七条 导爆管线路的接续应使用专用连接元件（图 3—14、图 3—15）或用雷管分级起爆的方法实施。

第三十八条 导爆管与装药的连结，必须在导爆管起爆装药的一端，用 8 号火雷管或毫秒延期火雷管通过卡口塞（图 3—16）连接后插入装药中。

Series, parallel, and mixed series-parallel configurations form the detonating tube circuit (Figures 3-11, 3-12, and 3-13).

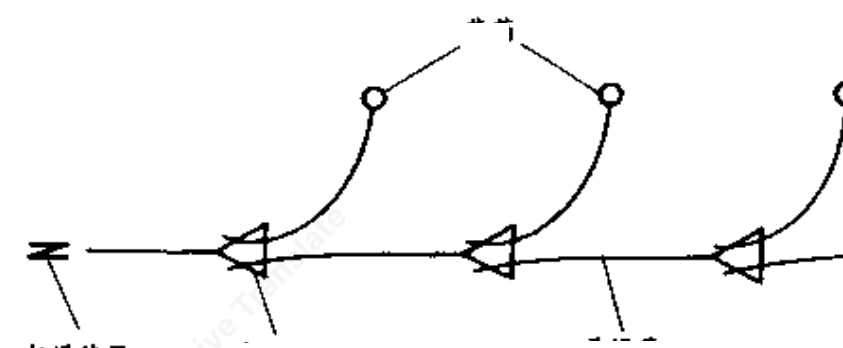


Figure 38—11 Detonating Tube Series Circuit

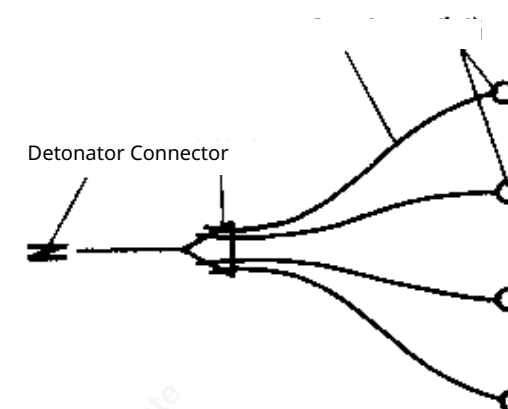


Figure 3-12 Detonator Arm Parallel Circuit

Article 37. The splicing of detonating tube lines shall be carried out using special connecting elements (see Figures 3-14 and 3-15) or by using the method of staged initiation with detonators.

Article 38: The connection between detonating tubes and charges must be made at the end of the detonating tube that initiates the charge, using No. 8 detonators or millisecond-delayed detonators connected via a locking plug (Figure 3-16), and then inserted into the charge.

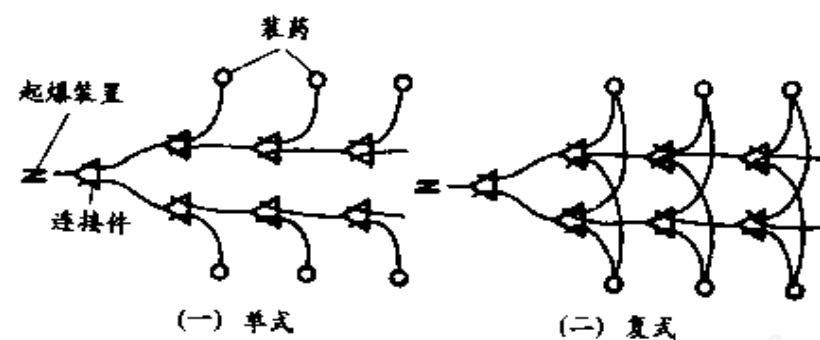


图 3—13 导爆管混联线路

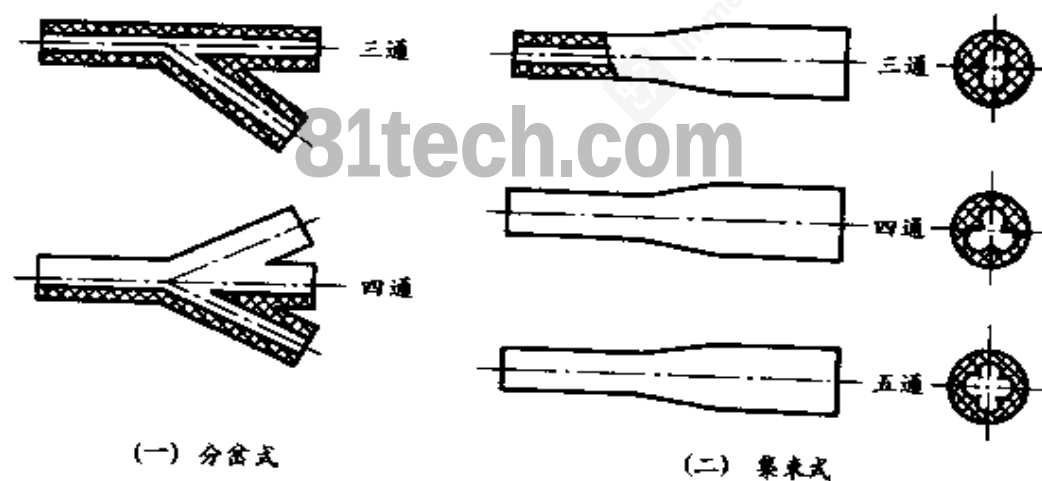


图 3—14 塑料连通管

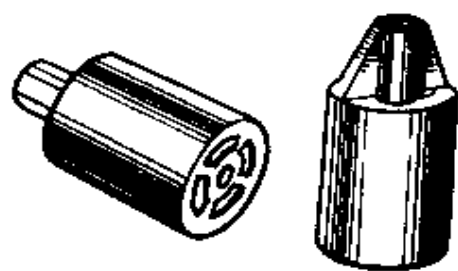


图 3—15 连接块



图 3—16 卡口塞

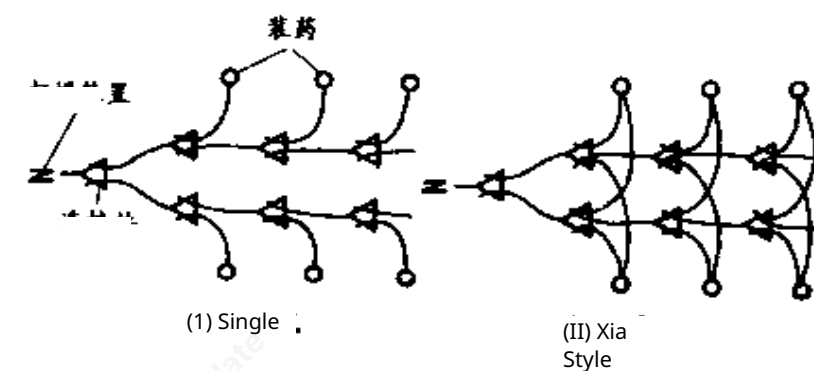


Figure 3-13 Detonator parallel and series circuit

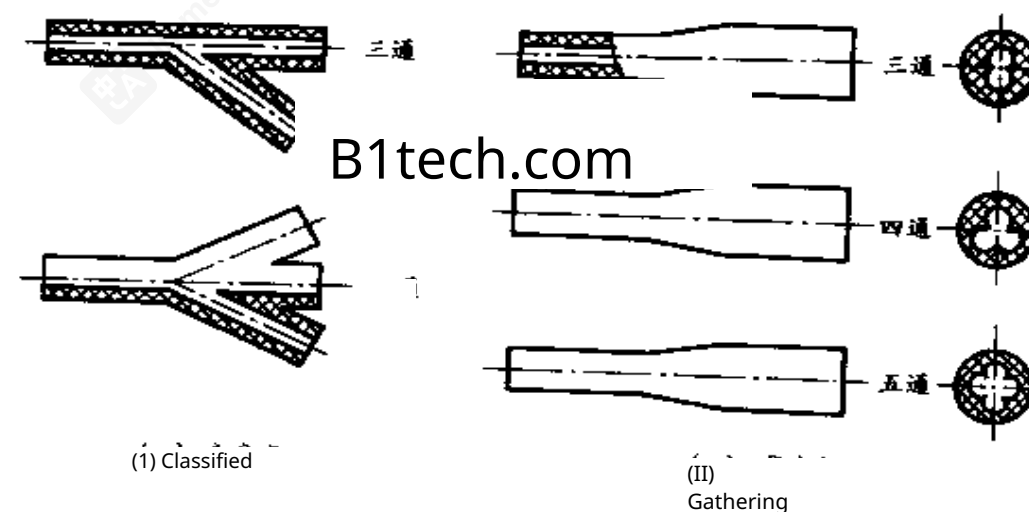


Figure 3-14 Plastic connecting pipe

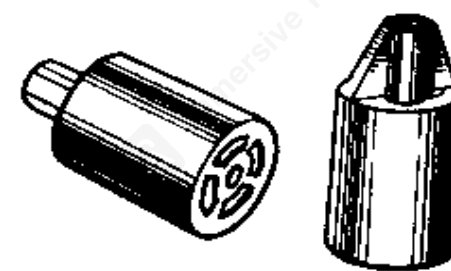


Figure 3-15



Figure 3—16 collar plug

第三十九条 导爆管线路的敷设，应按设置装药、起爆支线、传爆干线的顺序实施。

第四十条 导爆管线路用点火管或电雷管起爆，也可用专用起爆器起爆。当用点火管或电雷管起爆时，1发8号火雷管或电雷管最多可同时起爆40根导爆管，导爆管必须紧密、确实地固定在雷管周壁上。

第四十一条 敷设导爆管线路应注意以下事项。

(一) 导爆管在使用前应进行外观检查，如有破损、拉细、压扁等现象，均应剪去，不得使用。

(二) 敷设线路时，不得使导爆管扭结、打结或拉细变形，以免影响传爆可靠性。

(三) 导爆管与雷管、连接元件的连接处应接续确实，并用胶布包缠，严防砂土、水或其他杂物进入导爆管中造成拒爆。

(四) 用雷管起爆导爆管时，应先将雷管用胶布缠3~4层，再反向捆扎上导爆管（图3—17），然后在其外缠上不少于3层

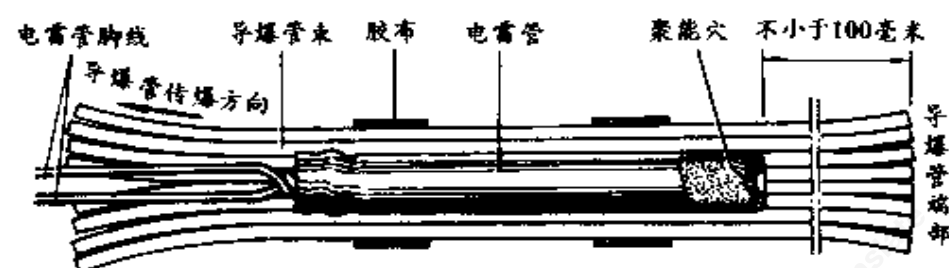


图3—17 导爆管的反向起爆

胶布，以防雷管爆炸时的冲击波和破片破坏管壁，造成拒爆。

(五) 导爆管用于药孔爆破时，禁止使用反向装药；填塞时，导爆管要紧贴孔壁，防止装填时捣伤管体或使导爆管在孔内扭结。

(六) 禁止在一条线路里用两发以上秒延期雷管起爆导爆管，

Article 39: The installation of detonating tube lines shall be carried out in the sequence of setting charges, connecting detonating branch lines, and laying the main detonating line.

Article 40: Detonating blasting tube lines can be done using ignition tubes or electric detonators, or with a dedicated detonator. When using ignition tubes or electric detonators, one No. 8 detonator or electric detonator may simultaneously detonate a maximum of 40 blasting tubes, and the blasting tubes must be firmly and securely fixed to the casing of the detonator.

Article 41 When laying detonating tube lines, the following precautions should be observed:

(1) Before use, the detonation tube shall be inspected for external damage. If any cracks, thinning, or deformation are observed, the affected portion shall be cut off, and the tube shall not be used.

(2) When laying the line, do not twist, knot, or thin and deform the detonating tube, as this may affect the reliability of detonation:

(3) The connection between the detonating tube and the detonator connecting element must be secure and wrapped with tape to prevent sand, soil, water, or other foreign objects from entering the detonating tube, which could cause a failure to detonate.

(4) When initiating detonation of the detonating tube with a detonator, first wrap the detonator with adhesive tape 3~4 times, then bind it in reverse [detonating tube (Figure 3-17), and then wrap at least 3 layers around that area.

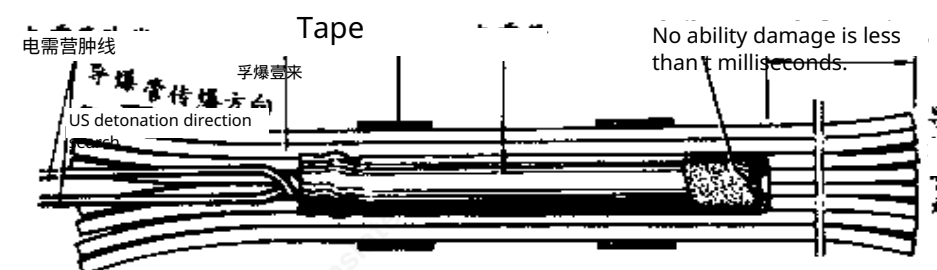


Figure 3-17 Reverse blasting of detonating tubes

Tape, to prevent the shockwave and fragments from the detonation of the detonator from damaging the pipe wall and causing a failure to explode.

(5) When using detonating tubes for blasting in charge holes, reverse charging is prohibited. During packing, the detonating tube must be pressed tightly against the hole wall to prevent damage to the tube body or twisting of the detonating tube within the hole during filling.

(六) 禁止在一条线路里用两发以上秒延期雷管起爆导爆管，

以防先起爆的装药将未爆线路炸断，造成拒爆。

第四节 电起爆法

第四十二条 电起爆法是利用电源所产生的电流，起爆电雷管而使装药爆炸的方法。运用电起爆法可以隐蔽在安全地点起爆较远距离上的预设装药，并可准确地同时或逐次起爆多个装药。但所需器材较多，作业较复杂。实施电起爆所需要的器材有电雷管、检测仪表、导电线和电源。

第四十三条 实施电起爆专用的检测仪表有 205 型欧姆表和 205-1 型欧姆表。

(-) 205 型欧姆表 (图 3-18)：用于精确测定电雷管、导电线及电起爆线路的电阻；其测定范围为 0.2 ~ 5000 欧姆。

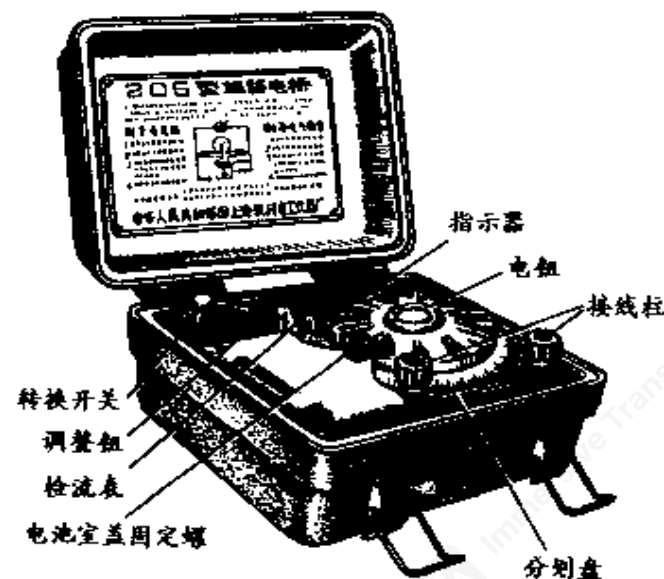


图 3—18 205 型欧姆表

1. 使用方法：

(1) 打开盖子，将表放平，缓慢地转动调整钮，使检流表指

To prevent the detonation of the initial charge from breaking the unexploded wire, causing a failure to detonate.

Section 4: Electric Initiation Method

Article 42. The electric initiation method is a method that uses the current generated by a power source to initiate electric detonators, causing the charge to explode. The use of the electric initiation method allows for the initiation of preset charges at a greater distance from a concealed safe location, and enables multiple charges to be initiated simultaneously or sequentially with high accuracy. However, it requires a larger number of equipment and more complex operations. The equipment required for implementing electric initiation includes electric detonators, testing instruments, conductive wires, and a power source.

Article 43: The dedicated detection instruments for electric blasting include the 205 ohmmeter and 205-1 Ohmmeter

(-)205 ohmmeter (Figure 3-18): Used for precise measurement of the resistance of electric detonators, lead wires, and electric blasting circuits, with a measurement range of 0.2-5000 ohms.

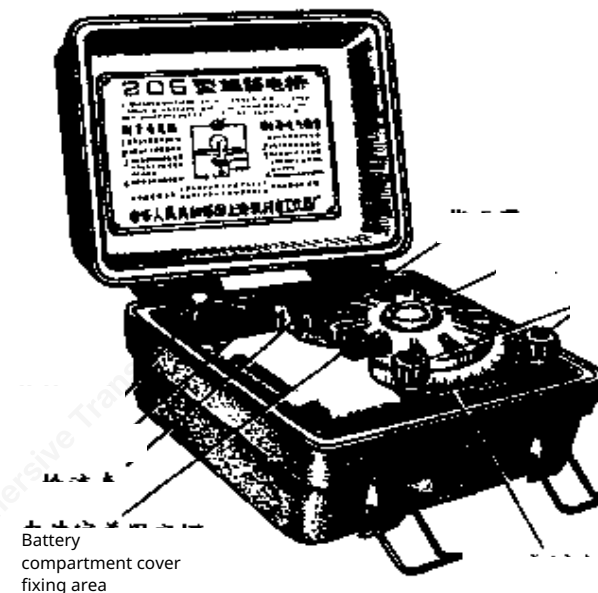


Figure 3—18205 Ohmmeter

1. Usage:

(1) 打开盖子，将表放平，缓慢地转动调整钮，使检流表指针
(1) Open the lid, lay the watch flat, and slowly turn the adjustment knob until the flowmeter pointer

针对正中间黑线。

(2) 转动转换开关。如测量 20 欧姆以下的电阻时，应转向标有“电雷管”字样的方向；如测量 20 欧姆以上的电阻时，则转向标有“导电线”字样的方向。

(3) 将要测量的电阻接到接线柱上（注意线头不得彼此互相接触或与表壳接触）；按下电钮，同时转动分划盘，直到检流表指针回到中间黑线上时，松开电钮。

(4) 判读电阻数。测量 20 欧姆以下的电阻时，判读分划盘外圈对正指示器的数字；测量 20 欧姆以上的电阻时，判读分划盘内圈对正指示器的数字。

(5) 用完后，将转换开关转回中间位置，关好盖子。

2. 检查方法：用 1 根短导电线（电阻小于 0.2 欧姆）连接两接线柱，把转换开关转向“电雷管”方向，然后按下电钮，检流表指针应向左偏转，如指针不动或偏转很小，须更换新电池再进行检查，如指针仍不偏转，则表明该表有故障。

经检查确认欧姆表无故障时，再按第十四条规定的防险措施，将电雷管接到欧姆表上，如按下电钮后电雷管不爆炸，则该表良好，否则不能使用。

(二) 205—1 型欧姆表（图 3—19）：用于精确测量电雷管、导电线及电起爆线路的电阻；其测定范围为 0 ~ 3000 欧姆。

1. 使用方法：

(1) 打开盖子，将表放平，旋转调整器，使指针指向“∞”。

(2) 转动转换开关。测量电雷管电阻时，旋至“3Ω”或“9Ω”档上；测量导电线或电起爆线路的电阻（大于 9 欧姆）时，旋至“导电线”档上。

(3) 旋转校准旋钮，使指针指向“0Ω”（即对准 Δ 中间）。

(4) 接上待测电阻，判读电阻数。导线的一端接在接线柱上，另一端用手按在接线按钮上。测量电雷管电阻时，判读与指针重合的第一条或第二条刻度上的数字；测量导电线或电起爆线

— 32 —

For the black in the exact center

(2) Range switch. When measuring a resistance of less than 20 ohms, turn the switch to the position marked "Electric Fuse"; when measuring a resistance of more than 20 ohms, turn it to the position marked "Conductor Wire".

(3) Connect the resistance to be measured to the terminals (note that the wire ends must not touch each other or the instrument case); press the battery button, while simultaneously rotating the scale disc, until the galvanometer pointer returns to the central black line, then release the button.

(4) Read the resistance value. When measuring resistances below 20 ohms, read the number on the outer ring of the scale that aligns with the indicator; when measuring resistances above 20 ohms, read the number on the inner ring of the scale that aligns with the indicator.

(5) After completing the work, return the conversion switch to the middle position, and close the lid.

2. Inspection method: Connect two terminals with a short wire (resistance less than 0.2 ohms), switch the conversion switch to the "electric detonator" position, then press the button. The galvanometer pointer should deflect to the left. If the pointer remains stationary or deflects very little, replace the battery and recheck. If the pointer still does not deflect, the instrument is faulty.

When inspection confirms that the ohmmeter is fault-free, connect the electric detonator tube to the ohmmeter in accordance with the safety measures specified in Article 14. If the electric detonator tube does not explode when the button is pressed, the ohmmeter is in good condition; otherwise, it cannot be used.

(2) 205-1 ohmmeter (Fig. 3-19): Used for precise measurement of electric detonators, Resistance of the current-carrying wire and electric detonation circuit; the measurement range is 0 ~ 3000 ohms.

1. Usage:

(1) Open the lid, lay the watch flat, and rotate the adjuster until the pointer points to "∞".

(2) Turn the conversion switch. When measuring the resistance of wall electric detonators, rotate it to the "32" or "92" position; when measuring the resistance of a conductive wire or electric blasting circuit (greater than 9 ohms), rotate it to the "Conductive Wire" position.

(3) Rotate the calibration knob so that the pointer points to "02" (i.e., align with the center of A).

(4) Connect the test resistor and read the resistance value. Connect one end of the wire to the terminal and press the other end against the connection button. When measuring the resistance of an electric detonator, read the number corresponding to the first or second scale; when measuring the resistance of a wire or electric blasting lead, read the number corresponding to the first or second scale.

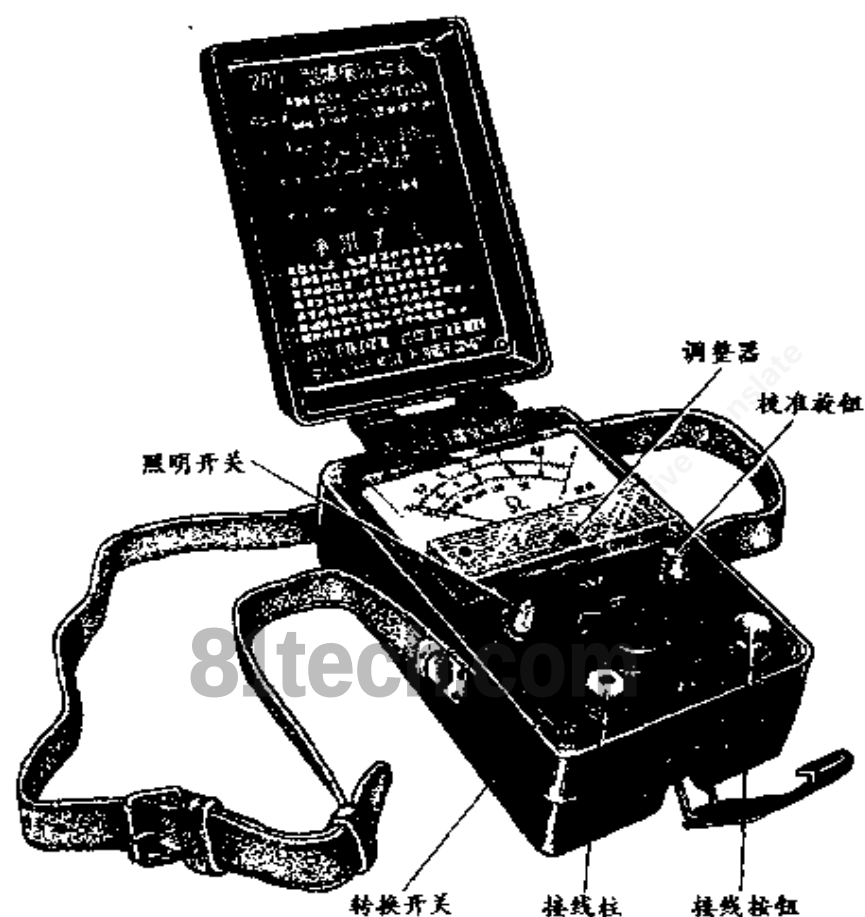


图 3—19 205—1 型欧姆表

路的电阻时，判读与指针重合的第三条刻度上的数字。

(5) 用完后，将转换开关转回“关”的位置，关好盖子。

夜间测量时，应先打开照明开关，然后按上述方法操作。使用完毕后关闭照明开关。

2. 检查方法：首先检查指针是否指向“ ∞ ”，旋转调整器，使其指向“ ∞ ”；然后打开转换开关（旋至任意一档上），旋转校准按钮，使指针指向“ 0Ω ”。如指针调不到“ 0Ω ”时，表明电池电压不足，须更换新电池再进行检查。更换电池后，指针仍不能指向“ 0Ω ”，表明欧姆表有故障，经检修后才可使用。

经检查确认欧姆表无故障时，再按第十四条规定的防险措



Figure 3-19205—1 Ohmmeter

When measuring the resistance of a path, read the number on the third scale that aligns with the pointer.

(5) After use, turn the switch to the "OFF" position and close the lid.

When measuring, first turn on the lighting switch, then operate as described above. Turn off the lighting switch after use.

2. Inspection method: First check whether the pointer points to " ∞ ", rotate the adjustment knob so that it points to " ∞ "; then turn on the conversion switch (rotate to any upper position), rotate the calibration knob until the pointer points to " 0Ω ". If the pointer cannot be adjusted to " 0Ω ", it indicates that the battery voltage is insufficient, and a new battery must be replaced before rechecking. After replacing the battery, if the pointer still cannot point to " 0Ω ", it indicates a fault in the ohmmeter, and the instrument can only be used after repair.

Upon inspection and confirmation that the ohmmeter is not faulty, proceed to implement the safety measures prescribed in Article 74.

施，将电雷管接到欧姆表上，打开旋转开关旋至“3Ω”或“9Ω”档上，如按下接线按钮电雷管不爆炸，则该表良好，否则不能使用。

(三) 检测仪表的维护与保养。

1. 在运输和使用中，要防止撞击和震动。
2. 禁止私自拆开表箱，若有故障，应交专人检修。
3. 用后及时擦拭，注意防潮。
4. 不能放在电机和强磁场附近，以免影响精度。
5. 长期不用或存放仓库的检测仪表，应将电池取出。

第四十四条 实施电起爆通常使用工兵导电线。当缺乏工兵导电线时，也可用电话线、电灯线等其它导线替代。

(一) 导电线的种类和性能：工兵导电线有双芯塑料绝缘线和橡皮绝缘线两种。双芯塑料绝缘线电阻为 0.1 欧姆/米；橡皮绝缘线又分单芯和双芯两种，单芯电阻为 0.025 欧姆/米，双芯电阻为 0.05 欧姆/米。

当使用电话线、电灯线等其它导线时，其电阻应在使用前用欧姆表测定。

(二) 导电线的检查：导电线在使用前，必须检查有无断路和短路。在水中和潮湿地点使用时，还要检查被复层绝缘是否良好。

1. 断路检查：将双芯导电线末端芯线拧在一起，首端接到欧姆表上进行测量（图 3—20）。如果电阻为无穷大（指针不摆动），则芯线已断。

2. 短路检查：将双芯导电线末端的两个线头分开，首端的两个线头接到欧姆表上，如果电阻为无穷大（指针不摆动），则

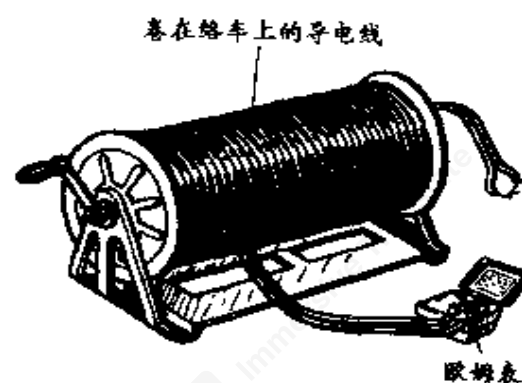


图 3—20 导电线的断路检查

Connect the electric detonator to the ohmmeter, turn the rotary switch to the "30" or "92" position. If the detonator does not explode when the connection button is pressed, the meter is good; otherwise, it cannot be used.

(3) Maintenance and care of detection instruments.

1. During transportation and use, prevent impact and vibration.
2. Private individuals are prohibited from dismantling the meter cabinet. In case of faults, it shall be inspected and repaired by designated personnel.
3. Wipe clean immediately after use and keep dry.
4. Do not place near motors or strong magnetic fields, as this may affect accuracy.
5. For testing instruments that are not used for a long time or are stored in a warehouse, remove the batteries.

Article 44. Implementation of electric blasting usually employs engineer's conductive wire. When engineer's conductive wire is lacking,

Wire replacement. (1) Types and performance of conductive wires: Engineer's wire consists of two-core plastic-insulated wires.

Two types of skin-insulated wires Dual-core plastic-insulated wire resistance is 0 1 ohm/meter; rubber

Insulated wires are divided into single-core and double-core types; the single-core resistance is 0.025 ohms/meter, and the double-core resistance is 0.05 ohms/meter.

When using other conductors such as telephone lines or light wire, their resistance should be measured with an ohmmeter before use.

(-2) Inspection of conductors: Condu

Before use, wires must be checked for

Open-circuit and short-circuit. When used in water or damp locations, also check whether the insulation is intact.

1. Open-circuit check: Twist the two cores of the double-core wire together at the ends, connect the other ends to an ohmmeter for measurement (Figure 3-20). If the resistance is infinite

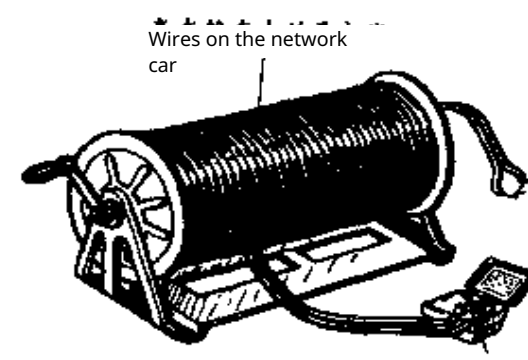


Figure 3-20 Open-circuit check of the conductor

(The pointer does not swing) Then the core wire is broken.

2. Short-circuit check: Separate the two wire ends at the tail end, connect the two wire ends at the head end to the ohmmeter. If the resistance is infinite (the pointer does not swing), then

没有短路；如果能测定出具体的电阻值，则有短路。对有短路的导电线应逐段检查，或用欧姆表测量其电阻，以确定短路的部位。

3. 绝缘检查：一般只检查导线外观，看绝缘层有无破裂、芯线有无裸露的现象。如需进一步检查，可在盛盐水（浓度为 3% ~ 5%）的容器中，放入一片面积不小于 400 平方厘米的无锈金属片和所要检查的导电线（图 3—21）。导电线的一端裹上胶布伸出容器之外，另一端接在欧姆表的接线柱上；再用一段导电线连接金属片和欧姆表的另一个接

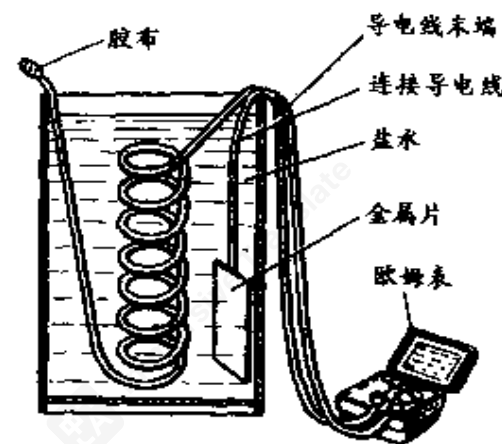


图 3—21 导电线的绝缘检查

线柱。如果导电线投入水中经过 20 ~ 30 分钟，指针基本不摆动，则绝缘层良好；如果指针有明显摆动，则说明绝缘层有损坏。为了找到损坏处，可将导电线慢慢拉出，用布擦干，如指针所示电阻增大，则说明损坏部分已拉出水面。损坏部位找到后，应用绝缘胶布严密包扎。

（三）导电线的使用、保管注意事项：导电线平时应缠在络车或线架上。敷设线路时，禁止在地上拖拉，以防绝缘层损坏漏电。

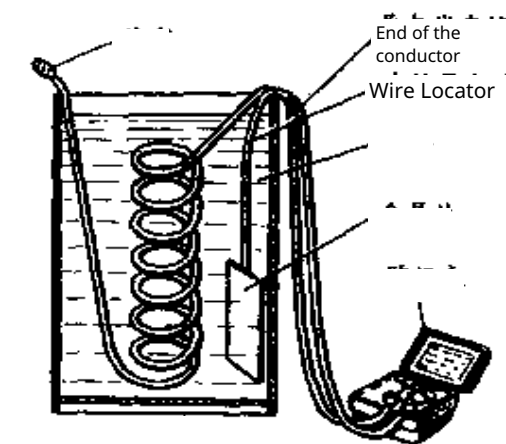
第四十五条 实施电起爆常用的电源有起爆器，也可使用蓄电池、照明及动力电源和移动发电站。

（一）起爆器：常用的起爆器有 GBP410 型起爆器、GBP411 型起爆器、GBP412 型起爆器。起爆器能输出瞬时电流，电压较高，电流强度较小。起爆器一般只适用于起爆串联线路。

1. GBP410 型起爆器（图 3—22）：是一种干电池电容式起

No short circuit: If the resistance value of the conductor can be measured, and a short circuit exists, each section of the shorted conductor should be inspected individually, or its resistance measured with an ohmmeter to determine the location of the short circuit.

3. Insulation check: Generally, only the appearance of the wire is inspected to check for cracks in the insulation layer or exposed core wires. If further inspection is required, place a piece of rust-free metal with an area of at least 400 square centimeters and the wire to be inspected into a container filled with salt water (concentration 3% ~ 5%), as shown in Figure 3-21.



The end of the conductive wire wrapped in tape extends outside the container, and the other end is connected to the ohmmeter.

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Terminal; then connect the metal piece to the other terminal of the ohmmeter with a short piece of wire.

Figure 3-21 Insulation check of the conductive wire

Line post. If the conductive wire is immersed in water for 20~30 minutes and the pointer shows little to no deflection, the insulation is intact; if the pointer deflects noticeably, the insulation is damaged. To locate the damaged section, slowly pull the conductive wire out of the water and dry it with a cloth. If the resistance increases as indicated by the pointer, the damaged portion has been pulled out of the water. Once the damaged area is identified, it should be tightly wrapped with insulating tape.

(3) Usage and storage precautions for conductors: Conductors should normally be coiled on reels or placed on wire racks. When laying the line, dragging it on the ground is prohibited to prevent damage to the insulation layer and leakage of electricity.

Article 45. The commonly used power sources for electric initiation are initiators; batteries, lighting and power sources, and mobile power stations may also be used.

(--) Blaster: Common blasters include the GBP410 blaster, GBP411 blaster, and GBP412 blaster. The blaster can output current, with higher voltage.

Small current intensity Detonators are generally only suitable for detonating series circuits.
。 1.GBP410 detonator (Fig. 3-22): is a dry battery capacitor-type detonator

爆器。其工作原理是：由低压的直流电源（电池），经晶体三极管自激振荡、变压器升压、次级得到很高的交流电压，通过二极管整流后向储能电容器充电。当电容器与起爆线路接通时，迅速将所储电能向起爆线路放出。

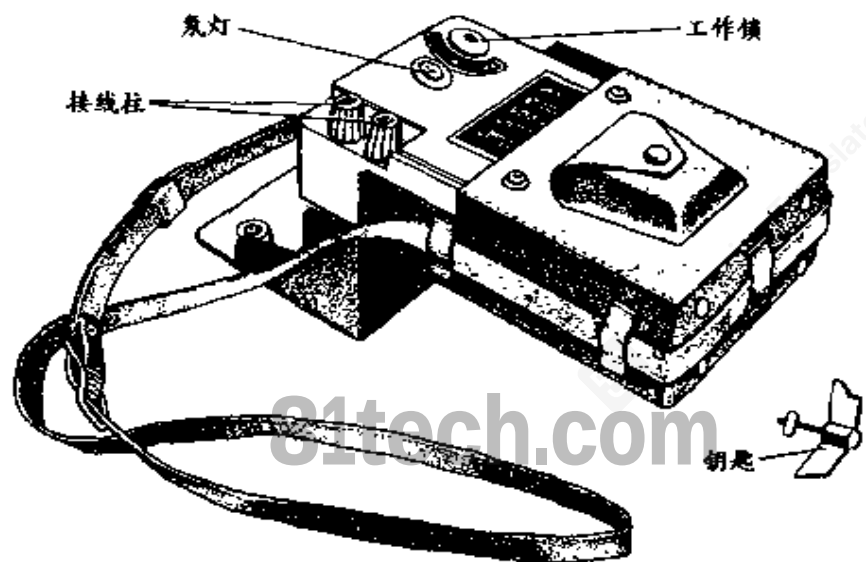


图 3—22 GBP410 型起爆器

(1) 起爆能力：当电起爆线路总电阻不超过 350 欧姆时，能起爆串联的 100 发镍铬桥丝电雷管；当电起爆线路总电阻不超过 135 欧姆时，能起爆串联的 50 发康铜桥丝电雷管。

(2) 使用方法：将干线接在接线柱上（注意勿使干线两接头接触或与机身接触，以防短路）；将钥匙插入工作锁中，旋至“充”的位置（即由左向右旋至中间），即开始充电（此时起爆器有轻微的蜂鸣声属正常现象）；待氖灯恒亮 3~5 秒后，立即将钥匙旋至“爆”的位置（即由中间向右），即可起爆。

起爆后，必须将钥匙旋至“停”的位置（即由右向左），取出钥匙，拆下干线。

(3) 检查方法：将钥匙插入并旋至“充”的位置，经 10 秒左右（-10~+45℃）如氖灯发亮，则起爆器良好。

Igniter. Its working principle is: a low-voltage DC power source (battery) undergoes self-excited oscillation and voltage boosting via a transistor and transformer, producing a high AC voltage at the secondary winding. After rectification by a diode, this charges an energy storage capacitor. When the capacitor connects to the detonation circuit, it rapidly discharges the stored energy into the detonation circuit.

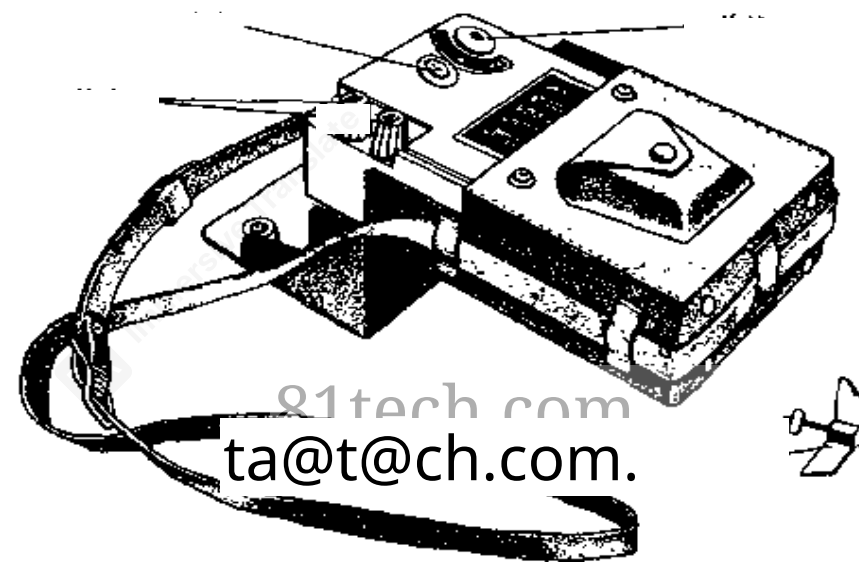


Figure 3--22GBP410 Initiator

(1) Initiation capability: When the total resistance of the electric initiation circuit does not exceed 350 ohms, it can

100 nickel-chromium bridge-wire detonators connected in series; when the total electric current in the electric detonation circuit does not exceed

At 135 ohms, it can initiate a series of 50 copper-constantan bridge-wire detonators.

(2) Usage: Connect the main cable to the terminal (note: ensure the two ends of the main cable do not touch each other or the machine body to prevent short circuits); insert the key into the working lock and turn to

Position (i.e., rotate from left to right to the center), which starts charging (a slight buzzing sound from the igniter at this time is normal): After the fluorescent lamp remains steadily lit for 3~5 seconds, immediately rotate the key to the "fire" position (i.e., from center to right), and the ignition will occur.

After detonation, the key must be turned to the position (i.e., from right to left), remove the key and disconnect the wire.

(3) Inspection method: Insert the key and turn it to the "CHARGE" position. If the incandescent lamp lights up after approximately 10 minutes (-10~+45℃), the detonator is in good condition.

(4) 注意事项：起爆器在使用、保管中应特别注意防潮；较长时间存放时，应将电池取出，以防腐蚀；长期停用后，在起爆前（未接入干线）应将起爆器反复“充”、“爆”几次，然后再使用。

2. GBP411 型起爆器（图 3—23）：是一种手摇发电机电容式起爆器。其工作原理是：转动摇柄带动发电机发电，经升压整流流向电容器充电。当电容器与起爆线路接通时，迅速将所储电能向起爆线路放出。

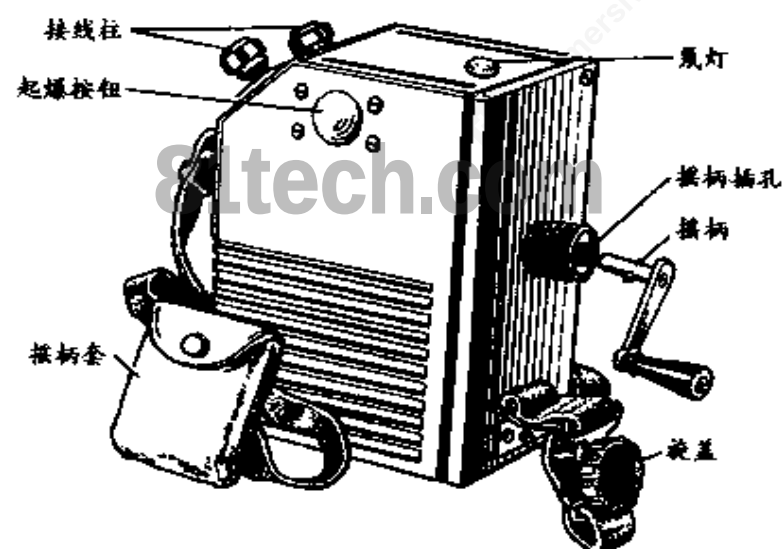


图 3—23 GBP411 型起爆器

(1) 起爆能力：

①充电后立即起爆（此时电压 ≥ 1600 伏特），其起爆能力为：当电起爆线路总电阻不超过 650 欧姆时，能起爆串联的 200 发镍铬桥丝电雷管；当电起爆线路总电阻不超过 220 欧姆时，能起爆串联的 100 发康铜桥丝电雷管。

②充电后在保留时间内（ $-40 \sim +40^{\circ}\text{C}$ 为 30 分钟）起爆（此时电压 ≥ 1250 伏特），其起爆能力为：当电起爆线路总电阻不超过 350 欧姆时，能起爆串联的 100 发镍铬桥丝电雷管；当电

(4) Precautions: Pay special attention to moisture protection when using and storing the detonator. When storing for a longer period, remove the battery to prevent corrosion. After long-term non-use, before firing (before connecting to the main line), repeatedly "charge" and "explode" the detonator a few times before use.

2. CBP411 type detonator (Figure 3-23): is a hand-cranked generator capacitor-type detonator. Its working principle is: turning the crank handle drives the generator to generate electricity, which is then stepped up and rectified to charge the capacitor. When the capacitor connects to the detonation circuit, it rapidly discharges the stored energy into the detonation circuit.

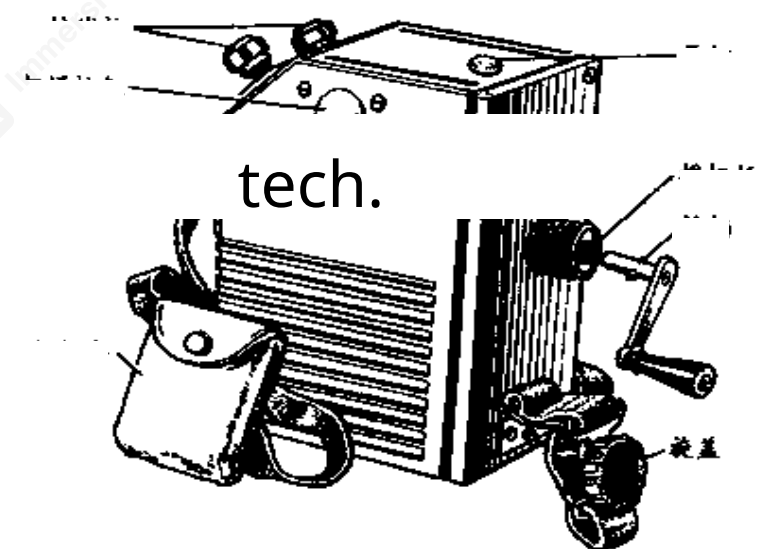


Figure 3-23 411-type detonator

(1) Initiation capability:

1D charge immediately after charging (at this time voltage 1600 volts), its detonation capability is: when the total resistance of the electric detonation circuit does not exceed 650 ohms, it can detonate 200 series-connected nickel-chromium bridge wire electric detonators; when the total resistance of the electric detonation circuit does not exceed 220 ohms, it can detonate 100 series-connected constantan bridge wire electric detonators.

2 After charging, detonate within the retention period ($-40 \sim +40^{\circ}\text{C}$ for 30 minutes) (voltage at this time is 1250 volts); its detonation capability is: when the total resistance of the electric detonation circuit does not exceed 350 ohms, it can detonate 100 series-connected nickel-bridge wire electric detonators; when electric

起爆线路总电阻不超过 135 欧姆时，能起爆串联的 50 发康铜桥丝电雷管。

(2) 使用方法：将干线接在接线柱上（注意勿使干线两接头接触或与机身接触，以防短路）；将摇柄插入摇柄孔内，顺时针方向迅速旋转，待氖灯恒亮后，立即停止转动；起爆时，按下起爆按钮。

(3) 检查方法：使用前，应按 3~4 转/秒的速度旋转摇柄，若在 28~35 转内氖灯恒亮，则起爆器正常。

(4) 注意事项：

①起爆器在充电后至起爆前，严禁取下摇柄（取下摇柄即自行放电）；不得缓慢转动摇柄，以防氖灯放电，降低电压；严禁短路放电，以防伤人和烧坏起爆器。

②起爆器在使用、保管中应避免剧烈撞击和震动；每用 5000 次左右，转动部分应加入航空润滑油并更换新电容器；平时严禁拆卸；长期停用后，使用前应先充、放电数次（每次摇至氖灯恒亮后，取下摇柄即可）。

3. GBP412 型起爆器（图 3—24）：是一种手摇发电机电容

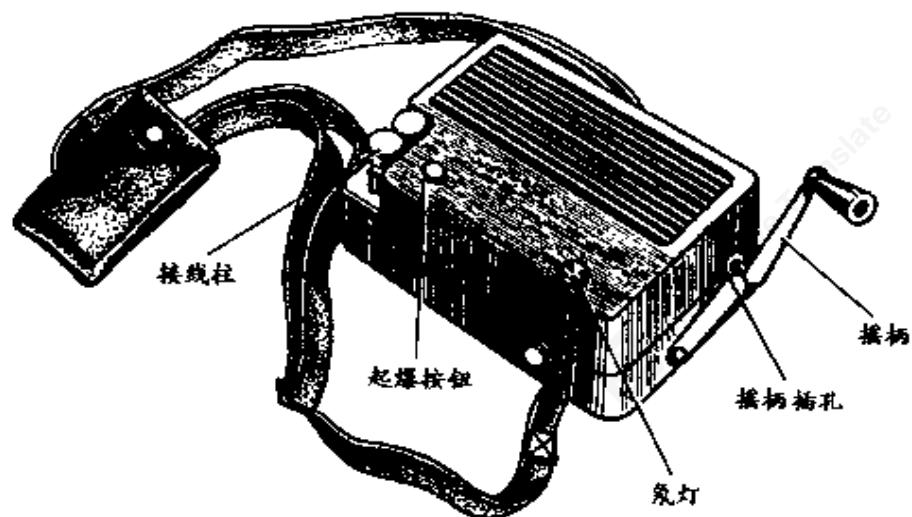


图 3—24 GBP412 型起爆器

When the total resistance of the detonation circuit does not exceed 135 ohms, it can detonate 50 copper-constantan bridge wire electric detonators connected in series.

(2) Usage: Connect the main cable to the terminal. (Note: Do not allow the two cable ends to touch each other or the device body to prevent short circuits; insert the crank handle into the crank hole and rotate it quickly in the clockwise direction until the nitrogen lamp glows steadily, then stop immediately; to detonate, press the detonator button.)

(3) Check method: Before use, rotate the handle at a speed of 3~4 revolutions per second. If the lamp remains steadily lit within 28~35 revolutions, the igniter is functioning normally.

(4) Notes:

(D) The detonator must not have the crank removed after charging but before detonation (removing the crank causes self-discharge); the crank must not be turned slowly to prevent lamp discharge and voltage drop; strictly prohibited

短路放电，以防伤人和烧坏起爆器。Short-circuit discharge to prevent injury to personnel and damage to the detonator. The Com 2 detonator should be protected from severe impact and vibration during use and storage; every 5000 cycles, the moving parts should be lubricated with aviation oil and new capacitors replaced; disassembly is strictly prohibited under normal conditions; after long-term storage, the device should be charged and discharged several times before use (shake until the indicator lamp glows steadily, then remove the handle).

3. (BP412 type detonator (Figure 3--24): is a hand-cranked generator with a capacitor)

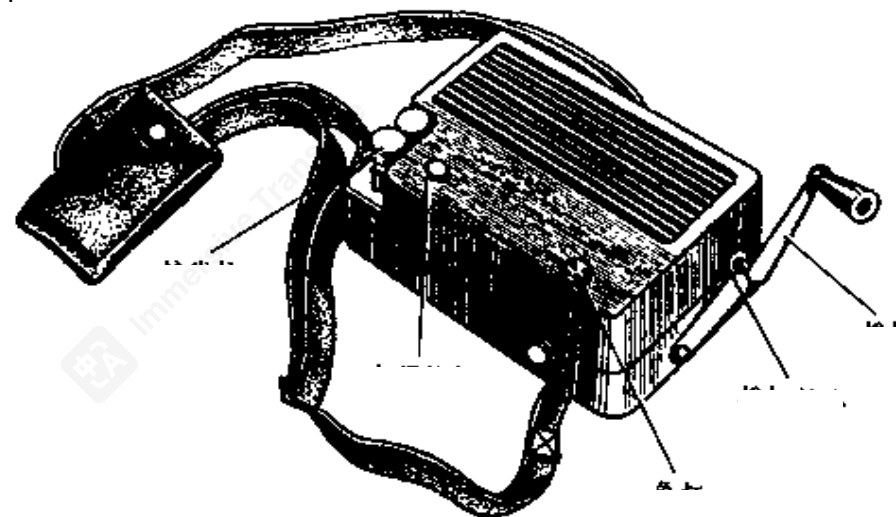


Figure 3--24GBP412 Initiator

式起爆器。其工作原理、使用方法和检查方法与 GBP411 型起爆器相同。

(二) 蓄电池：汽车、摩托车和工程机械等所用的蓄电池是化学电源。单个蓄电池的额定电压有 6 伏特、12 伏特和 24 伏特三种，其输出电流根据型号不同为 5 ~ 20 安培不等。蓄电池内电阻很小，使用时可忽略不计。

蓄电池在使用前应进行检查，只要蓄电池能够起动相应的车辆、机械，即证明有良好的起爆能力。当单个蓄电池的电流强度或电压不能满足电起爆线路需要时，可将若干数量的蓄电池连接成电池组使用。蓄电池组连接方法有串联、并联和混联三种。

如果单个蓄电池的电流强度能保证电起爆线路的需要，但不能保证电起爆线路所需要的电压，则采用串联（图 3—25）。串联蓄电池数按下式计算：

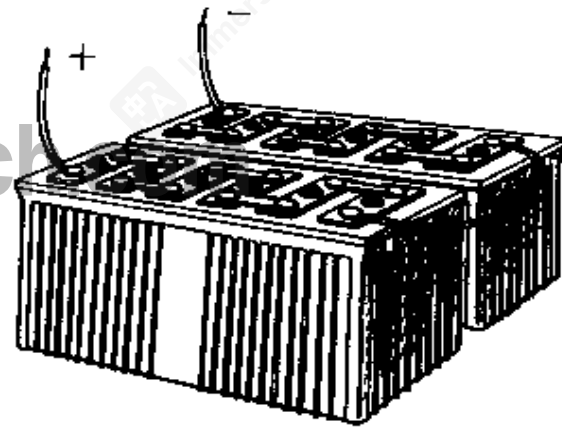


图 3—25 蓄电池的串联

$$m \geq \frac{U}{u}$$

式中：m——串联电池个数（如出现小数，应进成整数）

U——电起爆线路所需电压（伏特）

u——单个蓄电池的电压（伏特）

如果单个蓄电池的电压能保证电起爆线路的需要，但不能保证电起爆线路所需要的电流强度，则采用并联（图 3—26）。并联蓄电池数按下式计算：

$$n \geq \frac{I}{i}$$

The electric detonator operates on the same principle, and its usage and inspection methods are identical to those of the GBP411 detonator.

(II) Secondary batteries: The batteries used in automobiles, motorcycles, and construction machinery are chemical power sources. The rated voltage of a single battery is either 6 volts, 12 volts, or 24 volts, and the output current varies by model from 5 ~ 20 amperes. The internal resistance of the battery is very small and can be neglected during use.

Before use, the battery should be inspected; as long as the battery can start the corresponding vehicle or machine, it proves good starting capability. When the current intensity of a single battery

Or when the voltage cannot meet the requirements of the electric blasting circuit, several batteries can be connected in series to form a battery pack for use. The methods for connecting battery packs include series, parallel, and mixed connections.

If the current intensity of a single battery can meet the requirements of the electric blasting circuit but cannot guarantee the voltage required by the electric blasting circuit, then series connection should be used (Figure 3-25). The number of batteries in series is calculated according to the following formula:

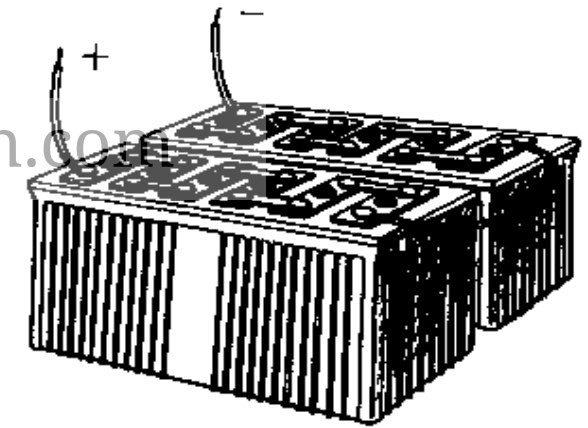


Figure 3-25 Battery Inspection and Certification

$$m \geq \frac{U}{u}$$

式中：m——串联电池个数（如出现小数，应进成整数）
In the formula: m is the number of series-connected batteries (if a decimal value appears, it should be rounded up to the nearest integer).

U——Voltage (volts) required for electric blasting circuit

u—voltage of a single battery (volts)

If the voltage of a single battery can meet the requirements of the electric initiation circuit but cannot guarantee the current intensity required by the electric initiation circuit, then parallel connection is used (Figure 3-26). The number of parallel-connected batteries is calculated according to the following formula:

$$n \geq \frac{I}{i}$$

式中：n——并联蓄电池个数（如出现小数，应进成整数）
I——电起爆线路所需电流强度（安培）
i——单个蓄电池的电流强度（安培）

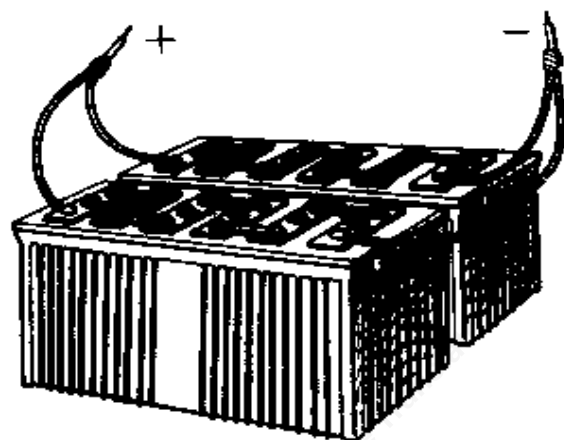


图 3—26 蓄电池的并联

如果蓄电池的电压与电流强度均不能保证电起爆线路的需要，则采用混联（图 3—27）。混联蓄电池数按下式计算：

$$N = mn$$

式中：N——混联蓄电池个数
m、n——意义同上

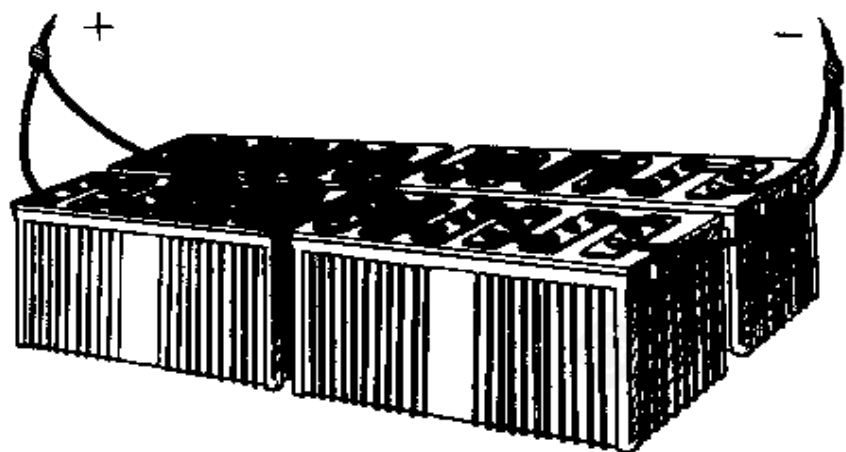


图 3—27 蓄电池的混联

Formula: n—parallel battery

Number of pools (e.g. out

Decimal, should be rounded up to an integer) I current required for electric detonation circuit (amperes) i current intensity of a single battery

(...)

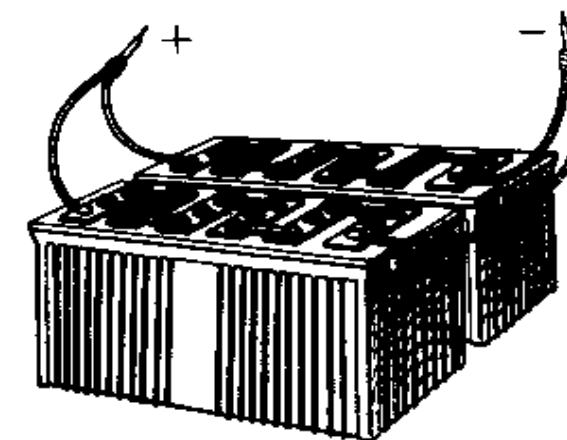


Figure 326 Parallel connection of batteries

If the voltage of the battery and

If the current intensity cannot guarantee the requirements for the electric start of tech.com explosion lines, then a mixed series-parallel connection (Figure 3-27) is adopted. The number of mixed series-parallel batteries is calculated according to the following formula:

Type: N—Number of series-parallel batteries

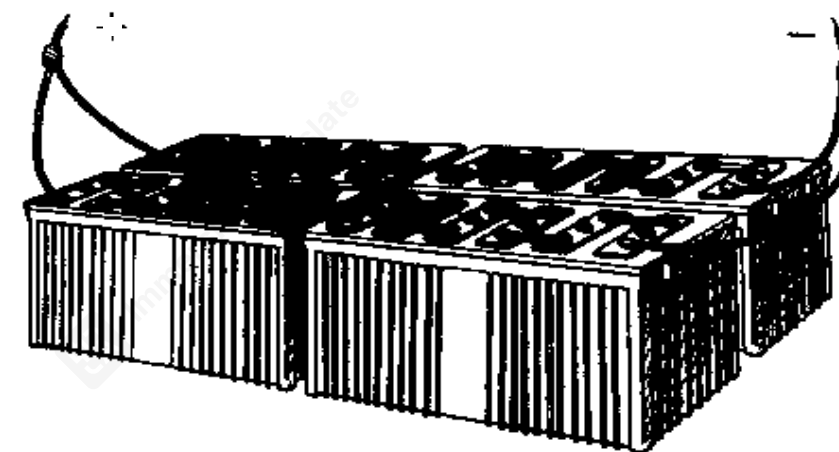


Figure 3-27 Series-parallel connection of batteries

(三) 照明、动力电源和移动发电站：其输出电压和电流强度均较大，适用于并联或混联起爆线路，只要电起爆线路所需要的电压和电流强度不超过其额定值，即能可靠起爆。

使用照明、动力电源时，应事先了解供电线路的供电、负荷情况，以便进行线路计算。如有必要和可能时，在起爆时应将其其他负荷切断。

起爆前，应预先敷设好电起爆线路。禁止把干线直接接到照明、动力电源和发电站供电线路上，必须设置中间开关（闸刀），直到起爆线路全部敷设完毕并导通后，才能将干线接到中间开关（闸刀）上，接到起爆命令后，才能闭合中间开关（闸刀）。

部队装备的移动发电站的有关性能见表 3—1。

表 3—1 移动发电站有关性能

名 称	电流种类	额定电压 (V)	额定电流 (A)
12kw 发电站	三相交流	400/230	21.8
20kw 发电站	三相交流	400/230	36.1
40kw 发电站	三相交流	400/230	72.2
48kw 发电站	三相交流	400/230	87
50kw 发电站	三相交流	400/230	90
75kw 发电站	三相交流	400/230	136

第四十六条 由电源、电雷管和导电线连结成的网路称为电起爆线路。由电源通向爆破目标的导电线称为干线，各电雷管之间及电雷管与干线之间的导电线称为支线。

电起爆线路有串联、并联和混联三种（图 3—28）。使用时应根据爆破任务及电源情况选定。

(一) 串联线路敷设和检查简便迅速，适合使用电压高但输出电流小的电源（如起爆器）起爆。如电雷管的电阻或感度不均

(3) Lighting, power supply, and mobile power stations: Their output voltage and current intensity are both high, making them suitable for parallel or mixed-series blasting circuits. As long as the voltage and current intensity required by the electric blasting circuit do not exceed their rated values, they can reliably initiate the blast.

When using lighting or power supply, the power supply conditions and load status of the power lines should be understood in advance to facilitate line calculations. If necessary and feasible, other loads should be disconnected during blasting.

Before detonation, the electric detonation circuit must be laid out in advance. It is prohibited to connect the main line directly to lighting, power supply, or power station supply lines. An intermediate switch (knife switch) must be installed. Only after the entire detonation circuit has been laid out and connected can the main line be connected to the intermediate switch (knife switch). After receiving the detonation command, the intermediate switch (knife switch) may be closed.

The performance of the mobile power station for military equipment is shown in Table 3-1.

Table 311E Mobile Power Station
Performance Specifications

12kw Power Station		400/230	
20kw Power Station		400/230	
40kw Power Station		400/230	
48kw Power Station		400/230	
50kw Power Station		400/230	
75kw Power Station		400/230	

Article 46 A network formed by connecting power sources, electric detonators, and connecting wires is called an electric blasting circuit. The connecting wire leading from the power source to the blasting target is called a sub-line, and the connecting wires between electric detonators and between electric detonators and the main line are called branch lines.

Electrical blasting circuits can be connected in series, parallel, or mixed configurations (Fig. 3-28). When in use, the appropriate configuration should be selected based on the blasting requirements and power supply conditions.

(1) Series-line laying and inspection are simple, rapid, and suitable for use with high voltages but limited output.

Initiate detonation with a low-current power source (such as a detonator). If the resistance or sensitivity of electric detonators is uneven,

匀, 通电后电阻大或感度高的电雷管可能先爆炸, 炸断线路, 使其余的电雷管拒爆。

(二) 并联线路中 1 条支路的电雷管早炸或拒爆, 不影响其他支路起爆。线路所需总电流强度较大, 适用于输出电流较大、电压较低的电源起爆, 且每条支路的电阻应相等, 否则电阻大的支路电流将减小, 可能发生拒爆。

(三) 混联线路适用于电压和电流均较大的电源起爆。在爆破重要目标时, 为了保证所有的装药准确起爆, 常用混联起爆线路。采用这种线路时, 各支路的电阻也必须相等。

第四十七条 在敷设电起爆线路以前, 应先进行线路计算。通常先计算线路的总电阻, 确定起爆线路所需电流强度 (表 3—2), 再根据电阻和电流强度计算出电压, 并根据计算结果选定电源。

表 3—2 起爆电起爆线路所需电流强度

电 流		直 流 电 (A)		交 流 电 (A)		附 注
		镍 铬	康 铜	镍 铬	康 铜	
电 流 强 度 线路种类	串 联	1.0	2.0	1.5	3.0	n 为支路数
	并联 (单发)	$0.6 \times n$	$1.0 \times n$	$0.9 \times n$	$1.5 \times n$	
	混 联	$1.0 \times n$	$2.0 \times n$	$1.5 \times n$	$3.0 \times n$	

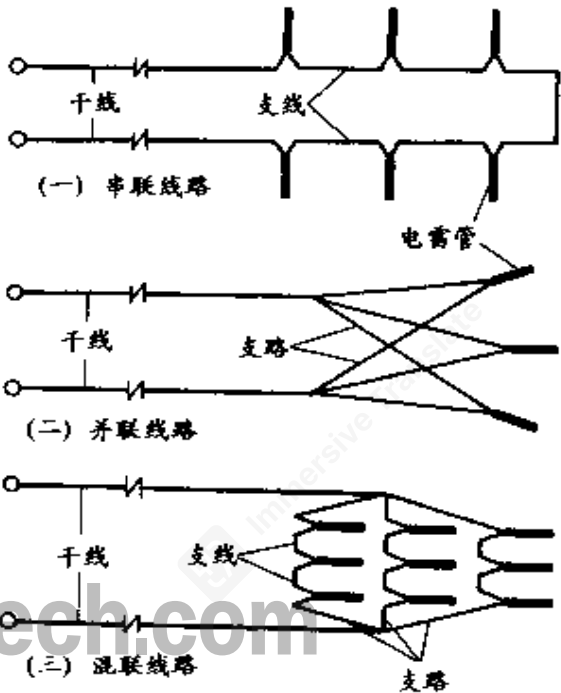


图 3—28 电起爆线路

When connected to power, electric detonators with high sensitivity or large current may explode first, breaking the circuit and causing the remaining electric detonators to fail to detonate.

(2) In a parallel circuit, if one branch's electric detonator explodes prematurely or fails to detonate, it does not affect the initiation of other branches. The total current required for the circuit is relatively large, making it suitable for initiation from power sources with high output current and low voltage. The resistance of each branch should be equal; otherwise,

then the current in the branch with higher resistance will

Small, there may be a failure to detonate.

(3) Hybrid circuits apply to

Voltage and current are both lower than those of a human power source.

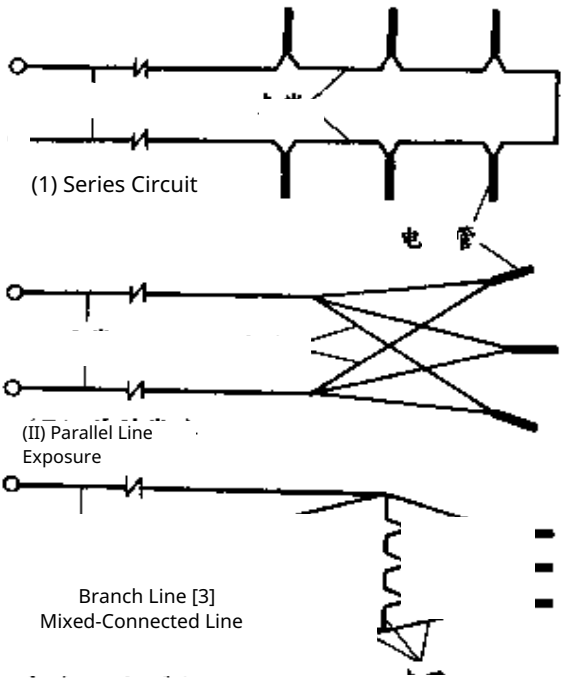


Figure 3-28 Electric blasting circuit

Initiate detonation. When detonating important targets, to ensure all charges detonate accurately, a mixed series-parallel detonation circuit is commonly used. When using such a circuit, the resistance of each branch must also be equal.

Article 47 Before laying electric blasting lines, a line calculation shall be conducted first. Usually, the total resistance of the line is calculated first, the current intensity required for the blasting line is determined (Table 3-2), and then the voltage is calculated based on the resistance and current intensity, and the power source is selected according to the calculation results.

Current intensity required for blasting circuit

High Current, Line Type	Electric detonator types 度	Direct Current (A)		AC (A)		n is the number of branches
		0.6xn	1.0xn	0.9xn	1.5xn	
Parallel (Single-shot)		1.0xn	2.0xn	1.5xn	3.0xn	

使用镍铬桥丝电雷管的串联线路，雷管之间电阻差不大于0.8 欧姆；使用康铜桥丝电雷管的串联线路，雷管之间电阻差不大于0.2 欧姆；不同工厂、不同批次生产的电雷管以及不同型号的电雷管均不得在同一串联线路中使用。

(一) 串联线路计算：

线路总电阻 $R = r_g + r_z + m r_l$

式中： r_g ——干线电阻（欧姆）

r_z ——支线电阻（欧姆）

r_l ——单个电雷管的电阻（欧姆）

m ——电雷管数（发）

所需电流强度 I 查表 3—2。

所需电压 $U = IR$ 。

(二) 并联线路计算：

线路总电阻 $R = r_g + \frac{r_z + r_l}{n}$

式中： r_z ——1 条支路上的支线电阻（欧姆）

n ——支路数量

所需电流强度 I 查表 3—2。

所需电压 $U = IR$ 。

(三) 混联线路计算：

线路总电阻 $R = r_g + \frac{r_z + m_z r_l}{n}$

式中： m_z ——1 条支路上的串联电雷管数（发）

所需电流强度 I 查表 3—2。

所需电压 $U = IR$ 。

第四十八条 电起爆线路的接续包括导电线的接续及导电线与电雷管的接续。其接续方法如下。

(一) 直线形接续法：接续前先将两根导电线末端的绝缘层各剥去 5 厘米，并刮亮（勿伤）芯线，然后将两根芯线交叉放

Use a series circuit with nickel bridge-wire electric detonators where the resistance difference between detonators does not exceed 0.8 ohms; use a series circuit with constantan bridge-wire electric detonators where the resistance difference between detonators does not exceed 0.2 ohms; electric detonators produced by different factories, different batches, and different models must not be used in the same series circuit.

(1) Series circuit calculation:

In which: r_g —line resistance (ohms)
 r_z —Branch resistance (ohms)
 r_l —Resistance of a single electric detonator (ohms)
 m —number of electric detonators (charges)

r_l —Resistance of a single electric detonator (ohms)

m —number of electric detonators (charges)

The required current intensity I is obtained from Table 3-2.

Required voltage $U = IR$.

(II) Calculation of parallel circuits:

$R = r_g + \frac{r_z + r_l}{n}$

In which: r_z —the branch resistance of branch t (ohms)

n —Number of n -branch

The required current intensity I is obtained from Table 3-2.

Required voltage $U = IR$.

(3) Series-parallel circuit calculation:

Total line resistance $R = r_g + \frac{r_z + m_z r_l}{n}$

In the formula: m_z —number of serially connected electric detonators on one branch (detonators)

Required current intensity I is to be obtained from Table 3-2.

Required voltage $U = IR$.

Article 48. The connection of electric blasting circuits includes the connection of conductive wires and the connection of conductive wires with electric detonators. The connection methods are as follows

(1) Straight-line splicing method: Before splicing, first remove the insulation layer from the ends of both conductors.

Remove 5 cm from each

and strip the core wire (do not damage)

Then cross the two wires and place them

置，紧密地拧在一起，缠上胶布（图 3—29）。

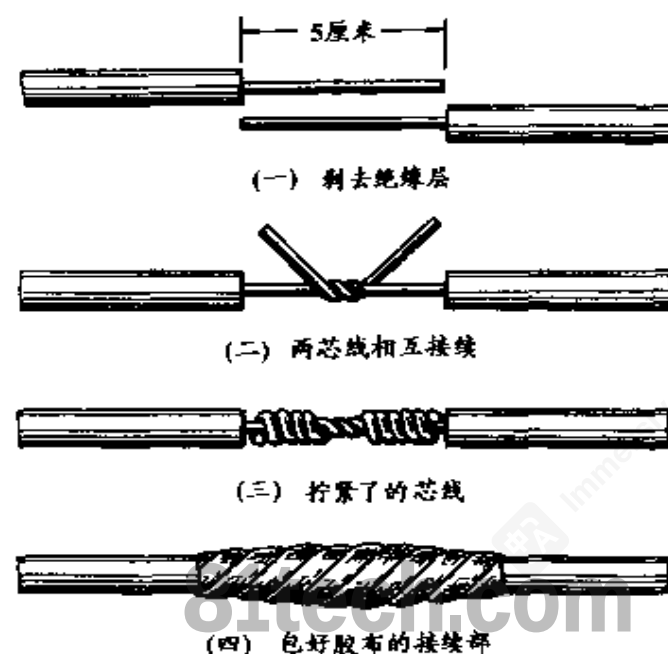


图 3—29 直线形接续法

导电线与电雷管脚线接续时（图 3—30），将电雷管脚线的绝缘层剥去 5 厘米，导电线的绝缘层剥去 2 厘米，并刮亮芯线；先将脚线在导电线上缠绕一周，用雷管（电工）钳在导电线芯线 1/2 处弯曲压紧，再将脚线紧密地缠在导电线的芯线上，最后缠上胶布。

（二）直角形接续法：按图 3—31 所示尺寸剥去导电线绝缘层并刮亮芯线，再将两根芯线成直角紧密缠绕，然后缠上胶布。若线路敷设在潮湿地区 and 水中时，接续部缠上胶布，还应涂以沥青或防潮剂。

第四十九条 敷设电起爆线路的作业组织应根据作业量的大小、人员和时间等情况而定。当 1 个班担任作业时，通常应区分为干线小组、电雷管连接小组及点火站小组。

班长应根据上级指示，选择点火站位置，区分任务，并带领

tighten tightly together and wrap with adhesive tape (Fig. 3-29).

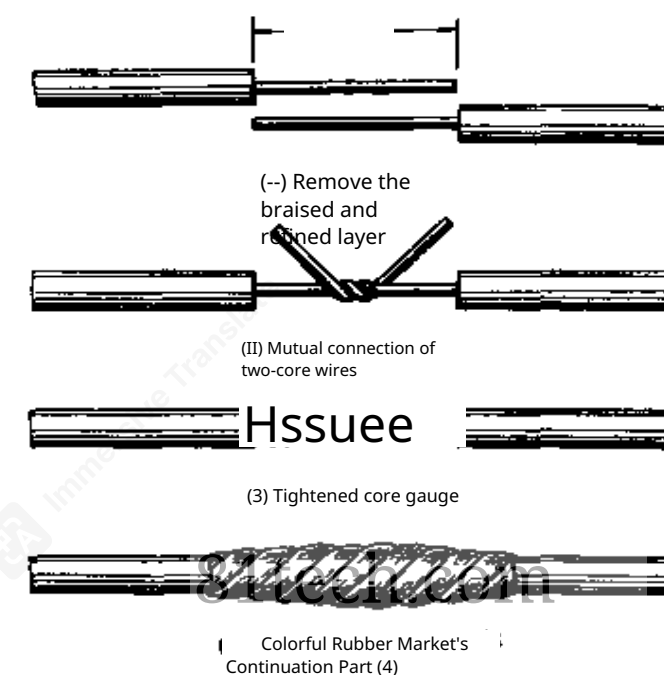


Figure 3-29 Straight-line splicing method

When connecting the lead wire of an electric detonator (Figure 3-30), strip the insulation of the detonator lead wire for 5 cm, strip the insulation of the connecting wire for 2 cm, and scrape the core wire bright. First, wind the lead wire around the connecting wire once, then use a detonator (electrician's) pliers to bend and press tightly the core wire of the connecting wire at the 1/2 mark. Next, tightly wind the lead wire around the core wire of the connecting wire, and finally wrap it with tape.

(2) Right-angle splicing method: Strip the insulation layer of the conductor wire and scrape the core wire to a bright finish according to the dimensions shown in Figure 3-31, then tightly wind the two core wires at a right angle, and finally cover with tape. If the line is installed in a humid area or in water, the spliced section covered with tape should also be coated with asphalt or a moisture-proofing agent.

Article 49 The organization of work for laying electric blasting lines shall be determined according to the scale of the work, the number of personnel, time, and other circumstances. When one shift is assigned to perform the work, it should generally be divided into sub-line teams, electric detonator connection teams, and firing station teams.

The class monitor should, according to superior instructions, select the ignition station location, distinguish tasks, and lead

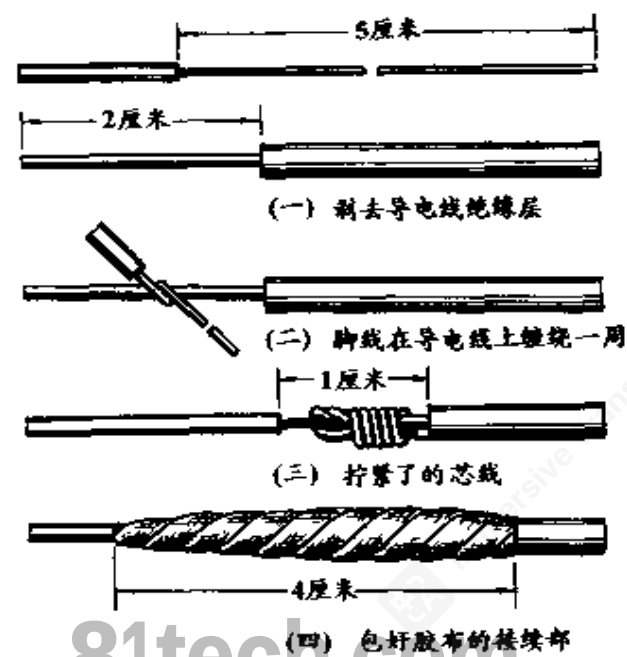


图 3—30 导电线与电雷管脚线的接续法

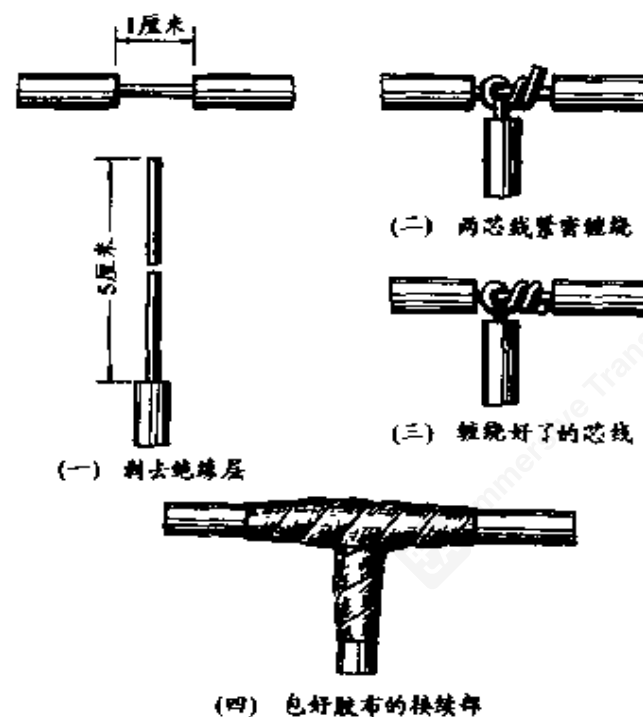


图 3—31 直角形接续法

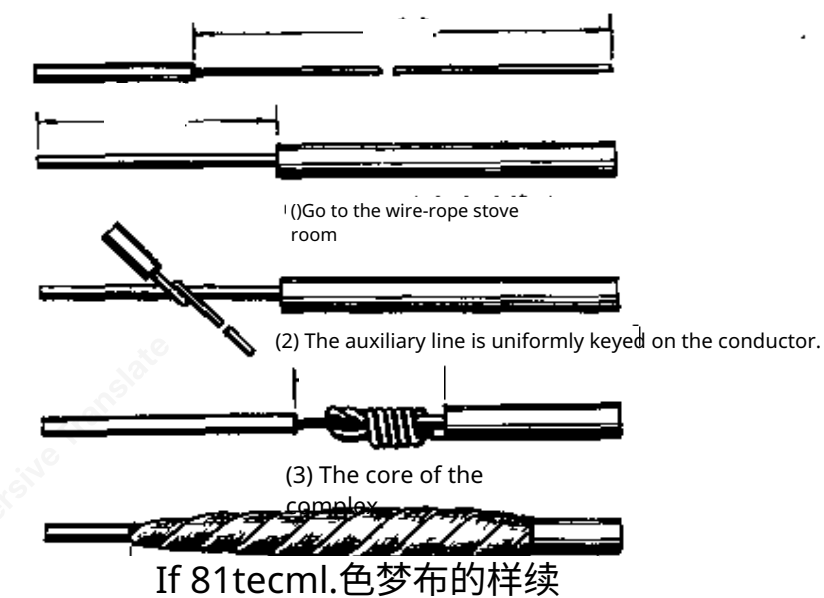
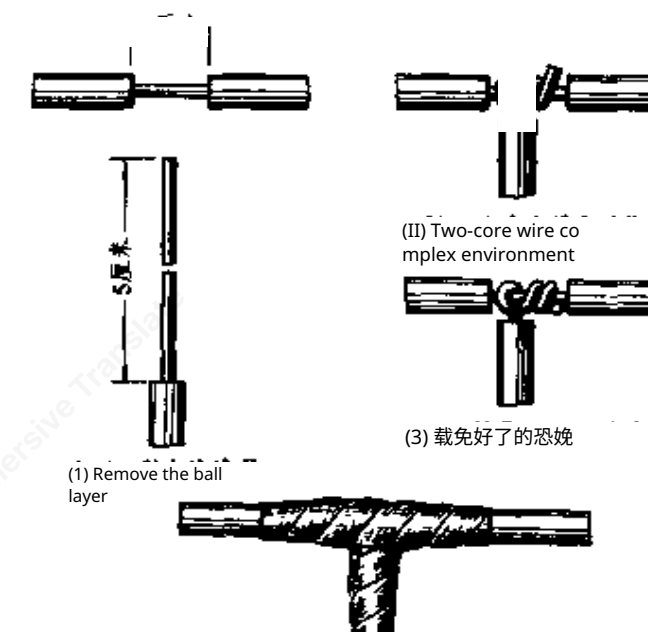


Figure 3-30: Method of connecting the live wire to the electric detonator lead



Continuing the
Year of the Snake (4)
Figure 3-31 Right-angle splicing
method

全班按时完成作业。

F线小组负责领取、检查导电线，并由装药位置向点火站延伸导电线。敷设好后再进行检查，并把干线末端交给点火站小组。

电雷管连接小组负责领取、检查电雷管，根据需要对电雷管的电阻加以选择，然后根据装药位置的情况连接电雷管和支线。电雷管连接完毕后，应根据指挥员的命令（信号），与干线接通。

点火站小组负责构筑点火站，领取、检查电源及检测仪表，接收干线小组敷设好的干线末端，加以绝缘。当线路较多时，应加以编号，以防混乱，并派专人看守。线路敷设好后，根据指挥员的命令，检查线路是否良好；此时，所有人员均应撤到安全地点。线路检查后，如不立即起爆，应将干线末端重新绝缘。

第五十条 敷设电起爆线路应注意以下事项。

（一）线路敷设不得过紧，所有干线、支线均应保持 10% 左右的松弛度。

（二）为防止破片切断或技术兵器轧断导电线，敷设时应利用遮蔽地形，或埋入不小于 20 厘米深的土中。

（三）在线路可能被敌火破坏的情况下爆破重要目标时，应敷设预备起爆线路和构筑预备点火站，以保证适时、可靠地起爆装药。

（四）敷设地下装药的电起爆线路时，应对导电线采取保护措施，如套入细钢管或木、竹制的保护槽中，以防填塞时损坏导电线。

（五）电源开关要派专人看守。起爆器摇柄（钥匙）应由指挥员掌握，待人员已撤至安全地带，指挥员发出起爆准备口令前，方可将起爆器摇柄（钥匙）发给作业手。

（六）严禁将电起爆线路与照明、动力线路混设在一起。

（七）敷设线路时，如无特殊措施，距离变电站、高压线、发电站及无线电发射台等目标不得近于 200 米。

— 46 —

Complete all homework assignments on time.

The launch group is responsible for collecting and inspecting the conductive wire, and laying it out from the charge position to the firing station. After setup, a check is conducted, and the end of the main line is handed over to the firing station team.

The electric detonator connection group is responsible for collecting and inspecting electric detonators, selecting the appropriate resistance for the detonators as needed, and then connecting the detonators to the branch lines based on the location of the charge. After the electric detonators are connected, they should be connected to the main line according to the command (signal) of the commander.

The ignition station team is responsible for constructing the ignition station, collecting and inspecting power sources and testing instruments, receiving the line ends laid by the main line team, insulating them, and when multiple lines are involved, assigning numbers to prevent confusion and designating a dedicated person for supervision. After the lines are laid, according to the commander's orders, inspect the lines to ensure they are in good condition; at this point, all personnel must withdraw to a safe location.

After the line check If not detonated immediately The end should be re-insulated.

Article 50. When setting up electric blasting circuits, the following precautions should be observed.

(-) The number of lines should not be set too tightly; all main lines and branch lines should maintain approximately 10% left.

in the looseness

(2) To prevent fragments from severing or technical weapons from crushing the conductive wire during laying, it should be buried in soil at least 20 cm deep, preferably in concealed terrain.

(3) When detonating important targets in cases where the line may be destroyed by enemy fire, a reserve detonation line and a reserve ignition station should be established to ensure timely and reliable detonation of the charge.

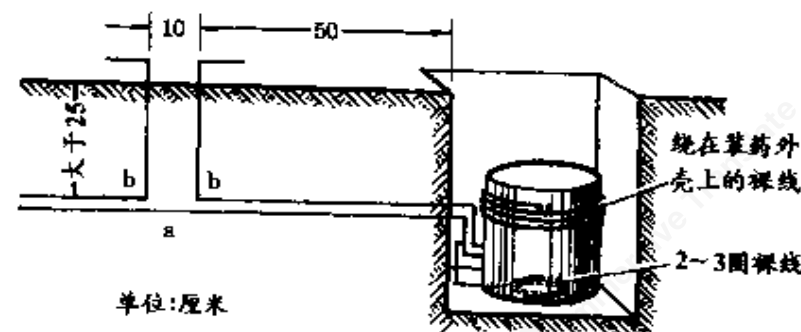
(4) When laying underground electric blasting circuits for charges, protective measures shall be taken for the lead wires, such as encasing them in thin steel pipes or wooden/bamboo protective troughs, to prevent damage to the lead wires during filling:

(9) The power switch must be guarded by a designated person. The starter handle (key) shall be held by the commander and may only be handed to the operator after all personnel have withdrawn to a safe area and the commander has given the command for the blasting preparation. (6) It is strictly prohibited to mix electric blasting lines with lighting or power lines.

(-7) When laying the line, without special measures, the distance to targets such as substations, high-voltage lines, power stations, and radio transmission towers shall not be less than 200 meters.

(八) 在雷电地区, 电起爆线路内可能产生脉冲电流, 使电雷管爆炸而引起装药爆炸。为了预防或减少线路附近发生雷电及静电感应、电磁感应时的杂散电流影响, 可采取下列措施:

1. 将全部线路埋入土中, 深度不小于 25 厘米。
2. 电起爆线路应尽可能使用双芯导电线。如用单芯导电线时, 应在敷设前将两根线扭在一起, 或用细绳、胶布每隔 1 ~ 1.5 米捆扎一道。
3. 用一根裸线 (可用有刺铁丝) 同线路导电线并排敷设。
4. 点火站干线的末端应分开放置, 并进行绝缘。
5. 尽可能避免支线并联, 防止形成闭合回路而产生感应电流。
6. 对具有金属壳的装药, 可将装药压在绕成 2~3 圈的裸露导电线上 (图 3—32), 其一端在金属壳上缠绕 3~4 圈并加以固定, 另一端则与由装药中伸出的一根导电线 a 的芯线相接; 装药中伸出的第二根导电线 b 在离装药 50 厘米处切断, 切断的末端彼此相距 10 厘米露出地面, 两端都要擦拭干净并缠上胶布。起爆前再接续起来, 接续处应缠上胶布。



7. 对非金属壳成无壳的装药, 可将两根导电线在距装药 50 厘米处切断, 切断末端彼此相距 20 ~ 30 厘米, 露出地而并进行

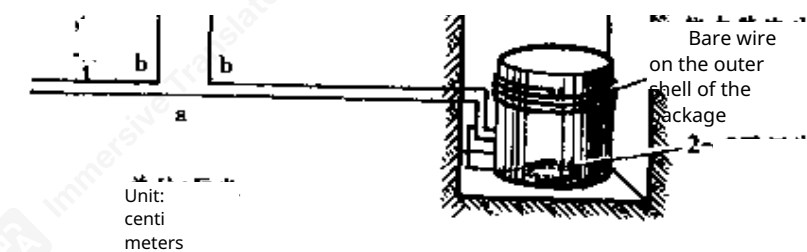
(8) In lightning-prone areas, pulse currents may be generated within the electric detonation circuit, causing electric detonators to explode and triggering the detonation of the charge. To prevent or reduce the impact of stray currents caused by lightning, static electricity induction, or electromagnetic induction near the circuit, the following measures can be taken:

1. Bury all cables underground at a depth of not less than 25 cm.
2. The electric blasting circuit should use double-core conductors as much as possible. If single-core conductors are used,

At this point, before the numerical design, twist the two wires together, or tie them with a thin rope or tape every 1 ~ 1.5 meters.

3. Use bare wire (thorn wire may be used) alongside the line conductor.
4. The ends of the ignition station main lines shall be placed separately and insulated.
5. Avoid parallel branch connections as much as possible to prevent the formation of closed loops that can induce voltage.

6. For charges with metal casings, the charge can be placed on a bare wire wound into 2 ~ 3 turns (Fig. 3-32). The E end is wound 3 ~ 4 times around the metal casing and secured, while the other end is connected to the core of a bare wire a extending from the charge. A second bare wire b extending from the charge is cut 50 cm from the charge; the cut ends are spaced 10 cm apart and exposed to the ground. Both ends must be wiped dry and wrapped with tape. They are connected before detonation, and the connection point must also be wrapped with tape.



7. For non-metallic shellless charges, cut two conductive wires 50 cm from the charge, with the cut ends spaced 20 ~ 30 cm apart, expose the ground, and proceed.

绝缘（图 3—33）。起爆前再接续起来，接续处缠上胶布。

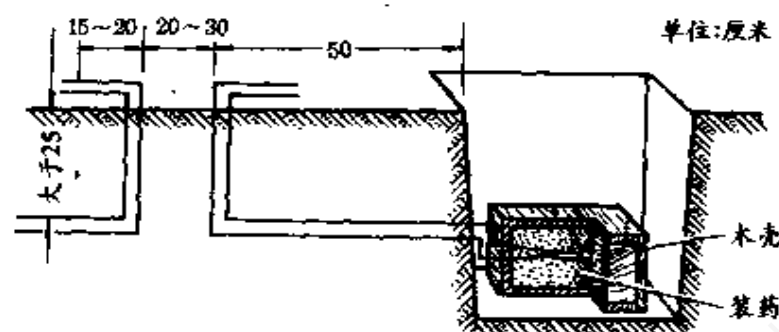


图 3—33 非金属壳装药的防雷电方法

第五节 无线电遥控起爆法

第五十一条 无线电遥控起爆法是使用无线电遥控起爆装置起爆装药的方法。它是通过接收机接收发射机所发出的远距离无线电遥控信号来起爆预设装药的。无线电遥控起爆法可准确地同时或逐次起爆多个装药，主要用于人员不便于直接接近爆破目标的时机和场合，隐蔽、突然地起爆装药。实施无线电遥控起爆需预先设置装药，作业较复杂，使用器材较多，易受电磁干扰。

第五十二条 实施无线电遥控起爆法通常使用 GBP421 型遥控起爆器和袖珍式（常温型）遥控起爆器。

（一）GBP421 型遥控起爆器：为全晶体管脉冲调相式多路遥控起爆装置。

1. 主要性能：

（1）遥控距离：正常条件下在中等起伏地形上不小于 3 千米（昼夜）；在寒区约为 2 千米。

（2）起爆能力：接收机使用机内电源，连接 100 米工兵导电线可同时起爆串联电雷管 20 发或并联电雷管 4 发。

（3）工作时间：在常温（ $20 \pm 5^\circ\text{C}$ ）条件下，接收机使用机

Insulation (Figure 3-33). Connect the wires together after priming, and wrap the connection with tape.

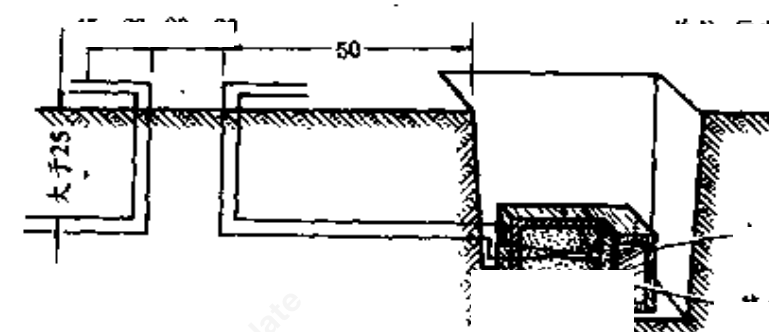


Figure 3-33 Lightning protection methods for non-metallic shell munitions

Section 5.1 Radio Remote Detonation Method OLECCO

Article 51 Radio remote detonation is a method of detonating charges using radio remote detonation devices. It detonates preset charges by receiving long-distance radio remote control signals transmitted by the transmitter via the receiver. Radio remote detonation can accurately detonate multiple charges simultaneously or sequentially and is mainly used for remote and concealed detonation of charges in situations where personnel cannot easily approach the blasting target. Implementing radio remote detonation requires pre-setting charges, involves more complex operations, requires more equipment, and is susceptible to electromagnetic interference.

Article 52 The implementation of radio remote detonation usually uses the GBP421 type remote Control detonator and pocket-type (room temperature) remote detonator.

(1) GBP421 Remote Control Initiator: A full-transistor pulse phase-modulation multi-channel

Remote initiation device.

1. Main Performance:

(1) Remote control range: Under normal conditions, not less than 3 km on medium undulating terrain (night); in cold regions, approximately 2 km.

(2) Initiation capability: The receiver uses its internal power source. When connected to a 100-meter conductive wire, it can simultaneously initiate 20 series-connected electric detonators or 4 parallel-connected electric detonators. (3) Operating time: Under normal temperature conditions ($20 \pm 5^\circ\text{C}$), the receiver uses its internal power

内电源可连续工作 10 昼夜。

(4) 抗干扰能力：受同频率电台的工作干扰、广播干扰以及雷电、工业干扰不会误动。

(5) 适应温度：全套器材在 $-30 \sim +40^{\circ}\text{C}$ 条件下能正常工作 (不含电池)；防水性能良好。

2. 组成：GBP421 型遥控起爆器由 1 部发射机、5 部接收机、两部无线电话机及部分辅助器材组成 (图 3—34)。

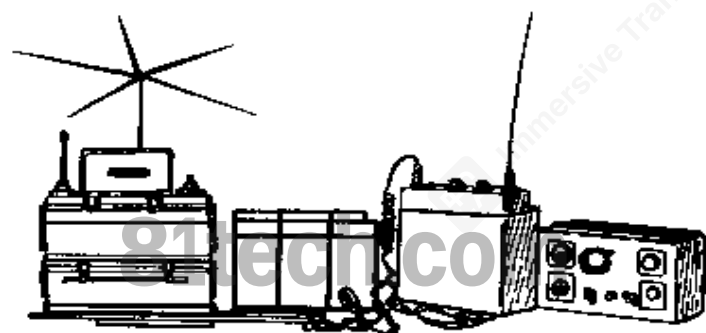


图 3—34 GBP421 型遥控起爆器

(1) 发射机：由机箱、电源箱、全向天线及背具组成 (图 3—35)，全机重 9 千克。

(2) 接收机：由机箱、电池盒、控制小盖及备份工具组成 (图 3—36)，全机重 2.5 千克。

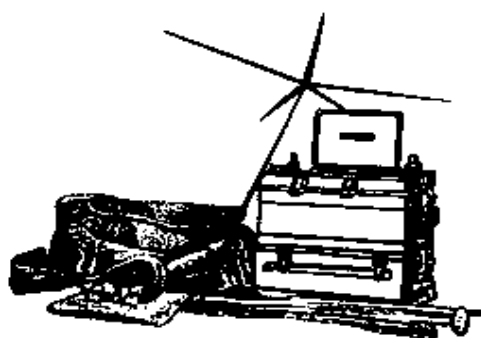


图 3—35 发射机

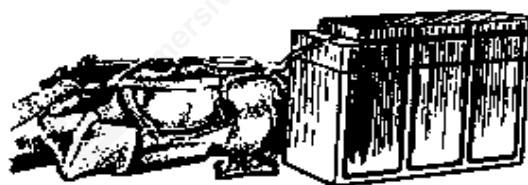


图 3—36 接收机

Internal power supply can operate continuously for 10 days and nights:

(4) Anti-interference capability: It will not malfunction due to interference from radio stations operating at the same frequency, broadcast interference, or lightning and industrial noise.

(5) Operating temperature: The complete equipment can operate normally under conditions of $30 \sim +40^{\circ}\text{C}$.

(Without battery): Good waterproof performance.

2. Composition: The GBP421 remote detonator consists of one transmitter, five receivers, two wireless telephones, and some auxiliary equipment (Figure 3-34).

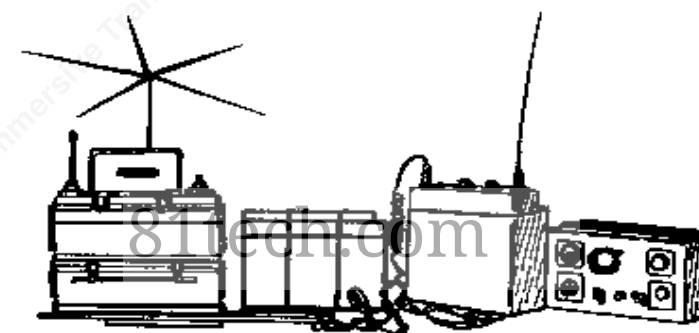


Figure 3—34 GBP421 Remote Initiator

(1) Transmitter: Comprises a chassis, power cabinet, omnidirectional antenna, and backplate (Fig. 3-35). The entire unit weighs 9 kg.

(2) Receiver: Composed of the chassis, battery box, control cover, and backup tools (Fig. 3-36), with a total weight of 2.5 kg.

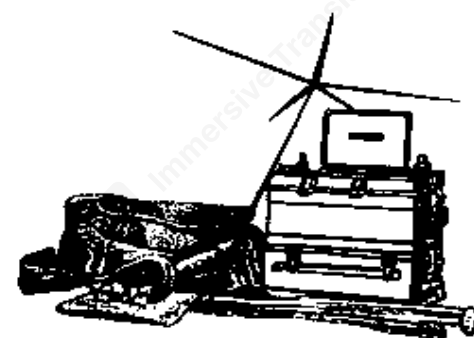


Figure 3—35
Transmitter

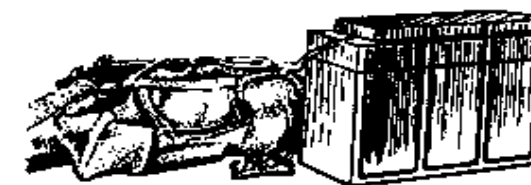


Figure 3—36
Receiver

(3) GBP421 型遥控起爆器配有两部无线电话机，用于作业中的通讯联络。

3. 发射机使用方法 (图 3—37):

(1) 打开机箱盖，插入天线和与接收机频率相对应的晶体；将指令旋钮置于预先规定的指令上；将工作选择旋钮置于调机位置。

(2) 接通电源，检查电源电压；调谐发射机至正常状态。

(3) 根据命令发出“开机”、“选机”和“起爆”控制信号，起爆预设装药。

(4) “起爆”指令发出后（电表指针显示下落），应立即将面板上的“电源开关”关闭。

4. 接收机使用方法:

(1) 选择爆破位置，设置装药并加以伪装。

(2) 装入电池，用万用表检查电源电压和接收机工作状态。

(3) 尽量选择地形开阔，远离钢筋混凝土建筑物、高压输电线以及其他不利于电波传播的位置设置接收机；连接装药与接收机之间的导电线；接通电源开关，然后迅速伪装并撤离现场。

(4) 当收到发射机发出的“开机”指令后，接收机电源在 3 分钟内进入连续供电状态，此后方可进行“选机”与“起爆”指令控制。超过 3 分钟后，接收机电源恢复间断供电状态，发射机须重新发出“开机”指令，方能进行正常控制。

(5) 当需要撤收时，应首先关闭发射机电源，停止工作。然后断开接收机与装药之间的导电线，取出雷管，撤收装药；去掉

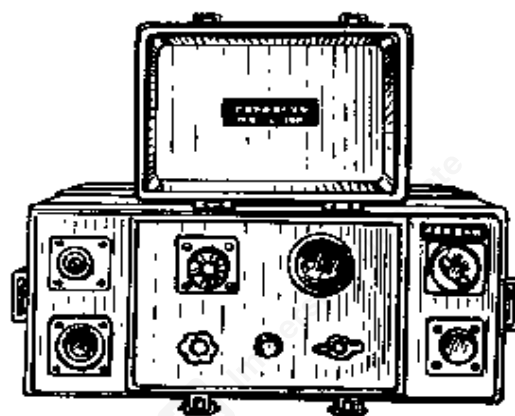


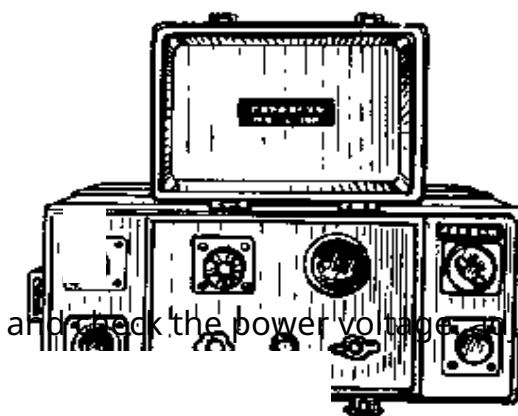
图 3—37 发射机面板

(3) The CBP421 remote detonator is equipped with two wireless telephones for communication during operations.

3. Transmitter Usage (Figure 3-37):

(1) Open the chassis cover, plug in

human antenna and crystal corresponding to the receiver frequency; set the instruction knob to the pre-specified instruction; set the selection knob to the tuning position,



(2) Connect the power supply and check the power voltage; adjust the transmitter to

Normal status.

(3) Follow the command from tech.com.

"Power On", "Select Machine", and "Start"

"blast" control signal, initiate preset charge

(4) After the "Arming" command is issued (indicated by the ammeter pointer moving downward), immediately turn off the "Power Switch" on the panel.

4. Receiver usage:

(1) Select the blasting position, set the charges, and camouflage them.

(2) Install the battery and use a multimeter to check the power voltage and receiver status.

(3) Whenever possible, choose terrain that is open and far from steel-reinforced concrete buildings and high-voltage power transmission lines.

set the receiver in locations that are not obstructed by wires or other factors that would impede radio wave transmission; connect the wire between the charge and the receiver; turn on the power switch, then quickly camouflage and evacuate the area.

(4) After receiving the "power on" command from the transmitter, the receiver's power supply enters a continuous power state within 3 minutes; only then can "device selection" and "initiation" commands be executed. After more than 3 minutes, the receiver's power supply returns to an intermittent power state, and the transmitter must issue a new "power on" command to resume normal control.

(5) When retraction is required, first turn off the launcher power and stop operation. Then disconnect the conductive wire between the receiver and the charge, remove the detonator, and withdraw the charge; remove

接收机上的伪装（或将接收机从坑中挖出），关闭电源，装入包装袋中以备下次使用。

5. 注意事项和安全措施：

(1) 发射机和接收机的工作频段、指令位置必须对应，发射机的工作频率不得自行随意更换，以防误控误爆。在设置接收机时，发射机必须关机，以防误爆。

(2) 发射机和接收机应尽量选择在开阔的位置，远离高压输电线、架高天线、建筑物、丛林及阻碍电波传播的高大物体。若无法避开时，发射机和接收机至这些物体的距离必须大于物体高度的 3 倍以上。

(3) 发射机的“开机”、“选机”信号发出的时间间隔必须大于 3 秒；“选机”、“起爆”信号发出的时间间隔必须大于 8 秒。

(4) 接收机在使用时机壳应接地，以防鞭状天线金属部件的高频电灼手，并可提高天线效率。在大风条件下使用时，应拉绳固定天线，以保证发射信号的稳定。

(5) 接收机连同天线埋设伪装时，其最大埋深不得超过 0.5 米。

(二) 袖珍式（常温型）遥控起爆器：为大规模集成电路、双音多频调频式多路遥控起爆装置。

1. 主要性能：

(1) 遥控距离：不小于 3 千米（昼夜）。

(2) 起爆能力：接收机使用机内电源，干线电阻不大于 5 欧姆时，A 型信号选择器可提供 10 路输出，每路可同时起爆串联电雷管 2 发；B 型信号选择器可提供 5 路输出，每路可同时起爆并联电雷管 2 发（或串联 10 发）。

(3) 工作时间：接收机在常温（ $20 \pm 5^\circ\text{C}$ ）条件下，使用 LR20 型锌锰碱性高性能电池可连续工作 12 昼夜，使用普通 1 号电池可连续工作 4 昼夜。

(4) 抗干扰能力：受同频率电台的工作干扰、广播干扰以及

Camouflage the receiver (or dig it out of the pit), turn off the power, and place it in a packaging bag for future use.

5. Precautions and Safety Measures:

(1) The operating frequency bands of the transmitter and receiver must correspond, and the instruction position must match. The operating frequency of the transmitter must not be changed arbitrarily to prevent accidental control and detonation. When setting up the receiver, the transmitter must be turned off to prevent accidental detonation.

(2) Transmitters and receivers should be installed as far as possible in high and open locations, away from high-voltage power lines, elevated antennas, buildings, forests, and other tall objects that may obstruct radio wave propagation. If avoidance is not possible, the distance between the transmitter or receiver and such objects must be at least three times the height of the object.

(3) The time interval between the "power-on" and "channel selection" signals of the transmitter must be in 3 seconds; the time interval between the "select machine" and "initiate explosion" signals must be greater than 8 seconds.

(4) When using the receiver, the housing should be grounded to prevent high-frequency electrical burns from the whip antenna's metal parts and to improve antenna efficiency. When operating in windy conditions, use a rope to secure the antenna to ensure stable transmission of the signal.

(5) When burying and camouflaging the receiver with its antenna, the maximum burial depth shall not exceed 0.5

(2) Miniature (ambient temperature) remote detonator: A large-scale integrated circuit, dual-tone multi-frequency FM multi-channel remote detonation device.

1. Main

Performance:

(1) Remote control range: not less than 3 kilometers (day and night).

(2) Initiation capability: When the receiver uses its internal power source and the main line resistance does not exceed 5 ohms, the Type A signal selector can provide 10 outputs, with each output capable of simultaneously initiating 2 series-connected electric detonators; the Type B signal selector can provide 5 outputs, with each output capable of simultaneously initiating 2 parallel-connected electric detonators (or 10 series-connected ones).

(3) Working time: Under normal temperature conditions ($20 \pm 5^\circ\text{C}$), the receiver can operate continuously for 12 days and nights using LR20 zinc-manganese alkaline high-performance batteries, or for 4 days and nights using ordinary No. 1 batteries.

(4) Anti-interference capability: Interference from radio stations operating at the same frequency, broadcast interference, and

天电、工业干扰不会误动。

(5) 适应温度：全套器材在 - 20 ~ + 50℃条件下能正常工作 (不含电池)。防水性能良好。

(6) 全重：≤7 千克。

2. 组成：袖珍式 (常温型) 遥控起爆器由超短波袖珍式无线电遥控指令发射机 (以下简称发射机)、无线电遥控指令接收机 (以下简称接收机)、发射机电池专用充电器和辅助器材组成 (图 3—38、表 3—3)。

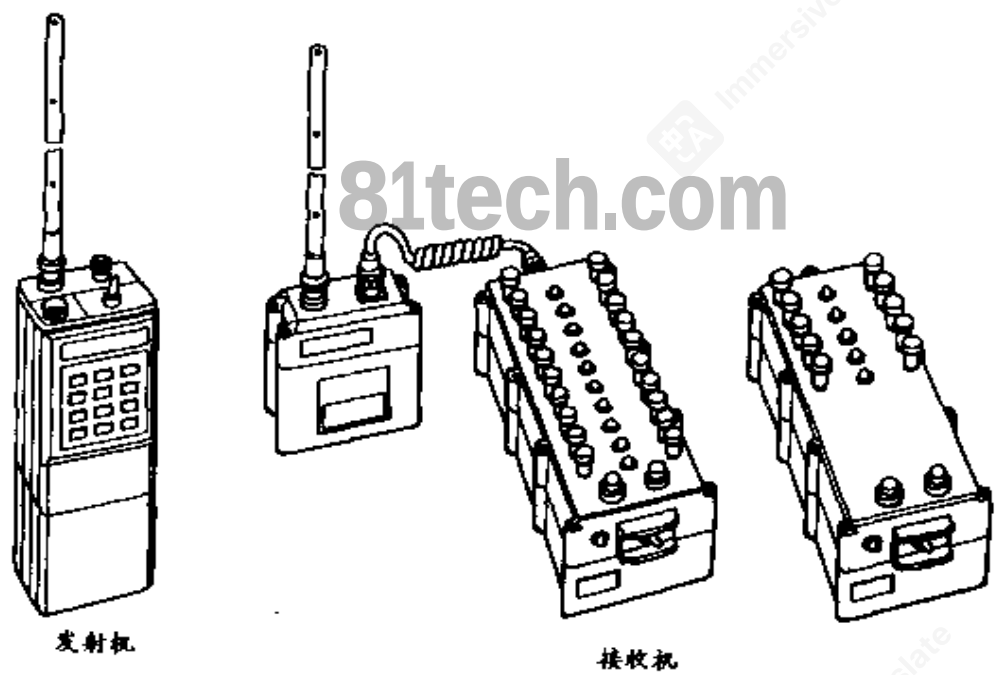


图 3—38 袖珍式遥控起爆器

表 3—3 主要设备

序 号	名 称	单 位	数 量
1	铝壳包装箱	个	1
2	发射机	部	1
3	信号接收机	部	1

No false triggering from lightning or industrial interference

(5) Operating temperature: The complete equipment can operate normally under conditions of 20 ~ +50°C.

(Excludes battery). Good water resistance.

(6) Total weight: up to 7 grams.

2 Composition: The pocket-sized (room temperature) remote control detonator consists of a very short wave pocket-sized radio remote control instruction transmitter (hereinafter referred to as the transmitter), a radio remote control instruction receiver (hereinafter referred to as the receiver), a dedicated charger for the transmitter battery, and auxiliary equipment (Fig. 3-38, Table 3-3).

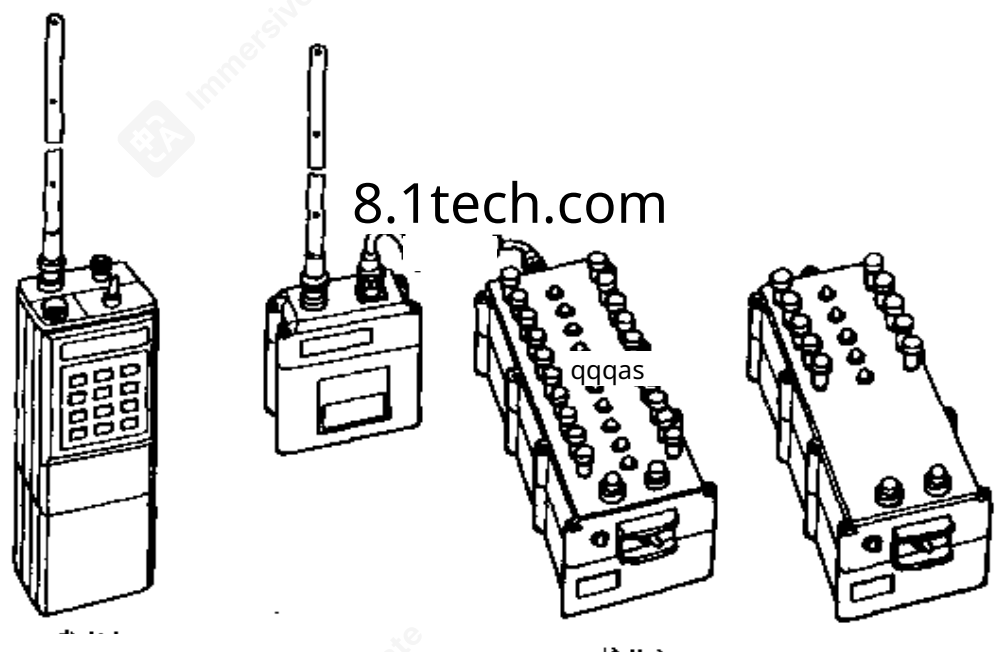


Figure 3—38 Pocket-sized Remote Detonator

1	Aluminum shell packaging	1
	Signal Receiver	

续 表			
序 号	名 称	单 位	数 量
4	信号选择器 A	部	1
5	信号选择器 B	部	1
6	发射机备用电池组	块	1
7	连接电缆线	根	2
8	天线	根	1
9	各种工具及使用说明书	套	1
10	充电机	部	1

(1) 发射机:由天线、机体和电池盒三部分组成(图 3—39)。

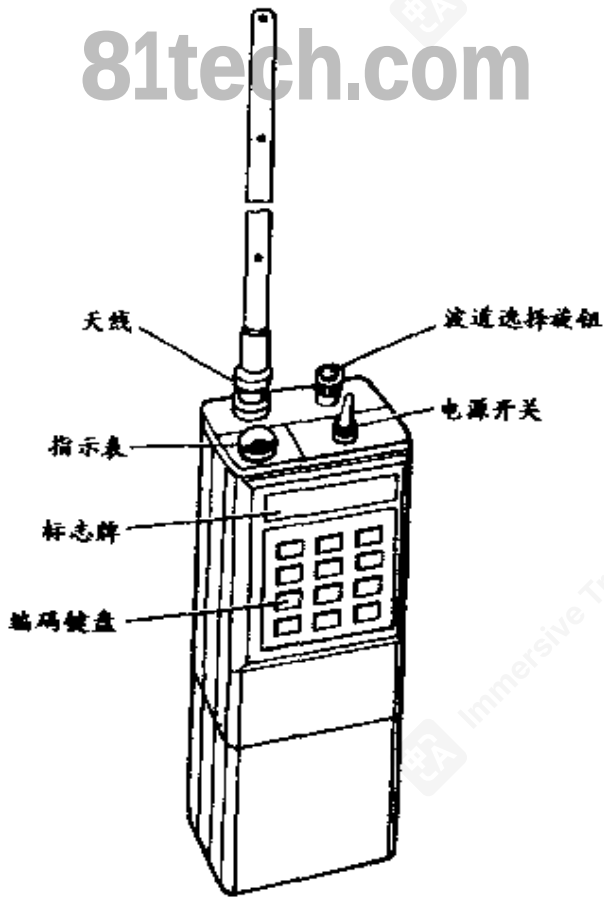


图 3—39 发射机

	Signal Selector A		
	Signal Selector B		
	Transmitter spare battery pack		
	Connection cable		
	Various tools and their user manuals		

(1) Transmitter: Composed of three parts: the antenna, the body, and the battery box (Fig. 3-39).

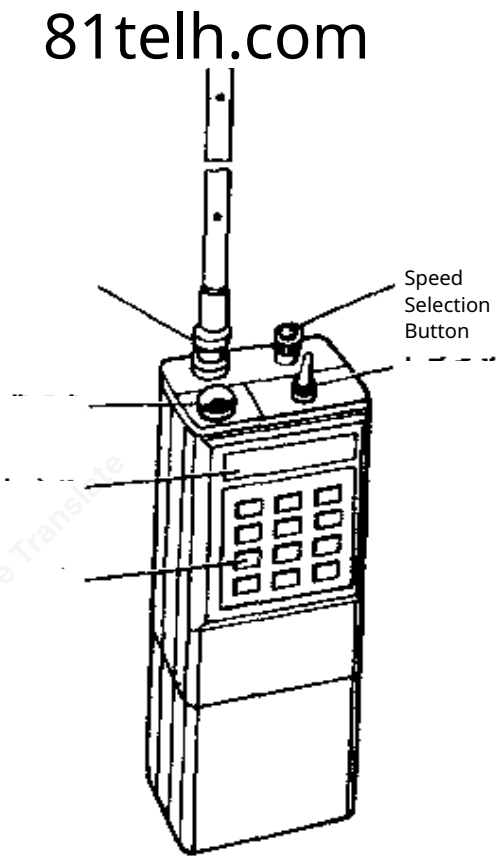


Figure 3-39
Transmitter

天线和机体通过天线插座连接；机体与电池盒之间通过自动定位导轨连接。

发射机面板上有电源开关、天线插座、波道选择旋钮、指示表、编码键盘及标志牌等装置。编码键盘用于选择密码指令，其中键盘上的“C”为开机指令，数字0~9为与接收机选择器外起爆电路接线柱号码相对应的起爆指令按键。

电池盒内装专用电池组，为发射机工作电源；盒底部有两个导电柱，可直接与充电机结合，为电池组充电。

天线为扁状钢带，具有较强的韧性，可以弯曲。

(2) 接收机：由信号接收机、信号选择器、接收天线和双插头四芯密封连接电缆组成（图3—40）。接收天线与信号接收机

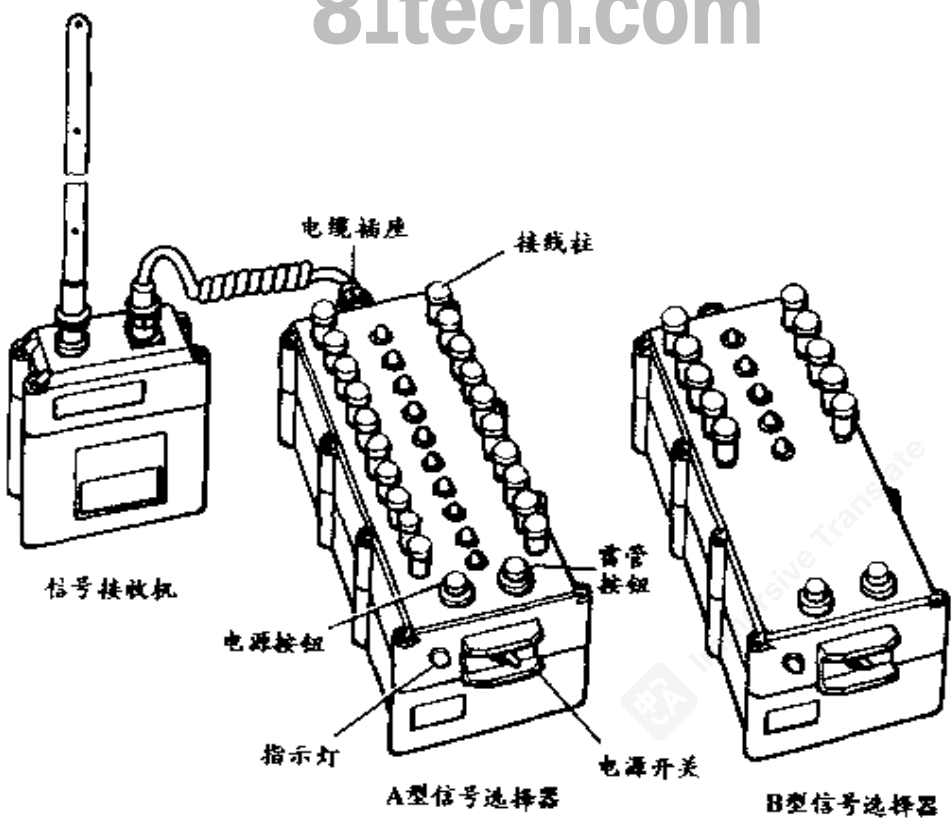


图 3—40 接收机

The antenna and the body are connected via an antenna socket; the body and the battery box are connected via an auto-aligning guide rail.

The transmitter panel is equipped with a power switch, antenna socket, channel selection knob, indicator panel, encoding keyboard, and nameplates. The encoding keyboard is used to select password commands, and its

The "C" key on the center keyboard is the parallel connection command, and the number 0~9 is for receiver selector external

Detonator circuit terminal number corresponding detonator instruction button

The battery box contains a dedicated battery pack serving as the power source for the transmitter; there are two at the bottom of the box.

Conductive column, which can be directly connected to a charger to charge the battery pack.

The antenna is a flat steel strip with strong toughness and can be bent.

(2) Receiver: consists of a signal receiver, signal selector, receiving lead, and a four-core sealed connector cable (Fig. 3-40). The receiving antenna and the signal receiver

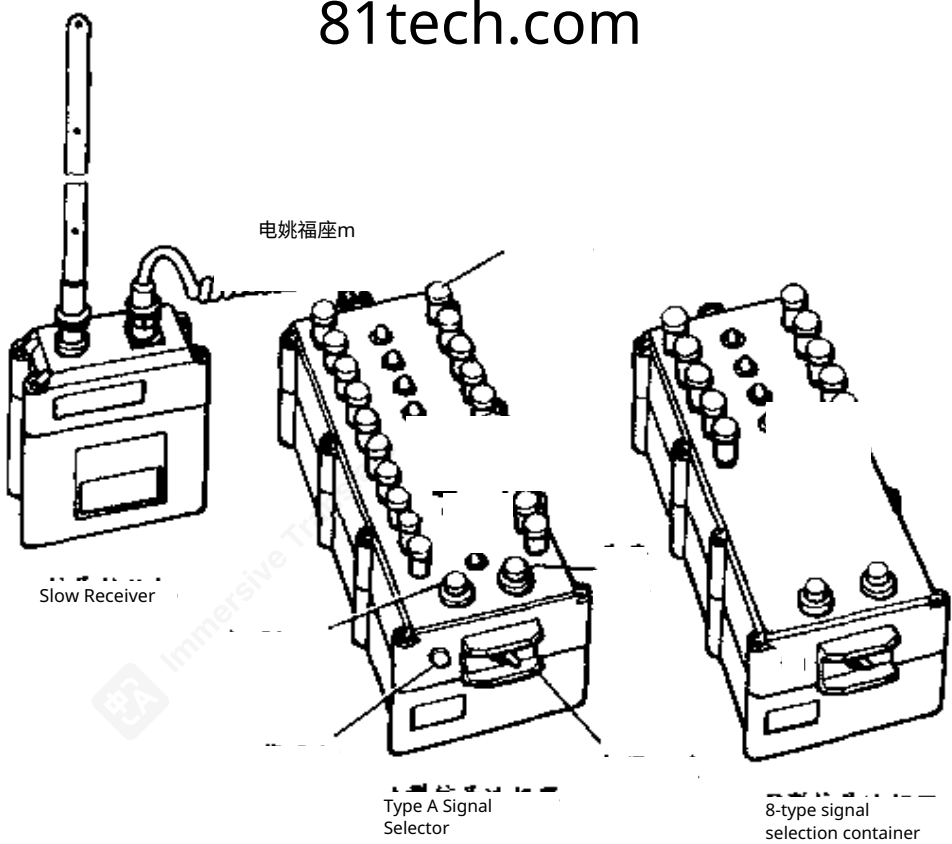


Figure 3—40

通过天线插座连接；信号接收机与信号选择器通过四芯密封电缆连接。

信号选择器分“A”、“B”两种类型，其机盖上有电源按钮、雷管按钮、接线柱、电缆插座、电源开关及指示灯等装置。

(3) 充电机：为 CDJ-87 型直流充电机，用于对发射机电源（专用电池组）充电。其主要性能如下：

充电截止电压：12 伏特

充电电流：一档（慢充档）：50 毫安

二档（快充档）：100 毫安

充电时间：一档：约 15 小时

二档：约 7 小时

适应温度：-10~+40℃

全重：0.8 千克

3. 发射机使用方法：

(1) 安装发射机天线。

(2) 将波道（频道）选择旋钮置于所需的工作波道位置（红线所指处，此旋钮位置在出厂时已预先设置好，一般不要再动），以发射机标牌频道代号为准。

(3) 安装电池（开关应处于“OFF”位置）。

(4) 接通电源开关（将开关置于“ON”位置）。

(5) 按下编码键盘上的开机指令键“C”，此时表示发射状态的指示表指针摆向右边，持续约 2.5 秒左右，等表针复归到原位时，即刻按下所需要的起爆指令键，此时指示表指针再次摆动，表示发射机已有功率输出，即完成一个预设装药的起爆。每次按键持续时间不超过 1 秒；每组指令的发射时间应在 5 秒内完成，否则，应重复上述过程。

(6) 关闭电源（将开关置于“OFF”位置）。

4. 接收机使用方法：

(1) 安装电池：将 6 节 1 号电池装入信号选择器电池仓中

Connection via antenna socket: The signal receiver and signal selector are connected via a four-core sealed cable.

The signal selector comes in two types, "A" and "B". On its cover are the power button, lightning button, terminals, cable socket, power switch, and indicator lights, etc.

(3) Charger: CDI-87 type DC charger, used to charge the transmitter power supply (dedicated battery pack). Its main performance specifications are as follows:

Charging cutoff voltage: 12 volts

Charging current: 1 ~ level (slow charge mode): 50 mA

Second Gear (Fast Charge Mode): 100 mA

Charging time: Level 1: 15 hours

Stage 2: About 7 hours

Temperature range: -10~+40℃ Full weight

tech.com

3. Transmitter usage:

(1) Install the transmitter

(2) Set the channel (frequency) selector knob to the required working channel position (indicated by the red line; this knob position is preset at factory and should generally not be adjusted), to push the transmitter label channel code.

(3) Install the battery (ensure the switch is in the "OFF" position).

(4) Turn on the power (set the switch to the "ON" position).

(5) Press the "C" power-on instruction key on the encoding keyboard. At this point, the indicator pointer on the status display will swing to the right for approximately 2.5 seconds. When the pointer returns to its original position, immediately press the required detonation instruction key. The indicator pointer will swing again, indicating that the transmitter has power output, thus completing the detonation of a preset charge. Each key press should last no more than 1 second; the entire transmission of each set of instructions should be completed within 5 seconds, otherwise, repeat the above process.

(6) Turn off the power (set the switch to the "OFF" position).

4. Receiver usage:

(1) Install batteries: Insert 6 No. 1 batteries into the battery compartment of the signal selector.

(串联),并用万用表检查电源电压;也可按下电源按钮检查电压,若电源指示灯发出较强绿光时为正常,否则应更换新电池。

(2) 检查工作状态:接收机各组成部分连接好后,将电引火头脚线接到信号选择器左右两排某一对应的接线柱上,按下“雷管”按钮,此时接线柱间的检查指示灯(红色)应发亮;然后在近距离操纵发射机起爆电引火头,电引火头应能准确起爆。

(3) 选择炸点:根据需要进行选择炸点、设置装药。使用 A 型信号选择器时,炸点在 10 个以内;使用 B 型信号选择器时,炸点在 5 个以内;炸点位置的选择应便于隐蔽设置装药、敷设导电线。

(4) 选择接收机位置:在距各炸点 100 米范围内,选择有利于电波传播、电磁干扰小,便于隐蔽的位置设置接收机。战时如不能回收接收机时,其位置应选择在最后一个炸点一同销毁,以利于保密。平时训练时,接收机的位置应远离各炸点,以保证回收,重复使用。

(5) 敷设导电线:由各炸点向接收机位置敷设导电线并加以伪装。敷设时如条件允许,电雷管与装药可暂不结合,并采取安全隔离措施;然后在接收机位置将各炸点的每对导电线与选择器左右两排(掀压式)接线柱一一对应连接。

(6) 检查线路:线路连接好后,按下“雷管”按钮,与各对线路相对应的接线柱间指示灯应发红光,否则,表明该指示灯所对应的线路不通,应检查、排除故障。

(7) 将电雷管插入装药。

(8) 接收机联机:将信号选择器与信号接收机通过电缆加以连接,然后将天线插入信号接收机天线插座。

(9) 信号选择器开机:利用地形对接收机加以伪装,然后打开信号选择器开关;作业人员在开机后 3 分钟内撤至安全位置。

(10) 起爆:当电源打开 3 分钟后,12 昼夜间可在 3 千米距离内用发射机遥控起爆。

(Connect in series), and check the power supply voltage with a multimeter: you can also press the power button to check the voltage; if the power indicator light emits a strong green light, it is normal, otherwise replace the battery with a new one.

(2) Check work status: After connecting all parts of the receiver, turn on the power.

Connect the ground wire to the corresponding terminals on either the left or right row of the signal selector, then press "雷

"Tube" button, at this time the inspection indicator light (red) between the terminals should be lit; then operate the detonator of the blasting transmitter at close range, and the detonator should be able to detonate accurately.

(3) Select detonation points: Select detonation points and set charges as needed. When using an A-type signal selector, there should be 10 or fewer detonation points; when using a B-type signal selector, there should be 5 or fewer detonation points. The selection of detonation point locations should facilitate concealed charge setting and laying of conductive wires.

(4) Select receiver location: Choose a location within 100 meters of each detonation point that is favorable for wave propagation, has low electromagnetic interference, and is conducive to concealment. In wartime, if the receiver cannot be recovered, its location should be selected to be destroyed together with the last detonation point to facilitate confidentiality. During peacetime training, the receiver's location should be kept away from each detonation point to ensure recovery and reuse.

(5) Lay ground wires: From each detonation point, lay ground wires to the receiver location and camouflage them. When laying, if conditions permit, the electric detonators and charges may be temporarily unconnected, and safety isolation measures shall be taken; then, at the receiver location, connect each pair of ground wires from each detonation point one-to-one with the left and right terminals (depressurization type) of the selector.

(6) Check the wiring: After connecting the lines, press the "fuse" button; the indicator lights between the fuse button and the terminals corresponding to each pair of lines should glow red. If not, it indicates that the line corresponding to that indicator light is not connected, and the fault should be checked and eliminated.

(7) Install the electric detonator.

(8) Receiver connection: Connect the signal selector to the signal receiver via a cable, then insert the antenna into the signal receiver antenna socket.

(9) Signal selector power-on: Camouflage the receiver using terrain, then turn on the signal selector switch; personnel must withdraw to a safe location within 3 minutes after power-on.

(10) Initiation: After the power source is turned on for 3 minutes, initiation can be remotely controlled using a transmitter within a distance of 3 meters during the 12 daylight hours.

5. 充电机使用方法：充电时，将充电机电源插头插入 220 伏特交流电插座，打开电源开关；将档位转换开关置于“50mA”位置；将电池盒底端的导电柱对准充电机充电仓内的两个弹簧片插入，此时面板充电指示灯应发红光，否则，应重新插入；当充电机充电指示灯不再发光（或亮度较暗）时，说明电池组已充足电，即可取下电池。

如需快速充电，可将转换开关置于“100mA”档，但不宜长期使用此档充电，以免影响电池使用寿命。

对新电池充电，有可能充不进去，此时应用“50mA”档反复充放电数次，放电电压一般不能低于 8 伏特，放电电流可控制在 100 毫安左右（可串联 100 欧姆电阻）。

充电机适用交流电压为 220 ± 20 伏特，电压过高过低都会影响使用。

充电机在使用过程中，充电仓内的接点不允许接反，更不允许将电池接反；充电时，若电池温度过高应立即停止充电。

电池盒一般不要随便打开。

6. 注意事项和安全措施：

(1) 严禁擅自改动发射机工作波道和密码指令。

(2) 发射机在未接上天线时不得打开电源开关，不得按压编码键盘上的各指令键，以免烧坏仪器。

(3) 从“开机”至“起爆”指令信号发出的时间间隔必须大于 2.5 秒；每组指令发出的时间间隔为 3~5 秒。

(4) 接收机电源需接通 4 分钟后（延时保护结束），发射机才能进行有效控制。

(5) 使用中应尽量避免影响电波传播的障碍物，并保持天线不弯曲或抖动，以免影响信号稳定。

(6) 数套遥控起爆器同时使用时，要注意信号接收机和信号选择器的机号一致，信号接收机和发射机的机号和波道号应一致，否则将出现误爆。

5. Charger usage method: When charging, insert the charger power plug into a 220-volt AC socket, turn on the power switch, set the mode switch to the "50mA" position, align the conductive pins at the bottom of the battery box with the two spring contacts inside the charger's charging compartment. When the panel's charging indicator light glows red, the connection is correct; otherwise, reinsert the plug. When the charger's charging indicator light stops glowing (or becomes dim), it indicates the battery pack is fully charged, and the battery can be removed.

For fast charging: set the conversion switch to the "100mA" position, but do not use this setting for extended periods, as it may affect the battery's service life.

Charge the new battery; it may not charge initially. In this case, repeatedly charge and discharge using the "50mA" setting. The discharge voltage should generally not drop below 8 volts, and the discharge current can be controlled at approximately 100 mA (by connecting a 100-ohm resistor in series).

The charger is designed for 220V AC mains power. Both excessively high and low voltages can affect operation.

During charging, the contacts inside the charging case must not be reversed, and the battery must not be connected in reverse; if the battery temperature is too high during charging, charging must be stopped immediately.

Do not open the battery box randomly.

6. Precautions and Safety Measures:

(1) Strictly prohibit unauthorized changes to the transmitter's operating frequency and password commands.

(2) Do not turn on the power switch or press any command keys on the coding keyboard when the transmitter is not connected to an antenna, to avoid damaging the instrument.

(3) The time interval from "power on" to the issuance of the "initiate blasting" command signal must be greater than 2.5 seconds; the time interval between each set of commands is 3~5 seconds.

(4) The receiver power must be connected for 4 minutes (after the delay protection ends) before the transmitter can be effectively controlled.

(5) Try to avoid obstacles that may affect radio wave propagation during use, and keep the antenna from bending or shaking to ensure signal stability.

(6) When using multiple sets of remote detonators simultaneously, ensure that the serial numbers of the signal receiver and signal selector are consistent, and that the serial numbers and channel numbers of the signal receiver and transmitter match.

Otherwise, there will be a false explosion.

第五十三条 实施遥控起爆应注意以下事项。

(一) 发射机与接收机必须在准备地点实施检查，确认良好后方可使用。

(二) 必须按照遥控爆破器的操作规程作业，不得擅自改动工作频率，防止误控误爆。

(三) 发射机与接收机设置小组要指定专人负责；作业完毕后要向指挥员报告。

(四) 作业前要明确规定联络信号，指定专人负责两地之间的联络，防止发生意外。

(五) 必须在接收机设置完毕，人员撤至安全位置后，方可打开发射机电源。

(六) 当需排除接收机故障或撤收接收机时，必须在确实关闭发射机电源后，方可前往作业。

(七) 发射机设置小组必须指定专人负责看管发射机；未经指挥员允许，任何人不得打开发射机电源。

Article 53 When implementing remote detonation, the following precautions should be observed:

(1) The transmitter and receiver must be inspected at the designated location to confirm they are in good working condition.

After that, you can use it.

(2) Operations must be conducted in accordance with the operating procedures for the blasting control device; unauthorized changes to the working frequency are prohibited to prevent accidental control or detonation.

(3) The team responsible for setting up the transmitter and receiver must designate a specific person in charge; after completing the operation, they must report to the commander.

(4) Before starting work, clearly define communication signals and assign a dedicated person responsible for communication between the two locations to prevent accidents.

(5) The transmitter power shall not be turned on until the receiver is set up and personnel have been moved to a safe location.

(6) When it is necessary to exclude receiver faults or remove the receiver, it must be done only when it is confirmed that the receiver is completely off.

After turning off the transmitter power, you can proceed to cr.commm

(7) The transmitter settings team must designate a specific person responsible for managing the transmitter; no one may open the transmitter power switch without the commander's permission.

第四章 爆破器材

第一节 制式药块

第五十四条 制式药块分为 75 克、200 克、400 克、2.5 千克和 5 千克五种，装药均为梯恩梯炸药（图 4—1）。

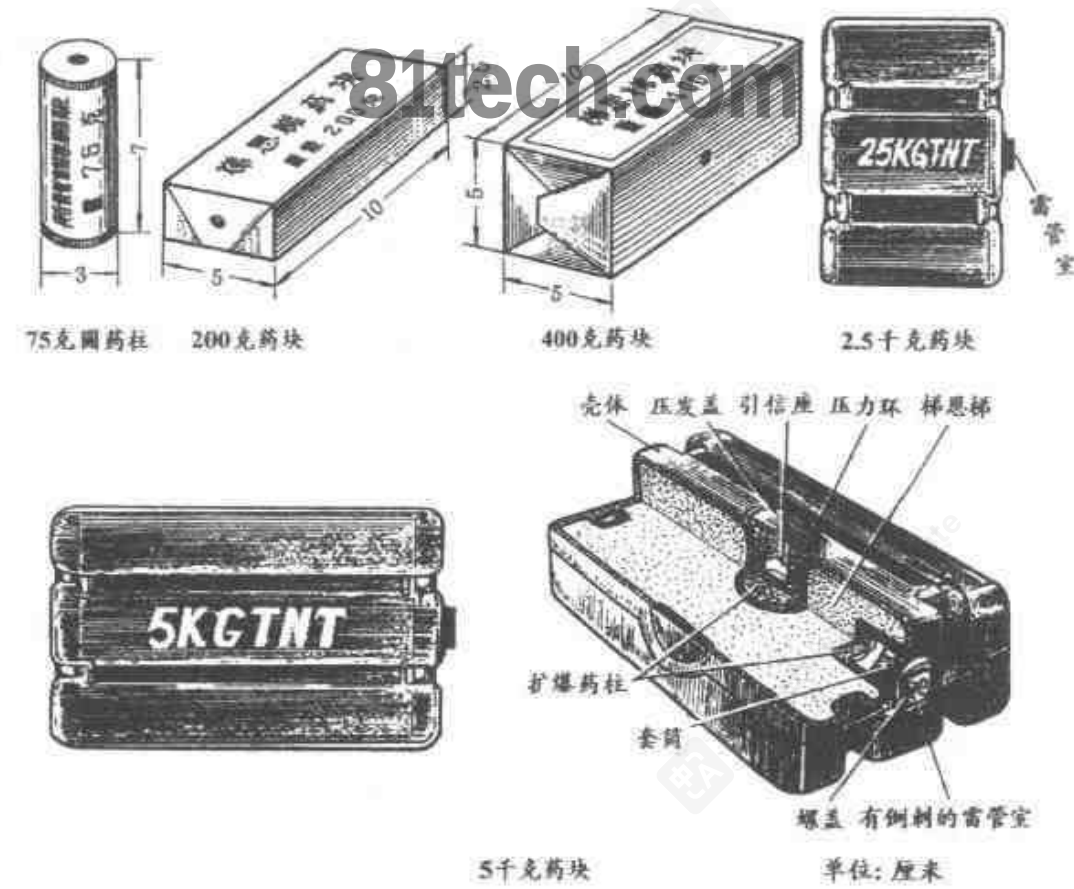


图 4—1 制式药块

Article 54
Standardized explosive blocks come in five sizes: 75 grams, 200 grams, 400 grams, 2.5 kilograms, and 5 kilograms. The explosive charge in all of them is TNT (Figure 4-1).

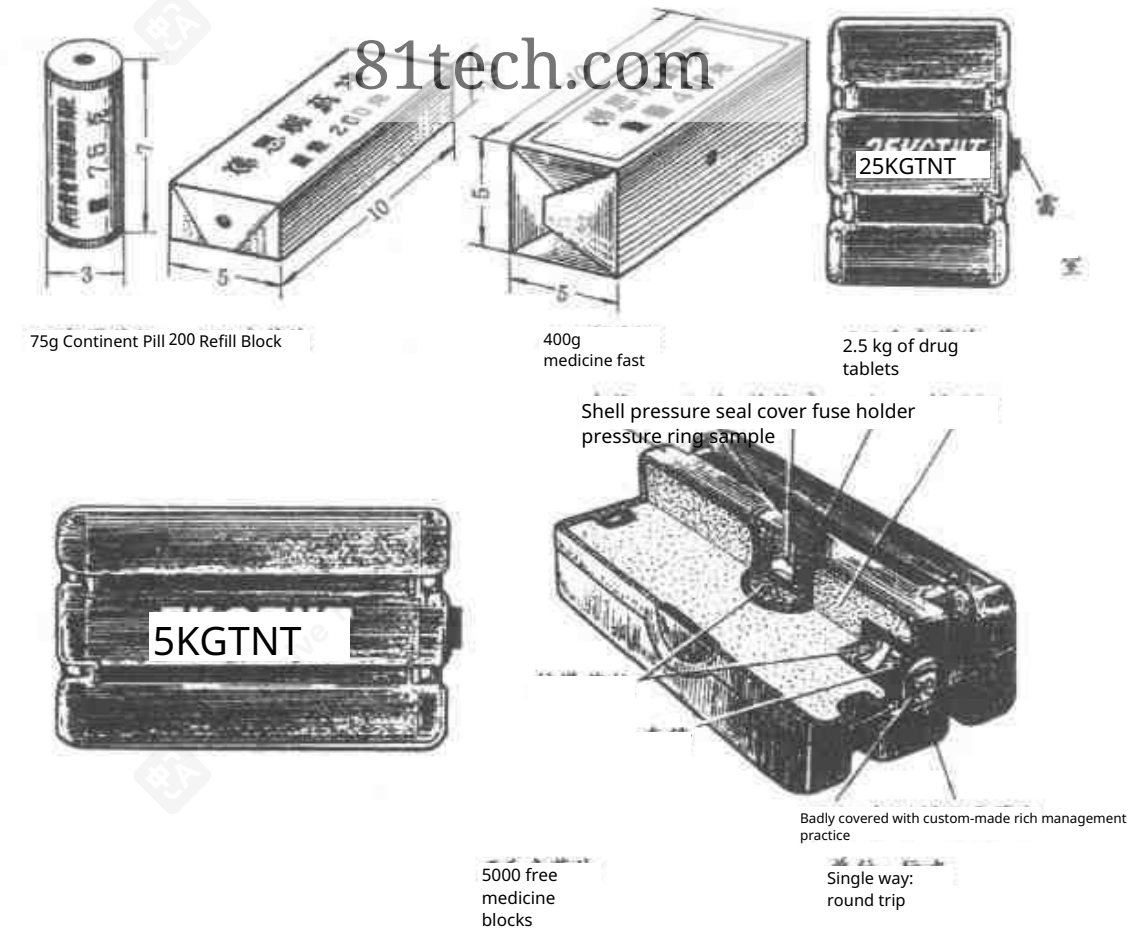


Figure 4-1
Standardized Drug
Tablets

第五十五条 75 克梯恩梯药柱、200 克和 400 克梯恩梯药块均有雷管孔，可用 8 号火雷管或电雷管起爆。药块可单块使用，也可捆包成集团装药或直列装药使用。

2.5 千克和 5 千克的药块，主要用于爆破各种目标。药块的塑料外壳一端装有一块重约 40～50 克的钝化黑索金扩爆药柱，并有两个雷管室。5 千克的药块正面设有引信室，配用 59 式防坦克地雷引信，可当作地雷使用。其性能见表 4—1。

表 4—1 制式药块的性能

性 能	2.5kg 药块	5kg 药块
全 重 (kg)	2.7	5.4
药 量 (kg)	2.5	5.0
外形尺寸 (mm)	135×178×88	260×178×90
发 火 方 式	拉发	拉发或压发
威 力	能炸穿中型坦克后上甲，破坏发动机	能炸穿中型坦克后上甲，炸断中型坦克履带

第二节 爆破筒

第五十六条 爆破筒是一种制式直列装药，主要用于爆破敌筑城工事，杀伤敌有生力量，在敌铁丝网、鹿砦和地雷场等障碍物中开辟通路。

第五十七条 我军装备的爆破筒有 GBP110 型、GBP110—1 型、GBP111 型、GBP112 型和 GBP113 型等五种。

(一) GBP110 型爆破筒 (图 4—2)：

1. 构造：外壳为无缝钢管，内装 13 个压制的梯恩梯药柱。一端有外螺纹，用于和另一节爆破筒连接，平时有一薄盖盖住；

— 60 —

Article 55: 75g TNT cartridges, 200g and 400g TNT blocks all have fuse holes: they can be detonated with No. 8 electric fuses or electric detonators. Blocks can be used individually, or bundled into group charges or line charges for use.

2.5-gram and 5-gram explosive blocks, primarily used for breaching various targets. The explosive block's outer casing contains a 1-gram end filled with a 1-gram non-initiating RDX booster charge, and two pipe chambers: the 5-gram block's front face is equipped with a trigger mechanism, compatible with the Type 59 anti-tank mine trigger, allowing it to function as a landmine; its performance is detailed in Table 4-1.

Table 4-1 Performance of Standardized Drug Tablets

	2.5kg medicine block	5kg drug tablets
g) Pile (kg)		
Dimensions (mm)		
		Pull or push
	After destroying medium tanks, destroy the engine.	Can penetrate the rear armor of tanks and sever the tracks of medium tanks.

Section 2: Detonator

Article 56: The demolition charge is a standardized straight-bore explosive, primarily used to destroy enemy fortifications, inflict casualties on enemy personnel, and clear paths through enemy obstacles such as barbed wire, foxholes, and minefields.

第五十七条 我军装备的爆破筒有 GBP110 型、GBP110—1 型、GBP111 型、GBP112 型和 GBP113 型等五种。

(-) GBP110 型爆破筒 (图 4-2)：

1. Construction: The outer shell is a seamless steel pipe, and the interior contains 13 pressed TNT cartridges.

The end has an external thread, connected with a detonator and a booster by a coupling, and is covered by a thin cap when in use;

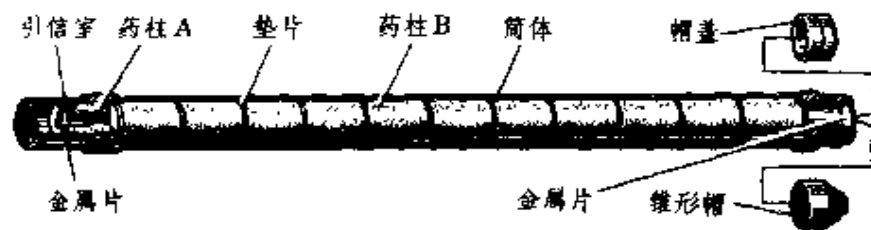


图 4—2 GBP110 型爆破筒

另一端有内螺纹，用于固定引信或与另一节爆破筒连接，该端还有一个引信室，平时用纸封住。为方便，每 4 根爆破筒附有 1 个带吊环的锥型帽，锥型帽的内螺纹与爆破筒的外螺纹结合。带锥型帽的为副级爆破筒，不带锥型帽的为正级爆破筒。

GBP110—1 型爆破筒的构造与 GBP110 型爆破筒基本相同，内装 7 个压制的梯恩梯药柱。

GBP110 型和 GBP110—1 型爆破筒可使用 68—1 式（图 4—3）、68—2 式、爆—1 甲式拉发延时引信（图 4—4）。引信一端有外螺纹和两个金属销钉，用于与爆破筒连接。

2. 主要战术技术性能：单节爆破筒能杀伤一般工事内的敌人，摧毁其武器，炸断轨条砦及直径 33 厘米以下的木桩砦。成一线连接使用时，能在两层以下的蛇腹形铁丝网中开辟 10 米宽的通路；在三列高桩铁丝网中开辟 4.5~6 米宽的通路；在防步兵地雷场中开辟 7~8 米宽的通路（表 4—2）。

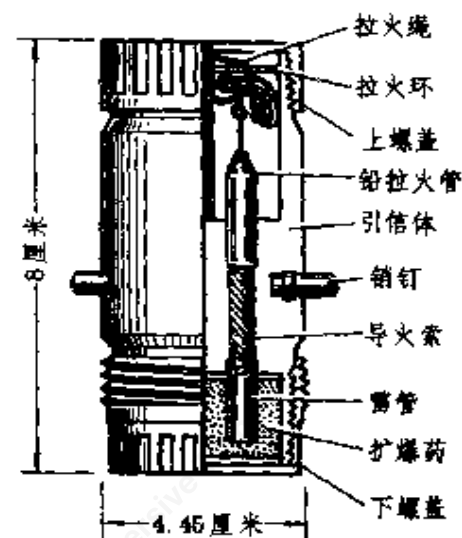


图 4—3 68—1 式引信

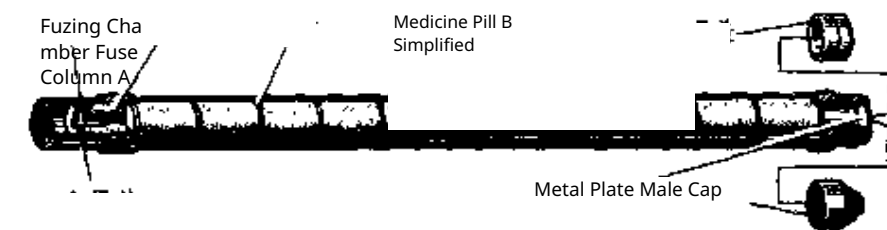


Figure 4—2GBP110 Detonator

The end has an internal thread, used for connecting blasting tubes in the courtyard or for blasting joints. This end also has a small chamber, which is normally sealed with paper. For convenience, one conical cap with a flange is attached to every four blasting tubes; the internal thread of the conical cap combines with the external thread of the blasting tube. Those with conical caps are secondary blasting tubes. Those without conical caps are primary blasting tubes.

GRP110-1 type explosive charge

Similar to the CP110 plastic explosive detonator, it is internally loaded with a compressed TNT charge.

CBP110 and CBP110-1

Explosive simplification can use the 68-1 style (Figure 4-

3), 682 Type, Explosive-1 Type Pull-Initiated Delay

Time fuse (Figure 4-4). One end of the fuse has

External thread and two metal pins, connected to the blasting tube.

2. Main tactical and technical performance: A single section can destroy enemy positions within general fortifications, destroy their weapons, and blow up rails, rock, and stakes with a diameter of 33 cm or less. Continuous line connection.

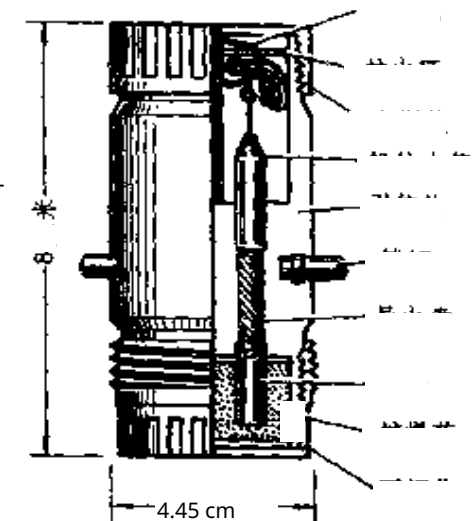


Figure 4—368--1 Fuse

When connected, it can open a 10-meter-wide passage through two layers or less of snake-mesh wire fencing; open a 4.5~6-meter-wide passage through three rows of high-stake wire fencing; and open a 7~8-meter-wide passage through an anti-personnel minefield (Table 4-2).



图 4—4 爆—1 甲引信

3. 使用方法：GB110 型、GB110-1 型爆破筒根据需要可单节使用，也可将多节连接在一起使用。使用时，先将引信有外螺纹的一端旋入爆破筒，旋松另一端螺盖。接近目标时，旋掉引信螺盖，将拉火环套入手指，用力将爆破筒投向目标或放置在目标爆破位置上，同时拉火，然后迅速撤离并隐蔽。

(二) GB111 型爆破筒 (图 4—5)：

1. 构造：外壳为无缝钢管，一端侧壁有两个销钉，用以和另一节爆破筒连接；另一端略粗，侧壁有两个卡槽和两个卡爪，用以连接引信或另一节爆破筒。两端都用金属片将药柱固定在外壳中，内装 8 个压制的梯恩梯药柱。

GB111 型爆破筒使用的引信同 GB110 型爆破筒。

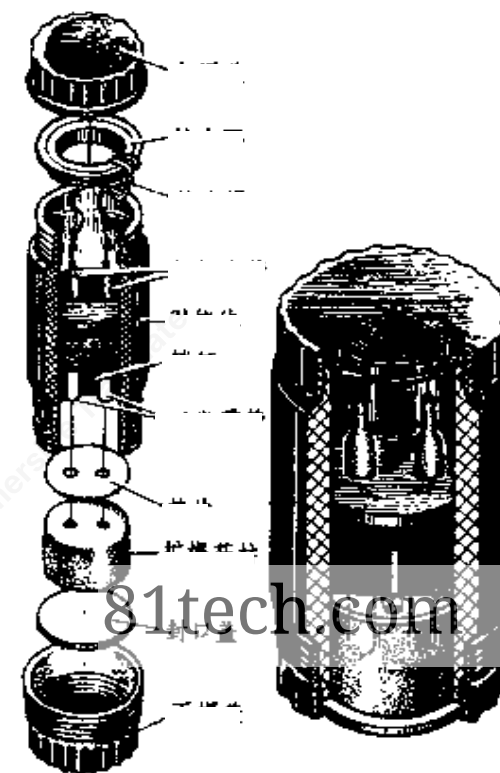


Figure 4-4-1-1 Mine Detonator

3. Usage method: The GB110 and GB110-1 type blasting tubes can be used as single sections according to needs, or multiple sections can be connected and used together. When using, first screw the end with the external thread of the fuse into the blasting tube, and loosen the other end cap. When approaching the target, remove the fuse cap, put the firing ring on your finger, and throw the blasting tube at the target or place it on the designated blasting position with force, while simultaneously pulling the fuse, then quickly evacuate and cover.

(一) GB111 type explosive charge (Fig. 4-5):

1. Construction: The casing is made of seamless steel pipe. One end has two pins on the side wall for connecting to another section of the explosive charge; the other end is slightly thicker, with two slots and two claws on the side wall for connecting a fuse or another section of the explosive charge. Metal plates are used at both ends to secure the charge inside the casing. It contains eight compressed TNT charges. The fuse used with the CBP111 explosive charge is the same as that used with the CBP110 explosive charge.

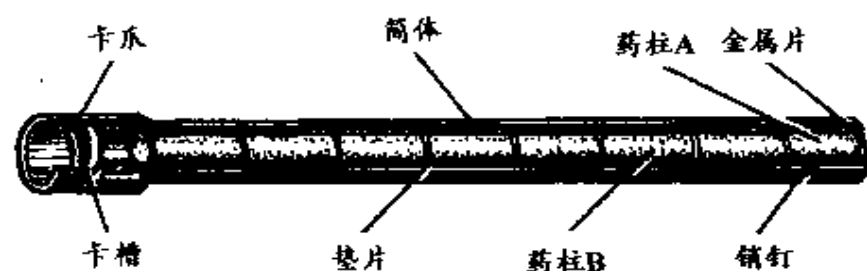


图 4—5 GBP111 型爆破筒

2. 主要战术技术性能：GBP111 型爆破筒的主要战术技术性能与 GBP110 型爆破筒基本相同，见表 4—2。

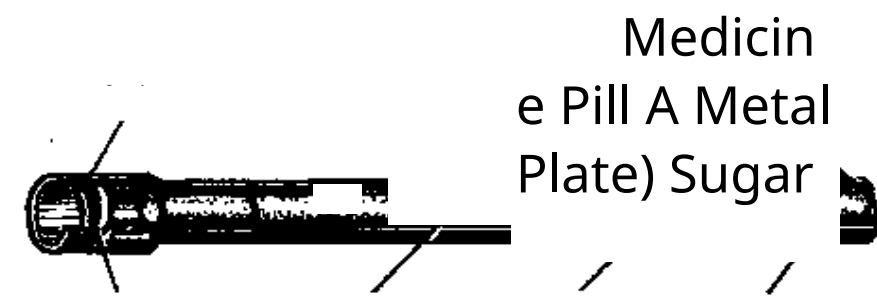
表 4—2 单节爆破筒的主要技术性能

项 目 \ 名 称	GBP110 型爆破筒		GBP110-1 型爆破筒		BGP111 型 爆破筒
	正级	副级	正级	副级	
长 度 (m)	1.12	1.16	0.6	0.64	0.62
重 量 (kg)	6.1	6.3	3.6	3.8	2.2
装药量 (kg)	3.0		1.5		1.06
外 径 (mm)	53				45
筒壁厚 (mm)	1.5				

3. 使用方法：根据需要可单节使用，也可将多节连接在一起使用。使用时，先将引信有外螺纹的一端插入爆破筒，使引信的两个销钉卡入爆破筒卡槽中并被卡爪固定，以防脱落。然后旋松引信另一端螺盖。接近目标时，旋掉引信螺盖，将拉火环套入手指，用力将爆破筒投向目标或放置在目标爆破位置上，同时拉火，然后迅速撤离并隐蔽。

(三) GBP112 型爆破筒 (图 4—6)：

1. 构造：外壳为布管，内装短节钢管，钢管内装钝化黑索



GBP111 type blasting
reducer

2. Main tactical and technical performance: The main tactical and technical performance of the CBP111 explosive charge is basically the same as that of the CBP110 explosive charge, as shown in Table 4-2.

Main technical performance of single-section blasting charge

	GBP110 Detonator		CBP110-1 type explosive charge		BGP111 Model
Quantity (kg)					
Charge (kg)					
Outer Diameter (mm)					
Wall thickness (mm)					

3. Usage method: Can be used individually as needed, or multiple sections can be connected at ~ for use. When using, first insert the end of the fuse with the external thread into the blasting tube, so that the two pins of the fuse are inserted into the slots of the blasting tube and fixed by the locking mechanism to prevent falling off. Then, loosen the screw cap on the other end of the fuse. When approaching the target, remove the fuse screw cap, put the firing ring on your finger, and forcefully throw the blasting tube at the target or place it in the target's blasting position, while simultaneously pulling the fuse. Then quickly withdraw and conceal.

(3) GBP112 type explosive charge (Fig. 4-6) :

1. Construction: The outer shell is made of cloth pipes, containing short steel pipe sections inside; the steel pipes are filled with deflagrated RDX.

金炸药。两端为销钉插口式、外加止退机构的连接件，可多节连接使用。筒身上布带用于将爆破筒捆扎在木棍、竹竿上使用。两端均有传爆药柱，其中一端有连接发火件螺口（图4—7），单节爆破筒长1.5~1.6米，外径38毫米，内装1.2千克钝化黑索金炸药。

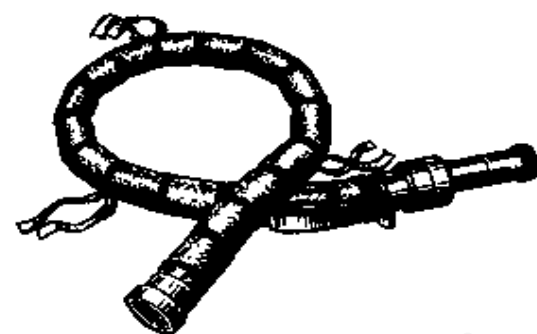


图4—6 GBP112型爆破筒

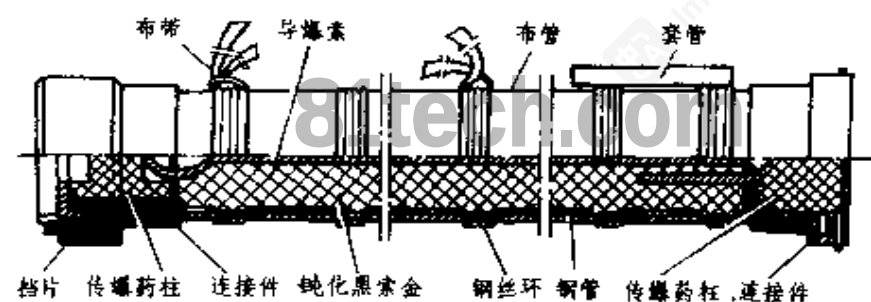


图4—7 筒身构造

GBP112型爆破筒用发火件（图4—8）起爆，延期时间约为

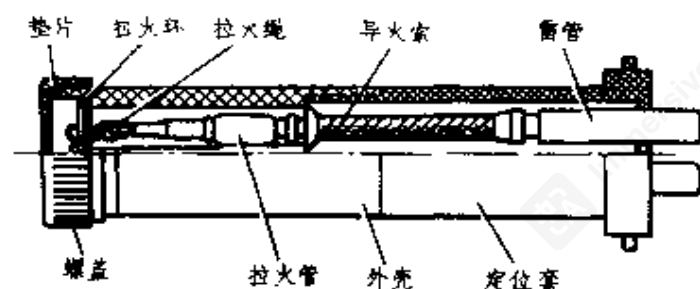


图4—8 发火件

High explosives. Connecting components with pin-ended inserts and additional anti-loosening mechanisms, capable of multi-section connection; straps on the barrel are used to secure the blasting tube to wooden sticks or bamboo poles for use; both ends are equipped with detonating columns, and its

End has connection ignition screw (

4—7: Single-section blasting charge length 1.5~1.6 meters, outer diameter 38 millimeters, containing 1.2 kilograms of stabilized RDX explosive,

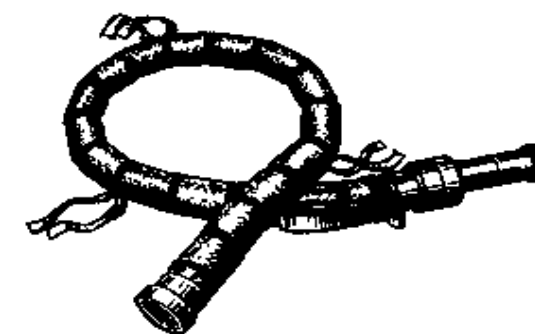
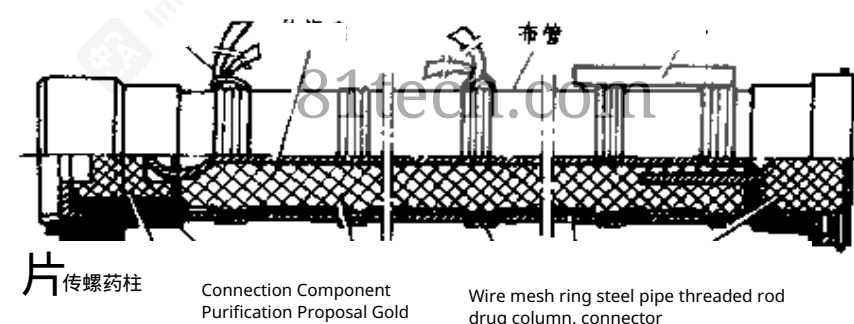
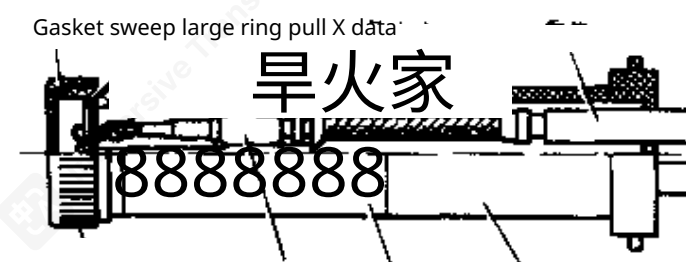


Figure 4-6 GBP112 explosive device



GBP112-type blasting delay fuse (Figure 4-8) initiation, the delay time is approximately



8 秒。也可用点火管起爆。

2. 主要战术技术性能：单节使用能杀伤一般工事内的敌人，摧毁其武器。成一线使用时，能在铁丝网中开辟不小于 2 米宽的通路；在防步兵地雷场中开辟不小于 1 米宽的通路。

表 4—3 爆破筒引信的技术性能

名称 项目	爆-1 甲引信	68-1 式引信	68-2 式引信	发火件 引信	GBP610 爆破引信	手榴弹 引信
长度(mm)	100	80	135		135	
最大直径(mm)	48	44.5	44.5		16	
扩爆药重(g)	24	17.5	28.5		1.5	
延期爆炸时间 (s)	6~7	6~8.5	6~8	6~8	9~11	3.2~4.2
配用爆破筒	GBP110 GBP111	GBP110 GBP111	GBP110 GBP111	GBP112	GBP113	GBP113

3. 使用方法：GBP112 型爆破筒可单节使用，也可多节串联使用。使用时，首先将发火件插入爆破筒母连接件中，拧下螺盖，一手握住发火件一端，另一手将爆破筒投向目标，然后取出拉火环并拉火，经 6~8 秒爆炸。



图 4—9 GBP113 型爆破筒

(四) GBP113 型爆破筒
(图 4—9)：

1. 构造：一套 GBP113 型爆破筒由 5 个刚性节、4 个柔性节、1 枚爆破引信和 5 枚手榴

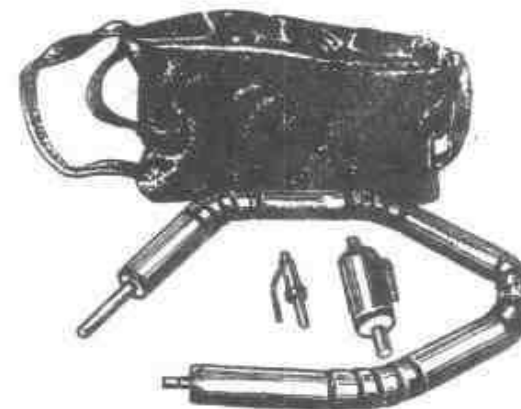
8 seconds; can also be ignited using a spark tube.

2. Main tactical and technical performance: When used singly, it can kill enemies in general fortifications and destroy their weapons; when used in a line, it can create a passage of not less than 2 meters wide through barbed wire and a passage of not less than 1 meter wide through anti-personnel minefields.

Technical performance of the detonator fuse for the demolition tube

	68-1	68-2	GBP610	---
Length (mm)				
Maximum diameter (mm)				
Explosive charge (g)				
Delayed explosion time				3.2~4.2
Fits with explosive canister	GBP110 GBP111	GBP110 GBP111	GBP110 GBP111	GBP112 GBP113 GBP113

3. Usage: The GBP112 blasting tube can be used as a single section or multiple sections connected in series. When using it, first insert the igniter into the blasting tube female connector, unscrew the cap, hold one end of the igniter with one hand, and throw the blasting tube toward the target with the other hand. Then remove the firing ring and pull it to ignite. The device will explode after 6~8 seconds.



(4) GBP113 Explosive Charge
(Fig. 4—9)：

1. Construction: a set of GBP113 Type detonator consists of 5 rigid sections, 4 flexible sections, 1 detonator fuse, and 5 hand grenades.

弹引信组成，用 1 个挎包式背具包装。爆破筒外径为 38 毫米，全重约为 4.5 千克，装药量约为 1.28 千克。

刚性节由金属筒体、传爆管及 143 克钝化黑索金炸药组成（图 4—10）；柔性节由钢筒圈、外钢圈、锦纶帆布套、133 克钝化黑索金炸药、导爆索及上、下连接体组成（图 4—11）。刚性节和柔性节通过螺纹连接；每个刚性节和柔性节都可与爆破引信或手榴弹引信连接。

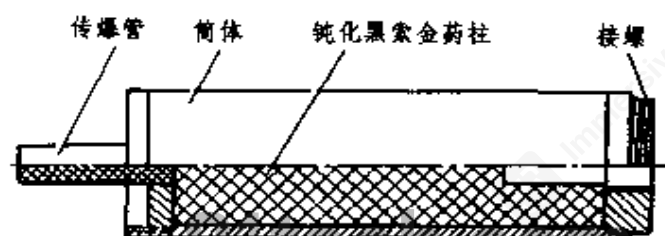


图 4—10 刚性节

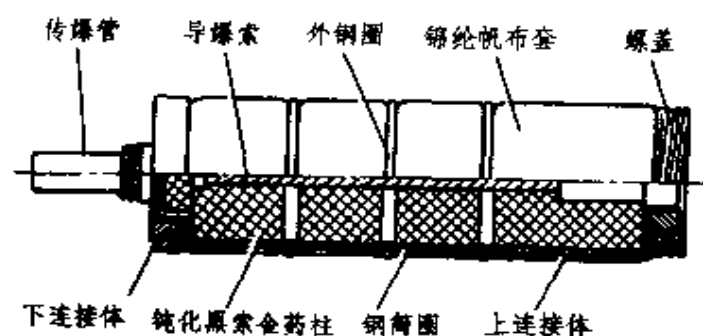


图 4—11 柔性节

爆破引信如图 4—12 所示，延期时间为 9 ~ 11 秒。

手榴弹引信的构造如图 4—13 所示，延期时间为 3.2 ~ 4.2 秒。

2. 主要战术技术性能：一套爆破筒能杀伤一般工事内的敌人，摧毁其武器。成线使用时，能在铁丝网中开辟宽度不小于

Fuzes are assembled and packaged in one shoulder bag. The diameter of the blasting fuse is 38 mm, the total weight is approximately 4.5 kg, and the charge weight is approximately 1.28 kg.

The rigid joint consists of a metal casing, a detonating tube, and 143 grams of stabilized RDX explosive (Fig. 4-10); the flexible joint consists of a steel casing ring, an outer steel ring, a nylon canvas sleeve, 133 grams of stabilized RDX explosive, a detonating cord, and upper and lower connecting bodies (Fig. 4-11). The rigid and flexible joints are connected by threads; each rigid and flexible joint can be connected to a blasting fuse or a hand grenade fuse.

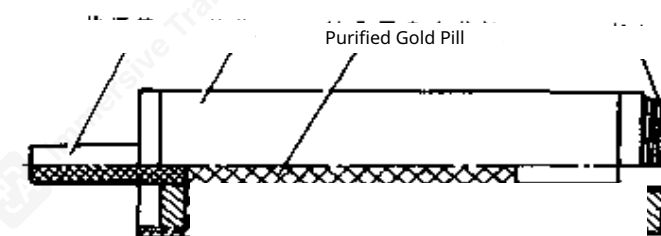


Figure 4—10

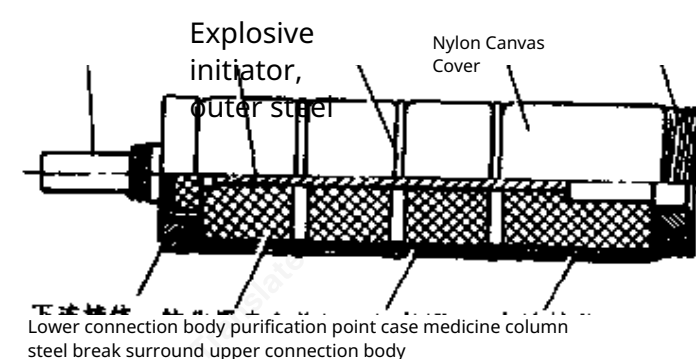


Figure 4-11 Flexible Joint

The blasting fuse is shown in Figure 4-12, with a delay time of 9 ~ 11 seconds.

The construction of the manual trigger is shown in Figure 4-13, with a delay time of 3.2 ~ 4.2

2. Main tactical and technical performance: The mine can kill enemies in general fortifications and destroy their weapons. When used in a line, it can open a passage in the barbed wire with a width of not less than

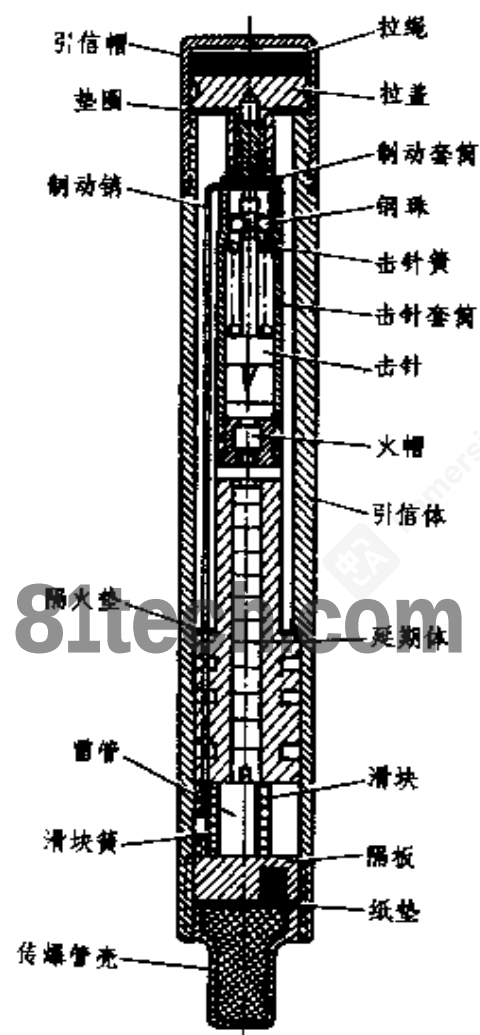


图 4—12 爆破引信

2 米的通路；在防步兵地雷场中开辟宽度不小于 1 米的通路。

3. 使用方法：用于爆破时，可根据需要任意组合，在不同条件下使用；爆破筒用爆破引信起爆。

作为手榴弹使用时，将手榴弹引信旋在单节刚性节上，一手握紧手榴弹及引信控制杆，另一手拔出控制销，投向目标，迅速隐蔽，经 3.2 ~ 4.2 秒即爆炸。

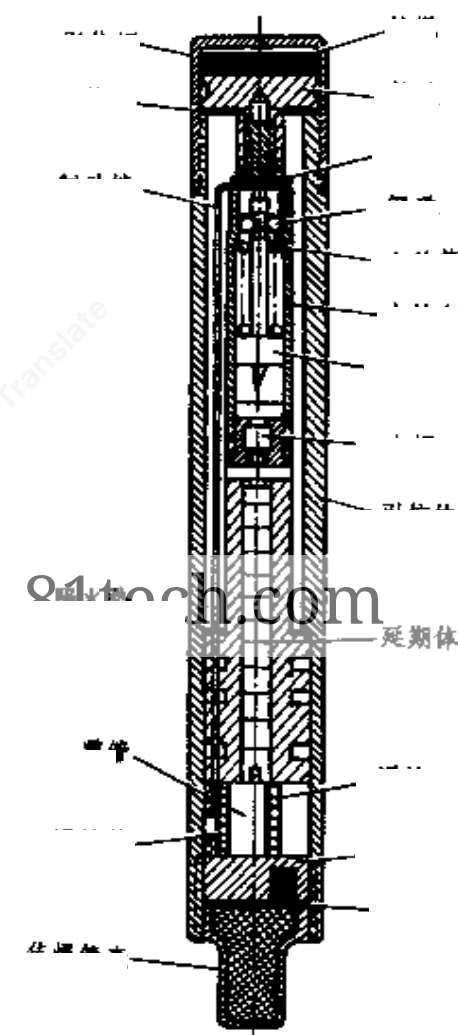


Figure 4-12 Detonator

2-meter passage; a passage of not less than 1 meter width shall be opened in an anti-personnel minefield.

3. Usage: When used for blasting, it can be combined arbitrarily according to needs and used under different conditions; the blasting charge is detonated using a blasting fuse.

When used as a grenade, twist the grenade launcher 1 clockwise onto the single rigid section.

Grip the grenade and firing pin lever with one hand, pull the firing pin with the other, throw it at the target, and quickly conceal yourself. It will explode in 3.2 ~ 4.2 seconds.

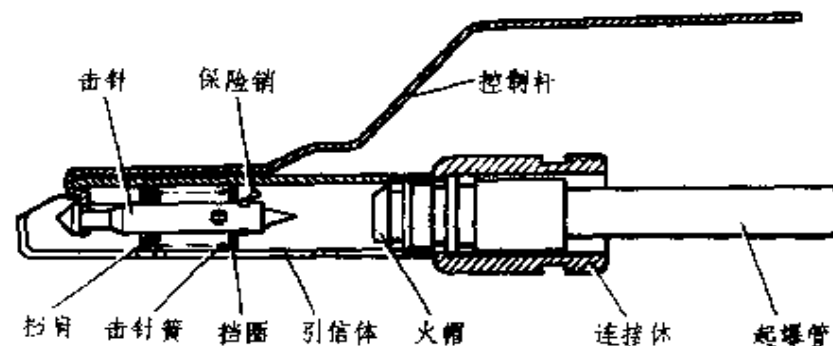


图 4—13 手榴弹引信

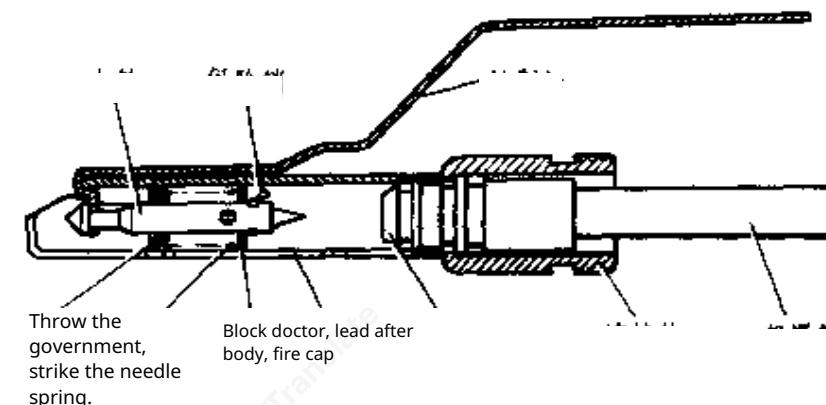


Figure 4-13 Grenade Call

第三节 掩体爆破器和爆破穿孔器

第五十八条 掩体爆破器是快速构筑掩体的制式爆破器材，主要用于在紧急情况下为单兵构筑跪姿射击掩体。通常在中等硬度土壤中使用。

爆破穿孔器是快速开设药孔的制式爆破器材，主要用于在冻土和坚硬土壤中快速构筑工事时的穿孔作业。

第五十九条 GBP132 型掩体爆破器（图 4—14）：是单兵使用的爆破器材，主要用于在中等硬度土壤快速构筑单人掩体。

（一）构造：由本体、炸高管和点火具（图 4—15）等组成。

（二）主要战术技术性能：见表 4—4。

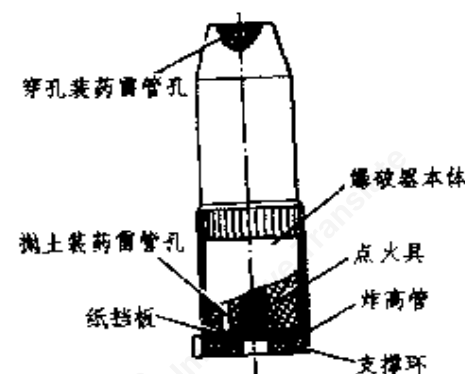


图 4—14 GBP132 型掩体爆破器

The Breacher is the standard explosive charge for rapidly constructing cover, Article 58: It is intended for use in emergency situations to allow a single soldier to construct a kneeling firing position. It is typically used in medium-hard soil.

The blasting drill bit is a standardized explosive charge used for rapidly drilling blast holes, primarily employed for drilling operations when constructing fortifications in frozen soil and hard earth.

Article 59 CBP132 mask

Body Breacher (Figure 414): A demolition device used by individual soldiers, primarily for rapidly constructing single-person shelters in medium-hard soil.

(一) Construction: Composed of the body, explosion pipe, and ignition device (Fig. 4-15).

(II) Main tactical and technical performance: see

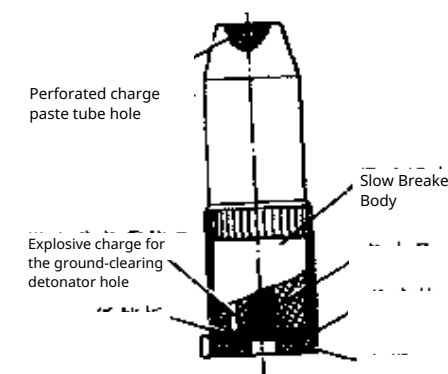


Figure 4-14 132-type Shelter Breacher



图 4—15 点火具

(三) 使用方法:

1. 打开背具, 取出爆破器; 取下炸高管并取出管内的纸垫、支撑环, 使炸高管豁口向上, 放在爆破点地面上。
2. 从心管内取出点火具: 打开防潮筒, 取出点火管和延期雷管。
3. 将延期雷管插入爆破器底部的雷管孔中, 然后将导爆管环套在爆破器的锥台部上。
4. 将延期雷管尾部的橡皮套对准炸高管的豁口, 将爆破器底部插到炸高管上端的凸缘上, 使之与地面基本垂直。
5. 取下点火管保护帽, 将雷管插入爆破器上端的雷管孔中并插到位 (图 4—16)。
6. 一手握住爆破器并用手指捏紧点火管导火索, 另一手垂直向上拉动拉火绳, 点燃点火管, 然后迅速撤至 30 米以远处隐蔽。待爆破结束后, 清理爆坑内的土块, 形成掩体。

第六十条 GBPI33 型掩体爆破器 (图 4—17): 是单兵使用的爆破器材, 主要用于在冻土中快速构筑单入掩体。

(一) 构造: 由穿孔器、抛土装药、炸高管、点火具 (图 4—18) 等组成。

(二) 主要战术技术性能: 见表 4—4。

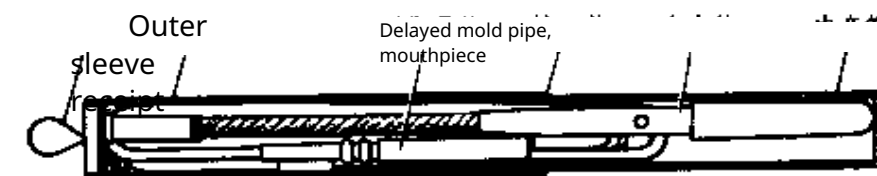


Figure 4-15 Ignition Device

(I) Make use of methods:

1. Open the back cover and remove the detonator; remove the detonation pipe and take out the paper pad and support ring inside the pipe, place the detonation pipe on the ground at the blasting point.
2. Remove the ignition tube from the borehole, open the moisture-proof tube, and remove the ignition tube and the delay tube.
3. Insert the delayed detonator into the detonator holder at the bottom of the blasting tool, then place the detonation tube ring over the conical section of the blasting tool.
4. Align the rubber sleeve at the tail of the delayed fuse with the opening of the blasting pipe, insert the bottom of the blasting device into the flange at the upper end of the blasting pipe, and ensure it is substantially vertical to the ground.
5. Remove the fuse tube protective cap, insert the detonator into the fuse tube hole at the top of the blasting cap, and insert it to the end (Figure 4-16).
6. Hold the detonator in one hand and grip the fuse of the ignition tube tightly with your fingers. With the other hand, pull the firing rope straight upward to ignite the ignition tube, then quickly retreat to a concealed position 30 meters away. After the explosion is complete, clear the debris from the blast crater to form a shelter.

Article 60 GBPI33 Type Shelter Breacher (Figure 4-17): A demolition device used by individual soldiers, primarily for rapidly constructing single-entry shelters in frozen ground.

(1) Construction: Composed of a perforator, soil-displacing charge, detonating tube, and igniter (Fig. 418).

(II) Main tactical and technical performance: See Table 4-4

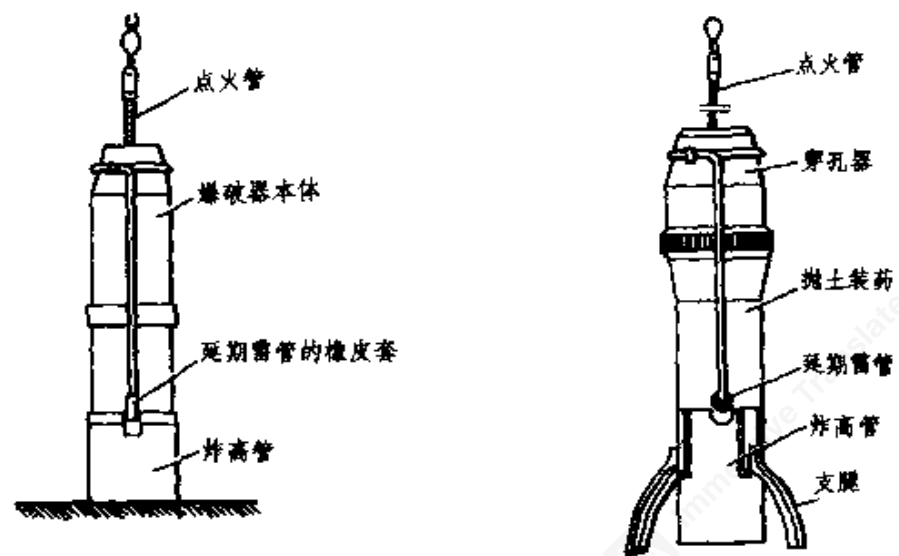


图 4—16 起爆前的爆破器

图 4—17 GBP133 型掩体爆破器

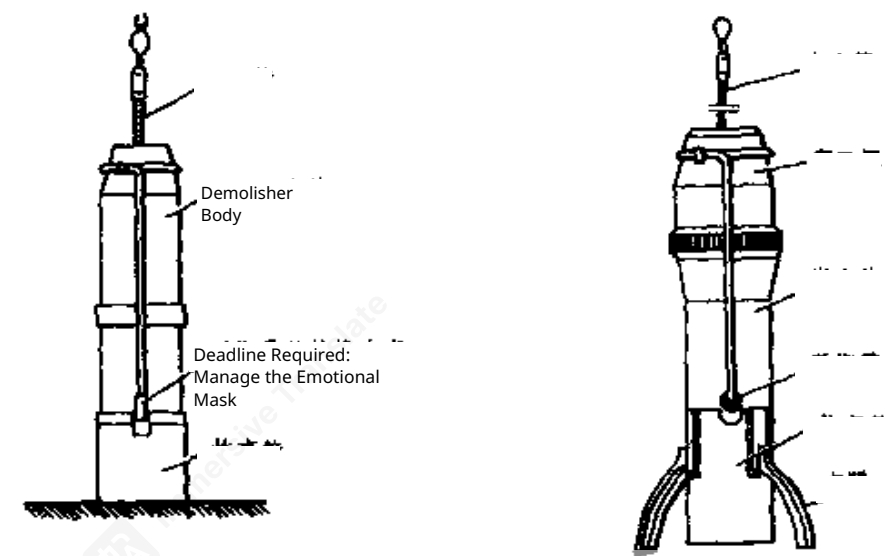


Figure 4-16 ech.com before detonation

Figure 4-17 CBP133 Shield Borer

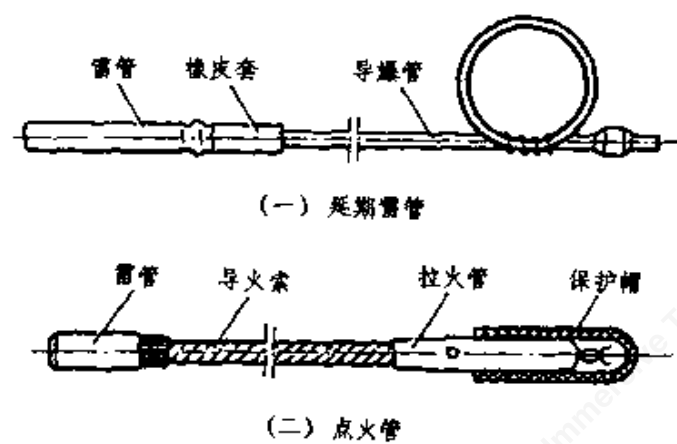


图 4—18 点火具

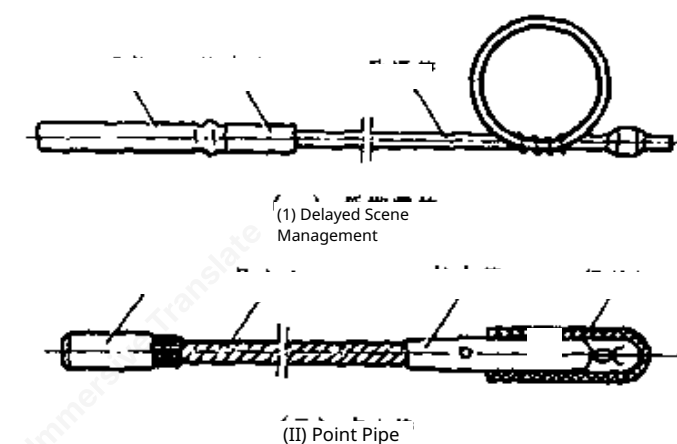


Figure 4--18
Ignition Tool

表 4—4 单人掩体爆破器战术技术性能表

型 号	GBP132 型掩体爆破器	GBP133 型掩体爆破器
全 重	1.77kg	5.0kg
全 长	287mm	440mm
直 径	82.6mm	130mm
装 药 量	1.021kg	穿孔: 1.60kg 抛土: 1.23kg
装药种类	黑梯	穿孔: 钝化黑索金 抛土: 黑梯 50/50
漏斗坑尺寸	口部直径约 130cm 可见深度约 40cm 全深 100cm	口部直径: $\geq 120\text{cm}$ 底部直径: $\geq 40\text{cm}$ 深 度: $\geq 50\text{cm}$
适应土壤	中等坚硬土壤	冻土; 对冻土爆破穿孔深度不小于 70cm, 口部直径不小于 10cm;
作业速度	$\leq 3\text{min}$	组合使用: $\leq 3\text{min}$ 分次使用: $\leq 6\text{min}$
安全距离	30m	100m
储存期限	爆破器: 10 年 点火具: 普通包装 2 年 铝塑包装 10 年	爆破器: 10 年 点火具: 普通包装 2 年 铝塑包装 10 年

(三) 使用方法:

1. 组合使用:

(1) 打开背具, 依次取出穿孔器、点火具、抛土装药和支

Table 4-4 Tactical and Technical Performance of Single-Man Breacher

	GBP132 Shelter Breacher	GBP133 Shelter Breacher
	1.77kg	5.0kg
	287mm	440mm
	82.6mm	130mm
	1.021kg	Perforation: 1.60kg Throw: 1.23kg
		Perforation: Desensitize RDX Throw dirt: Black ladder 50/50
Funnel pit dimensions	LI diameter is approximately 130cm ¹ . Visible depth approximately 40cm Full depth 100cm	Orifice diameter: $\geq 120\text{cm}$ Bottom diameter: $\geq 40\text{cm}$ Degree: $\geq 50\text{cm}$
	Medium hard soil	Frost soil, for frost soil blasting hole depth diameter of the mouth opening shall not be less than 70cm Not less than 10cm;
	$\leq 3\text{min}$	Use in combination with: $\leq 3\text{min}$ Use in portions: $\leq 6\text{min}$
	Blowtorch: 10 years, Lighter: Ordinary packaging 2 years, Aluminum-plastic packaging 10 years	Blowtorch: 10 years, Lighter: Ordinary packaging 2 years, Aluminum-plastic packaging 10 years

(3) Usage:

1. Combined use:

(1) Open the back cover, and in order, remove the perforator, igniter, soil-displacing charge, and support

腿；将炸高管从抛土装药上拔下，取出管内的纸垫和支撑环，将三条支腿分别插入炸高管插口内（图 4—19），放在爆破点的地面上。

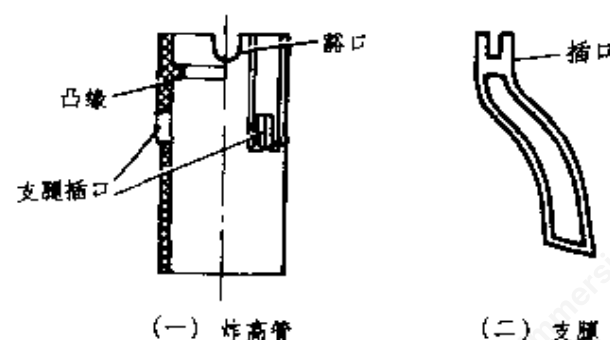


图 4—19 炸高管与支腿

(2) 取出一号点火具，打开防潮筒，从中取出点火管和延期雷管；将延期雷管插入抛土装药中部的雷管孔中。

(3) 将穿孔器与抛土装药对接在一起，然后将导爆管环套在爆破器的锥台部上。

(4) 将延期雷管尾部的橡皮套对准炸高管的豁口，将抛土装药底部插到炸高管上端的凸缘上，使之与地面基本垂直。

(5) 将点火管上的保护帽取下，将雷管插入爆破器上端的雷管孔中并插到底。

(6) 一手握住爆破器并用手指捏紧点火管导火索，另一手垂直向上拉动拉火绳，点燃点火管，然后迅速撤至 100 米以远处隐蔽。待爆破结束后，清理爆坑内的土块，形成掩体。

2. 分次使用：

(1) 将穿孔器直接置于炸高管上（图 4—20），用点火管起爆穿孔器，实施穿孔。

(2) 按图 4—21 所示设置抛土装药。当冻土层厚度为 30 ~ 70 厘米时，抛土装药的设置深度为冻土层厚度的 3/4 ~ 2/3。

Legs: Detonate the pipe to dislodge the charge from the ten-charge assembly, remove the paper pad and support ring from the arm, and insert the two legs into the pipe's insertion ports (Figure 4-19), placing them on the ground at the blasting point.

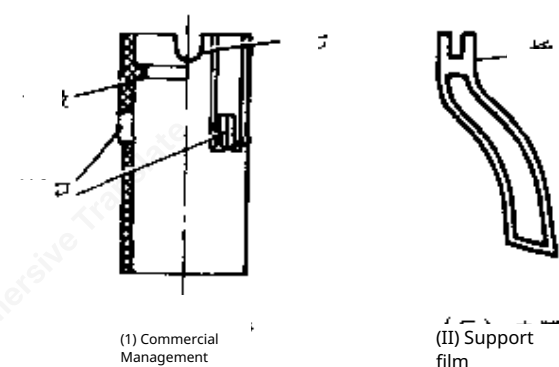


Figure 4-19 explosive pipe and support leg

(2) Take the attached fuse, ignite it, open the moisture-proof tube, and remove the firing tube and delay fuse from it; insert the delay fuse into the fuse hole located in the center of the charge container.

(3) Connect the perforator to the charge for throwing soil, then place the detonating tube ring over the conical part of the blasting device.

(4) Align the rubber sleeve at the tail of the delayed detonator with the opening of the blasting pipe, insert the bottom of the charge into the blasting pipe so that it rests on the upper flange, making it substantially perpendicular to the ground.

(5) Remove the protective cap from the igniter tube, insert the detonator into the detonator hole at the top of the blasting device, and push it all the way in.

(6) -- Hold the blasting fuse in one hand and squeeze it tightly with your fingers, while the other hand pulls the firing rope upward to ignite the fuse. Then quickly retreat to a concealed position 100 meters away. After the blast is complete, clear the debris (blocks) from the blast crater to form a shelter.

2. Use in divided doses:

(1) Place the perforator directly on the explosive pipe (Fig. 4-20), initiate the perforator with the igniter, and perform perforation.

(2) Set the charge according to Figure 4-21. When the thickness of the frozen layer is 30~

at 70 centimeters The setting depth of the charge is 3/4~2/3 of the frozen layer thickness.

(3) 将导爆管与点火管按图 4—21 所示用绑带扎紧（反向起爆），拔下点火管保护帽，拉燃点火管，然后迅速撤至 100m 以远处隐蔽。待爆破结束后，清理爆坑内的土块，形成掩体。

多人同时作业构筑单人掩体时，相邻爆破点的距离不得小于 5 米，并由一人统一指挥，同时点火。

第六十一条 GBP140 型爆破穿孔器（图 4—22）：主要用于在冻土中快速构筑工事时的穿孔作业。GBP140 型爆破穿孔器有 I 号、II 号、III 号等三种型号，其穿孔孔径与深度均不同，供不同条件下使用。

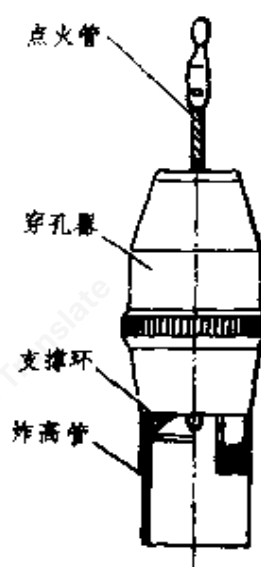


图 4—20
穿孔器设置状态

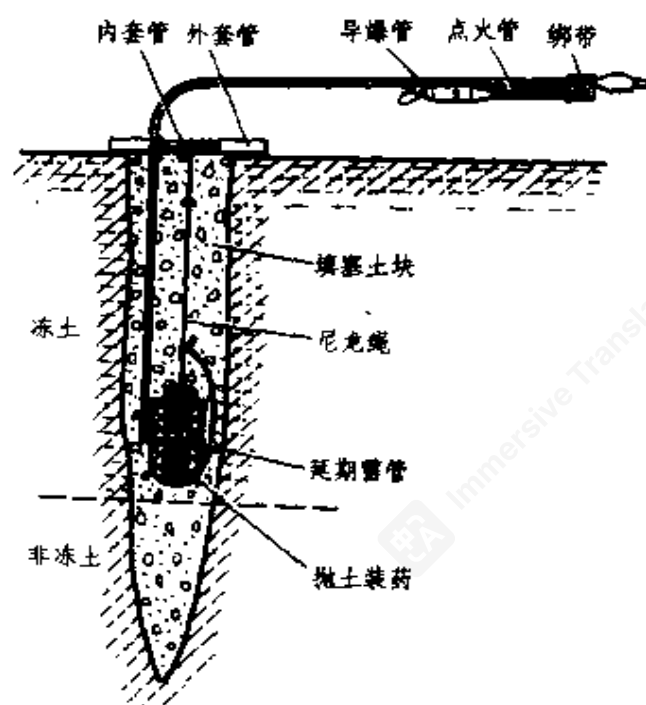


图 4—21 抛土装药的设置

(3) Connect the detonating tube to the igniter tube as shown in Figure 4-21

Secure with a binding strap (reverse detonation), remove the safety cap from the ignition tube, ignite it, then quickly retreat to cover 100m away. After the blast is complete, clear debris from the crater and form a protective shelter.

When multiple personnel simultaneously construct a single shelter, the distance between adjacent blasting points must not be less than 5 meters, and one person must uniformly command and ignite simultaneously.

Article 61 GBP140 type blasting hole drill (Figure 4-22): This is used for drilling operations when rapidly constructing fortifications in frozen soil. The GBP140 type blasting hole drill has several model variants, including No. 1, No. II, No. III, etc. The drilling diameter and depth vary among these models.

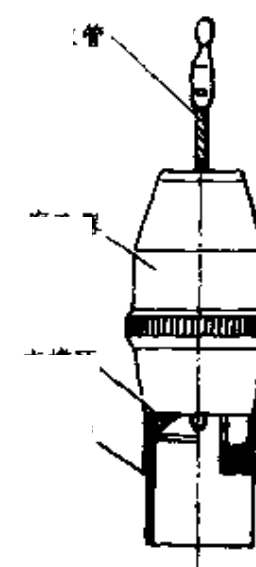


Figure 4-20
Perforator setting status

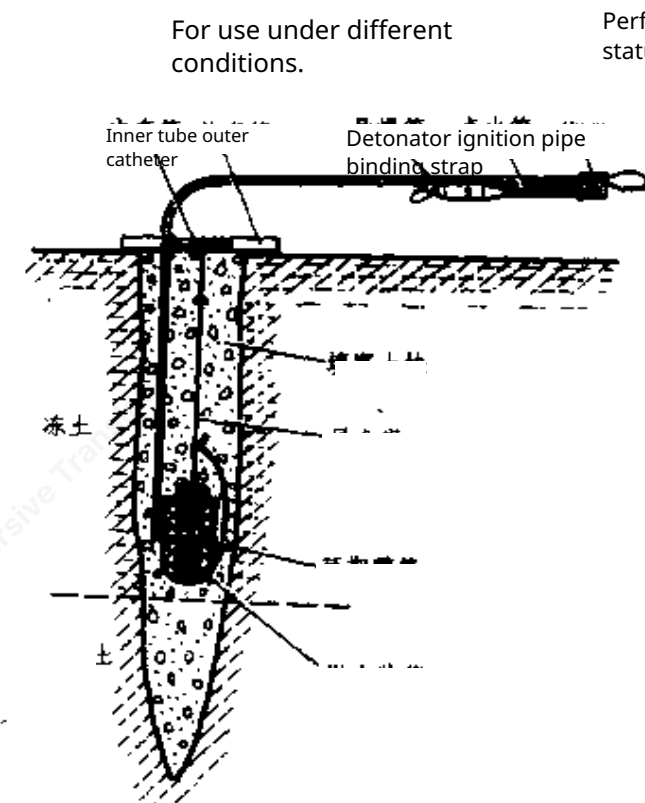


Figure 4-21: Arrangement of soil-loaded charges

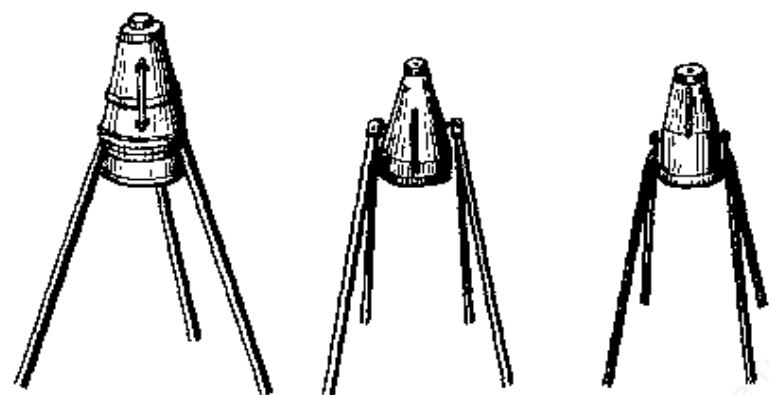


图 4—22 GBP140 型爆破穿孔器

(-) 构造：三种型号的爆破穿孔器结构基本相同，主要由塑料外壳、主装药（黑梯 50/50）、传爆药、药型罩、提手以及支架等部分组成（图 4—23）。支架用于调整炸高，以获得较好的穿孔效果；其中Ⅱ号、Ⅲ号爆破穿孔器经调整还可开设水平孔和斜孔。

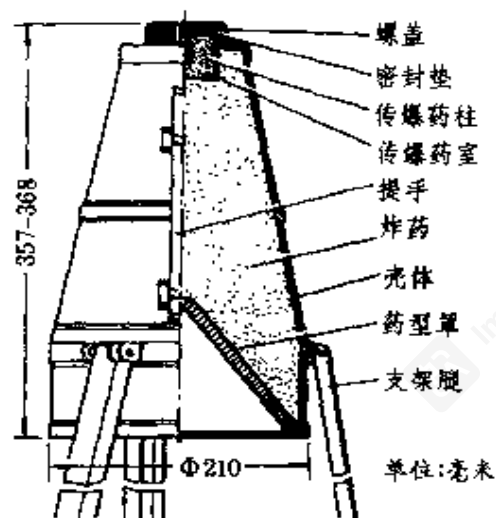


图 4—23 1 号爆破穿孔器组成

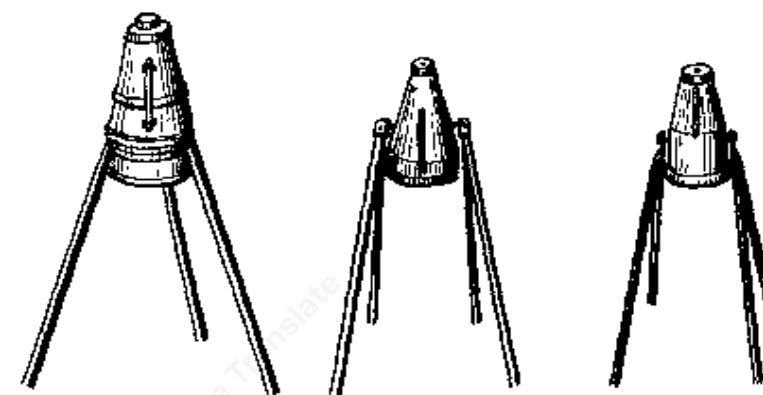


Figure 4-22 140mm Explosive Drill Bit

(-) Construction: The structural design of the main model blasting hole-drilling tools is essentially the same, consisting mainly of a casing, main charge (Black Ladder 50/50), detonating cord, liner, handle, and support frame (Fig. 4-23). The support frame is used to adjust the charge height to achieve better drilling results; the No. 1 and No. III blasting hole-drilling tools, after adjustment, can also be used to drill horizontal and inclined holes.

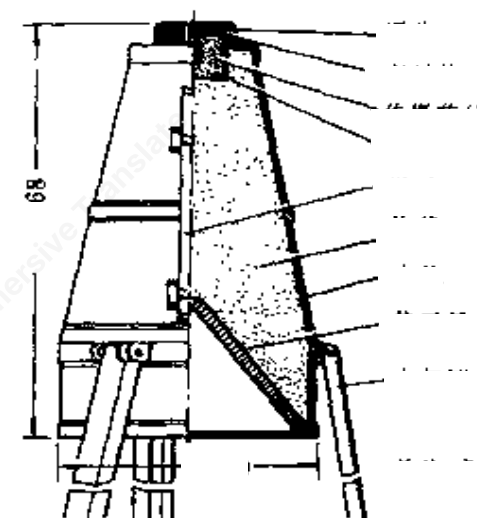


Figure 4-23 1 No. Blasting Hole Drill Bit Assembly

(一) 主要战术技术性能：见表 4—5。

表 4—5 GBP140 型爆破穿孔器的主要战术技术性能

型号	技 术 诸 元				战 术 诸 元		
	全 重 (kg)	装药重 (kg)	最大外径 (mm)	高 度 (mm)	炸 高 (cm)	穿孔深 (m)	穿孔直径 (mm)
I 号	12.0	9.0	210	357 ~ 368	75 ~ 80	1.9	150
II 号	6.0	4.0	162	289 ~ 293	60 ~ 65	1.5	100
III 号	2.0	1.3	110	193 ~ 198	26 ~ 30	1.0	40

(三) 使用方法：

1. I 号穿孔器：首先将支架装入并固定在穿孔器主体上，(每具配 3 根支架)，然后对准穿孔位置展开支架，架设高度为 75 ~ 80 厘米。架设完毕后，捅破密封垫，将电雷管插入雷管室，待人员撤至 80 米外隐蔽后起爆。当单具使用时，可用点火管起爆，导火索长度不得小于 30 厘米。

2. II 号穿孔器：首先将支架装于穿孔器两侧的支轴上并固定，然后对准穿孔位置展开支架，架设高度为 60 ~ 65 厘米。根据需要也可设置成水平或倾斜状态，以开设水平孔或斜孔。架设完毕后，捅破密封垫，将电雷管插入雷管室，待人员撤至 60 米外隐蔽后起爆。当单具使用时，可用点火管起爆，导火索长度不得小于 25 厘米。

3. III 号穿孔器：使用方法同 II 号穿孔器，架设高度为 26 ~ 30 厘米。起爆前人员必须撤至 40 米外隐蔽。若使用点火管起爆，导火索长度不得小于 20 厘米。

第六十二条 GBP141 型爆破器材 (图 4—24)：主要用于空降、登陆作战中快速构筑小型野战工事平底坑和破坏道路、桥梁

(一) Main tactical and technical performance: See Table 4-1-~5.

Main Tactical and Technical Performance of CBP140 Explosive Drilling Tool

Model	Technical Elements				Tactical Elements		
	Weight (kg)	Charge Weight (kg)	Max. Dia. (mm)	Height (mm)	Height (cm)	Depth (m)	Dia. (mm)
I	12.0	9.0	210	357 ~ 368	75 ~ 80	1.9	150
II	6.0	4.0	162	289 ~ 293	60 ~ 65	1.5	100
III	2.0	1.3	110	193 ~ 198	26 ~ 30	1.0	40

(3) Usage:

1. No. 1 perforator: First, insert and secure the bracket on the perforator body (3 brackets per unit), then align with the perforation position and deploy the bracket, setting the height to 75 ~ 80 cm. After deployment, remove the sealing gasket, insert the electric detonator into the detonator chamber, and detonate only after personnel have withdrawn to a concealed position at least 80 meters away. When used singly, a firing fuse may be used for detonation, with the fuse length not less than 30 cm.

2. No. 2 perforator: First, mount the bracket on the two support axes of the perforator and secure it, then unfold the bracket to align with the perforation position, setting the height to 60 ~ 65 centimeters. Depending on the requirements, it can also be set to a horizontal or inclined position to create a horizontal hole or an inclined hole. After setting up, remove the sealing gasket, insert the electric detonator into the detonator chamber, and detonate after personnel have withdrawn to a concealed position beyond 60 meters. When used singly, it can be detonated using a firing pipe; the fuse length must not be less than 25 centimeters.

3. Outage perforator: Usage method is the same as No. 2 perforator; height is 26 ~ 30 cm; personnel must withdraw to a concealed location at least 40 meters away before detonation. If detonation is performed using a fuse tube, the fuse length must not be less than 20 cm.

Article 62 CBP141 type blasting agents (Figure 4-24): Mainly used for air assault, amphibious landings, etc. to quickly construct small field fortifications such as flat-bottomed pits, and destroy roads and bridges during descent and amphibious landings.

及其他军事目标。

(一) 构造: 由快速炸坑器、线性切割装药、起爆装置等组成。

(二) 主要战术技术性能:

1. 快速炸坑器 (图 4—25):

(1) 全重: 13 千克。

(2) 体积: $40 \times 30 \times 20$ 厘米 (不含背具)。

(3) 炸坑装药量: 单套 6 千克; 双套 12 千克。

(4) 设置时间: 单兵单套作业不超过 3 分钟。

(5) 漏斗坑尺寸 (中等硬度非冻土壤): 单套使用口宽 2.8~4.6 米, 可见深度 0.6~1.4 米; 双套使用口宽 3~6 米, 可见深度 1~2 米。

(6) 适应温度: $-40 \sim +50^{\circ}\text{C}$ 。

(7) 安全距离: 大于 200 米。

(8) 每箱配 BGP141 型起爆装置三套。

2. 线性切割装药 (图 4—26):

(1) 每箱全重: 13 千克。

(2) 体积: $400 \times 300 \times 200$ 毫米 (不含背具)。

(3) 单位装药量: 不少于 0.28 千克/米。

(4) 威力: 切断厚 28 毫米的 45# 钢板; 可多节串联或用导爆索串联后起爆。

(5) 适应温度: $-40 \sim +50^{\circ}\text{C}$ 。

(6) 安全距离: 大于 50 米。

(7) 每箱配 BGP141 型起爆装置五套。

3. 起爆装置 (图 4—27):

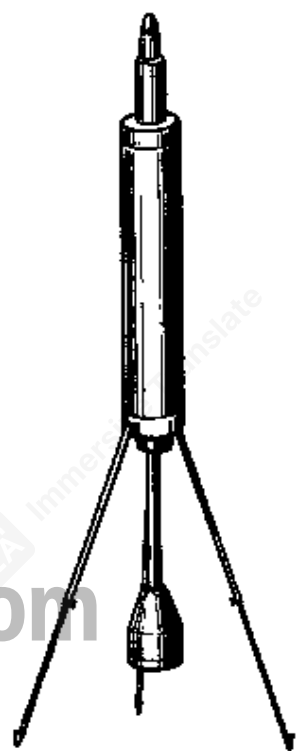


图 4—24 快速炸坑器

And other military objectives

(-) Construction: by rapid cratering, linear

Composed of charge cutting, detonators, and other components.

(1) Main tactical and technical performance:

1. Quick cratering device (Fig. 4-25):

(1) Gross weight: 13T kg.

(2) Volume: $40 \times 30 \times 20 \text{ cm}^3$ (not

With a gaster)).

(3) Charge quantity for blasting holes: 6 kg per set; 12 kg for two sets.

(4) Set time: Single soldier single set operation shall not exceed

After 3 minutes.

(5) Funnel pit dimensions (medium hardness, non-frozen soil)

Soil): Single set usage width 2.8~4.6 meters, visible Depth 0.6~1.4 meters; double set use mouth width 3~6 m, visible depth 1~2 m.

(6) Operating temperature: $-40 \sim +50^{\circ}\text{C}$.

(7) Safety distance: greater than 200 meters.

(8) Each box is equipped with a BGP141 detonator assembly.

2. Linear charge (Fig. 4-26):

(1) Gross weight per carton: 13 kg.

(2) Volume: $400 \times 300 \times 200 \text{ mm}^3$ (excluding the backplate).

(3) Unit charge quantity: not less than 0.28 kg/m.

(4) Power: Cut 45# steel plate with a thickness of 28 mm; can be connected in series in multiple sections or guided

Sequential initiation after blasting cord connection.

5) Temperature adaptability: $-40 \sim +50^{\circ}\text{C}$.

(6) Safety distance: 50 meters more.

(7) Each case shall be equipped with five sets of BGP141 detonators.

3, detonation device (Figure 4-27):

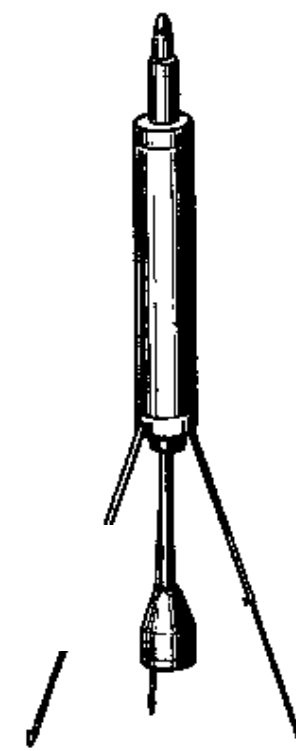


Figure 4-24 Quick Pit Blast Tool

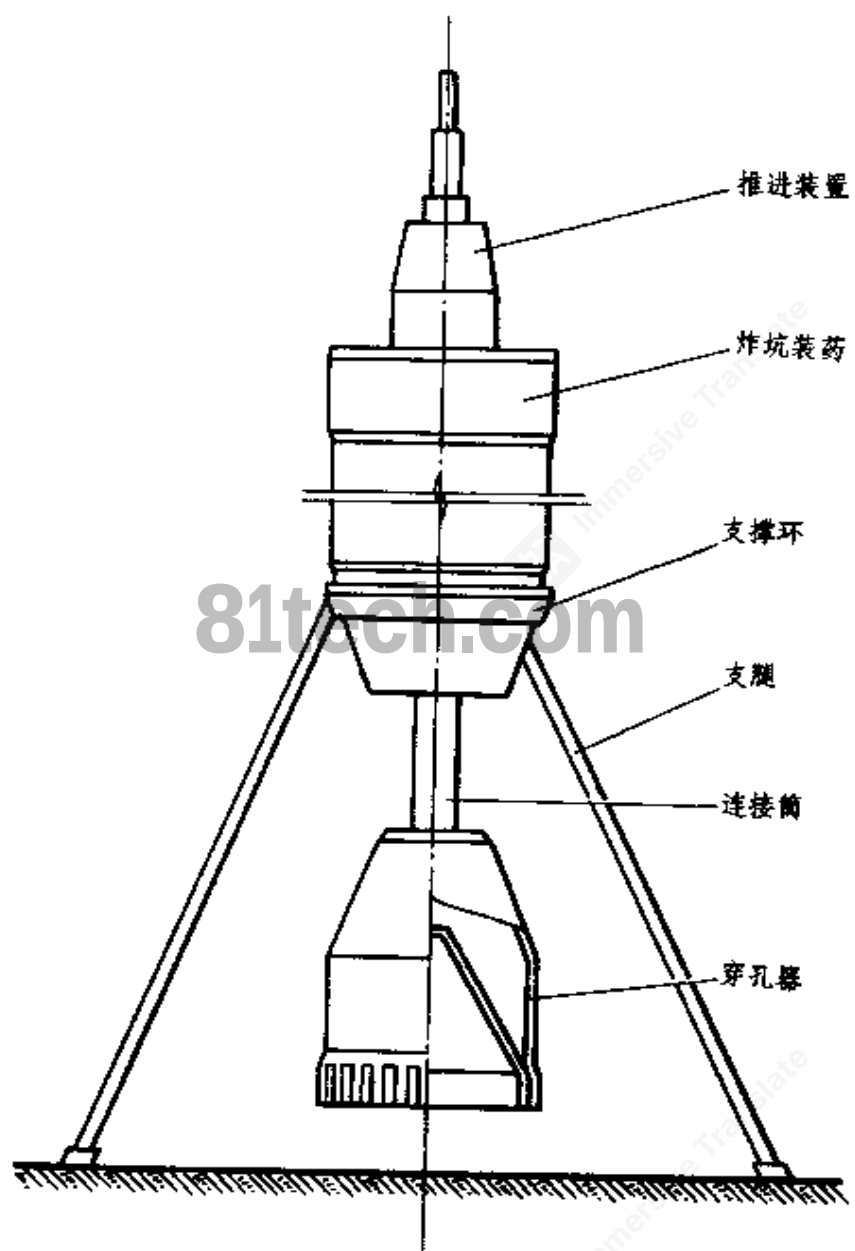


图 4—25 快速炸抗器组成

- (1) 全重：47 克。
- (2) 点火方式：机械发火。
- (3) 延期时间：> 35 秒。

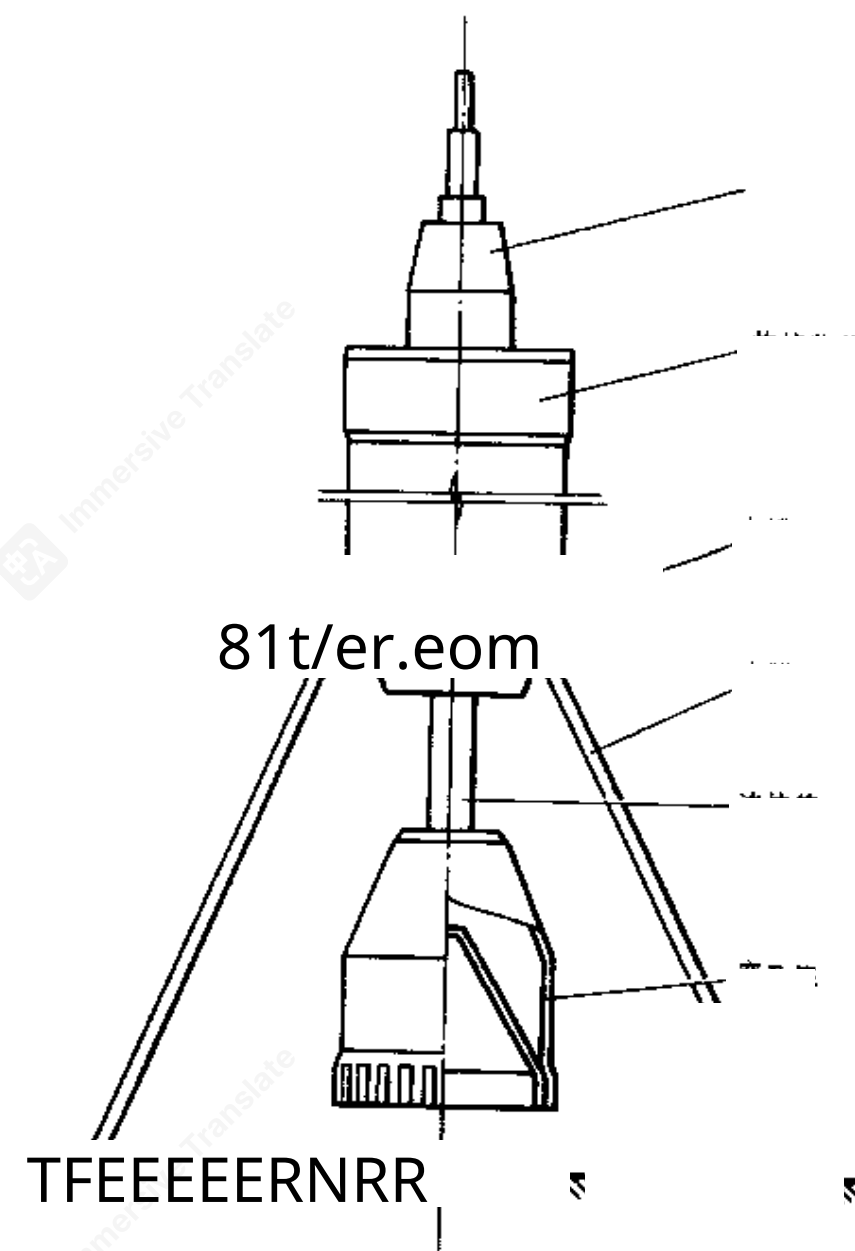


Figure 4-25: Composition of the Rapid Fire Resistor

- (1) Total weight: 47g.
- (2) Ignition method: Mechanical
- (3) Extension time: ≥ 35 seconds.

(4) 防潮性能: 良好。

(5) 适应温度: $-40 \sim +50^{\circ}\text{C}$ 。

(三) 快速炸坑器使用方法:

1. 打开背具, 取出各部件, 选择位置架设炸坑器。

2. 调整支腿长度, 尽量使炸坑装药保持铅垂方向。

3. 取出连接筒, 其螺纹端与穿孔器拧紧, 另一端凸耳插入炸坑装药下部锥形体中心豁口内并旋转 90° 。

4. 将推进装置套装在炸坑装药上部的螺纹外, 取出 1 发 8 号火雷管 (较短的) 插入穿孔器顶部的雷管孔中 (如遇雨天须将防雨罩展开后包在连接筒外), 再取出两发延期雷管 (较长的) 底朝上分别插入炸坑装药底部的雷管孔中。

5. 将起爆装置雷管端拧入推进装置上部的螺纹孔中, 然后一手扶住起爆装置的套筒, 另一手用手指套住拉火绳, 用力拉出拉火销, 迅速撤离至 200 米外隐蔽。

6. 当两套炸坑器组合使用时, 只需将一套炸坑器的炸坑装药下体拧掉, 将上体拧在另一套炸坑装药的上部。其余动作与单套使用相同。

7. 当需多套同时使用时, 可用电雷管串联起爆。

8. 当穿孔器与炸坑装药分开使用时, 可将泡沫塑料空箱平放在地面 (炸高约 20 厘米), 穿孔器锥孔向下放在箱上, 用起爆



图 4—26 线性切割装药

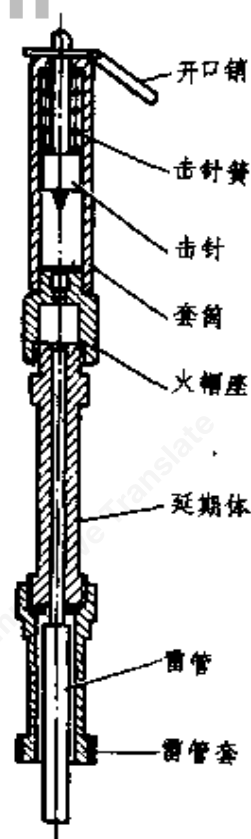


图 4—27 起爆装置

(4) Moisture-proof performance: Good.

(5) Temperature adaptability: $40 \sim +50^{\circ}\text{C}$.

(3) Quick Pit Drill Usage:

1. Open the back cover, remove the components, and select the position to deploy the mine.

2. Adjust the leg length to keep the charge in the crater as vertical as possible.

3. Remove the connecting rod, tighten its threaded end to the perforator, insert the ear of the other end into the central opening of the conical body below the explosive charge in the blast pit, and rotate 90° .

4. Mount the propulsion assembly on the charge in the blast hole.

In addition to the threads, remove one No. 8 detonator (the shorter one).

Insert the detonator into the detonator hole at the top of the insertion tool (if it rains, unfold the rain cover and wrap it around the connecting tube), then remove two delayed detonators (the longer ones), with the base facing up, and insert them into the detonator holes at the bottom of the charge in the blast hole.

5. Screw the detonator into the threaded hole on the upper part of the launching device, then with one hand hold the detonator's casing and with the other hand use the finger loop to pull the firing cord, forcefully extract the firing pin, and quickly retreat to a concealed position 200 meters away.

6. When two sets of blasting charges are used in combination, only the lower part of the blasting charge of one set needs to be removed, and the soil is twisted onto the upper part of the blasting charge of the other set. The remaining operations are the same as when using a single set.

7. When multiple sets are used simultaneously, use electric detonators.

8. When the perforator is used separately from the explosive charge in the blast hole, place the foam plastic empty box flat on the ground (blast height approximately 20 cm), position the perforator cone hole downward on the box, and use the detonator.

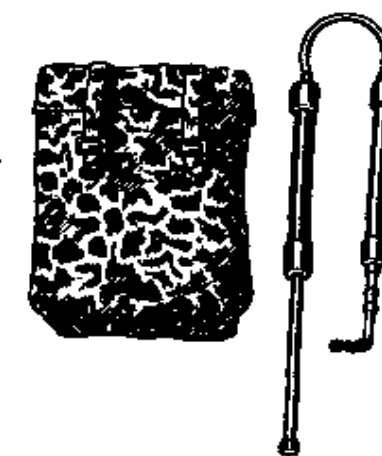


Figure 4—26 Linear charge cutting

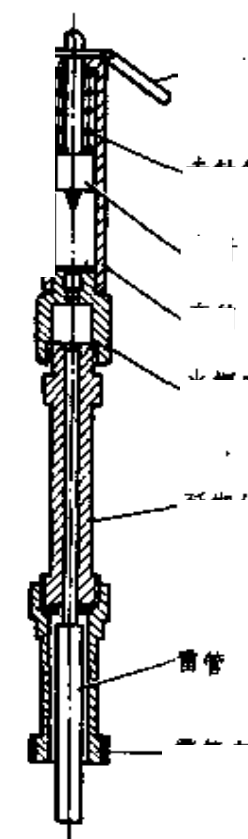


Figure 4-27 Detonator Assembly

装置引爆，人员撤至 50 米以外。爆破后清理回落土，再将炸坑装药设置在孔底，锥头朝上，用起爆装置或电雷管起爆；安全距离应大于 200 米。

第四节 火箭爆破器

第六十三条 火箭爆破器主要用于在敌障碍物中开辟通路。由一人至数十人操作使用，也可配置在战斗车辆或工程机械上使用。

第六十四条 GBP122A 型火箭爆破器：主要用于在防步兵地雷场和铁丝网中为步兵开辟通路。

(一) 主要战术技术性能：在防步兵地雷场和各类铁丝网中可开辟宽度为 3~6 米的通路；通路纵深不小于 90 米，最大可达 135 米（加长爆炸带）。其性能见表 4—6。

表 4—6 GBP122A 火箭爆破器发射参数

发射方式	爆炸带长度 (m)	适用温度范围	射角	控制绳长度 (m)	发射位置至障碍物前沿距离 (m)	射程 (m)
标准	100 (11 箱)	- 40 ~ - 10℃	56°	245	280	380
		- 10 ~ + 10℃	53°			
		+ 10 ~ + 30℃	51°			
		+ 30 ~ + 50℃	50°			
加长 (I)	125 (14 箱)	- 40 ~ - 10℃	56°	160	185	310
		- 10 ~ + 10℃	53°	170	195	320
		+ 10 ~ + 30℃	51°			
		+ 30 ~ + 50℃	50°			
加长 (II)	150 (16 箱)	- 40 ~ - 10℃	56°	100	115	270
		- 10 ~ + 10℃	53°	110	125	275
		+ 10 ~ + 30℃	51°	110	125	280
		+ 30 ~ + 50℃	50°			

Device detonated; personnel withdrawn to beyond 50 meters. After blasting, remove the backfilled soil, then place the explosive charge at the bottom of the blast hole with the cone tip facing upward, and detonate using a detonator or electric detonator; the safety distance must exceed 200 meters.

Section 4 Rocket Launcher

Article 63 Rocket demolition devices are primarily used to clear paths through enemy obstacles. They can be operated and used by one to dozens of personnel, or mounted on combat vehicles or engineering machinery for use.

Article 64: GBP122A Rocket Explosive Device: Primarily used to clear paths for infantry through anti-personnel minefields and barbed wire.

(1) Main tactical and technical performance: In anti-personnel minefields and various barbed wire obstacles, a passage with a width of 3 ~ 6 meters can be opened; the depth of the passage is not less than 90 meters and can reach up to 135 meters (with an extended explosive belt). Its performance is shown in Table 4-6.

GBP122A Rocket Bomber Launch

Parameters					Control rope length (m)	Distance from launch position to obstacle front edge (m)	Range (m)
Explosion zone length (m)							
(11 boxes)		- 40 ~ - 10℃					
		- 10 ~ + 10℃					
		+ 10 ~ + 30℃					
		+ 30 ~ + 50℃					
(14 boxes)		- 40 ~ - 10℃					
		- 10 ~ + 10℃					
		+ 10 ~ + 30℃					
		+ 30 ~ + 50℃					
Extended (16 boxes)		- 40 ~ - 10℃					
		- 10 ~ + 10℃					
		+ 10 ~ + 30℃					
		+ 30 ~ + 50℃					

Extended (I)

全套器材由 15 人背运（加长时最多可达 20 人），阵地作业时间为 5~10 分钟。

（二）构造与组成：由火箭发动机、发射架、爆炸带、控制标示绳、引信和附件等部分组成（图 4—28）。

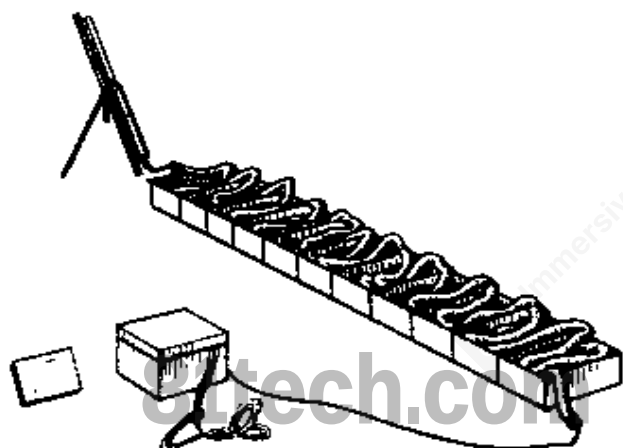


图 4—28 GBP122A 型火箭爆破器

（三）使用方法：

1. 携带：全套器材由 15 名作业手背运，指挥员 1 人。

第一名：背发射架和铁锤。

第二名：背火箭发动机。

第三名至第十三名：各背（对号）1 箱爆炸带。

第十四名：背控制标示绳。

第十五名：背附件箱。

指挥员：背附件包。

当加长爆炸带发射时，增加的作业手（对号）各背 1 箱爆炸带。

2. 展开作业：进入发射阵地后，各作业手按照指挥员的号令同时展开作业。

指挥员：确定发射位置、瞄准目标（查表 4—6）；确定发射

The equipment set is carried by 15 personnel (up to 20 when extended), with a station operation time of 5~10 minutes.

(1) Construction and Composition: It consists of rocket engines, launch stands, explosive belts, control marking ropes, fuses, and accessories, etc. (Figure 4-28)

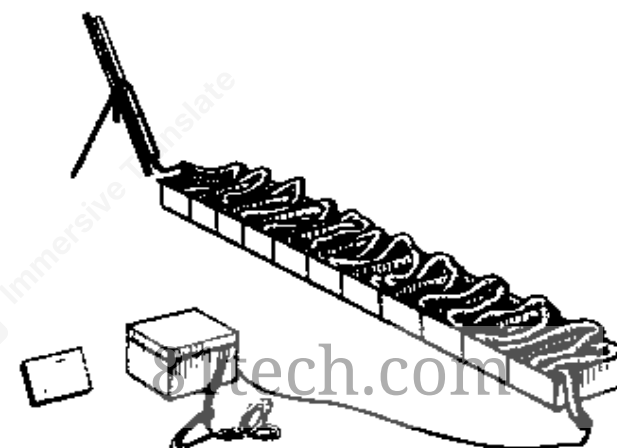


Figure 4—28G13PI224 Rocket Explosive Device

(3) Use the force method:

1. Carried: The full equipment set is carried by 15 porters, with 1 commander.

Rank 1: Back发射架和铁锤。

Second place: Rocket engine

Third place to 1st-3rd place: each carries (facing the number) 1 box explosive belt.

第+四名：背控制标示绳。

5th: Backpack

Commander: Carry the attachment bag,

When the extended explosive belt is fired, each additional operator (checkmark) carries one box of explosives.

2. Expand operation: After entering the firing position, each operator shall follow the signal of the commander.

Execute the tasks simultaneously.

Commander: Determine the firing position and aim at the target (consult Table 4-186); determine the firing

诸元、点火站位置；指挥作业及下达点火命令。

点火站通常应设置在发射位置侧后方 50 米处的掩体内或遮蔽物后。

第一名作业手：根据指挥员确定的瞄准目标和射击位置设置发射架。

第二名作业手：将火箭发动机设置在发射架上；敷设电点火线路，做好发射准备。

第三名至第十三名作业手：依次将爆炸带箱设置在距发射架正后方 1.5 米处；连接各爆炸带；第三名作业手与第十三名作业手分别连接爆炸带头、尾部引信。

第十四名作业手：在最后一箱爆炸带侧方或下风方向约 1 米处设置控制标示绳箱；设置控制桩（当土质松软时应同时使用钢钎和螺旋桩）；根据指挥员确定的控制绳长度，从箱中找出相应长度的两个抽头慢慢拉出 3~4 米，同时牢固地拴在控制桩的栓环或口环上。

第十五名作业手：将附件箱中各部件分发给各作业手；维护作业场的秩序或担任警戒；协助指挥员工作。

各作业手作业完毕后立即向指挥员报告。根据指挥员的口令，第一名作业手取下火箭发动机喷管上的橡皮防潮盖，接通电点火线路，并用胶布包好；第三名与第十三名作业手分别将引信拉火绳挂在钢丝绳和标示控制绳的拉环上；其余作业人员撤至指定地点隐蔽。

指挥员检查设置情况，确认无误后，指挥作业人员撤离发射位置至指定地点隐蔽。第二名作业手按指挥员的命令实施点火。

发射加长爆炸带时，应根据表 4—6 确定发射诸元；增加的作业手负责背运和设置爆炸带，其操作方法相同。

第六十五条 CBP123 型火箭爆破器（图 4—29）：主要用于在防步兵地雷场中为步兵开辟通路。可单具使用，也可两具串联使用。

Ignition, ignition station location; refers to the handling of the fall and issuing the ignition command.

The ignition station should typically be located in a shelter or sheltered area 50 meters behind the launch position.

第一名作业手：根据指挥员确定的瞄准目标和射击位置设置发射架。

Task 2: Set the rocket engine on the launch stand; wire the electric ignition.

Line, prepare for transmission.

Third through thirteenth operators: sequentially place the explosive belt boxes 15 meters from the bottom of the firing platform; connect the explosive belts; the second operator and the thirteenth operator connect the head and tail detonators of the explosive belts, respectively.

14th Position: Set the control rope about 1 meter to the side or downwind of the last explosive box. Box: Set control stakes (when the soil is loose, use both steel picks and screw piles simultaneously); according to the control rope length determined by the commander, slowly pull out two taps from the box of the corresponding length 3~4 meters and securely tie them to the shackle or ring of the control stake.

Fifth Job: Distribute components from the attachment box to each job hand; maintain order in the work area or serve as a guard; assist in directing operations.

After each operator completes their task, immediately report to the commander. According to the commander's order, the first operator removes the rubber moisture-proof cover from the rocket engine nozzle, connects the electric ignition circuit, and secures it with tape; the third and thirteenth operators respectively attach the fuse pull-rope to the steel wire rope and the pull-ring of the control rope; all other operators withdraw to the designated concealment location.

The commander inspects the setup, confirms it is correct, and directs the operators to withdraw from the launch position to a designated concealed location. The second operator ignites the device according to the commander's orders.

When firing the extended explosive belt, the firing parameters shall be determined according to Table 4-6; the additional operator is responsible for carrying and setting up the explosive belt, with the same operating procedure.

第六十五条 CBP123 型火箭爆破器（图 4—29）：主要用于在防步兵地雷场中为步兵开辟通路。可单具使用，也可两具串联使用。

(一) 主要战术技术性能：在防步兵地雷场中开辟宽度不小于 0.8 米、纵深不小于 20 米的通路；扫雷率不低于 90%。爆炸带头部射程约 100 米。单具火箭爆破器爆炸带长度为 28 米；为加大通路纵深，可两具串联使用。

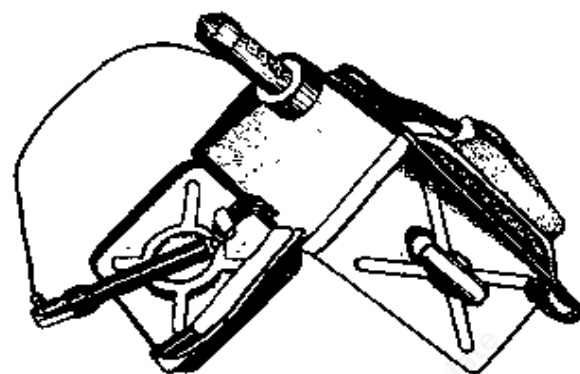


图 4—29 GBP123 型火箭爆破器

单具火箭爆破器全重约 17 千克，由 1 人携带。阵地作业时间：单具约为 30 秒；两具串联约为 2 分钟。

(二) 构造与组成：由击发器、火箭发动机、发射箱、爆炸带、引信和控制标示装置六部分组成（图 4—30）。

(三) 使用方法：GBP123 型火箭爆破器的发射准备工作一般在进入发射阵地前进行。进入发射阵地后，按下列顺序作业。

1. 单具使用：

(1) 选择发射位置，设置发射箱（将发射箱向前倾倒，射角约为 25° ），概略瞄准目标。

(2) 将引信放置在左前方，牵引钢丝绳放置在右前

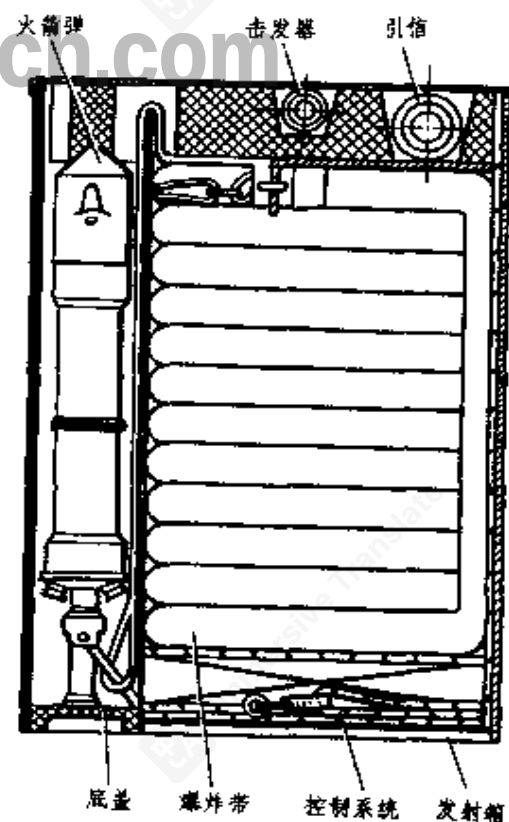


图 4—30
GBP123 型火箭爆破器组成

(--) Main tactical technical capabilities: Open a passage in an anti-personnel minefield with a width of no less than 8 meters and a depth of no less than 20 meters; mine clearance rate of no less than 90%; the explosive charge has a range of approximately 100 meters. Single unit

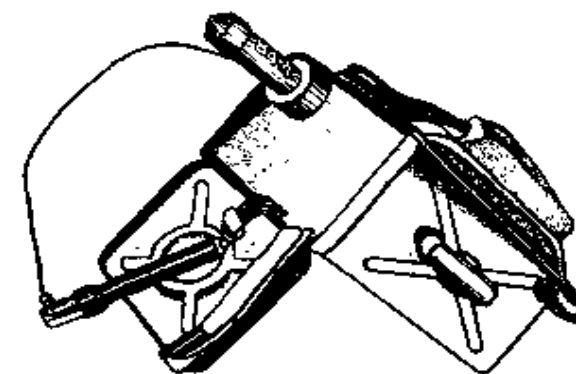


Figure 4-29 GBP123 Rocket Explosive Device

Rocket Grenade Launcher explosion radius length is 28 meters; to increase the depth of the passage, two can be used together.

Single rocket breacher weighs approximately 17 kg and is carried by one person. Arr

During ground operation: single unit takes about 30 seconds; two units in series take about 2 minutes.8Tt

(2) Construction and Composition: Consists of six parts: the firing mechanism, rocket engine, launch box, explosive belt, fuze, and control marking device (Figure 4-30).

(3) Usage: GBP123

Rocket Launcher Launch Preparation

Generally conducted before entering the firing position.

After entering the firing position, proceed with operations in the following order:

1. Single use:

(1) Select the firing position, set up the firing box (tilt the firing box forward, with a firing angle of approximately 25°), and make a general aim at the target.

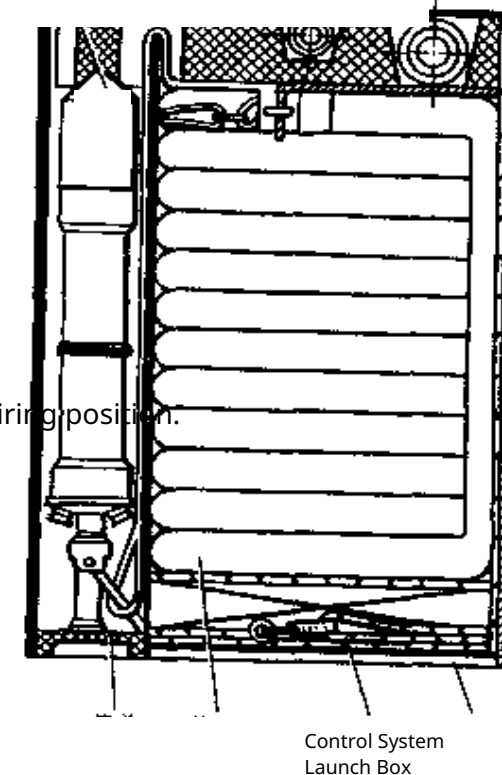


Figure 4—30

Composition of the GBP123 Rocket Explosive Device

(2) Place the fuse on the left front, and place the draw rope on the right front.

方；旋掉发射筒底盖和击发器保护帽，并将发动机向下轻推到位。

(3) 左手按住箱体上侧，右手食指或拇指勾住拉火绳，沿发射筒方向向下适当用力拉脱拉盖，迅速撤离至隐蔽位置。

2. 两具串联使用：

(1) 将两具火箭爆破器间隔 30 厘米并列放置，射角约 25° (图 4—31)，并概略瞄准目标。

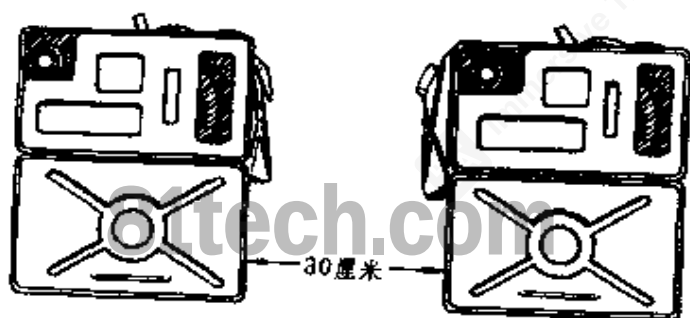


图 4—31 两具串联发射

(2) 分别卸掉右箱（以目标为前方）火箭爆破器的控制标示装置和左箱火箭爆破器的火箭发动机，然后将两箱爆炸带连接起来。

(3) 旋掉右箱发射筒底盖和击发器保护帽，并将发动机向下轻推到位。左手按住箱体上侧，右手食指或拇指勾住拉火绳，沿发射筒方向向下适当用力拉脱拉盖，然后迅速撤离至隐蔽位置。

第六十六条 GBP124 型火箭爆破器：主要用于在防步兵地雷场中开辟通路；可单具使用，也可多具串联使用。

(一) 主要战术技术性能：在防步兵地雷场中开辟通路宽度大于 0.5 米，扫雷率大于 90%；爆炸带悬空爆炸高度不超过 1.5 米时威力不减。单具火箭爆破器爆炸带长度为 40 米，根据不同的通路纵深要求，可两具或 3 具串联使用（表 4—7）；爆炸带长

Turn off the firing pin, remove the muzzle cover and the firing pin protector, and gently push the engine down to the stop position.

(3) Press the left hand against the side of the stock, and use the right index finger or thumb to hook the firing rope, then pull along the firing line.

Pull the safety cover off by pulling down and applying appropriate force in the direction of the safety pin, then quickly move to a concealed position.

2, use them in series:

(1) Place two rocket explosives side by side with a 30 cm gap between them, at an angle of approximately 25°.

(Fig. 4-31), and roughly aim at my target.

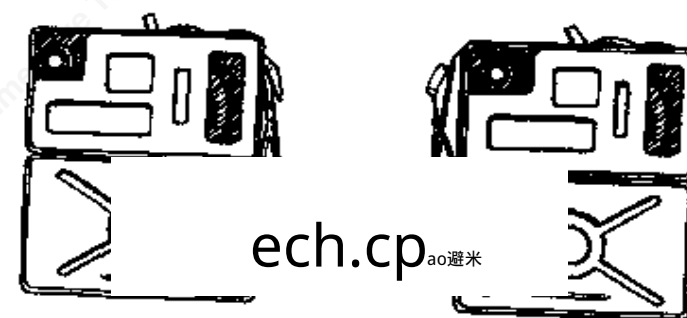


Figure 4-31 Two serial launchers

(2) Remove the control device of the right box rocket explosive (with the target as the front) and the rocket engine of the left box rocket explosive, then connect the two explosive belts together.

(3) Remove the bottom cover of the right-hand barrel and the firing pin cover, then gently push the engine downward into place. Press down on the upper side of the box with your left hand, and use your right index finger or thumb to hook the firing rope. Pull the firing cover downward with appropriate force along the direction of the barrel, then quickly move to a concealed position.

Article 66: GBP124 Rocket Detonator: Primarily used to clear paths in anti-personnel minefields; it can be used individually or in series with multiple units.

(一) 主要战术技术性能：在防步兵地雷场中开辟通路宽度大于 0.5 米，扫雷率大于 90%；爆炸带悬空爆炸高度不超过 1.5 米时威力不减。单具火箭爆破器爆炸带长度为 40 米，根据不同的通路纵深要求，可两具或 3 具串联使用（表 4—7）；爆炸带长

度可达 80~120 米，展直率均大于 90%。

表 4—7 GBP124 型火箭爆破器发射参数表

火箭发动机 (具)	爆炸带 (箱)	射 角	爆炸带头部射程 (m)		
			+ 50℃	+ 20℃	- 40℃
1	1	20°	69	66	66
2	2	25°	158	152	152
2	3	25	134	126	126

单具火箭爆破器全重 15.5 千克，由 1 人携带。阵地作业时间不大于 1 分钟。

(二) 构造与组成：由击发器、火箭发动机、发射箱、爆炸带、控制标示装置和引信六部分组成（图 4—32）。

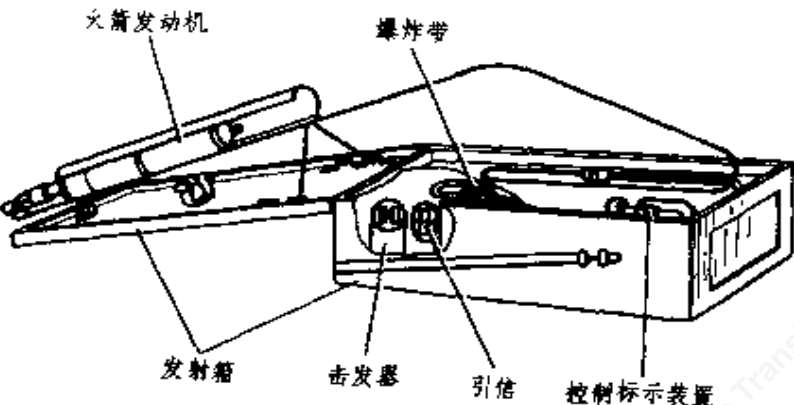


图 4—32 GBP124 型火箭爆破器

(三) 使用方法：GBP124 型火箭爆破器发射前的准备工作一般在进入发射阵地前进行，并根据敌障碍物的纵深确定使用方式。进入发射阵地后，应根据使用方式参照表 4—7 确定发射位置。

1. 当敌防步兵地雷场纵深为 20~30 米时，通常使用单具火

The degree can reach 80~120 meters, and the straightness is generally above 90%.

CRP124 Rocket Explosive Device Firing Parameters Table

Rocket engine		Explosive head shot	
		+50℃	+20℃
	3		

Single rocket breacher total weight 15.5 kg, carried by 1 person, deployment time reduced by 1 minute,

(:) Construction and Composition: Composed of the firing mechanism, rocket engine, launch box, explosive band, control marking device, and serial number 1 signal, consisting of six parts (Figure 4-32).

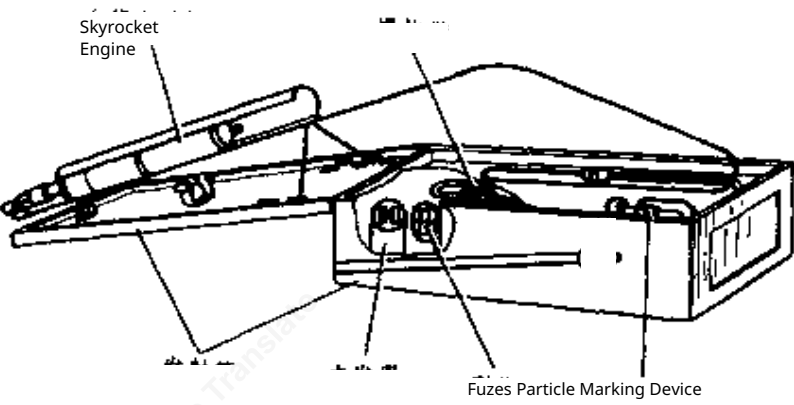


Figure 4— GBP124 Rocket Detonator 32

(3) Usage Method: Pre-launch preparation for the GBP124 rocket breacher is generally conducted before entering the firing position, and the method of use is determined based on the depth of enemy obstacles. After entering the firing position, the firing position should be determined according to Table 4-7 based on the method of use.

I. When the depth of the enemy anti-personnel minefield is 20~30 meters, a single fire is typically used.

箭爆破器开辟通路，发射位置距敌障碍物前沿约 30 米。作业手进入发射位置后，迅速打开发射箱盖，提起并固定发射筒于 20° 射角档上（图 4—33）；利用发射筒上的白线概略瞄准目标；挂上引信拉火绳；旋下击发器保护帽，取出拉火绳，一手按住发射筒，另一手拉火，迅速撤离至隐蔽位置。

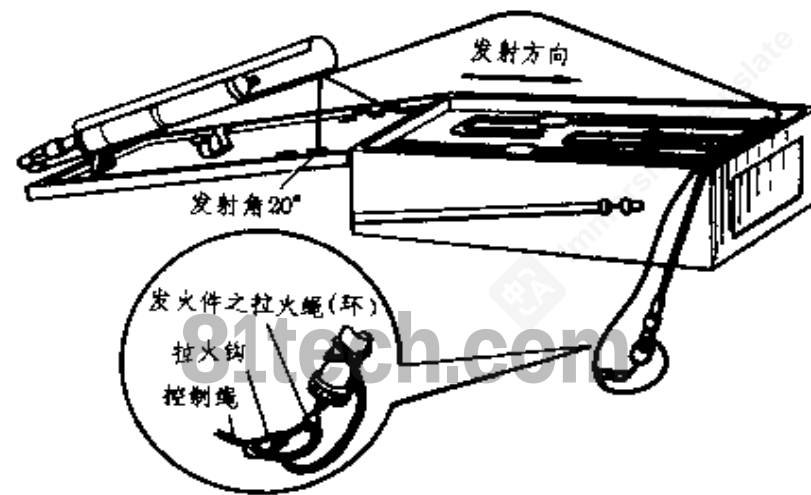


图 4—33 单具发射

2. 当敌防步兵地雷场纵深为 30 ~ 60 米时，使用两具串联火箭发动机拖带两箱爆炸带开辟通路，通常由两人作业。作业手进入发射位置后，将两箱火箭爆破器沿发射方向前后相对放置（图 4—34），第一箱（后箱）为发射箱，爆炸带由第二箱引信起爆。

第一名作业手将第一箱火箭爆破器发射筒固定于 25° 射角档上，然后利用发射筒上的白线概略瞄准目标；串联两部火箭发动机并装入第一箱发射筒内（图 4—35）。

第二名作业手取出第二箱的火箭发动机，卸下尾部连接组件后交给第一名作业手；将第一箱爆炸带引信套（含引信）与爆炸带解脱并放置于箱外；连接两箱爆炸带并连接引信；作业完毕后向侧后方迅速撤离、隐蔽。

The arrow breacher clears a path; the firing position should be 30 meters from the enemy obstacle's front edge. After the carrier enters the firing position, quickly open the firing box cover, lift and secure the firing tube at the 20° elevation setting (Figure 4-33); use the white line on the firing tube for rough aiming at the target; attach the fuse and pull cord; unscrew the firing device cap, remove the pull cord, press one hand against the firing tube, and pull with the other hand, then quickly withdraw to a concealed position.

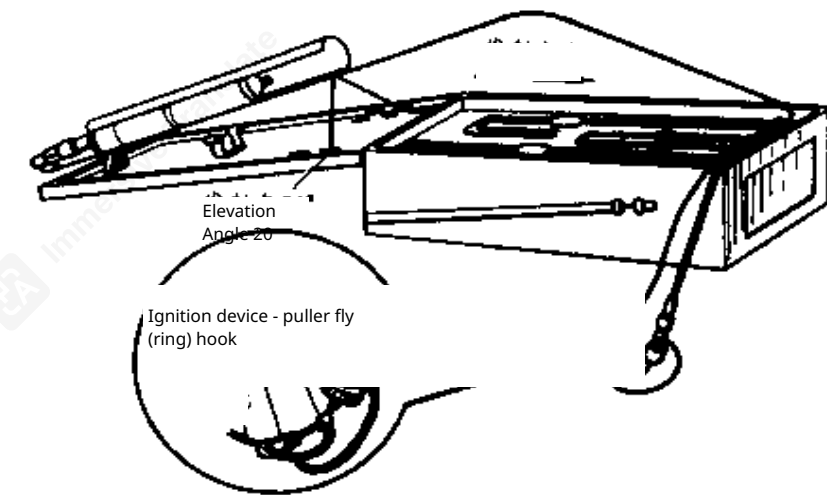


Figure 4-33 Single launcher

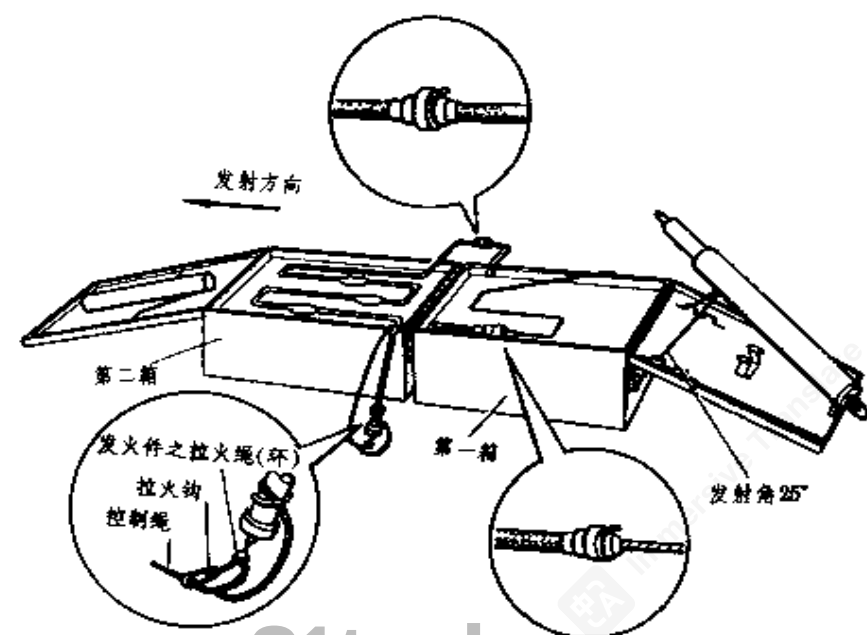
2 When the depth of the enemy anti-personnel minefield is 30 ~ 60 meters, use two rocket engines in series to tow two explosive charge cases and clear a path; this is typically done by two personnel. After the operator enters the firing position, place the two rocket demolition charges in front of and behind each other along the firing direction (Figure 4-34).

First box (rear box) is the launch box

The blast zone is initiated by the second fuze.

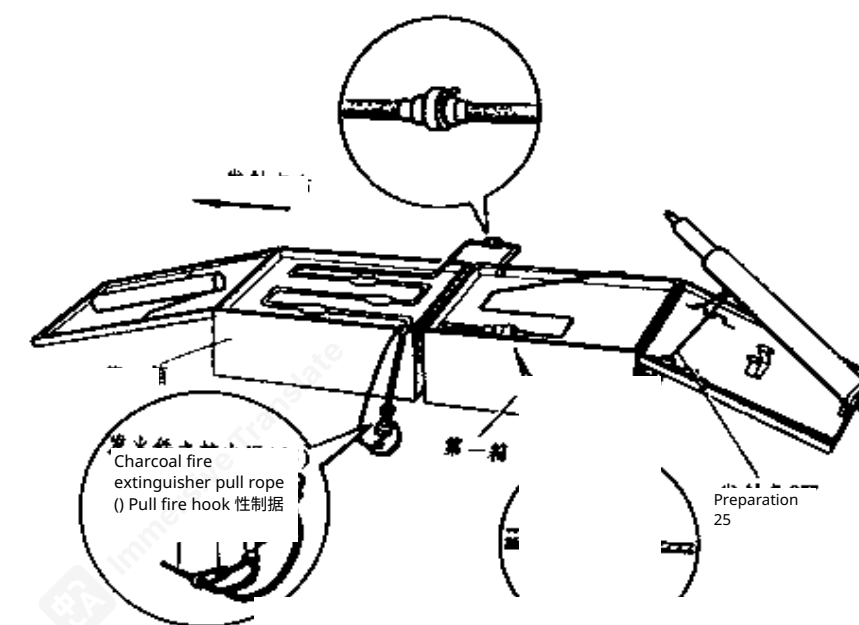
The first operator will mount the first box of rocket launcher tubes at a 25° elevation setting, then use the white line on the launcher for a rough aim at the target; connect two rocket motors and load them into the first box of launcher tubes (Figure 4-35).

The second crew member removes the rocket engine from the second box, disconnects the rear connection assembly, and hands it to the first crew member; the explosive belt fuse adapter (with fuse) from the first box is disconnected and placed outside the box; the two explosive belts are connected, and the fuses are connected; after completion, quickly withdraw and conceal to the rear side.



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图 4—34 两具串联发射



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Figure 4--34 Two serial launchers

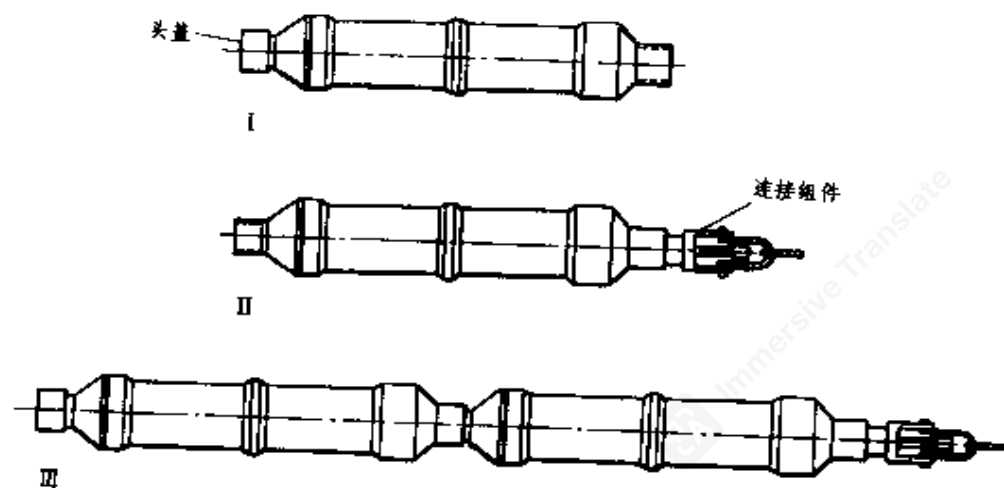


图 4—35 两具火箭发动机的串联

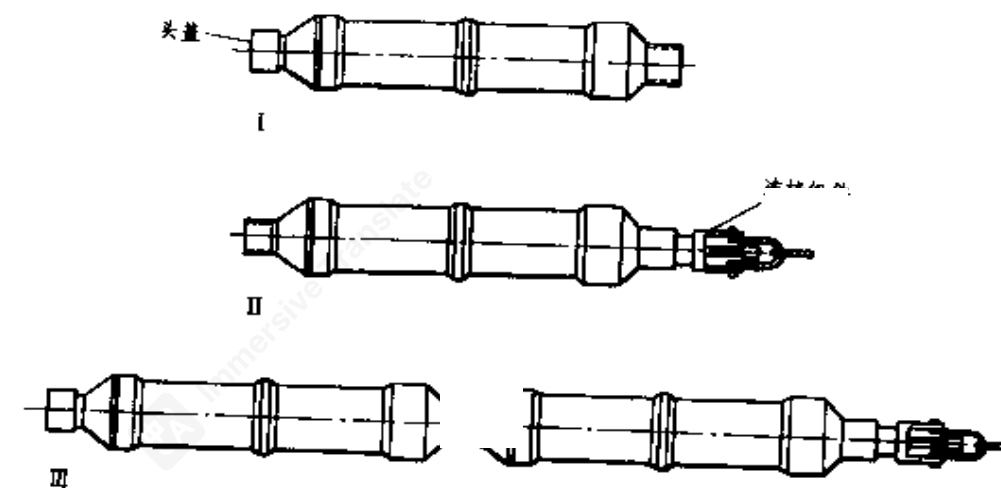


Figure 435: Series connection of two rocket engines

设置完毕后，由第一名作业手并负责点火。

3. 当敌防步兵地雷场纵深为 60 ~ 100 米时，使用两具串联火箭发动机拖带 3 箱爆炸带开辟通路，通常由 3 人作业。火箭爆破器按图 4—36 所示设置，第一箱（后箱）为发射箱，爆炸带由第三箱引信起爆。发射角约为 25°。

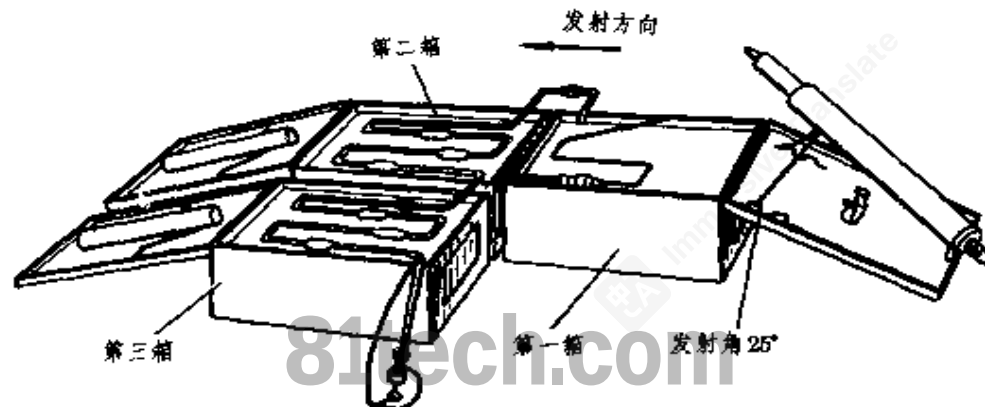


图 4—36 3 箱爆炸带串联发射

第一名作业手操作方法与“使用两具串联火箭发动机拖带两条爆炸带开辟通路”相同。

第二名作业手取出第二箱的火箭发动机，卸掉尾部连接组件后交给第一名作业手；将第一箱爆炸带引信套（含引信）与爆炸带解脱并放置于箱外；连接两箱爆炸带；作业完毕后向侧后方迅速撤离、隐蔽。

第三名作业手卸掉第二箱引信套（含引信），将其放置在箱外；解脱第三箱火箭发动机与爆炸带的连接；连接两箱爆炸带并连接引信；作业完毕后向侧后方迅速撤离、隐蔽。

设置完毕后，由第一名作业手负责点火。

第六十七条 GBP125 型火箭爆破器：主要用于在防步兵地雷场及铁丝网中开辟通路。

(一) 主要战术技术性能：在防步兵地雷场中开辟通路宽度

After setup, the first operator will be responsible for ignition.

3. When the depth of the enemy anti-personnel minefield is 60 ~ 100 meters, use two rocket engines in series to tow three explosive boxes and clear a path, typically operated by three personnel. The rocket explosive device is set up as shown in Figure 4-36; the first box (rear box) is the launch box, and the explosive belt is detonated by the fuse of the third box. The launch angle is approximately 25°.

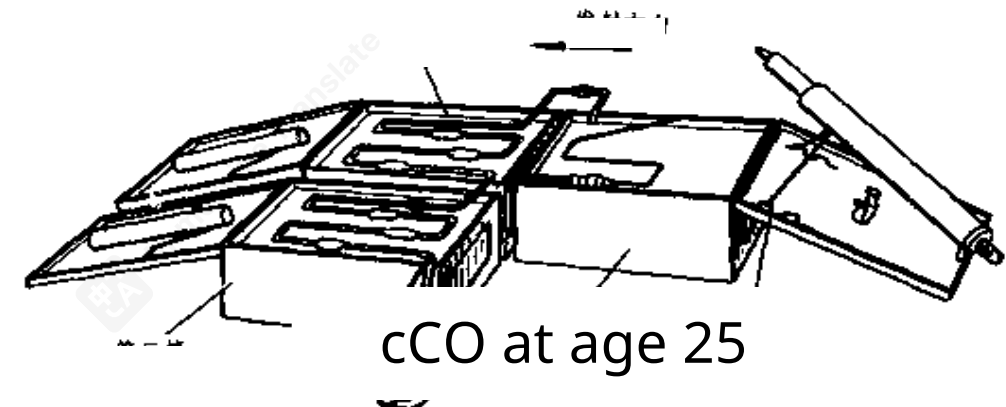


Figure 4363 box explosion zone serial launch

First, the operation method for the towed two-stage rocket engine is as follows:

"strip mine" is the same as "open-pit mine".

The second worker removes the rocket engine from the second crate, disconnects the rear connection assembly, and hands it to the first worker; the explosive belt fuse (including the fuze) from the first crate is disconnected from the explosive belt and placed outside the crate; the two explosive belts are connected; upon completion, quickly withdraw and conceal to the rear side.

Third: Remove the second box's fuse cover (including the fuse) and place it outside the box; disconnect the third box's rocket engine from the explosive belt; connect the explosive belts of the two boxes and connect the fuses; after completion, quickly withdraw and conceal to the rear side.

Once the setup is complete, the first operator will be responsible for ignition.

Article 60: GBP125 Rocket Mine, primarily used to clear paths through anti-personnel minefields and barbed wire.

(一) 主要战术技术性能：在防步兵地雷场中开辟通路宽度

大于 2 米，扫雷率大于 90%；在铁丝网中开辟通路宽度大于 2 米（表 4—8）。单具火箭爆破器爆炸带长度为 80 米。根据不同的通路纵深要求，可选择五种使用方式（表 4—9）；串联使用时爆炸带长度可达 400 米，展直率均大于 95%。

表 4—8 火箭爆破器战术、技术性能表

火箭爆破器型号		GBP122A (标准)	GBP123 (单具)	GBP124 (单具)	GBP125 (单具)
爆炸带头部射程(m)		400	100	66	220
在防步兵地雷场中开辟通路(m)	宽度	3~6	≤0.8	>0.5	>2
	纵深	100	≤20	>36	>76
有效扫雷率(%)		>90%	>90%	>90%	>90%
在各类铁丝网中开辟通路(m)	宽度	3~6			>2
	纵深	100			>76
爆炸带长度(m)		100	28	40	80
爆炸带展直率(%)			>90	>90	>95
控制标示绳长(m)		256	前 40 后 20	300	60
阻力伞(具)			1	1	1
器材全重(kg)		350	17	15.5	105
作业人数(人)		16	1	1	7
作业时间(min)		5~10	0.5	≥1	≥3
射角调整范围		50°~60°	25°	20°、25°	35°~70°
适用温度范围		-40~+50℃	-40~+50℃	-40~+50℃	-40~+50℃
适应风速(m/s)		<8	<4	<8	
贮存期限(年)		10	5	8	10

2 meters, mine clearance rate greater than 90%; a passage width of more than 2 meters (Table 4-8) can be cleared through barbed wire, with a single rocket explosive device having an explosion zone length of 80 meters; depending on different passage depth requirements, five usage methods can be selected (Table 4-9); when used in series, the explosion zone length can reach 400 meters, with an average straightening rate greater than 95%.

Rocket Blaster Tactical and Technical Specifications

Rocket Blaster Model	GBP122A (Standard)	GBP123 (Single)	GBP124 (Single)	GBP125 (Single)
Explosive head range (m)				
Anti-personnel field of view				
Open a path (m)				
Effective Mine Clearance Rate (%)				
In various types of wire mesh				
Open a passage (m)				
Explosion zone length (m)				
Explosion Range True Directness (%)				
Control indicator rope length (m)		前 40 后 20		
Drag parachute (s)			1	
Total weight of equipment (kg)				
Number of workers (person)				
Work time (min)			1	
Elevation Adjustment Range	50° - 60°		20°、25°	35° ~ 70°
Applicable temperature range	-40~+50℃	-40~+50℃	-40 ~ + 50	-40 ~ + 50°
Adaptable wind speed (m/s)				
Storage Period (Years)				

表 4—9 GBP125 型火箭爆破器组合使用方式

火 箭 发动机 (具)	爆炸带 数 量 (箱)	爆 炸 带 串联长度 (m)	开辟通路 纵 深 (m)	爆 炸 带 头部射程 (m)	器材携带 人 员 (人)
1	4	80	76	230	6
1	8	160	152	240	10
1	12	240	228	250	14
2	16	320	303	390	19
3	20	400	380	460	24

单具火箭爆破器总重约为 105 千克，分装于 7 箱（火箭发动机、控制装置、发射架各 1 箱，爆炸带 4 箱），由 6 人携带。阵地作业时间不大于 3 分钟。当串联组合使用时，需相应增加背运人员和作业时间。

(二) 构造与组成：由点火器、火箭发动机、发射架、爆炸带、控制装置和引信六部分组成（图 4—37）。

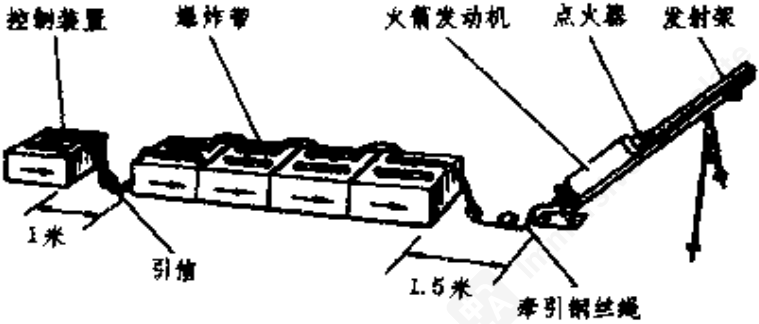


图 4—37 GBP125 型火箭爆破器

(三) 使用方法：

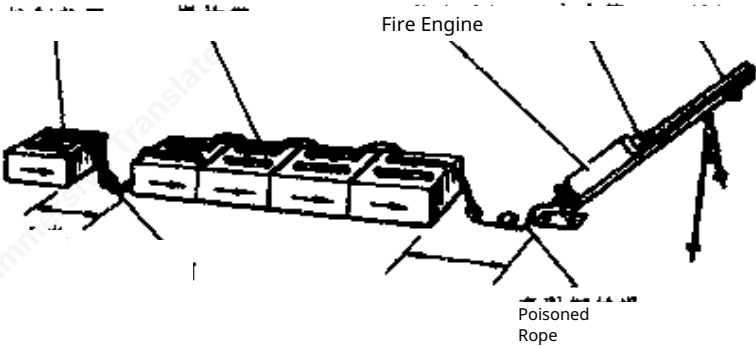
1. 携带：全套器材由 6 名作业手背运。

Table 4—9 C8P125 Type Fire Screen Drying and Crushing Machine Combination Usage Method

Number of blast zones	Explosion zone series length	Open the path and deepen the route.	Explosion Zone Head Range	Equipment Carrier Personnel

A single rocket breacher weighs approximately 105 kg, divided into 7 crates (rocket engine, control unit, and launcher each in 1 crate; explosive charge in 4 crates), carried by 6 personnel. Deployment time at a position does not exceed 3 minutes. When used in a serial combination, additional carrying personnel and deployment time are required accordingly.

(2) Construction and Composition: It consists of six parts: the igniter, rocket engine, launch stand, explosive belt, control device, and fuze (Fig. 4-37).



GBP125 Fire Energy Blaster Figure 4—37

(English) Usage:

1. Carry: The full equipment set is carried by six workers on their backs.

第一名：背发射架和控制装置。

第二名：背火箭发动机。

第三至第六名：各背 1 箱爆炸带。

班长 1 名。

2. 展开作业：进入发射阵地后，6 名作业手在班长指挥下同时展开作业。

班长：根据任务要求与使用方式确定发射位置和发射参数；检查各作业手的操作和火箭爆破器的设置；选择安全隐蔽位置；下达“准备发射”与“发射”命令。

第一名作业手：对准目标设置发射架，按确定的发射方式装定高低射角与方向射角（表 4—10）；配合第二名作业手安装火箭发动机。

表 4—10 GBPI25 型火箭爆破器发射参数

火箭发动机 (具)	爆炸带 长度 (m/箱)	控制绳 长度 (m)	发射位置至障 碍物前沿距离 (m)	射 角	爆 炸 带 头部射程 (m)
1	80/4	60	140	35°	230
1	160/8	40	70	44°	240
1	240/12	5	10	49°	250
2	320/16	5	60	59°	390
3	400/20	5	40	65°	460

第二名作业手：将火箭发动机装入发射架的 T 型槽（当火箭发动机串联使用时，应先将火箭发动机串联，如图 4—38、图 4—39）；将旋去防潮盖的点火器旋入（左旋）第一级火箭发动机的头部，直至点火器上刻线与火箭发动机头部端面接触为止。

第三至第五名作业手：距发射架正后方按图 4—37 所示设置爆炸带，各箱侧面箭头标记应指向发射方向；连接火箭发动机、

1st Place: Back-mounted launcher and control device

Second place: Rocket engine

1st to 6th place: Each gets 1 box of explosive belts.

2. Deploying the operation: After entering the firing position, six operators will simultaneously deploy the operation under the command of the squad leader.

Class Monitor: Determine launch position and launch parameters based on task requirements and usage methods; inspect the operations of all operators and the rocket explosive device settings; select a safe and concealed location; issue the "Ready to Launch" and "Launch" commands.

Job #...-th: Align the target and set up the launcher, then load according to the determined firing method.

Elevated low-angle and directional firing angles (Table 4-10); assist the second operator in installing the rocket engine.

Table 4-10 GBPI25 Rocket Explosive Device Firing Parameters

Rocket engine	Explosion zone length (m/box)	Control rope length (m)	Launch position to obstacle Distance to the front of the obstacle (m)
1	80/4	60	140
1	160/8	40	70
1	240/12	5	10
2	320/16	5	60
3	400/20	5	40

Second job: Install the rocket engine into the T-slot of the launch stand (when rocket engines are used in series, connect the rocket engines in series first, as shown in Figures 4-38 and 4-39); screw the igniter with the moisture-proof cover removed (left-hand thread) into the head of the first-stage rocket engine.

Until the engraved line on the igniter contacts the end face of the rocket engine nozzle.

Third through fifth position operators: Set up an explosive zone behind the launcher, as shown in Figure 4-37, with the arrow markings on the sides of each box pointing in the direction of launch; connect the rocket engine,

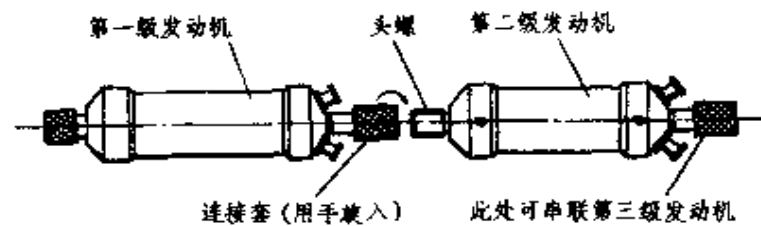


图 4—38 两具火箭发动机串联

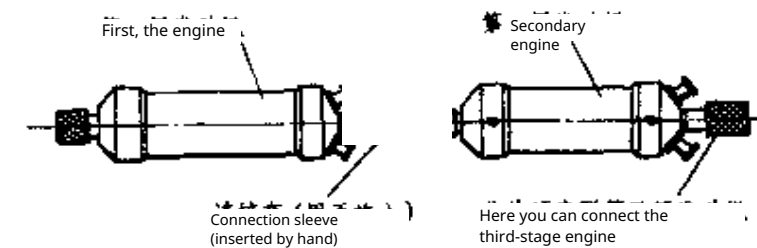


Figure 4—38 Two rocket engines are connected in series.

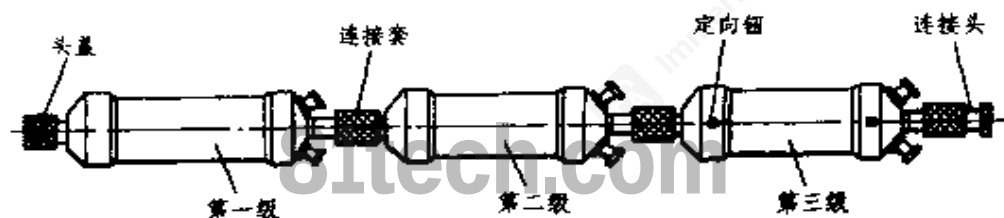


图 4—39 3 具火箭发动机串联

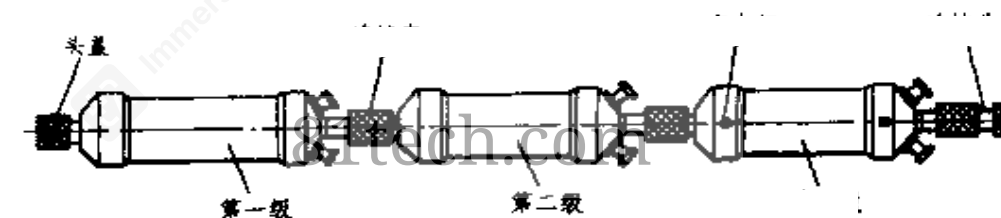


Figure 4-393 Rocket Engine is Linked

牵引钢丝绳和爆炸带。

第六名作业手：设置控制装置箱，根据发射参数（表 18）确定控制绳长度（多余部分用刀割去）；连接引信。

准备发射时，点火手将引信拉火环挂在控制绳拉火钩上（严禁使引信拉火环受力）。发射时，去掉点火器保护帽，一手扶着火箭发动机头部，另一手沿弹轴方向用力拉火，并迅速撤离至隐蔽位置。

当单具火箭发动机拖带 8 箱爆炸带时的设置方式见图 4—40。

当两具或 3 具火箭发动机串联发射时，爆炸带的设置方式见图 4—41 和图 4—42。

第六十八条 GBP126 型火箭爆破器：主要用于在防坦克地雷场中开辟通路。该器材配置在坦克或军用推土机上运载和发

Pull the wire rope and explosive belt.

6th Position Operator: Set up the control device box according to launch parameters (Table 18)

Determine the length of the control rope (cut off any excess with a knife); connect the fuse.

When preparing for launch, the igniter will attach the safety ring of the fuze to the pull-hook on the control rope (strictly

Do not apply force to the firing pin pull ring). When firing, remove the igniter safety cap, -- hold with one hand

Rocket engine head, with the other hand pull the fire along the axis of the projectile, and quickly withdraw to the hidden

The configuration when a single rocket engine is towing 8 explosive boxes is shown in Figure 4-40-.

When two or three rocket engines are fired in series, the arrangement of the explosion band is shown in Figures 4-41 and 4-42c.

Article 68: GBP126 Rocket Explosive Charge: Primarily used to create passages in anti-tank minefields. This equipment is mounted on tanks or military bulldozers for transport and deployment.

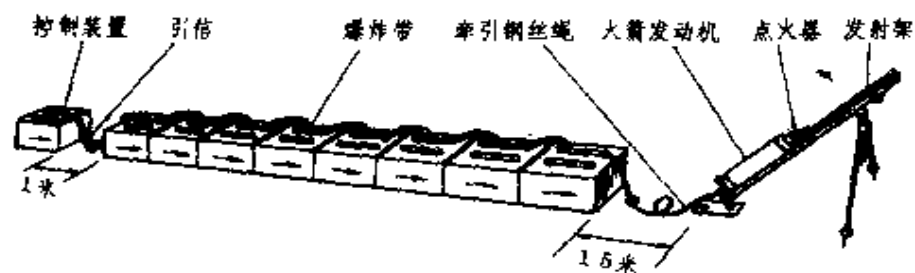
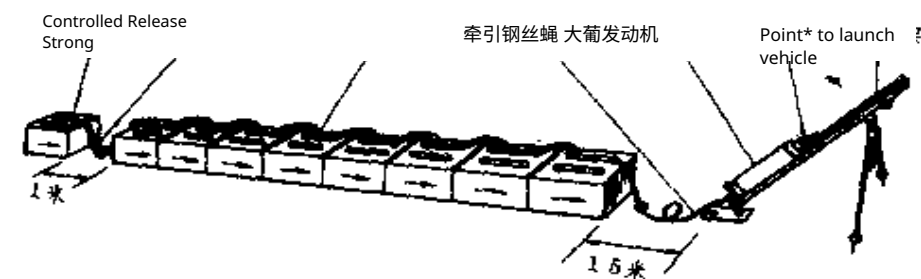


图 4—40 单具发射 (爆炸带 8 箱)



Single Wu Launch (Explosive Belt 8 Boxes)

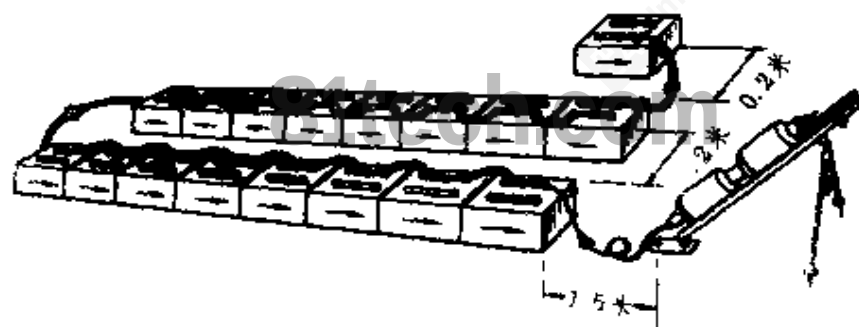


图 4—41 两具火箭发动机串联发射 (爆炸带 16 箱)

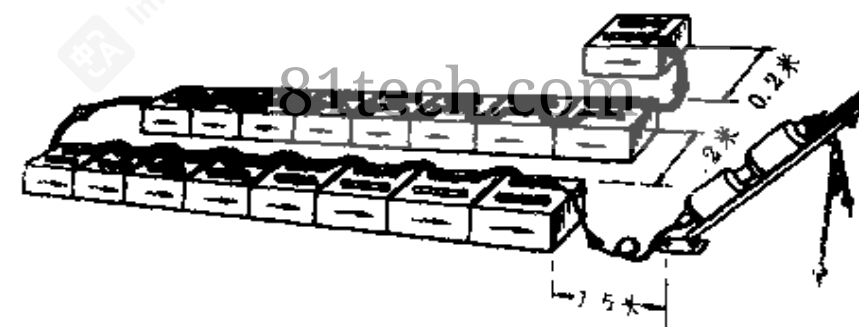


Figure 441: Two rocket engines fired in series (explosive train with 16 boxes)

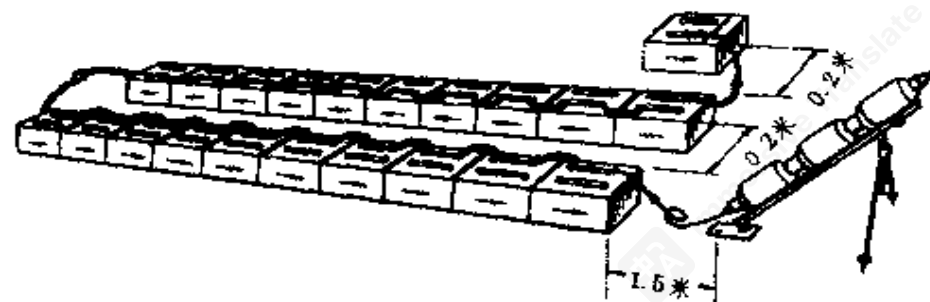


图 4—42 3 具火箭发动机串联发射 (爆炸带 20 箱)

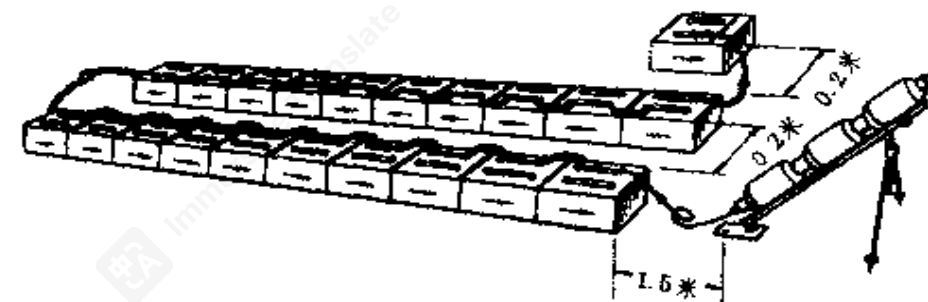


Figure 4-423 Rocket Engine Serial Launch (Explosion Zone 20 Boxes)

射，每辆坦克上装载两套 (图 4—43)，每辆军用推土机上装载 4

firing, each tank carries two sets (Fig. 4-43), and each military tractor carries 4

套 (图 4—44)。

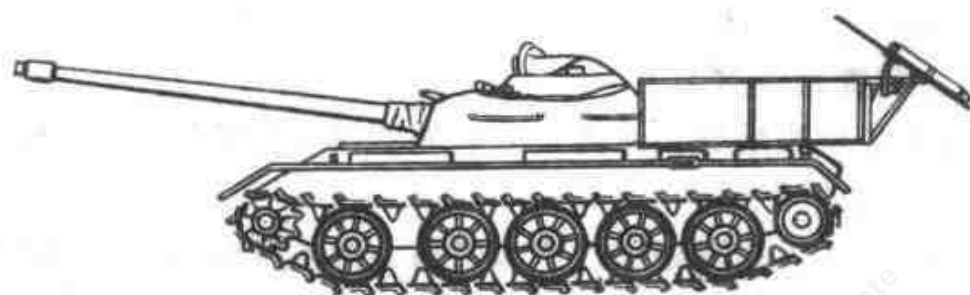


图 4—43 装载在坦克上的 GBP126 型火箭爆破器



图 4—44 装载在军用推土机上的 GBP126 型火箭爆破器

(一) 主要战术技术性能：在非耐爆防坦克地雷场中，一套火箭爆破器开辟通路宽度不小于 5 米；在耐爆防坦克地雷场中，一套火箭爆破器开辟通路宽度不小于 2.2 米；扫雷率不低于 90%。

全套器材重 750 千克；爆炸带头部射程 340 米；爆炸带全长 80 米，开辟通路纵深不小于 60 米。爆炸带被枪弹贯穿时不燃烧、不爆炸；使用全保险型药盘延期引信，延期时间为 12 秒。

车内发射时完成一次作业的时间不超过 30 秒。发射后可将发射箱抛弃，不影响坦克的战斗性能。

Set (Figure 4-44).

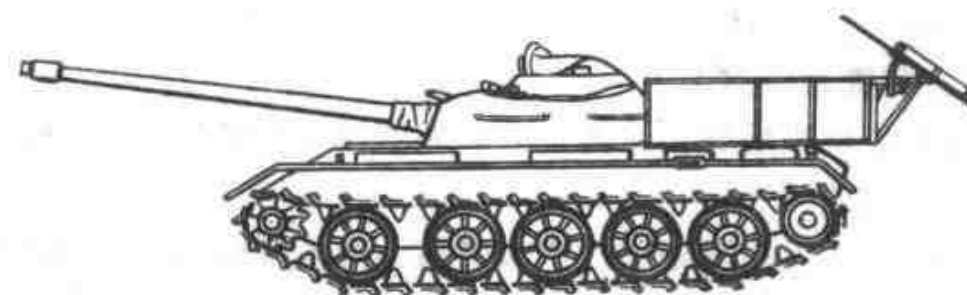


Figure 443 装载在坦克上的 GBP126 型火箭爆破器



Figure 444 GBP126 rocket mine mounted on a military tractor

(一) 主要战术技术性能：在非耐爆防坦克地雷场中，一套火箭爆破器开辟通路宽度不小于 5 米；在耐爆防坦克地雷场中，一套火箭爆破器开辟通路宽度不小于 2.2 米；扫雷率不低于 90%。

Complete equipment weighs 750 kilograms: explosive head has a range of 340 meters; the full length of the explosive belt is 80 meters, creating a passage depth of no less than 60 meters. When penetrated by bullets, the explosive belt does not burn or explode; it uses a fully safe cartridge with a delayed fuse, with a delay time of 12 seconds.

The time required to complete one operation during in-vehicle launch does not exceed 30 seconds. After launch, the launcher can be discarded without affecting the tank's combat performance.

(二) 构造与组成: 由火箭发动机、爆炸带、引信、控制机构、发射机构、固定机构、操纵与点火装置以及附件等组成。

(三) 使用方法:

1. 配置在坦克上:

(1) 在待机地域, 将两套火箭爆破器分别安装、固定在坦克车体后上方两侧。

(2) 进入发射阵地前, 调节射角, 安装火箭弹, 检查各机构的动作可靠性, 装入引信 (每套 2 枚)。

(3) 进入发射阵地后, 使坦克车体轴线基本对正射向, 将电源主合开关旋向右边 (准备发射右侧爆破器), 指示灯亮。

按下升起按钮, 当到位指示灯亮时, 即可发射。

按下发射按钮, 火箭弹即点火并飞离发射架。

按下抛箱按钮, 发射箱从坦克上被抛下。

当将电源主合开关旋向左边时, 可按上述方法发射左侧火箭爆破器。

2. 配置在军用推土机上: 与配置在坦克上使用基本相同。

第六十九条 GBP128 型火箭爆破器: 主要用于在防步兵地雷场及铁丝网中开辟通路。

(一) 主要战术技术性能: 在防步兵地雷场开辟通路宽度为 2 米, 扫雷率为 100%; 在蛇腹形铁丝网中开辟通路宽度为 4.5 米; 在三列桩铁丝网中开辟通路宽度为 3 米; 在低桩铁丝网中开辟通路宽度为 2 米。组合使用时爆炸带最大长度为 444 米, 开辟通路纵深为 452 米; 爆炸带展直率为 100%, 见表 4-11。

(二) 构造与组成: 全套器材由 12 具单兵火箭爆破器、1 套组合发射架、4 套组合管及 4 根粗钢丝绳组成。

单兵火箭爆破器由 I 型 (9 具) 和 II 型 (3 具) 组成。I 型单兵火箭爆破器爆炸带为导爆索串联塑料壳球形装药, 全长 42 米, 主要用于在防步兵地雷场中开辟通路; II 型单兵火箭爆破器爆炸带为导爆索串联金属壳球形装药, 全长 22 米, 主要用于在

(2) Construction and Maintenance: Rocket engines, explosive belts, communication systems, control mechanisms, launch mechanisms, fixation mechanisms, operation and ignition devices, and accessories, etc. (3) Usage Method:

1, Configure in Tank 1:

(1) In the standby area, install and secure two rocket launchers on opposite sides of the tank hull.

(2) Before entering the firing position, adjust the firing angle, install the rocket, check the operation of all mechanisms, and perform a preliminary check; load the signal (2 per set).

(3) After entering the firing position, align the tank's hull axis substantially with the firing direction, rotate the power switch to the "on" position (preparing the right-side explosive device for firing), and ensure the indicator light illuminates.

Press the raise button; when the limit switch light turns on, you can fire.

Press the fire button, and the rocket will ignite and launch from the launcher.

Press the drop box button to drop the box from the tank.

When the main power switch is rotated to the left, fire the left fuse according to the method described above.

2. Configuration on military bulldozers: Essentially the same as the configuration used on tanks. Article 69 CBP128 rocket breacher: Primarily used to clear anti-personnel minefields and barbed wire obstacles.

(-1) Main tactical and technical performance: When clearing a path through an anti-personnel minefield, the width is 2 meters with a 100% mine-clearing rate; when clearing a path through a herringbone wire fence, the width is 4.5 meters; when clearing a path through a three-row stake wire fence, the width is 3 meters; when clearing a path through a low-stake wire fence, the width is 2 meters. When used in combination, the maximum length of the explosive strip is 444 meters, and the depth of the cleared path is 452 meters. The straightening rate of the explosive strip is 100%, as shown in Table 4-11.

(II) Construction and Composition: The complete equipment set consists of 12 individual rocket demolition devices, 1 combined launcher channel, 4 sets of combined tubes, and 4 heavy steel wire ropes. The individual rocket demolition devices are composed of Type I (9 units) and Sub-type (3 units). The Type I individual rocket demolition device features a detonating cord-linked plastic-cased spherical charge with a total length of 42 meters, primarily used for clearing paths in anti-personnel minefields; the Type II individual rocket demolition device features a detonating cord-linked metal-cased spherical charge with a total length of 22 meters, primarily used for

铁丝网中开辟通路。两种单兵火箭爆破器既可单独使用，也可组合使用。

表 4—11 GBP128 型火箭爆破器使用方式

发射形式	发 射 器	射 角	爆炸带长 (m)	头部最大射程 (m)
单 具	包装箱	25°	22 ~ 42	72 ~ 93
两只串联	包装箱	25°	44 ~ 84	146
3 具并联	发射架	36°	66 ~ 126	187
6 具串并联	发射架	36°	192 ~ 252	314
9 具串并联	组合发射架	45°	318 ~ 378	436
12 具串并联	组合发射架	45°	444	557

组合管主要用于连接火箭发动机。一套组合管可并联 3 具火箭发动机，使之同时工作。组合管之间还可互相串联，使多组火箭发动机连续工作。

组合发射架由两个发射架单元组成。一个发射架单元可发射 1~2 组组合火箭发动机；当发射 3 组以上组合火箭发动机时，将两个发射架单元结合成一具组合发射架。

粗钢丝绳用于配合火箭发动机组使用，用于连接火箭发动机组和爆炸带。

(三) 使用方法：GBP128 型火箭爆破器有六种使用方法。使用前应在出发地域预先完成发射准备工作。

1. 单具使用：单具火箭爆破器由 1 人操作。

Open a path through the barbed wire. Both single-soldier rocket demolition devices can be used independently or in combination.

Table 4-11 GBP128 Type Firewire Explosive Device Usage Method

	Maximum Range
6 parallel events	
9 Series-Parallel	Combination Launch
12 Series-parallel	Bracket Combination Launching Rack

Combustion chambers are primarily used to connect rocket engines. A set of combustion chambers can be connected in parallel to three rocket engines, enabling them to operate simultaneously. Combustion chambers can also be connected in series to each other, allowing multiple sets of rocket engines to operate continuously.

The combination launcher consists of two launcher units. One launcher unit can fire 1~2 sets of combined rocket engines; when firing more than three sets of combined rocket engines, the two launcher units are combined into a single combination launcher.

Coarse wire rope is used in conjunction with rocket engine assemblies for connecting rocket engine nozzles and explosive bands.

(3) Usage Method: The GBP128 rocket demolition tool has six usage methods.

Preparation for launch must be completed in advance at the departure location before departure.

1. Single-unit operation: One person operates a single rocket breacher.

进入阵地后，选择与预定通路地段坡度相近的地点作为发射位置；将箱体前倾（射角约为 25°）并概略瞄准目标；将控制系统盒取出置于箱盖侧后方；旋掉引信帽，将挂钩挂入引信拉发绳的环内；旋掉击发器保护帽，一手按住发动机，另一手手指勾住击发器拉火绳，沿发动机轴向向前用力拉火，然后迅速撤至侧后方利用地形隐蔽。

2. 两具串联使用：两具火箭爆破器串联使用由两人操作。

进入阵地后，选择与预定通路地段坡度相近的地点作为发射位置，将两具火箭爆破器间隔 10~20 厘米并排放置。

第一名作业手使两具火箭爆破器呈单具发射状态；第二名作业手将两具火箭爆破器的阻力伞串联，并将第二具爆炸带头部与第一具爆炸带尾部连接；按“单具使用”的方法挂好引信。

由第一名作业手实施发射。拉火后两名作业手迅速撤至侧后方利用地形隐蔽。

3. 3 具并联使用：3 具火箭爆破器并联使用由 4 人操作。

第一名作业手：设置发射架（射角约 36°）；协助第四名作业手设置发射箱（在发射架正后方 1 米处直立向后顺序排列）；连接各爆炸带。

第二、三名作业手：将火箭发动机并联；将击发器旋入组合管头部；将粗钢丝绳连接在组合管的尾部；将火箭发动机装入发射架。

第四名作业手：将 3 具火箭爆破器的爆炸带头部细钢丝绳以及第一、二具火箭爆破器的引信组合器和控制系统盒卸下，并将两枚引信按单具爆破器操作方法连接在第三具火箭爆破器引信组合器上。串联 3 具火箭爆破器的控制系统阻力伞。

由第一名作业手挂引信挂钩实施发射。拉火后各作业手迅速撤至侧后方利用地形隐蔽。

4. 6 具组合使用：6 具火箭爆破器组合使用由 7 人操作。

第一名作业手：设置发射架，其操作方法同“3 具并联使

After entering the position, select a location with a slope similar to the planned route as the firing position; tilt the box forward (firing angle approximately 25°) and roughly aim at the target; remove the control system box and place it behind and to the side of the cover; unscrew the safety cap, insert the hook into the loop of the firing lanyard; unscrew the firing mechanism safety cap, place one hand on the engine and hook the other hand's fingers onto the firing mechanism lanyard, pull hard along the engine's axial direction, then quickly retreat to the side and rear, using terrain for concealment.

2 Dual Launchers: Two rocket launchers connected in series, operated by two personnel.

After entering the position, select a location with a slope similar to the designated route for placement, and place the two rocket demolition charges side by side with a gap of 10~20 cm.

First, attach the two rocket demolition charges in a single-launch configuration; second, connect the two rocket demolition charges' drag parachutes in series, and link the second charge's head to the first charge's tail. Then, according to the "single-charge" method, secure the fuse.

Fired by the first crew member. After the firing command, the two crew members quickly withdraw to the side and rear, using terrain for concealment.

3 in parallel: 3 rocket launchers used in parallel operated by 4 personnel.

First Operator: Set up the launcher (launch angle approx. 36°); assist the fourth operator in setting up the launch box (standing upright 1 meter directly behind the launcher in a row); connect all explosive belts.

Second and third place: Assemble the rocket engines in parallel; Screw the firing mechanism into the head of the launcher tube; Connect the coarse steel wire rope to the tail of the launcher tube; Assemble the rocket engine into the launch stand.

Fourth place: Remove the detonator head fine steel wire rope of three rocket demolition charges and the fuzing combination and control system boxes of the first and second rocket demolition charges, and connect the two fuzes to the fuzing combination of the third rocket demolition charge according to the single demolition charge operation method. Inspect the control system resistance chute of the three rocket demolition charges.

The first operator attaches the fuse hook to the firing pin and initiates the launch. After firing, all operators quickly withdraw to the side and rear, using terrain for concealment.

6 combined use: 6 rocket launchers combined use operated by 7 people.

First operator: Set up the launcher; its operation is the same as "3 parallel launchers"

用”；与第二、第三名作业手协同将火箭发动机装入发射架。

第一至第五名作业手：分别组合两组火箭发动机，然后实施串联，并连接击发器和粗钢丝绳。

第六、七名作业手：连接爆炸带与引信，其操作方法同“3具并联使用”；与第四、第五名作业手协同设置爆炸带和控制装置，其操作方法同“3具并联使用”（其中第六具包装发射箱呈单具发射状态设置在侧方）。

由第一名作业手挂引信挂钩实施发射。拉火后各作业手迅速撤至侧后方利用地形隐蔽。

5. 9具组合使用：9具火箭爆破器组合使用由10人操作。

由两名作业手组合并设置好发射架（射角45°），其余各作业手的操作方法与“6具组合使用”基本相同（其中第九具包装发射箱呈单具发射状态设置在侧方）。

由第一名作业手挂引信挂钩实施发射。拉火后各作业手迅速撤至侧后方利用地形隐蔽。

6. 12具组合使用：12具火箭爆破器组合使用由14人操作。除发射箱位于发射架前方0.8米处右侧直立向前顺序排列外（其中第十二具包装发射箱呈单具发射状态设置在侧方），其余操作使用方法与“9具组合使用”基本相同。

第五节 爆破工具和爆破手背包

第七十条 GGT111型爆破手背包：主要供爆破小组或单兵实施爆破作业时使用，其配套标准见表4—12。

第七十一条 GGT112型成套爆破工具：主要供工兵班实施爆破作业时使用，其配套标准见表4—12。

第七十二条 GGT113型爆破工具：主要供工兵班实施爆破作业时使用，其配套标准见表4—12。

: Second, the Lanming assemblyman and the fire engine assemblyman will coordinate to assemble the fire engine into the launch rack.

First to fifth place operators: Combine two sets of fire-jin engines, then connect them in series, and attach the firing mechanism and coarse steel wire rope.

Sixth and Seventh Operators: Connect the explosive belt to the fuze. Its operation method is simple. "Three in parallel use": Coordinate with the Fourth and Fifth Operators to set up the explosive belt and control device; its operation method is the same as "Three in parallel use" (where the sixth package launcher is included).

Single its emission state is set to the side).

The first operator attaches the fuse hook to the firing pin and initiates the launch. After firing, all operators quickly withdraw to the side and rear, using terrain for concealment.

5.9 Combined Use: 9 rocket launchers used in combination are operated by 10 players.

Set up the launcher (with a 45° elevation angle) by combining two operators; the remaining operators use the same procedure as when six units are used together (with the ninth packaged launcher set to single-fire mode on the side).

The firing is initiated by the first crew member pulling the firing pin hook. After pulling the trigger, all crew members quickly withdraw to the side and rear, using terrain for concealment.

6.12 Combined Use: 12 Rocket Launchers Combined Use is operated by 14 personnel. Except for the launch boxes, which are arranged upright in a forward sequence 0.8 meters to the right of the launcher (with the second launch box in a single-launch configuration positioned to the side), the remaining operating procedures are substantially the same as those for "9 Combined Use".

Section 5: Blasting Tools and Blaster's Backpack

第七十条 GGT111型爆破手背包：主要供爆破小组或单兵实施爆破作业时使用，其配套标准见表4—12。

第七十一条 GGT112型成套爆破工具：主要供工兵班实施爆破作业时使用，其配套标准见表4—12。

第七十二条 GGT113型爆破工具：主要供工兵班实施爆破作业时使用，其配套标准见表4—12。

表 4—12 爆破工具与爆破手背包配套标准

序号	工 具 称	单位	GGT111 型 爆破手背包	GGT112 型 成套爆破工具	GGT113 型 爆破工具
1	背箱(包)	个	1	1	1
2	起爆器(GBP412)	部		2	1
3	欧姆表(205 - 1)	部		1	1
4	药量计算盘	个	1		
5	双芯工兵导电线	m		300	100
6	导电线线架(络车)	部		1(络车)	1(线架)
7	白色线绳	m		50	50
8	线绳架	个		1	1
9	胶布	卷		1	1
10	钢卷尺	只	1	1	1
11	雷管钳	把	2	2	1
12	钢丝钳	把		1	1
13	剥线钳	把		1	
14	电工刀	把	1	2	
15	塑料雷管盒	个	1		1
16	电雷管盒	个			1
17	爆破手背包	套		1	

Table 4—12 Standard for Breaching Tools and Breacher Backpacks

		GGT111 Model Demolition Expert Backpack	GGT112 Model Complete set blasting tools	GGT113 Model
1	Backpack)			
	Blaster (GBP412)			
	Ohmmeter (205-1)			
	Dose Calculation Chart			
	Dual-Core Engineer Wire			
	Overhead wire line carrier (trolley)		1(Electric Vehicle)	1 (Line Rack)
				1
				1
				1
	Plastic RDX Box			
	Demolition Expert Backpack			

第六节 装药的捆包与制作

第七十三条 实施爆破用的准备好的定量炸药叫做装药。装药按其形状，通常分为集团装药、直列装药和聚能装药。装药量应根据爆破目标的坚固程度、有关尺寸、所需破坏程度、装药配置于目标的部位等条件确定。

捆包装药时，应根据炸药的性能、爆破目标周围的潮湿程度以及等待起爆时间的长短等条件，用麻袋、油纸、塑料薄膜等做包装材料，也可将炸药装在铁桶、木箱、竹筒及陶瓷罐等容器内。在潮湿地区 and 水中实施爆破时还必须在包装好的装药表面和接缝处涂以沥青或蜡等。装药应捆扎牢固，装填确实，便于携带和使用。

装药上一般应固定两个点火管。如果暂不结合点火管，应在装药上固定点火管处插一木棍，以表示雷管孔的位置。

第七十四条 长度不大于最小宽度或高度 5 倍的装药称为集团装药。

用块状炸药捆包集团装药时，将包皮平铺在地上，根据所需要的形状将药块紧密靠拢，并使雷管孔朝外，包起各边，然后用绳索或铁丝捆扎牢固。

用粉状炸药捆包集团装药时，根据需要可采用单层或多层包皮，将包皮在地上展开，放好炸药并压实，同时修整装药形状，然后用绳索或铁丝捆扎牢固（图 4—45）。

将炸药装入铁桶、木箱或陶瓷罐等容器内时，先将炸药的 1/2 装入容器，放入点火管或电雷管，再装入剩余的炸药，轻轻压实，最后将口部密封。当装



图 4—45
用布捆包的集团装药

Section 6: Bundling and Preparation of the Charge

Article 70. The quantity of explosive prepared for blasting is called the charge. Charges are commonly classified by shape into grouped charges, straight-line charges, and shaped charges. The charge quantity shall be determined based on conditions such as the hardness of the blasting target, relevant dimensions, the degree of destruction required, and the location of the charge within the target.

When bundling explosives for packaging, materials such as burlap sacks, oil paper, or plastic film should be used based on the explosive's properties, the moisture level around the blasting target, and the duration of the delay before detonation. Explosives may also be placed in containers such as iron drums, wooden crates, bamboo tubes, or ceramic jars. When blasting in humid areas or underwater, the surface of the packaged charge and any seams must be coated with asphalt, wax, or similar materials. The charge must be securely bundled, properly filled, and easy to carry. OLEC.CO

Two ignition pipes must be fixed on the charge. If the ignition pipes are not temporarily connected, a wooden stick should be placed at the location where the ignition pipes are fixed on the charge.

Indicates the location of the detonator hole.

Article 74. A charge whose length does not exceed five times the minimum width or height is called a compacted charge.

When bundling closed-packed charges with block explosives, lay the casing flat on the ground, pack the explosive blocks tightly together according to the required shape, ensure the detonators face outward, wrap the sides, and then secure firmly with rope or wire.

When bundling bulk charges with powder explosives, single or multiple layers of wrapping may be used according to requirements. The wrapping is spread out on the ground, the explosives are placed and compacted, the shape of the charge is trimmed, and then the bundle is secured with rope or wire (Fig. 4-45).

When loading explosives into iron drums, wooden crates, ceramic jars, or other containers, first place 1/2 of the explosive into the container, insert the firing tube or electric detonator, and then load the remaining explosive.

Finally, seal the mouth.

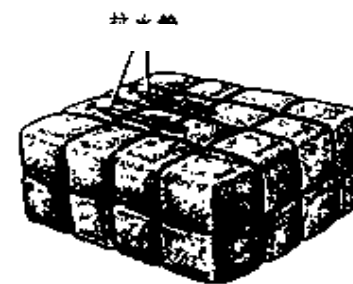


Figure 4-45 Grouped charge wrapped in cloth

药使用电雷管起爆时，电雷管脚线与导电线接续部应放入容器内，并将导电线的末端捆上一根横木棍，以防止电雷管被拉出或拉断接续部（图 4—46）。

用于水中的浮游装药，炸药约占容器容积的 1/2。为了使炸药在容器中不松动，上面可压以内盖（图 4—47）或交叉横木。

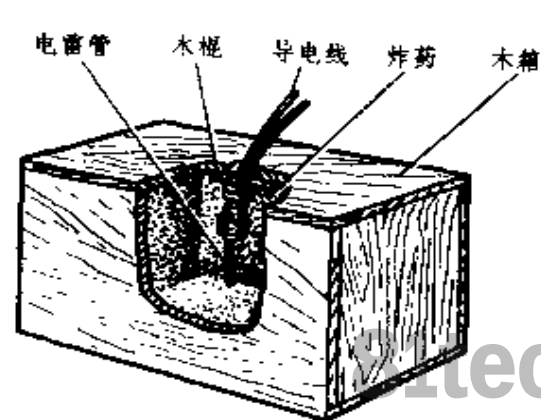


图 4—46 木箱装药

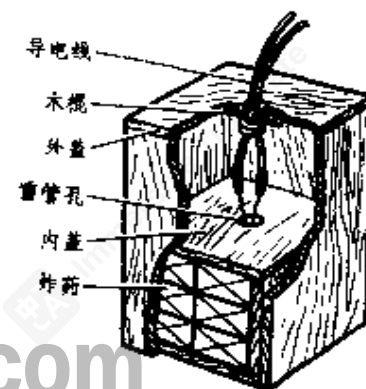


图 4—47
用于水中的浮游装药

第七十五条 长度大于宽度或高度 5 倍的装药称为直列装药。

用块状炸药捆包直列装药时，装药可捆在与其长、宽相等的木板上（图 4—48），先用包皮把装药的长边包起来，然后包两

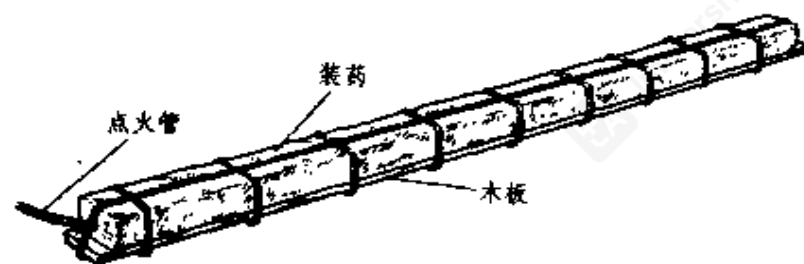


图 4—48 捆在木板上的直列装药

When detonating with electric detonators, the connection between the detonator lead and the conducting wire should be placed inside a container, and the end of the conducting wire should be bent over a horizontal stick to prevent the electric detonator from being pulled out or the connection from being severed (Figure 4-46).

For use as floating charges in water, the explosive occupies approximately one-half of the container's volume. To prevent the explosive from shifting within the container, an inner cover (Fig. 4-47) or cross beams may be placed on top.

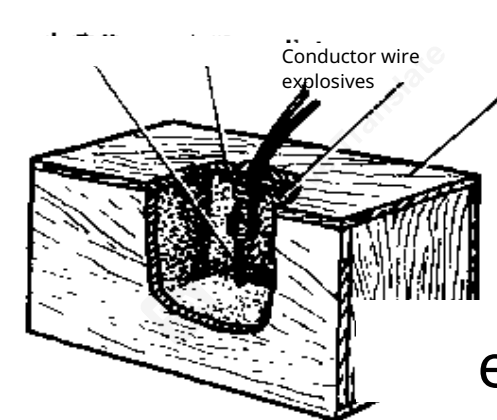


Figure 4-46 wooden
crate ammunition

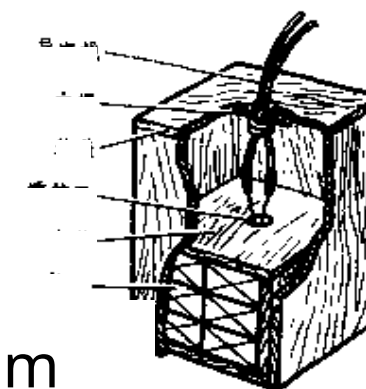


Figure 4—47
Floating charges for use in
water

Article 75. A charge whose length is more than five times its width or height is called a linear charge.

When bundling straight-line charges with block explosives, the charge can be bundled on a wooden board equal in length and width to the charge (Fig. 4-48). First, wrap the long side of the medicated item with a condom.

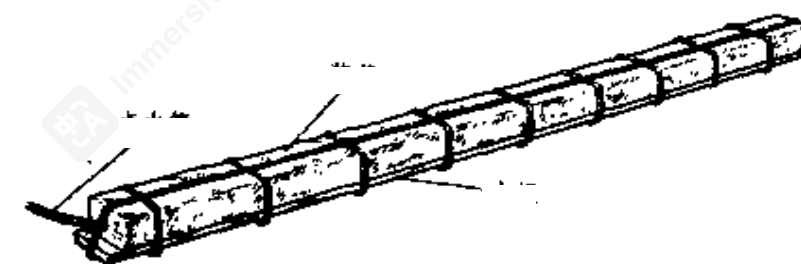


Figure 4—48 parallel charges bundled on a
wooden board

端（两端药块的雷管孔朝外），使药块紧密相接；最后用绳索或细铁丝每隔 20~30 厘米捆扎 1 道。如不用包皮捆包，每块药块应捆扎 1~2 道。

用粉状炸药捆包直列装药时，可先将包皮缝成筒形袋子，装入炸药并压实后再固定在木板或竹条上；也可将炸药直接装入竹筒或金属管内。为使用方便，可在装药插入目标的一端装入木尖头（图 4—49）。

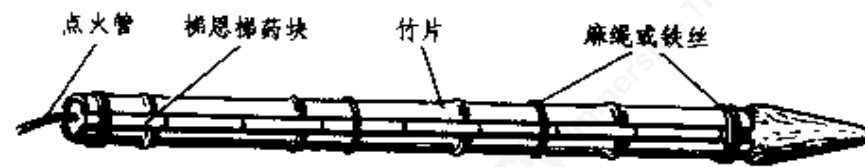


图 4—49 用竹材捆包的直列装药

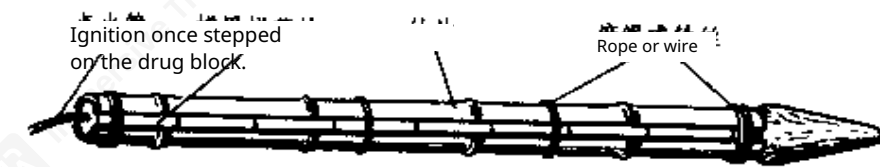
第七十六条 将装药一端制成带有空穴或凹槽，有的还带有药形罩，使装药爆炸后在空穴或凹槽方向形成聚能作用的装药称为聚能装药。主要用于炸穿装甲，炸断金属构件，爆破坚固的钢筋混凝土工事，以及在土壤、岩石中快速开设药洞等。聚能装药的破甲、破坏目标的效果，与炸药的爆炸性能、药形罩的尺寸和形状、药形罩材料的质量及炸高（聚能射流焦点至空穴的距离）有关。圆柱形聚能装药的装药高度 H 一般为装药直径 D 的 1.5~2 倍，锥形角为 $50^\circ \sim 60^\circ$ ，炸高 F 为装药直径 D 的 1~1.5 倍，药形罩高 h 为装药直径 D 的 1~1.5 倍，隔板至药形罩约为装药直径 D 的 $1/3$ ，点火管和扩爆药应装在聚能药形罩另一端的中央（图 4—50）。

（一）炸药：聚能装药通常采用密度大的高级炸药，或中、高级混合炸药。炸药密度大，则爆速大，爆压高，供给药形罩能量大，破甲深度也大。

（二）药型罩：用于穿透装甲和爆破钢筋混凝土工事时，空

End (with the detonator holes of the two blocks of explosive facing outward) to ensure the blocks are tightly joined; finally, tie each block with rope or thin iron wire every 20~30 cm. If not wrapped in protective casing, each block should be tied 1~2 times.

When bundling straight-line charges with powder explosives, the casing can first be sewn into a cylindrical bag, filled with the explosive and compacted, then fixed to a wooden board or bamboo strip; alternatively, the explosive can be directly loaded into bamboo tubes or metal pipes. For convenience, a pointed tip can be inserted at the end where the charge is inserted into the target (Figure 4-49).



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图4—49用竹材捆包的直列装

Article 76: A charge whose one end is formed with a cavity or groove, sometimes also with a liner, such that the charge produces a focusing effect in the direction of the cavity or groove upon detonation, is called a shaped-charge charge. It is mainly used for penetrating armor, breaking metal components, blasting reinforced concrete fortifications, and rapidly opening charge holes in soil and rock. The effectiveness of shaped-charge charges in armor penetration and target destruction depends on the explosive's performance, the dimensions and shape of the liner, the mass of the liner material, and the standoff distance (the distance from the liner to the cavity). For cylindrical shaped-charge charges, the charge height H is generally 1.5~2 times the charge diameter D , the cone angle is $50^\circ \sim 60^\circ$, the standoff distance F is 1~1.5 times the charge diameter D , the liner height h is 1~1.5 times the charge diameter D , the partition to the liner is approximately $1/3$ of the charge diameter D , and the primer and booster should be installed at the center of the shaped-charge liner at the opposite end (Figure 4—50).

(1) Explosives: High-explosive charges typically use high-density advanced explosives or medium-to-high density mixed explosives. Higher explosive density results in greater detonation velocity, higher detonation pressure, greater energy supplied to the shaped charge, and deeper armor-piercing depth.

(2) Penetrator: Used for penetrating armor and breaching reinforced concrete fortifications, the air

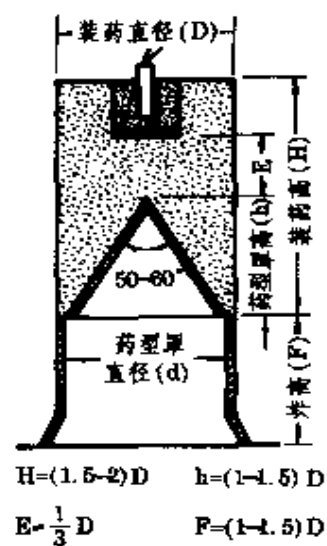


图 4—50 聚能装药尺寸关系

穴应带金属药型罩（通常用紫铜、生铁或低碳钢制成）；用于土壤、岩石中开设药洞，空穴可带非金属药型罩（如玻璃、陶瓷等）。药型罩的厚度一般为 1~3 毫米，药型罩的材料结构和尺寸必须保持严格的对称和均一，否则将会明显降低穿透效果。

（三）隔板：隔板可使爆炸产物作用在药型罩壁上的动压增大，一般可提高穿甲能力的 25%~30%。隔板可用木板、厚纸板或塑料等非金属材料制作，其形状呈圆锥形、半球形或圆台形等，直径等于或稍大于扩爆药的直径，厚度多为 8~10 毫米。隔板设置在扩爆药底部，在装药中的位置要适当，对称性要好。

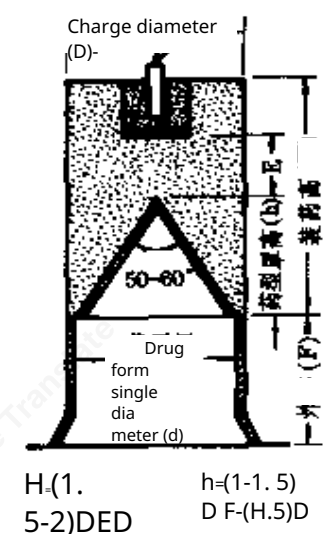


Figure 4301 Nengchu Jiejie

The borehole should be lined with a metal liner (typically made of copper, cast iron, or low-carbon steel); it is used to drill holes in soil and rock. The empty borehole may be lined with a non-metal liner (such as glass or ceramic). The thickness of the liner is generally 1~3 mm, and the material structure and dimensions of the liner must maintain strict symmetry and uniformity; otherwise, the penetration effect will be significantly reduced.

(3) Baffle: A baffle increases the dynamic pressure exerted by the explosive products on the liner wall, generally improving the penetration capability by 25%~30%. Baffles can be made of non-metallic materials such as wood, thick cardboard, or plastic. Their shape is typically conical, hemispherical, or frustum-shaped, with a diameter equal to or slightly larger than the diameter of the booster charge. The thickness is usually 8~10 mm. The baffle is placed at the bottom of the booster charge, and its position within the charge assembly should be appropriate and symmetric.

第五章 土壤与岩石爆破

第一节 基本知识

第七十七条 实施土壤与岩石爆破，装药通常应设置在地面以下，称为地下装药。

当地下装药在同一性质的土石中爆炸时，靠近装药的土石受到的压力最大，离装药越远受到的压力越小。装药爆炸后对土石的破坏程度可区分为压缩、破坏、震动3个范围（图5—1）。

（一）压缩范围：在此范围内，土壤被压缩形成空腔，如系坚硬岩石，则被粉碎。

（二）破坏范围：在此范围内，因土石间的连结受到破坏而被破碎成破裂。

（三）震动范围：在此范围内，土石只受到震动作用，产生轻微破裂。在震动范围以外，只有地震波的传播，土石无破坏现象。

上述3个范围的大小，分别用压缩半径 R_y 、破坏半径 R_p 和震动半径 R_z 表示。

第七十八条 与空气相接触的表面，称为临空面（自由面）。

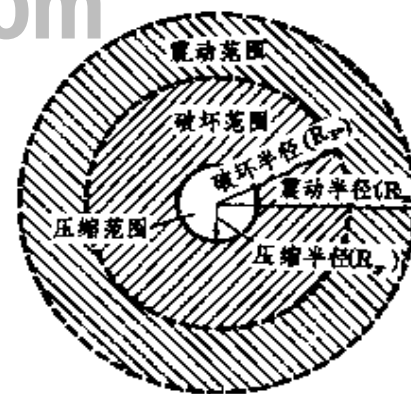


图 5—1

地下装药的爆炸作用范围

Chapter 5: Blasting of Soil and Rock

Section 1: Basic Knowledge

Article 7.7: When implementing soil and rock blasting, the charge is typically placed below ground level, known as underground loading.

When an underground charge explodes in soil and rock of the same nature, the pressure experienced by the soil and rock near the charge is greatest, and the pressure decreases as the distance from the charge increases. After the charge explodes, the degree of destruction to the soil and rock can be classified into three zones: compression, destruction, and vibration (Figure 5-1).

(1) Compression range: Within this range, the soil is compressed to form a cavity; if it is hard rock, it is crushed.

(2) Zone of destruction: Within this zone, the material is broken into fragments due to the disruption of connections between the rock and soil.

(3) Range of vibration: Within this range, the soil and rock are subjected only to dynamic action, resulting in slight cracking. Outside the vibration range, only the propagation of seismic waves occurs, with no damage to the soil and rock.

The sizes of the above three ranges are represented by the compression radius R_y , the destruction radius R_p , and the motion radius R_z , respectively.

Article 78 Surfaces in contact with air

referred to as the free surface (free face)

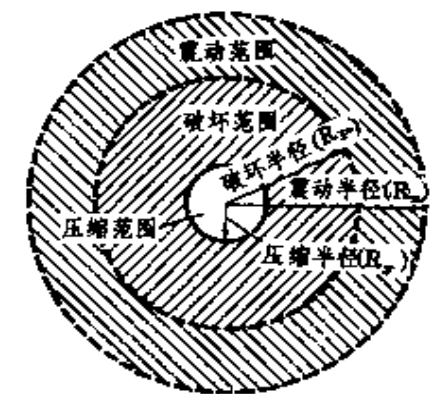


Figure S-1

Explosion range of underground charges

由装药中心至临空面的最短距离称为最小抵抗线 h (图 5—2)。

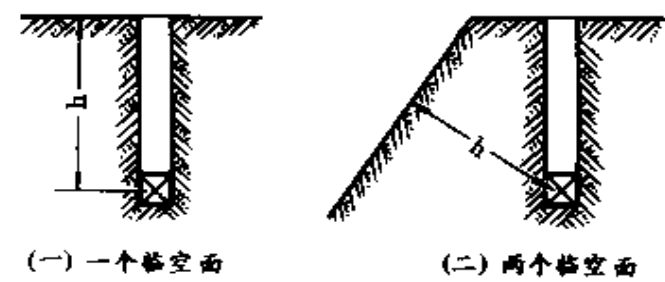


图 5—2 最小抵抗线

仅有 1 个临空面时，最小抵抗线与装药的人土深度是一致的。最小抵抗线方向是土石受到破坏和抛掷的主要方向。最小抵抗线的大小，关系到装药量和作业量的大小。

第七十九条 地下装药可分为抛掷装药、松散装药和压缩装药。

(一) 抛掷装药：当地下装药的破坏半径大于最小抵抗线的 1.75 倍时，土石沿最小抵抗线方向抛出，并在地面上形成漏斗坑 (图 5—3)，称为抛掷装药。抛掷装药是土石爆破工程中使用最广泛的一种装药。

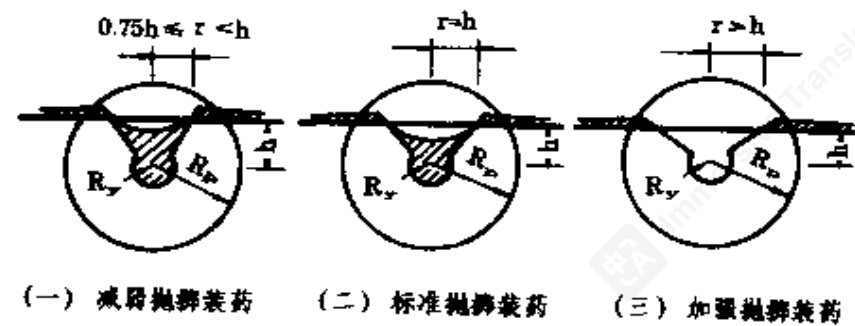


图 5—3 抛掷装药

漏斗坑半径 r 与最小抵抗线 h 的比值，称为爆破作用指数，

The shortest distance from the center of the charge to the free surface is called the minimum resistance line h (Fig. 5-2). A

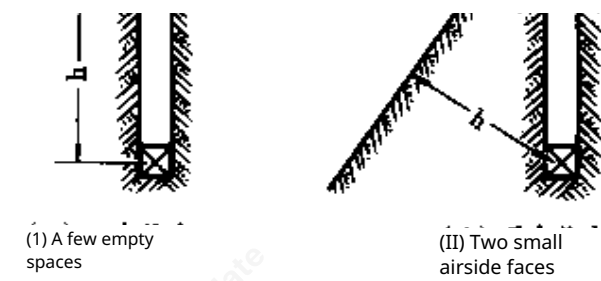


Figure 52 Most Resistant Line

When there is only one free face, the minimum resistance line is consistent with the depth of the charge into the ground. The direction of the minimum resistance line is the primary direction in which the rock and soil are broken and thrown. The magnitude of the minimum resistance line

Relates to the amount of explosive charge and the scale of operations.

Article 79 Underground charges can be classified into throwing charges, loose charges, and compressed charges.

(1) Blasting charge: When the destruction radius of underground charges exceeds 1.75 times the least resistance line, rock and soil are thrown along the direction of the least resistance line, forming a funnel-shaped crater on the ground (Figure 5-3), which is called blasting charge. Blasting charge is the most widely used type of charge in rock and soil blasting engineering.

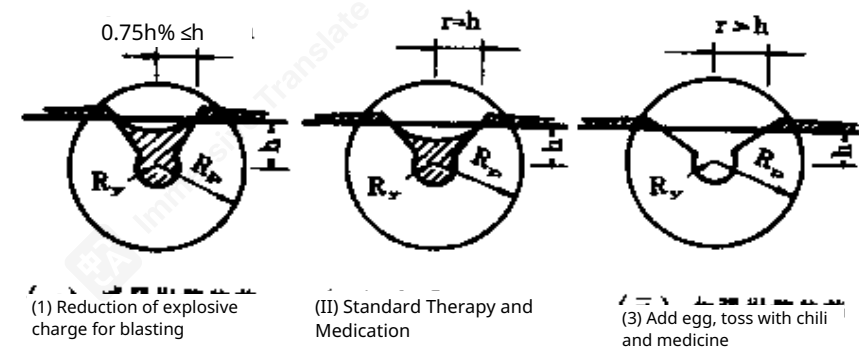


Figure 5-3: Throw Charge

The ratio of the radius of the funnel pit to the minimum charge depth h is called the blasting action index,

用 n 表示, 即:

$$n = \frac{r}{h}$$

式中: n ——爆破作用指数

h ——最小抵抗线 (米)

r ——漏斗坑半径 (米)

实施抛掷爆破的装药, 因爆破作用指数的不同分为: 减弱抛掷装药、标准抛掷装药、加强抛掷装药。

1. 减弱抛掷装药: $0.75 \leq n < 1$, 即 $0.75h \leq r < h$ 。

2. 标准抛掷装药: $n = 1$, 即 $r = h$ 。

3. 加强抛掷装药: $n > 1$, 即 $r > h$ 。当 $n = 1.5$ 时, 称为 1.5 倍加强抛掷装药; 当 $n = 2$ 时, 称为 2 倍加强抛掷装药。2 倍以上的加强抛掷装药一般不宜采用。

(二) 松散装药: 当装药爆炸的破坏半径等于最小抵抗线的 1~1.75 倍, 即 $R_p = (1 \sim 1.75) h$ 时, 土石将被松散 (图 5—4), 称为松散装药, 主要用于松散岩石和硬土。

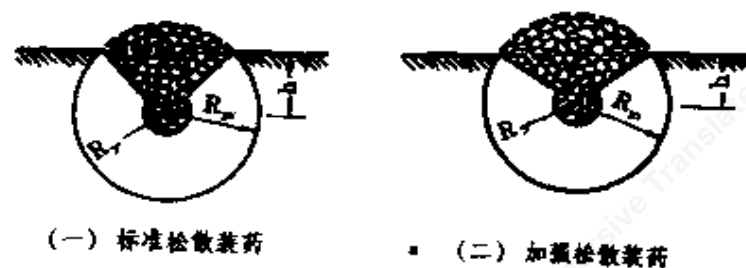


图 5—4 松散装药

实施松散爆破的装药, 因其对土石松散程度不同分为:

1. 标准松散装药: 破坏半径等于最小抵抗线的 1.4 倍, 即 $R_p = 1.4h$ 。

2. 加强松散装药: 破坏半径大于最小抵抗线的 1.4 倍, 且

Let n represent,
that is;

$$n = \frac{r}{h}$$

In which: n —explosive action index

h —minimum resistance line (m)

r —One funnel pit radius (meters)

Explosive charges used for throwing blasting are classified according to the blasting action index into: weakening throwing charges, standard throwing charges, and strengthened throwing charges.

1. Weak alkaline throwing charge: $0.75 \leq n < 1$, 即 $0.75h \leq r < h$

2. Standard charge throw : $n = 1$, i.e., $r = h$

3. Strengthen the throwing charge: $n > 1$. That is $r > h$. When $n = 1.5$, it is called 1.5

Doubly reinforced throw charge; when $n = 2$, it is called a 2x reinforced throw charge. Reinforced throw charges with 2x or more are generally not recommended.

(II) Loose charge: When the radius of destruction of the explosive charge equals the minimum resistance line,

1~1.75 times, i.e., at $R_p \pm (1 \sim 1.75) h$, the right bank will be loosened (Fig. 5

4), known as loose-packed blasting, is mainly used for loose rock and hard soil.

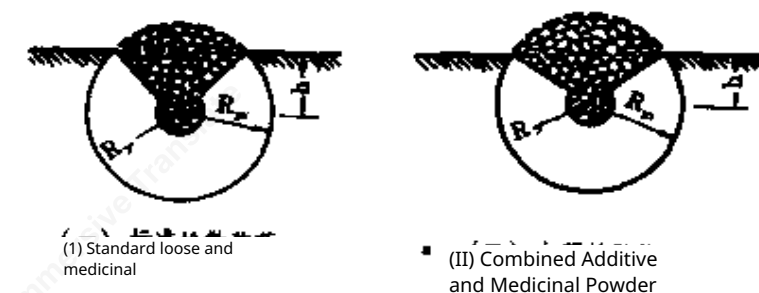


Figure 5-4 Loose Powder

The charge for loose blasting is classified according to the degree of loosening of the rock and soil into;

1. Standard loose charge: the radius of destruction is 1.4 times the minimum resistance, i.e., $R_p = 1.4h$ 。

2. Strengthen the blasting of loose charges: the radius of destruction shall be greater than 1.4 times the minimum resistance line, and

小于或等于最小抵抗线的 1.75 倍, 即 $1.4h < R_p \leq 1.75h$ 。

(三) 压缩装药: 当地下装药的破坏半径小于其最小抵抗线时, 装药爆炸后地表面只产生轻微的破裂或无破坏现象, 称为压缩装药, 主要用于在可塑性较好的土壤中构筑工事。

第八十条 漏斗坑的可见

深度 P (图 5—5) 是指从地表面到漏斗坑底部的最大深度, 其大小与土石性质、爆破作用指数、最小抵抗线有关。实施土石爆破时, 漏斗坑的可见深度可用下列公式计算:



图 5—5 抛掷漏斗坑可见深度

在岩石和砂性土壤中: $P = 0.33(2n-1)h$

在砂质粘土和粘土中: $P = 0.45(2n-1)h$

式中: P ——漏斗坑的可见深度 (米)

n 、 h ——意义同第七十九条

漏斗坑的孔唇高约为 $0.15r$ 。

第二节 装药量计算

第八十一条 抛掷、松散爆破装药量通常按下式计算:

$$C = Abh^3$$

式中: C ——装药量 (千克)

A ——土壤抗力系数, 见表 5—1

b ——爆破作用系数, 见表 5—2

h ——最小抵抗线 (米)

Less than or equal to 1.75 times the minimum resistance line, that is, $1.4h < R_p \leq 1.75h$

(3) Compressed charge: When the destruction radius of a subsurface charge is less than its minimum resistance line, the ground surface produces only slight cracking or no destructive effects after the charge explodes, which is called a compressed charge. It is mainly used for constructing fortifications in soils with good plasticity.

Article 80 Visibility of the funnel pit

Depth P (Figure 5—5) refers to from the surface

Maximum depth from the surface to the bottom of the funnel pit

Its size depends on the rock mass properties and blasting effect.

Index, minimum resistance line is related. When implementing the blasting of Shi Shi, the visible depth of the funnel pit can be calculated using the following formula:



Figure 5-5 Visible depth of the cast funnel pit

在岩石和砂性土壤中: $P = 0.33(2n-1)h$

In sandy clay and clay : $P = 0.45(2n-1)h$

In which: P —visible depth of the funnel pit (meters)

n , the meaning of h is the same as in Section 79.

The height of the lip of the funnel pit is approximately $0.15rc$.

Charge Calculation Section 2

Article 81 The charge quantity for scatter and loose blasting is usually calculated according to the following formula:

$$C = Abh^3$$

In which: C is the charge amount (in grams)

A —Soil resistance coefficient, see Table 5—1

b ——Blasting factor, see Table 5-2

h —minimum resistance line (m)

表 5—1 土壤抗力系数 A 值

材 料 名 称	A	附 注
新积松土地	0.44	
带有砂和碎石的土地	0.86	
生长植物的土壤	0.96	1. 如系分层土壤, A 值取最坚硬一层的数值。
夹砂地	1.11	
砂质粘土及坚硬青粘土	1.18	2. 硬岩层有缝隙时, 系数应缩小 0.5 倍。
多石土壤	1.29	
湿砂	1.43	3. 有条件时, 最好用标准抛掷装药试验爆炸校正系数 A。
红粘土	1.65	
石灰岩	1.86	
花岗岩	2.25	

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表 5—2 爆破作用系数 b 值

地下装药种类	$n = r/h$	爆破作用系数 b
标准松散装药		0.40
加强松散装药		0.65
标准抛掷装药	1.00	1.00
1.25 倍加强抛掷装药	1.25	1.57
1.5 倍加强抛掷装药	1.50	2.43
1.75 倍加强抛掷装药	1.75	3.62
2 倍加强抛掷装药	2.00	5.20

第八十二条 压缩爆破装药量按下列公式计算。

(-) 集团装药:

$$C = 0.7KAD^3$$

式中: C——集团装药量 (千克)

D——压缩空室的直径 (米)

Table 5-1 Soil resistance coefficient A value

Xinji Song Land	
Ground with sand and gravel	
Soil for growing plants	1. If the soil is stratified, use the A value of the hardest layer.
	The value of the first layer.
Sandy clay and hard green clay	When hard rock layers have gaps, the coefficient should be reduced by 2.
	Small 0.5 times.
	3. When possible, use standard throwing.
	1.65 Explosive test explosion correction coefficient A.

8 tec

Table 5--2 Bursting action coefficient b value

Underground charge types	$n=r/h$	Explosion factor b
Standard bulk loose powder		
Strengthen the loose powder charge		
标准抛掷装药		
1.25x Enhanced Throw Charge		
1.5x Enhanced Throw Charge		
1.75x boosted charge		
2x Enhanced Charge		

Article 82. The charge quantity for compressed blasting shall be calculated according to the following formula.

(-) Group charge:

$$C = 0.7KAD^3$$

In which: C- total charge weight (kg)

Diameter of a compressed void (meters)

A——土壤系数，依据土壤坚硬程度和含水量确定，见表 5—3

K——压缩作用系数，依据炸药种类和装药位置的土层厚度确定，见表 5—4

表 5—3 土壤系数 A 值

土 壤 种 类	A 值
含水量较多的水稻田和砂质粘土	0.5~0.6
含水量适中的粘土和砂质粘土	0.7
含水量较少的坚硬粘土和黄土	0.8~0.9

表 5—4 压缩作用系数 K 值

装药位置 的土层厚度	K 值		装药位置 的土层厚度	K 值	
	硝酸炸药	梯恩梯炸药		硝酸炸药	梯恩梯炸药
< 1m	3	3.3	> 4m	5	5.5
1 ~ 4m	4	4.4			

(二) 直列装药：

$$C = KAD^2$$

式中：C——直列装药的药量（千克/米）

D、A、K——意义同上

炸出的工事直径与设计直径并不都是一致的。对垂直坑道，其实际的空室直径等于设计直径；对于平（斜）坑道，其空室的垂直方向的直径大于水平方向的直径。垂直方向直径为设计直径的 1.1 倍，水平方向直径为设计直径的 0.9 倍。

A compaction coefficient, determined based on soil hardness and water content, is shown in Table 5-3.

K11 compression coefficient, determined based on the type of explosive and the thickness of the soil layer at the charge position, as shown in Table 5-14.

Table 5--3 Soil coefficient A value

	A value
Rice paddies with high water content and sandy clay	0.5~0.6
Clay and clayey loam with moderate moisture content	
Hard clay and loess with low moisture content	0.8~0.9

Table 5-41 Compression Coefficient K Value

Taxi layer thickness	TNT Explosive		Layer thickness	TNT Explosive	

(i) Inline charge:

$$C = KAD^2$$

Charge of parallel cartridges (kg/m)

D, A, K - same meaning as above

The diameter of the excavated work does not always match the design diameter. For vertical shafts, the actual chamber diameter equals the design diameter; for horizontal (inclined) shafts, the vertical diameter of the chamber is greater than the horizontal diameter. The vertical diameter is 1.1 times the design diameter, while the horizontal diameter is 0.9 times the design diameter.

第三节 抛掷爆破

第八十三条 抛掷爆破主要用于开设单个漏斗坑，构筑防坦克壕，开设斜坡路以及各种工事的平底坑等。

第八十四条 单个装药爆破法，用于在公路、铁路、机场跑道等处开设漏斗坑，以构成障碍，或开设工事的平底坑。单个装药爆炸后，一般不能同时满足所要求的漏斗坑的口宽和深度。因此，在计算装药量时，应根据任务要求，按满足口宽或深度要求计算。

第八十五条 一列装药爆破法，用于构成三角形断面的壕沟和防坦克壕等。

装药成一列配置时，装药的间距应按下列公式计算（图 5—6）：

在坚硬岩石中： $a=0.5(1+n)h$

在土壤和软岩中： $a=\sqrt[3]{bh}$

所有装药应同时起爆。爆破后，除土部的口宽约等于 $2r$ 。

第八十六条 二、三列装药爆破法，用于开设底宽大于深度的梯形断面除土部，如车辆掩体、沟渠和工事的平底坑。

（一）二列装药爆破时，装药应相对配置，装药的间距和列距均按第八十五条的公式计算。所有装药应同时起爆。爆破后，除土部的口宽约等于 2 个漏斗坑半径加 1 个列距，底宽约等于 1 个列距（图 5—7）。

（二）三列装药爆破时，各列装药应交错配置，装药的间距

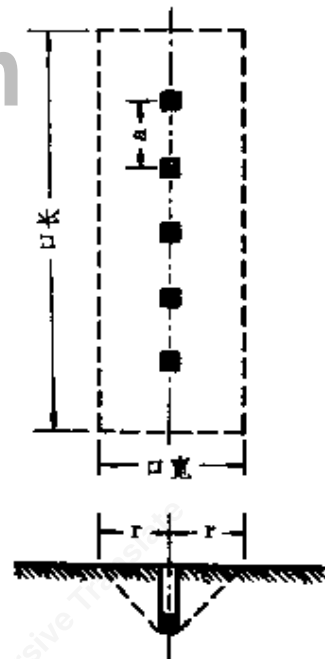


图 5—6 一列装药爆破法的装药配置

Section 3: Throwing Explosives

Article 83: Throw-and-blast demolition is mainly used for excavating individual combat pits, constructing anti-tank ditches, creating ramp roads, and digging bottom pits for various fortifications.

Article 84. The single-charge blasting method is used to excavate funnel pits for creating obstacles or flat-bottomed pits for constructing works on highways, railways, airport runways, and other locations. After a single charge explodes, it generally cannot simultaneously meet the required width and depth of the funnel pit. Therefore, when calculating the charge quantity, it should be determined based on task requirements, either to satisfy the required width or the required depth.

Article 85 One method of laying charges for blasting, using } to form a trench with a triangular cross-section and an anti-tank trench

When the charge is arranged in a line, the spacing between the charges should be

Calculate as follows (Fig. 5-6):

In hard rock: $a=0.5(1+n)h$

In soil and soft rock: $a=\sqrt[3]{bh}$

All charges shall be detonated simultaneously. After blasting, except

The width of the mouth of the Tufu is approximately equal to $2r$.

Article 86, Items 2 and 3: Ammunition blasting

Method, used for excavating trapezoidal cross-sections with a bottom width and depth, such as vehicle shelters, ditches, and embankments.

(1) When blasting with two rows of charges, the charges should be aligned

The spacing between charges and the column spacing are both calculated according to the formula in Article 80. All charges shall detonate simultaneously.

Explosion. After blasting, the width of the main section's opening is approximately equal to two times the radius of the funnel pit plus one column spacing.

The bottom width is approximately equal to one column width (Fig. 5-7).

(2) When blasting the Lan charge, the charges in each row should be staggered, and the spacing between charges should be

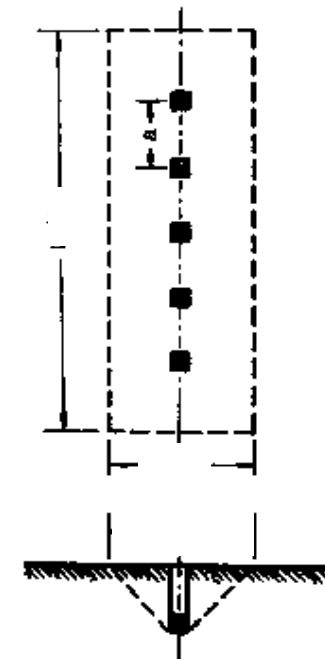


Figure 56-Configuration of charges for blasting method

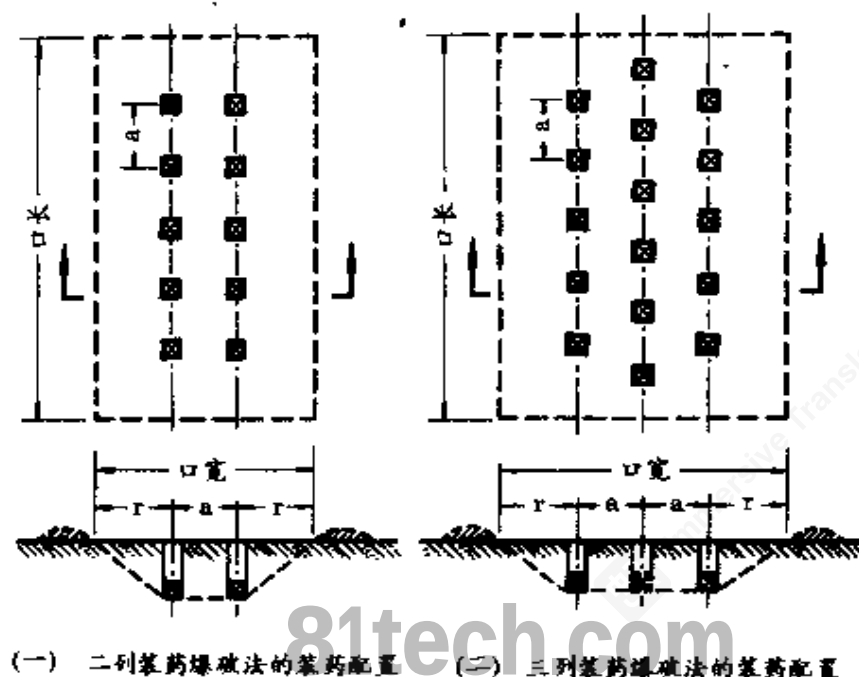


图 5—7 二、三列装药爆破法的装药配置

和各列的距离均按第八十五条的公式计算。为了减少回落土，满足可见深度的要求，中间一列装药的药量应增加 25%，所有装药应同时起爆。爆破后，除土部的口宽约等于 2 个漏斗坑半径加 2 个列距，底宽约等于 2 个列距（图 5—7）。

如不能同时满足口宽和底宽要求时，装药列数应根据需要（满足口宽或底宽）加以选择。

在实施抛掷爆破时，因装药爆炸对周围土壤有压缩作用，而使爆炸后平底坑的底宽较其计算宽度增大（0.4 ~ 0.8） r （图 5—8）。计算时可把此数值考虑进去，以减少装药列数或装药个数。

第八十七条 用爆破法开设斜坡路（渡口进出路）时，可采用作图法或查表法进行装药设计。

（一）作图法：先将现地地形测绘在图纸上（图 5—9、图

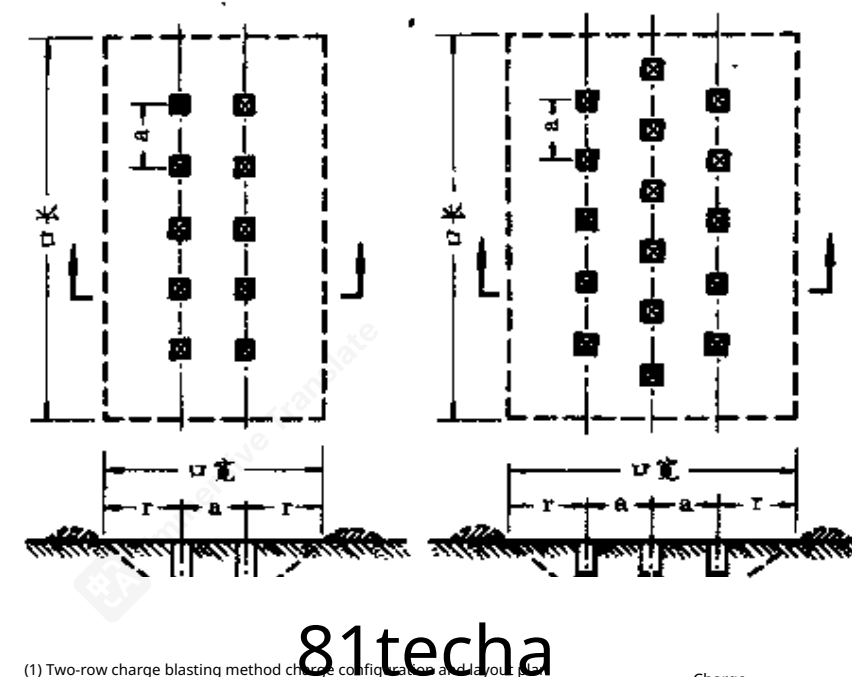


Figure 57: Charge Configuration for Three-Column Charging Blasting Method

The distance to each column is calculated using the formula from the 800,000th entry. To reduce backfill and meet the visible depth requirements, the charge quantity in the middle column should be increased by 25%, and all charges should detonate simultaneously. After blasting, except for the top part, the width is approximately equal to two funnel pit radii plus two column spacings, and the bottom width is approximately equal to two column spacings (Figure 5-7).

When both the mouth width and base width requirements cannot be met simultaneously, the charge count should be selected based on need (satisfying either the mouth width or the base width).

When implementing blasting with charge displacement, the explosive charge compresses the surrounding soil, causing the bottom width of the bottom pit after blasting to increase compared to its calculated width (0.4 ~ 0.8) (Fig. 5--8). This value can be taken into account during calculations to reduce the number of charge lines or the total number of charges.

Article 87 When opening a ramp road (road for ferry access) by blasting, the charge design may be carried out using the chart method or the table method.

(1) Graphical method: First, plot the existing terrain on the drawing paper (Figures 5-9, Fig.)

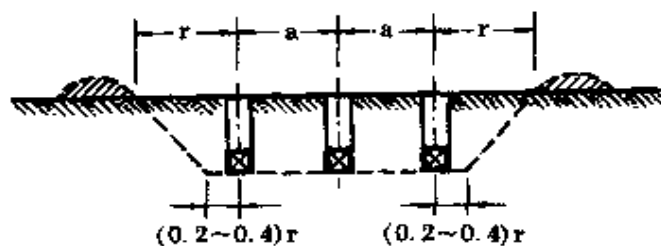


图 5—8 装药爆炸后平底坑底部被压缩的宽度

5—10), 然后通过河岸边的已知点 A (道路设计标高点), 按道路要求的纵坡度作一条线, 并与坡顶地面相交于 B, AB 线即为斜坡路设计线。设计线以上的土石, 就是要炸去的部分, 由设计线到地面的距离, 就是爆破后的可见深度。

1. 坡度较缓 (图 5—9) 时, 第一列装药的位置要标定在除土部最厚的地方 CD 上。以 CD 之长除以 0.33 ($2n-1$) 或 0.45 ($2n-1$) 得 CE, CE 之长就是第一列装药的入土深度 (一般此即为最小抵抗线)。连 AE 及 EB 即为装药线。当第一列装药位置确定后, 再以第一列装药为准, 向前后各量取 1 个漏斗坑半径的距离, 标定二、三列装药的位置 F、G。然后以同样方法向两端确定其余各列的装药位置。最后绘制平面图, 并根据道路宽度, 决定每一列装药的数量及其位置。

2. 坡度较陡 (图 5—10) 时, 第一列装药位置的确定, 可先作角 ACB 的角平分线, 交 AB 于 D, 再作 CB 的垂线 ED, E 点即为第一列装药的位置。以 ED 之长除以 0.33 ($2n-1$) 或 0.45 ($2n-1$) 得 EF, EF 之长就是第一列装药的入土深度。连 FB 即为装药线。从 E 点向后量取 1 个漏斗坑半径的距离, 标定第二列装药的位置, 然后以同样方法标定其余各列装药。最后绘制平面图, 标出各列装药的数量及其位置。

(二) 查表法: 时间仓促时, 在自然坡度 45° 以上, 坡高 1.0

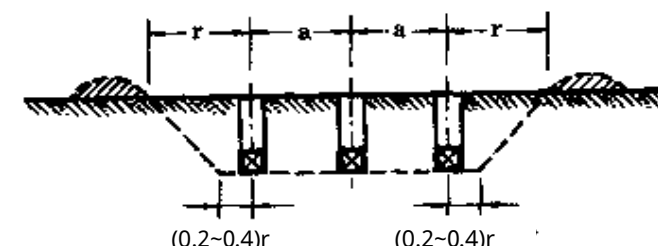


Figure 5--8 Width of the compressed bottom of the flat-bottomed crater after the charge explosion

5-10), then from a known point A on the riverbank (road design elevation point), draw a line according to the longitudinal slope required by the road, intersecting the ground at the top of the slope at point B; the line AB is the designed slope road line. The earthwork above the design line is the portion to be blasted, and the distance from the design line to the ground represents the visible depth after blasting.

1. When the slope is relatively gentle (Fig. 5-9), the position of the first row of charges must be marked on CD, the thickest part at the top. Divide the length of CD by 0.33 ($2m-1$) or 0.45 ($2n-1$) to obtain CE; the length of CE is the burial depth of the first row of charges (generally, this is the minimum resistance line). Connect AE and EB to form the charge line. After the position of the first row of charges is determined, use the first row as a reference and measure a distance equal to one radius of a funnel pit forward and backward to mark the positions of the second and third rows, F and G. Then, using the same method, determine the positions of the remaining rows at both ends. Finally, draw the plan view and, based on the road width, determine the number and position of charges in each row.

2. When the slope is steep (Figures 5-10), the determination of the first row of charges can be done by first drawing the angle bisector of angle ACB, intersecting AB at D, then drawing the perpendicular ED to CB; point E is the position of the first row of charges. Divide the length of ED by 0.33 ($2n-1$) or 0.45 ($2n-1$) to obtain EF; the length of EF is the burial depth of the first row of charges. Connect FB to form the charge line. From point E, measure a distance equal to one radius of the funnel pit backward to mark the position of the second row of charges, and then mark the remaining rows using the same method. Finally, draw the plan view, indicating the quantity and position of each row of charges.

(2) Table lookup method: When time is short, on natural slopes of 45° or greater, with a slope height of 1.0

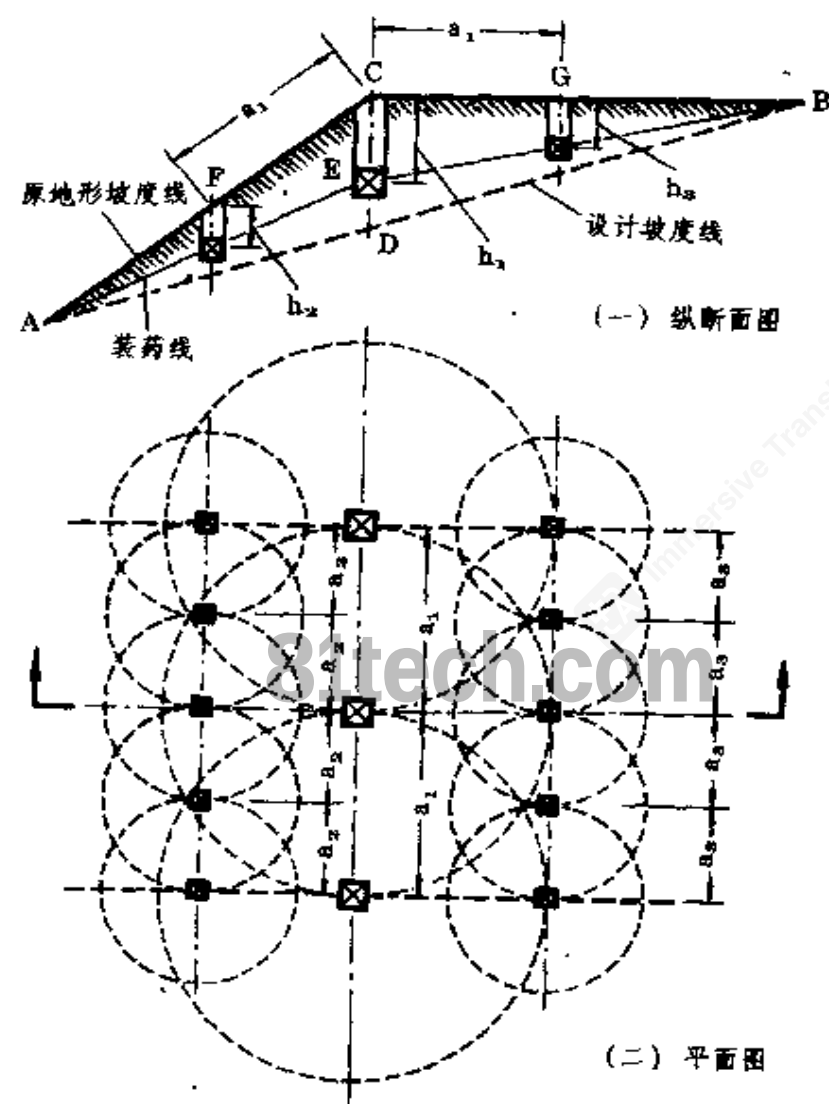


图 5—9 坡度较缓时开设斜坡路的设计图

~4.2 米，中等硬度土壤 ($A = 1.18$) 的梯坎或河岸上，开设宽度 4 米、纵坡度为 30% 的斜坡路，可采用查表法设计。

查表法使用简便，能在现地迅速标出装药位置，查出装药量。但这种方法只适用于陡坡，炸出的道路纵坡度也较陡。爆破参数的确定见表 5—5。

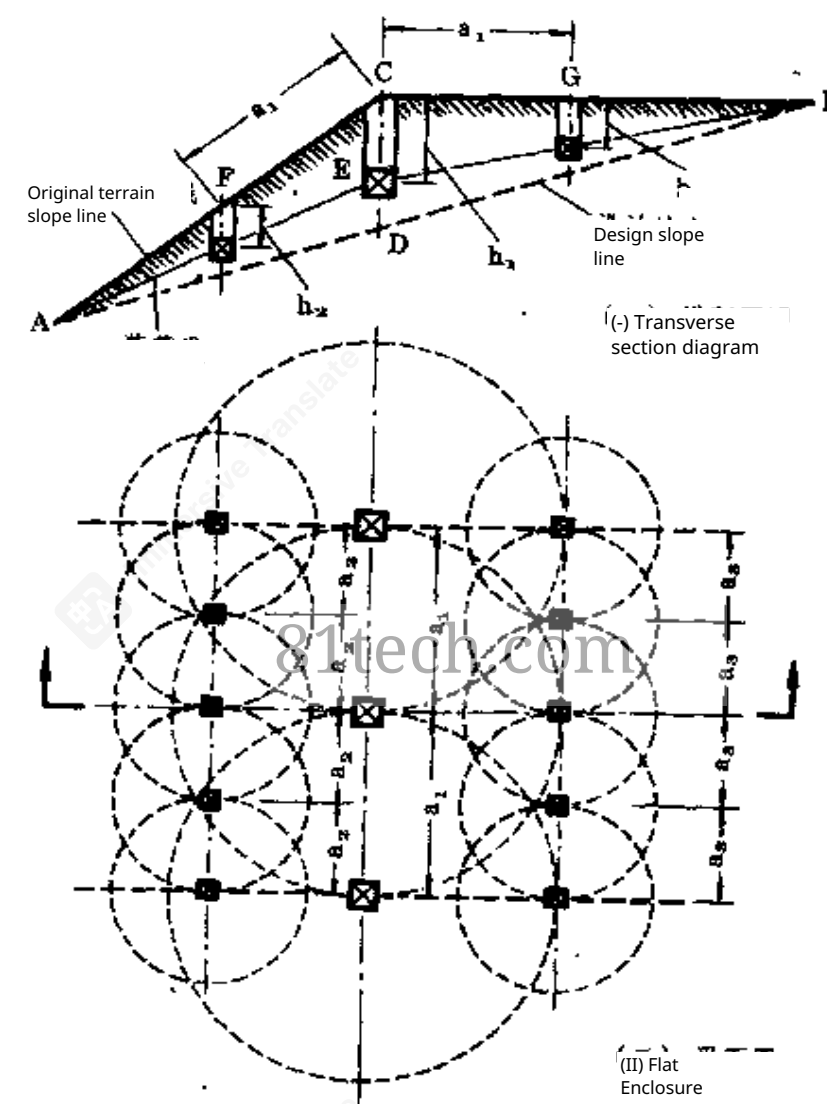


Figure 5-9: Design drawing for a gentle slope road

~4.2 meters, on a medium-hardness seven-壤 ($A=1.18$) embankment or riverbank, a ramp road with a width of 4 meters and a longitudinal slope of 30% can be designed using the tabular method.

The tabular method is simple to use, allows for quick identification of charge placement on-site, and determines the charge quantity. However, this method is only suitable for steep slopes, and the longitudinal gradient of the road blasted is also relatively steep. Blasting.

See Table 5-5 for parameter determination.

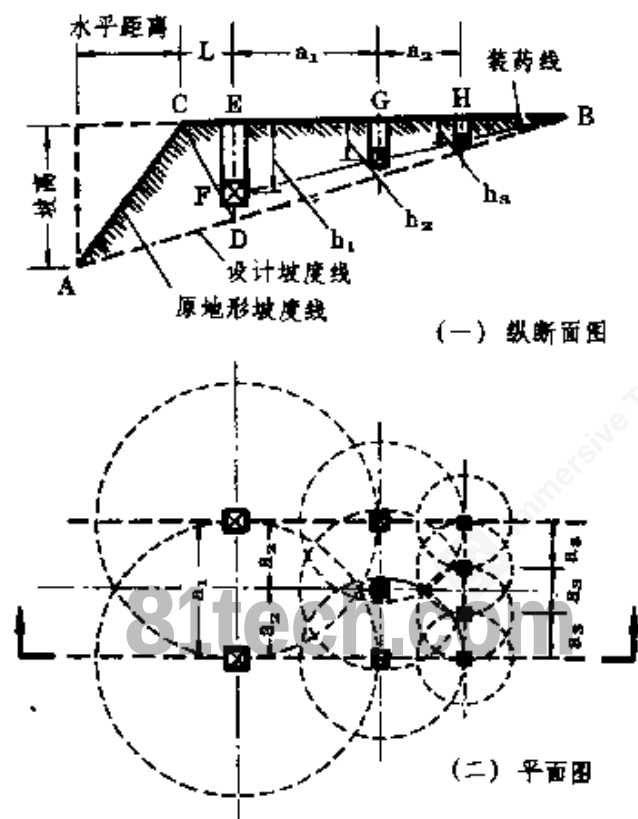


图 5—10 坡度较陡时开设斜坡路的设计图

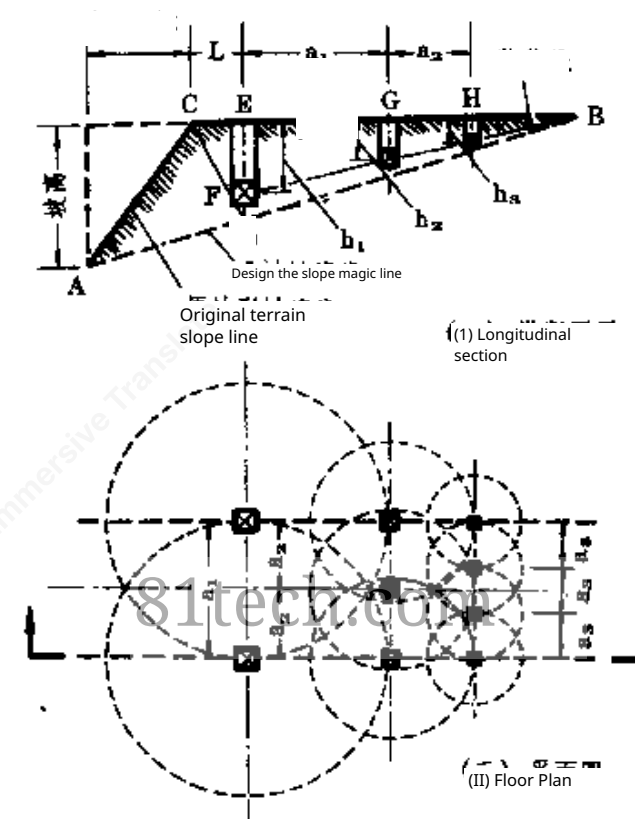


Figure 5-10 Design diagram for constructing a ramp road on a steep slope

表 5—5 斜坡路设计表

项目 数据 坡高	各列距离 (m)				装药个数				装药间距 (m)				最小抵抗线 (m)				单个装药量 (kg)			
	一 棱	二 ?	三 ?	四 ?	一	二	三	四	一	二	三	四	一	二	三	四	一	二	三	四
1.0~1.2	0.4~0.6	1.0			4	5			1.0	0.8			0.4	0.2			0.6	0.4		
1.3~1.5	0.5~0.8	1.0			4	5			1.0	0.8			0.5	0.3			1.4	0.6		
1.6~1.8	0.6~1.0	1.5	1.0		3	4	5		1.5	1.0	0.8		0.6	0.4	0.3		2.0	1.2	0.6	
1.9~2.1	0.7~1.2	1.5	1.0		3	4	5		1.5	1.0	0.8		0.7	0.5	0.3		3.2	1.6	0.8	
2.2~2.4	0.8~1.4	2.0	1.5		3	4	5		2.0	1.5	1.0		0.8	0.6	0.4		5.0	3.0	1.4	
2.5~2.7	0.9~1.6	2.0	1.5		2	3	4		2.0	1.5	1.0		1.0	0.6	0.4		9.0	4.0	2.0	
2.8~3.0	1.2~1.8	3.0	2.0	1.5	2	2	3	4	2.5	2.0	1.5	1.0	1.2	0.9	0.6	0.4	16.0	8.0	4.0	2
3.1~3.3	1.3~2.0	3.0	2.0	1.5	2	2	3	4	2.5	2.0	1.5	1.0	1.3	0.9	0.6	0.4	20.0	10.0	5.0	2
3.4~3.6	1.4~2.0	3.5	2.5	2.0	2	2	3	4	3.0	2.0	1.5	1.0	1.4	1.0	0.7	0.4	28.0	14.0	7.0	3
3.7~3.9	1.5~2.2	3.5	2.5	2.0	2	2	3	4	3.0	2.0	1.5	1.0	1.5	1.1	0.7	0.4	34.0	17.0	8.0	4
4.0~4.2	1.6~2.4	4.0	3.0	2.0	2	2	3	4	3.0	2.0	1.5	1.0	1.6	1.2	0.8	0.5	40.0	20.0	10.0	5

1. 开设坦克通路, 用粗线内的数据即可;

2. 第一列裝藥距稜線的距離有活動範圍,選用時,主要考慮地面坡度的陡緩。如坡度較緩,則用較小數據;如坡度較陡,則用較大數據。

[illegible]

第四节 松散爆破

第八十八条 松散爆破主要用于构筑掘开式工事，松散冻土或硬土，以及构筑道路、采集石料等。

第八十九条 松散岩石通常采用药孔法，有时也采用药壶法。

(一) 药孔法（露天穿孔爆破）用于构筑道路、采集石料和平整场地等。

1. 药孔位置的选择：药孔位置应选择在临空面较多的地方，避开岩石的裂缝，并与其保持一定的距离（图 5—11），以免爆炸气体沿裂缝逸出，影响爆破效果；但有时适当利用裂缝，可获得良好的爆破效果。



(一) 在裂缝之后 (二) 在裂缝之前 (三) 在裂缝之上

图 5—11 药孔避开裂缝

2. 药孔配置：药孔深度通常等于要炸去的高度。药孔成一行或数列平行于临空面配置，最小抵抗线通常为药孔深度的 $2/3$ 。药孔的间距，根据岩石的坚硬程度和需要的破碎程度，取最小抵抗线的 $1 \sim 2$ 倍，各列之间的距离等于最小抵抗线（图 5—12）。

3. 药量计算：按标准松散装药计算。采集石料，药量还可减少 $1/3$ 。另外，还可根据岩石的坚硬程度和需要破碎的程度，按药孔深度的 $1/5 \sim 2/3$ 装填炸药。

Section 4: Loose Blasting

Article 88 Loose blasting is mainly used for constructing cut-and-cover works, loosening frozen or hard rock, and for constructing roads and collecting stone materials.

Article 89: Loose rock masses are usually excavated using the hole-drilling method; the pot-hole method is sometimes also used.

(i) Drill-and-blast method (open-pit drilling and blasting) is used for road construction and quarrying stone and

Leveling the site, etc.

1. Selection of the charge hole position: The charge hole position should be selected in areas with more open faces, avoiding rock fractures, and maintaining a certain distance from them (Figure 5-11) to prevent blasting gas from escaping along fractures and affecting the blasting effect; however, sometimes appropriately utilizing fractures can achieve good blasting results. Tecncu存的



(I) After the Crack (II) Before the Crack (III) Above the Crack

Figure 5-11: The drug hole avoids the crack.

2. Charge hole configuration: The depth of the charge hole is usually equal to the height to be blasted. Charge holes are arranged in a single row or multiple parallel rows parallel to the free face. The minimum resistance line is typically $2/3$ of the charge hole depth. The spacing between charge holes, based on the hardness of the rock and the required degree of fragmentation, is $1 \sim 2$ times the minimum resistance line, and the distance between rows is equal to $\rightarrow$ times the minimum resistance line (Figure 512).

3. Drug dosage calculation: Calculate based on standard bulk rock powder. Collecting stone material can reduce the dosage by $1/3$. Additionally, the dosage can be further adjusted according to the hardness of the rock and the degree of fragmentation required.

Load the explosive into the powder hole to a depth of $1/5 \sim 2/3$.

4. 起爆顺序：同列中的装药，一般同时起爆；多列装药要首先起爆靠近临空面的一列，然后依次起爆其余各列。如有延期时间不等的雷管时，多列可同时点火。接近临空面的一列，用瞬发或延期时间较短的雷管，其余各列则依次用延期时间较长的雷管起爆。当缺乏延期雷管而又需要同时起爆两列装药时，因第二列装药的计算最小抵抗线尚未形成，为了保证爆破效果，两列之间的距离要缩小 $1/2$ 。

(二) 露天爆破中，当岩石的整体性较好、硬度不大又不含水时，可用药壶法实施松散爆破。

药壶位置应选在岩石比较完整的地段，否则扩壶时药孔容易被炸坏。穿孔前，应先清理碎石，注意避开裂缝。穿孔深度通常等于要炸去岩石的高度，最小抵抗线一般取壶深的 $0.5 \sim 1.0$ 倍。药壶间距取最小抵抗线的 $0.8 \sim 1.0$ 倍，列距取最小抵抗线的 $1.2 \sim 1.5$ 倍（图 5—13）。装药量按第八十一条计算，装药采用加强松散装药。

为便于作业，通常采用垂直药孔，如台阶上不便穿孔，也可穿水平药孔（应向下倾斜以便装药）。台阶较高时，可配置两层（图 5—14）。层距取下层最小抵

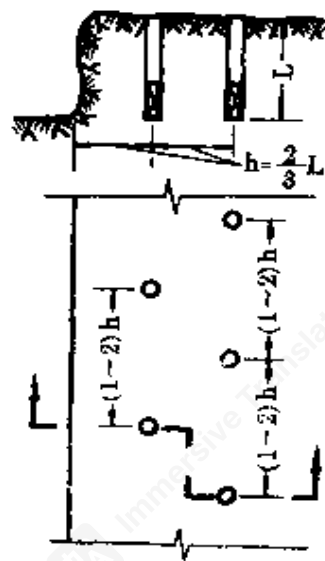


图 5—12 药孔配置

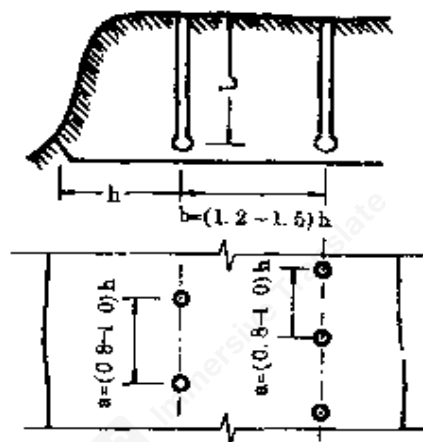
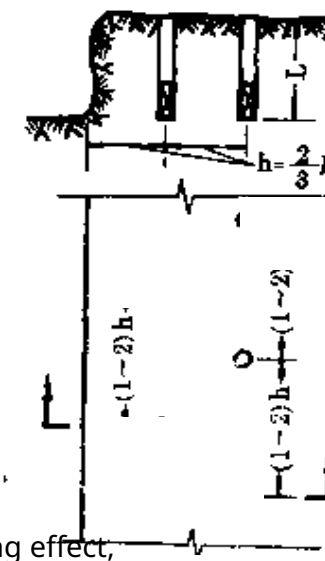


图 5—13 药壶的配置

4. Blast sequence: The charges in the same column are generally detonated simultaneously; for multiple columns, the column closest to the free face must be detonated first, followed sequentially by the remaining columns. If detonators with different delays are used, multiple columns can be ignited simultaneously. For the column closest to the free face, use instant or detonators with shorter delays; the remaining columns should be detonated sequentially using detonators with longer delays. When delay detonators are unavailable and two columns of charges need to be detonated simultaneously, the minimum resistance calculation for the second column of charges must be considered.



The line has not yet formed; to ensure the blasting effect,

Reduce the distance between the two columns by 2.

(i) In open-pit blasting, when the rock has good integrity, moderate hardness, and is not water-bearing, loose blasting can be implemented using explosives.

Select the blasting hole location in areas with relatively intact rock; otherwise, the blast holes may be damaged during hole enlargement. Before drilling, clear away loose stones and avoid cracks. The drilling depth is generally equal to the height of rock to be blasted. The minimum resistance line is typically taken as $0.5 \sim 1.0$ times the depth of the blasting hole. The spacing between blasting holes is $0.8 \sim 1.0$ times the minimum resistance line, while the column spacing is $1.2 \sim 1.5$ times the minimum resistance line (Figure 5-13). The charge quantity is calculated according to Article Eight, and the charge type is reinforced loose bulk charge.

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Figure 5-13 Alchemy Pot Configuration

For ease of operation, vertical is usually adopted.

Drug holes, if it is inconvenient to drill through the steps, can also be drilled horizontally (should be tilted downward to facilitate loading), and when the steps are high, two layers can be configured (Figure 5-14). The layer spacing shall be taken as the minimum resistance of the lower layer.

抗线 h_x 的 2 倍。下层药壶的间距同上层。筑路时，为不致损坏边坡及路基，装药与边坡、装药与路基间应留出保护层，一般为最小抵抗线的 0.15 倍。

第九十条 松散硬土时，装药通常设置在药洞或药壶内，最小抵抗线通常等于松散深度，装药的间距和各列的距离均取最小抵抗线的 1.5 倍，药量按标准松散装药或加强松散装药计算。所有装药应同时起爆。

第九十一条 松散冻土前，应对冻土的厚度、含水量进行测定。冻土的坚硬程度和冻结厚度与气温高低、寒冷持续时间长短、土壤性质以及含水量的大小有直接关系。其他条件相同时，土壤含水量少，土壤间有空隙则达不到很大的强度；土壤含水量过多，则冻结成冰，其强度反而降低。各种土壤只有达到饱和含水量时，强度最大。几种土壤的饱和含水量为：砂土 20%，砂质粘土 25%，粘土 40%。

松散冻土时，装药的最小抵抗线等于要求松散的厚度，但一般不应超过冻土厚的 $3/4$ 。否则，将会在非冻土内形成压缩坑，影响爆破效果。装药的间距和列距均等于最小抵抗线的 $1 \sim 1.5$ 倍。各列装药应交错配置（图 5—15）。为了增大爆破效果，最好先开设自由面。

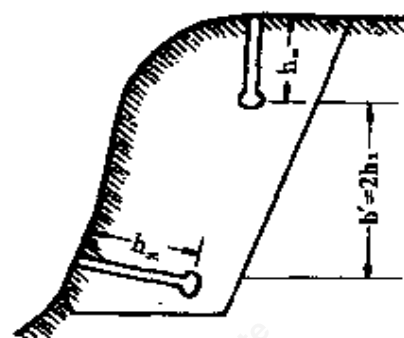


图 5—14 双层药壶的配置

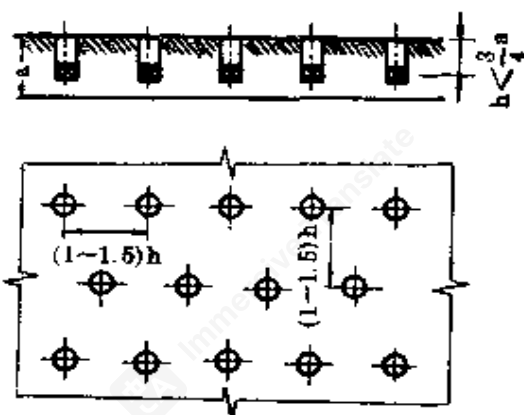


图 5—15 松散冻土的装药配置

Twice the length of the charge line. The spacing between lower charge pots is the upper layer. When constructing roads, to avoid damaging the slope and roadbed, a protective layer should be left between the charge and the slope, and between the charge and the roadbed, with a minimum thickness of 0.15 times the minimum resistance line.

Article 90: When dealing with loose hard soil, the charge is typically placed in a charge hole or a charge pot. The minimum resistance line is usually equal to the depth of the loose zone. The spacing of the charges and the distance between each row are both taken as 1.5 times the minimum resistance line. The charge quantity is calculated according to standard loose charge or reinforced loose charge standards. All charges must be detonated simultaneously.

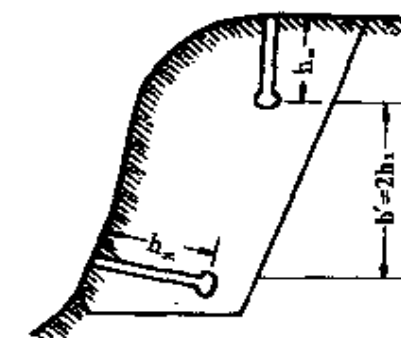


Figure 5-14: Pairing of double-layered medicine pots

Article 91: Before loosening the frozen soil, the thickness and water content of the frozen layer shall be measured. The hardness of the frozen soil and the thickness of the frozen layer are directly related to the temperature, the duration of cold weather, the nature of the soil, and the amount of water content. When other conditions are the same, if the water content is low and there are gaps between soil particles, the strength cannot reach a high level; if the water content is too high, the soil freezes into ice, and its strength may actually decrease. Only when various types of soil reach saturated water content can they achieve sufficient strength.

At water content, intensity is maximum. The saturation water content of several soils is: sandy soil 20%, sandy clay 25%, clay

At water content, intensity is maximum.

When loosening frozen soil, the minimum charge resistance line equals the required loosening thickness, but generally should not exceed $3/4$ of the frozen layer thickness. Otherwise, compression pits will form within the unfrozen soil, affecting blasting performance. The spacing and row distance of charges both equal 1.5 times the minimum resistance line. Charges in each row should be staggered.

(Fig. 5--15). To enhance blasting effects, it is best to first create a free face.

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Figure 5-15: Charge configuration for loose frozen soil

对冻土实施松散爆破,通常采用加强松散装药或标准抛掷装药、根据土壤性质、含水量和炸药种类的不同,土壤抗力系数取1.7~3.0。准确的土壤抗力系数值可经试验确定。

第五节 硐室爆破

第九十二条 硐室爆破用于开挖路堑、切削崖壁构成障碍、阻塞隘路、采集石料以及开挖河道等大量的土石方工程作业,以加速作业进度、节省作业力。由于硐室爆破技术要求高,实施方法与作业组织比较复杂,所以通常须经过工程侦察和设计后再开始实施。

第九十三条 实施硐室爆破时,必须进行周密细致的工程侦察。侦察时除查明第四条第一款所述内容外,还应查明以下事项。

(一) 爆破地点的土壤、岩石种类,坚硬程度以及有无裂缝和风化等地质现象;同时应查明地下水位的高低。

(二) 爆破区域的地形状况和预计危险区域内建筑物的分布情况及其坚固程度。

第九十四条 硐室爆破的装药,根据任务要求可配置成一系列或数列。在平地或各点标高大致相同的斜坡地形,装药的配置可参考第八十五条和八十六条所述方法进行。

(一) 当地面各点的标高相差较大时,应首先决定最高点的装药位置,然后向两侧逐次确定其余各装药的位置;各装药间的距离应按相邻药量较大装药的漏斗坑半径确定。

(二) 当炸去高度或挖深较大时,可配置两层装药(图5—16)。采用两层装药时,应首先确定上层装药的位置,然后确定下层装药的位置;上层装药应大致在同一水平面上。上层装药中心的水平线或其漏斗坑的下部边线的水平线,可视为下层装药的临空面(图5—17),而下层装药的最小抵抗线可依此确定。上

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Loose blasting is typically applied to frozen ground, usually by using reinforced loose charge or standard throw charge. According to soil properties, water content, and explosive type, the soil resistance coefficient is taken as 1.7 ~ 3.0. Accurate soil resistance coefficient values can be determined through testing.

Section 5: Chamber Blasting

Article 92: Room blasting is used for earthwork operations such as excavating road cuts, cutting cliff faces that constitute obstacles, tunneling, mining, and dredging rivers to accelerate progress and save labor. Due to the high technical requirements of room blasting and the complex nature of its implementation methods and organizational procedures, it is usually necessary to conduct engineering reconnaissance and design before proceeding with the operation.

Article 93 When implementing case blasting, a thorough and meticulous engineering investigation must be conducted. In addition to ascertaining the matters specified in the relevant paragraph of Article 4, the following items shall also be ascertained during the investigation.

(一) Soil and rock types at the blasting site, degree of hardness, and presence of cracks and geological phenomena such as weathering; at the same time, the groundwater level should be investigated.

(二) Terrain conditions in the blasting area and the distribution and structural integrity of buildings within the anticipated hazardous zone.

Article 94 The charge for blasting can be arranged in a single line or multiple lines according to task requirements. On flat terrain or on slopes where the elevations of the points are roughly the same, the charge arrangement shall be carried out in accordance with the methods described in Articles 85 and 86.

(一) When the elevations of points on the ground differ significantly, first determine the position of the charge at the highest point, then sequentially determine the positions of the remaining charges on both sides; the distance between charges shall be determined based on the radius of the funnel pit of the adjacent charge with the larger quantity.

(二) When the blast height or excavation depth is large, two layers of charges can be used (Figure 5-16). When using two layers of charges, the position of the upper layer charges should be determined first, followed by the position of the lower layer charges; the upper layer charges should be roughly on the same horizontal plane. The horizontal line through the center of the upper layer charges or the horizontal line through the lower edge of the bucket pit can be considered as the horizontal line for the lower layer charges (Figure 5-17). The minimum charge resistance of the lower charge can be determined as follows

层装药用抛掷爆破，爆破作用指数根据地面坡度按第九十五条确定；下层装药爆破作用指数通常取 1 ~ 1.25。

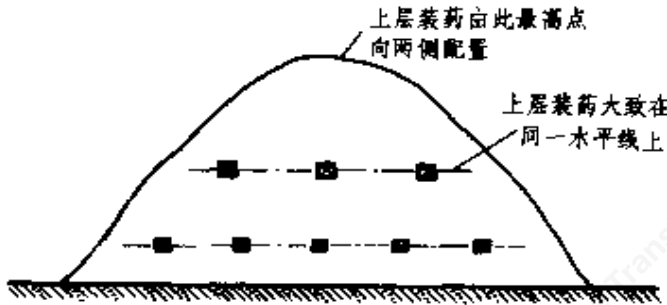


图 5—16 装药成两层配置

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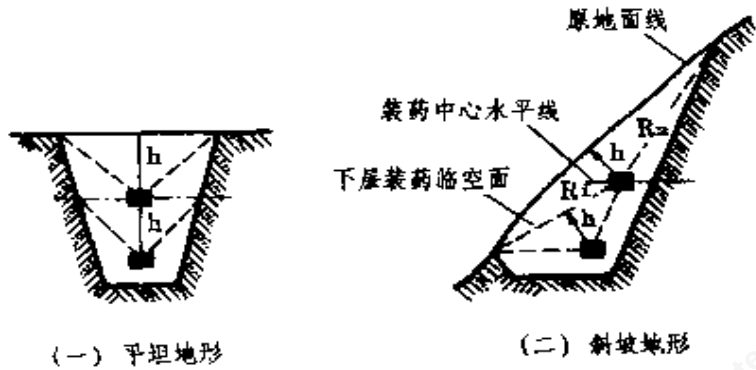
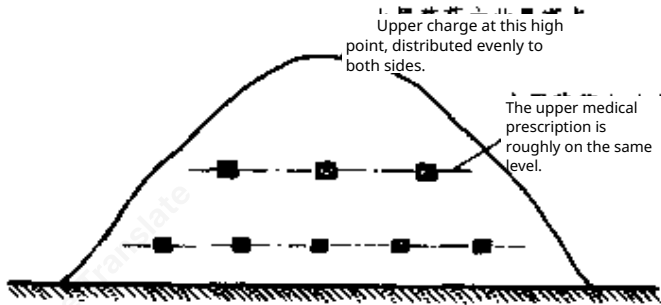


图 5—17 下层装药临空面的确定

(三) 爆破悬崖陡壁时，最小抵抗线通常取需炸去高度 H 的 0.6 ~ 0.7 倍 (图 5—18 (一))。当炸去的高度较大时，可配置多层装药，各层装药的距离及最上层装药至崖顶的距离，取最小抵抗线的 1.3 ~ 1.8 倍 (图 5—18 (二))。

第九十五条 硐室爆破的装药量按第八十一条计算。当采用

Layered charge blasting, the blasting index is determined according to the ground slope as specified in Article 95. For the lower layer charge, the blasting index is typically taken as 1 ~ 1.25.



Charge configuration diagram in two layers 5—16

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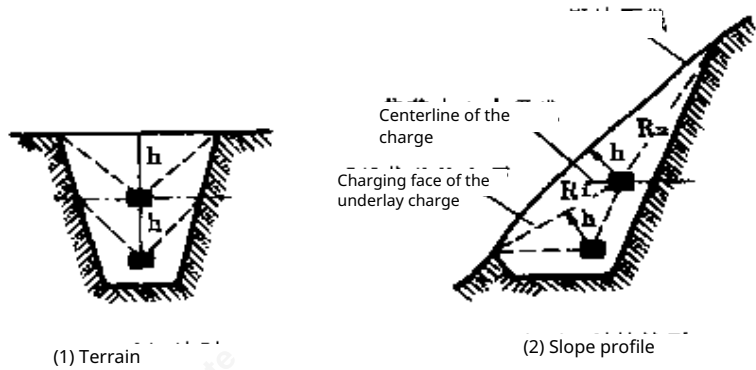


Figure 5-17 下层装药临空面的确定

(3) When blasting cliffs and steep slopes, the minimum charge line is typically taken as 0.6 ~ 0.7 times the required height H to be blasted (Fig. 5-18(1)). When the height to be blasted is large, multiple charges can be configured; the distance between each layer of charges and the distance from the top layer of charges to the cliff top shall be 1.3~1.8 times the minimum charge line (Fig. 5-18(2)).

Article 95 The charge quantity for chamber blasting shall be calculated in accordance with Article 80. When

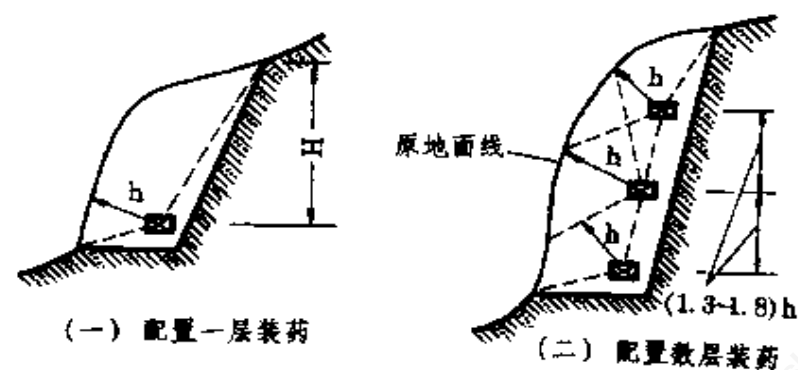


图 5—18 爆破悬崖陡壁的装药配置

抛掷爆破时，爆破作用指数应根据地面坡度采用下列数值：

- 当地面坡度为 $0^\circ \sim 20^\circ$ 时， n 取 $2.0 \sim 1.75$ ；
- 当地面坡度为 $20^\circ \sim 30^\circ$ 时， n 取 $1.75 \sim 1.5$ ；
- 当地面坡度为 $30^\circ \sim 45^\circ$ 时， n 取 $1.5 \sim 1.25$ ；
- 当地面坡度为 $45^\circ \sim 60^\circ$ 时， n 取 $1.25 \sim 1.0$ ；
- 当地面坡度为 60° 以上时，通常采用松散爆破。

第九十六条 当用硐室爆破开挖路堑时，为使路基和边坡不受破坏，在确定装药位置时，应使装药与路基和边坡保持一定的距离，这段距离称为保护层（图 5—19）。保护层的厚度依据土壤、岩石坚硬程度的不同，通常取最小抵抗线的 $0.2 \sim 0.3$ 倍。当采用硐室爆破采集石料、阻塞隘路和切削崖壁时，可不留保护层。



图 5—19 预留保护层

第九十七条 实施硐室爆破时，为确定每个装药爆炸后漏斗坑的大小，必须先计算漏斗坑边线的长度，以便在设计图上标定漏斗坑的范围。

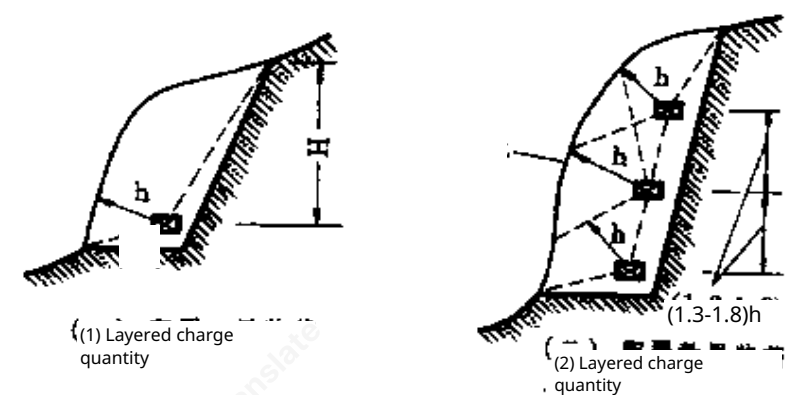


Figure 5-18: Charge configuration for blasting cliff faces and steep slopes

When blasting with throwing, the blasting action index shall be adopted as follows according to the ground slope:

- When the ground slope is $0^\circ \sim 20^\circ$, n is taken as $2.0 \sim 1.75$;
- When the ground slope is $20^\circ \sim 30^\circ$, n take $1.75 \sim 1.5$;
- When the ground slope is $30^\circ \sim 45^\circ$, n take $1.5 \sim 1.25$;
- When the ground slope is $45^\circ \sim 60^\circ$, n is taken as $1.25 \sim 1.0$;
- when the ground slope is above 60° , loose blasting is usually adopted.

Article 96 When using chamber blasting to excavate road cuts, in order to prevent damage to the roadbed and slopes, a certain distance should be maintained between the charge and the roadbed and slopes when determining the charge position. This distance is called the protective layer (Figure 5-19). The thickness of the protective layer depends on the overburden and the hardness of the rock and is usually $0.2 \sim 0.3$ times the minimum resistance line. When chamber blasting is used to collect stone, block mountain passes, or cut walls, a protective layer may be omitted.

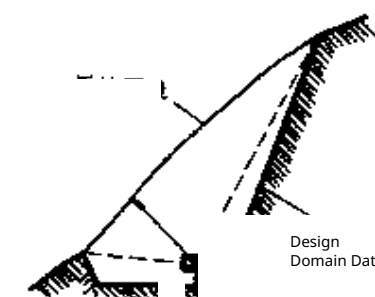


Figure 5-19 Reserved protective layer

Article 97 When implementing blasting, to determine the size of the crater formed after each charge explodes, the length of the crater rim must be calculated first so that the scope of the crater can be marked on the design drawing.

在平坦地形上的漏斗坑边线（图 5—20（一））及斜坡地形上的漏斗坑下部边线按下式计算：

$$R_1 = h \sqrt{n^2 + 1}$$

在斜坡地形上的漏斗坑上部边线（图 5—20（二））按下式计算：

$$R_2 = h \sqrt{\beta n^2 + 1}$$

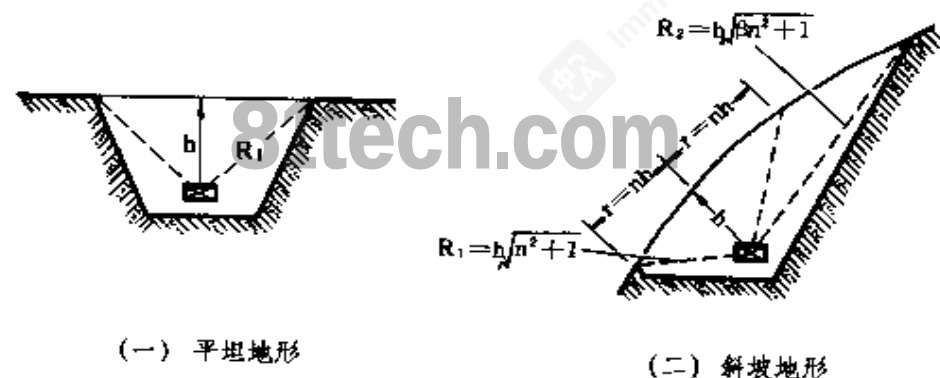


图 5—20 漏斗坑的边线

式中：R₁ 和 R₂——漏斗坑边线的长度（米）
β——系数，根据地面坡度按表 5—6 确定

表 5—6 系数 β 值

地面坡度	β 值	
	上、软石、次坚石	坚硬岩石及整石地带
20° ~ 30°	2 ~ 3	1.5 ~ 2
30° ~ 50°	4 ~ 5	2 ~ 3
50° ~ 60°	6 ~ 7	3 ~ 4

The edge line of a funnel pit on semi-flat terrain (Fig. 5-20(1)) and the lower edge line of a funnel pit on a slope are calculated as follows:

$$R_1 = h \sqrt{n^2 + 1}$$

Calculate as follows at the upper edge of the funnel pit in the slope terrain 1 (Fig. 5-20(II)):

$$R_2 = h \sqrt{\beta n^2 + 1}$$

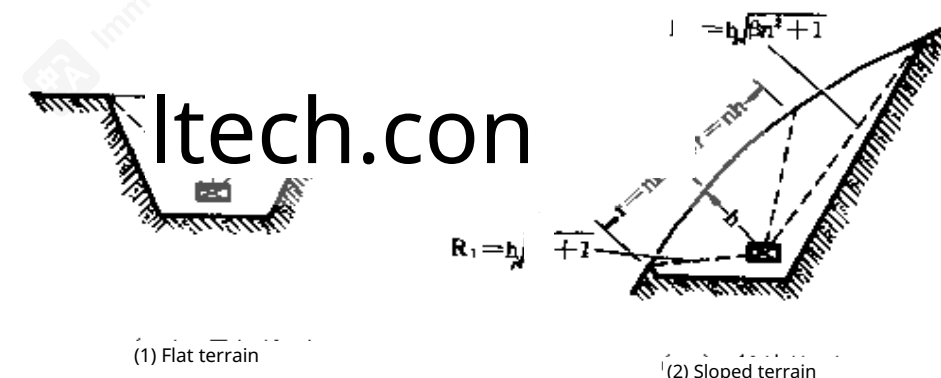


Figure 5-20: Outline of the Puchou Pit

In the formula: R₁ and R₂——the length of the funnel pit edge line (meters)

β——Coefficient, determined according to ground slope as shown in Table 5-6

Table 5-6 Coefficient β Value

	Soil, soft rock, semi-hard rock	Hard rock and monolithic areas
		1.5~2
200 ~ 500		
500 ~ 600		

第九十八条 为便于设置装药，必须首先开设坑道和构筑药室。药室通常构筑在坑道底部或靠近抵抗线的一侧，药室应尽量构筑成立方形，其容积根据装药量和炸药的密度按下式计算：

$$V = \frac{C}{\Delta}$$

式中：V——药室的容积（米³）

C——装药量（千克）

Δ——炸药的密度（千克/米³）

计算药室容积时，应考虑到如果炸药为整箱装填或药室必须加以被覆时，药室容积应增大20%~40%。

第九十九条 为了充分发挥炸药的爆炸作用，通向硐室的坑道应进行填塞，其长度一般不宜小于漏斗坑边线长的1.2倍。如果填塞长度小于上述数值时，应用挡板和支撑进行加固（图5—21）。为使填塞确实和不留有空隙，可用砂、土或土袋填塞。填塞时，在离药室口1.5米以内的地方，不应用力捣固。在平坑道中应特别注意对顶部的填实。填塞时必须随时注意对起爆线路的保护。

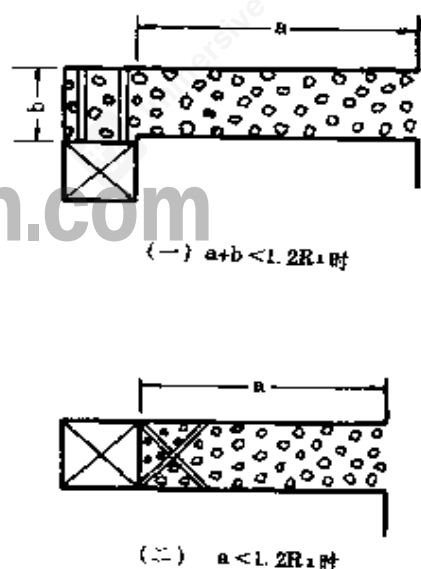


图5—21 坑道填塞的方法

第六节 压缩爆破

第一百条 压缩爆破是利用地下装药爆炸对土壤的压缩作用构成压缩空室以达到工程需要的爆破方法。采用压缩爆破法构筑

Article 98 To facilitate the placement of charges, tunnels must first be excavated and charge chambers constructed. Charge chambers are typically built at the bottom of tunnels or on the side near the resistance line. Charge chambers should be constructed as closely as possible to a cube shape, and their volume shall be calculated according to the following formula based on the charge quantity and the density of the explosive:

$$V = \frac{C}{\Delta}$$

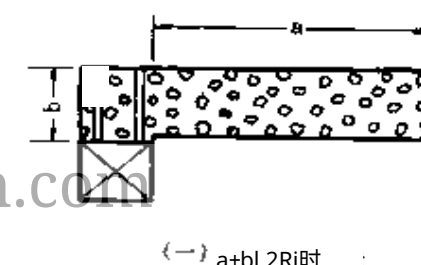
In which: V is the volume of the drug chamber (m³)

C——Charge amount (kg)

A- Density of explosives (kg/m³)

When calculating the chamber volume, account for a 20% increase in the chamber volume ~ 40% if the explosive is loaded in full cases or if the chamber must be lined.

Article 99. To fully utilize the explosive effect of the explosive, the tunnel leading to the charge chamber shall be filled with backfill. The length of the backfill shall generally not be less than 1.2 times the length of the funnel pit edge line. If the backfill length is less than the above-mentioned value, reinforcement shall be applied using retaining boards and supports (Figure 5-21). To ensure the backfill is compact and free of voids, sand, soil, or sandbags may be used for backfilling. During backfilling, no forceful tamping shall be applied within 1.5 meters of the charge chamber opening. In flat tunnels,



09
XE 《二》 ≤ 1.2R1 at

Figure 5—21 坑道填塞的方法

Pay special attention to filling the top area. When packing, always ensure protection of the blasting circuit.

Section 6 Compressive Blasting

Article 100: Compressive blasting utilizes the compressive effect of underground explosive charges on the rock mass to form a compressed void, achieving blasting methods required for engineering purposes. Compressive blasting is used to construct

工事，内部除土量少，可加快作业速度；工事具有一定的抗力，除口部外，一般不需被覆。

压缩爆破适用于可塑性较好的各种粘土和黄土等土壤（含砂量在 30% 以下，含水量在 20% ~ 30% 左右）。炸药的性质对压缩效果有一定的影响。硝酸炸药威力较大、猛度适中，压缩出的空室内壁密实、无大裂缝，适于构筑爆破压缩工事。

第一百零一条 开口是压缩爆破法构筑工事的关键，直接关系到工事的强度和作业量的大小，处理不当，会影响施工。一次爆破成型的装药或多次爆破成型的第一个装药，称为开口装药。

(一) 构筑平（斜）坑道。平（斜）坑道的开口设计除应满足战术要求外，还应满足安全厚度，减少土方作业量等要求。开口位置应尽量选择在具有一定高度的较陡峻的斜坡。坡度小于 25° 时，一般不适于构筑平（斜）坑道；必须构筑时，可先将缓坡地改造成陡坡，但挖去的部分不要超过原坡度的棱线（图 5—22）。

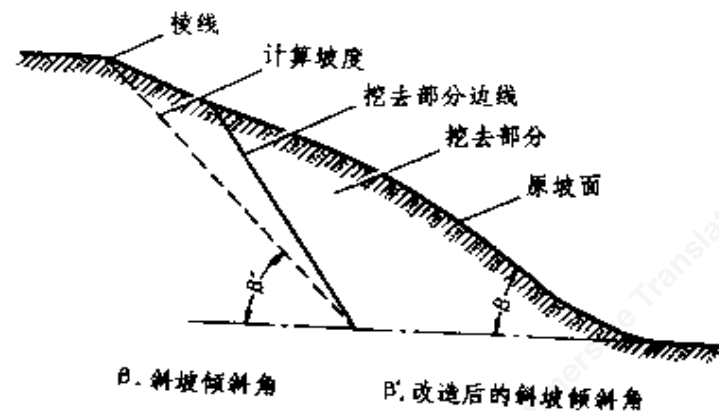


图 5—22 将缓坡改造成陡坡

1. 最小安全厚度 h_a 的确定：利用斜坡进行平（斜）坑道开口爆破时，由装药轴线到斜坡棱线的距离称为最小安全厚度；在平坦地形上进行斜坑道开口爆破时，则由装药轴线到地面的距离

Construction, internal removal is minimal, which can accelerate work speed; the construction has a certain resistance, and generally does not require covering except at the opening.

Compressive blasting is suitable for various clays and loess soils with good plasticity (sand content below 30%, water content around 20% ~ 30%). The properties of the explosive have a certain influence on the compression effect. Ammonium nitrate explosives have high power and moderate sensitivity; the compressed chamber walls are dense with no large cracks, making them suitable for constructing compressed blasting chambers.

Article 100: The open face is a compressed blast hole construction method. It is crucial to the success of the operation, directly affecting the strength of the blast and the size of the personnel involved. Improper handling can impact the work. A single charge that forms the blast in one operation, or the first charge in a multiple-blast formation, is called the open face charge.

(1) Construct level (or sloped) tunnels. The design of openings for level and (sloped) tunnels must meet tactical requirements, ensure sufficient safety thickness, and reduce excavation work. Openings should be located on steep slopes with adequate height. When the slope is less than 25° , constructing level (or sloped) tunnels is generally not suitable; if construction is necessary, the gentle slope should be converted into a steep one, and the portion excavated upward should not exceed the original slope line (Figure 5-22).

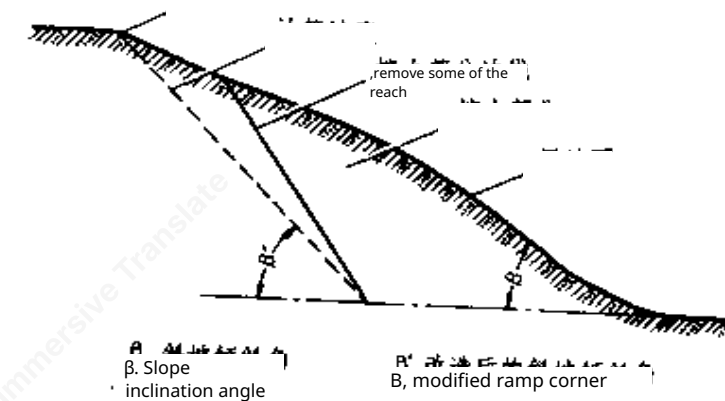


Figure 5-22 converts a gentle slope into a steep slope

1. Determination of the minimum safe thickness h_a : Utilizing a ramp for leveling (inclined) tunnels

When blasting, the distance from the charge axis to the slope edge is called the minimum safe thickness; when performing slope tunnel opening blasting on flat terrain then the distance from the charge axis to the ground — 123 —

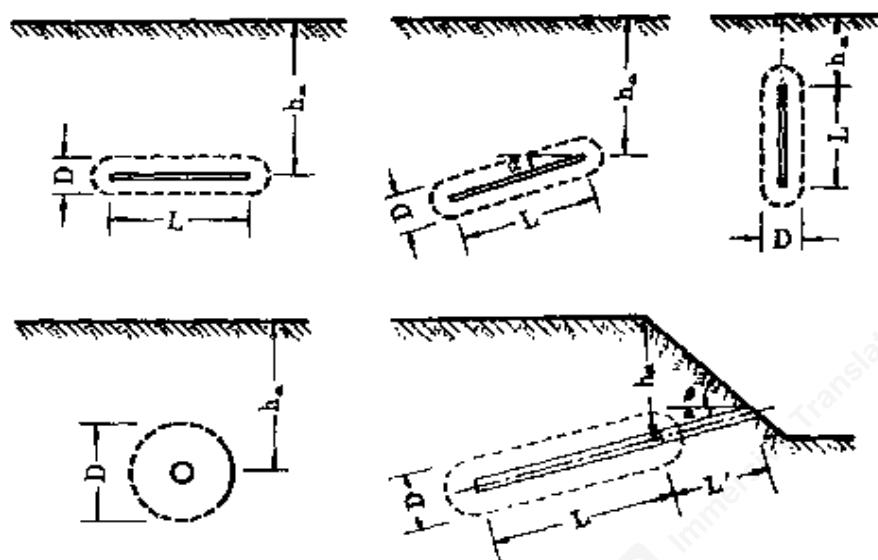


图 5—23 最小安全厚度

称为最小安全厚度（图 5—23）。其计算公式如下：

$$h_a = aFD$$

式中： h_a ——最小安全厚度（米）

a ——系数，依据 L/D 值查表 5—7，通常采用 4

F ——依据装药与水平地面的夹角 α 确定的系数，见表 5—8

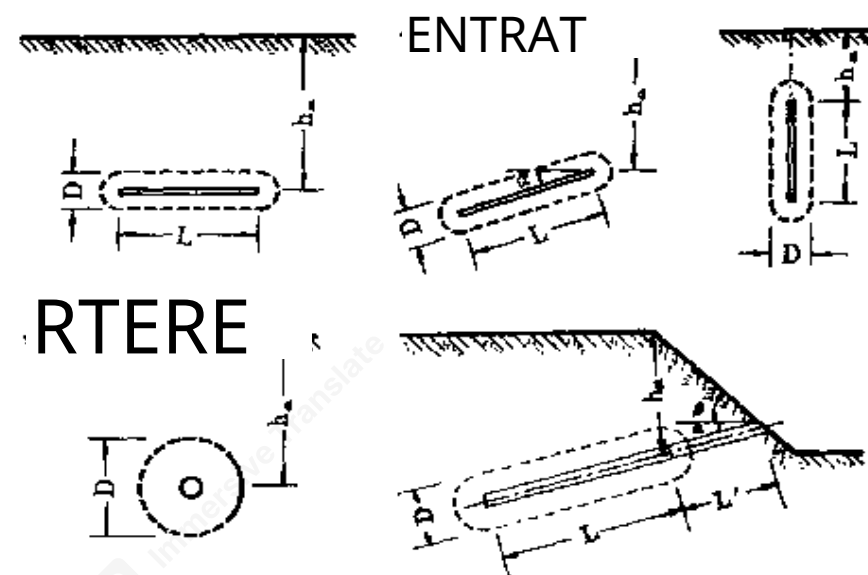
D ——工事的设计直径（米）

表 5—7 最小安全厚度系数 a 值

$\frac{L}{D}$	$\frac{L}{D} < 1$	$1 < \frac{L}{D} \leq 2$	$2 < \frac{L}{D} \leq 4$	$4 < \frac{L}{D} \leq 8$	$8 < \frac{L}{D} \leq 15$	$15 < \frac{L}{D} \leq 30$
a	3	3.5	4	4.5	4.8	5

表 5—8 装药与水平地面的夹角系数 F 值

α	0°	5°	15°	25°	30°	45°
F	1.00	0.95	0.90	0.85	0.80	0.75



81t Safest Thick
10m Image23

referred to as the minimum safe thickness (Figure 5-23). Its calculation formula is as follows:

$$h_a = aFD$$

In which: h is the minimum safe thickness (meters)

a ——coefficient, consult Table 5-17 based on the L/D value; typically 4 is used.

F ——Coefficient determined by the angle between the charge and the horizontal ground α , see Table 58

D ——Construction Design Diameter (meters)

Table 5#—7

Minimum safety thickness coefficient a value

4	88	8 L\$15	15 30
D			

a	3
-----	---

Coefficient F of the angle between the charge and the horizontal ground

2. 留空长度 L' 的确定: 留空长度就是开口装药末端到孔口不装药的那段药孔的长度 (图 5—23)。是为了保证爆破压缩工事开口成功而采取的措施。留空长度的大小与开口工事直径成正比, 其长度按下式计算:

$$L' = aeD$$

式中: L' ——留空长度 (米)

a ——安全系数, 见表 5—7

e ——留空系数, 依据装药与斜坡斜面或水平地而的夹角确定, 见表 5—9

D ——意义同上

表 5—9 留空长度系数 e 值

$\alpha + \beta$	50°	55°	60°	65°	70°	75°	80°	85° ~ 90°
e	0.60	0.55	0.52	0.50	0.48	0.47	0.46	0.45

3. 装药长度 L 的确定: 根据穿孔工具的钻深能力和装药可能装入药洞的最大长度 (可达 8 ~ 10 米) 确定。当工事直径在 2 米以内时, 装药长度最大为设计直径的 4 ~ 5 倍。

(二) 构筑垂坑道。开口位置应选择在较平坦的地形上, 装药应垂直装入预先开设的平底坑底部中央药孔中 (图 5—24), 装药上端与平底坑底部相平, 以减少回落土和保证口部强度。

平底坑各部尺寸根据工事直径和土质条件确定, 一般按下列经验公式计算:

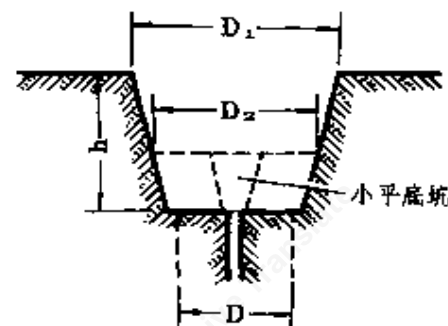


图 5—24 平底坑形状

2. Determination of the blank length L' : The blank length is the length of the uncharged section of the hole from the end of the charged column to the hole mouth (Figure 5-23). It is a measure taken to ensure the successful opening of the blasting excavation. The magnitude of the blank length is proportional to the diameter of the opening excavation, and its length is calculated according to the following formula:

$$L' = aeD$$

Wuzhong: L' —Leave blank length (meters)

a ——Safety factor, see Table 5-7

e ——Leave blank coefficient, based on the charge and the slope of the slope or the horizontal ground

Angle determined, see Table 5-9

D ——Same meaning as above

Leave empty length coefficient e value

85° ~ 90°

3. Determination of the charge length L : It is determined based on the drilling depth capability of the perforation tool and the maximum length of the charge that can be loaded into the charge hole (up to 8 ~ 10 meters). When the tunnel diameter is within 2 meters, the charge length shall not exceed 4 ~ 5 times the design diameter.

(2) Construct a vertical shaft. Opening.

The location should be chosen on relatively flat terrain.

Top, the charge should be inserted vertically into the central charge hole at the bottom of a flat-bottomed pit pre-excavated (Fig.

5—24), the upper end of the charge and the bottom of the flat-bottomed pit 部相平, to reduce the backfill and ensure the strength of the opening.

The dimensions of all parts of the sunken work are determined according to the diameter of the work and the soil conditions, and generally follow the following:

Empirical formula calculation:

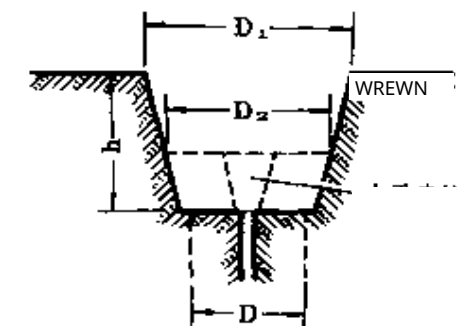


Figure 5-24 Flat-bottomed pit shape

$$h \geq 1.5D$$

$$D_1 = (2.7 \sim 3.3) D \text{ (土质松软时, 可取大值)}$$

$$D_2 = 1.2D$$

第一百零二条 开口后为继续掘进需实施连续压缩爆破。连续压缩爆破时, 在前后两次爆破形成的空室结合处, 由于后一次爆破后土壤被向外挤压, 会出现比其他部位的空室直径小很多的瓶颈现象。为消除或减小这一现象, 可在后一次爆破的主装药周围一定位置上, 设置一个或数个辅助装药, 使主装药与辅助装药同时起爆, 以免主装药爆炸时将土壤向外挤压形成瓶颈。

(一) 沿原方向连续爆破的辅助装药, 可按图 5—25 所示位置, 在主装药周围设置一个环形辅助装药, 其每纵长米的药量为每纵长米主装药药量的 $1/2 \sim 2/3$ 。主装药露出孔外的长度为工事直径的 $1/4 \sim 1/3$ 。

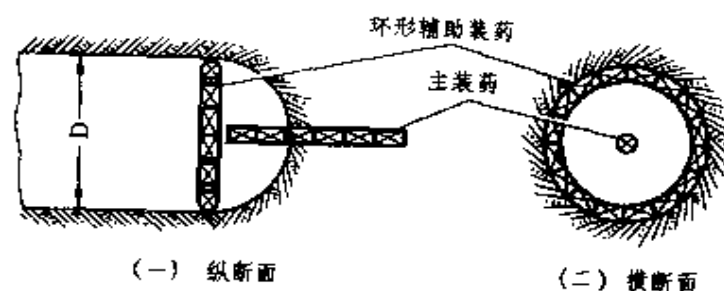


图 5—25 沿原方向连续爆破的装药配置

(二) 平 (斜) 坑道转向的辅助装药按以下方法设置。

1. 锐角转向: 转角最好小于 60° 。主装药应靠近转向一边, 并露出药孔外约 $1/4 \sim 1/3$ 工事直径的长度。在转向一边的侧壁上配置 2~3 个间隔相等的辅助装药 (工事直径小于 1.5 米时, 配置 2 个; 工事直径在 1.6 米以上时, 配置 3 个), 其长度为工事直径的 $1/2$, 每纵长米的药量为每纵长米主装药药量的 $1/3 \sim 1/2$ (图 5—26)。

$$h \geq 1.5D$$

$$D_1 = (2.7 \sim 3.3) D \text{ (土质松软时, 可取大值)}$$

$$D_2 = 1.2D$$

Article 102 After opening, if continuous compression blasting is required to continue advancing, when performing continuous compression blasting, at the junction between the voids formed by the two blasts, the soil behind the second blast is squeezed outward, resulting in a bottleneck phenomenon where the void diameter is significantly smaller than other areas. To eliminate or reduce this phenomenon, one or more auxiliary charges may be set at a certain position around the main charge of the second blast, causing the main charge and auxiliary charges to detonate simultaneously, thereby preventing the soil from being squeezed outward during charge detonation and forming a bottleneck.

(-) Auxiliary charges for continuous blasting in the original direction may be placed as shown in Figure 5-25.

Arm, set a ring-shaped auxiliary charge around the main charge, with a charge per longitudinal meter equal to $1/2 \sim 2/3$ of the main charge per longitudinal meter. The length of the main charge exposed outside the hole is $1/4 \sim 1/3$ of the work diameter.

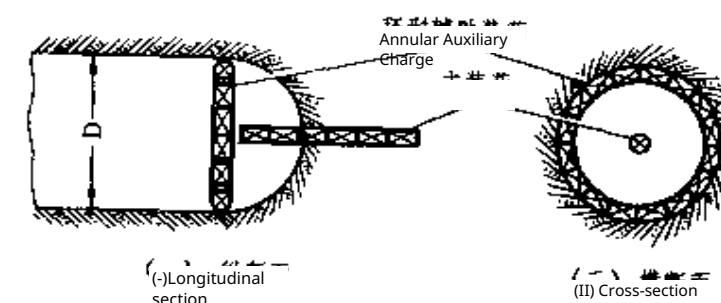


Figure 5-25: Charge configuration for continuous blasting along the original face

(2) Auxiliary charge for turning in flat (inclined) tunnels shall be set up according to the following methods.

1, Acute-angle turn: The turn angle should be as small as possible, preferably less than 60° . The main charge should be placed close to the turning side, with the charge hole exposed by approximately $1/4 \sim 1/3$ of the work diameter on the side of the turn. On the side wall of the turning side

Configure 2~3 auxiliary charges spaced equally (install 2 when the structure diameter is less than 1.5 meters; install 3 when the structure diameter exceeds 1.6 meters), with a length equal to

$1/2 \sim 2/3$ of the structure diameter, and a charge per longitudinal meter equal to $1/3 \sim 1/2$ of the main charge per longitudinal meter (Figure —).

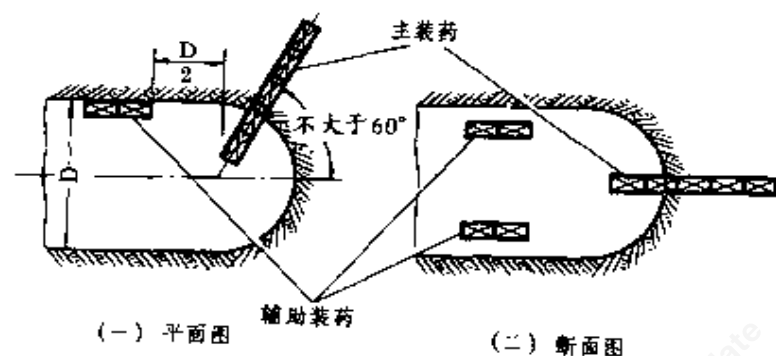


图 5—26 锐角转向的装药配置

2. 垂直转向：主装药装满全药孔长。在主装药的两侧壁上及其顶部设置 5 个装药，其长度均为工事直径的 $1/2$ 。两侧辅助装药的间距稍大于工事直径的 $1/2$ ，每纵长米的药量为每纵长米主装药药量的 $1/2$ （图 5—27）。

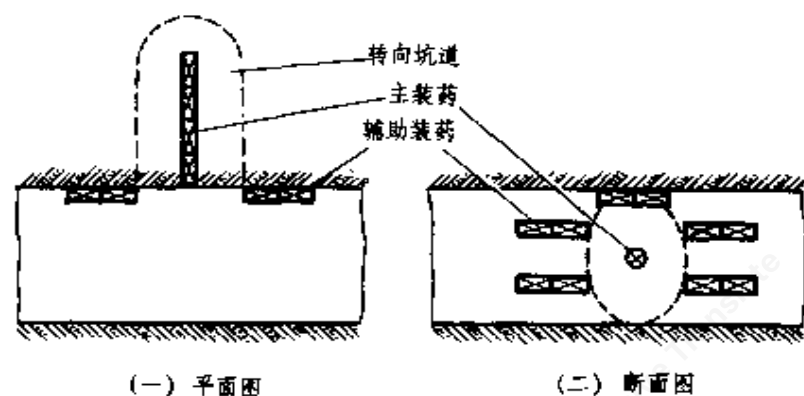


图 5—27 垂直转向的装药配置

3. 垂坑道转平坑道：应适当增大垂坑道底部的装药量，一次爆成上细下粗的垂坑，以便于转平坑道的作业。

垂坑道转平坑道应加辅助装药，以防止爆破压缩平坑道时，破坏垂坑道。辅助装药的配置见图 5—28。其直线部分一般取

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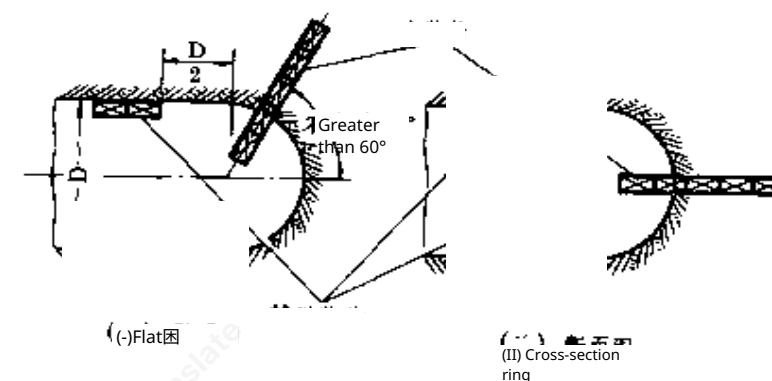


Figure 5-26 Charge configuration for acute-angle turn

2, Vertical orientation: The main charge fills the entire length of the charge hole. Five charges are placed on both walls and the top of the main charge, each with a length equal to one-half of the structure's diameter. The distance between the two side auxiliary charges is slightly greater than one-half of the structure's diameter, and the charge per longitudinal meter for each auxiliary charge is one-half of the charge per longitudinal meter for the main charge (Figure 5-27).

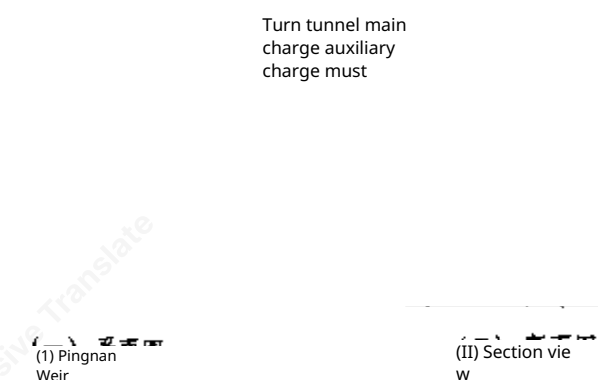


Figure 5-27 Charge configuration for vertical orientation

3. Turning from a vertical shaft to a horizontal shaft: the charge at the bottom of the vertical shaft should be appropriately increased, create vertical pits with a tapered shape (narrow at the top and wide at the bottom) to facilitate the operation of the horizontal tunnel.

The transition from a vertical tunnel to a horizontal tunnel should include auxiliary charges to prevent damage to the vertical tunnel when the horizontal tunnel is compressed by blasting. The configuration of the auxiliary charges is shown in Figure 5-28. The straight section is generally taken as

— 127 —

0.4 米，U 形部分的总长度约等于平坑道的设计直径；每纵长米的药量均为每纵长米主装药药量的 $1/3 \sim 1/2$ 。

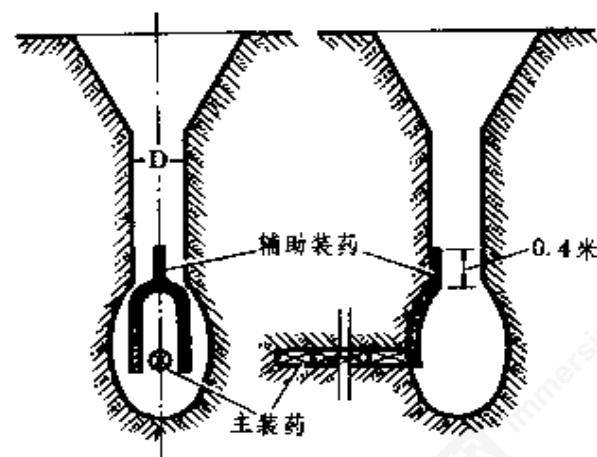


图 5—28 垂坑道转平坑道的装药配置

各种辅助装药的设置，均应紧贴空室壁并固定牢固。若压缩后的空室有较大的裂缝或含砂量较大，强度不高时，辅助装药药量应适当减少。瓶颈部分的直径如满足不了要求，可用人工清理或用小装药爆破的方法扩大。

第一百零三条 构筑压缩爆破工事通常按下列步骤实施。

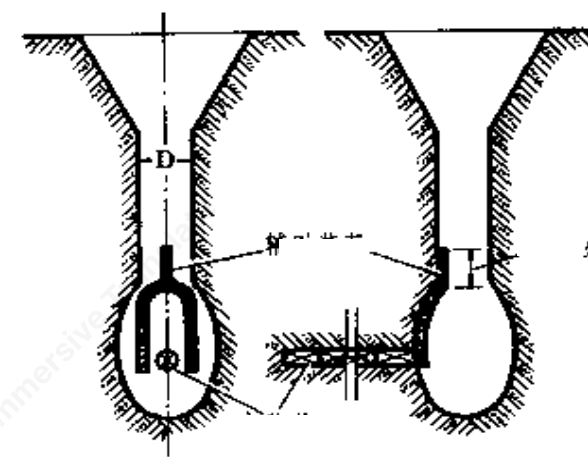
(一) 标定：

1. 平（斜）坑道：当斜坡倾角在 60° 以上，且高度较大时，开口装药可采用水平配置；在 $30^\circ \sim 60^\circ$ 之间时，装药可倾斜 $20^\circ \sim 30^\circ$ ，即 $\alpha = 20^\circ \sim 30^\circ$ ，最大不超过 45° 。

2. 垂坑道：为减少开口装药爆破后土块的回落，应预先开设平底坑。平底坑的斜面应尽量光滑整齐；第一次不要挖到底，应留出扩孔用的小平底坑深度，待扩孔完毕后，再挖到全深。小平底坑的各部尺寸，由扩孔直径决定，比例大致与大平底坑相同（图 5—24）。

(二) 穿孔：可用人工或机械方法开设所需的药孔。

0.4m, the total length of the U-shaped section equals the design diameter of the tunnel; the charge per meter of longitudinal length is $1/3 \sim 1/2$ of the main charge per meter of longitudinal length.



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图5—28垂坑道转平坑道的装药配置

Settings for various auxiliary charges must be placed tightly against the chamber wall and secured firmly. If the compressed narrow chamber has significant cracks or contains a high sand content resulting in low strength, the amount of auxiliary charge should be appropriately reduced. If the diameter of the bottleneck section does not meet requirements, it can be enlarged using manual cleaning or small charges for blasting.

Article 113. Construction of compressed blasting works is generally implemented according to the following steps: 前。

(1) 标定：

Calibration

1. Slope (inclined) tunnel: When the slope inclination exceeds 60° and the height is significant,

Open-face charge configuration may be horizontal; at $30^\circ \sim 60^\circ$, the charge may be inclined $20^\circ \sim 30^\circ$, i.e., $\alpha = 20^\circ \sim 30^\circ$, with a maximum not exceeding 45° .

2. Vertical shaft: To reduce the fall of soil fragments after blasting with open-face charges, a flat-bottomed pit should be excavated in advance. The slope of the flat-bottomed pit should be as smooth and neat as possible; the bottom should not be excavated in the first pass, but rather a small flat-bottomed pit depth should be left for subsequent hole enlargement. After the enlargement is completed, the full depth should be excavated. The dimensions of all parts of the small flat-bottomed pit are determined by the enlargement diameter, and the proportions are roughly the same as those of the large flat-bottomed pit (Figure 5-24).

(2) Perforation: The required blasting holes can be opened by manual or mechanical methods.

(三) 扩孔：可用小型直列装药或导爆索扩孔。小型直列装药的药量也可按第八十二条的公式计算，式中 D 值为扩孔直径。

扩孔装药应预先装入制好的纸筒中（直径见表 5—10），每个纸筒的长度以 30～40 厘米为宜。然后切取一根稍长于孔深的导爆索，将导爆索夹在薄竹片与炸药之间加以捆扎（图 5—29）。如孔中有水，应加一个塑料套。

表 5—10 扩孔装药量或导爆索数量

工事直径 (m)	0.8	1.0	1.2	1.5	1.8	2.0	2.5	3.0
扩孔直径 (cm)	16	19	21	24	27	29	34	39
扩孔药量 (kg/m)	0.13	0.17	0.21	0.26	0.33	0.39	0.52	0.69
装药直径 (cm)	1.5	1.7	1.9	2.1	2.3	2.5	2.9	3.2
导爆索数 (根)	5	7	9	11	13	15	20	27
说 明	炸药密度为 0.8～0.9 克/厘米 ³							



图 5—29 扩孔装药的捆包

若用导爆索扩孔时，应根据孔深和孔径截取所需的导爆索并将其捆扎成束，固定在竹片（板条）上。扩孔导爆索根数可用下式计算：

$$m = 50KA d^2$$

式中：m——扩孔用导爆索根数（根）

(3) Bangkang: The charge of small straight charges or charges for small straight charges expanded by detonating cord can also be calculated according to the formula in Article 82, where D is the expanded diameter.

Charging for reaming should be preloaded into prepared paper tubes (diameters as shown in Table 5-10); the length of each paper tube should be approximately 30～40 cm. Then, cut a detonating cord slightly longer than the hole depth, place it between a thin bamboo strip and the explosive, and tie it together (see Figure 5-29). If there is water in the hole, add a plastic sleeve.

Table 5-10 Chamber charge or detonating cord quantity for reaming

Construction diameter (m)	0.8	1.0	1.2	1.5	1.8	2.0	2.5	3.0
Bore diameter (cm)	16	19	21	24	27	29	34	39
Bore charge (kg/m)	0.13	0.17	0.21	0.26	0.33	0.39	0.52	0.69
Diameter of the charge (cm)	1.5	1.7	1.9	2.1	2.3	2.5	2.9	3.2
Detonating cord quantity (pieces)	5	7	9	11	13	15	20	27
Explosive density is 0.8~0.9 g/cm ³ .								



Figure 5-29 Bundling of expanded hole charges

When using detonating cord for hole enlargement, cut the required length of detonating cord according to the hole depth and diameter, bundle it, and fix it to bamboo strips (planks). The number of detonating cord strands for hole enlargement can be calculated using the following formula:

$$m = 50KA d^2$$

In which: m--number of detonating cords for reaming (pieces)

K、A——意义同第八十二条

d——设计扩孔直径（米）

常用工事的扩孔导爆索数量见表 5—10。

扩孔时，扩孔装药或导爆索束的末端应与孔口相平，不需填塞。

（四）捆包装药和装药起爆：

1. 捆包装药时，如用成卷硝铵炸药，可将药卷按每纵长米的药量排好，在中间放 1~3 根导爆索（其中一根稍长些，便于安装雷管），然后用竹片（板条）夹好，用麻绳捆紧成圆柱形即可（图 5—30）。



图 5—30 主装药的捆包

2. 若有辅助装药时，可先根据其尺寸用刚性较好的铁丝或竹片弯成所需的形状，然后在上面捆包炸药，中间也应加 1~3 根导爆索，并与主装药的导爆索接续，以保证同时起爆。

3. 起爆前，认真清理坑道内部人员物资，应特别注意口部所对方向约 60° 范围内（平斜坑道）的警戒，以防冲击波或飞散的土块伤人（个别土块有时可飞到 500 米以外）。

（五）开口清渣：装药爆炸后，迅速开口，用人工或机械挖出空室，清除空室中滚进的余土，修好出入口，以便继续作业和连续爆破。

（六）连续爆破：根据实际情况可实施沿原方向连续爆破、平坑转向的连续爆破和垂坑转平坑的连续爆破。具体方法见第

K. A one meaning same as Article 82

d1 design reaming diameter (m)

The number of detonating cords for common fortifications is shown in Table 5-10.

When enlarging the hole, the unended of the enlarging charge or detonating cord bundle should be level with the hole mouth, and no filling is required.

(4) Bundling and packing of explosives and initiating detonation:

1. When bundling packaged explosives, if rolled ammonium nitrate explosives are used, arrange the explosive rolls according to the charge per longitudinal meter, place 1~3 detonating cord(s) in the middle (with one slightly longer to facilitate fuse installation), then secure them with bamboo strips (planks) and tightly bind them with hemp rope into a cylindrical shape (Figure 5-30).



Figure 5—30 Bundle of Main Charge

2. If auxiliary charges are used, they can first be bent into the required shape using stiff wire or bamboo strips according to their dimensions, then wrapped with explosives on top. A 1~3 detonating cord should also be added in the middle and connected to the detonating cord of the main charge to ensure simultaneous detonation.

3. Before blasting, thoroughly clear personnel and materials from inside the tunnel. Pay special attention to the safety zone within approximately 60° in the direction facing the entrance (for horizontal or inclined tunnels) to prevent injury from shock waves or flying debris (individual pieces can sometimes travel up to 500 meters).

(5) Open the mouth and clear the slag: After the charge explodes, quickly open the mouth, manually or mechanically excavate the empty chamber, remove the rolled-in residual soil from the chamber, and repair the exit and entrance to facilitate continued work and continuous blasting.

(6) Continuous blasting: Depending on the actual conditions, continuous blasting along the original direction, continuous blasting with a horizontal pit turn, and continuous blasting with a vertical pit turning into a horizontal pit may be implemented. For specific methods, see the next section.

百零二条。

(七) 口部清理、加工和被覆：一般在坑道掘进结束后进行。为了防止口部因多次震动而塌方，可在坑道转向两次，且掘进总长度达 100 米以上时，进行临时支撑。如因口部塌方无法施工而必须被覆时，则被覆层必须与工事壁相平齐或略凹进些。被覆与工事壁的整体性要好，否则，被覆层将被冲击波破坏或冲出洞口。

第七节 药孔、药洞和药壶的开设与装填

第一百零四条 实施土石爆破时用于装填炸药的药孔和药洞，除可用机械或人工开设外，当土壤的压缩性较好时，也可用导爆索束或小直列装药扩爆构成。

药壶是在药孔（药洞）底部，利用少量炸药爆炸所构成的药室（图 5—31），适用于中等坚硬以下的岩石和土壤中爆破；在坚硬的岩石中一般不宜采用。

开设药壶所需的扩爆药量按下式计算：

$$C_k = K_0 C$$

式中：C_k——开设药壶所需的扩爆药量（千克）
K₀——扩爆系数，见表 5—11
C——预计装入药壶内药量（千克）

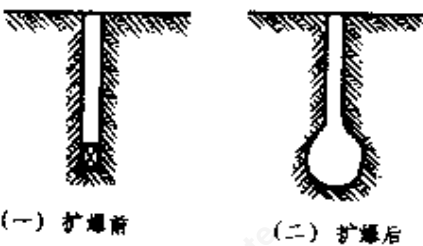


图 5—31 药壶的构成

Article 102,

(7) Mouth clearing, processing, and covering: Generally performed after tunneling is completed. To prevent collapse at the mouth due to repeated vibrations, temporary support may be installed after the tunnel has turned twice and the total excavation length reaches 100 meters. If mouth collapse prevents construction and covering becomes necessary, the covering layer must be flush with or slightly recessed relative to the structure wall. The integrity between the covering and the structure wall must be maintained; otherwise, the covering layer may be damaged by the shock wave or ejected from the tunnel entrance.

Section 7 of the preparation and loading of the medicine hole, medicine cavity, and medicine pot

Article 104 When implementing blasting with stone and soil, the charge holes and charge holes used for loading explosives may be opened by machinery or manually; when the compressibility of the soil is good, they may also be formed by detonating cord bundles or small parallel charges.

The medicine pot is located at the bottom of the medicine hole (medicine cavity),

Chamber formed by the explosion of a small amount of explosive

(Fig. 5-131), applicable to medium-hard to blast the rocks and soil below; in hard

Generally not recommended for use in rock.

The amount of explosive required to open the medicine pot is according to Calculate as follows:

$$C_k = K_0 C$$

In this formula: C_k—the charge of explosive required to create a charge hole (kg))
K₀—explosion coefficient, see Table 5-11
C—1 Estimated amount of medicine to be loaded into the medicine pot (in grams)

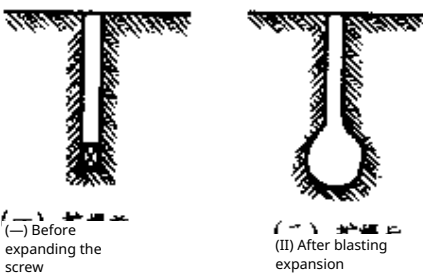


Figure 5-31 Composition of a mud pot

表 5—11 扩爆系数 K_0 值

材料分类	材 料 名 称	系数 K_0 值
土 壤	植物土、粘土地	0.003 ~ 0.005
	泥 炭 地	0.005 ~ 0.01
	冻结的粘土及细砂土	0.03 ~ 0.06
软 岩 石	各种坚硬的页岩、石膏、煤、中等坚硬的页岩、中等坚硬的泥灰岩、孔隙节理多的石灰岩	0.05 ~ 0.10
次 坚 硬 岩 石	风化的节理多的粘土质砂岩、坚硬的泥灰质页岩、坚硬的泥灰岩、泥灰质石灰岩、粘土质砂岩、砂质页岩、硬石膏、密实的石灰岩、砂岩、砂质石灰质的页岩、风化较甚的花岗岩、片麻岩	0.10 ~ 0.20

当计算出的扩爆药量较大时，可分成数次扩爆。采用两次扩爆时，药量按 1:2 分配；采用 3 次扩爆时，药量按 1:2:3 分配。多次扩爆时，要待前次扩爆的药壶壁冷却后（约 30 分钟），再装填炸药继续扩爆。在土壤或松软的岩石中开设药壶时，药孔可不加填塞；在中等坚硬岩石中，应用砂质粘土填塞 20 ~ 30 厘米。

第一百零五条 药孔和药壶内通常装填硝铵炸药卷。装填时，应边装药边用木棍挤压密实。电雷管或点火管通常装在装药中间。装好后，用混合有粗砂（或石屑）的粘土加以填塞。

药洞内的装药通常预先捆包好，装上火具，然后用绳索吊入药洞底部，最后用土填塞。填塞 20 ~ 30 厘米后逐渐捣实。捣固时，先轻后重，先捣周围，后捣中央，注意勿损伤电雷管脚线或导火索、导爆索。

当装药量较大时，为使装药可靠起爆，应制作起爆体。起爆体通常用梯恩梯炸药制作。装药时将起爆体置于装药中间。

Table 5-11 Explosion Coefficient K_0 Value

	Coefficient K_0 value
	0.003 ~ 0.005
	0.005 ~ 0.01
Frozen clay and fine sandy soil	0.03 ~ 0.06
Various hard shales, gypsum, coal, medium-hard shales, medium-hard argillaceous limestones, and porous joints.	0.05 ~ 0.10
Weathered jointed clayey sandstone, hard mudstone, hard limestone, mudstone limestone, clayey limestone, clayey sandstone, sandy shale, anhydrite, compact limestone, sandstone, sandy limestone shale, heavily weathered granite gneiss CCO	0.10 ~ 0.20

When the calculated charge for blasting is large, it can be divided into multiple stages. When using two stages, the charge is allocated in a 1:2 ratio; when using three stages, the charge is allocated in a 1:2:3 ratio. During multi-stage blasting, wait for the blast hole walls from the previous stage to cool (approximately 30 minutes) before filling with explosives to continue blasting. When creating blast holes in soil or soft rock, the holes do not need to be packed; in moderately hard rock, pack with sandy clay to a depth of 20 ~ 30 cm.

Article 105. The gun barrel and the gunpowder pot are usually filled with ammonium nitrate explosive cartridges. When filling, the gunpowder should be packed tightly while being inserted. The electric detonator or the ignition tube is usually placed in the middle of the filling.

Backfill with clay mixed with coarse sand (or crushed stone)

The charge in the borehole is usually pre-bundled, placed on the ignition device, then lowered to the bottom of the borehole using a rope, and finally backfilled. After filling 20 ~ 30 cm, gradually tamp it down. When tamping, start light and gradually increase pressure, work from the periphery to the center, and take care not to damage the detonator leads or fuse and detonating cord.

When the charge quantity is large, an initiating device should be manufactured to ensure reliable detonation of the charge. Initiating devices are typically made of TNT. During charging, the initiating device is placed in the center of the charge.

第六章 构件爆破

第一节 木材的爆破

第一百零六条 爆破圆木和方木通常用外部集团装药或直列装药。

爆破圆木通常用集团装药。装药应与圆木紧贴，也可将装药位置削平（图 6—1）。

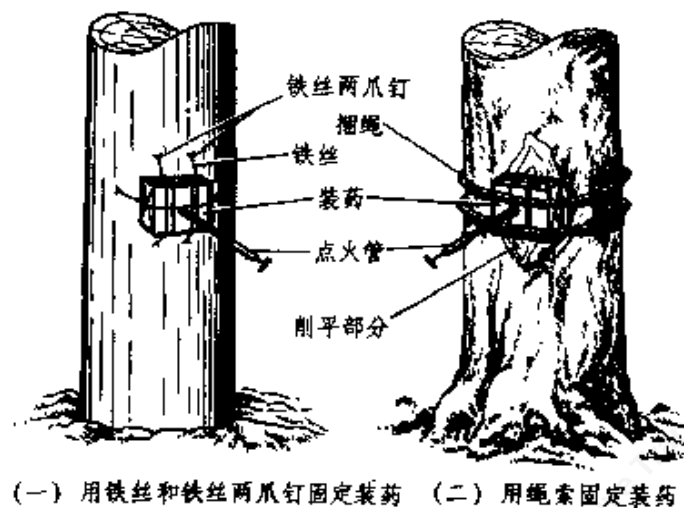


图 6—1 用集团装药爆破圆木

爆破方木通常用集团装药或直列装药。当方木断面长边较大时，应采用直列装药，装药应配置在炸断面较宽的一边，其长度应与方木的宽度相等（图 6—2）。装药用绳索、铁丝或两爪钉等固定。

Chapter 6, Component Blasting

Section 1: Blasting of Timber

第一百零六条 Blasting timbers and square timbers are usually charged with external group charges or straight-line charges.

Blasted logs are usually charged with group charges. The charge should be tightly pressed against the log; the charge position may also be shifted forward (Fig. 6-1).

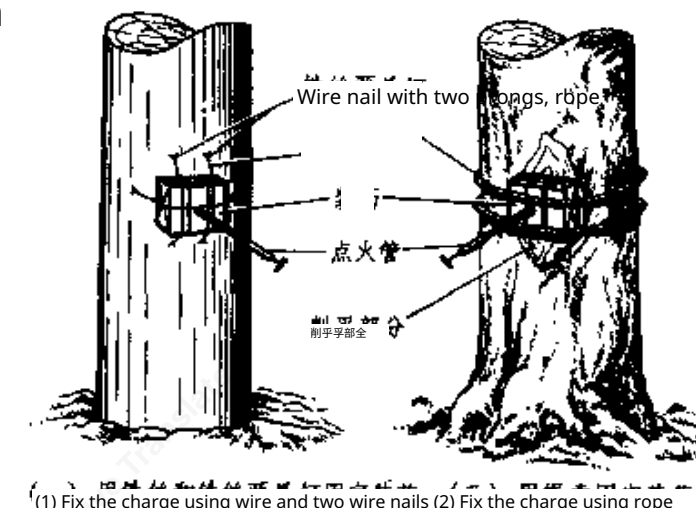


Figure 6-1: Blasting round logs with group charges

Blasted timber is typically loaded with grouped charges or straight-line charges. When the long side of the timber cross-section is large, straight-line charging should be used; the charge should be placed on the wider side of the blast face, with its length equal to the width of the timber (Figure 6-2). The charge should be secured with ropes, iron wire, or two-pronged nails.

在水中爆破木材时，可将装药捆在木板或小圆木上，沿目标上游放入水中，下端插入河底，然后在水上用绳索或铁钉固定。还可将装药捆在绳索套箍上，放入水中进行固定（图 6—3）。

在采伐树木时，为使树木定向倒下，装药应配置在树木预定倒下的一边。

爆破圆木和方木时，装药量按下式计算：

$$C = KF$$

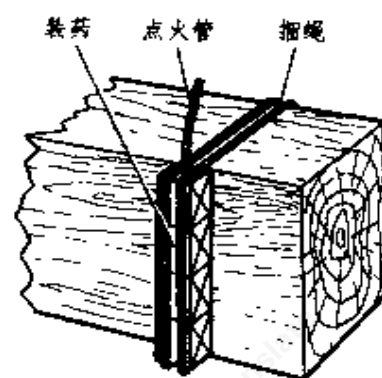
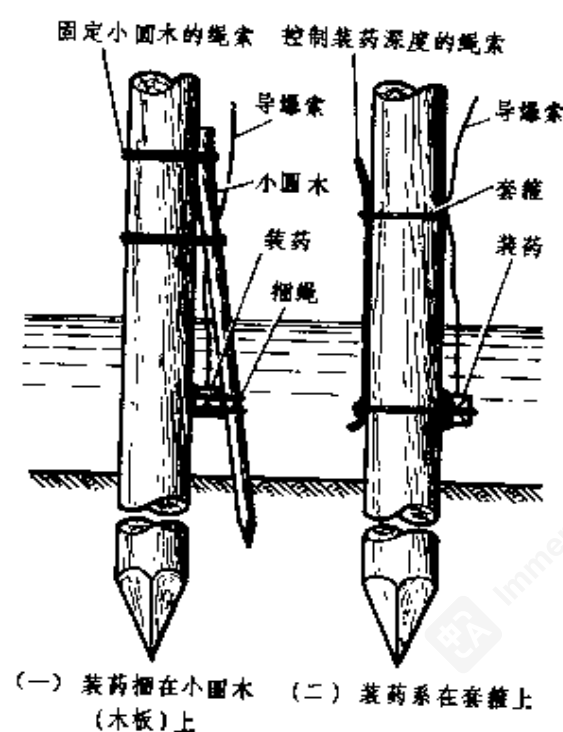


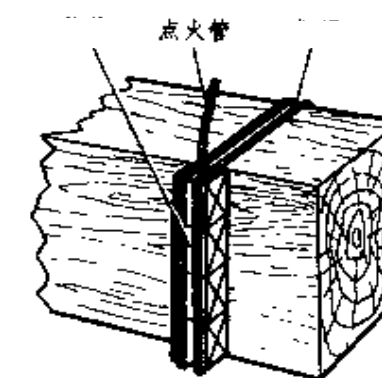
图 6—2
用直列装药爆破方木



(一) 装药捆在小圆木 (木板) 上 (二) 装药系在套箍上

图 6—3 在水中固定装药的方法

When blasting wood in water, the charge can be placed on a floating board or small log, floated upstream along the target, inserted into the riverbed at the lower end, and then secured on the water surface with ropes or iron nails. Alternatively, the charge can be tied to a rope band and placed in the water for securing (Fig. 6-3).

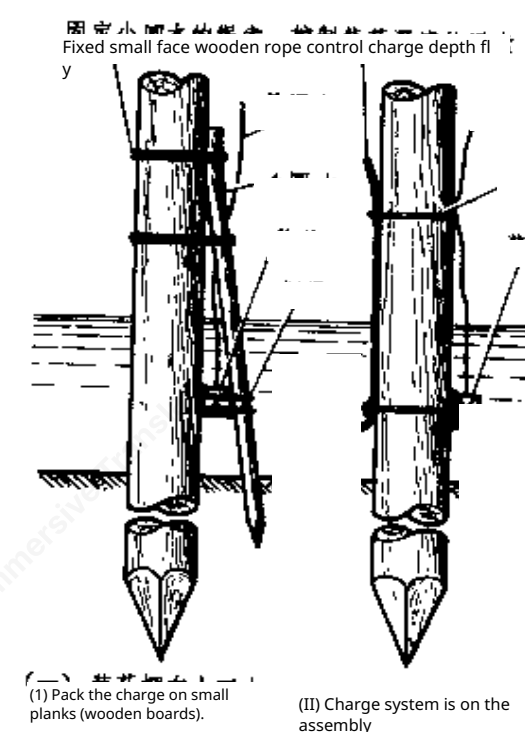


When felling trees, to ensure the tree falls in a specific direction, the charge should be placed on the side where the tree is intended to fall.

When blasting logs and timber, the charge quantity is calculated according to the following formula:

Blow up timber with parallel charge

$$c = kF$$



(I) Pack the charge on small planks (wooden boards). (II) Charge system is on the assembly

Figure 63 在水中固定装药的方法

式中：C——中级炸药药量（克）
K——木材抗力系数，见表 6—1
F——炸断面面积（厘米²）

表 6—1 木材抗力系数 K 值

木材种类	K 值	湿 度	干 的	活树或新伐的
脆弱木材（杨、柳）	0.80			1.00
中等坚硬木材（松、杉）	1.00			1.25
坚硬木材（枫、樟、橡、栗）	1.60			2.00

使用低级炸药时，应按上式计算的药量增加 50%。

第一百零七条 爆破密集木桩采用集团装药；装药应设置在密集木桩中央。根据木桩数量和位置，可使用 1 个装药（图 6—4），也可以使用多个装药（图 6—5）。

爆破密集木桩时，装药量按下式计算：

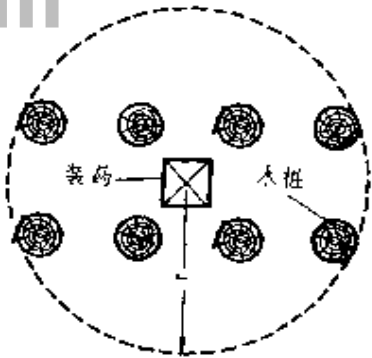


图 6—4 用 1 个集团装药爆破密集木桩

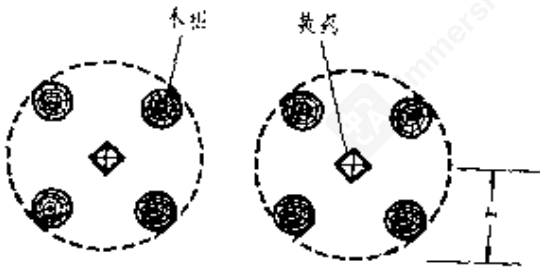


图 6—5 用两个集团装药爆破密集木桩

In which: (— grade explosive charge (grams)))
K—Wood resistance coefficient, see Table 6—1
F—Fracture surface area (cm²)

Table 6-1 Wood resistance coefficient K value

Weak Wood (Poplar, Willow)
Medium-hard wood (pine, fir)
Hardwood (Bottle, Cypress, Oak, Chestnut)

Live trees or recently felled

When using low-grade drugs, increase the calculated dosage by 50%Ttecn.com

Article 107: Blasting dense wooden stakes using group charging: The charge should be placed in the dense bamboo fire. According to the number and position of the bamboo stakes, one charge (Figure 6-4) may be used, or multiple charges (Figure 6-5).

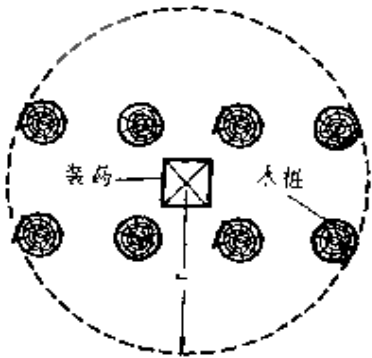


Figure 6—41 charge sets for blasting densely driven wooden stakes

When breaking up a dense log raft, the charge quantity shall be calculated according to the following formula:

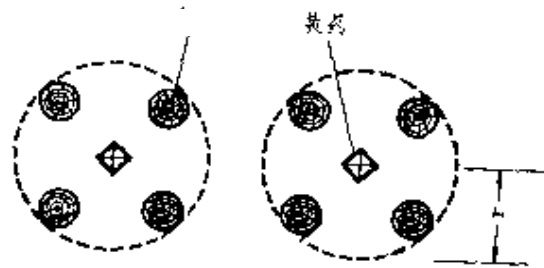


Figure 6--5: Blast with two group charges to detonate densely packed wooden stakes.

$$C = 30KDr^2$$

式中：C——中级炸药药量（千克）

K——木材抗力系数，查表 6—1 确定

D——距装药最远最大圆木直径或方木长边（米）

r——破坏半径，即由装药中心到最远木桩外缘的距离（米）

上式也适用于水中爆破密集木桩。

第一百零八条 用爆破法拔除树根时，装药量应根据树木的种类、树根的新旧和根系蔓延的情况及土壤性质而定，一般按露出地面的最大直径 D 计算药量，每 1 厘米需炸药 10~20 克。

装药配置在树根底部中央并靠近主根，深度等于树根直径的 1~1.5 倍。药洞用铁钎或七钻开设。装药长度不得超过洞长的 1/3（图 6—6），剩余部分应加以填塞。

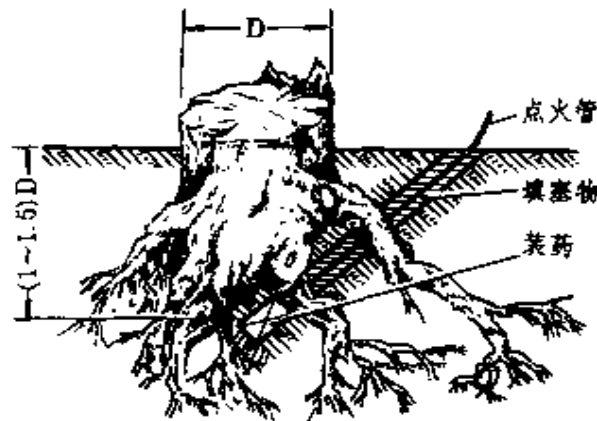


图 6—6 树根的爆破

第二节 钢构件的爆破

第一百零九条 炸断钢板采用直列装药。装药按钢板的整个宽度配置，其高度应不大于装药的宽度。如用梯恩梯药块，当计

$$C = 30KDr^2$$

In this formula: C—amount of medium-strength explosive (kg)

K——coefficient of resistance of wood, determine from Table 6—1

D—距装药最远最大圆木直径或方木长边 (米) 破坏半径，即由装药中心到最远木桩外缘的距离 (米)

The above equation also applies to underwater blasting of closely spaced wooden piles.

第一百八十八条 When removing tree roots by blasting, the charge quantity shall be determined based on the type of tree, the age of the roots, the extent of root spread, and soil conditions. Generally, the charge is calculated based on the maximum diameter D exposed above ground, with 10~20 grams of explosive required per 1 centimeter.

The charge is placed at the bottom center of the tree root, close to the main root, at a depth equal to 1~1.5 times the tree root diameter. The boreholes are drilled with a steel rod or a seven-point drill. The charge length shall not exceed one-third of the borehole length (Fig. 6-6); the remaining portion must be packed.

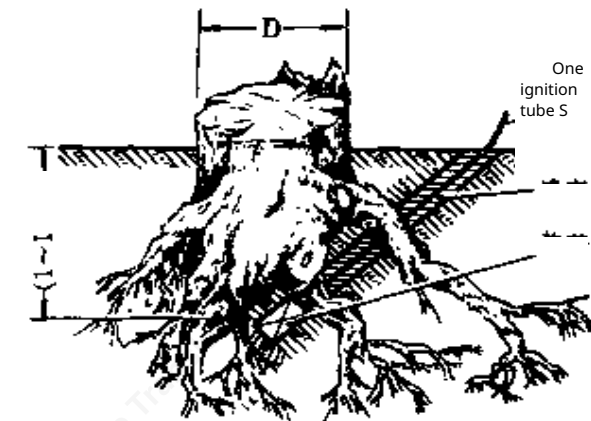


Figure 6-6 Blasting of the tree root

Section 2 钢构件的爆破

Article 109: When breaking steel plates with explosives, use a linear charge. The charge is distributed across the entire width of the plate, and its height shall not exceed its width. If TNT blocks are used, when the

算的药块在钢板的炸断面上不足以排满一行时，应增加药块排满，以保证炸断；如一行排不完可以排数列，排满一行或数列后尚有剩余的药块时，可放在上面的中央（图 6—7）或增加药块排满。

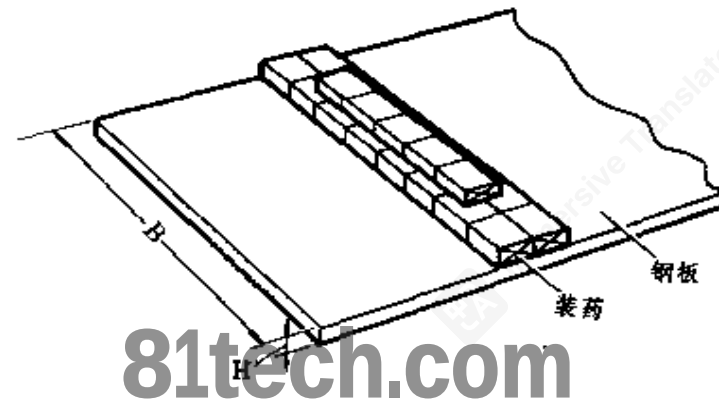


图 6—7 炸断钢板的装药配置

炸断钢板的直列装药药量根据钢板厚度不同，分别按下式计算：

炸断厚度为 2.5 ~ 10 厘米的钢板时：

$$C = 10HF$$

式中：C——中级炸药药量（克）

H——钢板厚度（厘米）

F——钢板炸断面横截面积（厘米²）

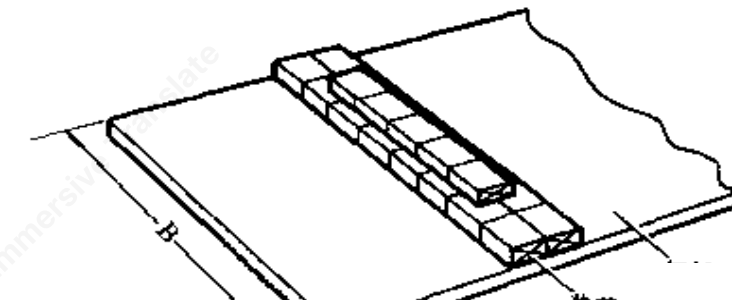
炸断厚度为 2.5 厘米以下的钢板时：

$$C = 25F$$

式中：C、F——意义同上式

当钢板厚度在 2.5 厘米以下时，也可按每厚 1 厘米需要一行

When the number of drug blocks on the fractured surface of the steel plate is insufficient to fill a single row, additional drug blocks should be added to fill the row, ensuring complete fracture; if a single row cannot be filled, multiple rows may be used. If, after filling one or more rows, there are remaining drug blocks, they may be placed in the center of the upper section (Fig. 6-7) or additional blocks may be added to fill the row.



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Figure 6-7: Charge configuration for bursting steel plates

The charge quantity for the linear charge that causes the steel plate to rupture is calculated according to the following formulas, depending on the thickness of the steel plate:

Blast through a steel plate with a thickness of 2.5~10 centimeters.

$$C = 10HF$$

In which: C—the amount of medium-strength explosive (grams)

H—Steel plate thickness (cm)

F—Cross-sectional area of the steel plate explosion fracture surface (cm²)

When breaking through steel plates with a thickness of less than 2.5 cm:

$$C = 25F$$

In which: C, F——have the same meaning as in the above equation.

When the steel plate thickness is less than 2.5 cm, it can also be arranged with one column per 1 cm of thickness.

200 克梯恩梯药块概略计算。钢板厚度的小数应进成整数。

如果要炸断用铆钉组合的数层钢板，而且装药又必须配置在铆钉上时，应将一面铆钉头的高度与钢板厚度加起来计算。组合钢板间有空隙时，还应加上空隙厚度。

爆破装甲时，装药量应比按上述公式计算的药量增加一倍。

第一百一十条 爆破钢梁时，装药量按第一百零九条公式计算。但在按厚度确定药量时，应在每一对紧贴翼缘的角钢上增加 2~4 块 400 克梯恩梯药块。

由于钢梁的断面厚薄不同，在配置装药时，应按各个组成部分所需的药量，分别配置在相应的部位上。

装药通常预先捆包成所需的形状，然后固定在钢梁上。为了保证装药同时爆炸，应用连接药块把上下翼缘的装药与腹板的装药连接起来（图 6—8）。

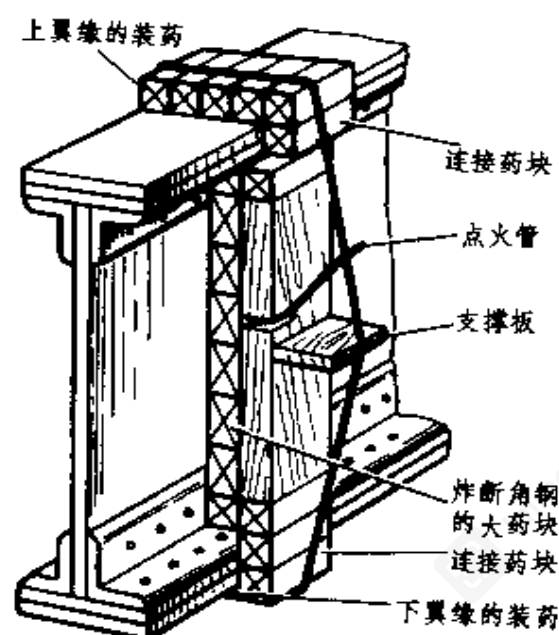


图 6—8 装药在钢梁上的配置

爆破钢梁时，为了简化作业可采用集团装药；根据钢梁的断

200 克梯恩梯药块概略计算。钢板厚度的小数应进成整数。

If multiple layers of steel plates joined by rivets are to be burst, and the charge must be placed on the rivets, the height of the rivet head on one side plus the plate thickness shall be used for calculation. If gaps exist between the plates, the gap thickness shall also be added.

When detonating the armor, the charge quantity should be doubled compared to the amount calculated by the above formula.

Article 110. When blasting steel beams, the charge quantity shall be calculated in accordance with the formula specified in Article 109. However, when determining the charge quantity based on thickness, an additional charge shall be added to each pair of angle steel tightly abutting the flanges.

2~4400g TNT block

Since the cross-sectional thickness of steel beams varies, when arranging the explosive charge, it should be distributed separately in the corresponding parts according to the charge quantity required for each component.

The charge is usually pre-wrapped into the required shape and then fixed to the steel beam. To ensure simultaneous detonation of the charge, connecting charges are used to connect the charges in the flanges with those in the web (Fig. 6-8).

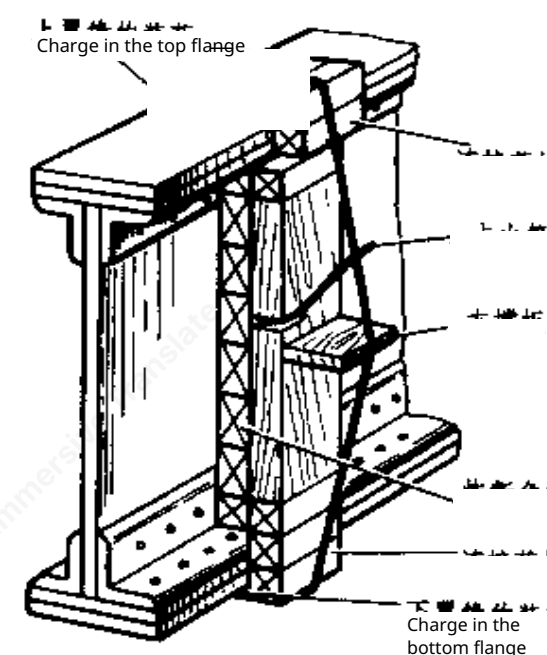


Figure 6-8: Arrangement of the charge on the steel beam

When blasting steel beams, group charging may be adopted to simplify operations: according to the steel beam's cross-section, the charge is arranged in groups.

面形状，将装药配置在腹板或翼缘旁（图 6—9、图 6—10）；装药量应比按第一百零九条公式计算的药量增加 1 倍。

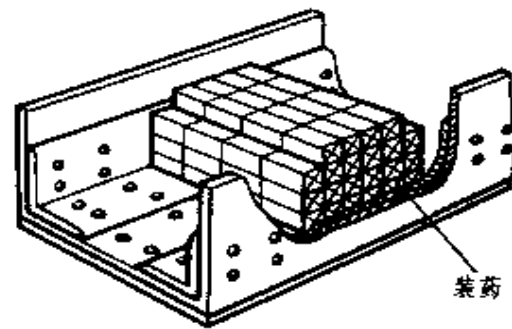


图 6—9 用集团装药炸断钢梁

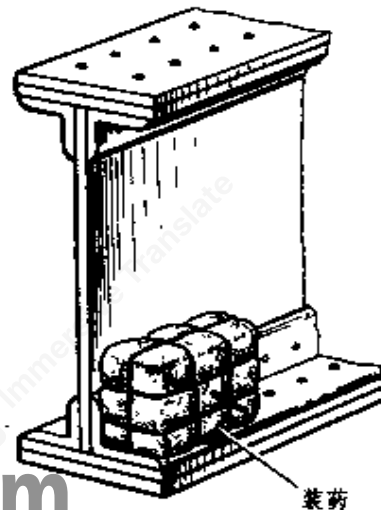


图 6—10
用集团装药炸断工字梁

炸断各种断面不同的钢梁时，装药的配置与固定如图 6—11、图 6—12 和图 6—13 所示。

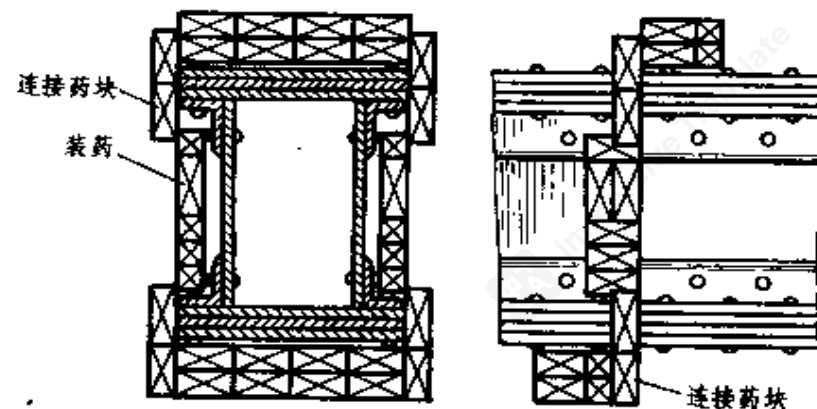


图 6—11 炸断箱形梁

Shape of the face, place the charge on the web or flange (Fig. 6-9, Fig. 6-10); the charge quantity should be increased by 100% compared to the amount calculated by the formula in the first hundredth of the page.

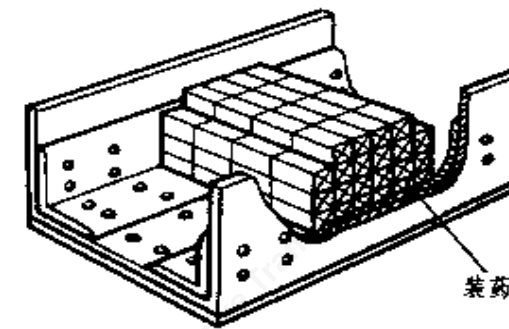


图 6—9 用集团装药炸断钢梁
Figure 6-9 Using the Ji Mengjie Special Package

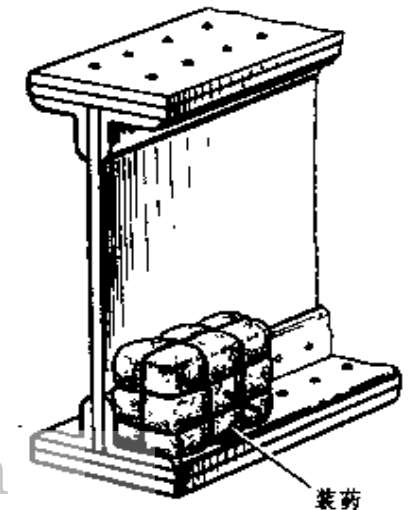


Figure 6—
10
Use group charges to blast
through the I-beam.

When breaking various steel beams with different cross-sections, the arrangement and fixation of the charges are shown in Figures 6-11, 6-12, and 6-13.

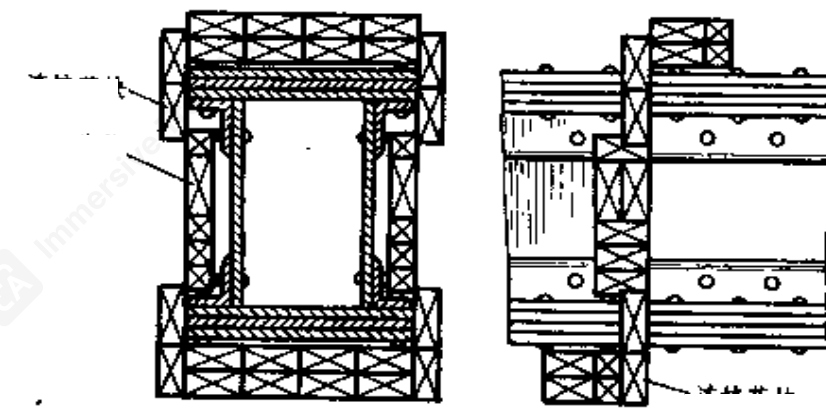


Figure 6-11: Sheared box
girder

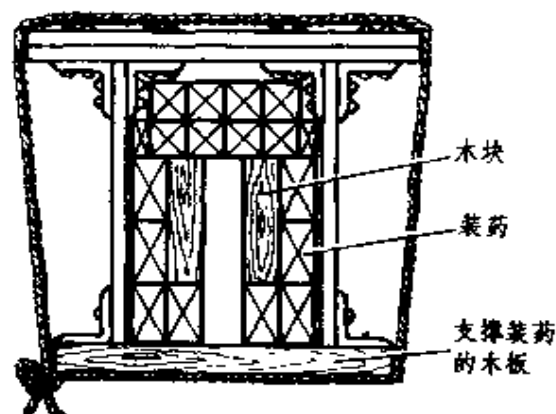


图 6—12 炸断桥梁桁架上弦

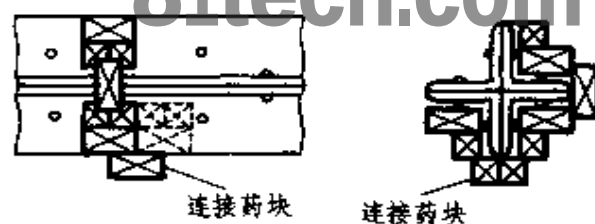


图 6—13 炸断吊杆或斜杆

第一百一十一条 爆破钢索（圆钢）时，通常将计算的炸药捆成两个集团装药，分别捆在钢索（圆钢）相对的两侧，各用 1 发瞬发电雷管或用导爆索连接使其同时起爆，以两个装药的爆炸剪力将其切断（图 6—14）。

爆破钢索（圆钢）时，装药量按下式计算：

$$C = 100d^2$$

式中：C——中级炸药药量（克）

d——钢索（圆钢）的直径（厘米）

第一百一十二条 爆破钢管时，装药配置在钢管的外面，围绕其圆周的 2/3 ~ 3/4（图 6—15）。

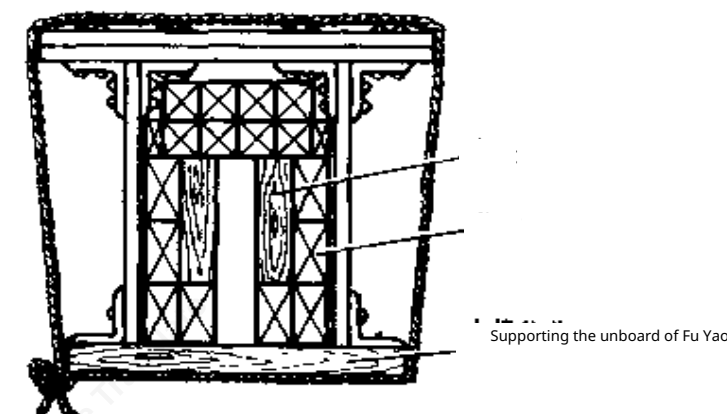
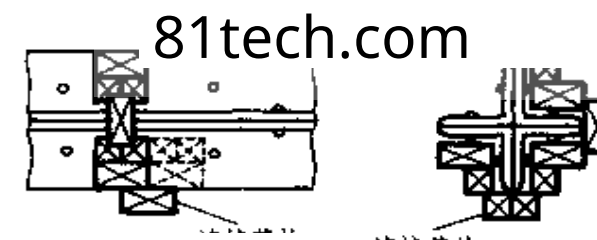


Figure 6-12: Blast fracture of a truss bridge girder



Break the suspension rod or inclined rod Figure 6—13

Article 111 When blasting steel cables (round steel), the calculated charge of explosives is typically divided into two groups, each tied to opposite sides of the steel cable (round steel). Each group is connected to a single instant-acting detonator or linked with a detonating cord to ensure simultaneous initiation, thereby severing the cable through the shear force generated by the explosion of both charges (Figure 6-14).

When blasting steel cables (round steel), the charge quantity is calculated according to the following formula:

In which: C—amount of medium-strength explosive (grams)
d diameter (cm) of one steel cable (round steel)

Article 112. When blasting steel pipes, the charge configuration is placed outside the pipe, surrounding its circumference at 2/3 ~ 3/4 (Figure 6—15).



图 6—14 用两个集团装药炸断钢索

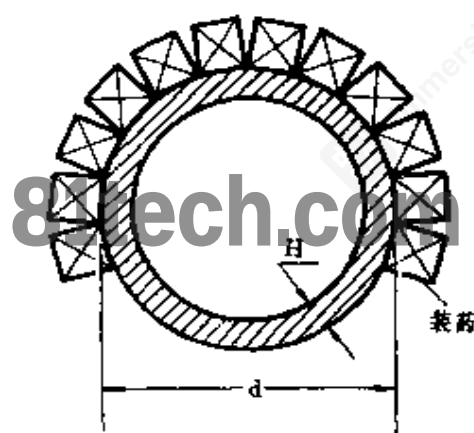
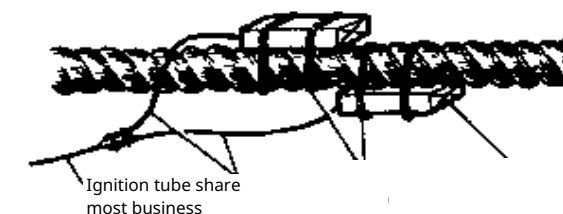


图 6—15 炸断钢管的装配置

爆破钢管时的装药量按第一百零九条公式计算。当钢管的壁厚不能直接测定时，可用 200 克或 400 克梯恩梯药块（如用 200 克梯恩梯药块则应使 2.5×10 厘米的一面与钢管表面接触）爆破。

第三节 砖、石、混凝土和钢筋 混凝土构件的爆破

第一百一十三条 爆破砖、石、混凝土和钢筋混凝土构件时，根据情况可采用外部装药或内部装药。用外部装药爆破时，



Blow up the steel cable with two group charges, Figure 6--14

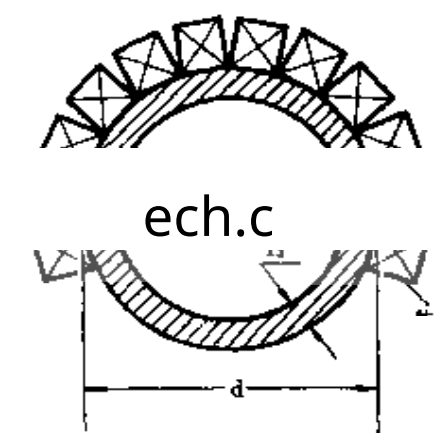


Figure 6-15 Configuration of the cut-off steel pipe

The charge quantity for blasting steel pipes shall be calculated according to the formula in Article 109. When the wall thickness of the steel pipe cannot be directly measured, it may be blasted using a 200 g or 400 g block of TNT (if a 200 g TNT block is used, the 2.5×10 cm² surface shall be in contact with the surface of the steel pipe).

Section 3 砖、石、混凝土和钢筋 Blasting of Concrete Members

Article 113 When blasting bricks, stone, concrete, and reinforced concrete members, external or internal charging may be adopted according to the situation. When blasting with external charging,

作业准备时间短，所需炸药较多；用内部装药爆破时，需在目标上开设药室，作业准备时间较长，但所需炸药较少。

爆破砖、石、混凝土和钢筋混凝土建筑物时，通常采用集团装药。当目标厚度不大时，可采用直列装药。为了限制破片的飞散，有时可采用穿孔爆破法。装药尽可能用土、砂等加以填塞。

集团装药的药量按下式计算：

C = ABR³

- 式中：C——中级炸药药量（千克）
A——材料抗力系数，查表 6—2 确定
B——填塞系数，查表 6—3 确定
R——破坏半径（米）

直列装药的药量按下式计算：

C = ABR²L

- 式中：C、A、B、R——意义同上
L——装药长度（米）

表 6—2 材料抗力系数 A 值

材 料 名 称	系数 A 值
石灰砂浆砌的砖墙：	
不坚固的	0.77
坚固的	1.08
水泥砂浆砌的砖墙	1.24
料石砌的墙	1.45
混凝土	1.80
钢筋混凝土(只炸散混凝土不需炸断钢筋时)	5.00

说明：1.表中系数值是指中级炸药而言。低级炸药只用作内部装药，如用于外部爆破应按计算药量增加 50%。
2.坚硬的材料有裂缝时，系数值减小一半。

Short preparation time and high explosive charge required; when blasting with internal charges, a substitute chamber must be opened on the target, resulting in a longer preparation time but requiring less explosive.

When blasting brick, stone, concrete, and reinforced concrete structures, group charging is typically used. When the target thickness is not large, line charging may be used. To limit the dispersion of fragments, hole blasting may sometimes be employed. The charge should be backfilled as much as possible with soil, sand, or similar materials.

The amount of charge for group charges is calculated according to the following formula:

- In which: C- Intermediate Explosive Charge (kg)
1. Material resistance coefficient, determine from Table 6-2
—Compaction coefficient, determine from Table 6-3
—Destruction Radius (meters)

直列装药的药量按下式计算：
The charge of a parallel cartridge is calculated according to the formula ch.com

STTEABRL

In which: C, A, B, R - same meaning as above

L——Length of charge (meters)

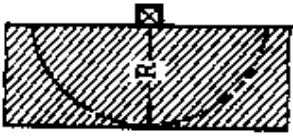
Material resistance coefficient A value

Brick walls made of lime mortar: not sturdy	
Brick walls made of cement mortar	
walls made of ashlar masonry	
Reinforced concrete (only when the concrete is shattered but the steel bars are not broken)	

说明：1.表中系数值是指中级炸药而言。低级炸药只用作内部装药，如用于外部爆破应按计算药量增加 50%。
Note: Coefficient values in the main table refer to medium-grade explosives. Low-grade explosives are used only for internal charges, such as

- External blasting shall increase the calculated charge by 50%.
2. When hard materials have cracks, the coefficient value is reduced by half.

表 6—3 填塞系数 B 值

装 药 的 配 置	填 塞 系 数 B	
	无填塞物	有填塞物(土壤)
1. 在表面上(外部装药) 	9.0	5.0(爆破钢筋混凝土时 6.5)
2. 在药盒中 	6.0	4.5
3. 在爆破目标 1/3 厚度的药洞中 	1.7	1.5
4. 在爆破目标的中央 	1.3	1.15
5. 在桥台、挡土墙土壤中 	1.7	1.5

Fill in the coefficient
B value table 6—3

Configuration of the charge	B Packing Factor	
	There is a plug (soil))	
1. On the surface (external charge)	9.0	5.0 (6.5 when blasting reinforced concrete)
2. In the medicine box	6.0	4.5
3. In the blast hole with a charge depth of 1/3 of the target thickness	1.7	1.5
4. In the center of the blasting target	1.3	1.15
5. In the soil of abutments and retaining walls NA	1.7	1.5

第一百一十四条 爆破墙壁通常采用集团装药或直列装药。装药量按第一百一十三条公式计算。

(一) 用集团装药爆破墙壁：装药成一行配置，装药间距为破坏半径的2倍。为减少装药个数，爆破部位应选在窗台以上。使用外部装药爆破时，破坏半径等于墙壁厚；装药设置于墙壁中央时，破坏半径等于墙壁厚度的1/2（图6—16（一））。

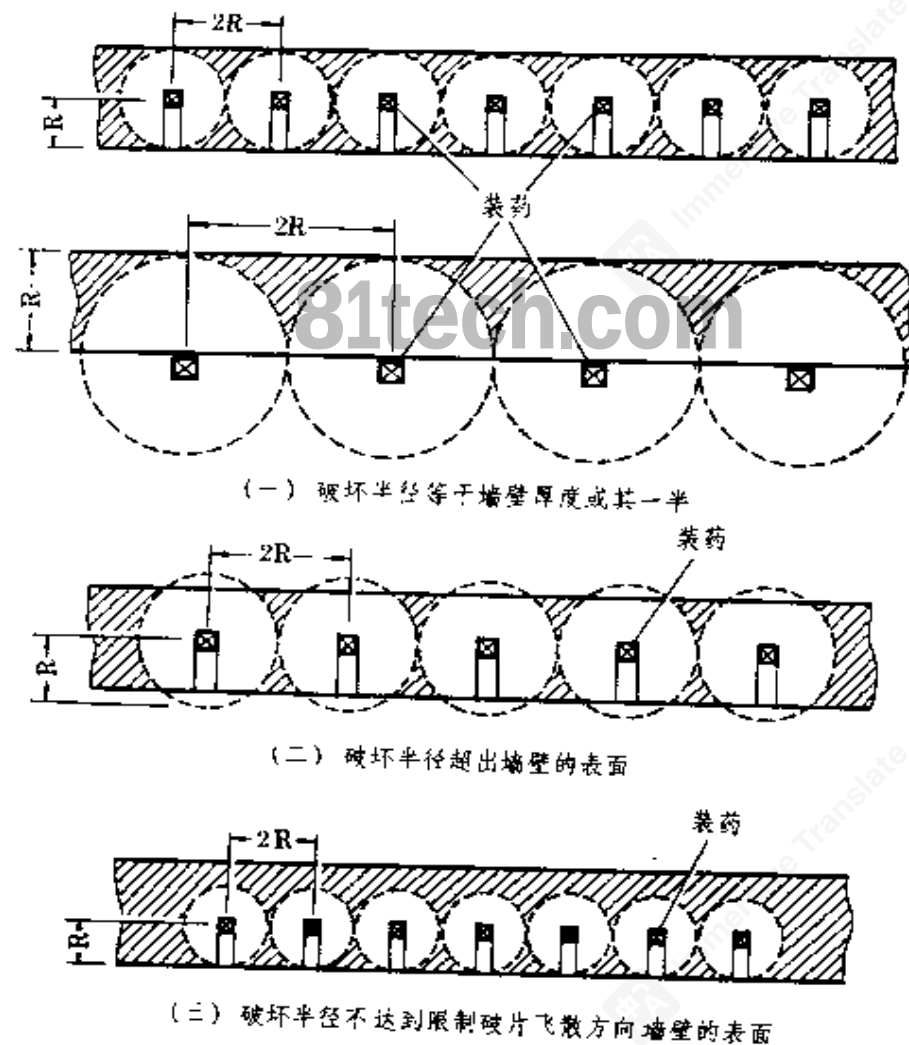


图 6—16 爆破墙壁的装药配置

Article 114. Blast walls are usually loaded with concentrated charges or straight-line charges, and the charge quantity shall be calculated in accordance with the formula specified in Article 113.

(一) Use group-charged blasting on wall sections: arrange charges in rows with a spacing equal to twice the charge interval of the main charge. To reduce the number of charges, select the blasting location above the window sill. When blasting with partial charges, the radius of destruction equals the wall thickness; when blasting with full charges, the radius of destruction equals one-half the wall thickness (Figure 6-16(-)).

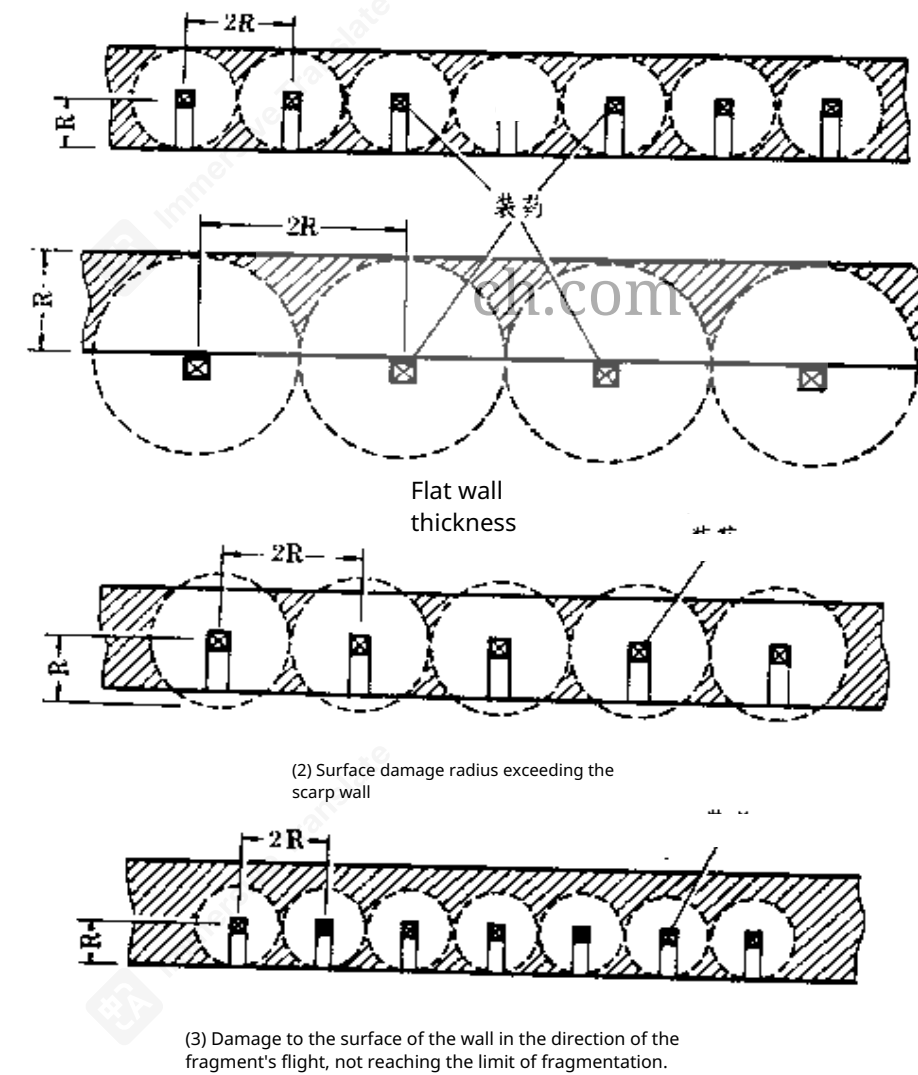


Figure 6-16: Charge configuration for blasting a wall

为加快作业速度，减少装药个数，可增大破坏半径配置装药（图 6—16（二））。

如果需限制破片飞散的方向，装药应偏向破片飞散方向的墙面，且其破坏半径不应达到另一方向的墙面（图 6—16（三））。

（二）用直列装药爆破墙壁：墙壁厚度不大时，可采用直列装药爆破，破坏半径等于墙壁厚度，装药长度等于爆破部位的断面宽。

（三）用穿孔爆破法爆破墙壁（图 6—17）：药孔通常不少于两列；每一药孔的长度为墙厚的 $\frac{2}{3}$ 。孔深的 $\frac{2}{3}$ 装药，靠近孔口的 $\frac{1}{3}$ 填塞。药孔间距、列距均取墙厚的 $1 \sim 1.5$ 倍。如须防止破片飞散，可在装药位置覆盖木板、钢板或土袋、草袋等。也可在距装药不近于 $2 \sim 3$ 米处设置护板。

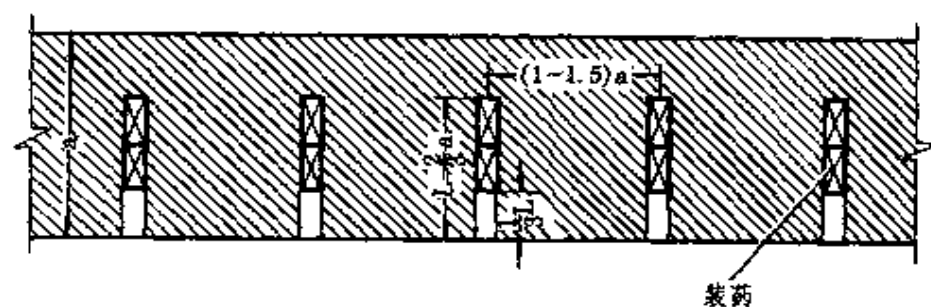


图 6—17 用穿孔爆破法炸毁墙壁

第一百一十五条 爆破砖、石、混凝土梁（柱）时，通常采用外部集团装药；当目标厚度不大时，也可采用直列装药；条件允许时也可采用穿孔法爆破。爆破单根砖、石、混凝土和钢筋混凝土梁（柱）时，通常采用外部集团装药即可；装药配置在梁（柱）截面的长边面，装药的破坏半径取梁柱的截面短边长，其破坏半径应完全包括整个断面，否则应增加装药个数或采用直列装药。装药量按第一百一十三条公式计算。

爆破钢筋混凝土梁（柱）时按上式计算出的装药量只能炸散

To accelerate the rate of operation, reduce the number of charges, and increase the radius of destruction, charges are configured (Figure 6--16(2)).

If it is necessary to restrict the direction in which fragments scatter, the charge should be biased toward the wall in the direction of fragment scattering.

face, its damage to the flat shall not reach the wall in another direction (Fig. 6-16 (3)).

(2) Blasting walls with parallel charges: When wall thickness is small, parallel charges may be used; the radius of destruction equals the wall thickness, and the charge length equals the width of the blast section.

(3) Blast walls using the perforated blasting method (Figure 6-17): The number of drug holes is usually not less than two rows; the length of each drug hole is $\frac{2}{3}$ of the wall thickness. $\frac{2}{3}$ of the hole depth is loaded with explosives, and $\frac{1}{3}$ near the hole mouth is packed. The spacing between drug holes and between rows is taken as 1.5 times the wall thickness. If it is necessary to prevent fragments from flying, wooden boards, steel plates, sandbags, or straw bags can be placed over the drug loading position. A protective plate can also be installed at a distance of not less than 2-3 meters from the drug loading position.

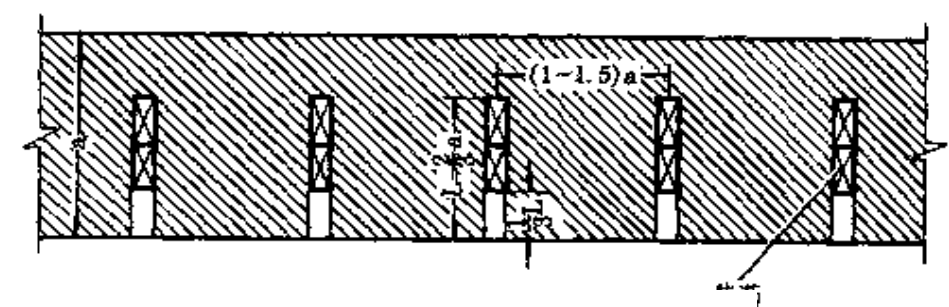


Figure 617: Destroying a wall using percussion blasting.

Article 115 When blasting bricks, stone, concrete beams (columns), external group charging is usually adopted; when the target thickness is not large, line charging may also be used; when conditions permit, hole blasting may also be adopted. When blasting single bricks, stone, concrete, and reinforced concrete beams (columns), external group charging is typically sufficient; the charge configuration should be on the long edge face of the beam (column) cross-section, the destructive radius of the charge should be taken as the short edge length of the beam (column) cross-section, and the destructive radius should completely cover the entire cross-section; otherwise, the number of charges should be increased or line charging should be adopted. The charge quantity shall be calculated according to the formula in Article 111.

When blasting reinforced concrete beams (columns), the charge wall calculated by the above formula can only scatter the structure.

混凝土上，不能炸断钢筋（图 6—18）；如果需要在炸散混凝土的同时炸断钢筋，其装药量按每平方厘米炸断面积需中级炸药 25 ~ 50 克计算，即 $C = (25 \sim 50) F$ 。设置装药时应将所计算出的药量等分成两部分，上下错开配置于目标的相对两侧（图 6—19）并同时起爆。

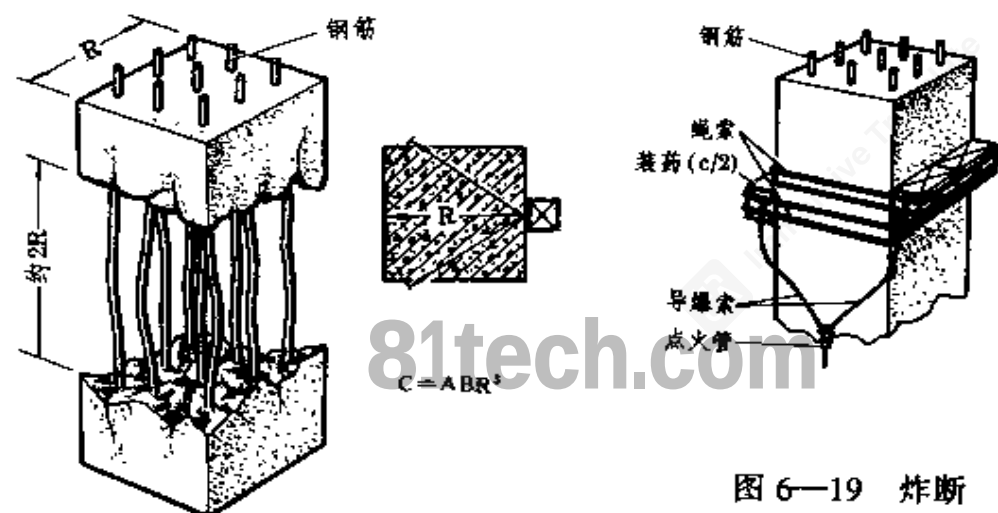


图 6—18

只炸断混凝土不炸断钢筋

当混凝土和钢筋可以分别爆破时，可采用两次爆破法（图 6—20），以节省炸药。第一次的装药量按 $C = ABR^3$ 计算，炸散混凝土。第二次的装药量按 $C = (25 \sim 50) F$ 计算，炸断钢筋；其横断面积，按含有钢筋的断面部分计算。

对于工事侧墙（图 6—21）一类的目标，按 $C = ABR^3$ 计算出的装药量不能将其炸穿。此时，要炸散混凝土，装药必须增加 1 ~ 2 倍，即 $C = (2 \sim 3) ABR^3$ 。

第一百一十六条 爆破房屋通常采用集团装药。可通过炸毁墙壁破坏房屋（图 6—22），也可直接将装药设置于房屋内部爆破。

In the concrete, do not break the steel bars (Fig. 6-18): If it is necessary to break the steel bars while blasting the concrete, the charge quantity shall be calculated as 25~ 50 grams of medium-strength explosive per square centimeter of the area to be broken, i.e., $C = (25 \sim 50)F$. When setting the charge, divide the calculated quantity into two equal parts, stagger them vertically on opposite sides of the target (Fig. 6-19), and detonate them simultaneously.

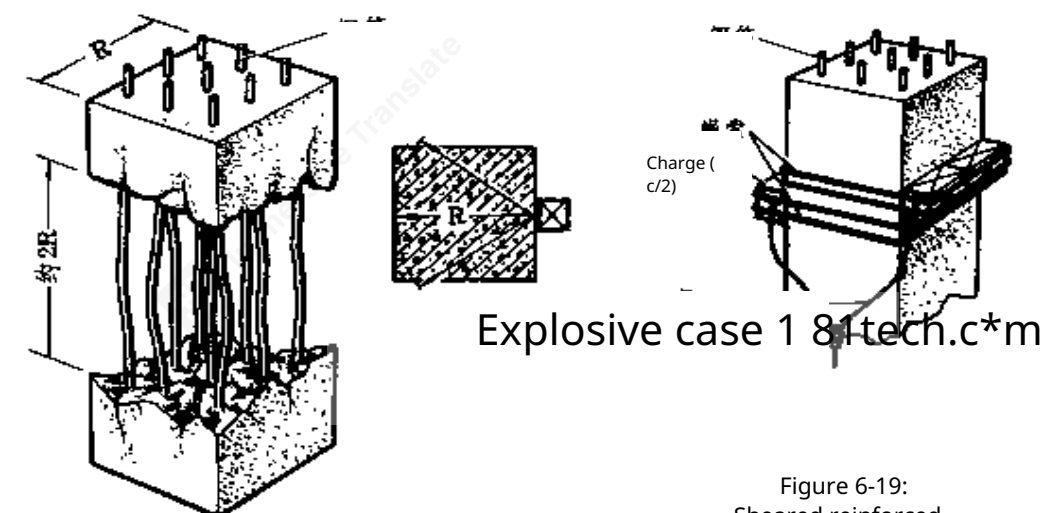


Figure 6-18

Only shatter the concrete, not the rebar.

Figure 6-19:
Sheared reinforced
concrete straight
column

When concrete and reinforcement bars can be detonated separately, the two-stage blasting method (Fig. 6--20) can be used to save explosives. The charge for the first stage is calculated according to $C=ABR^3$ to disperse the concrete. The charge for the second stage is calculated according to $C=(25 \sim 50)F$ to break the reinforcement bars; its cross-sectional area

Calculate based on the cross-section containing steel reinforcement.

For targets such as construction walls (Fig. 6-21), the charge quantity calculated by $C=ABR^3$ is insufficient to penetrate them. In this case, to disperse the concrete, the charge must be increased by a factor of 1 ~ 2, that is, $C=(2 \sim 3)ABR^3$.

Article 116. Demolition of buildings is usually carried out by group charging. The building may be destroyed by blowing up the walls (Fig. 6-22).

You can also set the charge inside the building and detonate it.

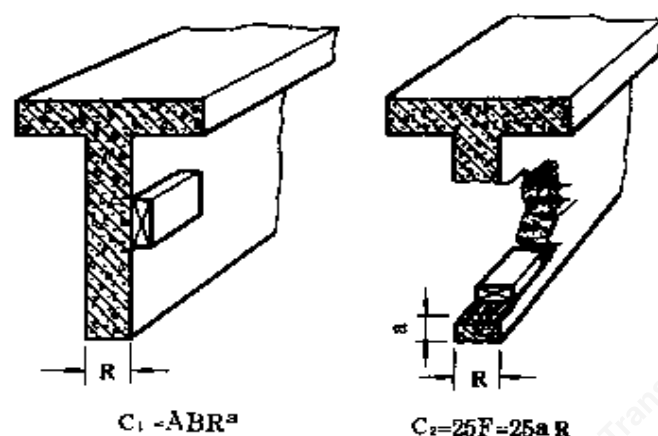


图 6—20 用两次爆破法炸钢筋混凝土梁

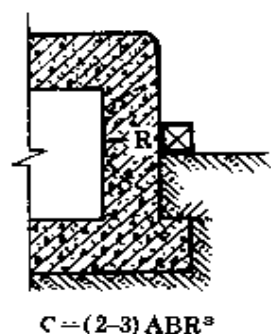


图 6—21 爆破钢筋混凝土工事侧墙

炸毁墙壁破坏房屋时，装药通常配置在第一层楼的门窗之间的墙壁上，与窗台同在一个水平面上。

用大集团装药爆破房屋时，装药应设置于房屋内部（图 6—23）；墙厚 0.5~2.0 米的房屋，通常按内部容积每立方米需中级炸药 0.1~0.6 千克计算。爆破有地下室的房屋，装药应设置于地下室内，药量按地下室容积每立方米需中级炸药 1 千克计算。爆破前须用木板、土袋

堵塞所有门窗。

第一百一十七条 爆破水塔，可将其彻底炸毁，也可实施局部破坏，使其短期内不能使用。

彻底破坏水塔时，对砖砌圆筒形水塔，可采用非接触爆破，将集团装药设置于水塔内部地面中央，门窗用砖或土（砂）袋封闭；药量按水塔下层容积计算，每立方米需中级炸药 1 千克（低级炸药增加 50%）。

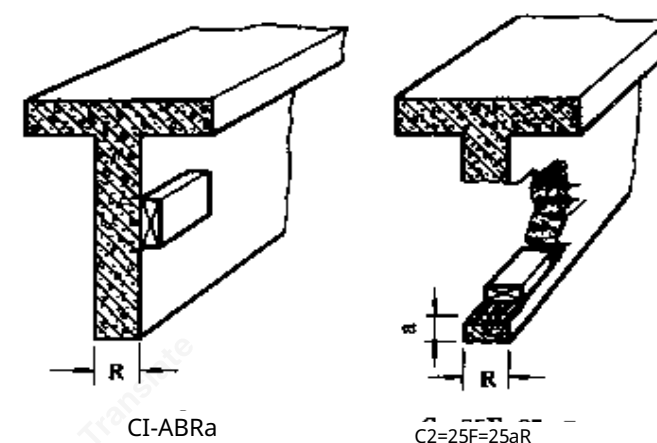


Figure 6-20: Breaking reinforced concrete beams using two blasting methods

When destroying walls and damaging buildings, place the explosive charge on the wall B1te
常配置在第一层楼的门窗之间的墙 at the same horizontal level as the window sill.

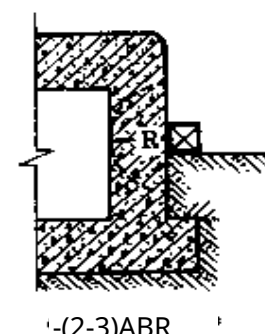


Figure 6-21 Blasting Reinforced Concrete Lateral Wall

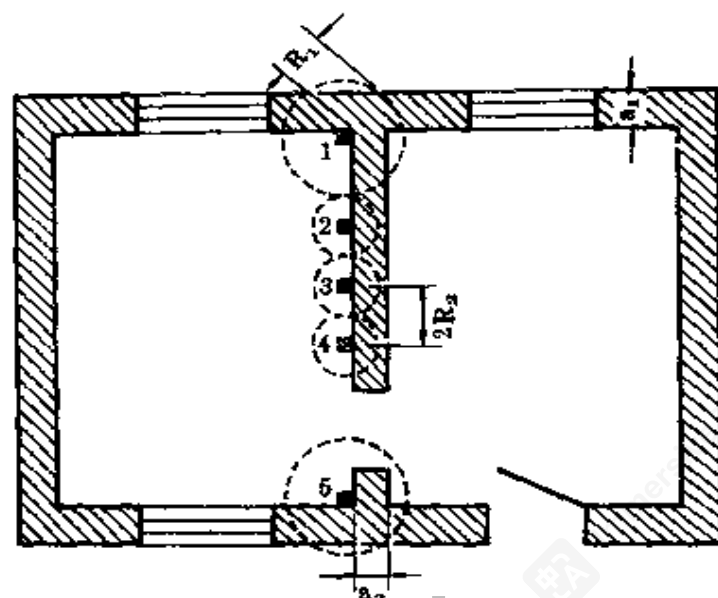
When using large charges to blast houses, the charges should be placed inside the house (Fig. 6-23): For houses with wall thickness of 0.5~2.0 meters, the medium explosive is typically calculated at 0.1~0.6 kg per cubic meter of internal volume. For houses with basements, blasting is...

Rooms: The charge should be placed in the basement, with the quantity calculated as 1 kg of medium-grade explosive per cubic meter of basement volume. Before blasting, wooden boards and earthbags must be used

Block all doors and windows.

Article 117: Demolishing a water tower may result in its complete destruction or partial damage, rendering it unusable for a short period.

When completely destroying a water tower, for brick cylindrical water towers, non-contact blasting can be used, with the group charge placed at the center of the ground inside the water tower; windows and doors should be sealed with bricks or earth (sand) bags; the charge quantity is calculated based on the lower volume of the water tower, requiring 1 kg of medium-grade explosive per cubic meter (increase by 50% for low-grade explosive).



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图 6—22 炸毁房屋的主要隔墙

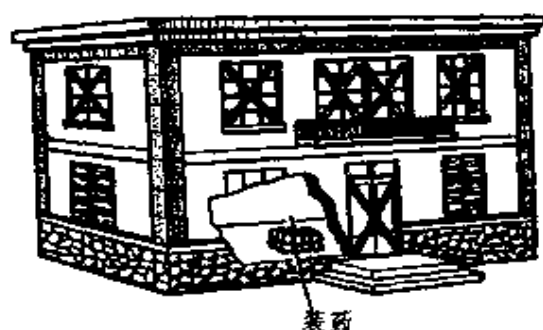
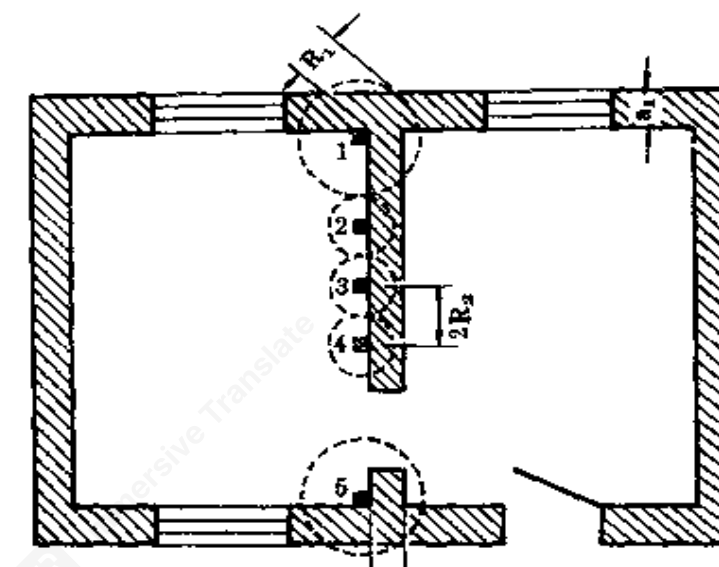


图 6—23 用大集团装药爆破房屋

局部破坏水塔时，可将 1.2 千克的梯恩梯装药设置在水箱的底部或水箱的外部爆破。另将 0.2 ~ 0.4 千克的梯恩梯装药设置在进水管上或闸阀上爆破（图 6—24）。

彻底炸毁钢筋混凝土支架水塔，按爆破钢筋混凝土柱的方



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Figure 6-22 Main load-bearing walls of the destroyed house

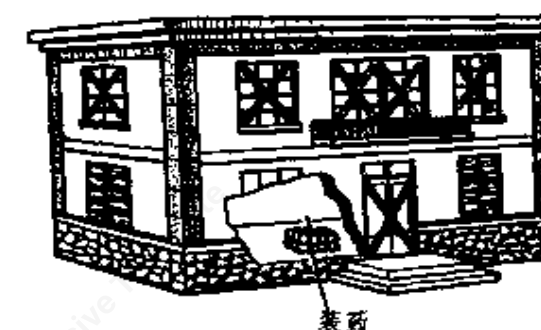


Figure 6-23 Blasting a house with a large charge

When locally destroying a water tower, 1.2 kg of TNT can be placed at the bottom of the tank or used for external blasting of the tank. Additionally, 0.2 ~ 0.4 kg of TNT charges should be placed on the inlet pipe or gate valve for blasting (Fig. 6-24).

Completely demolish the reinforced concrete water tower support structure, following the method for blasting reinforced concrete columns.

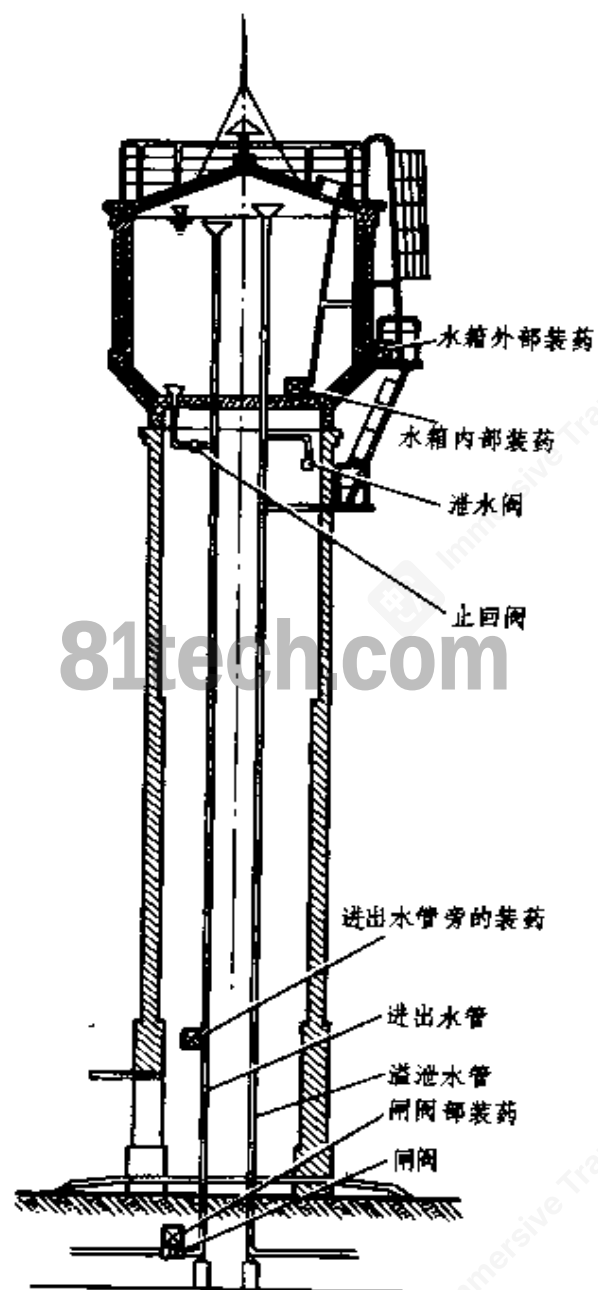
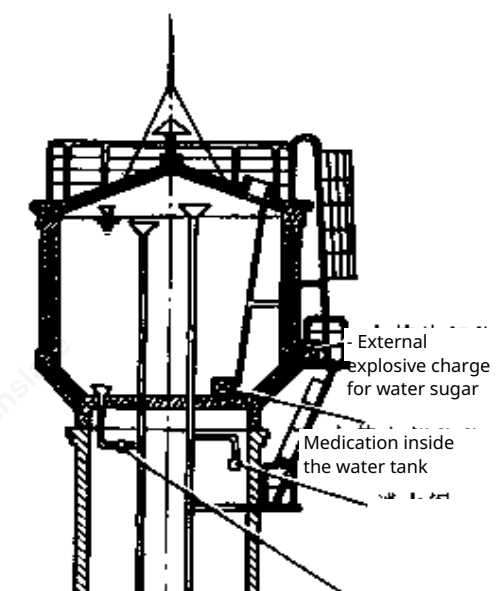


图 6—24 砖砌水塔的爆破

法，炸毁所有支柱。

第一百一十八条 爆破砖砌烟囱并使其倒塌时，应将装药紧



Loading of explosives near the water inlet and outlet
Water inlet and outlet pipe Overflow pipe South section
loading Same valve T



Figure 6-24 Blasting of a brick water tower

Destroy all pillars.

Article 118 When blasting brick chimneys and causing them to collapse, the charge shall be tightly...

靠烟囱内壁平均配置，并加以填塞。烟囱下部所有开口部分均应堵塞，药量按烟囱底部面积每平方米需中级炸药 4.5 千克计算。

欲使烟囱向一侧倒塌时，应将装药设置在预定倒塌方向的药洞内；药洞沿烟囱外壁的半周开设，深度为壁厚的 $2/3$ （图 6—25）。装药量按第一百一十三条公式计算。预定倒塌方向上的装药破坏半径应为壁厚的 $3/4$ ；其他方向上的装药破坏半径应为壁厚的 $1/2$ 。装药的间距为破坏半径的 1.75 倍，沿烟囱的外表面量取。

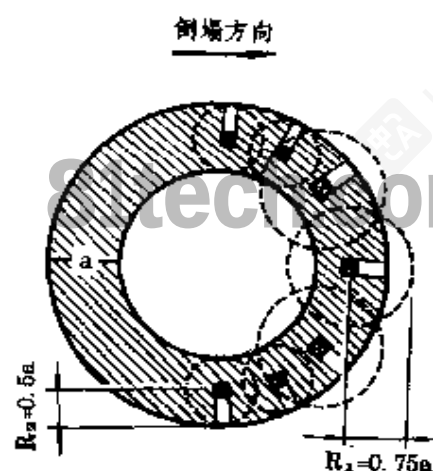


图 6—25 炸倒烟囱时装药的配置

爆破钢筋混凝土烟囱，用直列装药设置于烟囱的内部或外部，沿烟囱壁的 $1/2 \sim 2/3$ 周设置。装药量按 $C = (25 \sim 50) F$ 计算。装药设置在预定倒塌的方向上。

爆破金属烟囱，按爆破钢管的方法实施，装药设置在预定倒塌的方向上，同时将另一方向上的控制钢索炸断。

Average lining of the flue inner wall, and then packed. All openings in the lower part of the flue shall be blocked; the amount of explosive shall be calculated as 4.5 kg of medium-grade explosive per square meter of the flue bottom area.

To ensure the smoke screen collapses to one side, the charge should be placed approximately inside the hole in the direction of the intended collapse; the charge hole is excavated along half the circumference of the outer wall of the smoke screen, with a depth of $2/3$ of the wall thickness (Figure 6-25). The charge quantity shall be calculated according to the formula in Article 113. The charge destruction radius in the direction of the intended collapse shall be $3/4$ of the wall thickness; the charge destruction radius in other directions shall be $1/2$ of the wall thickness. The spacing of the charges shall be 1.75 times the destruction radius, measured along the outer surface of the smoke screen.

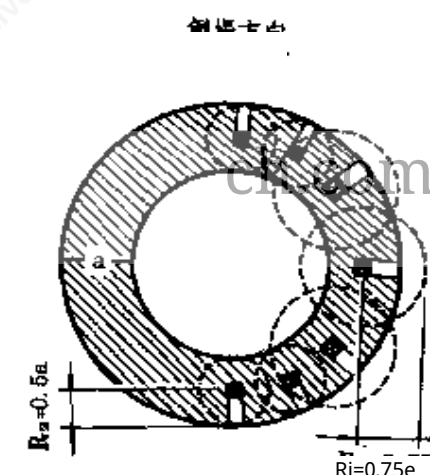


Figure 625: Configuration of the meat-shaped explosive charge

Blow up reinforced concrete smoke windows using parallel charges placed inside or outside the window, arranged along $1/2 \sim 2/3$ of the window wall circumference. The charge quantity is calculated according to $C = (25 \sim 50)F$. The charges are positioned in the direction of the intended collapse.

Blow up metal smoke chart, implement according to the method of blowing up steel pipes, set the charge in the predetermined collapse direction, and at the same time blow up the control cable in the other direction.

第七章 桥梁爆破

第一百一十九条 战时对桥梁实施破坏可以迅速构成障碍，阻止或迟滞敌人行动。局部破坏时，可炸毁河流航道上的桥脚和上部结构，或只炸毁数个跨径的上部结构；彻底破坏时，则炸毁全部或大部跨径的桥脚和上部结构。

第一节 钢筋混凝土梁桥的爆破

第一百二十条 爆破桥墩，可根据情况采用外部集团装药、直列装药或内部装药。

(一) 用集团装药爆破桥墩，应根据允许的作业时间和桥墩结构类型采取相应的方法。

1. 时间充裕时，可在水面以上 0.5 米处开设药洞（图 7—1）或药龛（图 7—2）；也可直接使用外部装药。装药量按 $C = 1.3ABR^3$ 计算。药室和药洞内装药的破坏半径等于装药中心至桥墩外表面的距离，外部装药和药龛内装药的破坏半径等于桥墩的厚度。装药间距等于破坏半径的 2 倍，装药个数等于桥墩宽除以装药间距。

爆破较高桥墩时，装药应成倾斜配置，其倾斜角为 $30^\circ \sim 45^\circ$ （图 7—3），以使上部结构向一侧倒塌，防止敌人利用原桥墩。

爆破较矮桥墩时，应将装药配置在桥轴线的一侧，破坏半径应大于桥墩宽度的 $1/2$ （图 7—4）。

2. 时间仓促时，可在水面下接近基础处或水面上 0.5 ~ 1 米处紧贴桥墩设置外部集团装药。装药可用木棍支撑或绳索悬吊，

Chapter 7 Bridge Blasting

Article 119: Bombing bridges during war can quickly create obstacles, block mountain passes, or delay enemy movements. In partial destruction, bridge piers and one superstructure on river channels may be blown up, or only a few spans' superstructures may be destroyed; in total destruction, all or most spans' piers and superstructures may be destroyed.

Section 1: Blasting of Reinforced Concrete Beam Bridges OLECCO

Article 120: Blasting bridge piers may, depending on the situation, use external group charges, linear charges, or internal charges.

(-) When blasting bridge piers with group charges, appropriate methods should be adopted based on the allowable working time and the structural type of the pier.

1. When time is abundant, open the drug hole 0.5 meters above the water surface (Figure 7-1) or the drug (Figure 7-2); or directly use external loading. The charge quantity is calculated according to $C = 1.3ABR^3$. The destructive radius of the charge in the charge chamber and drug hole equals the distance from the center of the charge to the outer surface of the pier. The destructive radius of external loading and internal loading equals the thickness of the pier. The spacing between charges equals twice the destructive radius, and the number of charges equals the width of the pier divided by the charge spacing.

When blasting higher bridge piers, the charge should be arranged at an inclined (angle of $30^\circ \sim 45^\circ$ (Fig. 7-3) so that the superstructure collapses toward and to the side, preventing the enemy from using the original piers.

When blasting shorter bridge piers, the charge should be placed on one side of the bridge axis, with a blast radius greater than half the pier width (Figure 7-4).

2. When time is short, place external group charges tightly against the bridge pier at a depth of approximately 0.5 ~ 1 meters below the water surface or at the water surface. The charges may be supported by wooden sticks or suspended by ropes.

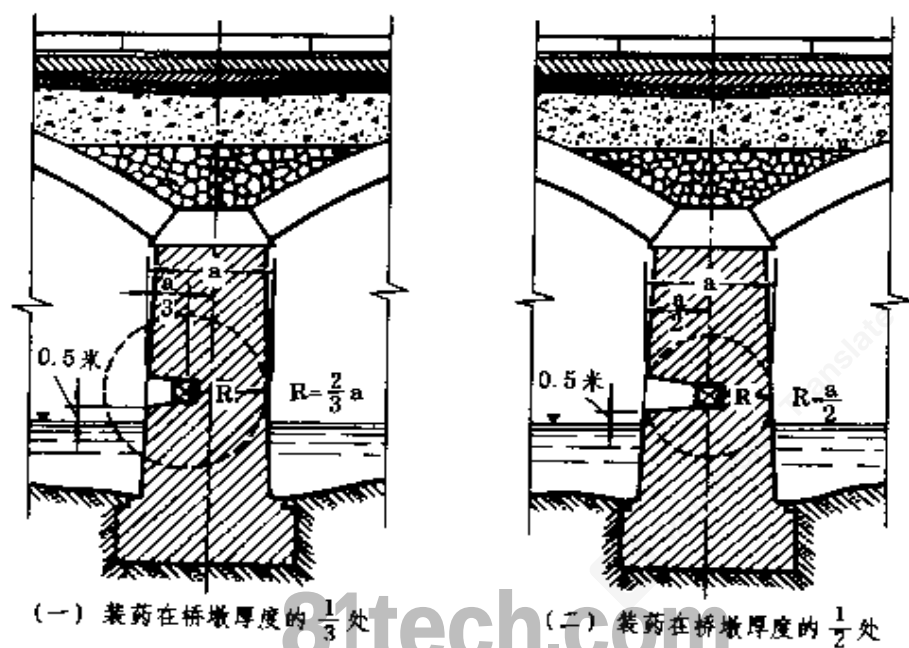


图 7—1 设置在药洞内的装药

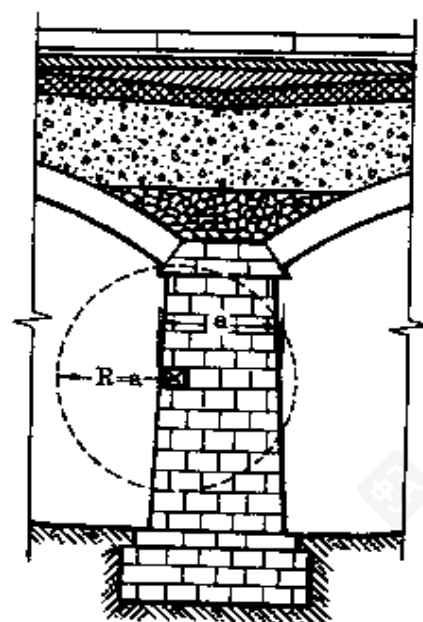
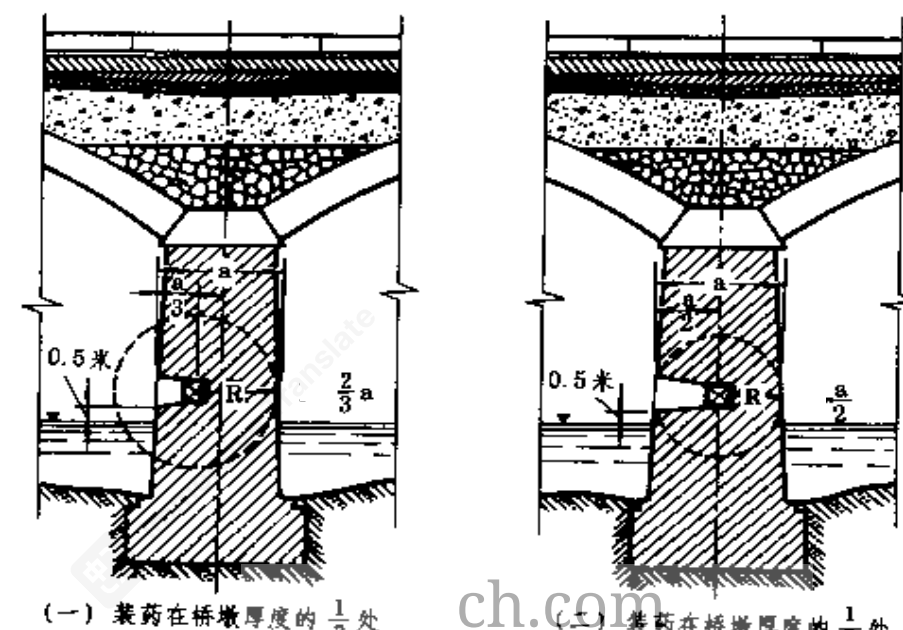


图 7—2 设置在药窠内的装药



(1) Drug at the bridge thickness special tech (already exceeded drug at the sample thickness death place)

Figure 7-1: Charge placement within the drug hole

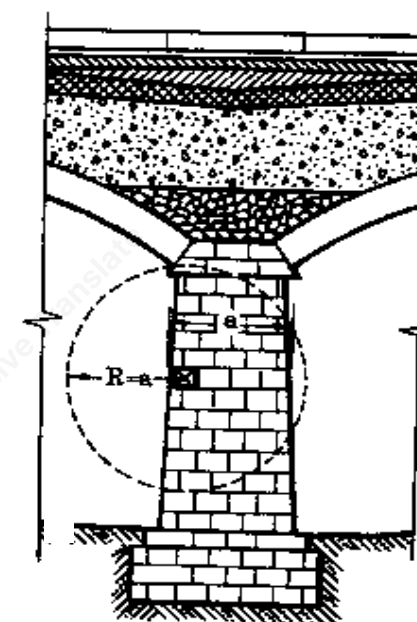


Figure 7-2: Ammunition placed inside the medicinal needle

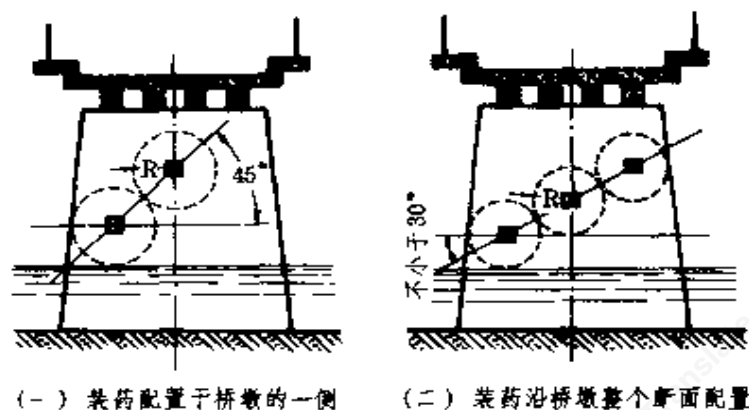


图 7—3 爆破高桥墩的装药配置

也可堆放在舟（筏）上。装药量按 $C = 1.3ABR^3$ 计算。破坏半径等于桥墩厚度，装药间距等于破坏半径的 2 倍，装药个数等于桥墩宽除以 2 倍破坏半径（图 7—5）。

3. 爆破 H 型或桩柱式钢筋混凝土桥墩时，应在预定倒塌方向的桩柱上设置两个装药，在另一根桩柱上设置 1 个装药（图 7—6）。如只炸散混凝土，则炸散的长度不小于破坏半径的 2 倍，以使钢筋暴露容易倒塌，装药量按 $C = 1.3ABR^3$ 计算；如需同时炸断钢筋，装药量按 $C = (25 \sim 50) F$ 计算；装药设置方法同第一百一十五条。

4. 有些桥梁在桥墩上设有预留药室，爆破时应充分利用。

(1) 用直列装药爆破桥墩，当桥墩厚度不超过 2 米时，可在桥墩靠近水面处开设药槽或紧贴桥墩设置直列装药爆破（图 7—7）。装药量按 $C = 1.3ABR^2L$ 计算。装药长度不小于桥墩宽

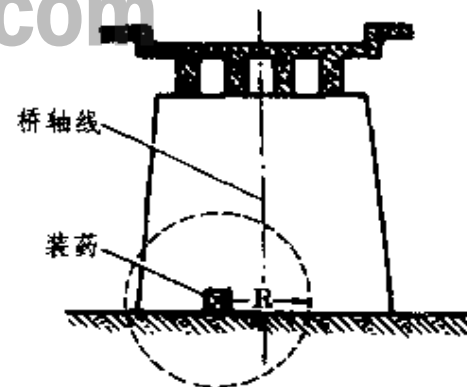


图 7—4 爆破矮桥墩的装药配置

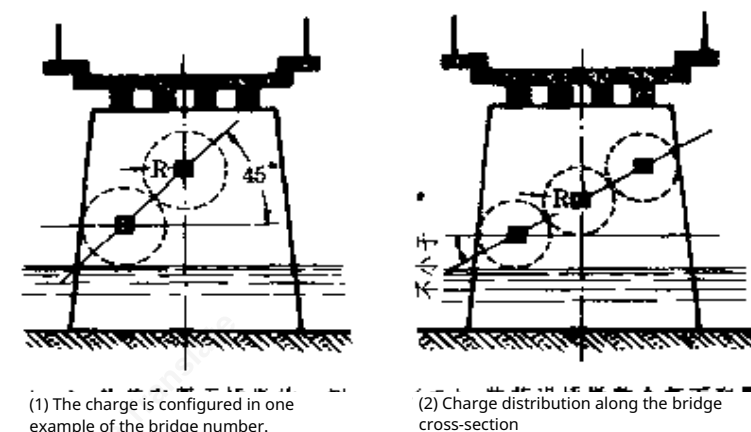


Figure 7-3: Charge configuration for blasting the young bridge piers

Also, the charges are stacked on the boat (on the bamboo). The charge quantity is calculated according to $C = 1.3ABR^3$. The destruction radius is equal to the pier thickness, the charge spacing is twice the destruction radius, and the number of charges equals the pier width divided by twice the destruction radius (Figure 7-5).

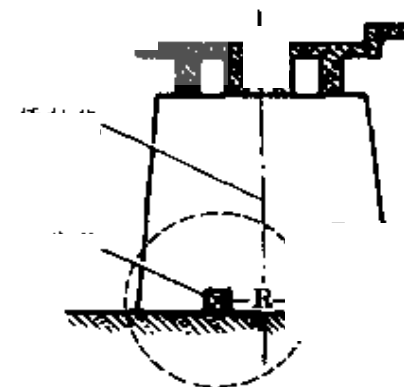


Figure 7-4: Charge configuration for blasting low piers

3, Blast H-beam or pile-type rebar

When the concrete bridge pier is about to collapse, it should be...

Two charges are set in the pile columns on the side, and in the other

.One explosive charge is installed on a peach column (Fig.

7-6). If only the concrete is to be broken up, then break up

The length is not less than twice the blast radius, to make it easy for the steel bars to be exposed and collapse, and the charge amount

Calculate according to $C = 1.3ABR^3$; if required to simultaneously blast through the steel bars, the charge quantity shall be calculated according to $C = (25 \sim$

50) F calculation; the method for setting the charge is the same as that specified in Article 115.

4. Some bridges have pre-excavated chambers on the piers; these should be fully utilized during blasting. When blasting piers with linear charges, if the pier thickness does not exceed 2 meters, a charge groove may be cut near the water surface on the pier, or a linear charge may be placed directly against the pier (Fig. 7-7). The charge quantity shall be calculated according to $C = 1.3ABR^2L$. The charge length shall not be less than the pier width.

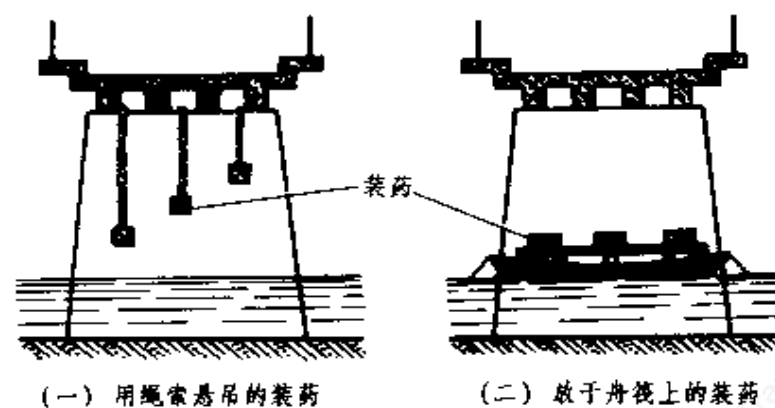


图 7—5 用外部集团装药爆破桥墩

度的 $1/2$ ，破坏半径等于桥墩厚度。

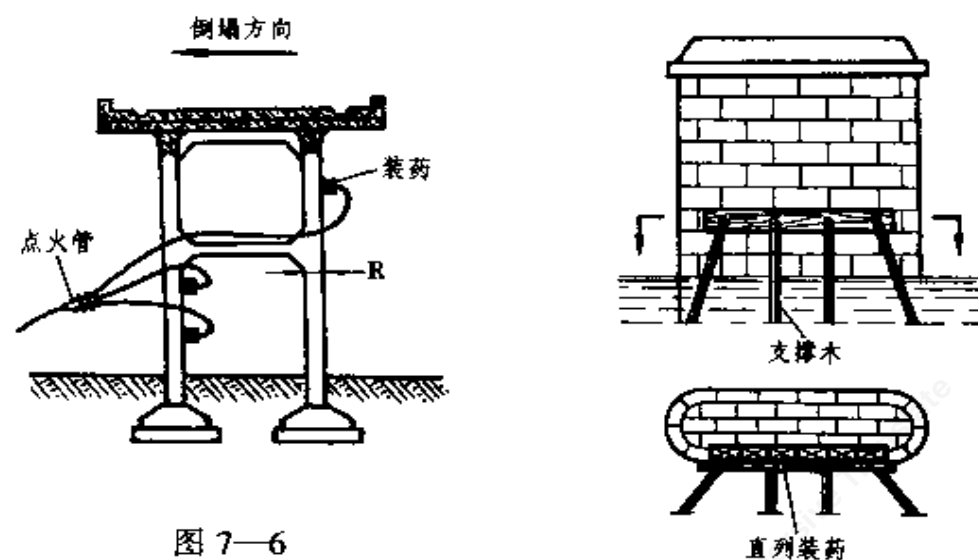


图 7—6

爆破 H 型桥墩的装药配置

图 7—7 设置于药槽内的装药

第一百二十一条 爆破桥台一般应采用内部集团装药。装药设置在路基与桥台结合部开设的垂坑内 (图 7—8 (一))，或在靠近水面开设的平洞内 (图 7—8 (二))。垂坑深度应大于桥台

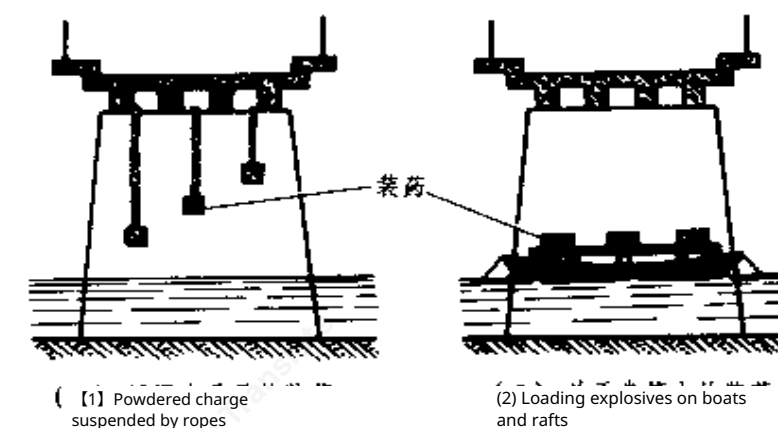
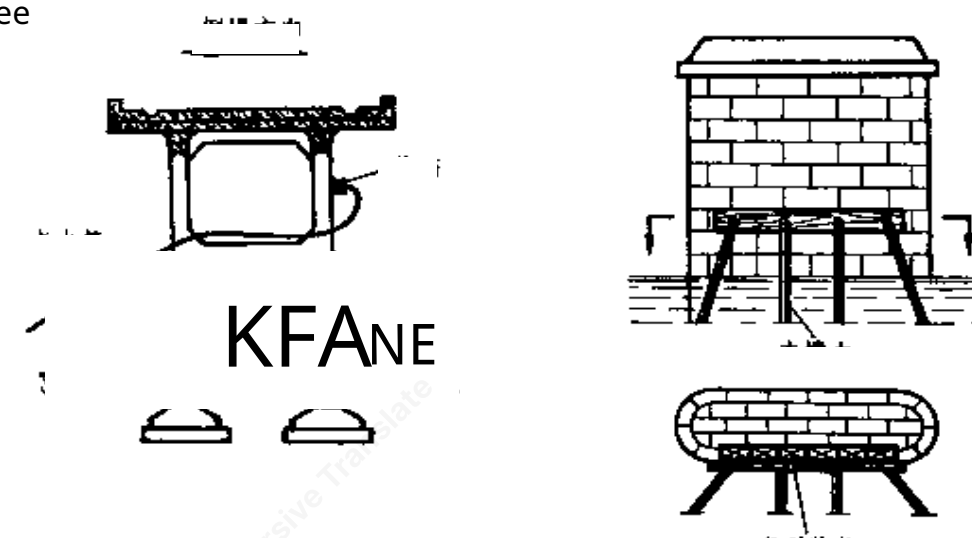


Figure 7-5: Blasting bridge piers with external group charges

$1/2$ of a degree

Radius of curvature and other soil parameters: h



Charge configuration for blasting H-shaped bridge abutments

Setting of the drug in the drug trough, Figure 77

Article 120. Blasting of bridge abutments should generally be carried out with internal group charges. The charges are placed in vertical shafts excavated at the junction of the roadbed and the bridge abutment (Fig. 7-8(1)), or in horizontal tunnels excavated near the water surface (Fig. 7-8(2)). The depth of the vertical shafts should be greater than the height of the bridge abutment.

厚度，平洞深度不小于桥台厚度的 $\frac{2}{3}$ 。装药量按 $C = 1.3ABR^3$ 计算。破坏半径取桥台厚度，装药间距等于破坏半径的 1.5 倍；两侧装药与桥台两端的距离为破坏半径的 $\frac{3}{4}$ 。

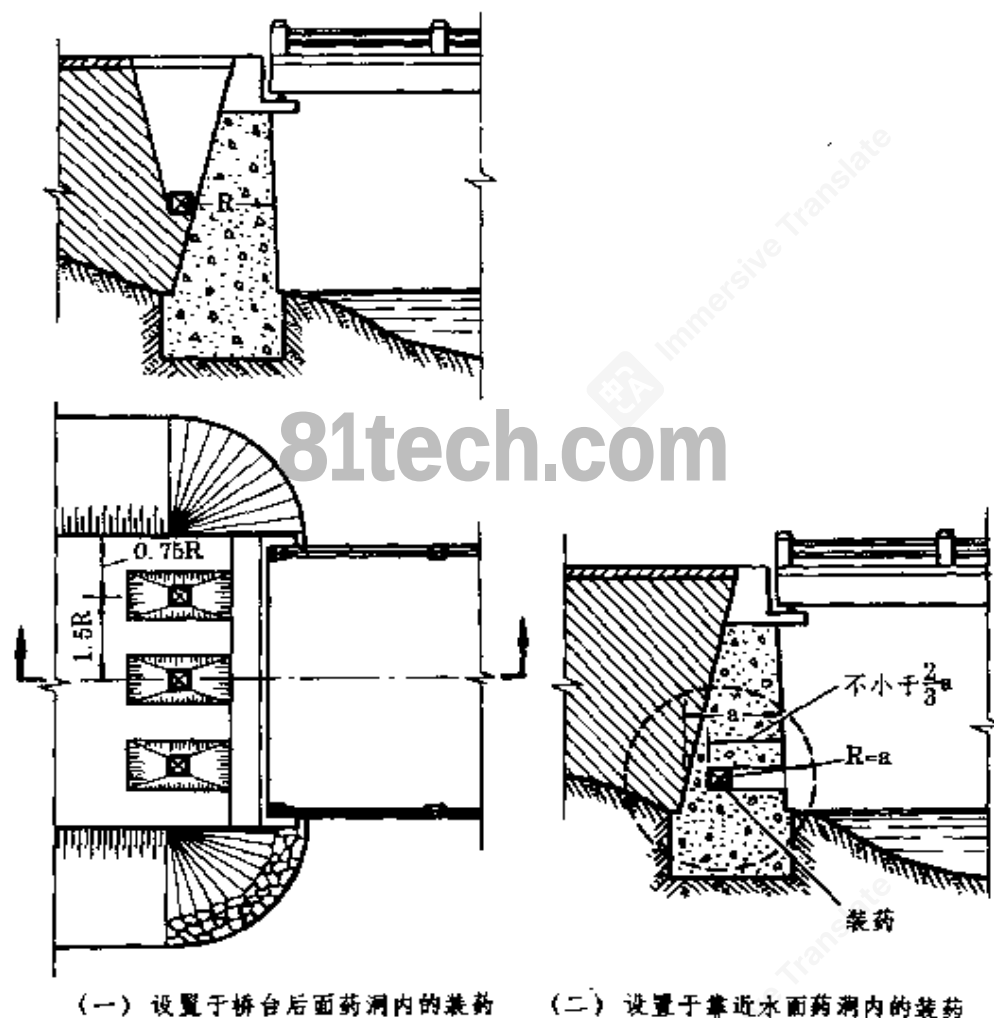


图 7—8 用集团装药爆破桥台

当桥台较高时，装药应成倾斜配置，其倾斜角为 $30^\circ \sim 50^\circ$ 。如果桥台上留有预留药室，爆破时应充分利用。

第一百二十二条 爆破上部结构，可采用外部集团装药或直列装药，装药应设置在炸断线上。

Thickness, the tunnel depth shall not be less than $\frac{2}{3}$ of the abutment thickness. The charge quantity shall be calculated according to $C=1.3ABR^3$. The radius of destruction shall be taken as the abutment thickness, and the spacing between charges shall be 1.5 times the radius of destruction; the distance from the charges on both sides to the ends of the abutment shall be $\frac{3}{4}$ of the radius of destruction.

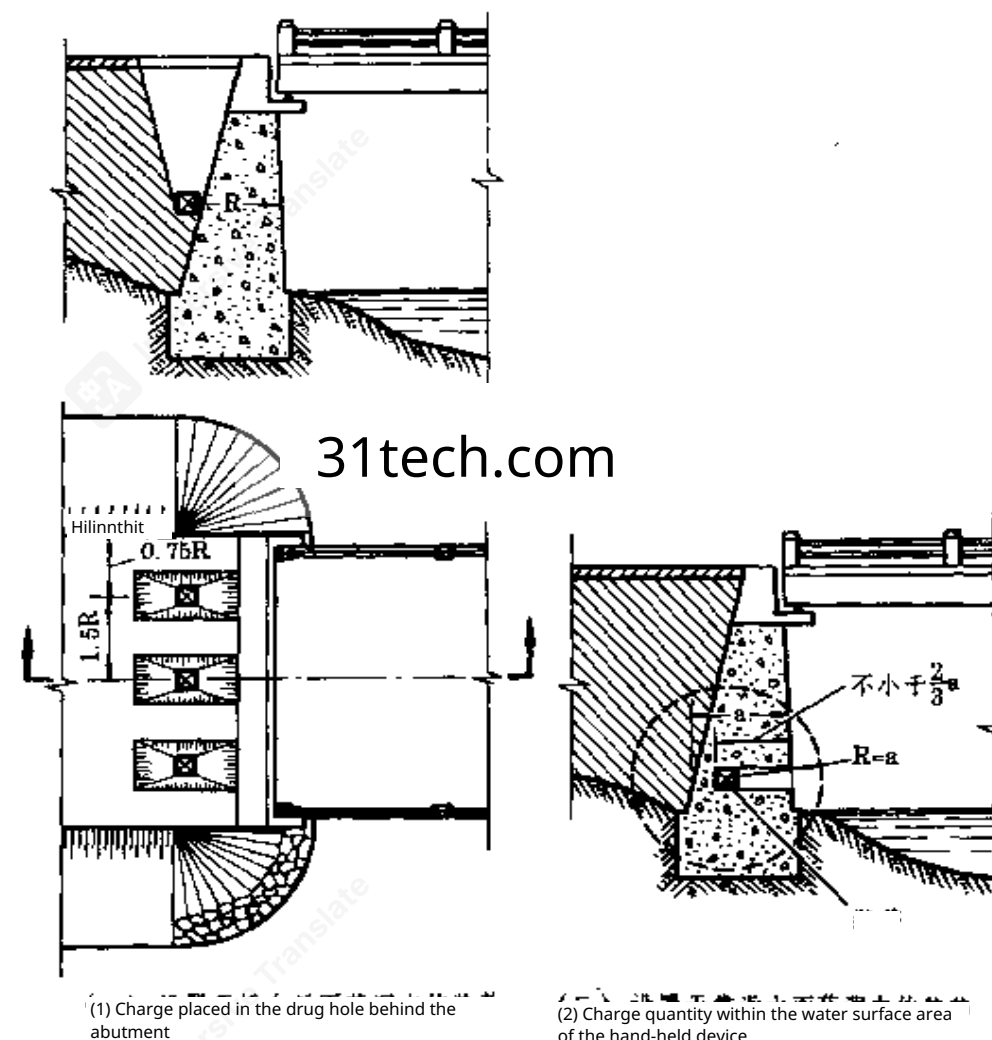


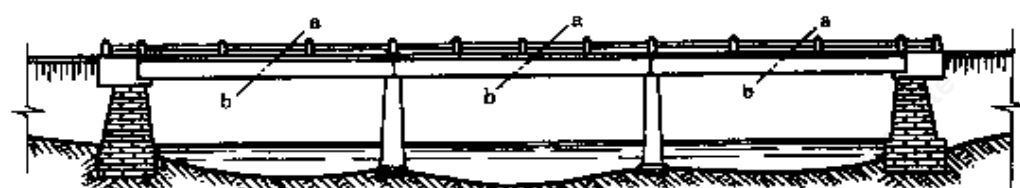
Figure 7-8: Group charge blasting of abutments

When the abutment is high, the charge should be arranged at an inclined angle of $30^\circ \sim 50^\circ$. If a pre-drilled charge chamber is provided on the abutment, it should be fully utilized during blasting.

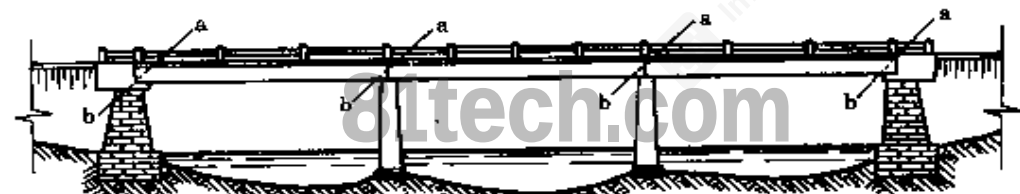
Article 122. For blasting the upper structure, external group charging or line charging may be adopted, and the charge shall be placed on the break line.

(一) 炸断线应根据桥梁上部结构类型选定。

1. 爆破简支梁桥时，炸断线常选在桥梁跨径的中央，也可选在桥墩上两跨径上部结构的结合部或桥台上主梁旁（图 7—9）。



(一) 炸断线(a-b)选在跨径中央



(二) 炸断线(a-b)选在结合部

图 7—9 简支梁桥的炸断线

2. 爆破悬臂梁桥（T 型刚构桥）时，炸断线应靠近桥台，有悬吊部分的跨径可不设置装药（图 7—10）。

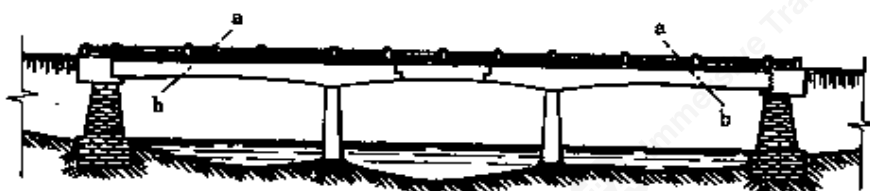
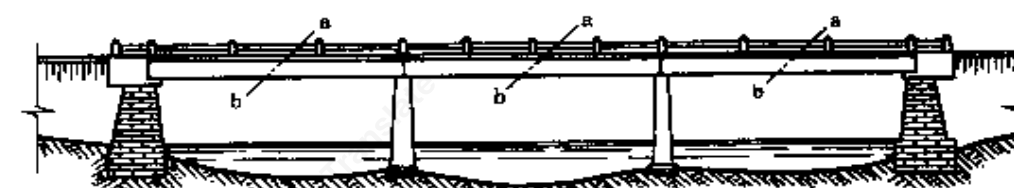


图 7—10 悬臂梁桥的炸断线

3. 爆破连续梁桥（连续刚构桥）时，每一跨径选一条炸断线，所有炸断线均应在各跨径的同一部位，并不得选在跨径的中

(1) The selection of the broken wire shall be determined according to the type of the superstructure of the bridge.

1. When blasting a simply supported beam bridge, the blast line is often selected at the center of the bridge span, or alternatively at the junction between the two spans of the pier structure or beside the main beam next to the abutment (Figure 7-9).



(1) Break the line (a-b) at the center of the span



(2) Fracture of the disturbed (self-b) selection at the junction.

Figure 7-9: Blast Failure Line of Simply Supported Beam Bridge

2 When blasting cantilever beam bridges (T-shaped rigid frame bridges), the detonation line should be close to the abutment. Spans with cantilevered sections may not require charge installation (Figure 7-10).

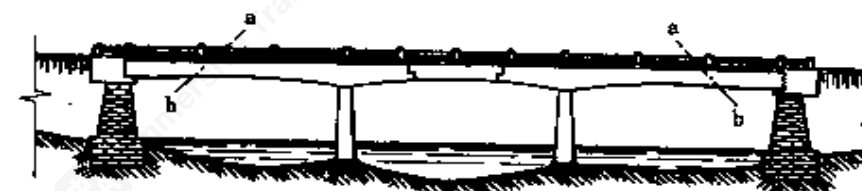


Figure 7-10: Blast fracture line of the suspended girder bridge

3. When blasting continuous beam bridges (continuous rigid-frame bridges), select one blast line per span; all blast lines must be located at the same position across all spans and must not be selected at the mid-span.

央 (图 7—11)。

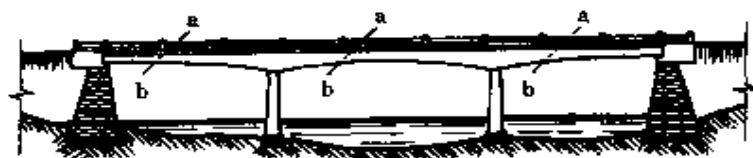


图 7—11 连续梁桥的炸断线

(二) 用集团装药爆破时, 应在每根主梁旁各设置 1 个集团装药 (图 7—12); 也可在桥面上对正每一根主梁设置 1 个集团装药 (图 7—13)。爆破简支梁和悬臂梁桥上部结构的装药量按第一百一十三条公式计算, 破坏半径等于主梁高度加桥板厚度; 爆破连续梁桥的上部结构应同时炸断钢筋, 装药量按 $C = (25 \sim 50) F$ 计算。

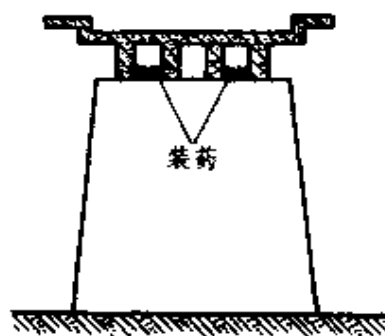


图 7—12 装药配置
在桥墩上紧靠每根主梁

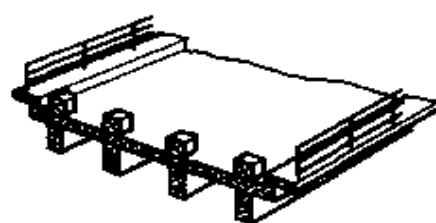


图 7—13 装药配置
在桥面上对正每根主梁

(三) 用直列装药爆破时, 装药沿桥面宽度和主梁高度设置。主梁下部钢筋粗面密, 应配置较多的炸药 (图 7—14)。装药量按第一百一十三条公式计算。

Central (Figures 7-11).

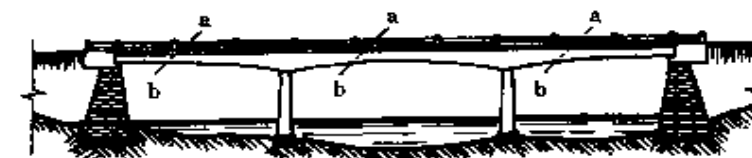


Figure 7-11: Blast fracture line of a continuous beam bridge

(2) When using group charging blasting, one group charge shall be set up beside each main girder (Fig. 7-12); alternatively, one group charge may be set up on the bridge deck aligned with each main girder (Fig. 7-13). The charge quantity for blasting simply supported and cantilever bridge superstructures shall be calculated according to the formula in Article 113, with the radius of destruction equal to the main girder height plus the bridge deck thickness; for the superstructure of continuous beam bridges, the reinforcement bars shall be simultaneously broken, and the charge quantity shall be calculated as $C = (25 \sim 50) F$.

Figure 7-12 Charge Configuration

Tighten against each main beam on the pier

Figure 7-13 Charge Configuration: Align each main girder on the bridge deck

(3) When using linear charge blasting, the charge is arranged along the bridge deck width and main beam height. Since the main beam's lower reinforcement has a rough surface and is dense, more explosives should be configured (Figure 7-14). The charge quantity shall be calculated according to the formula in Article 113.

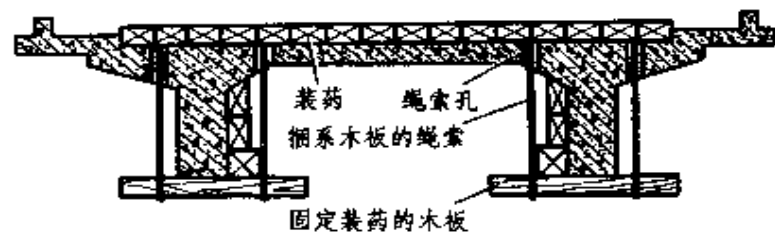


图 7—14 用直列装药爆破钢筋混凝土桥的上部结构

第二节 拱桥的爆破

第一百二十三条 爆破桥墩、桥台，其方法同第一百二十条、第一百二十一条。

第一百二十四条 采用集团装药爆破拱桥上部结构时，装药量均按 $C = 1.3ABR^3$ 计算。装药配置方法必须区别拱桥的类型，采用不同的爆破方法。

(一) 爆破实腹式拱桥上部结构时，根据情况可采取以下方法。

1. 装药设置在拱顶桥面上，破坏半径应大于或等于拱顶厚度的 2 倍 (图 7—15)。

2. 装药设置在拱顶两侧桥拱跨度的 $1/12 \sim 1/6$ 处的药洞内，破坏半径应等于或稍大于拱体厚度 (图 7—16)。

3. 装药设置在桥墩上部的药洞内，破坏半径应大于装药中心至拱脚的距离 (图 7—17)。

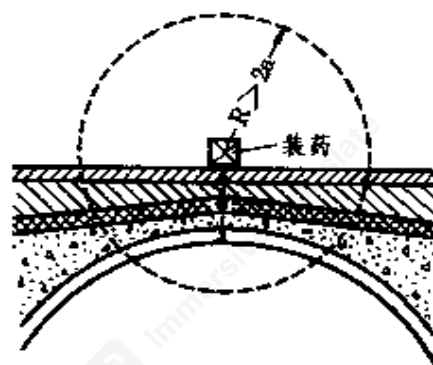


图 7—15 装药设置在拱顶上

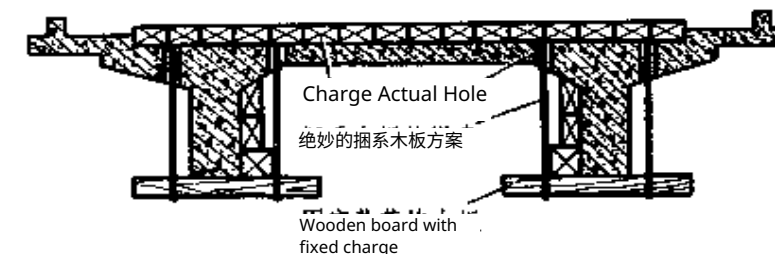


Figure 7-14 Blasting of the superstructure of a reinforced concrete bridge using linear charges

Explosion of the arch bridge

Article 123, Article 121.

Blow up the piers and abutments (the method is the same as in section 120)

Article 134 When using group-charged blasting to blast the upper structure of an arch bridge, the charge shall be

All quantities are calculated according to $C = 1.3ABR^3$. The charge configuration method must distinguish between arch correction types, employing different blasting methods.

-) When blasting the superstructure of a solid-web arch bridge, the following methods may be adopted depending on the situation.

1. The charge is placed on the arch deck. The radius of destruction should be greater than or equal to twice the thickness of the arch deck (Fig. 7-15).

2. The charge is placed in the charge holes located at $1/12 \sim 1/6$ of the span on both sides of the arch top, with the radius of destruction equal to or slightly greater than the thickness of the arch (Figure 7-16).

3. The charge is placed in the charge hole located on the upper part of the pier, and the radius of destruction should be greater than the distance from the center of the charge to the springing line of the arch (Figure 7—17).

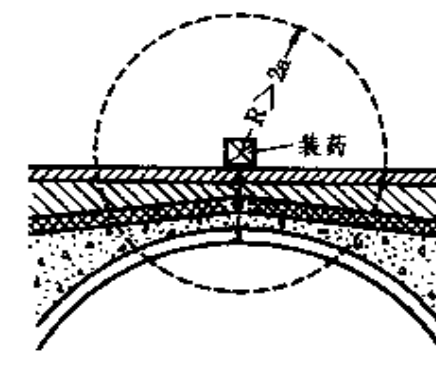


Figure 7-15: Charge placement on the crown

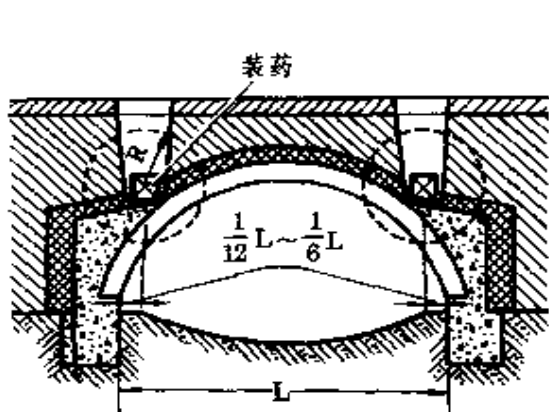


图 7—16 装药设置
在拱顶两侧的药洞内

同一炸断线上的装药沿桥面宽度配置，装药间距为破坏半径的 2 倍，装药个数等于桥面宽除以 2 倍破坏半径。

(二) 爆破空腹式板拱桥上部结构时，根据情况可选用以下方法。

1. 装药设置在拱顶桥面上，破坏半径应大于或等于拱顶厚度的 2 倍 (图 7—18)。同一炸断线上的装药沿桥面宽度配置，

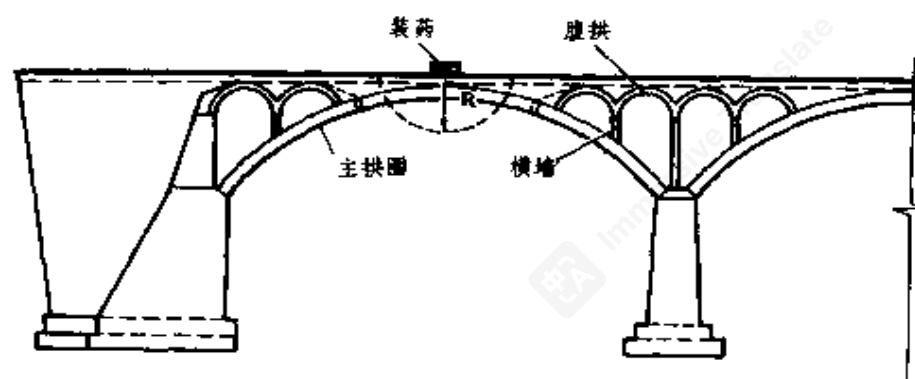


图 7—18 爆破空腹式板拱桥上部结构装药配置

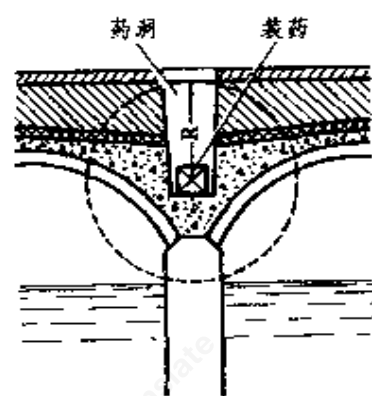


图 7—17 装药设置
在桥墩上部的药洞内

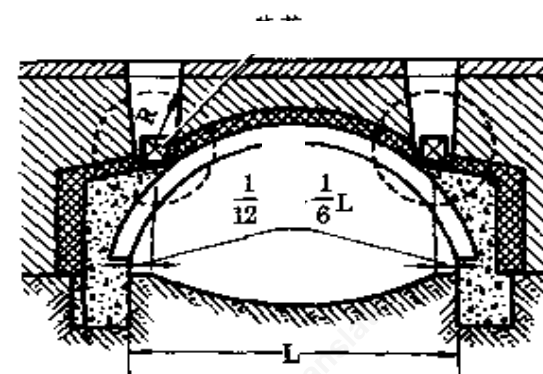


Figure 7-16: Charge Configuration

In the medicinal holes on both sides of the arch

81tech.com Same configuration of charge along the broken wire along the bridge deck width, charge spacing is 2 times the destruction radius, number of charges equals bridge deck width divided by 2 times the destruction radius.

(2) When blasting the superstructure of a hollow arch bridge, the following methods may be selected according to the situation.

1. The charge is set on the arch deck; the radius of destruction should be greater than or equal to twice the thickness of the arch deck (Figure 7-18). The charges on the same blast line are arranged along the width of the deck,

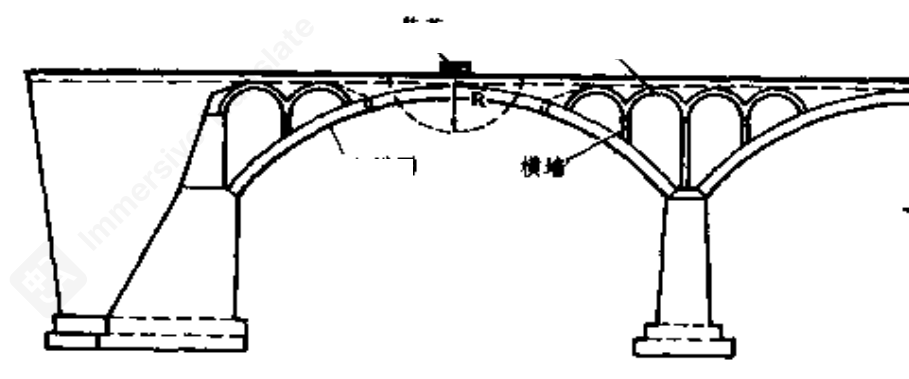


Figure 7-18 Blasting charge configuration for the superstructure of an open-spaced arch bridge

装药间距为破坏半径的 2 倍，装药个数等于桥面宽除以 2 倍破坏半径。

2. 装药设置在空腹横洞中主拱圈上，破坏半径等于主拱圈的高度（图 7—19）。同一炸断线上的装药沿拱洞横向宽度配置。装药间距为破坏半径的 2 倍，装药个数等于横洞宽度除以 2 倍破坏半径。

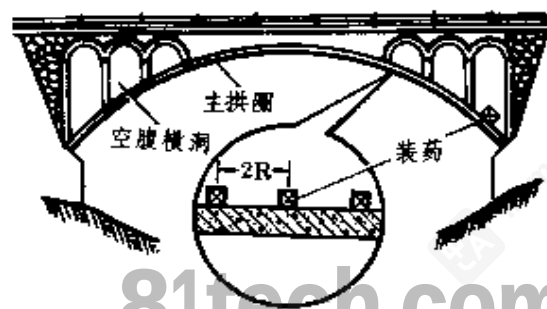


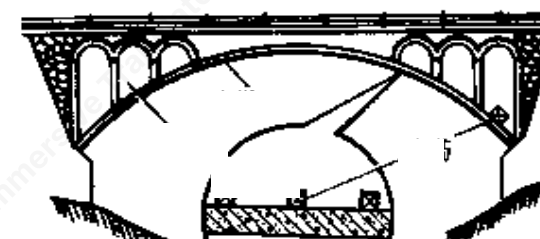
图 7—19 设置在空腹拱洞内的装药

（三）爆破肋拱桥上部结构时，可将装药成一线配置在拱顶桥面上并对正拱肋，装药个数等于拱肋根数，破坏半径等于拱肋下缘至桥面的高度；也可将装药成一线配置在横洞中对正并紧贴拱肋，装药个数等于拱肋根数。破坏半径等于拱肋间距的 1/2。

（四）爆破双曲拱桥上部结构时，可将装药配置在拱脚处的每根拱肋旁或空腹拱洞内每根拱肋上，也可在拱顶桥面上将装药对正拱肋成一线配置。装药个数等于拱肋根数，破坏半径等于拱肋间距的 1/2 或为拱肋高度与拱板厚度之和（比较后取大值）；当拱肋下缘至拱顶桥面的厚度大于拱肋间距的 1/2 时，破坏半径取拱肋下缘至拱顶桥面的厚度（图 7—20）。

The spacing between charges is twice the radius of destruction, and the number of charges equals the bridge deck width divided by twice the radius of destruction.

2. The charge is placed on the main arch ring of the empty cross-cut, with a destruction radius equal to the height of the main arch ring (Figure 7-19). The charges along the same break line are arranged according to the transverse width of the arch tunnel. The spacing between charges is twice the destruction radius, and the number of charges equals the cross-cut width divided by twice the destruction radius.



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Figure 7-19: Charge placement within a hollow arch tunnel

(2) When blasting the superstructure of a ribbed arch bridge, the charges can be arranged in a single line on the arch crown bridge deck, facing the stop arch ribs; the number of charges equals the number of arch ribs, and the destruction radius equals the height from the lower edge of the arch ribs to the bridge deck. Alternatively, the charges can be arranged in a single line in a cross tunnel, aligned and tightly adjacent to the arch ribs; the number of charges equals the number of arch ribs. The destruction radius equals half the spacing between the arch ribs.

(4) When blasting the superstructure of a double-curved arch bridge, the charge can be placed beside each arch rib at the springing or within each hollow arch rib, or aligned in a straight line with the arch ribs on the bridge deck at the crown. The number of charges equals the number of arch ribs, and the radius of destruction is either half the spacing between arch ribs or the sum of the arch rib height and the arch plate thickness (whichever is larger); when the thickness from the lower edge of the arch ribs to the bridge deck at the crown exceeds half the spacing between arch ribs, the radius of destruction is taken as the thickness from the lower edge of the arch ribs to the bridge deck at the crown (Figure 7-20).

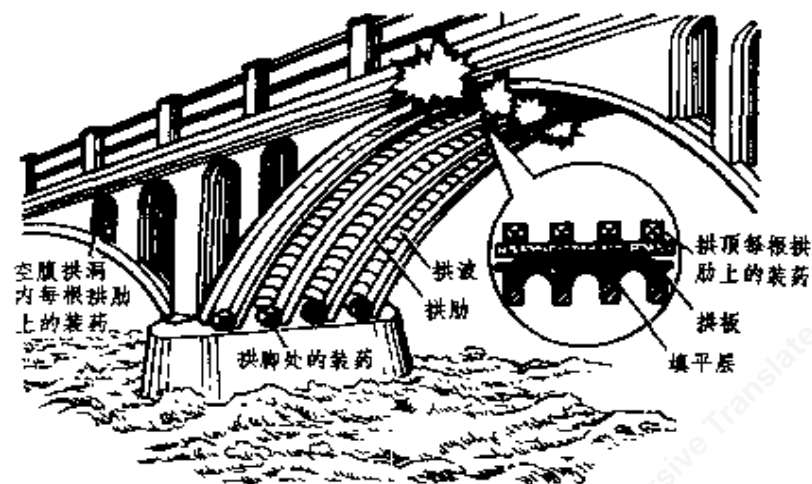


图 7—20 爆破双曲拱桥的装药配置

第三节 钢桥的爆破

第一百二十五条 爆破桥墩、桥台，其方法同第一百二十条、第一百二十一条。

第一百二十六条 爆破钢桥的上部结构，应区别其结构类型(图7—21、图7—22)，根据允许的作业时间确定炸断线和装药

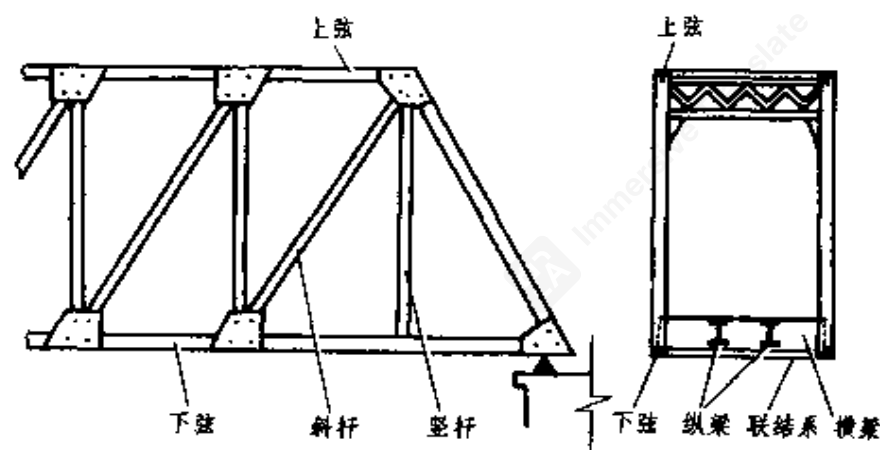


图 7—21 桁架钢桥

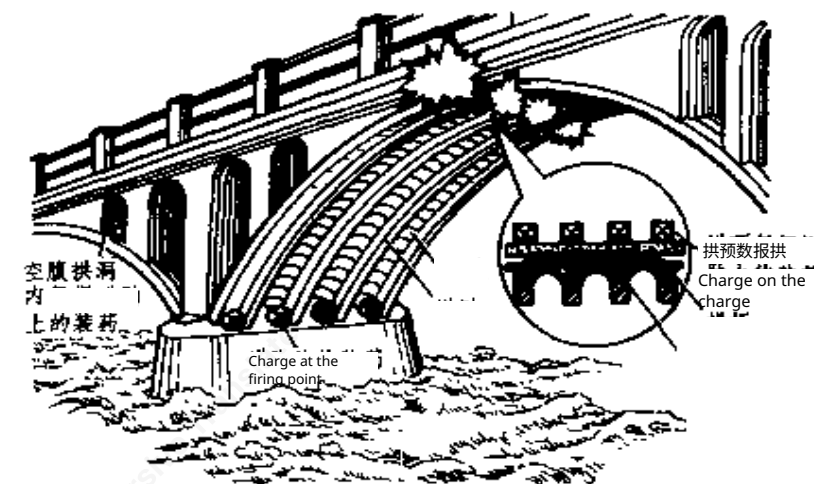


Figure 7-20: Charge configuration for blasting a hyperbolic arch bridge

81tech.com 第三节 Blasting of steel bridges

Article 125: Blasting of bridge piers and abutments shall be carried out in accordance with the methods specified in Articles 120 and 121.

Article 126: When blasting steel bridges, the superstructure shall be treated according to its structural type.

(Figures 7-21, 7-22), determine the blasting wire breakage and charge loading based on the allowable working time.

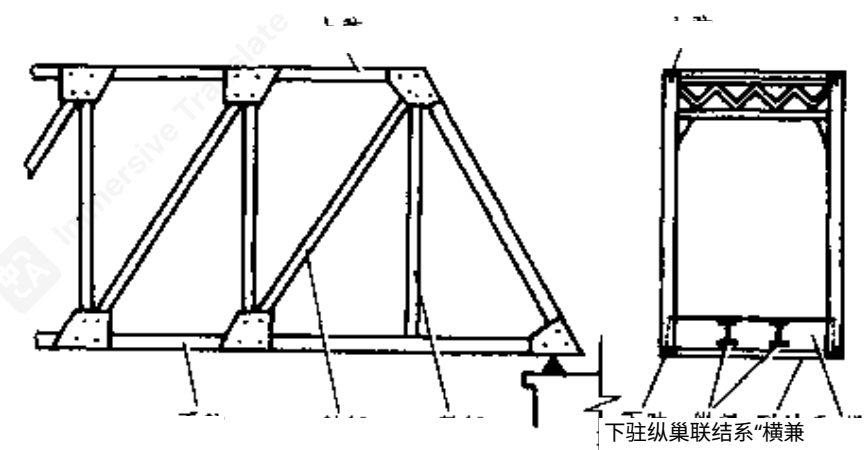


Figure
7-21

方法。

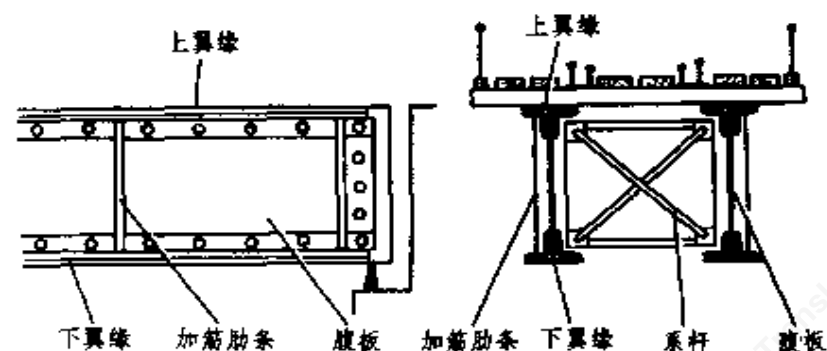


图 7—22 板梁钢桥

(一) 当时间充裕时，炸断线位置可选在跨径中央；或跨径一端，距桥脚为跨径长度的 $1/6 \sim 1/4$ 处；或跨径两端，距桥脚为跨径长度的 $1/6 \sim 1/4$ 处 (图 7—23)。

设置装药时，应使炸断线向下张开，以免桁架被炸断后其末端互相搭挂；炸断线内的上弦、下弦和斜杆应全部炸断 (图 7—24)。

板梁通常用直列装药爆破，炸断线应选在靠近桥墩或跨径长度的 $1/4 \sim 1/2$ 处 (图 7—25)。

装药量的计算和装药设置方法同第六章第二节。

(二) 当时间仓促时，根据情况可采取以下爆破方法。

1. 用 4 个集团装药爆破桁架。其中两个装药设置在桁架一端一侧的上弦和下弦上；另两个装药设置在桁架另一端另一侧的上弦和下弦上 (图 7—26)。每个集团装药的药量按下式计算：

$$C = 0.25L + 10$$

式中：C——装药量 (千克)

L——桁架长度 (米)

2. 用两个集团装药爆破板梁。每根板梁配置 1 个装药，装药量按下式计算：

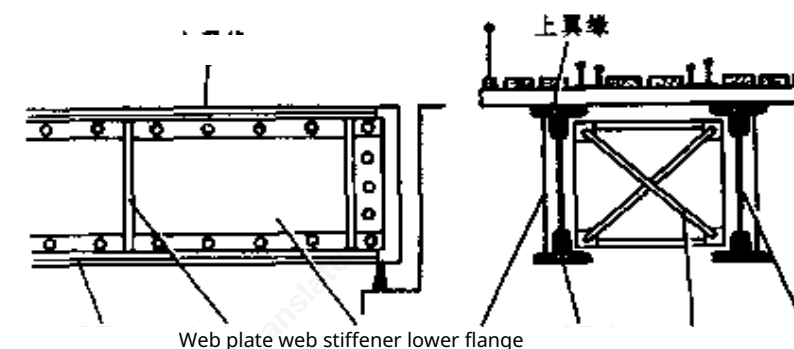


Figure 7—22 板梁钢桥

(1) When time permits, the location of the cable break can be selected at the center of the span; or at one end of the span, at a distance from the bridge abutment equal to $1/6 \sim 1/4$ of the span length; or at both ends of the span, at a distance from the bridge abutment equal to $1/6 \sim 1/4$ of the span length (Figure 7—23).

When setting the charge, the bursting wire should be opened downward to prevent the truss ends from interlocking after the truss is burst; all upper chords, lower chords, and diagonal members within the bursting wire should be completely burst (Fig. 7-1).

Slab-beam structures are typically blasted using linear charge detonation; the blast line should be selected near the pier or at the span length.

at the $1/4 \sim 1/2$ position (Fig. 7—25).

The calculation of charge quantity and the method of charge setting are the same as those described in Section 2 of Chapter 6.

(二) When time is short, the following blasting methods can be adopted according to the situation.

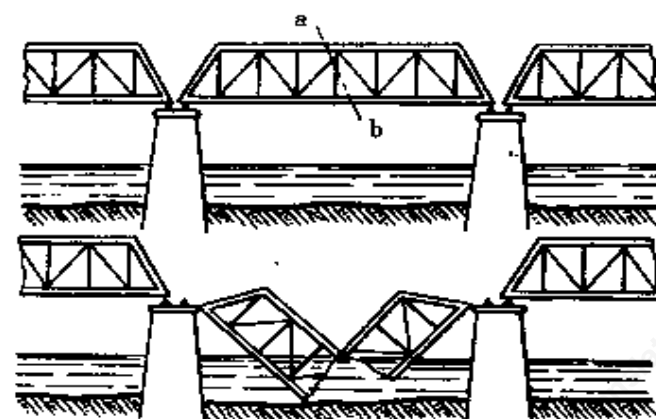
1. Use four group charges for blasting the truss. Two charges are placed on the top and bottom chords on one side of one end of the truss, and the other two charges are placed on the top and bottom chords on the opposite side of the other end of the truss (Figure 7-26). The charge quantity for each group charge is calculated according to the following formula:

$$C = 0.25L + 10$$

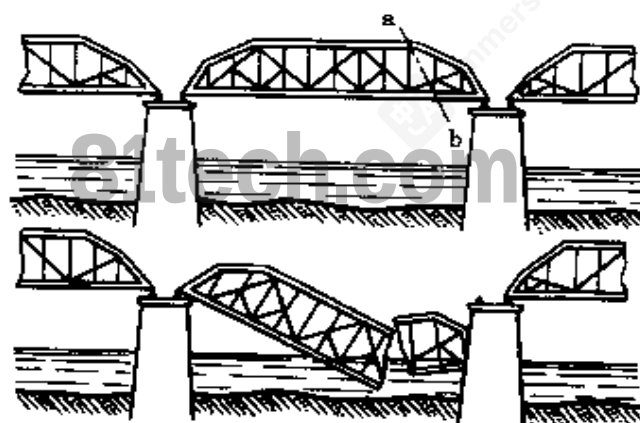
In which: C is the charge amount (kilograms)

L one truss length (meters)

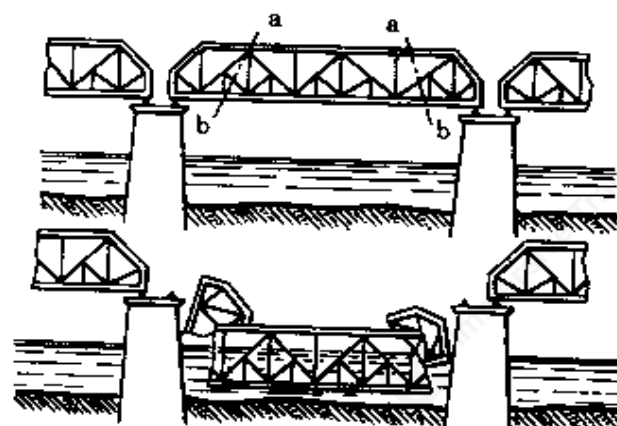
2. Blast the plate beam using two sets of closed charges. Each plate beam is configured with one charge, and the charge quantity is calculated according to the following formula:



(一) 跨径中央

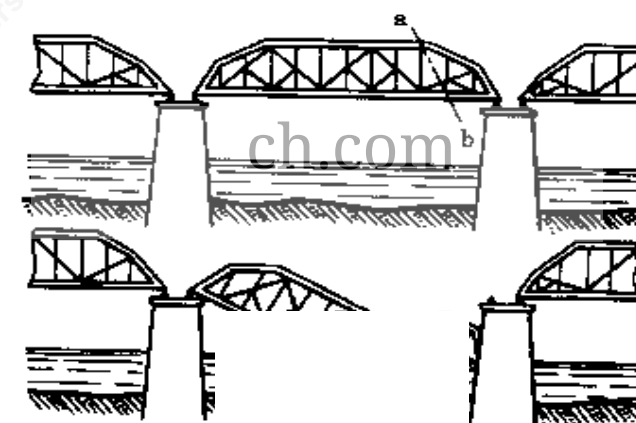
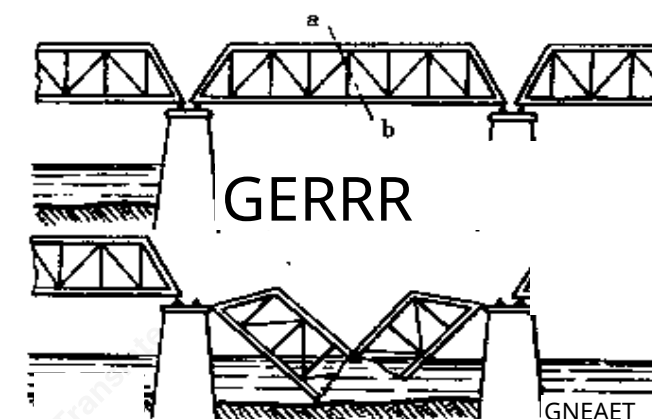


(二) 靠近一个桥脚

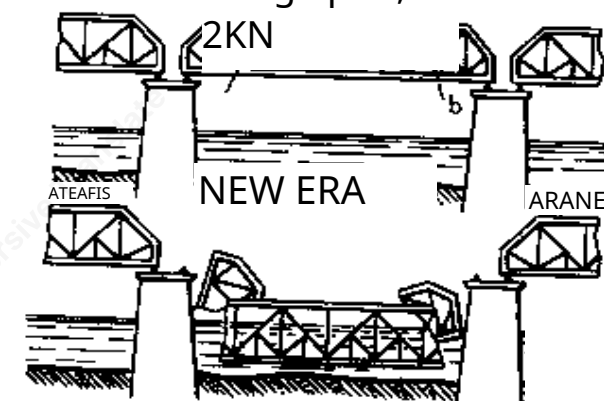


(三) 靠近两个桥脚

图 7-23 爆破桁架的炸断线



Near a
bridge pier,
2KN



(3) Close to the two bridge
piers

Figure 7-23 Blasted truss break line

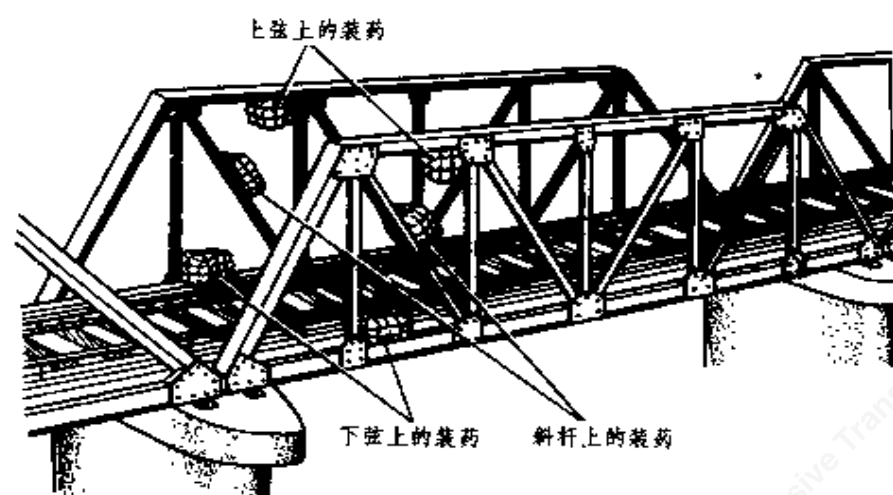


图 7—24 设置在上弦、下弦和斜杆上的装药

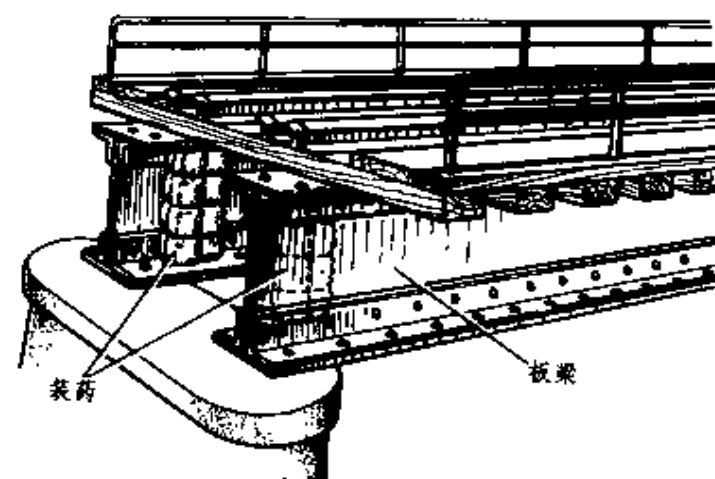


图 7—25 用直列装药爆破板梁

当板梁长度等于或小于 15 米时：

$$C = L + 4$$

式中：C——装药量（千克）

L——板梁长度（米）

当板梁长度大于 15 米时：

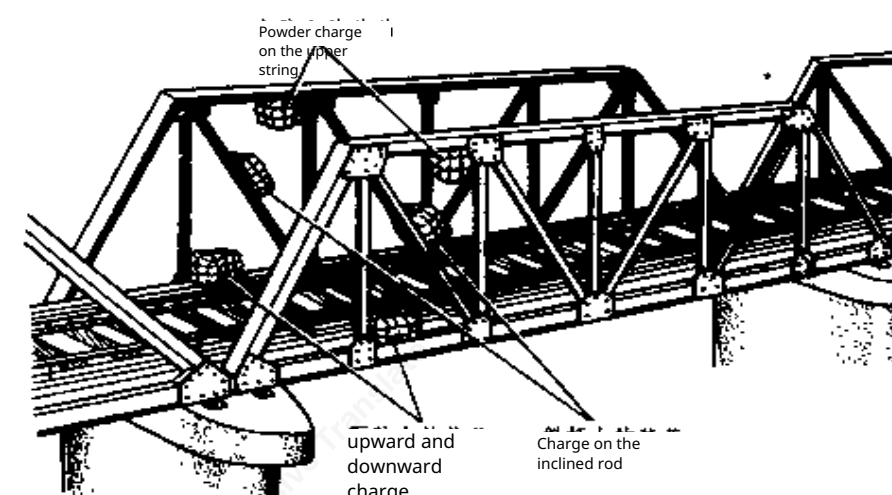


Figure 7-24: Charge placement on the top chord, bottom chord, and diagonal members

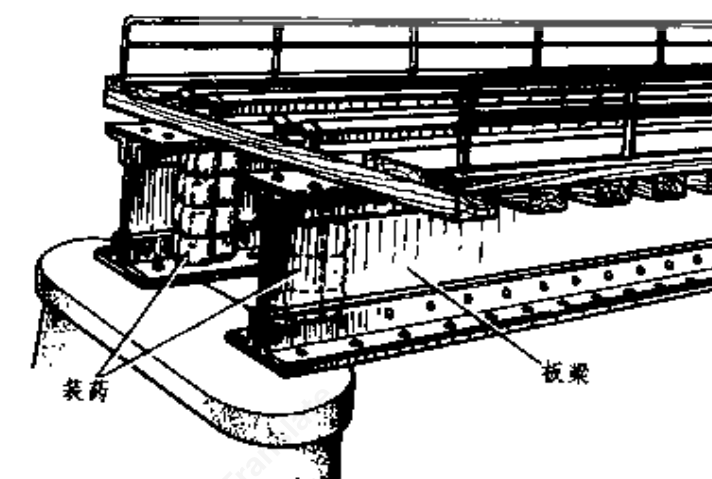


Figure 7-25: Blasting of a plate girder with linear charges

When the length of the girder and beam is equal to or less than 15 meters:

$$C = L + 4$$

In the formula: C—charge amount (kg) L

When the plate girder length exceeds 15 meters:

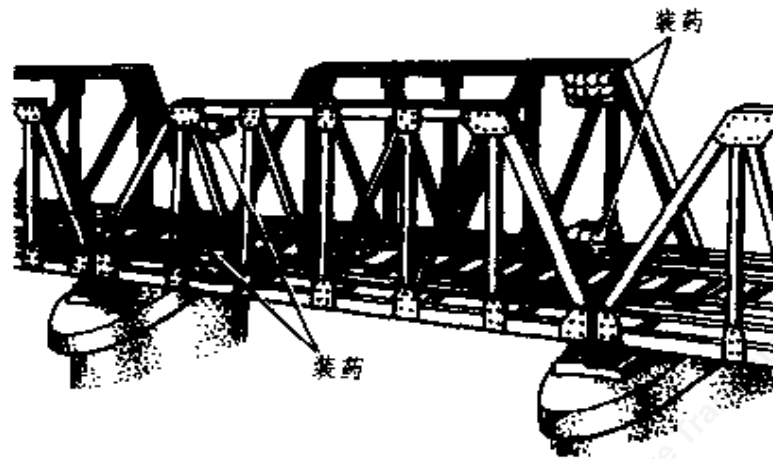


图 7—26 用 4 个集团装药爆破桁架

$$C = 0.5L + 15$$

式中：C、L——意义同上

3. 用 1 个大集团装药爆破桁架支点。将装药设置在桥墩（台）上部紧靠支点处爆破（图 7—27）。装药量按 $C = 1.3ABR^3$ 计算。破坏半径取桥墩（台）宽度的 1/3，如此值小于 2.5 米则取 2.5 米。

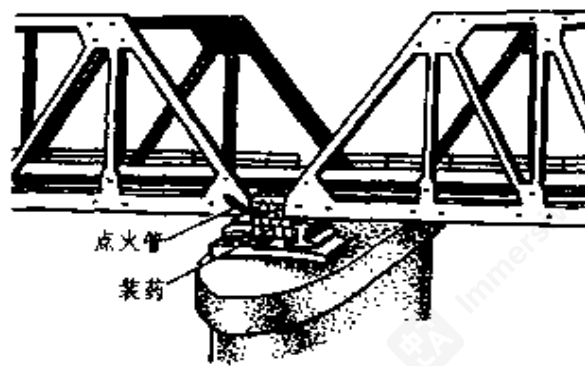


图 7—27 装药设置于桁架支点处

4. 用非接触装药爆破板梁。用 1 个集团装药设置于两板梁之间桥轴线上（图 7—28）。装药量按下式计算：

— 165 —

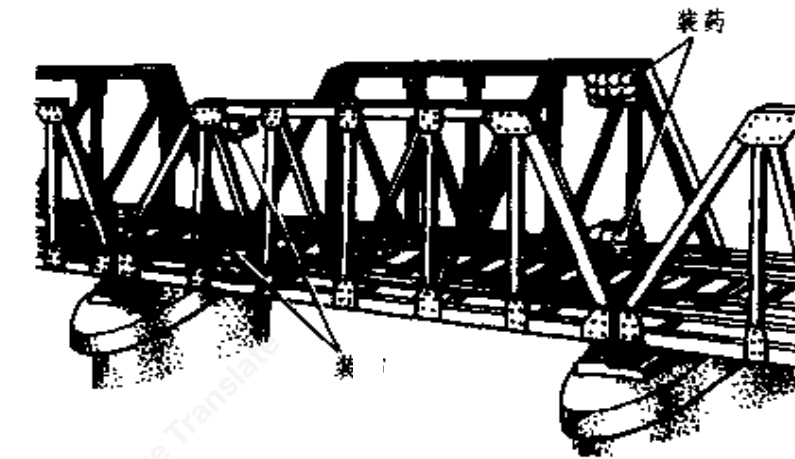


Figure 7-26: Blast truss using four group charges

式中：C、L——意义同上

3. Use one large charge in the blasting framework support point. Place the charge on the upper part of the bridge (abutment) immediately adjacent to the support point for blasting (Fig. 727). Calculate the charge quantity according to $C=1.3ABR^3$, with the radius of destruction taken as one-third of the width of the bridge pier (abutment); if this value is less than 2.5 meters, then Take 2.5 meters.

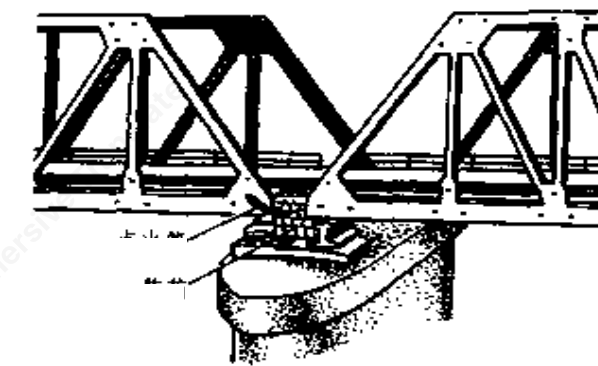


Figure 7-27: The charge is placed at the truss support points.

4. Use non-contact charge blasting of plate girders. Place one group of charges on the bridge axis between the two plate girders (Figure 7-28). The charge quantity is calculated according to the following formula:

— 165 —

$$C = 20r^2$$

式中：C——装药量（千克）

r ——由装药中心至板梁上、下翼缘的距离（米）

第一百二十七条 为了阻塞河道，并最大限度地使敌人难于修复和利用，爆破较大跨径的桁架梁桥时，必须将所有桥台、桥墩和桁架同时炸毁。

桥台、桥墩采用斜切式爆破，相邻桥墩装药的斜切方向应形成交错（图 7—29、图 7—30）；装药量按 $C = 1.3ABR^3$ 计算。

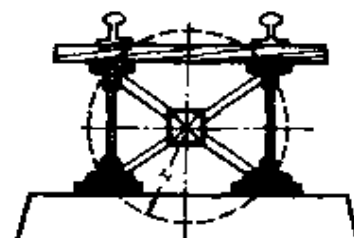


图 7—28 非接触爆破板梁桥的装药配置

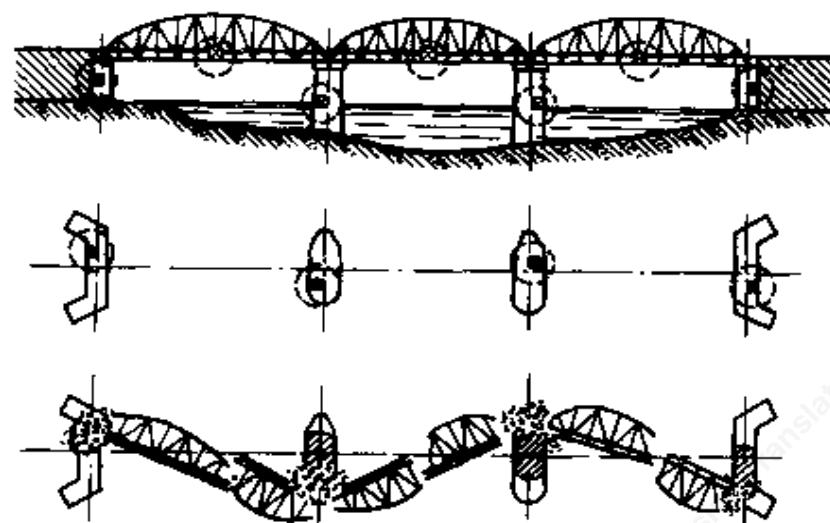


图 7—29 同时炸毁单线桥的桁架和桥脚

每个跨径的桁架用两个集团装药。炸断线在跨径中央，装药固定在桁架两侧的下弦、斜杆、竖杆的结合处；每个集团装药的药量按 $C = 0.25L + 10$ 计算。

In which: C—charge amount (kilograms)

r —— From the center of the charge to the girder
Distance between top and bottom flanges (meters)

Article 127. To block the river

path, and make it as difficult as possible for the enemy to repair and utilize; when demolishing truss beam bridges with large spans, all abutments, piers, and trusses must be destroyed simultaneously.

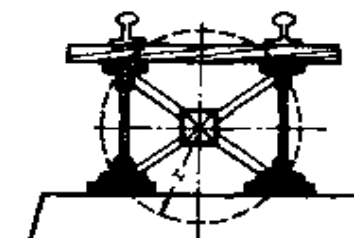


Figure 7-28 Non-contact blasting charge configuration for plate girder bridges

Abutments and piers are blasted using a sloped cut method. 破，

The staggered direction of charges on adjacent piers should form an interlocking pattern (Figures 7-29, 7-30); cha

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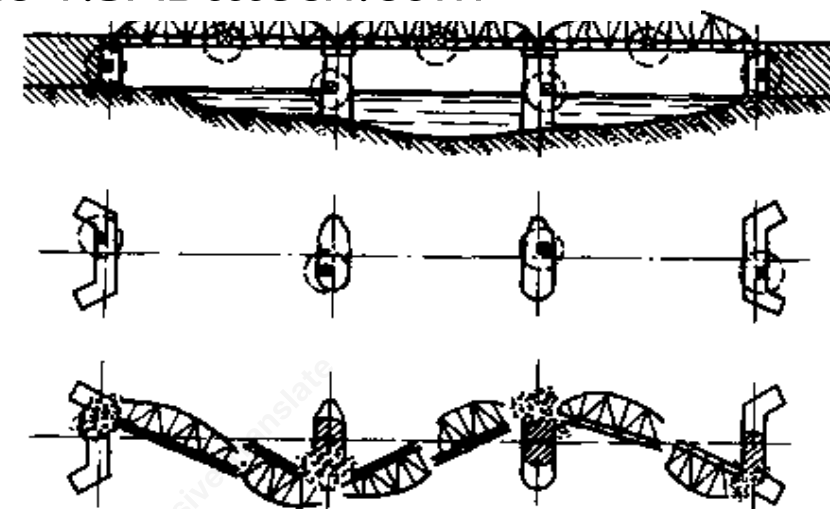


Figure 7-29: Simultaneous destruction of the bridge deck and piers of a single-track bridge

Each truss span is charged with two groups of explosives. The detonating line is placed at the center of the span, and the charges are fixed at the junctions of the bottom chord, diagonal members, and vertical members on both sides of the truss; the charge quantity for each group is calculated as $C = 0.25L + 10$.

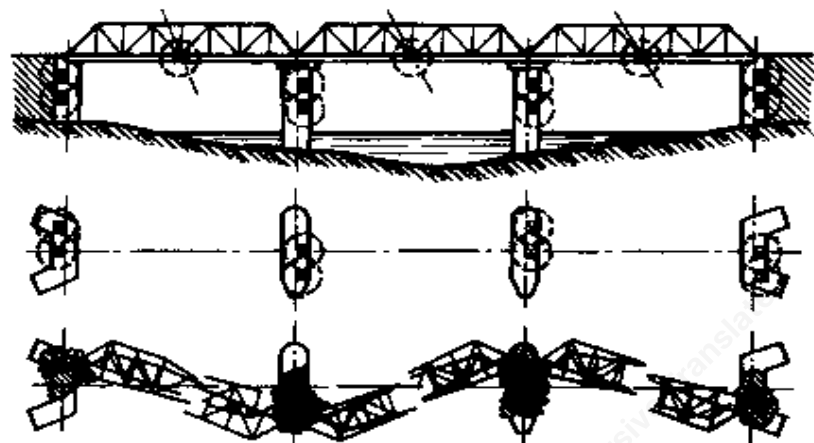


图 7—30 同时炸毁双线桥的桁架和桥脚

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第四节 吊桥的爆破

第一百二十八条 爆破桥塔可采用外部集团装药或内部集团装药。

(一) 用外部集团装药爆破时，将装药设置在桥墩的桩柱上，每根桩柱上设置 1~2 个装药；若使吊桥在爆破后向预定方向倒塌，则在预定倾倒方向上设置 2~3 个装药。装药量按 $C = 1.3ABR^3$ 计算。破坏半径取桩柱直径或矩形桩断面的短边长度。

(二) 在时间充裕的情况下，可在爆破位置开设药洞，采用内部集团装药爆破。每根桩柱上设置 2~3 个装药。装药量按 $C = 1.3ABR^3$ 计算。破坏半径取桩柱直径的 1/2 或矩形断面厚度的 1/2，装药间距等于 2 倍破坏半径。

桥墩上如有预留药室，爆破时应充分利用。

第一百二十九条 爆破悬索吊桥时应炸断全部主缆索和大部分辅助缆索；爆破缆索的装药配置与装药量计算参照第一百一十

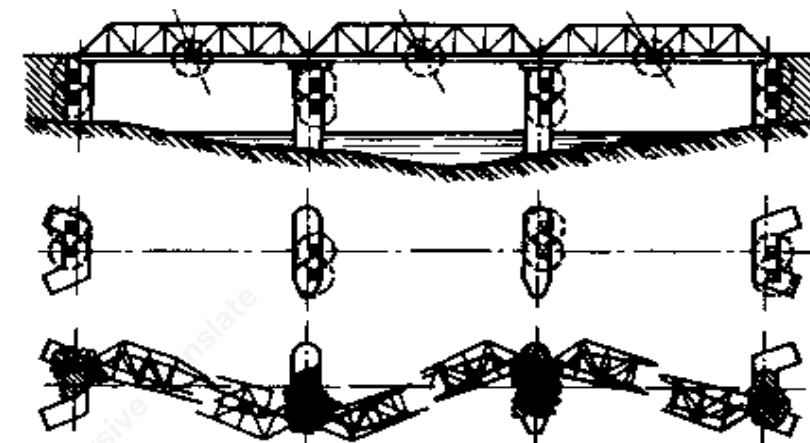


Figure 7-30 Simultaneous destruction of the truss and piers of a double-track bridge 81tech.com

Section 4: Blasting of Suspension Bridges

Article 128: Blasting of bridge towers may be carried out using external group charges or internal group charges.

(1) When blasting with external group charges, place the charges on the pile columns of the pier, with 1~2 charges per pile column; if the suspension bridge is to collapse in a predetermined direction after blasting, place 2~3 charges in the direction of the intended collapse. The charge quantity shall be calculated according to $C=1.3ABR^3$, and the radius of destruction shall be taken as the diameter of the pile column or the shorter side length of the rectangular pile cross-section.

(2) When time permits, a charge hole may be opened at the blasting location, and internal group charging blasting shall be adopted. 2~3 charges shall be set on each pile column. The charge quantity shall be calculated according to $C=1.3ABR^3$. The radius of destruction shall be taken as 1/2 of the pile column diameter or 1/2 of the thickness of the rectangular section, and the spacing between charges shall be equal to twice the radius of destruction.

If there are pre-drilled charge chambers on the pier, they should be fully utilized during blasting.

Article 129: When blasting suspension bridges, all main cables and most auxiliary cables shall be severed; the charge configuration and charge quantity calculation for cable blasting shall refer to Article 110.

一条。

第五节 木桥的爆破

第一百三十条 用大集团装药爆破木桥，当桥脚高出水面不足4米时，每个桥脚用1个集团装药，设置在冠材上部中央或桥面上对正冠材中央处；当桥脚高出水面大于4米时，则在水面下增设1个装药（图7—31）。装药量按 $C = 30KD^2$ 计算。D值取桥桁或桩柱的直径（取大值），破坏半径取桥梁宽度的1/2。

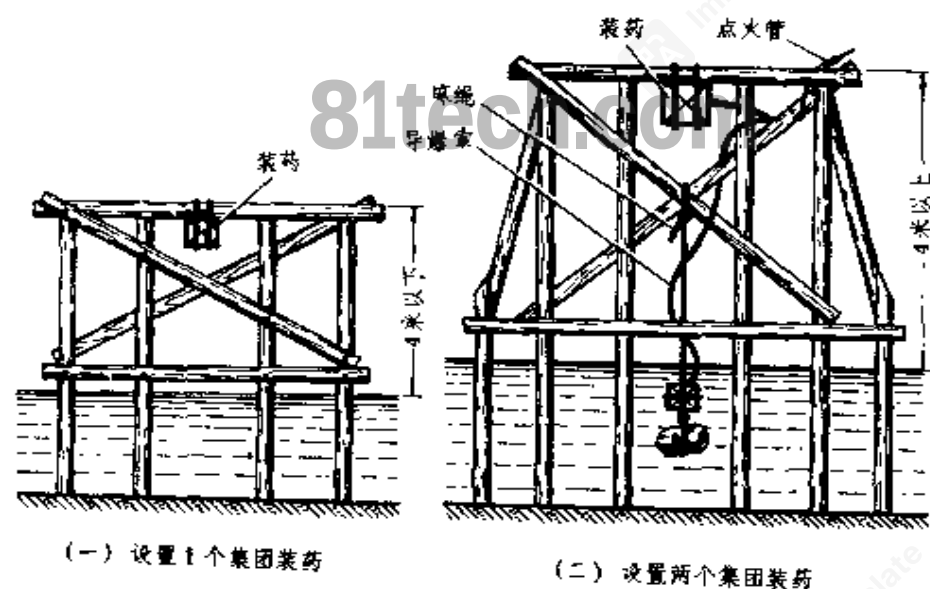


图7—31 用集团装药爆破列柱桥脚

固定装药和敷设起爆线路可在台架、舟筏或吊板上进行，用绳索或铁丝将装药固定在桥梁构件上。固定水下装药时，如流速较大，可在装药下面坠一重物，然后捆在木棍或绳索上，放入水中再行固定。导电线与导爆索敷设于缘材外侧的桥板上或桥板下，以免在爆破前被车辆损坏。设置于水下的装药，如不立即起爆，可暂时将其固定在水面以上，待起爆时再放入水中，以防浸

Section 5: Blasting of this bridge

The first charge uses a large group charge to blast the wooden bridge. When the bridge piers are less than 4 meters above the water surface, one group charge is used per pier, placed at the center of the crown material above the pier or aligned with the center of the crown material on the bridge deck; when the bridge piers are more than 4 meters above the water surface, an additional J charges are installed underwater (Figure 7-31). The charge quantity is calculated as $C=30KD^2$. The D value is taken as the diameter of the bridge or pile column (using the larger value), and the radius of destruction is taken as one-half of the bridge width.

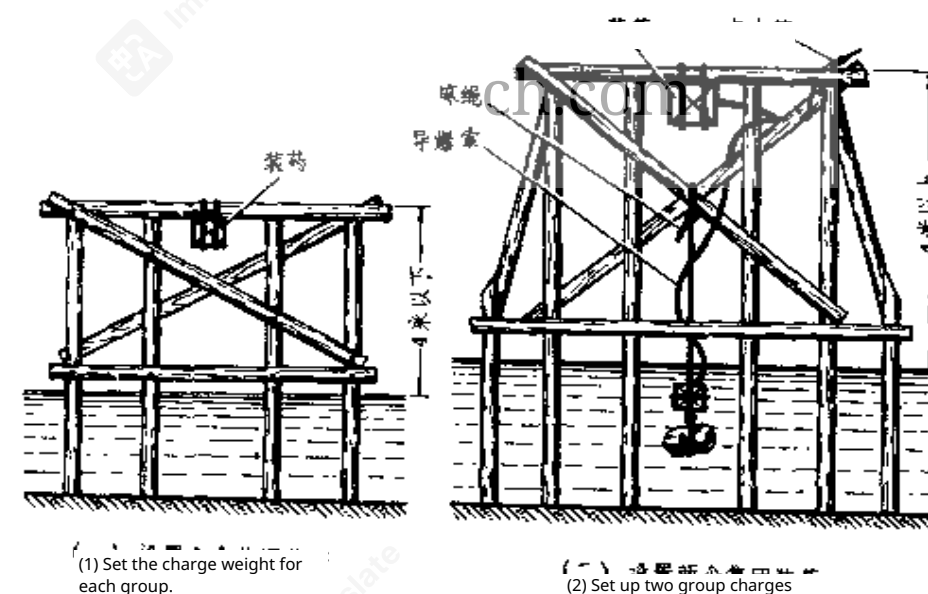


Figure 7-31 Group charge blasting of pier columns

Fixed charges and laying of detonation lines can be carried out on stands, boats, or suspended boards, with the charges secured to bridge components using ropes or wire. When fixing underwater charges, if the current is strong, a heavy weight may be suspended beneath the charges, then tied to a stick or rope and lowered into the water before being secured. The detonating wire and detonating cord are laid on the bridge deck or beneath the bridge deck on the outer side of the edge material to prevent damage by vehicles before blasting. Underwater charges that are not to be detonated immediately may be temporarily fixed above the water surface and lowered into the water at the time of detonation to prevent immersion.

水过久而受潮。

第一百三十一条 用直列装药爆破木桥上部结构时，应从跨径中央处炸断。爆破桥脚时，若桥脚高出水面不足 4 米，应在水面下不小于 0.5 米处炸断。若桥脚高出水面 4 米以上时，应在水面上、下各炸断 1 处。炸断面厚度不足 25 厘米时，用一行 200 克梯恩梯药块；大于 25 厘米时，用一行 400 克梯恩梯药块。

用直列装药爆破堡篮桥脚时，装药设置在木杆层纵壁和横壁的交叉处。木杆直径不足 25 厘米时，用一行 200 克梯恩梯药块；大于 25 厘米时，用一行 400 克梯恩梯药块。装药下端浸入水中（图 7—32）。

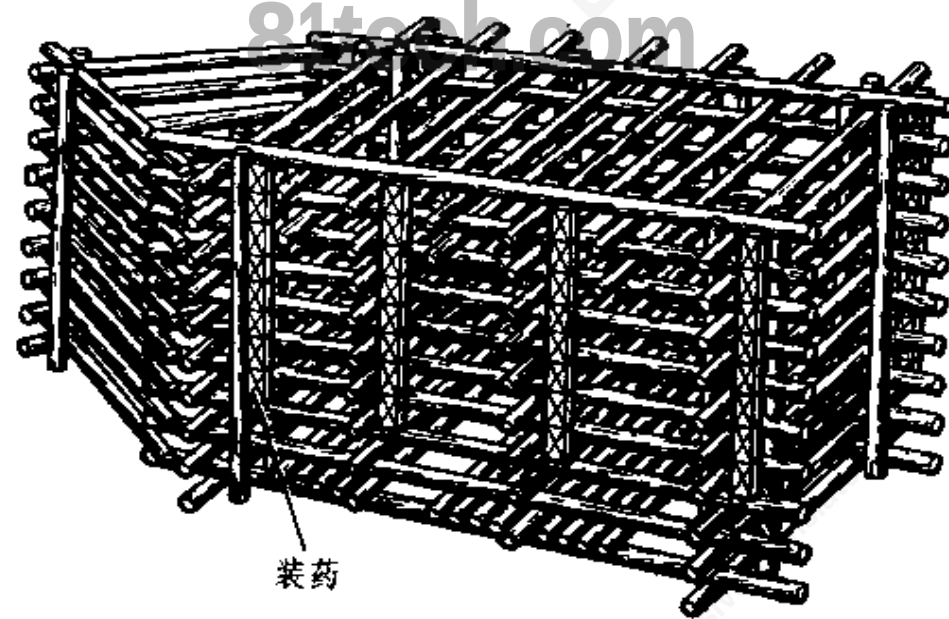


图 7—32 用直列装药爆破堡篮桥脚

第一百三十二条 用爆破单根木材的方法爆破木桥，应将装药设置在各桥桁和桩柱上。装药量按第一百零六条公式计算。

Water becomes damp when exposed to moisture for too long.

Article 131 When blasting the superstructure of a wooden bridge using parallel charges, the bridge should be broken from the center of the span. When blasting the bridge piers, if the pier height above the water level is less than 4 meters, it should be broken at a depth of not less than 0.5 meters below the water surface. If the pier height above the water level is more than 4 meters, it should be broken at a depth of not less than [] meters below the water surface and at a height of not less than 1 meter above the water surface. If the thickness of the blast section is less than 25 centimeters, use a row of 200-gram TNT blocks; if it is more than 25 centimeters,

Use 400 g of 梯恩梯药块.

When blasting the bridge piers of a basket bridge with a longitudinal charge, the charge is placed at the intersection of the longitudinal and transverse walls of the wooden pole layer. When the wooden pole diameter is less than 25 cm, use one row of 200 g TNT blocks; when greater than 25 cm, use one row of 400 g TNT blocks. The lower end of the charge should be immersed in water ([Fig. 7—32).

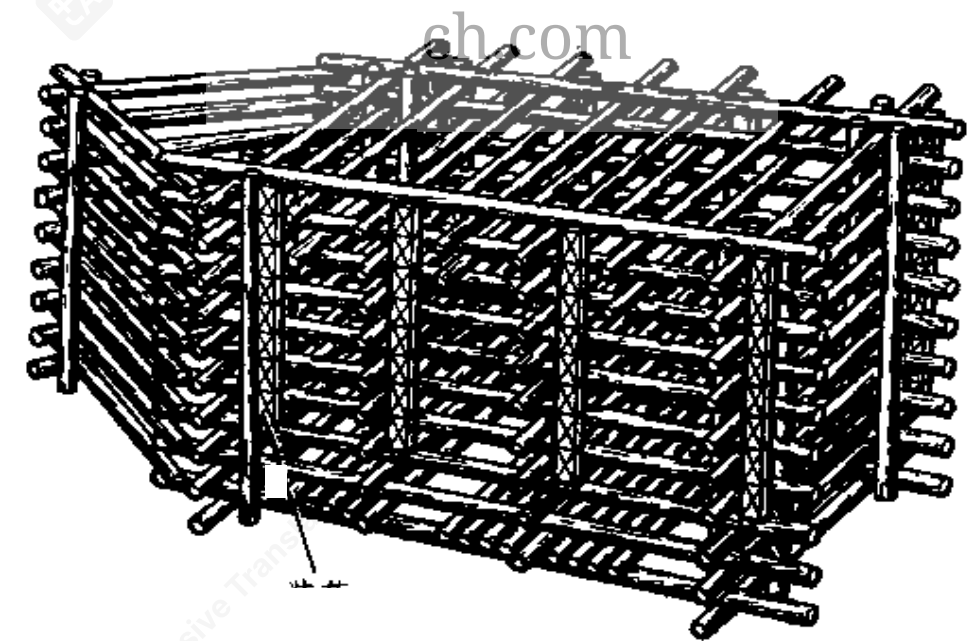


Figure 7-32 Blasting of the bridge piers using parallel charges

Article 132. When blasting wooden bridges using single logs, the charges shall be placed on each truss and pier column. The quantity of charges shall be calculated in accordance with the formula in Article 106.

第八章 道路、铁路的爆破

第一百三十三条 为阻滞敌方机动而破坏道路、铁路，爆破位置应选在重要地段或难以迂回的地段（江河、隘路、谷地、沼泽地）。根据情况可爆破路基、涵洞、隧道、桥梁、道轨和车站设施等。

在我军准备撤出地区执行上述爆破任务时，可在撤离前预先实施，也可以预先设置装药，使其在预定时间内爆炸或遥控起爆。在敌后实施爆破作业时，应采取秘密行动或在火力掩护下，接近目标强行爆破。

第一节 道路的爆破

第一百三十四条 爆破路基应根据其类型分别采取不同的方法。

(一) 爆破填土路基，一般可自路面开设药洞设置装药。如路面坚硬或爆破前需维持交通，可自路肩或边坡开设药洞设置装药。爆破后形成漏斗坑或壕沟，构成障碍。装药量按加强抛掷装药计算（图 8—1）。

(二) 爆破挖土路基，可在路基一侧或两侧的边坡上开设药洞设置装药，爆破后造成大量塌方，堵塞道路。爆破两侧时，最小抵抗线应大于路基宽度的 $1/2$ （图 8—2（一））；爆破一侧时，最小抵抗线不应小于路基宽度的 $3/4$ （图 8—2（二））。装药量按标准抛掷装药计算。

(三) 爆破山腹道应按有无挡土墙分别实施。

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Chapter 8: Blasting of Roads and Railways

Article 133: To impede enemy maneuvering by destroying roads and railways, blast positions should be selected in critical areas or areas difficult to bypass (rivers, roads, valleys, marshlands). Depending on the situation, blast targets may include roadbeds, culverts, tunnels, bridges, tracks, and station facilities.

When our forces are preparing to withdraw from the area to carry out the 1-mentioned demolition tasks, they can be executed in advance before withdrawal, or pre-set charges can be arranged to detonate within a predetermined time or via remote control. When conducting demolition operations behind enemy lines, secret actions should be taken, or the target should be approached under fire cover to force a demolition.

Section 1: Blasting of Roads

Article 134: Excavation of road embankments shall be carried out according to different methods based on their type.

(一) 爆破填土路基，一般可自路面开设药洞设置装药。如路面坚硬或爆破前需维持交通，可自路肩或边坡开设药洞设置装药。爆破后形成漏斗坑或壕沟，构成障碍。装药量按加强抛掷装药计算（图 8—1）。

If the road surface is hard or traffic must be maintained before blasting, charge holes can be drilled from the shoulder or slope for loading. After blasting, a funnel pit or trench is formed, creating an obstacle. The charge quantity is calculated based on reinforced throwing charges (Figure 8—1).

(2) Blasting excavation of road embankments may cause significant landslides and road blockages if blasting holes are set up on the slope or both slopes of the embankment. When blasting on both sides, the minimum charge distance should be greater than one-half of the embankment width (Figure 8-1-2(1)); when blasting on one side, the minimum charge distance should not be less than three-quarters of the embankment width (Figure 8-1-2(2)). The charge quantity shall be calculated according to standard throwing charges.

(三) 爆破山腹道应按有无挡土墙分别实施。
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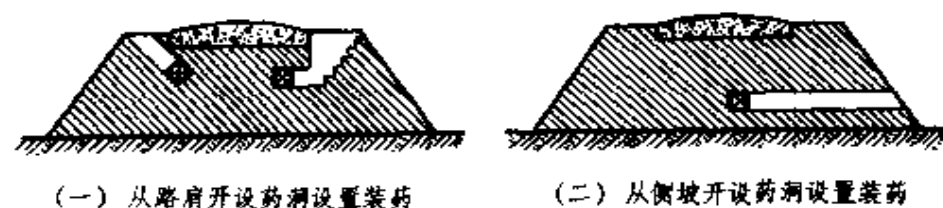


图 8—1 爆破填土路基的装药

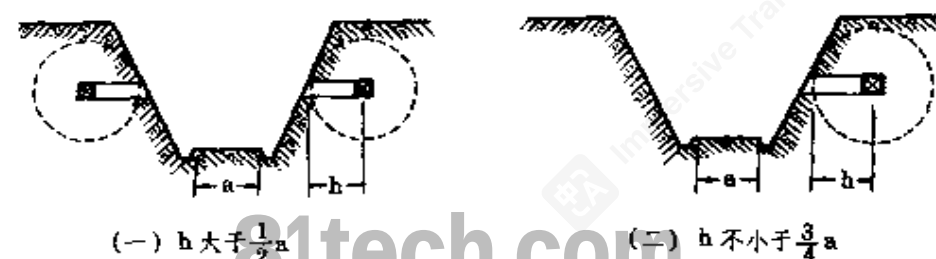


图 8—2 爆破挖土路基的装药

1. 爆破有挡土墙的山腹道时应炸毁挡土墙。如路基不宽，可在挡土墙内侧路基上开设一列药洞设置装药，药洞深度稍大于破坏半径，破坏半径等于装药中心至挡土墙外缘的距离，装药间距等于或小于破坏半径的 2 倍（图 8—3）。装药量按第一百一十三条公式计算。A 值取挡土墙材料抗力系数，B 值取 1.5。如路基较宽，一列装药爆炸后不能破坏全部路基时，则增加一列装药。

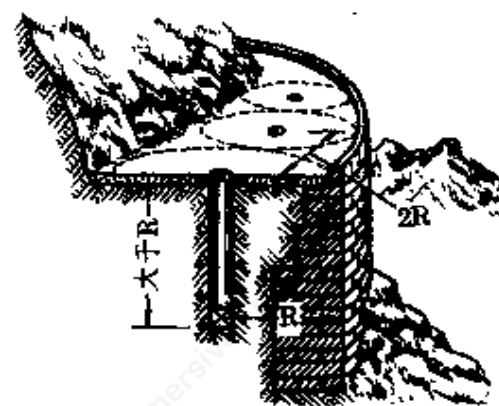
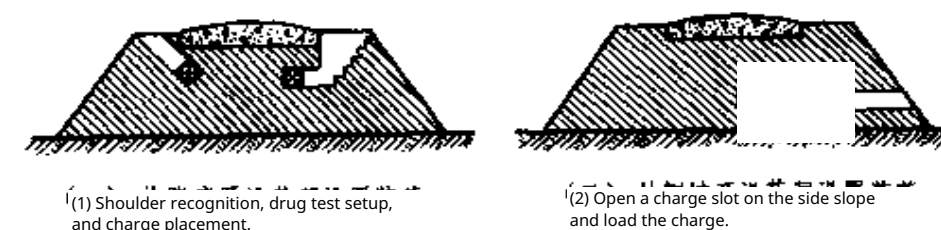


图 8—3 爆破挡土墙的装药

2. 爆破无挡土墙的山腹道时按填土路基的爆破方法实施。
第一百三十五条 爆破涵洞，主要是炸毁拱顶，使路基塌



Loading of explosives for blasting fill embankments

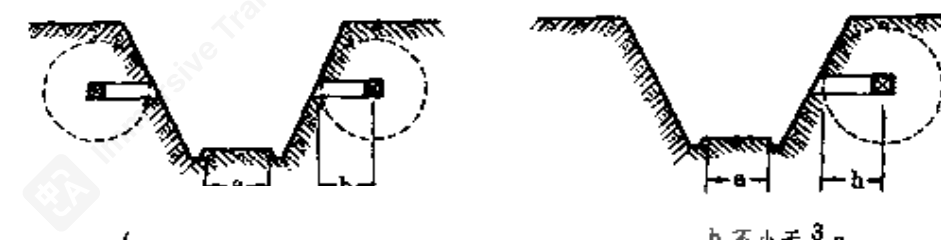


Figure 8-2: Blasting charge for roadbed excavation

1. Blasting in the mountain interior behind a retaining wall

The retaining wall should be blown up. If the roadbed is too narrow, a row of blast holes may be opened in the roadbed inside the retaining wall for placing charges. The depth of the blast holes should be slightly greater than the radius of destruction, and the radius of destruction should equal the distance from the center of the charges to the outer edge of the retaining wall. The spacing of the charges should be equal to or less than twice the radius of destruction (Figure 8-3). The quantity of charges shall be calculated according to the formula in Article 113. The value of A shall be taken as the resistance coefficient of the material of the retaining wall.

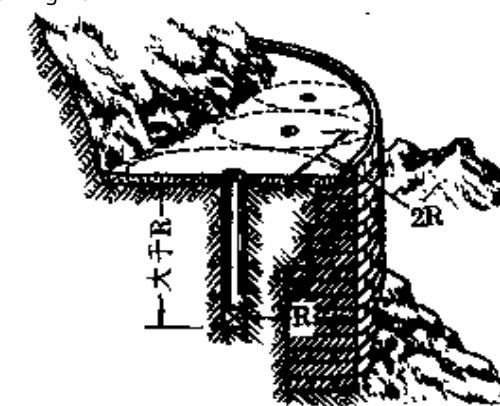


Figure 83: Blasting charges in a retaining wall

number, B value is 1.5. If the roadbed is relatively wide

When the explosion of the charge cannot destroy the entire roadbed, an additional row of charges is added.

2. When blasting through the mountain interior without retaining walls, implement the blasting method used for embankment roadbeds.

Article 135: Blasting through tunnels primarily involves destroying the arch top, causing the roadbed to collapse.

陷，造成积水，冲毁路基。

(一) 在涵洞内爆破拱顶。将装药设置在涵洞内，紧贴拱顶排成一行 (图 8—4)。装药量按 $C = 1.3ABR^3$ 计算。破坏半径等于涵洞净空高度的 $1/2$ ，装药间距等于破坏半径的 2 倍。根据涵洞内有无积水，可分别用浮筏或台架等设置装药 (图 8—5)。

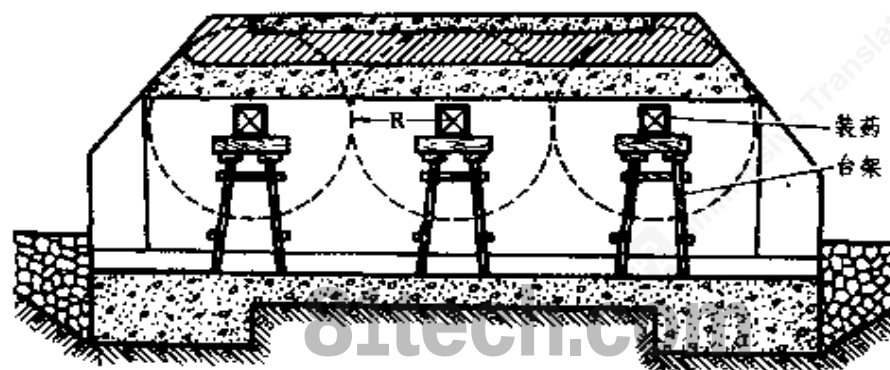
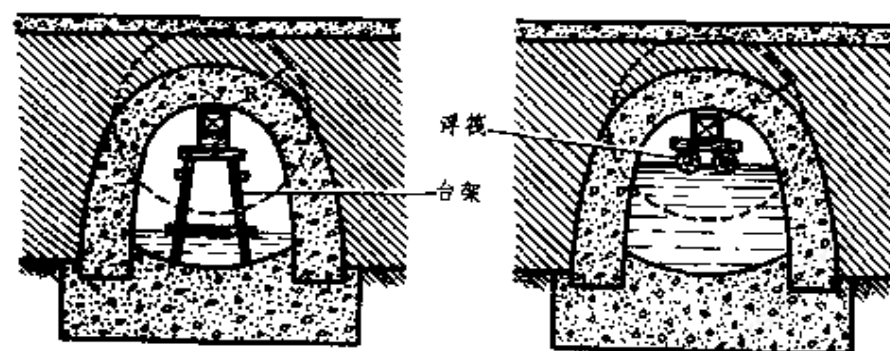


图 8—4 装药紧贴涵洞拱顶成一行配置



(一) 利用台架设置装药

(二) 利用浮筏设置装药

图 8—5 涵洞内有水时的装药配置

(二) 在路面上开设药洞爆破拱顶。当涵洞处的填土路基厚度不大或不便于在涵洞内设置装药时，可在路面上开设垂直药洞，装药设置在拱顶上部。装药量按 $C = 1.3ABR^3$ 计算。破坏半

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径，造成积水，冲毁路基。

(i) Blast the crown of the culvert. Place the charges inside the culvert, aligned in a row directly against the crown (Fig. 84). The charge quantity is calculated according to $C=1.3ABR^3$. The radius of destruction equals $1/2$ of the clear height of the culvert, and the spacing between charges equals twice the radius of destruction. Depending on whether there is standing water inside the culvert, the charges can be set using floating platforms or stands, etc. (Fig. 8-5).

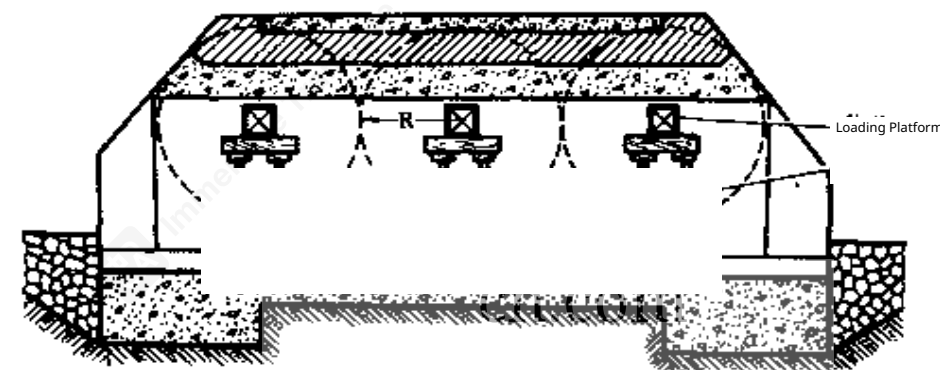
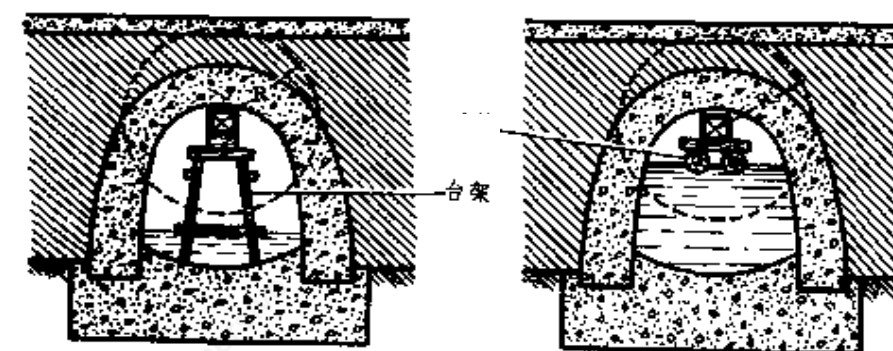


Figure 84: Charges placed tightly against the arch crown of the culvert in a row.



(1) Set up the charge using a test stand.

(2) Use floating charge placement

Figure 8-5: Charge configuration when water is present inside the culvert

(2) Open a vertical charge hole at the road surface and place the charge at the crown. When the backfill embankment thickness at the culvert is small or it is not convenient to place the charge inside the culvert, open a vertical charge hole at the road surface and place the charge at the upper part of the crown. The charge quantity shall be calculated according to $C=1.3ABR^3$. Destroy the half

径等于装药中心至涵洞净空高度的 1/2 处之间的距离，装药间距等于破坏半径的 2 倍。药洞深度不小于填土路基高度的 2/3（图 8—6）。

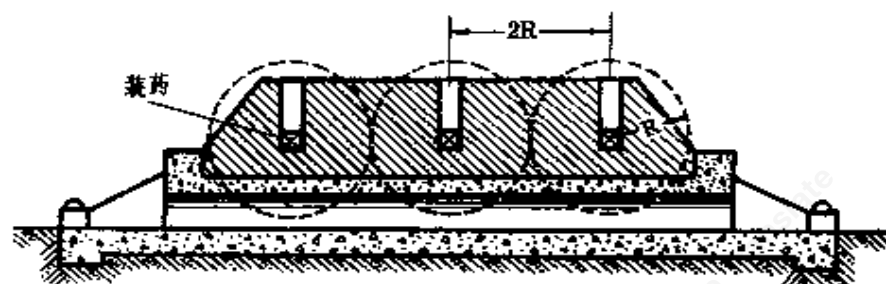


图 8—6 由路面开设药洞设置装药

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第一百三十六条 破坏铁路运输，除爆破桥梁、涵洞、路基之外，还要爆破道床设施、车站设施、隧道及机车、车厢等。

第一百三十七条 爆破道床设施主要是毁坏钢轨、道岔、辙叉。

(一) 爆破钢轨时，用 400 克梯恩梯药块紧贴轨头下缘（或轨腰）设置，用土石填塞或用铁丝夹夹紧，可将钢轨炸断（图 8—7（一））。在开阔地段爆破时，部分破片向设置装药相反方向的飞散距离可达 500 米，其余方向为 200 米，故须注意警戒。

(二) 爆破辙叉时，用 0.8~1.6 千克梯恩梯集团装药，设置在辙叉心和翼轨之间，可将辙叉炸毁（图 8—7（二））。

(三) 爆破道岔时，用两块 400 克梯恩梯药块分别设置在两辙轨和基本轨之间，可将道岔炸毁（图 8—7（三））。

第一百三十八条 爆破车站设施，主要是毁坏给水、自动化控制、机车回转设备等。

(一) 爆破给水设施，可炸毁水塔与水鹤。

The distance from the center of the charge to the point where the net height is half the distance, the charge interval equals twice the radius of destruction. The depth of the charge hole shall not be less than two-thirds of the height of the embankment fill (Figure 8-6).

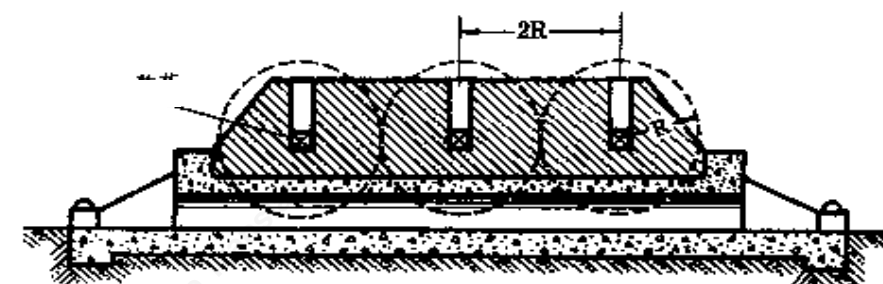


Figure 8-6: Open charge holes in the road surface and place charges.

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第二节 铁路的爆破

Article 136: Destruction of railway transportation, in addition to blasting bridges, culverts, and roadbeds, also includes blasting trackbed facilities, station facilities, tunnels, and locomotives, carriages, and other equipment.

Article 137: Blast track bed facilities mainly destroy rails, switches, and frog supports.

(一) 爆破钢轨时，用 400 克梯恩梯药块紧贴轨头下缘（或轨腰）设置，用土石填塞或用铁丝夹夹紧，可将钢轨炸断（图 8—7（一））。在开阔地段爆破时，部分破片向设置装药相反方向的飞散距离可达 500 米，其余方向为 200 米，故须注意警戒。

8-7(1). When blasting in open areas, fragments may scatter up to 500 meters in the direction opposite to the charge placement, and up to 200 meters in other directions; therefore, vigilance is required.

(2) When blasting a switch rail, use 0.8~1.6T grams of C4 explosive placed between the switch rail heart and the wing rail, which can destroy the switch rail (Fig. 8-7(2)).

(三) 爆破道岔时，用两块 400 克梯恩梯药块分别设置在两辙轨和基本轨之间，可将道岔炸毁（图 8—7（三））。

Article 138: Blasting railway station facilities, mainly damaging water supply, automated control, and locomotive turning equipment.

(一) 爆破给水设施，可炸毁水塔与水鹤。

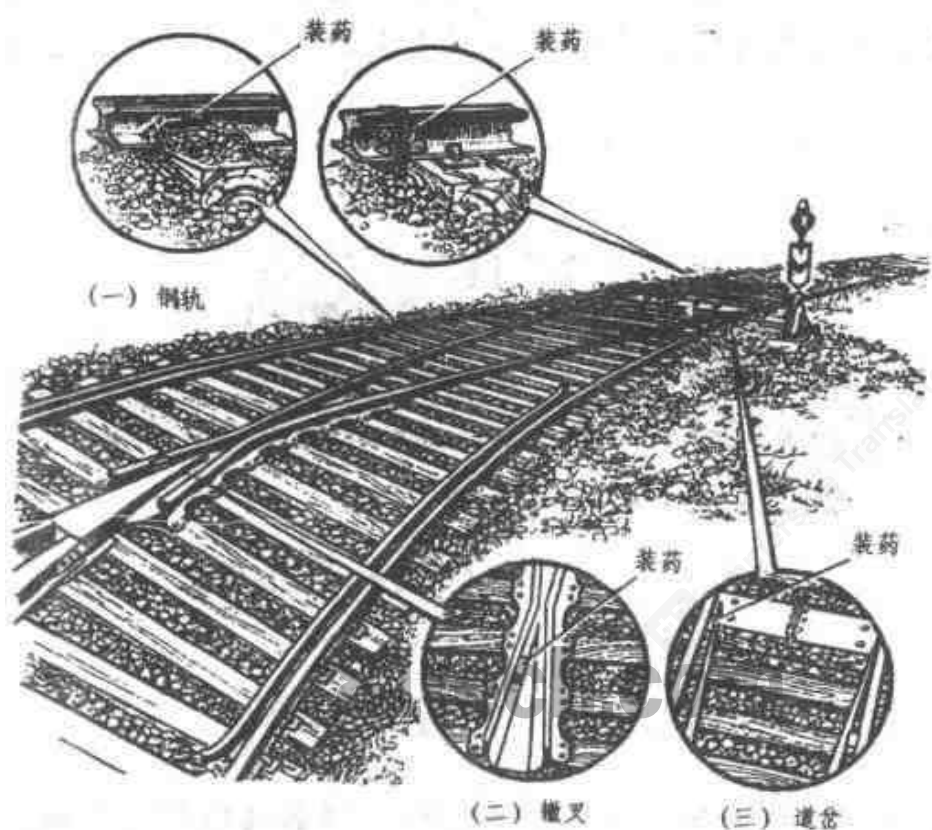


图 8—7 铁路的爆破

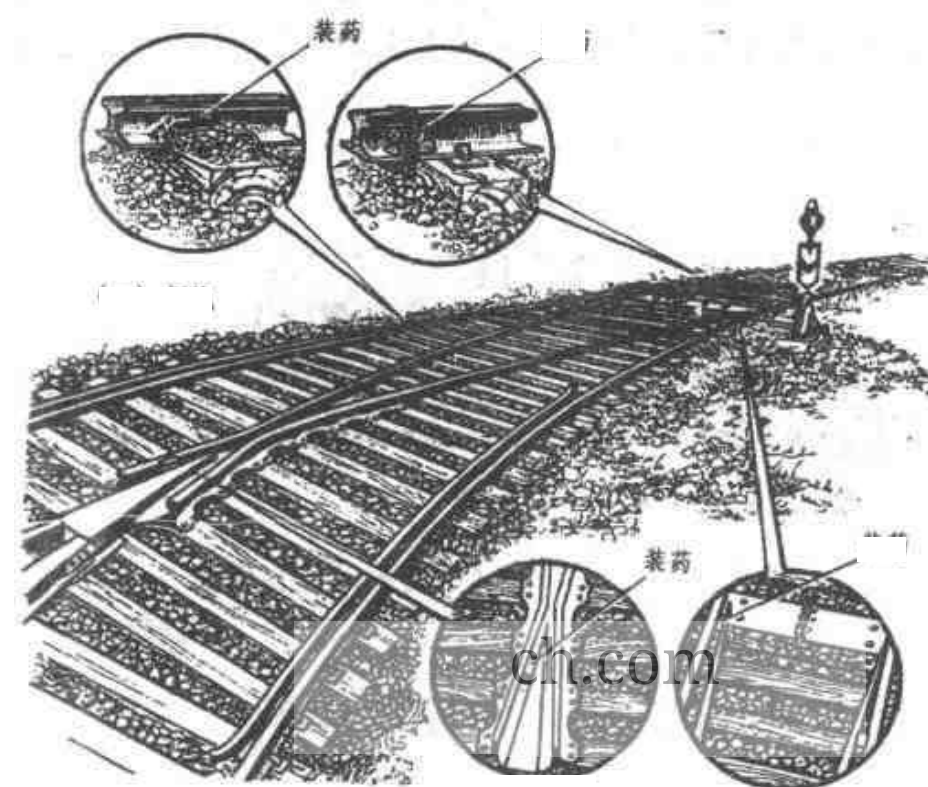


Figure 8-7 Blasting of the railway

1. 水塔的爆破见第一百一十七条。

2. 爆破水鹤时，可将 0.8 千克梯恩梯炸药设置在导水管阀门旁；或将 1.6 千克梯恩梯炸药设置在水鹤柱旁爆破（图 8—8）。

（二）爆破自动化控制设备时，可将 0.6 ~ 1.2 千克梯恩梯炸药设置在监控室内的操纵台、机电室内的继电器和电缆束等处，将其炸毁。

（三）爆破机车回转设备时，对于三角式轨道回转设备，可按钢轨的爆破方法实施；对于转盘式回转设备，可将 4 千克梯恩梯集团装药设置在中轴旁（图 8—9（一）），或将两个 400 克梯恩梯药块设置在滚轴旁（图 8—9（二））爆破。转盘桁架按钢桥桁架的爆破方法实施。

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1. The explosion of the water tower is governed by Article 117.

2. When blasting the water hydrant, 0.8 kg of TNT can be placed next to the guide valve; or 1.6 kg of TNT can be placed next to the hydrant column for blasting (Fig. 8-8).

(2) When detonating automated control equipment, TNT explosives weighing 0.6 ~ 1.2 kilograms may be placed at the control panel in the monitoring room, at the relays and cable bundles in the electromechanical room, and other locations to be destroyed.

(2) When blasting locomotive turning equipment, triangular track turning equipment may be blasted according to the rail blasting method; for turntable turning equipment, 4 kg of TNT charges may be placed beside the central axis (Figure 8-9(1)), or two 400 g TNT blocks may be placed beside the rollers (Figure 8-9(2)) for blasting. Turntable trusses shall be blasted according to the steel bridge truss blasting method.

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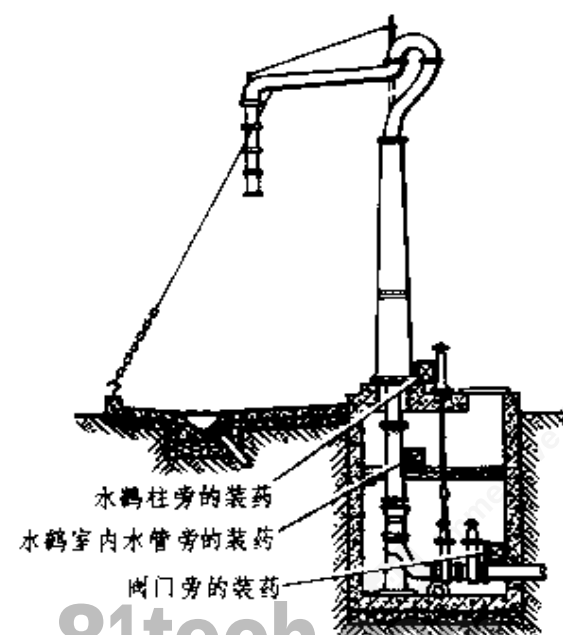


图 8--8 水鹤的爆破

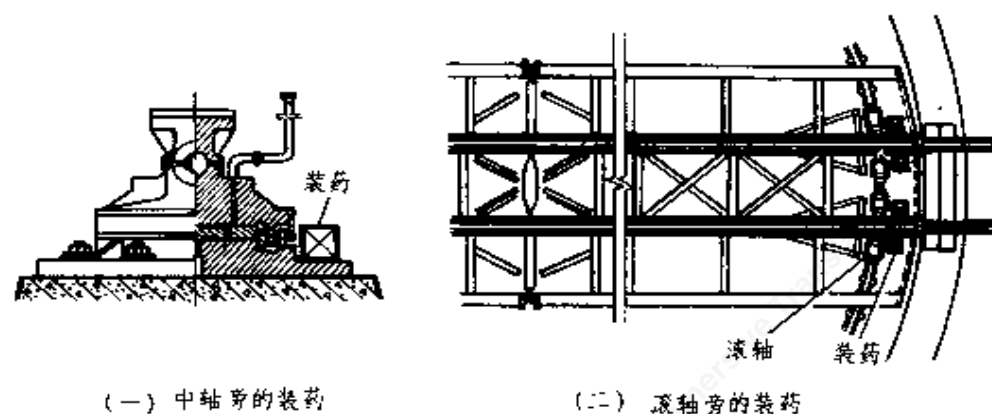


图 8—9 转盘的爆破

第一百三十九条 爆破机车、车厢，对蒸气机车，可将装药设置在摇杆或勾贝杆旁；对未生火的机车，装药可设置在气缸、气包、主蒸汽管安全阀、锅炉壁处（图 8—10）；对内燃机车，

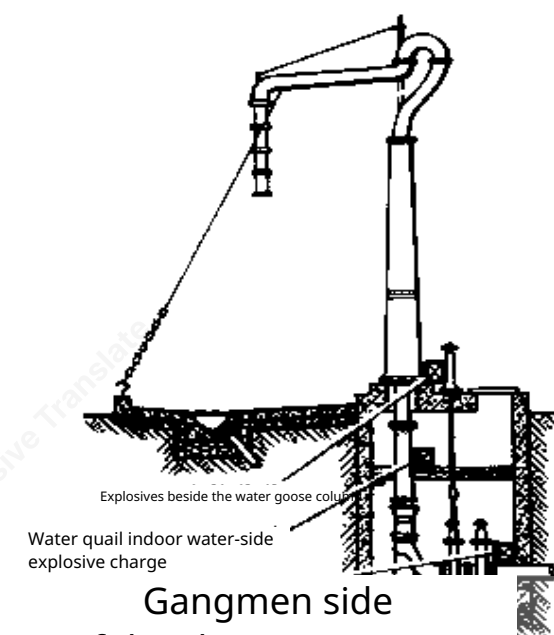


Figure 8---8 Water Crane Blasting

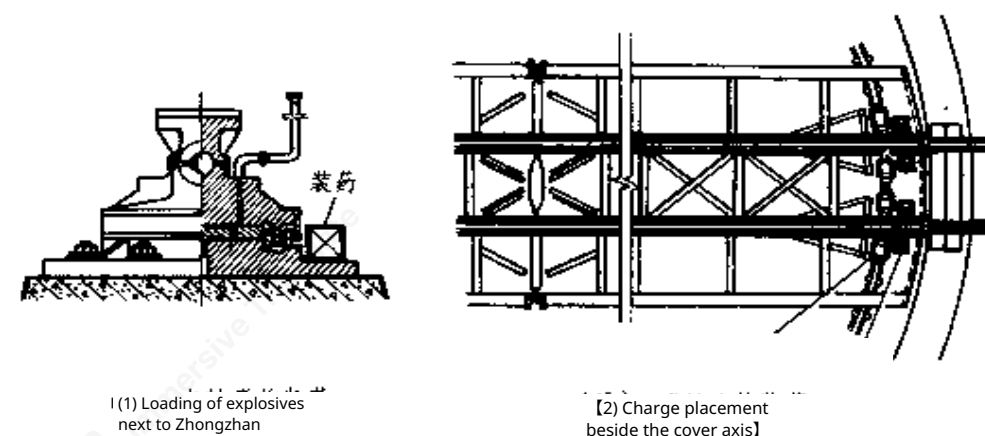


Figure 89: Explosion of the Roulette

Article 139: For blasting locomotives and carriages, for steam locomotives, the charge may be placed near the connecting rod or piston rod; for locomotives that are not yet fired, the charge may be placed near the cylinder, steam dome, main steam pipe safety valve, or boiler wall (Figures 8-10); for internal combustion locomotives,

可将装药设置在发动机、变速箱、油箱及驾驶室操纵台等处；对电力机车，可将装药设置在机车的变压器、整流器、直流电动机和传动机构等处；其装药量均为1~2千克梯恩梯炸药。对车厢，可用数个400克梯恩梯药块分别设置在减震弹簧上面、车轴或车轮折缘上爆破（图8—11）。

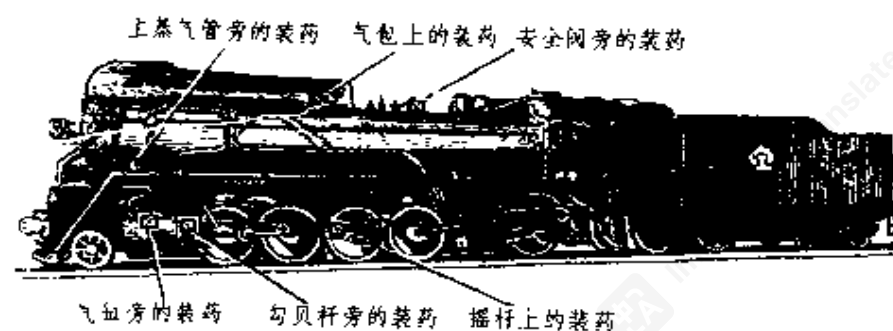


图8—10 机车的爆破

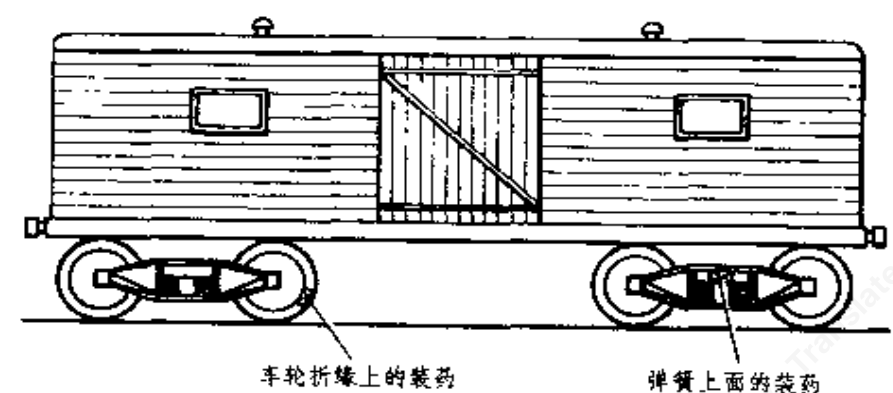
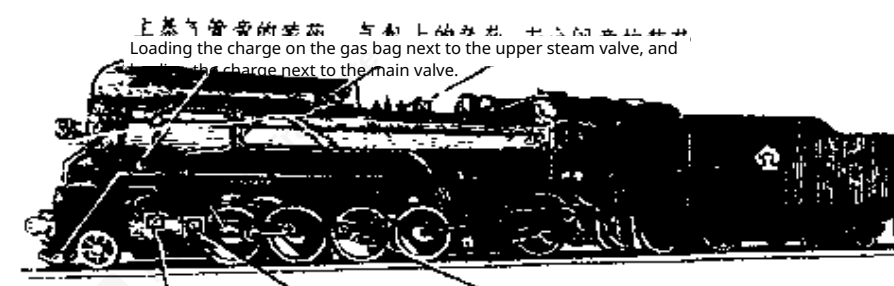


图8—11 车厢的爆破

第一百四十条 爆破隧道，主要是炸塌岩层堵塞隧道。对较短的隧道，可只炸毁其两端入口；对较长的隧道还要炸毁中间部分。还可采用在隧道中爆破钢轨颠覆列车的方法堵塞隧道。

(一) 爆破隧道入口部。可在隧道上部距隧道口10~20米处

The explosive charge can be placed in the engine, transmission, fuel tank, and driver's cab control panel; for electric locomotives, it can be placed in the locomotive's transformer, rectifier, direct current motor, and transmission mechanism; the charge quantity is 1~2 kilograms of TNT. For the car, several 400-gram TNT blocks can be placed on top of the shock absorber springs, on the axle, or on the wheel flange for blasting (Fig. 8-11).



Loading of explosives on the side of the gas pipe and on the side of the rod and on the loading on the shaft 81tech.com

Figure 8-10 Locomotive Explosion

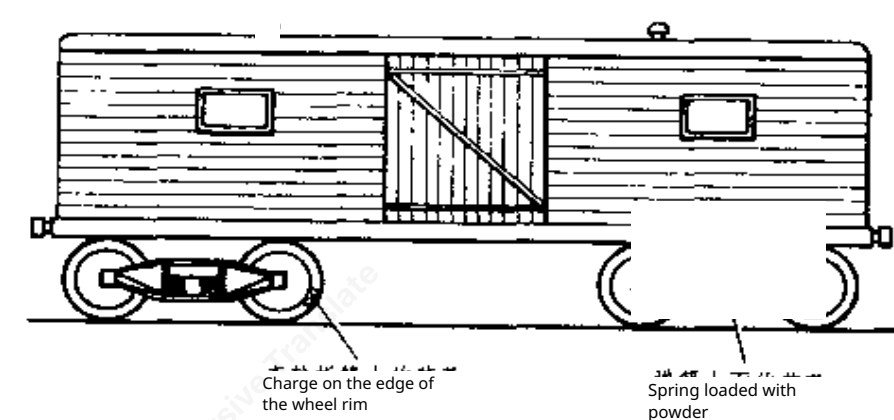


Figure 8-11 Blasting of the carriage

Article 140: Blasting tunnels primarily involves collapsing rock strata to block the tunnel. For shorter tunnels, only the entrances at both ends need to be destroyed; for longer tunnels, the middle section must also be blasted. Another method involves blasting railway tracks within the tunnel to overturn trains and block the tunnel.

(1) Blasting tunnel entrance section. Can be located at 10~20 meters above the tunnel entrance.

开设药洞，设置 1~2 个集团装药。隧道上部岩层很厚时，可开设平坑道（图 8—12（一））；如隧道上部岩层较薄，则开设垂坑道（图 8—12（二））。为了能崩塌大量岩石堵塞隧道，装药至被覆层上表面的距离应不小于 3 米。装药量按第八十一条公式计算。A 值依被覆层材料确定。

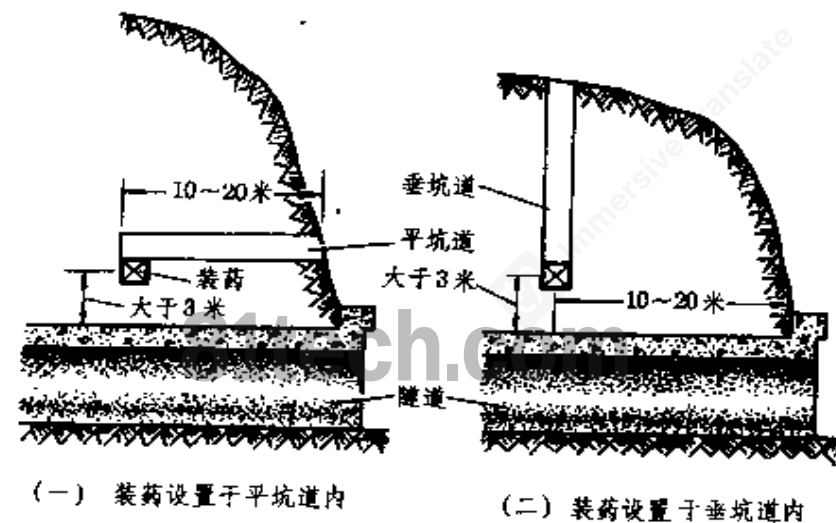


图 8—12 开设坑道爆破隧道

（二）爆破隧道中间部分。如岩层为松软岩石，可将装药紧靠被覆层（图 8—13（一）），装药量按 $C = 1.3ABR^3$ 计算。破坏半径取被覆层厚度的 2 倍，装药间距取破坏半径的 2 倍；如岩层为坚硬岩石，则装药应离开被覆层（图 8—13（二）），以使崩塌较多的岩石，装药量按 $C = 1.3ABR^3$ 计算，A 值取被覆层材料的抗力系数，破坏半径取被覆层厚度的 2~3 倍，装药间距取 1~1.5 个破坏半径。

Open a drug cave and set 1~2 group charges. When the rock layer above the tunnel is very thick, open a horizontal pit (Fig. 8-12(I)); if the rock layer above the tunnel is relatively thin, open a vertical pit (Fig. 8-12(II)). To ensure a large amount of rock collapses to block the tunnel, the distance from the charge to the upper surface of the overburden should not be less than 3 meters. The charge quantity is calculated according to the formula in Article 81. The value of A is determined based on the overburden material.

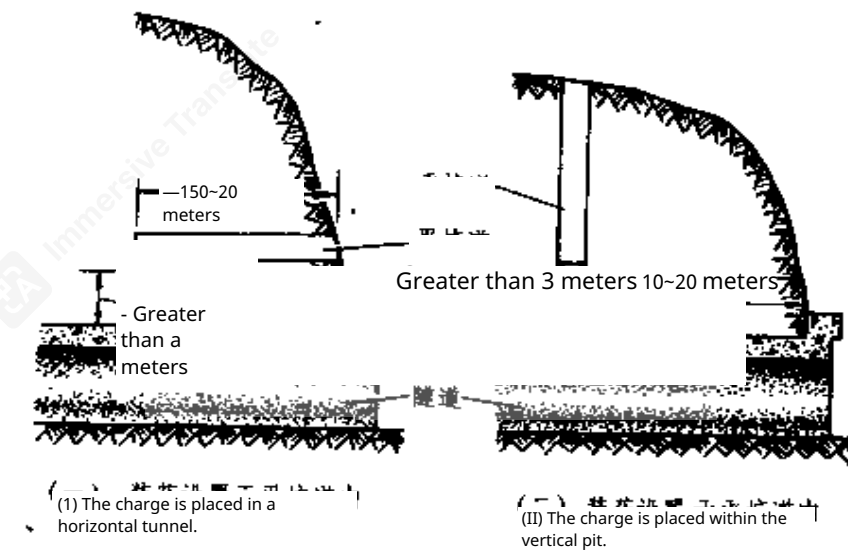
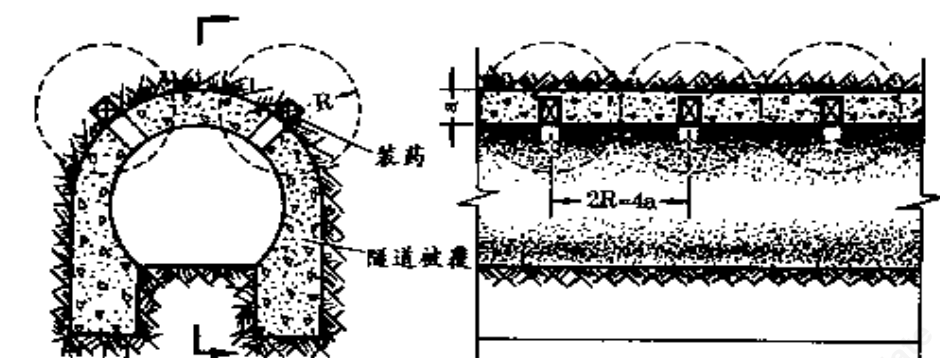
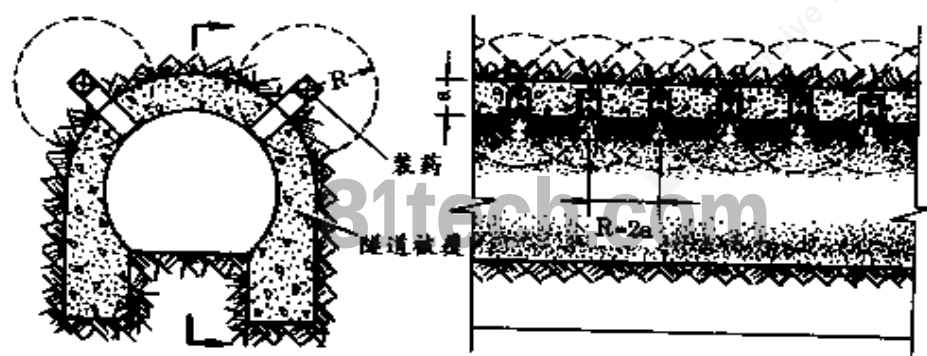


Figure 8-12: Open-cut tunnel blasting

(2) Blast the middle section of the tunnel. If the rock layer is soft, place the charges tightly against the cover layer (Fig. 8-13(1)), and calculate the charge quantity according to $C=1.3ABR^3$. The radius of destruction shall be twice the thickness of the cover layer, and the spacing between charges shall be twice the radius of destruction. If the rock layer is hard, the charges should be placed away from the cover layer (Fig. 8-13(2)) to facilitate the collapse of a larger amount of rock. The charge quantity shall be calculated according to $C=1.3ABR^3$, where the value of A is the resistance coefficient of the cover layer material, the radius of destruction shall be 2~3 times the thickness of the cover layer, and the spacing between charges shall be 1~1.5 times the radius of destruction.

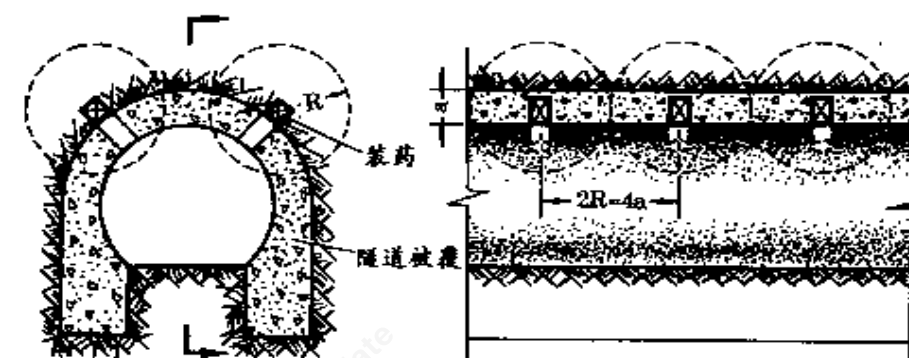


(一) 装药紧靠被覆层

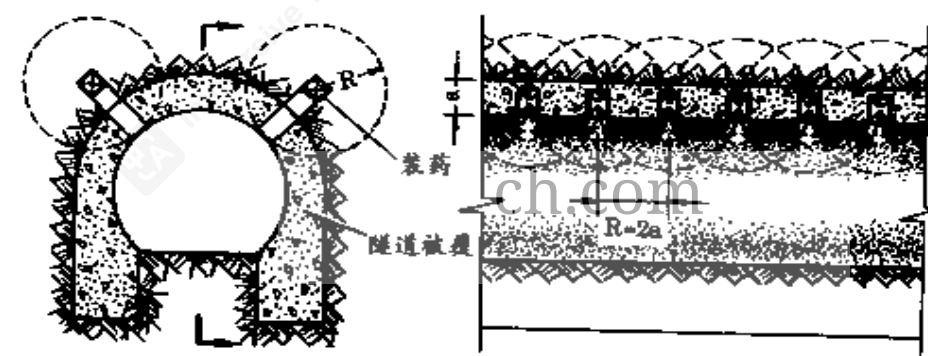


(二) 装药离开被覆层

图 8—13 从内部开设药洞爆破隧道



Charge tightness
process layer



(2) Charge separation from
the borehole layer

Figure 8-13 Tunnel blasting with internal drill
holes

第九章 码头、堤坝、机场、 管 线 的 爆 破

第一百四十一条 用爆破法在我军准备撤出地区对码头、堤坝、机场、管线等目标实施破坏，可在撤离前预先实施，也可以预先设置延期装药或遥控装药，使其在预定时间内爆炸或遥控起爆。在敌后实施爆破作业时，应采取秘密行动或在火力掩护下，接近目标强行爆破。

第一节 码头、堤坝的爆破

第一百四十二条 爆破码头，应根据其结构类型采取不同的方法。

(一) 爆破框架码头，可炸毁所有桩柱使其倒塌。如仅破坏上部结构则按爆破钢桥桁架或钢筋混凝土梁（柱）的方法实施。采用外部集团装药爆破钢筋混凝土框架码头时，可将装药配置在桩柱上；所有炸断面上的装药，应从码头内侧向外成下斜线式配置（图 9—1）。装药量按 $C = 1.3ABR^3$ 计算。破坏半径取桩柱直径或矩形断面短边的尺寸。

(二) 爆破方块码头，通常采用内部集团装药。装药设置在胸墙后由地面开设的垂坑内（图 9—2），垂坑深度要低于水面，并不小于破坏半径。装药量按 $C = 1.3ABR^3$ 计算。破坏半径取装药处墙身厚度，装药间距取破坏半径的 1.5 倍。

(三) 爆破趸船码头，用 3~4 个集团装药，均匀配置在趸船一侧船舷水线下；每个装药的药量为 3~5 千克。也可用装药量

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Chapter 9: Blasting of wharves, embankments, and airport pipelines

Article 141: When using blasting methods to destroy docks, dams, airports, pipelines, and other targets in areas from which our army is preparing to withdraw, the operation may be carried out in advance before withdrawal, or delayed charges or remotely controlled charges may be pre-set so that they explode or are detonated within a predetermined time. When conducting blasting operations in enemy-held areas, secret operations should be undertaken, or the operation should be carried out under fire support.

Forcefully breach the target at 81tech.com

Section 1: Blasting of Wharves and Dams

Article 142: When blasting a wharf, different methods shall be adopted according to its structural type.

(1) Blast framework wharf: capable of destroying all piles and columns to cause them to collapse. If only the superstructure is to be damaged, implement it according to the method of blasting steel bridge trusses or reinforced concrete beams (columns). When using external group charges to blast reinforced concrete framework wharves, the charges can be configured on the piles and columns; all charges on the fractured surfaces should be configured in a downward diagonal line from the inner side of the wharf to the outer side (Figure 9-1). The charge quantity shall be calculated according to $C = 1.3ABR^3$. The radius of destruction shall be taken as the diameter of the pile and column or the dimension of the shorter side of the rectangular cross-section.

(2) Blast the block wharf, typically using internal group charges. The charges are placed in a vertical pit dug from the ground behind the breast wall (Fig. 9-2). The depth of the vertical pit must be lower than the water surface and not less than the radius of destruction. The charge quantity is calculated according to $C = 1.3ABR^3$. The radius of destruction is taken as the wall thickness at the charge location, and the charge spacing is taken as 1.5 times the radius of destruction.

(3) Blastboat wharf, using 3~4 group charges, uniformly distributed on one side of the boat below the waterline; the charge weight for each charge is 3~5 kilograms. Alternatively, the charge weight can be

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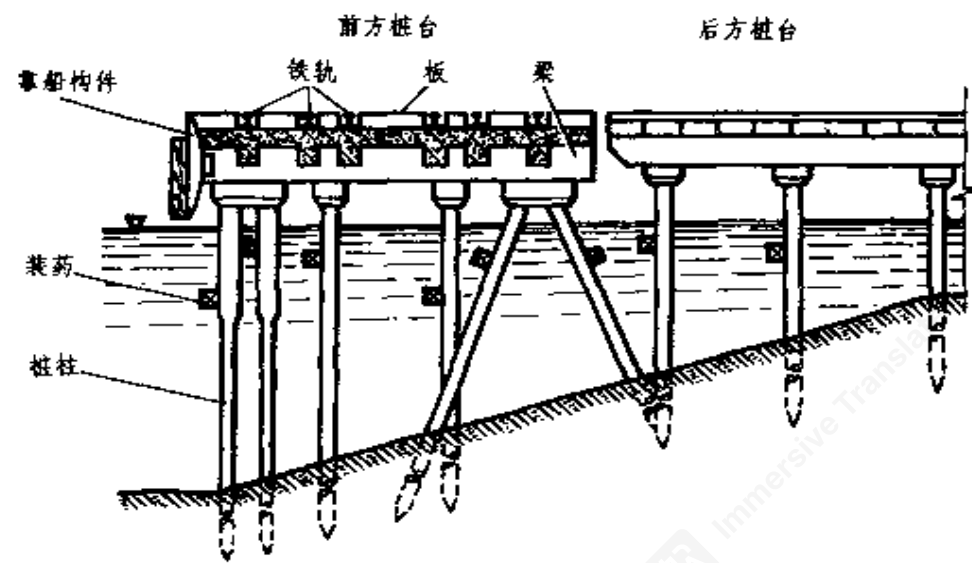


图 9-1 框架码头的爆破

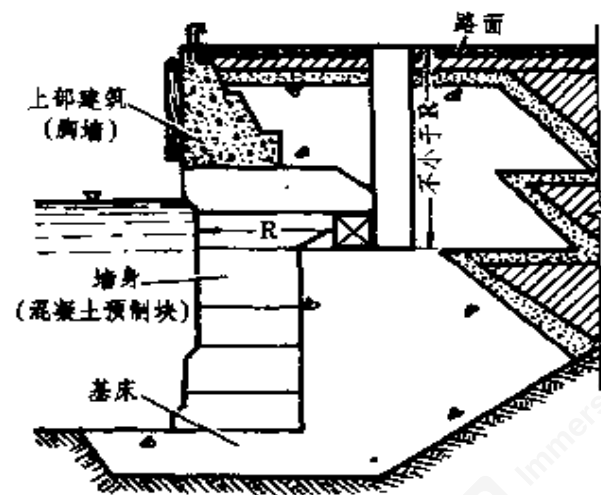
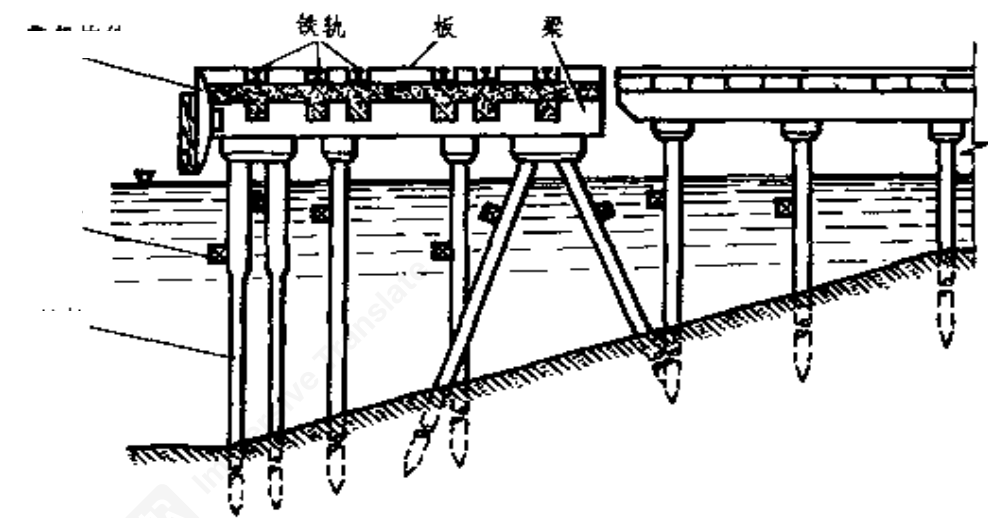


图 9-2 方块码头的爆破

相当的防坦克地雷、陆军水雷或磁性水雷爆破。

(四) 爆破沉箱码头，可将装药设置在舟（筏）上靠在码头。



81tech.com 框架码头的爆破
Figure 9

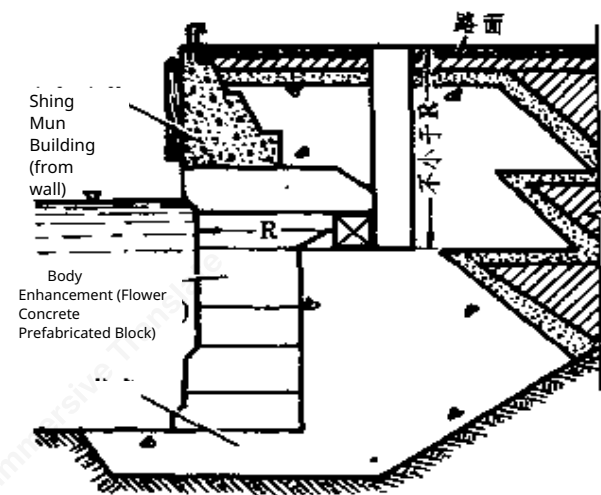


Figure 9-2: Blasting of the Blockade Wharf

equivalent anti-tank mines, land mines, or magnetic mines for detonation,

((4) Blast caisson wharf: the charge can be placed on a boat (筏) and leaned against the wharf.

边上实施爆破 (图 9—3)。装药量按 $C = 10Ah r^2$ 计算。A 值取钢筋混凝土的抗力系数, h 值取沉箱壁厚, r 为由装药中心至码头外缘的距离, 可取码头宽度。

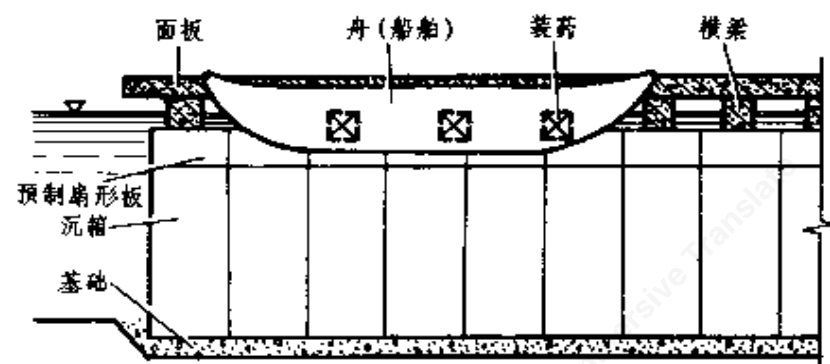


图 9—3 沉箱码头的爆破

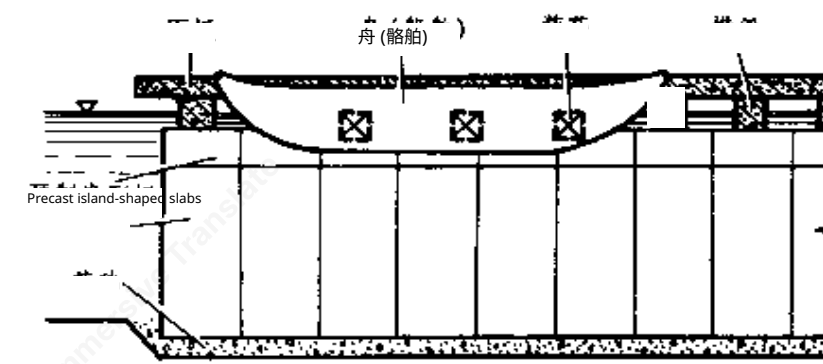
在时间仓促情况下, 只要条件允许 (如有船), 对各种结构形式码头的爆破, 均可采用爆破沉箱式码头的方法。

第一百四十三条 爆破土坝, 应开挖药室 (洞), 将装药设置于坝体内, 并低于水面线。装药量按加强抛掷装药计算。

爆破混凝土和钢筋混凝土溢流坝, 可将装药设置在闸墩上或闸门旁的水中, 或坝身节道内 (图 9—4 (一)), 装药量按第一百四十三条公式计算; 破坏半径根据所需破坏范围确定。

爆破有发电站的混凝土和钢筋混凝土溢流坝, 装药还可设置在主闸门和检修闸门旁的闸墩上。当须爆破发电设备时, 装药应直接设置在水轮机室、发电机室和变电室的主要机件上 (图 9—4 (二))。

Explosive blasting is carried out on the side (Figure 9—3). The charge quantity is calculated according to $C=10Ah$. The value of A is taken as the resistance coefficient of reinforced concrete, the value of h is taken as the thickness of the caisson wall, and r is the distance from the center of the charge to the outer edge of the wharf, which can be taken as the wharf width.



8eci Box Terminal Sample Break

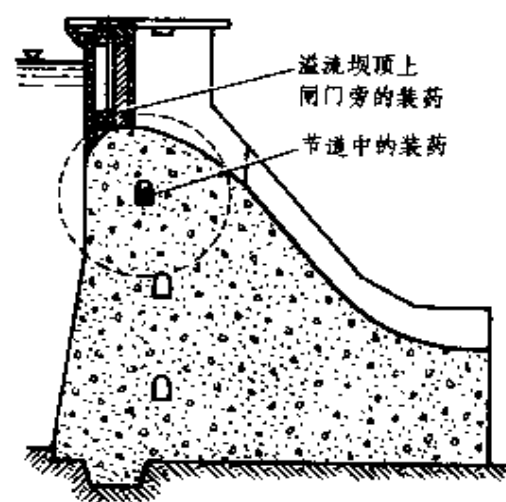
In time-constrained situations, provided conditions permit (such as the availability of vessels), demolish various structural forms of wharves.

All can be constructed using the blast-and-settling cofferdam method.

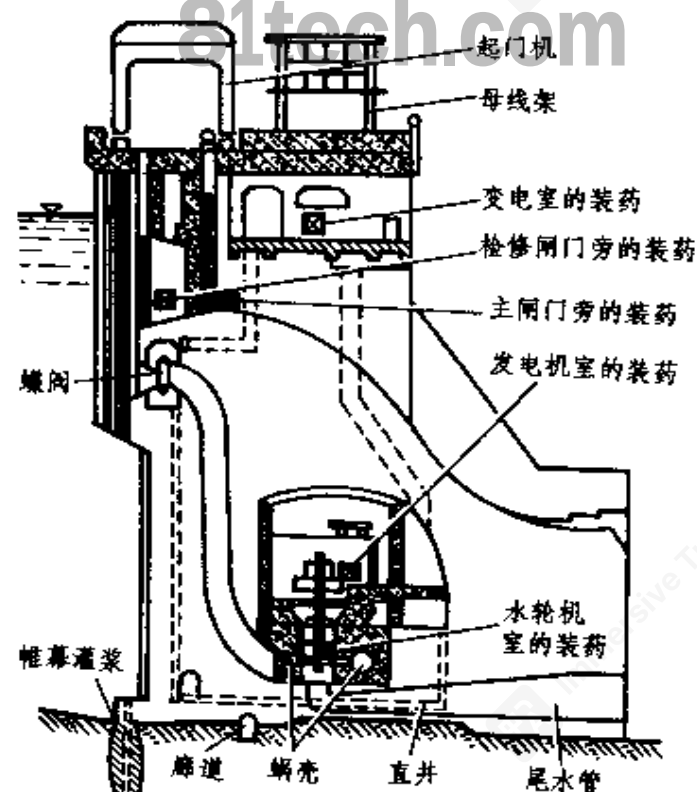
Article 143. When blasting an embankment dam, a charge chamber (hole) shall be excavated, and the charges shall be placed within the dam body and below the waterline. The charge quantity shall be calculated based on reinforced throwing charges.

Explosive concrete and reinforced concrete spillways can have charges placed in the water beside the gate piers or gates, or within the dam's joints (Fig. 9-4(1)); the charge quantity is calculated according to the first three formulas; the radius of destruction is determined based on the required destruction area.

Explosive charges are placed on the concrete and reinforced concrete spillways of the power station. The charges can also be set on the gate piers next to the main gate and the maintenance gate. When it is necessary to detonate the power station equipment, the charges should be placed directly on the main components of the water turbine room, generator room, and substation (Figure 9-4).

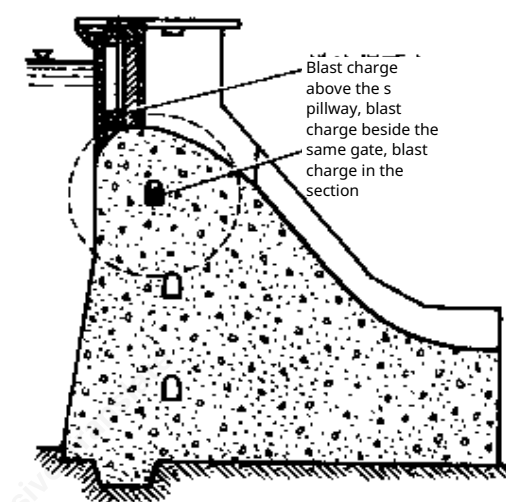


(一) 混凝土溢流坝

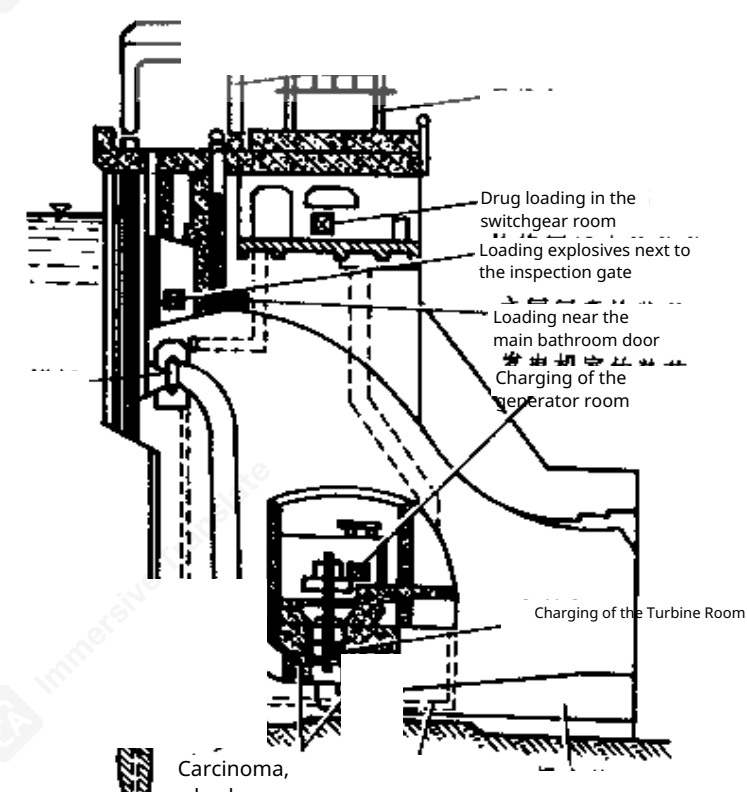


(二) 带发电站的混凝土溢流坝

图 9—4 堤坝的爆破



(一) Concrete spillway dam



(2) Concrete ogee spillway with power station

Figure 9-4 Blasting of the dam

第二节 机场的爆破

第一百四十四条 爆破机场，主要是破坏跑道、滑行道、停机坪、飞机库、导航台、雷达站以及油库、弹药库等。

(一) 爆破跑道、滑行道、停机坪时，可用内部集团装药开设漏斗坑或壕沟，装药量按加强抛掷装药计算；当不能采用内部装药时，则将 50~100 千克的梯恩梯集团装药放在跑道、滑行道表面爆破。

(二) 爆破飞机库、导航台、雷达站时，可用 0.4~0.6 千克梯恩梯炸药炸毁导航台的无线电导航设备、雷达站的雷达机及雷达天线；同时用 0.6~0.8 千克梯恩梯炸药炸毁为上述设备提供能源的变电站（所）、发电机、变压器。爆破飞机库、导航台、雷达站的建筑物按第六章第三节方法实施。

(三) 爆破油库、弹药库，按第十一章第六节方法实施。

第三节 管线设施的爆破

第一百四十五条 爆破输油、输气管线设施，主要是破坏贮油（气）罐、输油（气）泵及其管线。

(一) 爆破贮油罐时，对永久性贮油罐的爆破分别按第六章第二节（金属罐）、第三节（钢筋混凝土罐）规定的方法实施。野战贮油罐的爆破，可将 0.4~1 千克梯恩梯炸药设置在贮油罐口部爆破并造成纵火（图 9—5）。

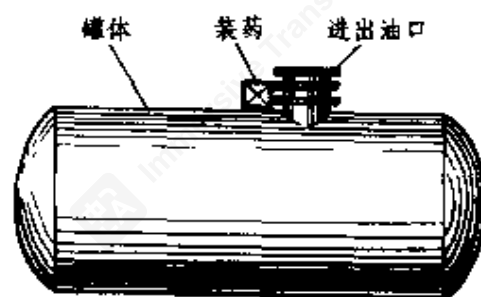


图 9—5 油罐的爆破

Section 2: Blasting at the Airport

Article 144: Blowing up an airport mainly involves destroying runways, taxiways, aprons, hangars, navigation towers, radar stations, as well as fuel depots and ammunition stores.

(1) When blasting runways, taxiways, or aprons, use internal group charges to create hopper pits or trenches; the charge quantity shall be calculated based on reinforced throwing charges. When internal charges cannot be used, place 50 ~ 100 kg of TNT group charges on the surface of the runway or taxiway for blasting.

(2) When demolishing aircraft hangars, navigation towers, or radar stations, use 0.4 ~ 0.6 kg of TNT to destroy the radio navigation equipment of the navigation tower, the radar equipment of the radar station, and the radar cables; simultaneously use 0.6 ~ 0.8 kg of TNT to destroy the generators and transformers of substations (stations) that provide power to the aforementioned equipment. The demolition of the buildings of aircraft hangars, navigation towers, and radar stations shall be carried out in accordance with the method specified in Section 3 of Chapter 6.

(3) For blasting oil depots and ammunition depots, implement according to the method in Section 6 of Chapter 11.

Explosion of the pipeline facilities in the first section

Article 145: Blasting oil and gas pipeline facilities mainly involves damaging oil (gas) tanks, oil (gas) pumps, and their pipelines.

(1) When blasting oil, the blasting of permanent oil storage tanks shall be carried out according to the methods prescribed in Section 2 (metal tanks) and Section 3 (reinforced concrete tanks) of Chapter 6. For the blasting of field oil storage tanks, 0.4~1 kilograms of TNT may be placed at the top of the oil storage tank to cause blasting and arson (Figure 9-5).

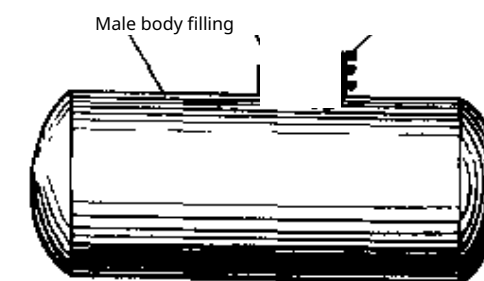


Figure 9--5: Explosion of the oil tank

对钢筋混凝土贮气柜（罐）的爆破按第六章第三节规定的方法实施；对钢质贮气柜（罐）的爆破按第六章第二节规定的方法实施。对贮存可燃气体的贮气柜（罐），在爆破的同时应尽量造成纵火。

（二）爆破输油（气）泵时，可将 0.4 ~ 1 千克梯恩梯炸药设置在输油泵、电动机或其他动力设备上以及输气加压泵的壳体上爆破。

（三）爆破输油（气）管时，可将 0.4 千克梯恩梯炸药设置在输油管的结合部爆破（图 9—6）；也可将 0.4 ~ 1 千克梯恩梯炸药设置在输气管壁上爆破，使之泄漏并燃烧；或将 2 千克的直列装药设置在输油（气）管闸阀旁爆破，装药长度约为 0.5 米（图 9—7）。

第一百四十六条 爆破输水、输料管线，主要是破坏管道和泵站的传动部分。

（一）爆破输水管道时，对架空和地面设置的输水管，应将装药紧贴在管壁上爆破。装药量应根据管材不同分别按第一百一十二条、第一百一十三条的规定计算；爆破埋设在地下的输水管线时，应在输水管线上方或侧方开

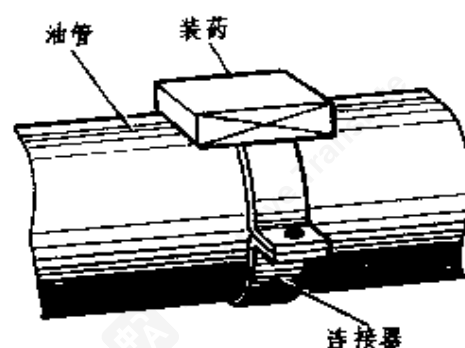


图 9—6 油管的爆破

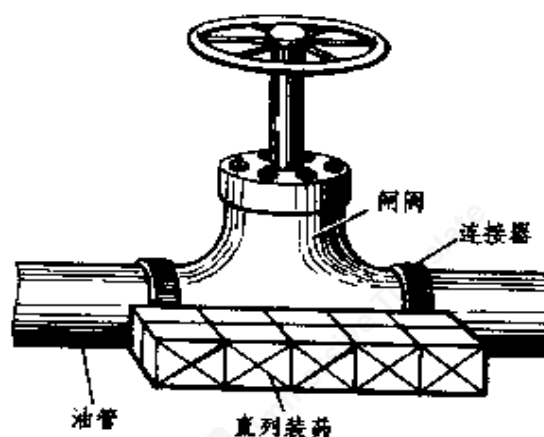


图 9—7 输油管闸阀的爆破

Explosive demolition of reinforced concrete gas storage tanks (vats) shall be carried out in accordance with the methods prescribed in Section 3 of Chapter 6; explosive demolition of steel gas storage tanks (vats) shall be carried out in accordance with the methods prescribed in Section 2 of Chapter 6. For gas storage tanks (vats) storing flammable gases, an attempt should be made to ignite them simultaneously with the explosion.

() When blasting oil (or gas) pumps, place 0.4 ~ 1 kilograms of TNT explosive on the oil pump, motor, or other moving equipment, as well as on the casing of the gas pressurization pump.

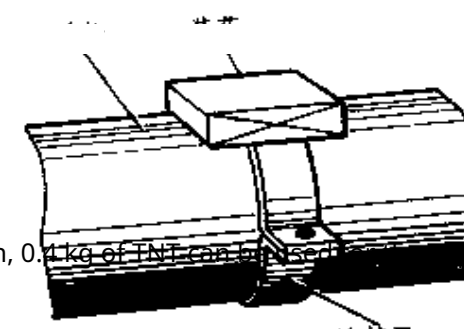
(3) During blasting oil (or gas) transportation, 0.4 kg of TNT can be used explosive mixture.

Explosion at the joint of the oil pipeline (Fig. 9-6): Alternatively, 0.4 g of TNT can be placed against the wall of the gas pipeline to cause an explosion, resulting in leakage and combustion; or a 2 kg linear charge can be placed next to the gate valve of the oil (gas) pipeline to cause an explosion, with a charge length of 0.5 m (Fig. 9-7).

Article 146: Blasting water and material pipelines mainly damages the transmission parts of the pipes and pumping stations.

(--) When blasting water conveyance pipelines, for overhead and ground-level water conveyance pipes, the charge should be tightly pressed against the pipe wall for blasting. The charge quantity should be based on

According to the provisions of Article 112 and Article 113, depending on the type of pipe, when burying underground water supply pipelines, trenches shall be excavated above or to the side of the water supply pipeline.



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Figure 9-6: Bursting of the pipe

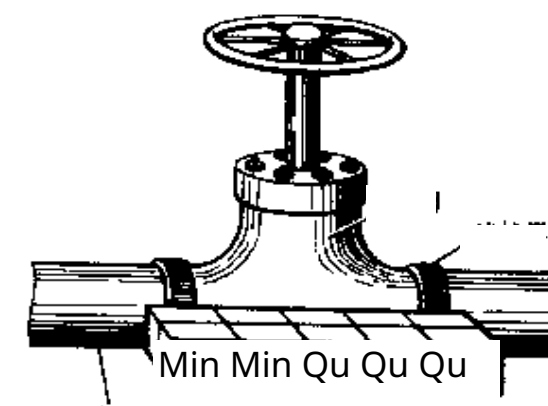


Figure 97 输油管闸阀的爆破

挖药洞，将装药设置在药洞中靠近输水管线爆破，以减少药量，便于水流溢出。

(二) 爆破泵站时，通常将 1~2 千克的集团装药设置在水泵的叶轮壳体上、发动机的转子壳体上以及闸阀上爆破。

(三) 爆破输料管道时，通常将 1~2 千克梯恩梯炸药设置在输料管管壁或接头处实施爆破；同时用 2~4 千克梯恩梯炸药爆破传动部分的电动机、滚筒、减速箱。

第一百四十七条 爆破输电路，主要是破坏架空线路的设备以及地下输电电缆等。

(一) 爆破架空输电路，可按以下方法实施。

1. 爆破输电铁塔时，通常在铁塔底部紧贴目标设置装药以炸断钢构件；装药配置与装药量计算按第六章第二节的规定实施。

2. 爆破输电钢管线杆按第一百一十二条的规定实施。

3. 爆破钢筋混凝土线杆时，对直线段单根线杆，应将 1 个 2~4 千克梯恩梯装药固定在离地固 0.5~1 米处的线杆外壁；对耐张段双根线杆，应将两个 2~4 千克梯恩梯装药固定在离地面 0.5~1 米处的线杆外壁。其爆破方法按第一百一十三条的规定实施。另外，炸断拉索也可使耐张段线杆倾倒。

4. 爆破木质线杆的方法按第一百零六条的规定实施。

5. 爆破变压器时，应将 1~2 千克梯恩梯炸药设置在变压器外部爆破，使其燃烧或爆炸。

(二) 爆破埋设在地下的输电电缆，应在爆破位置开挖药洞，使装药靠近电缆爆破；对设置在电缆沟和电缆隧道中的输电电缆，应将装药设置在电缆沟（隧道）中靠近电缆处爆破，装药量为 2~4 千克梯恩梯炸药。

Dig a blasting hole, place the explosive charge in the hole near the water supply pipe to reduce the amount of explosive used, and allow the water to flow out clearly.

(2) When blasting the pump station, the group charge of 1~2 grams is typically set in the water pump.

explosion of the impeller casing, the engine rotor casing, and the gate valve 施。

(3) When blasting the conveying pipeline, typically 1~2 kilograms of TNT are placed in the pipeline wall or at joints to implement blasting: simultaneously, 2~4 grams of TNT are used to blast the motors, rollers, and gearboxes of the transmission part.

Article 147 Explosive blasting of power lines: mainly involves damaging overhead line equipment and underground transmission cables, etc.

(1) Blasting overhead transmission lines may be implemented according to the following methods. 施。

1. When blasting transmission tower structures, explosives are typically placed directly against the target at the base of the tower to fracture steel components; the charge configuration and charge quantity calculations shall follow the provisions of Section 2, Chapter 6.

2. The blasting of transmission steel pipe poles shall be implemented in accordance with the provisions of Article 112. 施。

3. When blasting reinforced concrete poles, for single poles on straight sections, 1 pole should be

2~4 kilograms of TNT explosive are fixed to the outer wall of the pole located 0.5~1 meters above the ground; for double poles in a tension span, both 2~4 should be fixed to the outer wall of the pole located 0.5~1 meters above the ground. The blasting method shall be implemented in accordance with the provisions of Article 113. Additionally, breaking the stay cable can also cause the pole in the tension span to topple.

4. The method for blasting wooden poles shall be implemented in accordance with the provisions of Article 106. 施。

5. When blasting the transformer, 1~2 kilograms of TNT should be placed outside the transformer for blasting to cause it to burn or explode.

(二) 爆破埋设在地下的输电电缆，应在爆破位置开挖药洞，使装药靠近电缆爆破；对设置在电缆沟和电缆隧道中的输电电缆，应将装药设置在电缆沟（隧道）中靠近电缆处爆破，装药量为 2~4 千克梯恩梯炸药。

(2) For underground power transmission cables subjected to blasting, drill a charge hole at the blasting location to place the charge close to the cable for detonation; for power transmission cables installed in cable trenches or cable tunnels, detonate the charge in the trench (tunnel) near the cable, with a charge quantity of 2~4 grams of TNT.

第十章 障碍物和工事的爆破

第一节 筑城障碍物的爆破

第一百四十八条 铁丝网可用火箭爆破器、爆破筒或直列装药（通常为 4 千克/米梯恩梯炸药）爆破。用直列装药爆破时，必须在装药表面捆上 1~2 根与装药同长的钢筋或铁条；捆有钢筋或铁条的一面应朝向铁丝网，以增大切割作用。爆破筒和直列装药应紧靠桩脚插入，或靠近桩头放在铁丝网上；也可用与铁丝网同高的直列装药靠近木桩垂直挂在铁丝网上。爆破蛇腹形铁丝网时，可从上、下层之间插入（图 10—1）。装药的长度，应不小于铁丝网的纵深；当铁丝网纵深较大时，可实施连续爆破。爆破后开辟的通路宽度达 4~5 米。

第一百四十九条 鹿砦可用火箭爆破器爆破；对不同类型的桩砦的爆破所需装药量和配置方法如图 10—2 所示；对设在海滩上的轨条砦，用 3 千克梯恩梯药块，配置在钢轨和混凝土墩的结合部爆破（图 10—3），可炸断钢轨，同时炸碎混凝土墩。在桩砦中开辟通路时，各个装药应同时爆炸。若为木桩砦，可按第一百零七条实施。

第一百五十条 巨石可用外部集团装药或药孔法爆破。

当石块体积不超过 5 立方米时，可采用外部装药爆破。装药放在石块的坑凹处（图 10—4）。装药量按每立方米需 1~2 千克中级炸药计算。

当石块体积大于 5 立方米时，通常采用药孔法爆破。装药量按每立方米需 100~150 克中级炸药计算。药孔深度为石块高度

Chapter 障碍物和工事的爆破

Section 1: Blasting of Obstacles for Fortification

第一百八十八条 Wire mesh can be blown up using rocket demolition charges, demolition charges in a simple form, or straight-line charges (typically 4 kg/m of TNT). When using straight-line charges, 1~2 steel bars or iron rods of the same length as the charge must be tied to the surface of the charge; the side with the steel bars or iron rods should face the wire mesh to increase the cutting effect. Demolition charges and straight-line charges should be inserted close to the base of the pile or placed near the head on the wire mesh; alternatively, straight-line charges at the same height as the wire mesh can be vertically hung on the wire mesh. When blowing up a herringbone-shaped wire mesh, charges can be inserted between the upper and lower layers (Figure 10-1). The length of the charge should not be less than the depth of the wire mesh; when the depth of the wire mesh is large, continuous blasting can be implemented. The width of the passage opened after blasting reaches 4~5 meters.

Article 149: The deer can be blown up using a rocket explosive device; the charge quantity and configuration methods for blowing up different types of deer are shown in Figure 10-2. For deer located on the beach, use a 3-kilogram block of TNT, configure it at the junction of the steel rail and concrete pier to blow it up (Figure 10-3), which can break the steel rail and simultaneously shatter the concrete pier. When creating a passage in piles, all charges should explode simultaneously. If it is a wooden deer, implement according to Article 107.

Fifteenth hundred and fifty large boulders can be blasted using external group charges or hole drilling methods.

When the volume of the rock mass does not exceed 5 cubic meters, external blasting may be used. The charge is placed in the concave areas of the rock mass (Figure 10-4). The charge quantity is calculated based on 1~2 kilograms of medium-grade explosive per cubic meter.

When the volume of the rock mass exceeds 5 cubic meters, blasting using charge holes is typically employed. The charge quantity is calculated based on 100~150 grams of medium-grade explosive per cubic meter. The depth of the charge hole is equal to the height of the rock mass.

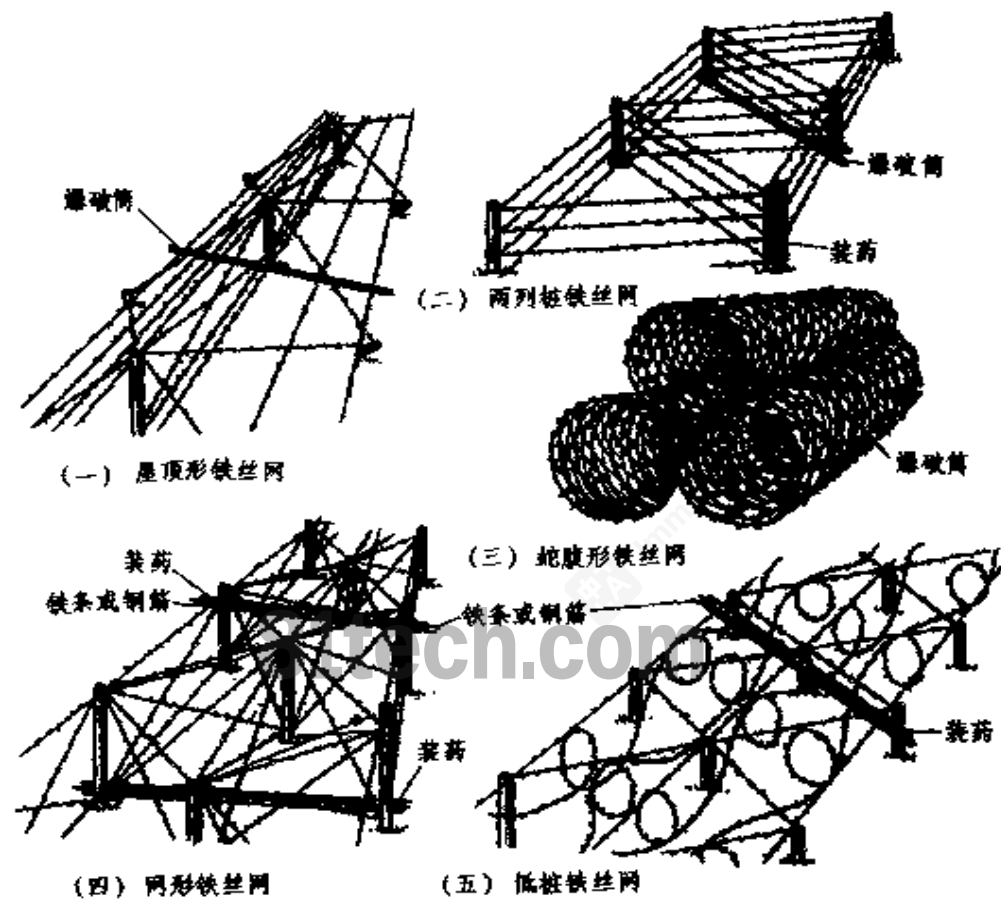


图 10—1 爆破铁丝网的装药配置

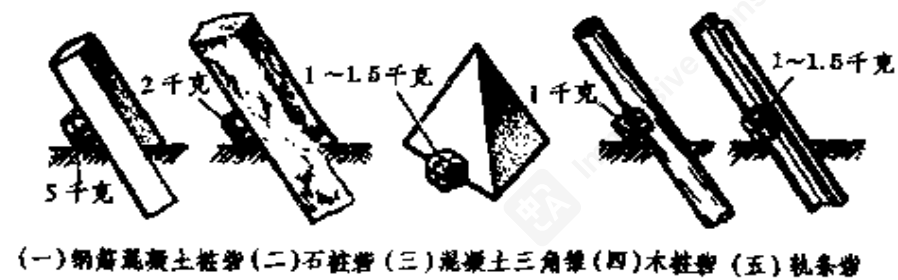


图 10—2 爆破桩窖的装药配置

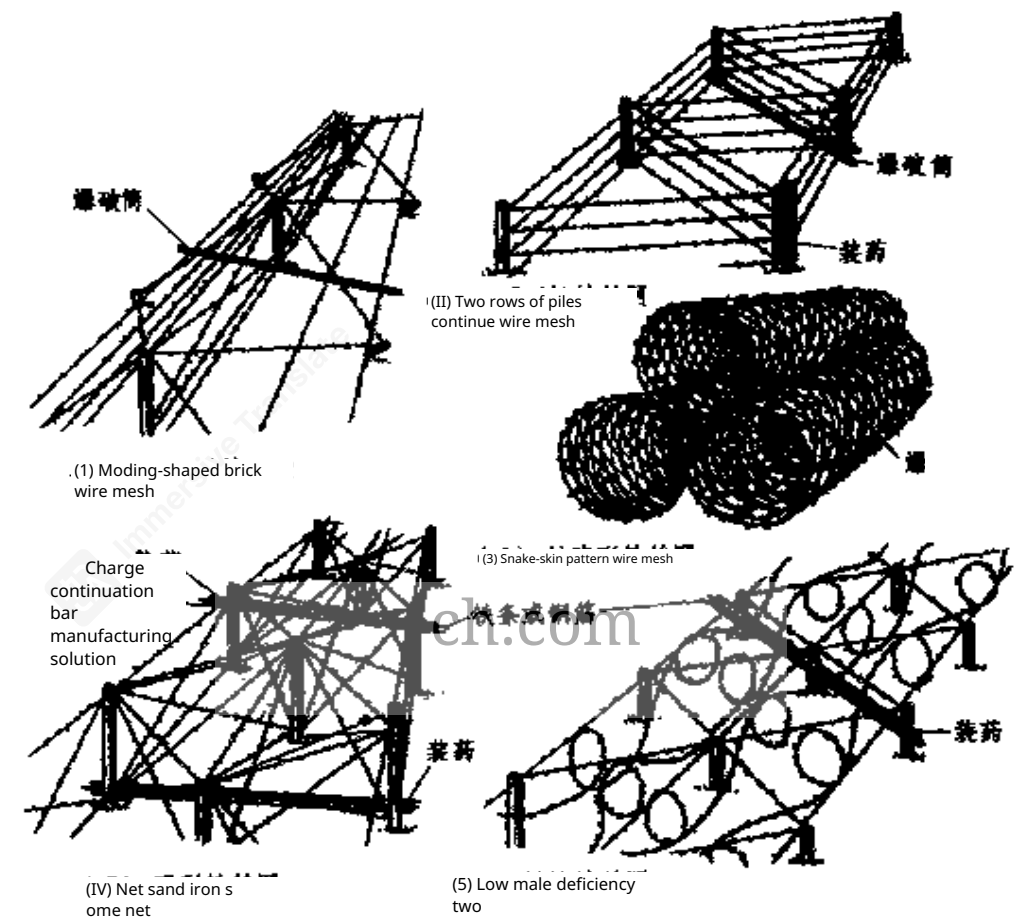


Figure 10-1 Charge configuration for breaching a wire fence

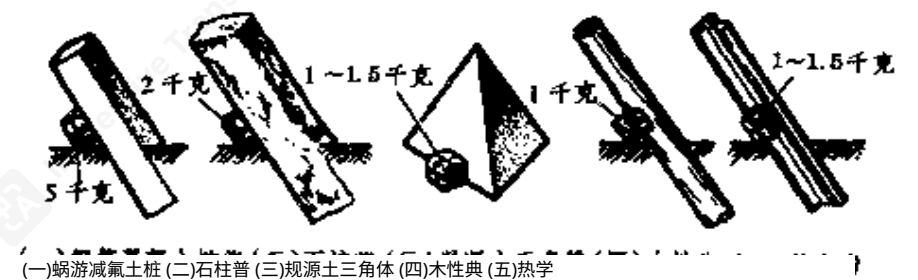


Figure 10-2: Charge configuration for blasting pile potatoes

的 $1/2 \sim 2/3$ 。药孔之间的距离为孔深的 $1 \sim 2$ 倍（图 10—5）。如果仅需破碎 10 立方米以下的石块，开设 1 个药孔即可。

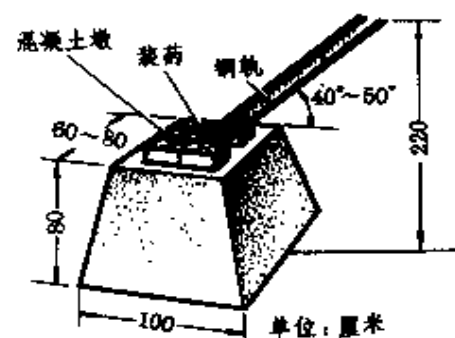


图 10—3

爆破带有混凝土墩的轨条岩



图 10—4

用外部装药爆破石块

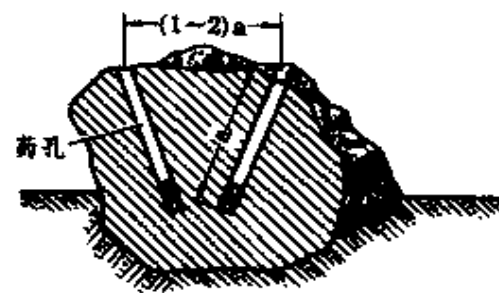


图 10—5 用药孔法爆破石块



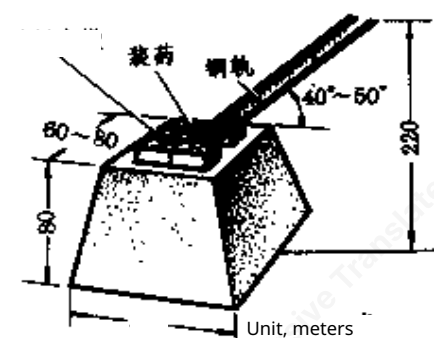
图 10—6 向一侧飞散石块

如欲使石块向一侧飞散，则将装药设置在石块飞散方向反面的底下（图 10—6）。体积 15 立方米以下的石块，按每立方米需 $1 \sim 2$ 千克中级炸药计算。也可将爆破穿孔器或与其装药量相当的其他穿孔装药设置在同样位置上实施爆破。

第一百五十一条 爆破防坦克壕和崖壁，采用集团装药或直列装药，按以下方法实施。

（一）两次爆破法（图 10—7（一））：将梯恩梯药块捆包成 5 千克和 10 千克的集

$1/2 \sim 2/3$. The distance between the drug holes is $1 \sim 2$ times the depth of the hole (Figure 10-5). If only rocks less than 10 cubic meters need to be broken, one drug hole is sufficient.



Figure

爆破带有混凝土墩的轨条岩

Blasting rails with concrete tendons tech.com

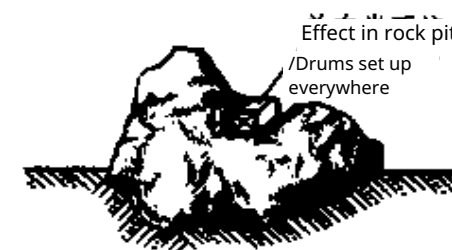
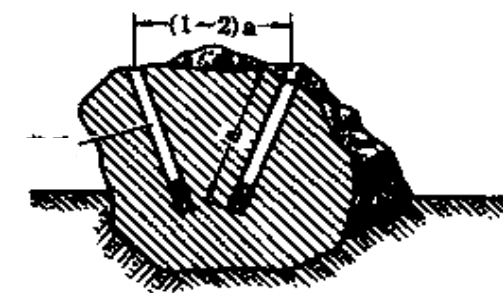


Figure 10-4

blast rocks using external charges



5 Drug hole blasting rock diagram 10-5



Mon 106 Throw stones to one side

To disperse the rock in one direction, place the charge beneath the rock on the side opposite to the direction of dispersion (Fig. 106). For rocks with a volume of less than 15 cubic meters, calculate the amount of medium explosive required as $1 \sim 2$ grams per cubic meter. Alternatively, implement blasting by placing a blasting hole drill or another hole-drilling charge with an equivalent charge quantity in the same position.

Article 151. For anti-tank minefields and obstacles, use grouped charges or linear charges, implemented according to the following methods.

（一）Two-blasting method (Figure 10—7(1): Pack TNT explosive blocks into bundles of 5 kilograms and 10 kilograms.

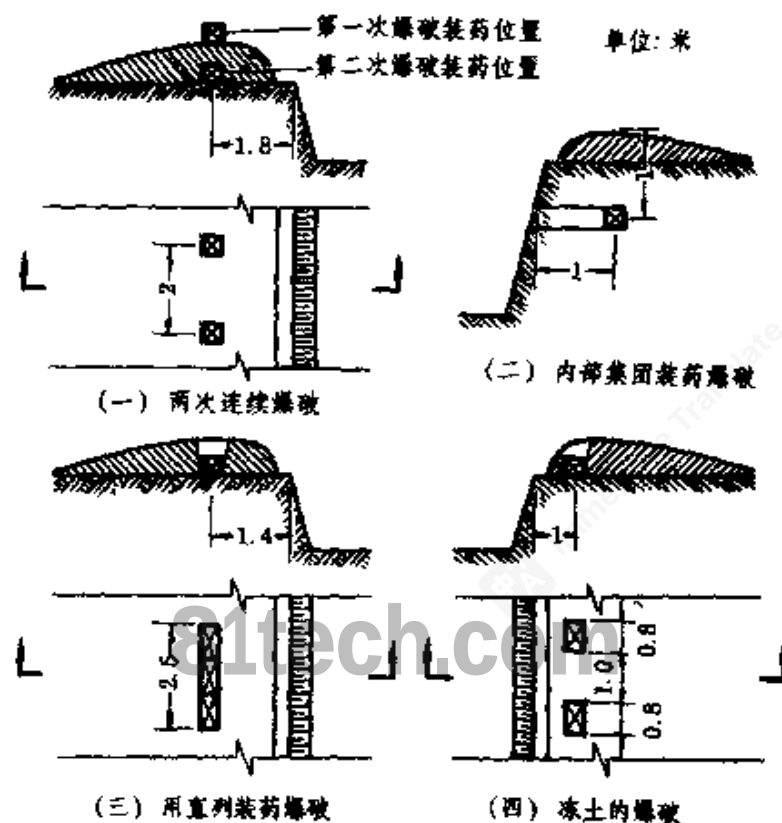


图 10—7 爆破防坦克壕的装药配置

团装药各 4 个。第一次每侧用两个 5 千克的装药，装药相隔 2 米置于距壕缘 1.8 米的积土上爆破；第二次每侧用两个 10 千克的装药，装药置于第一次爆破的漏斗坑底，并略加填塞。每次同侧的两个装药须同时起爆。

(二) 内部集团装药爆破法 (图 10—7 (二))：每侧用一个 6 千克的集团装药，设置在沿壕 (崖) 壁开设的深 1 米的水平药洞内实施爆破。

(三) 直列装药爆破法 (图 10—7 (三))：

1. 在中等硬度土壤条件下，每侧将 35 千克梯恩梯药块，捆成长 2.5 米的直列装药实施爆破。两侧的装药须同时起爆。如土质不同时，应适当增减药量。

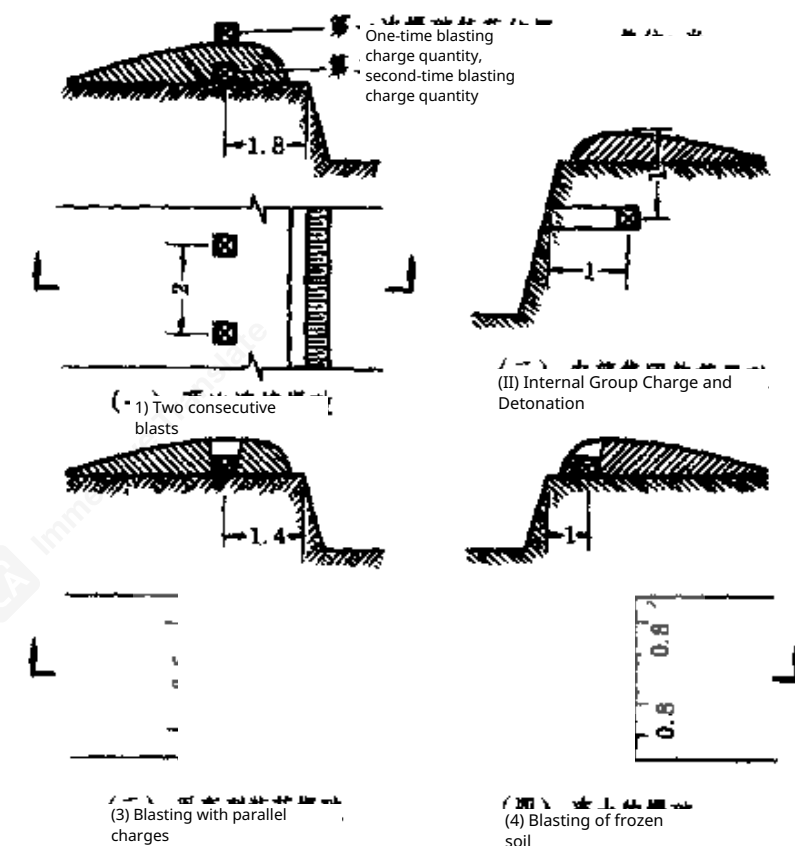


Figure 107: Charge configuration for blasting anti-clay environment

Four charges per group. For the first round, use two 500g charges per side, spaced 2 meters apart, detonated in the soil mound 1.8 meters from the damaged edge; for the second round, use two 1000g charges per side, placed at the bottom of the crater from the first detonation, with slight backfilling. The two charges on each side must be detonated simultaneously.

(2) Internal charge blasting method (Figure 10-7(2)): A group charge of 6 kg is used on each side, placed in a horizontal blast hole 1 meter deep excavated along the slope (cliff) wall for blasting.

(L) Straight charge blasting method (Fig. 10-7(3)):

1. Under medium-hard soil conditions, place 35 kg of TNT blocks on each side, bundled into a straight line 2.5 meters long, for blasting. The charges on both sides must detonate simultaneously. If the soil conditions are unfavorable, adjust the charge quantity accordingly.

2. 在冻土条件下 (图 10—7 (四)), 每侧将 64 千克梯恩梯药块, 捆成两个 80×25×10 厘米的直列装药实施爆破。同侧的两个装药须同时起爆。

在不超过 4 米高的土崖壁上为步兵开辟通路时, 可将 20 千克的梯恩梯炸药, 利用木杆支撑在崖高 2/3 处爆破。

爆破后, 应对通路进行加修和标示。

第二节 地雷障碍物的爆破

第一百五十二条 对单个防坦克地雷, 通常将 200 克或 400 克梯恩梯药块直接放在地雷上面, 将其诱爆。对压发防步兵地雷, 一般采用 75 克梯恩梯药柱或 200 克梯恩梯药块紧靠地雷的一侧诱爆。

第一百五十三条 运用爆破手段在地雷场中快速开辟通路, 可使用火箭爆破器爆破, 也可使用短直列装药爆破。

使用火箭爆破器在地雷场中开辟通路时, 应根据地雷场的种类和战术要求选择所需的火箭爆破器。

使用短直列装药在地雷场中开辟通路时, 通常将梯恩梯药块或鳞片状梯恩梯炸药捆扎在木板上制成。装药长度通常为 2~3 米, 装药量通常为 4 千克/米或 8 千克/米。

一列 4 千克/米的直列装药爆炸后, 在防坦克和防步兵地雷场中开辟的通路宽度分别为 3.7~5.2 米和 9.0~10.5 米; 一列 8 千克/米的直列装药爆炸后, 在防坦克和防步兵地雷场中开辟的通路宽度分别为 5.2~6.7 米和 10.5~12.0 米。成二列配置时, 开辟的通路宽度为一列装药开辟通路宽度的 2 倍。

第三节 工事的爆破

第一百五十四条 爆破敌土木、砖石射击工事和钢筋混凝土

2. Under frozen conditions (Figure 10-7(4)), place 4 grams of TNT explosive blocks, bundle them into two 80×25×10-cm straight-line charges and detonate them. The two charges must be detonated simultaneously.

When clearing a path for infantry on a Saturn wall not exceeding 4 meters, 20 kg of TNT can be used, supported by wooden poles and detonated at 2/3 height.

Blowout start, respond to the passage by relocating and marking it.

Section 2: Blasting of Mine Obstacles

Article 152 For individual anti-tank mines, typically 200 grams or 400 grams of TNT blocks are placed directly on top of the mine to detonate it. For pressure-activated anti-personnel mines, a 75-g TNT column or a 200-g TNT block is placed tightly against the ottcon.conn side of the mine to detonate it.

Article 153: When using blasting means to quickly open a passage in the ground, rocket-blasting devices may be used, or short straight-line charges may be used.

When using rocket breachers to clear paths in minefields, select the appropriate rocket breacher based on the type of minefield and tactical requirements.

When clearing a path in a minefield using short straight charges, TNT blocks or flake-shaped TNT explosives are typically bundled onto wooden boards. The charge length is usually 2~3 meters.

The charge amount is typically 4 kg/m or 8 kg/m.

A single line of 4 g/m charge, after explosion, opens a passage width of 3.7~5.2 m in anti-tank and anti-personnel minefields, and 9.0~10.5 m; a single line of 8 g/m charge, after explosion, opens a passage width of 5.2~6.7 m and 10.5~12.0 m in anti-tank and anti-personnel minefields. When arranged in two lines

The width of the opened passage is twice the width of the passage opened by a single column of charges.

Section 3: Blasting of Works

1. Four types of blasting against earth and masonry firing positions and reinforced concrete structures.

射击工事时,通常使用 5 千克和 10 千克的外部集团装药。爆破点应选在敌工事的射孔旁、出入口等薄弱部位。也可将爆破筒从射孔或出入口塞入工事内爆破。为炸穿钢筋混凝土工事墙壁或顶盖,可用集团装药实施连续爆破或用 I 号、II 号爆破穿孔器爆破。

第一百五十五条 爆破我军放弃的工事,只要达到使敌人无法利用即可。

(一) 爆破混凝土(钢筋混凝土)工事,可按以下方法实施。

1. 将装药设置在工事内部,爆破前将所有孔口用土、砂袋或石块等堵塞。装药量按下式计算:

$$C = 1.5Va$$

式中: C——中级炸药药量(千克)

V——工事内部容积(米³)

a——工事墙壁或顶盖的最大厚度(米),1 米以下均按 1 米计算

2. 将装药设置在工事墙壁上开设的药龛或药洞内。装药量按第一百一十三条公式计算。墙角处必须同时配置装药。

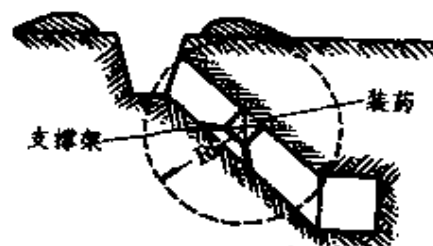


图 10—8

坑道式掩蔽部的爆破

(二) 爆破坑道式掩蔽部(图 10—8),通常将集团装药固定在坑道入口的顶部。装药量按下式计算:

$$C = 4R^3$$

式中: C——中级炸药药量(千克)

R——破坏半径(米)

(三) 爆破掘开式土木工事(图 10—9),通常将集团装药设置在掩蔽部入口处的顶盖下。装药量按下式计算:

$$C = 12R^3$$

式中: C、R——意义同上

When firing at fortifications, external group charges of 5 kg and 10 kg are typically used. The blast point should be selected at weak areas of enemy fortifications, such as near firing ports or entrances. Prior to detonation, the blasting tube should be inserted into the fortification through a firing port or entrance. To blast through concrete-reinforced walls or roofs of fortifications, commercial group charges are used for continuous blasting, or No. 1 or No. 2 blasting perforators are employed.

Article 155: Demolish enemy fortifications abandoned by our forces, provided they are rendered unusable by the enemy.

(-) Blasting concrete (reinforced concrete) works can be implemented according to the following methods.

1. Place the charge inside the structure and cover all borehole openings with soil or sandbags before detonation.

or with rocks, etc., blocking it. The charge quantity is calculated according to the following formula:

$$C = 1.5Va$$

In this formula: C—amount of medium-strength explosive (kg)

Internal volume of the construction site (meters)

—Maximum thickness of construction walls or roof (meters), all below 1 m

Per meter

2. Set the charge in the earth of the fortification wall

In the opened pill box or pill hole. The dosage is according to

Article 13 Formula calculation. Corner wall

Charge must be configured simultaneously at the location.

(2) Blasting tunnel-type shelter (Figure

10-8), usually the group charge is fixed in

Top of the tunnel entrance. The charge quantity is calculated by the following formula

$$C = 4R^3$$

Wuzhong: C1—Intermediate explosive charge (kg)

R—Destruction Radius (meters)

(3) Blasting excavation method for earthwork (Figure 10-9). The group charge is typically placed under the roof at the entrance of the shelter. The charge quantity is calculated according to the following formula:

$$C = 12R^3$$

In which: C, R - same meaning as above



Figure 10-8

Blasting of tunnel-type shelters

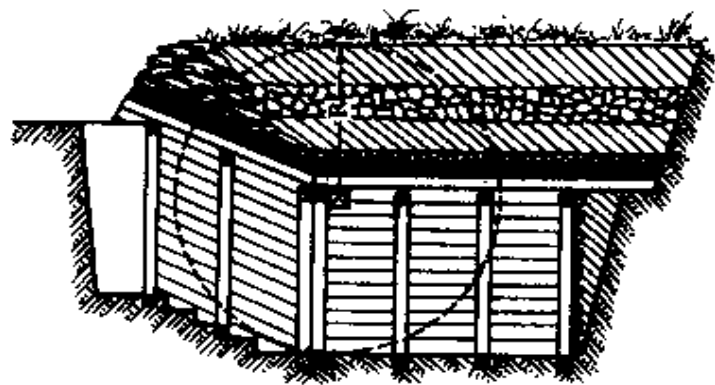


图 10—9 掘开式土木工事的爆破

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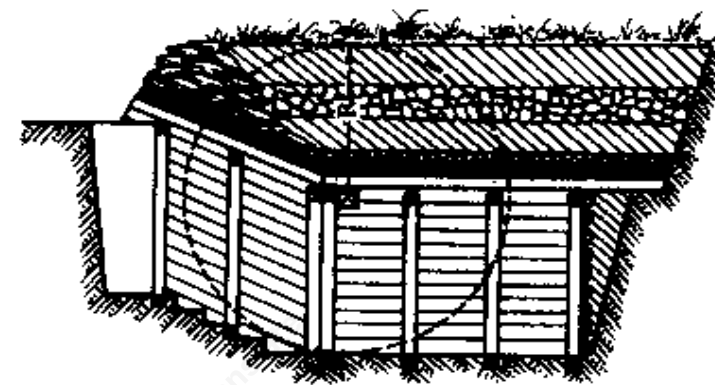


Figure 109: Blasting of cut-and-fill earthworks

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第十一章 兵器及军用物资的爆破

第一节 坦克、装甲战斗车辆的爆破

第一百五十六条 爆破坦克，破坏部位应选择在发动机、通风窗、驾驶舱顶盖、炮塔侧后装甲、主动轮或履带等要害、薄弱部位（图 11—1）；所需装药量及破坏效果见表 11—1。

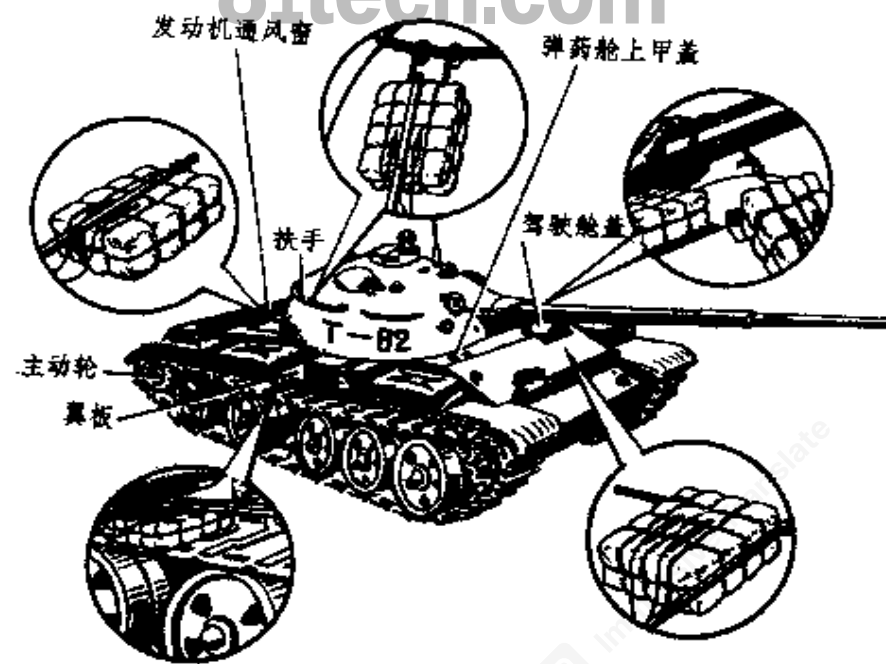


图 11—1 坦克的爆破

Chapter 11: Demolition of Weapons and Military Supplies

Section 1: Explosive Breaching of Tanks and Armored Fighting Vehicles

Article 156: When breaching tanks, the target areas should be selected as critical or weak points such as the engine, ventilation hatches, top of the driver's compartment, side and rear armor of the turret, or the active wheels or tracks (Figure 11-1). The required charge quantity and resulting damage effects are shown in Table 11-1.

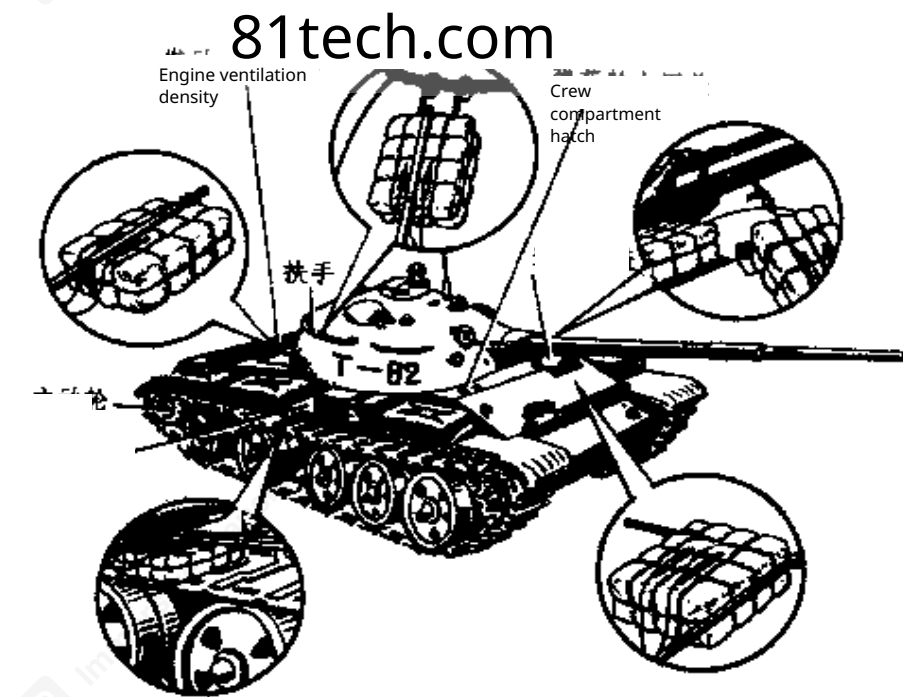


Figure 111 Tank Breaching

表 11—1 爆破各部位所需装药量及破坏效果

破 坏 部 位	破 坏 程 度	装 药 量(kg)		GBP111 型 爆破筒 (节)
		梯恩梯 药 块	硝 铵 炸 药	
发动机、通风窗和 驾驶舱顶盖	炸穿装甲、破坏发动 机、杀伤驾驶员	1	3	1
炮塔和车体结合部	可碎裂装甲、杀伤乘员	2~3		
炮塔侧后甲	可碎裂装甲、杀伤乘员	10		
主动轮、履带	炸断履带或损坏主动 轮,使其不能行驶	2	5	1
说 明	1. 爆破履带时,装药应与履带接触紧密。 2. 对坦克各部位的爆破也可用装药量相当的防坦克 地雷(不装引信,改用点火管起爆)。			

破甲厚度和所需装药量的关系曲线见图 11—2。

第一百五十七条 爆破装甲战斗车辆,破坏部位的选择及爆破方法参照第一百五十六条实施。

Explosive charge quantity and destructive effect
at each section Table 11—1

破 坏 部 位	破 坏 程 度	装 药 量(kg)		GBP111 型 爆破筒 (节)
		TNT tablets	Ammonium Nitrate Explosives	
Engine, ventilation window	Pierce armor, destroy engines			
Cabin Hatch	machine, kill the pilot			
Turret body joint	Breakable armor, crew-killing			
Turret side and rear armor	Breakable armor[inflicts damage on crew			
Drive wheel, heating belt	Break the drive belt or damage the drive pulley, preventing the vehicle from moving.			
说 明	1. When blasting tracks, the charge should be in tight contact with the track. 2. Detonating various parts of a tank can also be done using anti-tank mines with equivalent explosive charges (without fuses, using ignition tubes for detonation).			

The relationship curve between armor thickness and required charge quantity is shown in Figure 11-2.

Article 157. The selection of damaged areas and the method of breaching for armored combat vehicles shall be implemented in accordance with Article 156.

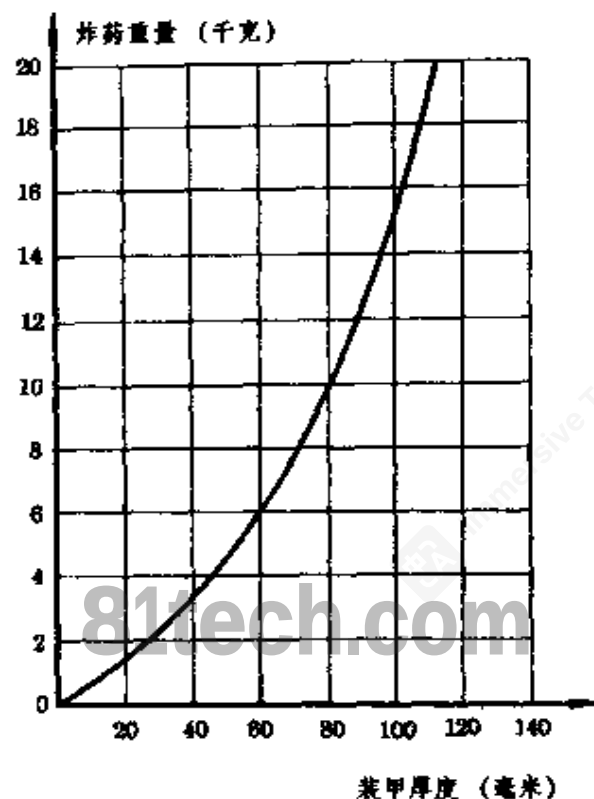


图 11—2 破甲厚度与所需装药量的关系

第二节 飞机、火炮的爆破

第一百五十八条 爆破飞机,应将炸药设置在座舱内靠近机首部位,以炸毁操纵装置、军械部分、仪表和雷达;也可将 1~2 千克梯恩梯炸药设置在油箱上爆破(油箱通常位于机翼和机尾部位),如果油箱内有油,可引起油箱爆炸,烧毁整架飞机。对螺旋桨飞机,可将 1~2 千克梯恩梯炸药设置在发动机的汽缸上爆破;对喷气式飞机,可将 2 千克梯恩梯炸药由喷气口送入靠近发动机部位爆破;对轰炸机或运输机,可将 5 千克梯恩梯炸药设置在起落架舱内,炸毁起落架,同时引起油箱爆炸,烧毁整架飞机。

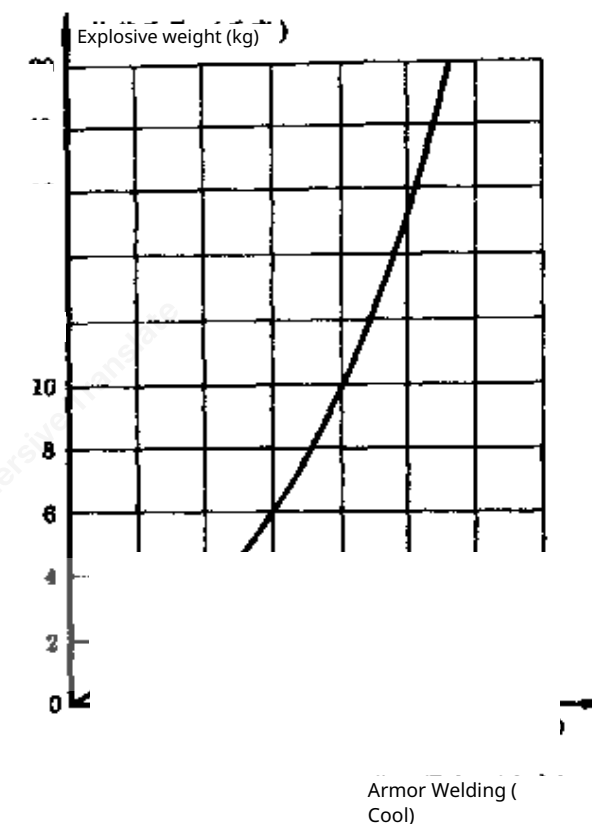
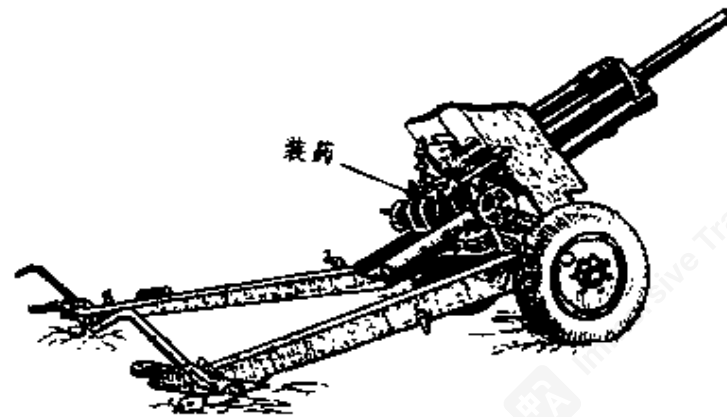


Figure 11-2 Relationship between armor penetration thickness and required charge weight

Section 2: Demolition of Aircraft and Artillery

Article 158: For aircraft with explosive charges, the explosives should be placed inside the cockpit near the nose to destroy the control mechanisms, armament, instruments, and radar; alternatively, 1~2 kilograms of TNT may be placed on the fuel tank for detonation (fuel tanks are typically located in the wings and tail sections); if there is fuel in the tank, it may cause an explosion of the tank, burning the entire aircraft. For propeller-driven aircraft, 1~2 kilograms of TNT may be placed on the engine cylinders for detonation; for jet aircraft, 2 kilograms of TNT may be delivered through the jet exhaust to the area near the engine for detonation; for bombers or transport aircraft, 5 kilograms of TNT may be placed in the landing gear compartment to destroy the landing gear and simultaneously cause the fuel tank to explode, burning the entire aircraft.

第一百五十九条 爆破火炮,可将装药设置在炮膛内或炮尾上(图 11—3),所需梯恩梯装药量根据火炮口径,查表 11—2 确定。



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图 11—3 火炮的爆破

表 11—2 炸毁各种口径火炮所需装药量

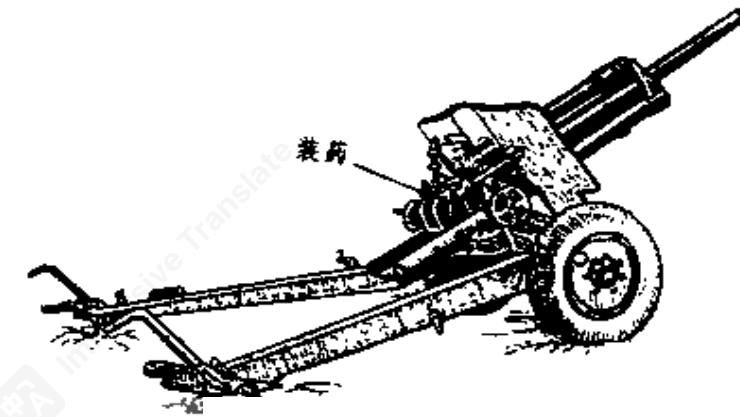
火炮口径 (mm)	装 药 量 (kg)	火炮口径 (mm)	装 药 量 (kg)
37 ~ 50	0.2 ~ 0.4	150 ~ 200	4.0 ~ 5.0
70 ~ 76	1.0 ~ 1.2	200 ~ 300	5.0 ~ 7.0
80 ~ 100	1.2 ~ 2.0	300 ~ 400	7.0 ~ 10
100 ~ 150	2.0 ~ 4.0	400 以上	10 ~ 15

破坏自行火炮可参照第一百五十六条、第一百五十七条、第一百六十条实施。

第三节 汽车、工程机械的爆破

第一百六十条 爆破汽车,可将 0.5 ~ 1 千克梯恩梯炸药设
— 196 —

Article 159: For blasting cannons, the explosive charge can be placed inside the cannon shell or on the cannon tail (Figure 11-3). The required TNT charge quantity shall be determined by consulting Table 11-2 according to the caliber of the cannon.



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Figure 11-3: Blasting of the artillery piece

Table 11-2 Explosives required to destroy artillery of various calibers

Caliber of artillery (mm)		Caliber of artillery (mm)	
	0.2~0.4	150-200	4.0~5.0
	1.0-1.2		5.0~7.0
80 - 100	1.0		7.0~10
100 - 150	2.0~4.0	Above 400	10 15

Destruction of self-propelled artillery may be implemented in accordance with Articles 156, 157, and 160.

Section 3: Blasting of Automobiles and Construction Machinery

Article 160: Blasting automobiles may involve setting 5 ~ 1 kilograms of TNT explosives.

置在发动机汽缸、万向传动轴、差速器、变速箱等要害部位（图 11—4）。



图 11—4 汽车的爆破

第一百六十一条 爆破拖拉机、推土机、挖掘机、装载机等工程机械，可将 0.4~2 千克梯恩梯炸药设置在发动机汽缸、后桥、主动轮、行走部分的履带或轮胎上（图 11—5）。

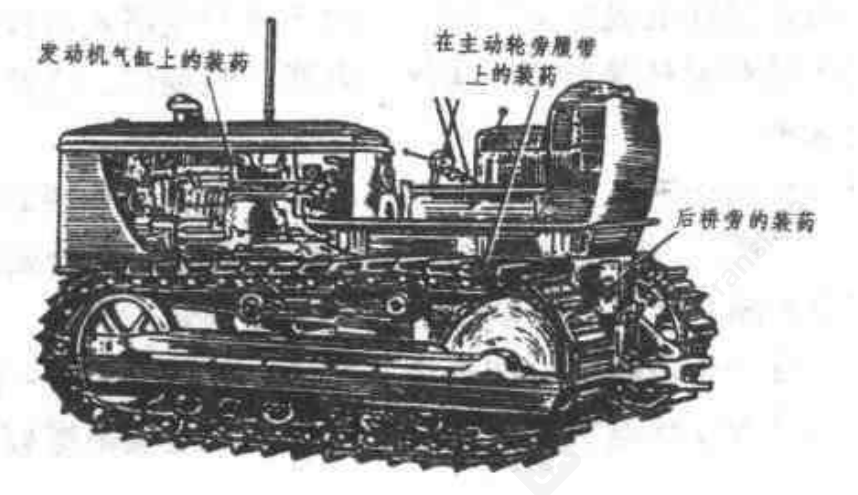


图 11—5 工程机械的爆破

Placed in critical areas such as the engine cylinder, universal drive shaft, differential, and transmission (Fig. 11-4).

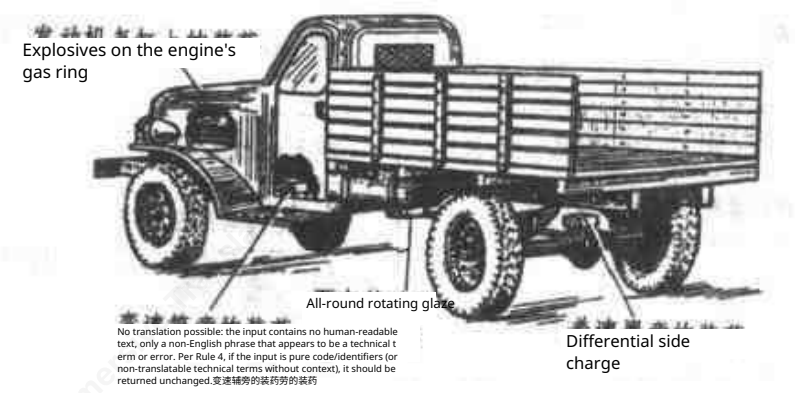


Figure 11-4: Car Blast

81techcom第一百六十一条爆破拖拉机、推土机、挖掘机、装载机等 construction machinery, which can place 0.4~2 kilograms of TNT explosive on the engine cylinder, rear axle, drive wheel, or tracks/tires of the walking part (Figure 11-5).

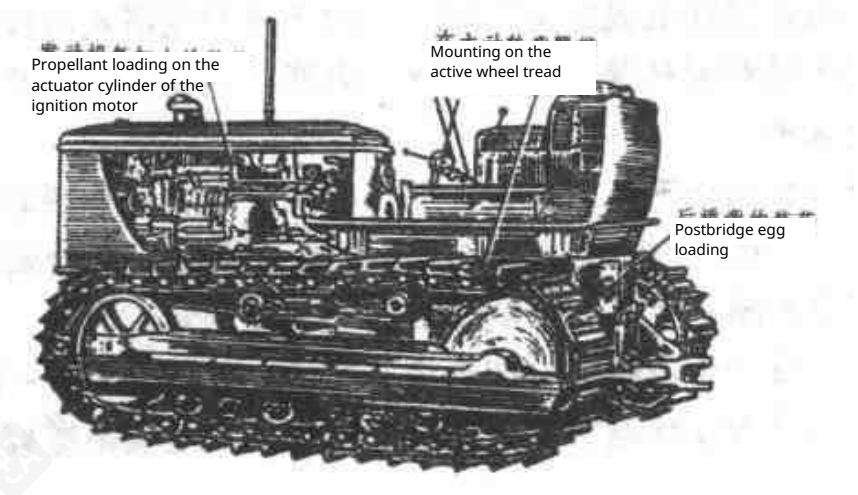


Figure 11-5 Blasting of Construction Machinery

表 11—3 炸毁工程机械、汽车所需梯恩梯装药量

工 程 机 械		汽 车	
破 坏 部 位	装药量 (kg)	破 坏 部 位	装药量 (kg)
发 动 机 汽 缸	0.4~0.8	发动机汽缸	0.4~0.8
主动轮旁的履带	2	方向转动轴	
驾 驶 台	2	差 速 器	
		变 速 器	

第四节 通信设备的爆破

第一百六十二条 爆破通信线路，主要是截断线路、炸毁电源及天线装置。爆破钢筋混凝土电线杆时，通常将 1~2 千克梯恩梯炸药设置在电线杆下部爆破；对木质和铁塔式电线杆的爆破方法按木材和钢材爆破方法实施。电线杆倾倒后，应截断电线并破坏绝缘子。

第一百六十三条 爆破广播、电视设备，应炸毁其电源、发射装置（天线）、机械室、控制室等要害部位。对金属塔架式天线装置应炸断一半以上至全部塔脚及其控制索。

第一百六十四条 爆破电报、电话设备，可将 5~10 千克梯恩梯炸药设置在继电器室、交换机室和电倾室实施爆破。

第五节 弹药的爆破

第一百六十五条 钢毁炮弹，可根据情况单发钢毁或集中销毁。单发销毁时，应将装药设置在弹体上（有引信时靠近引信），

Table 11-3 Tetryl charges required for explosive engineering machinery and automobiles

Engine cylinder	0.4-0.8	Engine cylinder	0.4~0.8
Track beside the drive sprocket		Directional Rotation Shaft	

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第四节通信设备的爆破

Article 162: Blasting communication lines mainly involves cutting the lines and destroying power sources and antenna devices. When blasting reinforced concrete poles, typically 1~2 kilograms of TNT are placed at the lower part of the pole for blasting; blasting methods for wooden and lattice-type poles shall be implemented according to the blasting methods for wood and steel. After the pole falls, the wires should be cut and the insulators destroyed.

Article 163: When demolishing broadcasting and television equipment, the power source, transmission devices (antennas), control rooms, and other critical areas such as the control tower should be destroyed. For metal tower-type antenna systems, the tower legs and their control cables should be destroyed, with at least half to all of the tower legs severed.

Article 4 of Section 16: Blasting telegraph and telephone equipment by placing 5~10 kilograms of TNT in the relay room, switchboard room, and telegraph room.

Section 5: Detonating Ammunition

Article 16, Paragraph 5: Steel-detonating shells may be destroyed individually or in batches according to circumstances. When destroyed individually,

The charge should be placed on the projectile (close to the fuse if present).

所需梯恩梯装药量根据炮弹口径确定（表 11—4）。集中销毁时，可根据炮弹数量和环境情况等，将炮弹分堆摆放，每堆中的炮弹要集中靠拢，然后将 3~5 千克梯恩梯炸药设置在上面诱爆销毁。

表 11—4 销毁单发炮弹所需装药量及破片飞散距离

炮弹口径 (mm)	装药量 (kg)	破片飞散距离 (m)
37~76	0.2	500 以下
80~105	0.4	750 以下
105~150	0.6	1200 以下
150~200	0.6~1.0	视炮弹内的药量而定， 但不小于 1500m
200~300	1.0~2.0	
300~400	2.0~3.0	
400 以上	3.0 以上	

第一百六十六条 销毁航空炸弹，通常为单枚销毁，装药可直接设置在弹体上，所需梯恩梯装药量见表 11—5。

表 11—5 销毁航空炸弹所需装药量

炸弹重量 (kg)	25~50	100	250	500
装药量 (kg)	0.4	0.6	1.2	2

第一百六十七条 销毁地雷、爆破筒（器）、爆炸带、火箭弹和扫（布）雷弹等爆炸器材，可单个销毁或集中销毁。销毁时，将梯恩梯药块直接设置在被销毁的器材上，所需梯恩梯装药量见表 11—6。

The required quantity of TNT charge depends on the caliber of the shell (Table 11-4). During centralized destruction, shells may be stacked according to the number of shells and environmental conditions; shells within each stack must be gathered closely together, and then 3~5 kilograms of TNT explosive shall be placed on top to initiate detonation and destruction.

Table 11—4 Distance of fragmentation and shrapnel dispersion from the charge of a single-round shell upon destruction

		Fragment dispersion distance
		Below 500
		Below 750
		Below 1200
	0.6~1.0	Depends on the amount of explosive in the shell, but not less than 1500m
	t@G2.0CC	
	2.0~3.0	
Above 400	3.0 and above	

Article 166. Destruction of aviation bombs. Usually, destruction is performed on a single bomb, with the explosive charge placed directly on the bomb body. The required quantity of TNT explosive is shown in Table 11-5.

Table 11-5 Charge required for destruction of air bombs

Bomb weight (kg)	
Charge (kg)	

Article 167 The destruction of landmines, blasting charges (devices), explosive belts, firestring bombs, and anti-sweeping (lawn) mines and other explosive equipment may be carried out individually or in a centralized manner. When destroying such equipment, TNT blocks shall be directly placed on the equipment to be destroyed. The required amount of TNT charge is shown in Table 116.

表 11—6 销毁单个爆炸器材所需装药量

器 材 名 称	装 药 量 (kg)	器 材 名 称	装 药 量 (kg)
爆破筒	0.2	火箭爆破器(爆炸带)	0.2~0.4
掩体爆破器、穿孔器	0.2~0.4	各类火箭发动机	0.2~1.0
火箭扫雷弹	2.0	防步兵地雷	0.075~0.2
防坦克地雷	0.2~0.4	特种地雷	0.2~0.8

销毁炮（炸）弹及爆炸器材，在装卸、搬运或设置时，要谨慎小心，轻拿轻放，防止震动，并加强安全措施。

第六节 仓库的爆破

第一百六十八条 爆破弹药库，应将装药设置在库房内的弹药堆上，每个弹药堆上设置 1 至数个装药。装药量参照表 11—4、表 11—5、表 11—6 确定。各装药之间用导爆索连接，同时起爆。

第一百六十九条 爆破汽油和煤油库，可将 0.2~0.4 千克梯恩梯炸药设置在油筒或油罐（槽）内，用电起爆法起爆。爆破柴油和机油库，可先将 0.2~0.4 千克梯恩梯炸药设置在汽油或煤油桶内，而后将其放入待销毁的油料中，起爆装药后使其燃烧。

第一百七十条 爆破被服、粮秣、军械等军需物资库，可采用大集团装药爆破房屋；也可以浇上汽油或煤油，通过爆破纵火烧毁。

Table 11—6 Explosive charge carried by a single explosive device in a sales segment

		Fire Flute Demolisher (Explosive Belt)	0.2-0.4
Turret Breacher, Perforator	0.2~0.4	Various types of fire-curing engines	0.2~1.0
Firewire Mine		Anti-personnel mine	0.075 ~0.2
Anti-tank mine	0.2-0.4		0.2~0.8

Destroy artillery (bomb) shells and explosive devices. When loading, transporting, or setting them up, proceed with extreme caution, handling them gently to prevent accidental discharge, and strengthen safety measures. 8t

Section 6. Breaching the Warehouse

Article 168 Explosive Ammunition Storage: The explosive charges shall be placed on the ammunition piles within the storage facility, with one to several charges per pile. The charge quantity shall be determined in accordance with Tables 11-4, 11-5, and 11-6. The charges shall be connected by detonating cord and detonated simultaneously.

Section 169. For blasting gasoline and kerosene depots, 0.2 ~ 0.4 kg of TNT can be placed inside a cover within the oil drums or tanks (tanks) and detonated using an electric blasting method. For blasting diesel and engine oil depots, 0.2 ~ 0.4 kg of TNT can first be placed inside gasoline or kerosene drums, and then introduced into the fuel awaiting destruction; after the charge is detonated, it shall be allowed to burn.

Article 170: When demolishing warehouses containing military supplies such as uniforms, food, socks, and weapons, large-charge blasting of the building may be used; alternatively, gasoline or kerosene may be applied to ignite the building via blasting.

第十二章 水中爆破

第一百七十一条 水中爆破常用于在封冻的江河上爆破冰层构成障碍；爆破流冰、冰坝保护桥梁和水工建筑物；加深河床、清除礁石以及爆破其他水中目标。设置在水中的装药必须采取防水措施，并注意水流对装药位置的影响。水中作业较困难，冰面和岸边较滑，应尽量在岸上做好准备，并采取有效的防险、防滑等安全措施。

第一节 冰的爆破

第一百七十二条 爆破冰层、流冰、冰坝以及其他冰冻目标，一般采用集团装药，实施冰下爆破；也可在冰面上设置集团装药或直列装药，将冰层炸碎。冰面上爆破所需装药量增多，爆破效果降低。当冰层、冰坝厚度在 1 米以上时，也可在冰内开设药室实施爆破。

第一百七十三条 将冰层炸开形成冰窟障碍，可阻滞敌人在封冻江河上的机动。冰窟可根据情况事先构成或临时构成。事先构成的冰窟应经常将复冻的冰层捣碎，保持其不冻结状态；临时构成冰窟，则利用炸药或用采取防水措施的防坦克地雷实施爆破。

(一) 开设冰窟的单个装药量，可根据冰层厚度和装药设置深度，查表 12—1 确定。

当冰层厚度小于 0.5 米时，装药量可按冰面 0.075 千克/米²概略计算；冰层厚度在 1.0 ~ 1.5 米时，装药量可按冰面 0.24 千克/米²计算。

Chapter 12: Underwater Blasting

Article 171 Water-borne blasting is commonly used to blast ice layers forming obstacles on frozen rivers and streams; to blast floating ice and ice dams protecting bridges and hydraulic structures; to deepen riverbeds, clear reefs, and blast other underwater targets. Explosives placed in water must be protected against water, and the effect of water flow on the position of the explosives must be considered. Underwater operations are more difficult, and the ice surface and riverbanks are slippery; preparations should be made on shore as much as possible, and effective safety measures against hazards and slipping should be taken. 81tech

Section 1: Ice Shattering

Article 172: For blasting ice layers, floating ice, ice dams, and other frozen targets, group charging is generally adopted to implement underwater blasting. Alternatively, concentrated charging or linear charging may be set up on the ice surface to shatter the ice layer. Blasting on the ice surface requires increased charge quantities, resulting in reduced blasting effectiveness. When the thickness of the ice layer or ice dam exceeds 1 meter, blasting chambers may also be excavated within the ice for blasting operations.

Article 173: Breaking up the ice layer to form ice caves and obstacles can hinder the enemy's mobility on frozen rivers and lakes. Ice caves may be pre-established or temporarily created as needed. Pre-established ice caves should be frequently broken up to prevent refreezing, maintaining their unfrozen state; temporarily created ice caves

Then use explosives or anti-tank mines with waterproofing measures to carry out the blast.

(-1) The single charge quantity for opening an ice cave can be determined from Table 12-1 based on the ice layer thickness and the depth of charge placement.

When the ice thickness is less than 0.5 meters, the charge quantity can be roughly calculated as 0.075 kg/m² on the ice surface; when the ice thickness is 1.0 ~ 1.5 meters, the charge quantity can be calculated as 0.24 kg/m² on the ice surface.

表 12—1 爆破冰所需装药量

装 药 量 (kg)	装药设置深度 (m)			说 明
	1.0	1.5	2.0	
冰层厚度 (m)				
0.2~0.3	1.0	2.0	4.0	1. 单个装 药爆炸后 构成的冰 窟直径为 装药设置 深度的 4 倍。 2. 所用炸 药为梯恩 梯炸药。
0.3~0.4	1.5	2.6	4.6	
0.4~0.5	2.2	3.2	5.4	
0.5~0.6	2.6	3.8	5.8	
0.6~0.7	3.2	4.2	6.4	
0.7~0.8	3.8	4.6	6.8	
0.8~0.9	4.2	5.4	7.3	
0.9~1.0	4.6	5.8	7.8	
1.0~1.1	5.4	6.4	8.4	
1.1~1.2	6.0	6.8	8.8	
1.2~1.3	6.6	7.4	9.4	
1.3~1.4	7.2	8.0	10.0	
1.4~1.5	7.8	8.6	10.6	
1.5~1.6	8.4	9.2	11.2	

(二) 用于装药的冰洞，通常用冰穿（图 12—1）、铁槌、钢



图 12—1 冰穿

Table 12—
1 Charge quantity required
for blasting ice

Charging depth (m)				Ice layer thickness (m)	
1.0	1.5	2.0	2.5		
0.2~0.3				0.2~0.3	1. Single pack
0.3~0.4				0.3~0.4	
0.4~0.5				0.4~0.5	
0.5~0.6				0.5~0.6	
0.6~0.7				0.6~0.7	
0.7~0.8				0.7~0.8	
0.8~0.9				0.8~0.9	
0.9~1.0				0.9~1.0	
1.1				1.1	2. Used frying
1.1~1.2				1.1~1.2	
1.2~1.3				1.2~1.3	
1.3~1.4				1.3~1.4	
1.4~1.5				1.4~1.5	

(II) Ice caves used for loading propellant are typically created by ice drilling (Fig. 12-1), iron picks, or steel

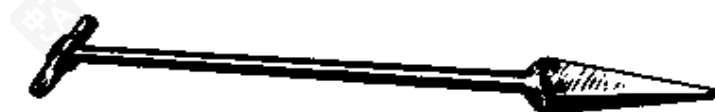


Figure 12-1 Ice
Breaker

钎开设或用小块装药连续爆破构成,也可用冰穿结合电锯开设。药洞的大小以能通过装药和方便作业为准。作业时,应在冰洞周围铺设砂土、草袋、木板或用冰穿捣成麻面,以保证作业人员安全。

(三) 设置装药时,应采取严密的防水措施;可将装药系在绳索或木杆上放入冰下水中(图 12—2)。

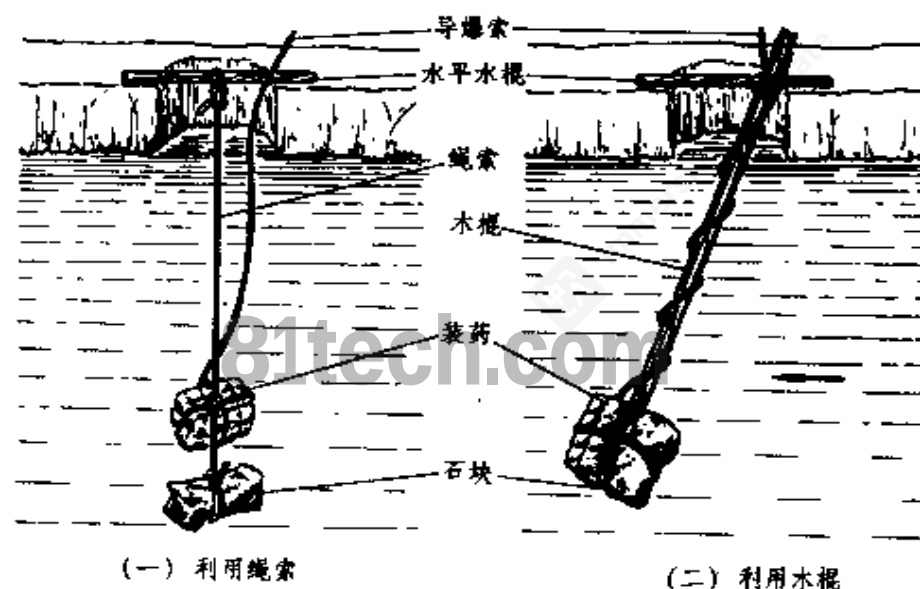


图 12—2 冰下装药的设置

当冰层的厚度超过 1 米时,应将装药设置于冰洞内爆破,其深度可等于冰层厚度的 $3/4 \sim 4/5$ (图 12—3)。如将装药设置在冰层下的水中,爆炸后易形成冰堆。装药配置应各个相对,装药的间距和列距均取装药设置深度的 4~5 倍,用导爆索或电雷管同时起爆。

当使用密封性较好,具有

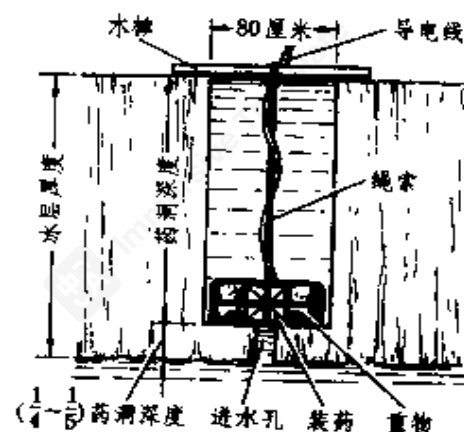


图 12—3 冰洞内装药的设置

The borehole is formed by continuous blasting with small charges, or by combining ice drilling with an electric saw. The size of the charge hole should be sufficient to allow the insertion of the charge and convenient for operation. During operation, sand, straw bags, wooden boards, or roughened ice surfaces created by ice drilling should be laid around the ice hole to ensure the safety of personnel.

(3) When setting the charge, strict waterproof measures shall be taken; the charge may be attached to a rope or wooden pole and lowered into the ice-covered water (Fig. 12-2).

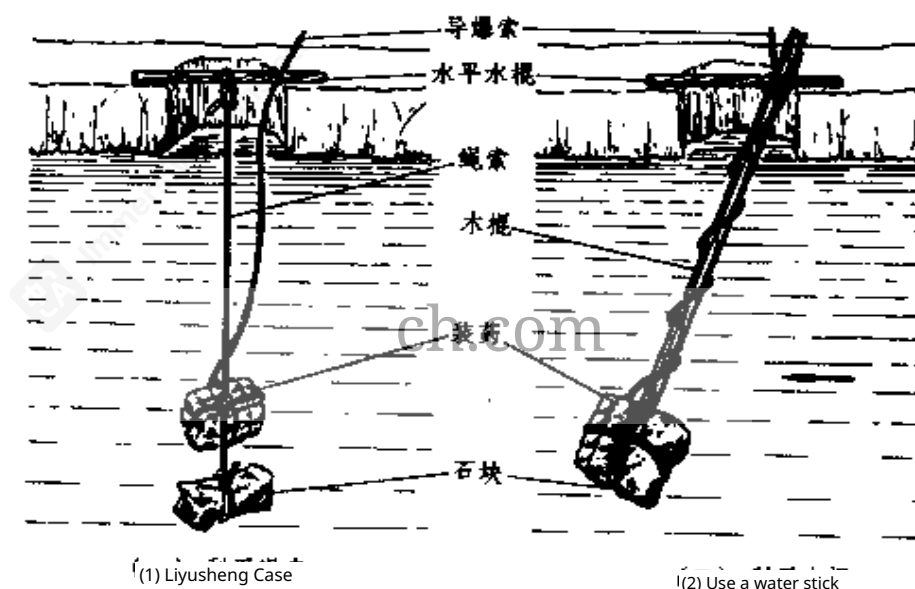


Figure 12-2: Setting of underwater charges

When the ice layer thickness exceeds 1 m, the charge should be set up in an ice hole for blasting, with a depth equal to $3/4 \sim 4/5$ of the ice layer thickness (Fig. 12—3). If the charge is set up in the permafrost below the ice layer, the explosion is likely to form an ice pile. The charge configuration should be adjusted relative to each other; the spacing between charges and the row spacing should both be 4~5 times the charge setting depth. Blasting should be initiated simultaneously using detonating cord or electric detonators.

When using a seal with good sealing performance, having

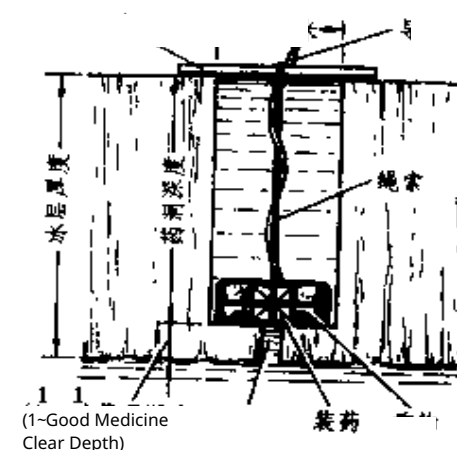


Figure 12-3 冰洞内装药的设置

一定防水性能的防坦克地雷开设冰窟时，地雷应设置在水中，深度为 1.5 米左右，地雷间距为 6~9 米。初发雷用电雷管起爆时，可先在雷盖上钻一个小孔，以便引出电雷管脚线；初发雷还可利用梯恩梯药块诱爆。所有次发雷均使用瞬发引信，由初发雷诱爆，引信不一定对正初发雷，均可诱爆（图 12—4）。

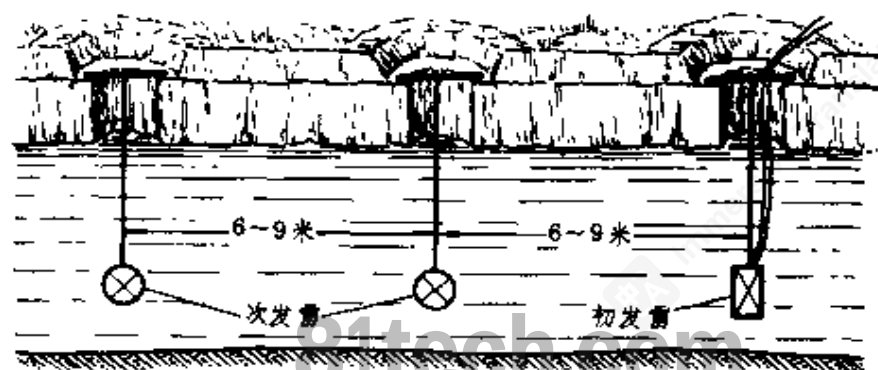


图 12—4 冰下地雷的设置

第一百七十四条 用爆破手段开设流冰路，可避免流冰阻塞河道和冲坏桥梁。解冻前在桥梁附近开设流冰路时，首先必须围绕所有桥脚和破冰棱将冰层穿透，形成宽度不小于 0.5 米的小沟，以保护桥梁。此外，还应在流冰路下游边缘开设一条小沟，其长度不小于流冰路宽度，以保持下游冰层的完整，便于作业人员站在冰面上处理冰块。

开设流冰路所需装药量与装药设置方法均与开设冰窟相同。流冰路的宽度等于江河宽度的 $\frac{1}{4} \sim \frac{1}{3}$ ，长度不小于江河宽度的 3 倍（在桥梁上游部分的长度不小于江河宽度的 2 倍，下游部分的长度不小于江河宽度，如图 12—5）。装药自下游最后的一列开始逐次向上游爆炸，距桥梁 15 米以内不准爆破。装药爆炸后，如果桥脚附近的冰层没有破碎，应用人工捣碎。爆炸后形成的大冰块，用捞钩或带钩的绳索将其塞入流冰路下游的冰层下面。

When setting anti-tank mines with waterproof performance in ice, the mines should be placed in water at a depth of approximately 1.5 meters, with a spacing of 6~9 meters between mines. When initiating detonation using electric detonators, a small hole may first be drilled in the mine cover to allow the electric detonator lead wires to be brought out; the initial mine can also be primed using TNT blocks. All secondary mines use instant fuses and are detonated by the initial mine; the fuses do not necessarily need to be aligned with the initial mine, as they can still be detonated (Figure 12-4).

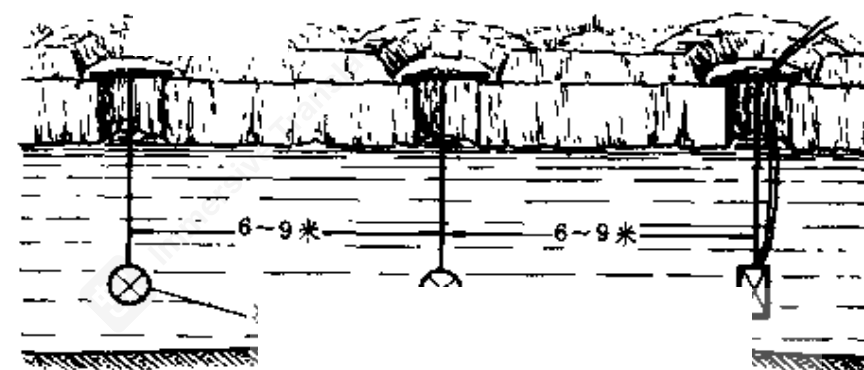


Figure 12-4: Setting of Ice-Under Mines

Article 174: Opening a flow-ice road by blasting can prevent flow-ice from blocking the river channel or damaging bridges. Before the ice thaws, when opening a flow-ice road near a bridge, the ice layer must first be penetrated around all bridge piers and the ice-breaking ridge, forming a small ditch with a width of not less than 0.5 meters to protect the bridge. Additionally, a small ditch should be opened along the downstream edge of the flow-ice road, with a length not less than the width of the flow-ice road, to maintain the integrity of the downstream ice layer and facilitate workers standing on the ice surface for handling ice blocks.

The charge quantity and placement method required for opening a drifting ice road are the same as those for opening an ice cave. The width of the drifting ice road shall be one- $\frac{1}{4} \sim \frac{1}{3}$ of the river width, and its length shall not be less than three times the river width (the length of the upstream portion shall not be less than two times the river width, and the length of the downstream portion shall not be less than the river width, as shown in Figure 125). The charge shall be detonated sequentially from the last column downstream toward the upstream direction. Blasting is prohibited within 15 meters of the bridge. If the ice near the bridge piers has not broken up after detonation, it shall be manually broken. Large ice blocks formed after the explosion shall be placed under the ice downstream of the drifting ice road using a scoop hook or a rope with a hook.

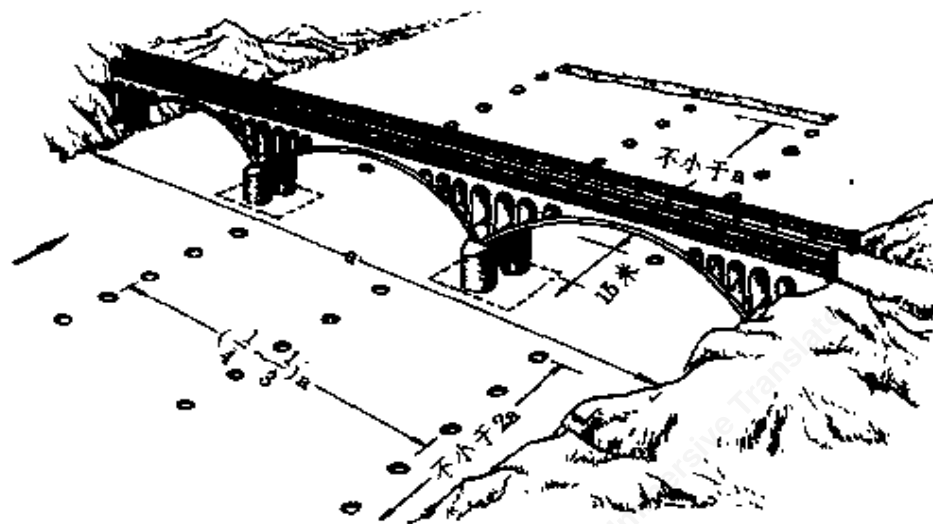


图 12—5 构成流冰路时设置装药的冰孔位置

第一百七十五条 爆破流冰，可在桥梁和可能形成冰坝的上游 1~4 千米处，配置数个爆破组。爆破组应配置在河幅狭窄、河道弯曲、流速小或有浅滩的地方。各组相隔适当距离，在流冰通过各组负责地段时，将其逐次炸碎。

对流冰通常采用投掷装药爆破法。装药量一般为 0.2~2 千克梯恩梯炸药。当河幅较窄时，可由一岸或两岸投掷装药；当河幅较宽、流速小、流冰量不大时，也可由船上投掷装药，此时，装药上的导火索长度，以船只只能离开危险区为度。

第一百七十六条 江河解冻时，易在浅滩或河道弯曲部分，由大量流冰结成冰坝而堵塞河道，可能造成泛滥并损坏桥梁及其他水利工程，可采用爆破法炸开冰坝。爆破冰坝，应在其冻结尚不稳定时进行，通常是在流线部构成一条宽 20~30 米的流冰路。爆破冰坝的单个装药量为 5~25 千克梯恩梯。装药垂直接流部配置 1~3 列，间距为装药设置深度的 4~5 倍。装药应放入水中或设置在药洞内，所有装药应同时起爆。也可乘直升机在离冰面高度为 60~100 米的空中投掷装药，实施爆破。

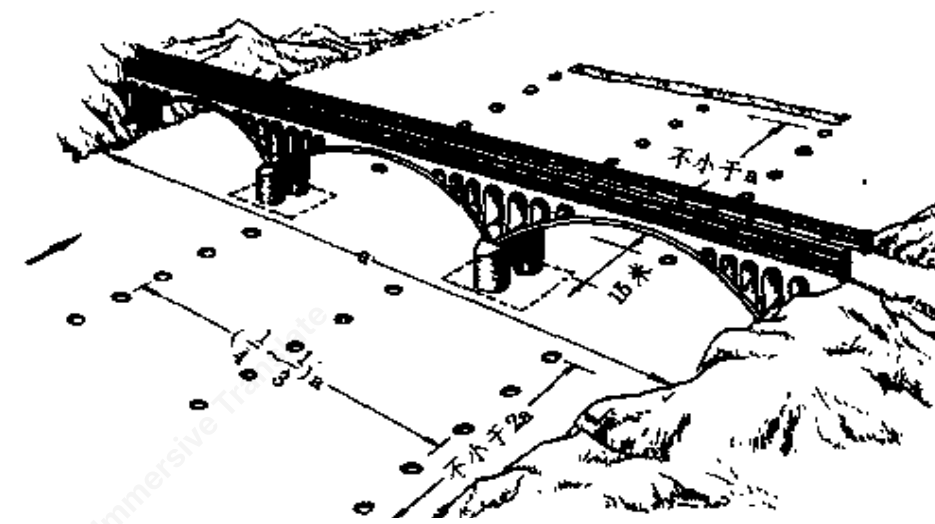


Figure 12-5: Position of ice holes when setting cover charges to form an ice road

Article 177: Ice breaking operations may be conducted at bridges and at locations where ice dams might form, 1~4 meters from the bank, with several ice-breaking teams deployed. Ice-breaking teams should be positioned in areas where the river is narrow, the channel is curved, the current is slow, or there are shallow sections. Teams should be spaced appropriately so that, as ice flows through the section assigned to each team, it is broken up sequentially.

Ice breaking is usually carried out by the method of throwing charges and blasting. The charge amount is generally 0.2~2 kg of TNT. When the river width is relatively narrow, the charge can be thrown from one bank or both banks. When the river width is relatively wide, the current is slow, and the amount of ice is not large, the charge can also be thrown from a boat; in this case, the length of the fuse on the charge should be such that the boat can leave the danger zone.

Article 176 When rivers thaw, large quantities of flowing ice may form ice dams at shallow areas or in bends of the river channel, blocking the channel, potentially causing flooding and damaging bridges and other water conservancy projects. Ice dams can be broken using blasting methods. Blasting of ice dams should be carried out when the ice is still unstable, typically when a flow ice road with a width of 20~30 meters has formed. The single charge quantity for blasting ice dams is 5~25 kilograms of TNT. The charges are arranged in 1~3 rows perpendicular to the flow ice road, with a spacing equal to 4~5 times the depth of charge placement. Charges should be placed in the water or set up in charge holes, and all charges should be detonated simultaneously. Alternatively, charges can be dropped from a helicopter at an altitude of 60~100 meters above the ice surface to implement blasting.

第二节 河床的加深与礁石的爆破

第一百七十七条 爆破加深河床，可采用外部装药或内部装药实施。

(一) 外部装药爆破，通常采用梯恩梯药块，装药直接设置在河底；单个装药量按表 12—2 确定，并可根据试爆效果校正。装药应成列配置，装药的间隔和列距为所需加深深度的 3 倍。用多个装药实施大规模爆破作业时，应使装药同时起爆。

表 12—2 加深河床所需的装药量

需加深的深度 (m)	单个装药量 (kg)		
	软质岩石	中硬岩石	坚硬岩石
0.4	0.8	1.7	2.6
0.5	1.6	3.4	5.0
0.6	2.9	6.0	8.8
0.7	4.5	9.2	13.5
0.8	6.5	13.5	20.0
0.9	9.2	19.7	29.2
1.0	13.5	27.0	40.0

爆破前，应对河底的性质进行勘察，并将爆破区域及装药位置加以标定，以便装药能准确地配置在需要加深的位置。

装药位置的标定和设置通常在锚定的舟上进行（图 12—6）。装药及电起爆线路也应预先在岸上准备好。

当用单个装药或少量装药实施爆破时，可采用点火管起爆法起爆。爆破手乘舟将准备好的装药运到标定的位置，按规定的次序依次点火，将装药准确投入水中后，乘舟迅速驶离危险区（图

Section 2: Deepening of the riverbed and blasting of reefs

Article 177 Deepening of riverbeds by blasting may be implemented using external or internal charges.

(1) External blasting with explosives typically uses TNT blocks, which are placed directly on the riverbed. The charge per hole shall be determined according to Table 12-2 and may be adjusted based on test blast results. Charges should be arranged in rows, with the spacing between charges and the distance between rows equal to three times the required depth of penetration. When conducting large-scale blasting operations using multiple charges, all charges should be detonated simultaneously.

Table 12-2: Charge quantity required to deepen the riverbed

The depth that needs to be increased	Single charge weight (kg)		
	Soft Rock C		

Before blasting, the nature of the riverbed shall be surveyed, and the blasting area and charge positions shall be marked to ensure that the charges are accurately placed at the locations requiring deepening.

Calibration and setting of the charge position are typically performed on the moored barge (Fig. 12-6). The charge and electric detonation circuit should also be prepared in advance on shore.

When blasting is carried out with a single charge or a small number of charges, the blasting can be initiated using a firing tube. The blaster, riding in a boat, transports the prepared charges to the marked positions, ignites them in the prescribed sequence, accurately drops the charges into the water, and then quickly drives the boat away from the danger zone (Figure

12—7)。

如果河底需要加深很深，爆破可分数次进行。每次爆破相隔的时间应很好掌握，以便炸散的土壤被水冲走。对于不能冲走的碎石和石块，可用人工、机械清除，或用爆破法破碎。

(二) 用穿孔法实施内部装药爆破加深河床，装

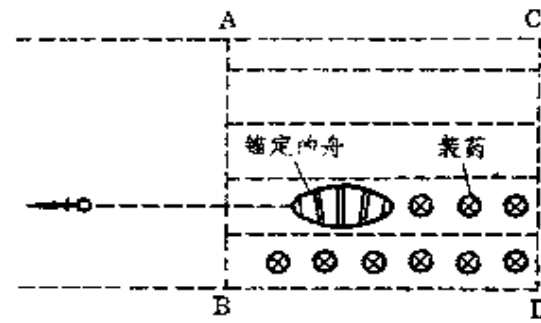


图 12—6 从舟上标定装药位置并设置装药

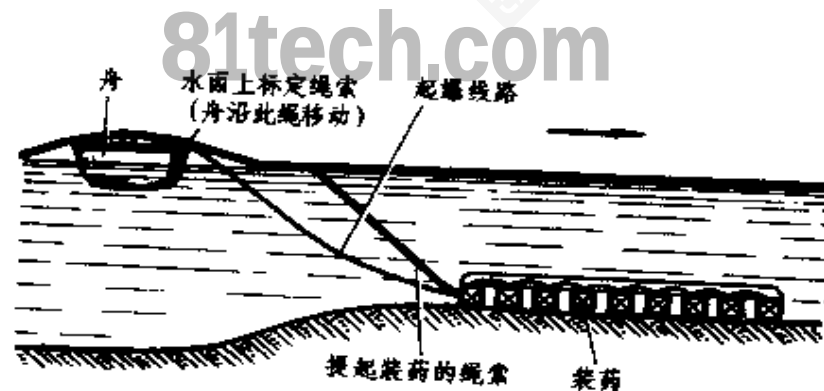


图 12—7 装药在河底的设置

药量可查表 12—3 估算。装药配置按露天爆破方法实施。爆破加深砂质河床，可用穿孔器先穿孔，然后将装药放入药孔内实施爆破。穿孔器是由套筒和装在套筒内的尖脚木桩组成（图 12—8）。穿孔时，用大锤沿着套筒将木桩打入河底，抽出木桩即成所要求深度的药孔（洞），然后通过套筒将炸药装入药孔（洞），再抽出套筒。

12—7)。

If the riverbed requires a very deep trench, blasting can be performed in multiple stages. The time interval between each blast should be carefully controlled so that the dispersed soil is washed away by water. For unmovable rubble and stones, they can be cleared manually or mechanically, or broken using blasting methods.

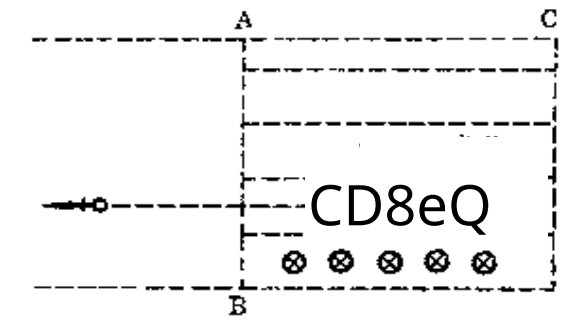


Figure 12-6: Calibrate the charge position from the boat and set the charge.

(2) Implement internal charge blasting to deepen the riverbed using the perforation method, charge

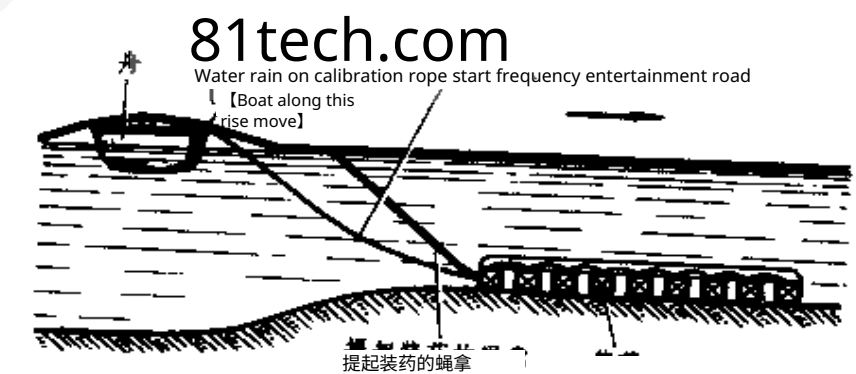


Figure 12-7: Placement of the charge at the riverbed

The charge quantity can be estimated from Table 12-3. The charge configuration shall be implemented according to open-pit blasting methods. When blasting deepens a sandy riverbed, a drilling tool may be used to drill holes first, after which the charge is placed into the charge holes for blasting. The drilling tool consists of a sleeve and a pointed wooden stake installed inside the sleeve (Figure 12-8). During drilling, a large hammer is used to drive the wooden stake along the sleeve into the riverbed; upon removing the stake, a charge hole (borehole) of the required depth is formed. Explosives are then loaded into the charge hole (borehole) through the sleeve, and the sleeve is subsequently removed.

表 12—3 水中爆破单位耗药量参数表

土石类别 \ 爆破方法	裸露爆破 (kg/m ³)	穿孔爆破 (kg/m ³)
含砾石的土	3.50	0.70
坚硬粘土	9.80	1.40
松软有裂隙岩石	13.50	1.53
中等坚硬岩石	27.00	1.86
坚硬岩石	40.00	2.20
说明	表内参数只适应于水深大于 2 米时使用, 若水深小于 2 米时药量应增加 25% ~ 50%。	

加深硬质（岩石）河床时，通常在水面以上使用钢钎、风动凿岩机或大型钻孔机具穿孔。

第一百七十八条 爆破礁石，清理航道，根据情况可采用外部装药或内部装药实施。

（一）外部装药爆破，装药量按单个石块的爆破方法确定；装药的位置应根据探测结果加以选择。装药应系以重物（石块），固定在礁石的凹坑、天然石窟、裂缝等部位（图 12—9），以增大爆破效果。

（二）内部装药爆破，如礁石的体积较小，可按单个石块穿孔爆破方法实施；如礁石的体积较大，则可在礁石上设置数列装药爆破。药孔配置均按露天穿孔爆破法破碎岩石的方法实施，药孔的深度通常比需要的深度增加 10% ~ 20%。

在水中穿孔时，可在锚定的门桥、木筏或搭设的作业台上进行。为了避免钢钎被水冲动，可在钢钎上套一粗铁丝箍或竹筒（但不影响钢钎转动），并牢固地固定在作业台上。

清除水中残存桥梁结构、加深水中建筑物基础，可根据结构

Table 12-3 Water-blast Unit Charge Consumption Parameters Table

	Exposed blasting (kg/m ²)	Perforation blasting (kg/m ³)
Soil with gravel		
Soft rock with fractures		
Medium hard rock		

Table parameters are only suitable for use when water depth exceeds 2 meters; if the water depth is less than 2 meters, the dosage should be increased by 25% ~ 50%.

When deepening hard (rocky) riverbeds, holes are typically drilled above the water surface using steel picks, pneumatic rock drills, or large drilling machines.

Article 178. For blasting rocks and clearing channels, external or internal charging may be used according to the situation.

(-→) External charge blasting; the charge quantity shall be determined according to the blasting method for individual rock blocks. The position of the charge shall be selected based on survey results. The charge shall be secured with a heavy object (rock) in concavities, natural rock cavities, cracks, and other locations of the reef (Fig. 12-9) to enhance the blasting effect.

(1) Internal blasting: If the volume of the reef is small, blasting can be carried out using the method of drilling individual stones; if the volume is large, a series of charges can be set up on the reef. The arrangement of blast holes shall be implemented according to the method of rock breaking by open-pit drilling and blasting, and the depth of the blast holes is usually increased by 10%~20% compared to the required depth.

When perforating in water, this can be done on a moored gate bridge, a wooden platform, or a constructed work platform. To prevent the steel rod from being pushed by the water, a thick wire coil or bamboo tube can be placed around the steel rod.

(while not affecting the rotation of the steel drill bit), and firmly fixed on the workbench.

Clear residual bridge structures in the water and deepen the foundations of underwater structures, which can be done according to the structure

材料的类型及其坚硬程度，分别参照木材、钢材、混凝土和钢筋混凝土以及土石爆破方法实施。

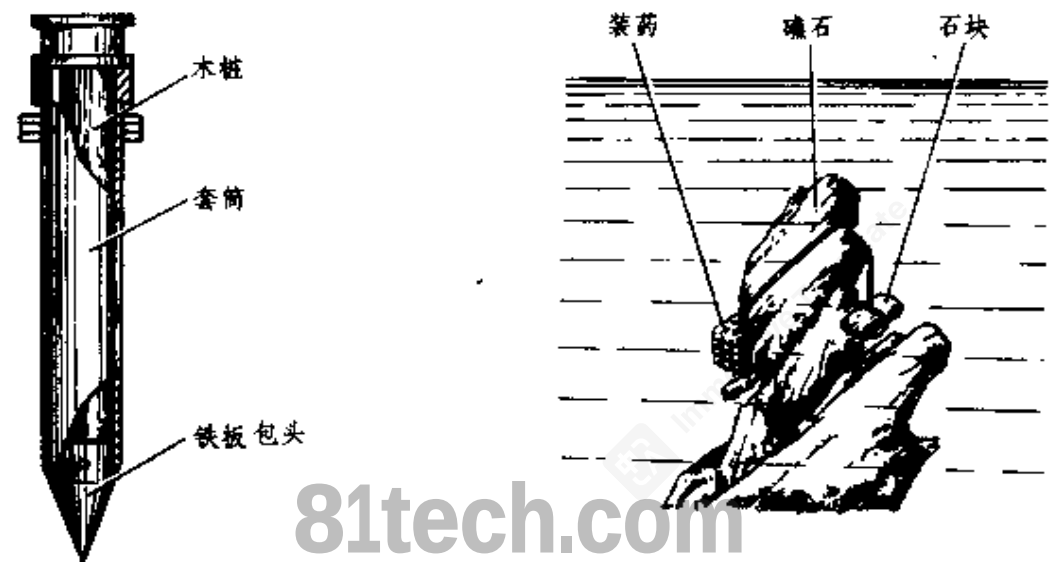


图 12—8 穿孔器

图 12—9 用外部装药爆破礁石

The type and hardness of the material shall be implemented by blasting methods, respectively, referring to wood, steel, concrete, reinforced concrete, and rock.

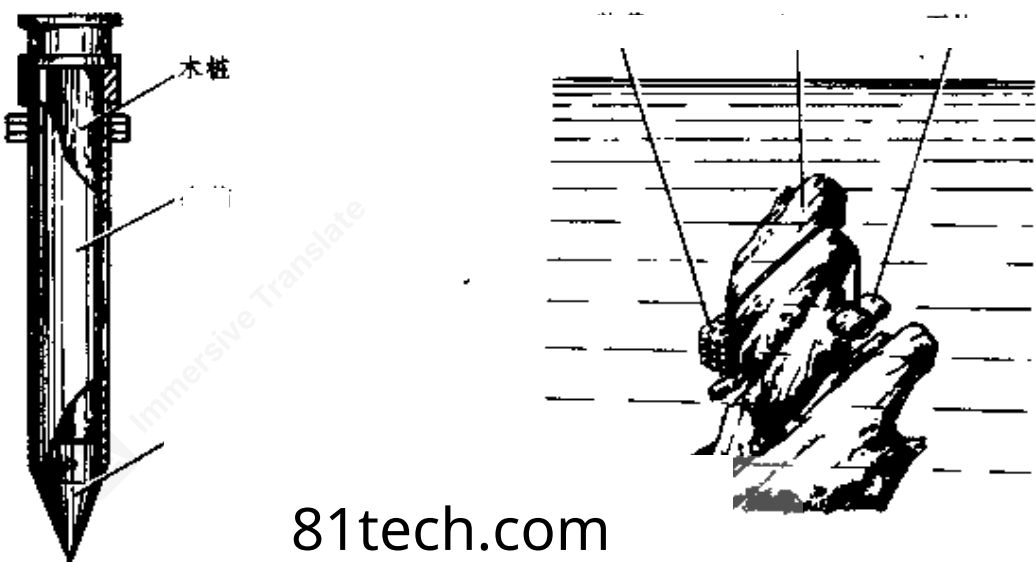


Figure 12-8 Drill

Figure 12-9 Use external explosive charges to blast the reef.

第十三章 爆破作业的组织 指挥与安全规则

第一百七十九条 组织实施爆破作业应遵守以下一般程序。

(一) 理解任务：执行爆破任务应根据上级的命令实施。命令通常应包括：

1. 爆破的目标及对其破坏程度的要求。
2. 完成准备作业的时限。
3. 起爆的时机，起爆命令下达者及下达的方式。
4. 作业的掩护和警戒措施。
5. 所需炸药、火具等器材的保障方法。

(二) 组织准备：指挥员受领任务后，应立即组织有关人员和分队做好各项准备工作。

1. 组织工程侦察。通常由分队指挥员带领有关人员对爆破目标、作业地段实施工程侦察，以查明第四条第一款规定的有关事项并绘制要图。

2. 拟制爆破计划。分队指挥员应根据所受领的任务和侦察获得的资料进行分析研究，并按第四条第二款的规定拟制爆破计划。

3. 下达任务，组织准备。分队指挥员应根据爆破任务和计划，对所属分队进行思想动员和战斗编组，区分任务，准备器材，并尽可能实施临战实兵模拟训练。

(三) 实施作业：指挥员应在作业前率领分队按时到达准备作业位置，与掩护分队协同，派出警戒，然后展开作业。

Chapter 3: Organization, Command, and Safety Rules for Blasting Operations

Article 179 The implementation of blasting operations shall comply with the following general procedures

第。

(-1) Understand the task: Breaching operations must be carried out in accordance with superior orders. Orders transmitted should include:

1. The blasting target and the required degree of destruction.
2. Deadline for completing preparatory work.
3. Timing of detonation, the person who issues the detonation order, and the method of issuing it.
4. Cover and security measures for the operation.
5. Methods for ensuring the supply of required explosives, pyrotechnics, and other equipment

(II) Organizational Preparation: After receiving the mission, the commander should immediately organize relevant personnel and detachments to carry out all preparatory work.

1. Conduct engineering reconnaissance. Usually, the squad commander leads relevant personnel to conduct engineering reconnaissance of the demolition target and the work area to ascertain the matters specified in paragraph 1 of Article 4 and to prepare the required maps.

2. Formulate a breaching plan. The squad commander shall analyze and study the assigned task and intelligence obtained, and formulate a breaching plan in accordance with the provisions of paragraph 2 of Article 4.

3. Issue orders and organize preparations. The squad commander should, based on the demolition mission and plan, conduct ideological mobilization and combat grouping for subordinate units, assign tasks, prepare equipment, and, where possible, implement live-fire simulation training under imminent combat conditions.

(Chinese) Conducting operations: The commander should lead the squad to the prepared operation position on time before the operation, coordinate with the covering squad, deploy a security detail, and then commence the operation.

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1. 作业中应注意敌情，加强警戒和作好战斗准备，防止敌人的突然袭击。

2. 掌握作业进度，必要时调整兵力、器材。

3. 指导检查作业，确保装药配置与装药量符合要求，起爆线路正确可靠。

4. 严格要求作业人员遵守安全规则，确保作业安全，灵活果断处置作业中遇到的各种情况。

5. 完成起爆准备后，应立即向上级报告。在待命起爆期间，对装药和起爆线路应进行不间断地检查和维护，使其始终保持良好状态；遵照命令或按预定计划适时起爆。

6. 组织检查爆破效果。对未达到预期效果的目标，应迅速组织补充爆破。

(四) 报告完成任务情况：爆破结束后，应立即向上级报告。报告主要说明起爆时间、爆破效果、主要经验教训，并请示分队尔后的行动。

第一百八十条 爆破作业应遵守以下一般安全规则。

(一) 作业人员必须熟悉炸药、火具的性能及处理方法，明确自己的职责、作业实施方法和步骤。

(二) 作业人员必须明确作业纪律，严格遵守操作规程，并按指挥员的命令行动。

(三) 加强责任制，严密组织。两人以上共同作业时，应指定负责人。

(四) 对存放炸药、火具和起爆器材的地点，以及运输炸药、火具的车辆等，必须严密警戒。警戒哨由爆破作业指挥员派出并根据其命令撤收。

(五) 炸药、火具应分别保管；炸药、火具附近严禁烟火和存放易燃物品。

(六) 作业时严禁无关人员进入作业场；起爆时禁止己方一切人员进入危险区。

1. During operations, pay attention to enemy forces, strengthen vigilance, and prepare for combat to prevent the enemy from...

sudden attack by a person

Master the progress of assignments

Adjust forces as necessary.

才人

3. Guide inspection operations to ensure that the charge configuration and charge quantity meet requirements, and that the detonation circuit is correct and reliable.

4. Strictly require operators to comply with safety rules, ensure safe operations, and handle various situations encountered during work flexibly and decisively.

5. After completing the preparation for detonation, report immediately to the superior. During the standby period for detonation, conduct continuous inspections and maintenance of the charge and detonation circuit to ensure they remain in good condition; detonate in accordance with orders and the planned schedule as appropriate.

6. Conduct an inspection of the blasting effect. For targets that have not yet achieved the expected results, act quickly.

组织补充爆破

Supplemental blasting. Q1+. (4) Report on task completion: Immediately after blasting, report to the superior authority. The report should primarily cover the detonation time, blasting effect, and main lessons learned, and request instructions for the squad's subsequent actions.

Article 180 Explosive operations shall comply with the following

General Security Rules

则。

(1) Personnel must be familiar with the characteristics and handling methods of explosives and firing tools, clearly understand their responsibilities, and know the implementation methods and steps of the operation.

(2) Personnel must clearly understand work discipline, strictly adhere to operating procedures, and act according to the commander's orders.

(3) Strengthen responsibility systems and organize tightly. When two or more people work together, an assigned person should

(4) Locations where explosives, blasting agents, and detonating equipment are stored, as well as vehicles transporting explosives and blasting agents, must be closely guarded. Guard posts shall be established by the blasting operation commander and withdrawn upon his order.

(5) Explosives and ignition tools shall be stored separately: No smoking or open flames, nor storage of flammable materials, is permitted near explosives or ignition tools.

(6) During operations, unauthorized personnel are strictly prohibited from entering the work area; during blasting, all personnel are forbidden from entering the danger zone.

(七) 准确计算与确定爆炸冲击波、地震波和土石、破片飞散的距离, 计算与确定方法见第一百八十一条。根据计算结果, 采取安全措施, 适时指挥所有人员撤离危险区。

(八) 用点火管或延期电雷管起爆装药时, 如未按时起爆, 须等待 15 分钟后, 方可派人前往检查拒爆原因。对拒爆装药, 通常由原装药人员排除。排除拒爆的内部装药时, 可轻轻掏出堵塞物, 另行装药诱爆; 也可向药孔(洞)内灌水, 使炸药溶解失效, 将雷管取出销毁。禁止从药孔(洞)中拔出点火管或电雷管。

(九) 爆破完毕后, 指挥员(或指定的人员)应进行现场检查。未经检查, 其他人员不得接近爆破目标。

(十) 对剩余或未爆的炸药和火具, 应带回或就地销毁, 不得遗留在作业现场。

第一百八十一条 实施爆破作业, 应先进行安全距离计算和校核, 以防止空气冲击波、飞石、地震波使人员、机械、车辆和附近建筑物遭受损害。

(一) 空气冲击波对人员和建筑物的最小安全距离。

1. 对人员的最小安全距离按下式计算:

$$R_c = 10 \sqrt{C}$$

式中: R_c ——冲击波的最小安全距离(米)

C ——一次齐爆的总装药量(千克)

2. 对建筑物的最小安全距离按下式计算:

$$R_c = K_b \sqrt{C}$$

式中: R_c 、 C ——意义同上

K_b ——系数。 n 为 2 时, 取 2~5; n 为 3 时, 取 5~

10; 装药埋入地表面附近, 取 10~40; 裸露

装药取 50~150

(二) 个别飞散物对人员的安全距离。

(7) Accurately calculate and determine the distance of the blast shock wave, ground roll, and the dispersion of earth, rock, and fragments; the methods for calculation and determination are set forth in Article 181. Based on the calculation results, take safety measures and timely direct all personnel to evacuate the danger zone.

(8) When detonating the charge with a firing rod or delayed electric detonator, if it has not been detonated on time, wait 15 minutes before sending personnel to investigate the cause of the failed detonation. Failed detonated charges are generally cleared by the original charge personnel. When clearing internal charges of failed detonations, the packing material may be gently removed and the charge reloaded to induce detonation; alternatively, water may be poured into the charge (hole) to dissolve the explosive and render it ineffective, after which the detonator is removed and destroyed. It is prohibited to pull out the firing rod or electric detonator from the charge hole (hole).

(9) After blasting is completed, the commander (or designated personnel) shall conduct a site search for unexploded ordnance.

Check. Without inspection, no other personnel may approach the blasting target.

(10) Remaining or unexploded explosives and pyrotechnics shall be removed to a safe location or destroyed on site and must not be left at the work site. 8Ttecr.com

Article 181 Before carrying out blasting operations, safety distance calculations and verify to prevent air shock waves, flying debris, and ground waves from causing damage to personnel, machinery, vehicles, and nearby structures.

(1) Minimum safe distance for personnel and structures from an air shock wave.

1. The minimum safe distance for personnel is calculated as follows:

In which: R —minimum safe distance (meters) for a shock wave

C —Total charge weight (kg) per simultaneous detonation

2. The minimum safety distance for buildings is calculated as follows:

$$R_c = K_b \sqrt{C}$$

In which: R_c 、 C —Same meaning as above

K_b coefficient. When n is 2 Take 2~5; when 3, take 5~

10; Place the charge near the ground surface, take 10~40; Expose the charge, take 50~150

(1) Safety distance for personnel from individual flying debris.

1. 土壤、岩石爆破中个别土、石块的飞散距离按下式计算：

(1) 沿除土部两侧方向的飞散距离：

$$L = 40n^2h$$

式中：L——土、石块飞散的距离（米）

n——爆破作用指数

h——最小抵抗线（米）

(2) 沿除土部两端方向的飞散距离：

$$L = 20n^2h$$

式中：L、n、h——意义同上。

当风力强烈时，石块沿顺风方向的飞散距离和沿斜坡向下爆破时的飞散距离，都应增大 25% ~ 50%。

2. 露天爆破时人员的安全距离也可参照表 12—4 执行。

表 12—4 露天爆破时个别飞散物对人员的安全距离

爆破类型和方法	个别飞散物最小安全距离 (m)
树根爆破	200
金属材料爆破	1500
炸倒建筑物及破坏基础	100
裸露装药爆破土壤岩石	400
药孔、药壶法松散土石	200
洞室爆破	300
扩药壶	50
水中非坚硬土壤爆破	100
水中坚硬土壤爆破	200
浮冰爆破	200
冰层下土壤爆破	100
阻塞冰的爆破	200

(三) 地震波对建筑物的最小安全距离可按下式计算：

1. In soil and rock blasting, the individual scattering distance of soil and rock fragments is calculated according to the following formula:

(1) Fly distance in the direction along both sides of the soil removal section:

$$L = 40n^2h$$

In which: L is the distance (meters) that soil and stones scatter.
n blasting action index

h minimum resistance line (m)

(2) Fly distance in the direction of both ends of the soil removal section:

$$L = 20n^2h$$

In which: L, n, h - have the same meaning as above.

When the wind is strong, the dispersion distance of rocks in the downwind direction and the dispersion distance when blasting down a slope should both be increased by 25%~50%.

2. When conducting open-pit blasting, the safe distance for personnel may also be referred to Table 12-4.

Table 12-4 Safety distance for personnel from individual flying debris during blasting

Explosion type and method	Minimum safe distance for individual scattered objects (m)
Metal material blasting	1500
Destruction of buildings and damage to foundations	100
Exposed charge blasting of soil and rock on the right	400
Loose rock and soil using the medicine hole and medicine pot method	200
Explosive blasting of non-rigid soil in water	100
Explosive blasting of hard soil in water	200
Soil blasting under the ice layer	100
Explosive blasting of block ice	200

(三) 地震波对建筑物的最小安全距离可按下式计算：
(3) The minimum safe distance from the ground wave to a building can be calculated using the following formula:

$$R = \left(\frac{K}{V}\right)^{\frac{1}{\alpha}} C^{\frac{1}{3}}$$

式中：R——地震波对建筑物的最小安全距离（米）

V——普通建（构）筑物地面质点安全垂直震动速度（厘米/秒），见表 12—5

C——一次齐爆的总装药量（千克）

K、α——与爆破点地形、地质等条件有关的系数和衰减指数，可按表 12—6 选取，或由试验确定

表 12—5 普通建（构）筑物地面质点安全垂直震动速度

建（构）筑物类型	震动速度 (cm/s)
土窑洞、土坯房、毛石房屋	1.0
一般砖房、非抗震大型砖块建筑物	2.0~3.0
钢筋混凝土框架房屋	5.0
水工隧道、交通隧洞	10~15
矿山巷道、坑道工事	10~30

表 12—6 不同性质的岩石的 K、α 值

岩 性	K	α	岩 性	K	α
坚硬岩石	50~150	1.3~1.5	软岩石	250~350	1.8~2.0
中硬岩石	150~250	1.5~1.8			

在特殊建（构）筑物附近或爆破条件复杂地区进行爆破时，必须进行必要的爆破地震效应的监测或专门试验，以确定被保护物的安全性。

$$R = \left(\frac{K}{V}\right)^{\frac{1}{\alpha}} C^{\frac{1}{3}}$$

In which: R is the minimum safe distance (meters) between the building and the seismic wave.

V Ground particle safety vertical seismic velocity for ordinary buildings (structures)

{(cm/s), see Table 12-5}

("—...-th total charge of the simultaneous explosion (kg)")

K, α is a coefficient and attenuation index related to the terrain and geological conditions at the blast point, which can be selected from Table 12-6 or determined by testing.

Ground particle safety vertical coverage velocity of ordinary buildings (structures) Table 12-5

Building type	Descent speed (cm/s)
Qian'an Dong, Tu Huai Fang, Mao You House	
General brick buildings, non-seismic large brick structures	2.0~3.0
钢筋混凝土框架房屋	
Hydraulic tunnels, traffic tunnels	
Mine tunnels, shafts, and underground works	

Table 12--6 K, α values of rocks of different natures

		1.3~1.5		250~350	1.8~2.0
		1.5~1.8			

When blasting near special buildings (structures) or in areas with complex blasting conditions, necessary monitoring of blasting seismic effects or special tests must be conducted to determine the safety of protected objects.

第十四章 附 则

第一百八十二条 本教范由总参谋部兵种部负责解释。

第一百八十三条 本教范自颁发之日起实行。1978 年 9 月 10 日由中国人民解放军工程兵司令部颁发的《爆破教范》即行废止。

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Chapter 14 Supplementary Provisions

Article 182. The interpretation of this manual shall be the responsibility of the Branch of the General Staff Department of the Armed Forces.

Article 183 This manual shall come into effect from the date of its promulgation. The "Manual of Demolition" promulgated by the Headquarters of the Engineering Troops of the PLA on September 10, 1978, shall be abolished immediately.

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附录一 建筑物拆除爆破

运用爆破方法拆除建筑物，可加快作业速度；与一般方法相比，具有安全、快速、费用低等特点。

一、基础爆破

根据结构物、构筑物不同，基础类型分为设备、机具基础，工事、楼房、厂房基础，公路、铁路桥梁的桥墩、桥台等。以材质不同分为混凝土、钢筋混凝土、浆砌块（片）石或砖砌体、天然岩石、各种土的混合体。

运用爆破法拆除基础，主要是对目标进行破碎，以便于清除。对于桥梁、墩台，各种结构物或构筑物的基础等露天目标，应特别注意控制碎块的飞散距离，避免对人员、车辆造成伤害以及对周围建筑物和设施造成损坏。对于建筑物、结构物内部的基础，还应注意爆破震动对仪器、仪表、设备等的影

响。基础爆破设计包括确定最小抵抗线 h 、孔深 L 、孔距 a 、列距 b 、单孔装药量 c 、起爆方法及起爆线路等。

（一）最小抵抗线。当爆破较大体积基础，并用人工清碴时，最小抵抗线 h 一般为：

浆砌块（片）石：0.50～0.70 米

混凝土：0.40～0.60 米

钢筋混凝土：0.30～0.50 米

最小抵抗线 h 与块度大小成正比。

（二）孔深。药孔深度 L 应根据爆破目标的几何尺寸，材料均匀程度，穿孔条件等因素确定。

1. 要求整体破碎时，孔深按下式计算确定：

$$L = K_f H$$

式中： L ——孔深（米）

K_f ——边界条件系数，见附表 1

Appendix Building Demolition Blasting

Using explosive demolition methods to remove buildings can accelerate the work process: compared with conventional methods, it offers the advantages of safety, speed, and low cost.

I. Yanchu blasting

Depending on the structure or building type, foundation types include equipment and machinery foundations, earthwork, building, and factory foundations, as well as bridge piers and abutments for highways and railways. Based on material composition, foundations are classified into concrete, reinforced concrete, masonry of blocks (or slabs) of stone or brick, natural rock, and various soil mixtures.

Use the breakage method to demolish foundations, primarily by breaking the target to facilitate removal. For exposed targets such as foundations of bridges, piers, various structures, or constructions, special attention should be paid to controlling the dispersion distance of fragments to avoid injury to personnel and vehicles, as well as damage to surrounding buildings and facilities. For foundations within buildings and structures

Also note the impact of blasting bag movement on instruments, gauges, and equipment.

Basic blasting design includes determining the minimum charge distance h , hole depth L , hole spacing, row spacing b , single-hole charge quantity c , blasting method, and blasting sequence.

(1) Minimum charge distance. When blasting a large volume of foundation and manually clearing debris, the minimum charge distance h is generally:

浆砌块（片）石：0.50～0.70 米

Concrete: 0.40～0.60m

Reinforced concrete: 0.30～0.50 meters

The minimum resistance line h is directly proportional to the block size.

(2) Hole depth. The depth of the charge hole, L , should be determined based on factors such as the geometric dimensions of the blasting target, the homogeneity of the material, and drilling conditions.

1. When the overall fragmentation is required, the hole depth shall be determined according to the following formula:

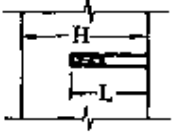
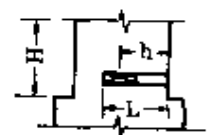
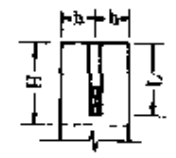
$$L = K_f H$$

In which: L —Borehole depth (meters)

K_f : Boundary condition coefficient, see Table 1

H——设计爆破部分的高度或厚度（米）（附图 1）

附表 1 边界条件系数 K_f

边界条件	系数 K_f
爆破目标底部有临空面或断裂层 	0.6 ~ 0.8
设计爆裂面在施工接缝上 	0.8
设计爆裂面在变截面中 	0.9 ~ 1.0
设计爆裂面在强度均匀的等截面中 	1.0

2. 要求保留部分不得损伤时，孔深按下式计算确定：

$$L = H - (0.2 \sim 0.4) h$$

(三) 孔距。药孔间距 a （附图 2）决定目标的破碎程度，通

H- Design blasting section height or thickness (meters) (see Figure 1)

Boundary condition
coefficient K_f

The bottom of the blasting target has a free
face or fault zone.

0.6~0.8

Design explosive
surface on construction
joints

Design the bursting surface i
n the varying section

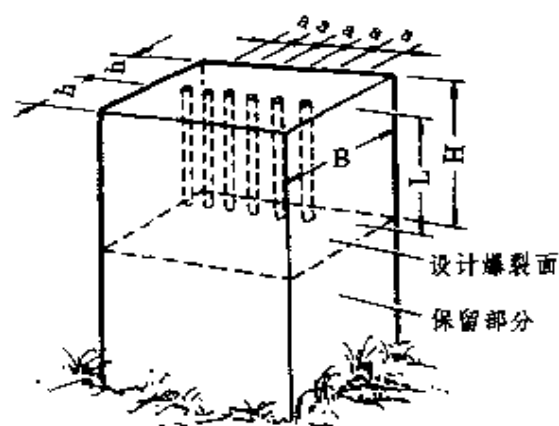
0.9~1.0

Design the explosive surface in a
uniform-strength equal-section

2. When retaining parts must not be damaged, the hole depth shall be
determined according to the following formula:

$$L = H - (0.2 \sim 0.4) h$$

(三) 孔距。药孔间距 a （附图 2）决定目标的破碎程度，通
determines the degree of fragmentation of the target, and the...



附图1 设计爆除部分的高度(或厚度)

常按下式计算确定:

$$a = K_a h$$

式中: a ——孔距(米)

K_a ——间距系数,

见附表2

(四) 列距。列距 b 按下式计算确定:

$$b = K_b a$$

式中: b ——列距(米)

K_b ——列距系数;

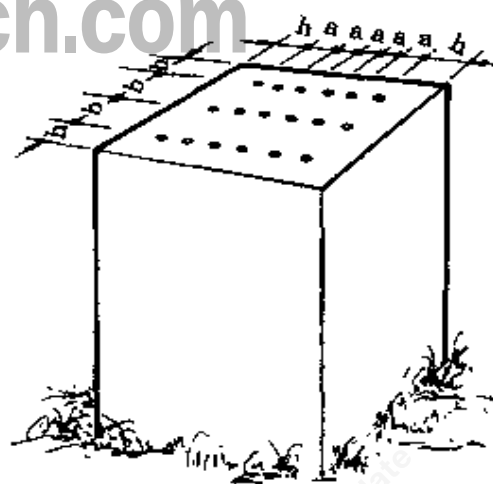
多列装药同

时起爆时,

取0.8~1.0; 多列装药延期起爆时, 取1.0~

1.2; 材料强度较低时, K_b 取大值, 反之取小

值



附图2 药孔间距与列距

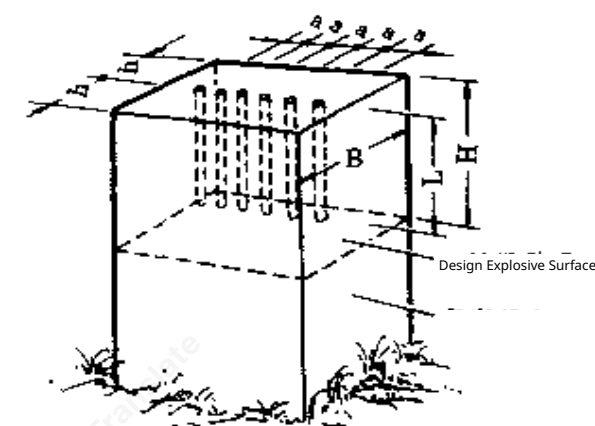


Figure 1 Design height (or thickness) of the explosion removal section

Determined as follows:

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Spacing (meters)

Spacing coefficient,

() Column spacing. Column spacing b press down

Calculated as follows:

$$b = K_b a$$

Column spacing (meters)

Column spacing coefficient;

Multi-column charge same

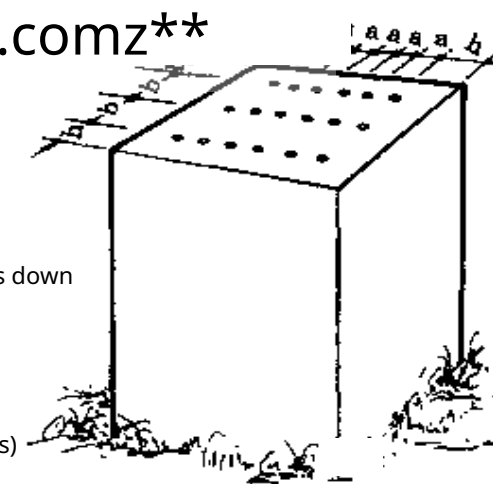


Figure 2: Spacing between drug holes and row spacing

Take 0.8~1.0; for multi-column charge delay initiation, take 1.0~1.2; when material strength is low, take the larger value, otherwise take the smaller value

附表 2 孔距系数 K_a

爆破要求与材料种类	K_a 值
破碎混凝土、浆砌块（片）石	1.0~1.5
破碎钢筋混凝土	1.3~1.8
破碎砖砌体	1.2~2.0
切割混凝土，要求爆裂面平整	0.5~0.8
切割混凝土，不要求爆裂面平整	0.8~1.0

（五）装药量。单孔装药量 C 按下式计算：

$$C = K_a b H$$

式中： C ——单孔装药量（克）

K ——单位药量系数（克/米³）；不同材质及爆破条件下的系数，见附表 3

b ——列距（米）；多列孔爆破时，外列孔可取 h 值；单列孔爆破时取 h 值

a 、 H ——意义同上

单孔装药量是爆破中最重要的参数，直接关系着爆破效果和安全。在厂房或一般建筑物内爆破拆除基础时，对钢筋混凝土结构只要求将混凝土疏松破碎，不要求炸断钢筋；对浆砌块（片）石、砖砌体及混凝土结构，只要求原地破碎，不允许碎块飞散。

（六）起爆方法及起爆线路。通常采用电起爆方法。在人口稠密区、工业区及室内实施基础爆破，为防止杂散电流、较强射频电流对电起爆线路的影响，可选用导爆管传爆法起爆。

二、钢筋混凝土框架结构房屋爆破

钢筋混凝土框架结构房屋的爆破，必须在保证爆破效果的同时，有效地控制破片飞散、震动、噪声等爆破危害的范围。

Table 2 Spacing coefficient K_a

Explosion Requirements and Material Types	
Broken concrete, mortar blocks (slabs) of stone	1.0~1.5
Broken steel reinforced concrete	1.3~1.8
Cracked brick masonry	1.2~2.0
Cut concrete, requiring the explosive surface to be flat	0.5~0.8
Cut concrete 1, no requirement for a flat fractured surface	0.8~1.0

（9）Charge quantity. The single-hole charge quantity C is calculated according to the following formula:

$$C = K_a b H$$

Single-hole charge amount grams com

Unit drug coefficient (g/m³); coefficients under different materials and blasting conditions, see Appendix 3.

Distance between rows (m); when blasting with multiple rows of holes, the outer row holes may use the h value; b

Take the h value when blasting a single-hole hole.

a 、 H —Same meaning

as above

The single-hole charge quantity is the most critical parameter in blasting, directly affecting blasting efficiency and safety. When demolishing foundations within a plant or general building, for reinforced concrete structures, only loosening and crushing the concrete is required; breaking the steel bars is not necessary. For mortared block (slab) stone, brick masonry, and concrete structures, only in-place crushing is required; flying fragments are not permitted.

(6) Blasting method and blasting circuit. The electric blasting method is generally used. When carrying out preliminary blasting in densely populated areas, industrial zones, and indoors, to prevent the influence of stray currents and strong radio frequency currents on the electric blasting circuit,

The detonation can be initiated using the detonating tube method.

II. Blasting of Reinforced Concrete Frame Structure

Buildings

Explosive demolition of reinforced concrete frame structure buildings must effectively control the range of blasting hazards such as fragment dispersion, vibration, and noise while ensuring the desired blasting effect.

附表 3 单位用药量系数 K 及单位耗药量 C/V

建筑物名称及材质	h (cm)	k(g/m³)			C/V (g/m³)
		1 个 临空面	2 个 临空面	多个 临空面	
混凝土与土强度较低	35 ~ 50	150 ~ 180	120 ~ 150	100 ~ 120	90 ~ 110
混凝土与土强度较高	35 ~ 50	180 ~ 220	150 ~ 180	120 ~ 150	110 ~ 140
混凝土桥墩及桥台	40 ~ 60	250 ~ 300	200 ~ 250	150 ~ 200	150 ~ 200
混凝土道路路面	45 ~ 50	300 ~ 360			220 ~ 280
钢筋混凝土桥墩台帽	35 ~ 40	440 ~ 500	360 ~ 440		280 ~ 360
钢筋混凝土铁路桥板梁	30 ~ 40		480 ~ 550	400 ~ 470	400 ~ 460
浆砌块石或料石	50 ~ 70	400 ~ 500	300 ~ 400		240 ~ 300
浆砌 砖墙	厚约 37 厘米	18.5	1200 ~ 1400	1000 ~ 1200	850 ~ 1000
	厚约 50 厘米	25	950 ~ 1100	800 ~ 950	700 ~ 800
	厚约 63 厘米	31.5	700 ~ 800	600 ~ 700	500 ~ 600
	厚约 75 厘米	37.5	500 ~ 600	400 ~ 500	330 ~ 430
混凝土 大块	$B_0H = 0.08 \sim 0.15m^3$			180 ~ 250	130 ~ 180
次爆破	$B_0H = 0.16 \sim 0.40m^3$			120 ~ 150	80 ~ 100
	$B_0H > 0.40m^3$			80 ~ 100	50 ~ 70

钢筋混凝土框架结构房屋爆破设计主要包括：选择坍塌方案，确定爆破部位和破坏程度，确定各爆破部位的起爆顺序及间隔延时时间，确定爆破参数、药孔布置、单孔装药量，确定起爆方法及起爆线路。

(一) 选择坍塌方案。实施爆破之前，应充分研究结构物的受力状态，承重立柱的部位、荷载分布，并详尽了解爆破点周围环境情况及施工的条件，以选择相应的爆破坍塌方案。

1. 原地坍塌：要求将钢筋混凝土立柱从底部向上爆破足够的高度，同时对立柱之间的钢筋混凝土联系梁予以充分的破坏。

Appendix3单位用药量系数K及单位耗药量C/V

Building Name and Material		k(g/m²)			C/V (g/m³)
		1 个 临空面	2 个 临空面	多个 临空面	
Concrete has lower strength.	35-50				
Concrete Plant [High Strength		180-220	150-180		
Concrete bridge piers and abutments					
Concrete Road Surface					
Reinforced concrete: bridge piers and abutments					
Reinforced concrete railway bridge deck stain	30-40		480-550		
Blockwork or rubble stone					
Thick approximately 37 cm		1200 ~ 1400	1000 1200		
thick approximately 50 cm masonry					
Thick approximately 63 cm					
Thick approximately 75 cm					
BH= 0.08 ~ 0.15m					
H,H=0.16-0.40m					
B,H>0.40m					

Design of blasting for reinforced concrete frame structure buildings mainly includes: selecting a collapse scheme, determining the blasting area and degree of destruction, establishing the detonation sequence and delay intervals for each blasting area, defining blasting parameters, charge hole arrangement, and charge per hole, and determining the detonation method and detonation circuit.

(-) Select the collapse scheme. Before implementing blasting, thoroughly study the stress state of the structure, the location of load-bearing columns, and the distribution of loads, and gain a detailed understanding of the surrounding environment and construction conditions at the blasting point to select the appropriate collapse scheme.

1. In-place collapse: Requires blasting the reinforced concrete column from the bottom upward to achieve sufficient height, while simultaneously causing sufficient damage to the reinforced concrete tie beams between columns.

原地坍塌爆破，要求爆破目标四周有 $1/4 \sim 1/3$ 框架高度的水平距离。

2. 定向坍塌：当钢筋混凝土结构房屋的爆破只允许向一个方向倾倒时采用，要求倾倒方向的水平距离不小于框架高度的 $1/3 \sim 1/2$ 。对倾倒方向的承重立柱，应爆破足够的高度，在框架自重作用下形成倾覆力矩；对非倾倒方向的承重立柱，应爆破适当的高度，形成框架倾倒时的铰支点。

3. 折叠坍塌：分为单向连续折叠坍塌和内向折叠坍塌两种基本形式。

(1) 单向连续折叠坍塌适用于高层钢筋混凝土框架结构房屋爆破，允许倒塌方向的水平距离约为框架高度的 $1/2$ 时采用。要求自上而下对每层或隔层框架结构按定向坍塌方式顺序起爆，使框架结构向一个方向以设计的时间间隔连续倒塌。

(2) 内向折叠坍塌适用于高层钢筋混凝土框架结构房屋爆破，四周的水平距离约为框架高度的 $1/4 \sim 1/3$ 时采用。要求对框架结构内部承重立柱和外部承重立柱予以充分破坏。

(二) 确定爆破部位。为保证钢筋混凝土框架结构整体倾覆或坍塌，必须形成倾覆力矩和相应数量的转动铰链。倾覆力矩可以通过两种方法取得：

1. 通过倾倒方向上各立柱不同的破坏高度形成倾覆力矩。各承重立柱的破坏高度依次取 $h_4 > h_3 > h_2 > h_1$ (附图 3)，并在各立柱与顶梁连接处将混凝土炸松以形成铰链，框架整体以 A 点为支点，在倾覆力矩作用下转动倾倒。立柱 D 的破坏高度一般取柱高的 $1/2 \sim 2/3$ ；立柱 C、B 的破坏高度依据立柱 D 的破坏高度递减；立柱 A 及各立柱与顶梁间的破坏高度，一般取立柱长边的 $1.0 \sim 1.5$ 倍。

2. 运用延时起爆技术使各立柱依次起爆产生倾覆力矩。各立柱爆破高度相同，按“1、2、3”的顺序 (附图 4)，先起爆各立柱与顶梁部位，各立柱中间部分及柱 A、柱 B 底部，再起爆柱

In-place Shan Tan blasting, requiring a horizontal distance of $1/4 \sim 1/3$ framework heights around the blasting target.

2. Directed collapse: Used when the blasting of a reinforced concrete structure is permitted to collapse only in one direction; the horizontal distance in the direction of collapse must be at least $1/3 \sim 1/2$ of the frame width. For load-bearing columns in the direction of collapse, blast sufficient height to create an overturning moment under the self-weight of the frame; for load-bearing columns in the non-collapse direction, blast an appropriate height to form a hinge point during the frame's collapse.

3-fold collapse: divided into unidirectional continuous folding collapse and inward folding collapse.

Basic form.

(1) Unidirectional continuous folding collapse is applicable to high-rise reinforced concrete frame structure buildings when the horizontal distance in the allowed collapse direction is approximately half the frame height.

Initiate blasting of each frame or alternate frame structure in the framework from top to bottom in a progressive collapse sequence, causing the framework structure to collapse continuously in one direction at a set time interval.

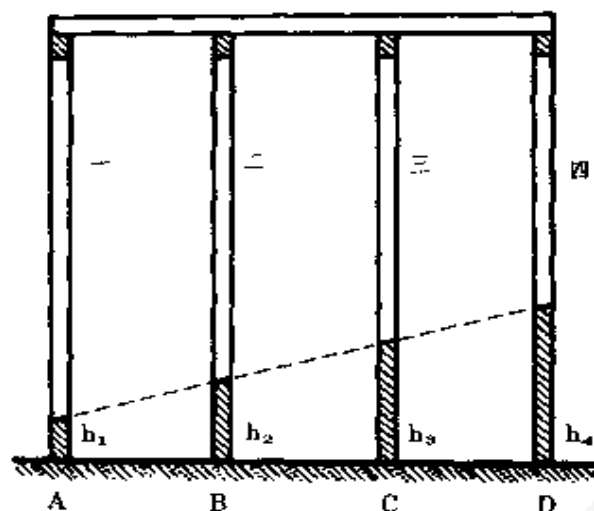
(2) Inward folding collapse is applicable for high-rise reinforced concrete frame structure buildings during demolition, when the horizontal distance around the structure is approximately $1/4 \sim 1/3$ of the frame height. It requires sufficient destruction of the load-bearing columns inside the frame structure and the external load-bearing columns.

(二) Determine the blasting area. To ensure the overall overturning of the reinforced concrete main frame structure

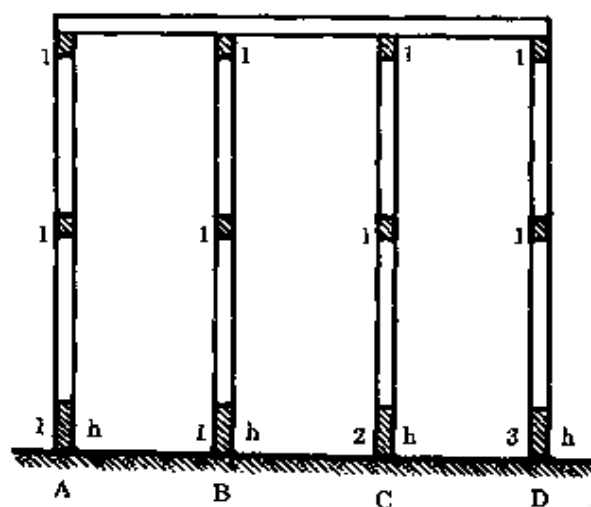
or collapse, it is necessary to form an overturning moment and a corresponding number of rotational hinges. The overturning moment can be obtained by two methods:

1. A overturning moment is generated by varying the collapse height of each column along the direction of overturning. The collapse heights of the load-bearing columns are sequentially set to $h_4 > h_3 > h_2 > h_1$ (see Figure 3), and the concrete is blasted loose at the connection points between each column and the top beam to form hinges. The entire frame pivots around point A and rotates and topples under the action of the overturning moment. The collapse height of column D is generally taken as $1/2 \sim 2/3$ of the column height; the collapse height of column B decreases based on the collapse height of column D; the collapse height of column A and the collapse degree between each column and the top beam are generally taken as $1.0 \sim 1.5$ times the length of the long side.

2. Use delayed blasting technology to sequentially detonate each prop, generating an overturning moment. The blasting height of each prop is identical. Following the sequence 1, 2, 3 (see Figure 4), first detonate the sections of each prop near the roof beam, then the middle sections of each prop and the bottom sections of columns A and B, and finally detonate the remaining parts of the prop.



附图3 立柱不同破坏高度



附图4 通过间隔起爆形成倾覆力矩

C底部，最后起爆柱D底部，整体框架以柱D底部为支点，在倾覆力矩作用下倾倒。各立柱底部的破坏高度取立柱长边的2~3倍；各立柱中间部位及与顶梁间的破坏高度取立柱长边的1.0

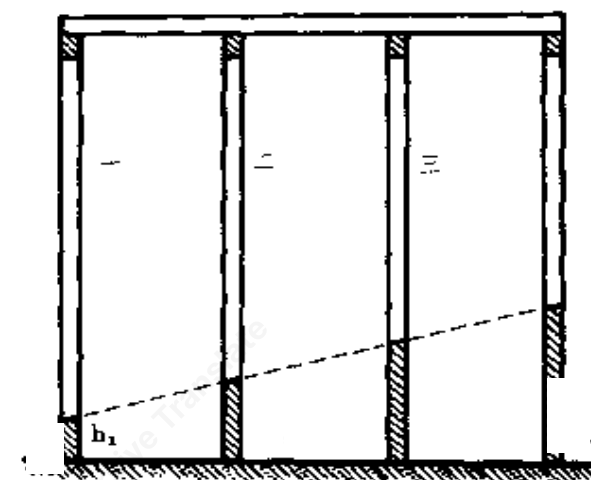


Figure 3:
Different failure

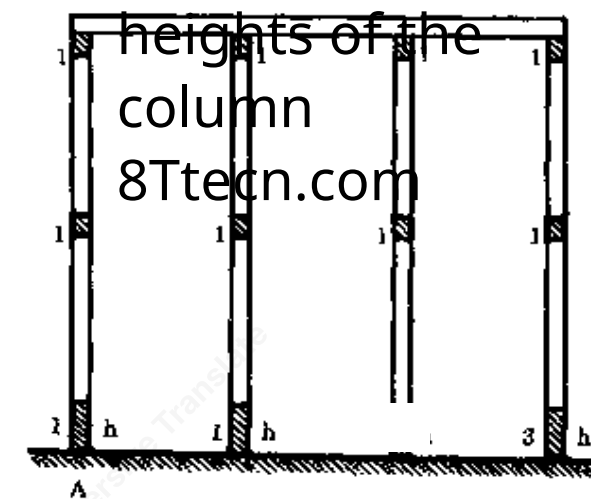
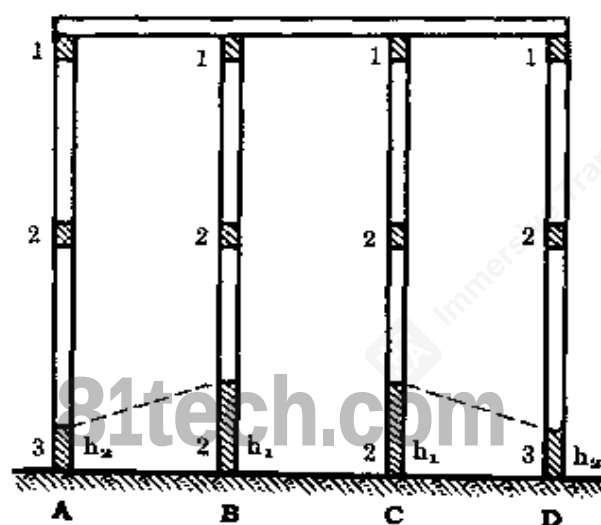


Figure 4 shows the overturning moment
formed by interval blasting.

At the bottom of column C, and finally at the bottom of column D, the entire framework pivots around the bottom of column D and topples under the overturning moment. The failure height at the base of each column is taken as 3 times the long side of the column: the failure height at the middle section of each column and between the columns and the pre-beam is taken as 1.0 times the long side of the column. 222

~ 1.5 倍。

将以上两种方法结合起来，可形成钢筋混凝土框架结构整体坍塌的各种破坏形式（附图 5），并由此确定爆破部位。立柱的破坏高度可参照上述两种方法实施。



附图 5 框架由中间向下坍塌

（三）确定起爆顺序及时间间隔。倒塌方向的承重立柱先起爆，非倒塌方向的承重立柱后起爆。同一层中的立柱起爆时间间隔一般在 500 毫秒以内；层与层之间取半秒差或秒差。

（四）确定爆破参数。

1. 最小抵抗线：爆破小截面梁柱时，最小抵抗线 h 按下式计算确定：

$$h = \frac{B}{2}$$

式中： h ——最小抵抗线（米）

B ——梁柱断面中最小边长（米）

爆破大截面梁柱时，最小抵抗线宜取 0.2~0.5 米，且应多列药孔交错配置。

5x

Combining the above two methods can form various forms of collapse of reinforced concrete frame structures (Figure 5), and the blasting areas can be determined accordingly. The height of the column damage can be implemented by referring to the above two methods.

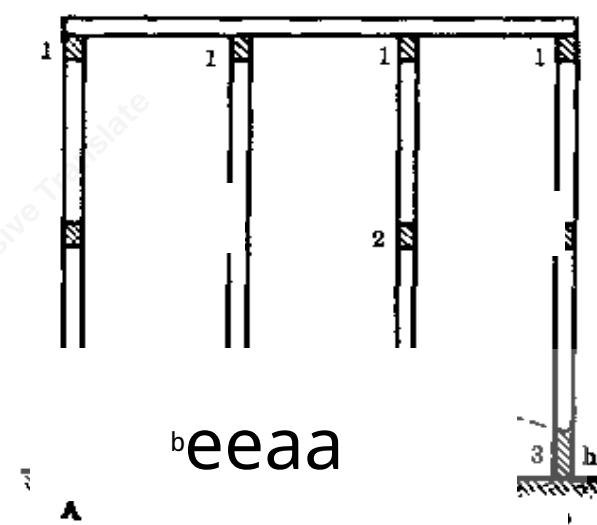


Figure 5 framework collapses downward from the center

(3) Determine the blasting sequence and time intervals. The load-bearing columns in the direction of collapse are blasted first, followed by those in the non-collapse direction. The time interval between blasting columns within the same layer is generally within 500 milliseconds; a half-second or one-second difference is taken between layers.

(4) Determine blasting parameters.

1. Minimum charge: When blasting small cross-section beams and columns, the minimum charge h is determined according to the following formula:

$$h = \frac{B}{2}$$

In which: h is the minimum charge diameter (meters)

B ——Minimum side length of the beam-column cross-section (meters)

When blasting large cross-section beams and columns, the minimum charge spacing shall be 0.2~0.5 meters, and multiple charge holes should be staggered.

2. 孔距：药孔间距 a 决定爆破部位的破碎程度和穿孔作业量，应按下式计算确定：

$$a = (1.2 \sim 1.25) h$$

式中： a ——孔距（米）

h ——最小抵抗线（米）

3. 孔深：药孔深度 L 决定装药位置和穿孔作业量。对于正方形或圆形截面的立柱，药孔深度按下式计算确定：

$$L = (0.58 \sim 0.60) D$$

式中： L ——孔深（米）

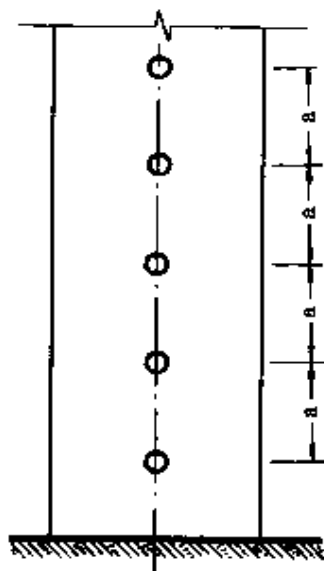
D ——正方形立柱边长或圆柱直径（米）

对于矩形立柱，药孔深度按下式计算确定：

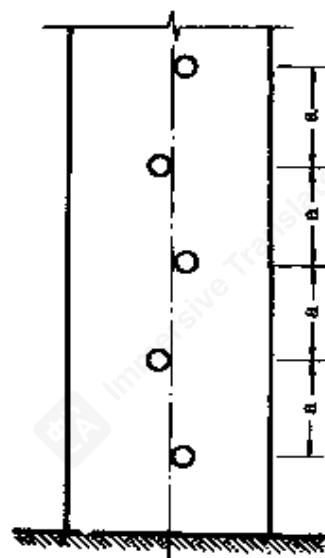
$$L = H - h$$

式中： H ——矩形梁柱截面的高度或长边尺寸（米）

（五）布置药孔。对于小截面梁柱，可沿梁柱中心线布置单列药孔（附图 6），也可以沿梁柱中心线两侧布置药孔（附图 7）。



附图 6 沿中心线布置单列药孔



附图 7 沿中心线两侧布置药孔

2, Hole spacing: The distance between the explosive hole and the wall (a) determines the degree of fragmentation at the blasting zone and the drilling operation.

value, should be determined according to the following formula:

$$a = (1.2 \sim 1.25) h$$

In which: a - distance between holes (meters) h

Minimum resistance line (meters)

3. Hole depth: The depth of the drug hole L determines the placement of the charge and the drilling operation. For uprights with square or circular cross-sections, the depth of the drug hole is calculated and determined as follows:

$$L = (0.58 \sim 0.60) D$$

In which: L bore depth (meters)

One square column side length or cylinder diameter (meters)

For the Chu Xing column, the depth of the drug hole is determined by the following formula:

h Com - height or long side dimension of a rectangular beam-column section (meters)

Wu: H 81

(5) Arrange the medicine holes. For small cross-section beams and columns, arrange a single one along the centerline of the beam and column.

Drilled holes (see Figure 6) can also be arranged on both sides of the centerline of the beam and column (see Figure 7).

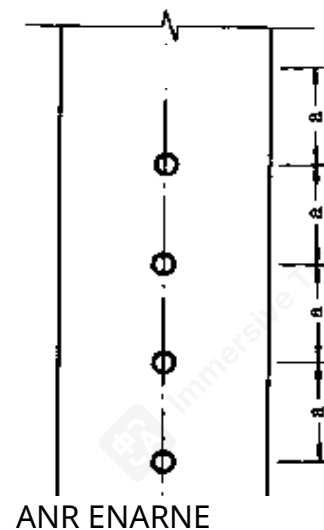
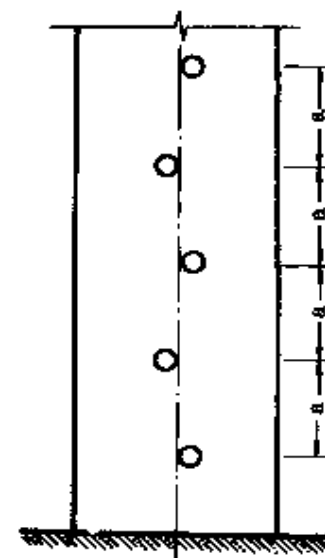


Figure 6: Single row of drug holes arranged along the centerline



Arrange explosive holes on both sides of the center line. See Figure 7:

对于大截面立柱的爆破，为保证爆破效果，有效地控制破片飞散，可沿立柱纵向布置3列药孔（附图8）。

（六）计算装药量。

1. 以单列孔爆破正方形或矩形梁柱时，装药量按下式计算：

$$C = kBaH$$

式中：C——单孔装药量（克）

B——梁柱短边长度（米）

H——梁柱长边长度（米）

a——孔距（米）

K——单位用药量系数，可在附表4中选取

2. 以多列孔爆破正方形或矩形梁柱时，按基础爆破装药量计算公式确定装药量。

3. 圆形立柱的爆破，装药量按下式计算：

$$C = k\pi r^2 a$$

式中：C——单孔装药量（克）

r——立柱的半径（米）

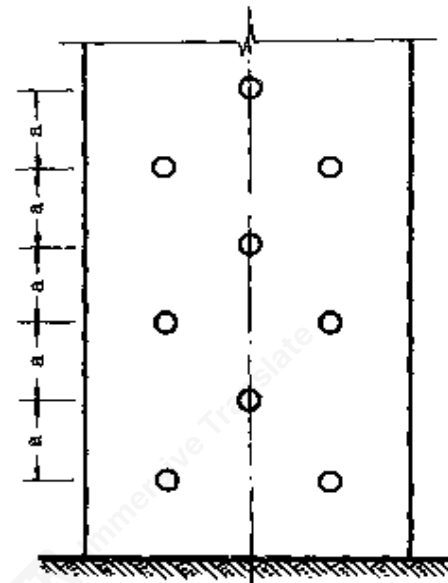
a、K——意义同前

（七）选择装药结构。通常分为集中装药和分层装药。

1. 集中装药：当药孔深度 $L \leq 1.5h$ 时，用集中装药，即每孔1个药卷。

2. 分层装药：装药分层装填的层数依下列情况确定。

（1） $L = (1.6 \sim 2.5)h$ 时：将单孔装药量分成两个药卷，



附图8 沿立柱纵向布置3列药孔

Explosion of large-section columns 莎，

To ensure blasting effectiveness and effectively control

Scattered by the blade, they can be arranged longitudinally along the column. 3-column drug wells (see Figure 8)

(6) Calculate the charge quantity.

square blasting with single-hole drilling

or rectangular beam-column, the charge quantity is calculated according to the following formula

$$C = kBaH$$

In which: C is the charge quantity for a single hole. (克)

B——梁柱短边长度（米）

H——Length of the long edge of the beam-column

Degrees (meters)

a—Spacing (meters)

K is the dosage coefficient per unit, which can be selected from Appendix 4.

2. When blasting square or rectangular beams and columns with multiple column holes, determine the charge quantity according to the formula for calculating the charge quantity for foundation blasting.

3. Blasting of round columns, the charge quantity is calculated according to the following formula: K

In which: C—charge per hole (grams)

r——Radius of the column (meters)

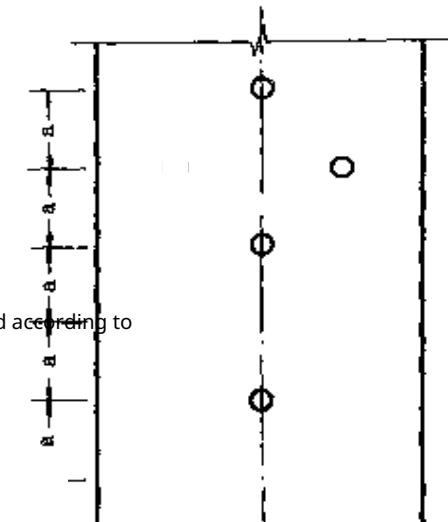
a、K—Same meaning as before

(7) Select the charge structure. It is generally divided into concentrated charging and layered charging.

[Concentrated charge: When the depth of the charge hole $L \leq 1.5h$, use concentrated charge, i.e., one charge cartridge per hole.

2. Layered charge: The number of layers for layered charge filling is determined as follows.

(1) $L = (1.6 \sim 2.5)h$: Divide the single-hole charge quantity into two charge sections,



ARRRRA

Arrange 3 rows of drug holes vertically.

附表4 单位用药量系数 K 及单位耗药量 C/V

h (mm)	K (g/m ³)	C/V (g/m ³)	布筋 情况	爆 破 效 果
100	1150 ~ 1300	1100 ~ 1250	正 常 布 筋	混凝土破碎,疏松,与钢筋分 离,部分碎块逸出钢筋笼
	1400 ~ 1500	1350 ~ 1450	单箍筋	混凝土粉碎,脱离钢筋笼,箍 筋拉断、主筋膨胀
150	500 ~ 560	480 ~ 540	正 常 布 筋	混凝土破碎,疏松,与钢筋分 离,部分碎块逸出钢筋笼
	650 ~ 740	600 ~ 680	单箍筋	混凝土粉碎,脱离钢筋笼,箍 筋拉断、主筋膨胀
200	380 ~ 420	360 ~ 400	正 常 布 筋	混凝土破碎,疏松,与钢筋分 离,部分碎块逸出钢筋笼
	420 ~ 460	400 ~ 440	单箍筋	混凝土粉碎,脱离钢筋笼,箍 筋拉断、主筋膨胀
300	300 ~ 340	280 ~ 320	正 常 布 筋	混凝土破碎,疏松,与钢筋分 离,部分碎块逸出钢筋笼
	350 ~ 380	330 ~ 360	单箍筋	混凝土粉碎,脱离钢筋笼,箍 筋拉断、主筋膨胀
	380 ~ 400	360 ~ 380	布 筋 较 密	混凝土破碎,疏松,与钢筋分 离,部分碎块逸出钢筋笼
	460 ~ 480	440 ~ 460	双箍筋	混凝土粉碎,脱离钢筋笼,箍 筋拉断、主筋膨胀
400	260 ~ 280	240 ~ 260	正 常 布 筋	混凝土破碎,疏松,与钢筋分 离,部分碎块逸出钢筋笼
	290 ~ 320	270 ~ 300	单箍筋	混凝土粉碎,脱离钢筋笼,箍 筋拉断、主筋膨胀
	350 ~ 370	330 ~ 350	布 筋 较 密	混凝土破碎,疏松,与钢筋分 离,部分碎块逸出钢筋笼
	420 ~ 440	400 ~ 420	双箍筋	混凝土粉碎,脱离钢筋笼,箍 筋拉断、主筋膨胀

Unit drug dosage coefficient K and unit drug
consumption C/V

(g/m ²)	(g/m)		
		Normal Wiring	Concrete crushing, loosening, and separation from the reinforcement bars, with some fragments escaping the reinforcement cage.
			Concrete crushing, separation from the rebar cage, stirrup breaking, and main bar expansion.
		Normal Wiring	Concrete crushing, loosening, and separation from the reinforcement bars, with some fragments escaping the reinforcement cage.
650-740			Concrete crushing, separation from the rebar cage, stirrups 筋断裂、主筋膨胀
380-420		Normal layout	Concrete crushing, loosening, and separation from reinforcement, with some fragments escaping the reinforcement cage.
420-460			Concrete crushing, separation from the rebar cage, stirrups Tendon rupture, main bar expansion
	280-320	Normal Wiring	Concrete crushing, loosening, and separation from the reinforcement bars, with some fragments escaping the reinforcement cage.
			Concrete crushing, separation from the rebar cage, stirrups Tendon rupture, main bar expansion
			Concrete crushing, loosening, and separation from reinforcement bars off, some fragments escape the r ebar cage
			Concrete crushing, separation from the rebar cage, stirrups Tendon rupture, main bar expansion
		Zhengbu Chang Jin	Concrete crushing, loosening, and separation from the reinforcement bars, with some fragments escaping the reinforcement cage.
290-320			Concrete crushing, separation from the rebar cage, stirrup breaking, and main bar expansion.
		Dense muscle fibers	Concrete crushing, loosening, and separation from the reinforcement bars, with some fragments escaping the reinforcement cage.
			Concrete crushing, separation from the rebar cage, stirrup breaking, and main bar expansion.

续 表				
h (mm)	K (g/m ³)	C/V (g/m ³)	布筋 情况	爆 破 效 果
500	220 ~ 240	200 ~ 220	正 常 布 筋	混凝土破碎, 疏松, 与钢筋分 离, 部分碎块逸出钢筋笼
	250 ~ 280	230 ~ 260	单箍筋	混凝土粉碎, 脱离钢筋笼, 箍 筋拉断、主筋膨胀
	320 ~ 340	300 ~ 320	布 筋 较 密	混凝土破碎, 疏松, 与钢筋分 离, 部分碎块逸出钢筋笼
	380 ~ 400	360 ~ 380	双箍筋	混凝土粉碎, 脱离钢筋笼, 箍 筋拉断、主筋膨胀

两层装药, 上、下层药量分配比为 0.4:0.6。

(2) $L = (2.6 \sim 3.7) h$ 时: 分成 3 个药卷, 3 层装药, 上、中、下层药量分配比为 0.2:0.3:0.5。

(3) $L \geq 3.8h$ 时: 分成 4 个药卷, 4 层装药, 由上至下各层分配比为 0.15:0.25:0.25:0.35。

装药分层装药必须注意: 最上层药卷的中心距孔口的填塞长度不小于最小抵抗线; 分层药卷筒的中心距离 a_1 应满足的条件是: $20 \text{ 厘米} \leq a_1 \leq h_0$ 。

(八) 选择起爆方法及起爆线路。钢筋混凝土框架结构房屋爆破, 可采用电起爆、导爆管起爆。对于倾倒方向的梁、柱及其他关键部位上的装药, 必须用双雷管起爆。当实施电起爆时, 可选用混联线路; 用导爆管传爆时可选用复式线路。当不同楼层或部位需要按一定时间间隔延时起爆时, 可使用相应段别的延期雷管或电雷管起爆。

三、烟囱、水塔爆破

烟囱、水塔属高大、细长型特种结构, 爆破时应准确确定倒塌方向和范围。

烟囱、水塔爆破设计内容包括: 选择倒塌方案、确定爆破参

Continued table: Blast effect				
h (mm)	K(g/m)	y (g/m ²)	Rebar Arrangement Details	
500	220 ~ 240	200 ~ 220	Zhengbu Changjin Dan	Concrete crushing, loosening, and separation from the reinforcement bars, with some fragments escaping the reinforcement cage.
	250 ~ 280	230 ~ 260	Gujin	Concrete crushing, separation from the rebar cage, stirrup breaking, and main bar expansion.
	320 ~ 340	300 ~ 320	布较筋 密 双箍筋	Concrete crushing, loosening, and separation from the rebar, with some fragments escaping the rebar cage.
	380 ~ 400	360 ~ 380		Concrete crushing, separation from the rebar cage, stirrup breaking, and main bar expansion.

Two-layer charge, with the upper and lower layer charge ratio of 0.4:0.6。

(2) $L=(2.6 \sim 3.7)h$: divided into 3 cartridges, 3 layers of charge, top, middle, bottom layer dosage distribution ratio is 0.2:0.3:0.5。

(3) At 13.8h: divided into 4 charge sections, 4 layers of charges, with the layer-wise distribution ratio from top to bottom as 0.15:0.25:0.25:0.35,

Loading of charges in layers must be noted: the center-to-center distance of the charge cartridge in the uppermost layer from the borehole mouth must not be less than the minimum resistance line; the center-to-center distance between the layered cartridge tubes and a_1 should meet the following conditions: $20 \text{ cm} \leq a_1 \leq h_0$ 。

(8) Select the blasting method and blasting circuit. For reinforced concrete frame structure buildings, electric blasting or detonating tube blasting may be used. For charges on beams, columns, and other critical components in the direction of collapse, double detonators must be used. When implementing electric blasting, a mixed series-parallel circuit may be selected; when using detonating tubes for transmission, a compound circuit may be selected. When different floors or sections require delayed blasting at specific time intervals, corresponding delay detonators or electric detonators may be used.

III. Chimney and water tower
blasting
Chimneys and water towers are tall, slender special structures; during blasting, the direction and scope of collapse must be accurately determined.

Smoke, water tower blast design includes: selecting collapse schemes, determining blast parameters

数、确定布孔范围、计算单孔装药量、确定起爆方法及起爆线路。

(一) 选择倒塌方案。对烟囱及圆筒式支承的水塔, 可采用原地坍塌或定向倒塌方式实施爆破拆除。

当强度较低的砖砌烟囱或砖结构承重的水塔, 其周围场地的水平距离不小于烟囱或水塔高度的 1/2 时, 可采用原地坍塌方式爆破。

当烟囱或水塔周围有宽度大于 2 倍其直径、长度大于 1.2 倍其高度的狭长空地时, 可采用定向倒塌方式爆破。

(二) 确定爆破参数。

1. 药孔深度 L 按下式计算:

$$L = 0.6B$$

式中: L —药孔深度 (米)

B ——烟囱或水塔的壁厚 (米)

2. 药孔间距 a 和列距 b 分别按下列公式计算:

$$a = (0.8 \sim 0.9)L$$

$$b = 0.85a$$

(三) 确定布孔范围。药孔沿烟囱或水塔周壁水平方向和垂直方向上分布的范围, 也称爆破切口。常用的爆破切口有梯型和水平型两种 (附图 9)。

当要求目标原地坍塌时, 可采用水平切口, 长度为烟囱或水塔爆破部位的整个圆周长, 高度取大于或等于其爆破部位壁厚的 2 倍。

当要求目标定向倒塌时, 两种切口类型均可使用, 切口长度和高度可按下列公式计算:

$$L_k = (0.60 \sim 0.75)\pi D$$

$$H = (1.5 \sim 2.0)B$$

式中: L_k ——切口长度 (米)

H ——切口高度 (米)

determine the number, establish the blasting area, calculate the charge per hole, and determine the detonation method and detonation circuit.

(1) Select the inverted scheme. For water towers with chimneys and cylindrical supports, you may use

Implement blasting demolition using in-place collapse or directional collapse methods.

When the water tower with a brick masonry chimney or brick structure bearing load has a lower intensity, and the horizontal distance from the surrounding site is not less than 1/2 of the height of the chimney or water tower, the in-place collapse blasting method may be adopted.

When a narrow open space with a width greater than twice the diameter of a chimney or water tower and a length greater than 1.2 times its height is present around the chimney or water tower, directional collapse blasting may be adopted.

(2) Determine blasting parameters.

1. The depth of the medicine hole is calculated according to the following formula:

$$L = 0.6B$$

In the formula: L is the depth of the drug hole (already ch.com

B ——烟囱或水塔的壁厚 (米)

2, the spacing between medicine holes a and the row spacing b are calculated according to the following formulas:

$$a = (0.8 \sim 0.9)L$$

$$b = 0.85a$$

(3) Determine the blasting hole layout. The distribution range of the drug holes along the horizontal and vertical directions around the smoke window or water tower wall is also referred to as the blasting cut. Common blasting cuts include the stepped type and the horizontal type (see Figure 9).

When the target is required to collapse in place, a horizontal cut can be used, with a length equal to the entire circumference of the blast window or water tower explosion area, and a height greater than or equal to twice the wall thickness of the blast area.

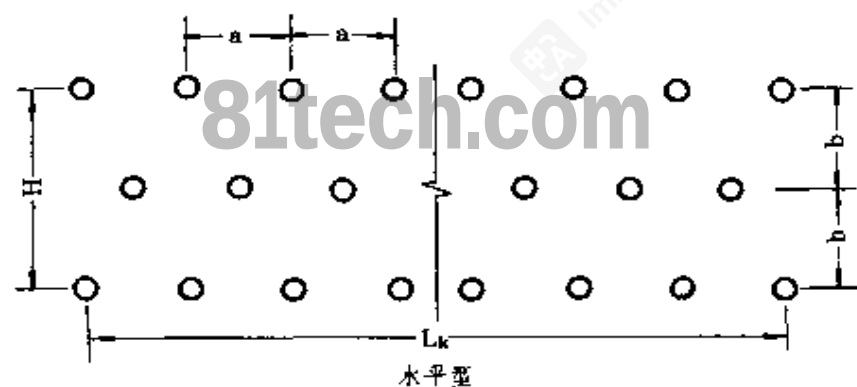
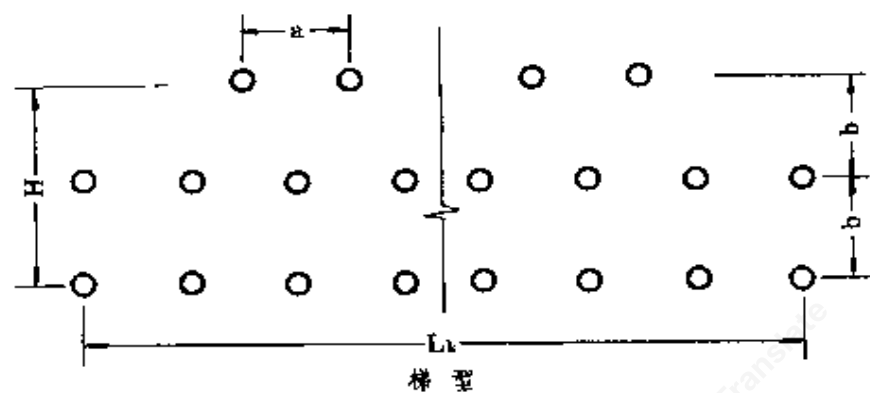
When target-oriented collapse is required, both cut types can be used, and the cut length and height can be calculated using the following formulas:

$$L_k = (0.60 \sim 0.75)\pi D$$

$$H = (1.5 \sim 2.0)B$$

In which: L_k —cut length (meters)

H ——Cut height (meters)



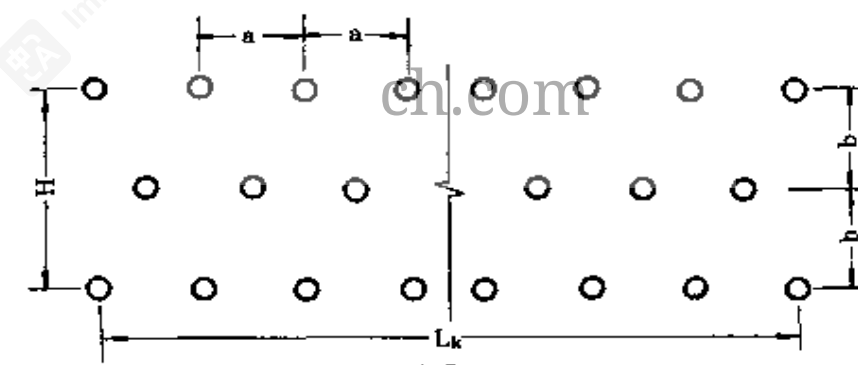
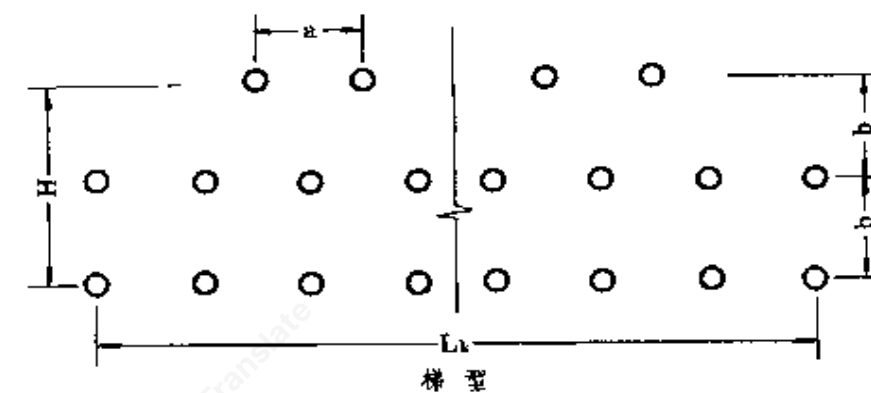
附图 9 烟囱、水塔爆破切口

D——烟囱或水塔爆破部位的外直径（米）
(四) 计算单孔装药量。单孔装药量按下式计算：

$$C = kabB$$

式中：C——单孔装药量（克）

对水泥砂浆砖砌结构体的爆破，k 值可根据不同的壁厚从附表 5 中选取；对钢筋混凝土结构体的爆破，k 值可从附表 6 中选取。



Chimney, water tower blast cut diagram Figure 9

Outer diameter (m) of the blast area of a chimney or water tower (4) Calculate the charge per hole. The charge per hole is calculated according to the following formula:

$$C = kabB$$

In which: C—single-hole charge amount (grams)

For blasting of cement mortar brick structures, the k-value can be selected from Appendix Table 5 based on different wall thicknesses; for blasting of reinforced concrete structures, the k-value can be selected from Appendix Table 6.

270 - 300

烟囱、水塔爆破，拒爆，每个装药均

1

1

Table 6
Drug Dose

1

asting
struction

Sequence of building demolition blasting includes: preparation, marking and drilling holes, and loading explosives

Construction preparation. Construction preparation for blasting includes: organizational preparation, equipment preparation

1

情况下，爆破施工现场可成立指挥组，下设技术、施工、器材、安全 4 个小组；其组成和任务是：

(1) 指挥组：由总指挥、副总指挥和各小组组长组成。总指挥和副总指挥由熟悉爆破知识和安全规则、掌握爆破施工规律、组织能力较强的干部或技术人员担任；其主要任务是：

①根据爆破设计的要求，研究确定爆破施工方案和施工计划。必要时与技术小组一同结合试验，进一步确定爆破参数。

②全面组织和检查施工准备、施工进度和施工质量，及时研究解决施工中遇到的问题。

③对参加施工的所有人员进行安全教育，组织安全检查。

④检查爆破效果，进行施工总结。

(2) 技术小组：组长由参加爆破设计的技术人员担任；小组的任务是：

①进行爆破设计。

②向施工人员提出技术要求。

③标定药孔位置。

④检查炸药、火具的质量，必要时进行试验。

⑤对施工进行技术指导，及时解决施工中的技术问题。

(3) 施工小组：组长由施工分队的指挥员担任；小组的任务是：

①根据爆破设计要求，实施穿孔作业。

②导通电雷管、导电线，测量其电阻。

③制作药卷，进行装药、填塞。

④连接、检查起爆网路。

⑤检查电源，实施起爆。

(4) 器材小组：组长由器材部门的有关人员担任；小组的任务是：

①请领炸药、火具。

②筹备、运输、保管各种非爆炸器材及作业机具，并保证各

In certain cases, a command group may be established at the blasting construction site, with four subgroups: technical, construction, equipment, and safety. Their composition and tasks are as follows:

(1) Command Group: Composed of the Chief Commander, Deputy Chief Commander, and leaders of each sub-group. The Chief Commander and Deputy Chief Commander shall be appointed as cadres or technical personnel who are familiar with blasting knowledge and safety regulations, understand the principles of blasting construction, and possess strong organizational capabilities; their primary task is:

D. Based on the blasting design requirements, research and determine the blasting construction plan and construction schedule.

Combine with the technical team and conduct trials when necessary.

Further determine blasting parameters

2. Organize and inspect construction preparation, construction progress, and construction quality, and timely study and resolve problems encountered during construction.

Conduct safety education for all personnel participating in construction and organize safety inspections.

(2) Technical Team: The team leader shall be a technical personnel participating in the blasting design; the team consists of the tasks are:

1 Conduct blasting design

2. Ask the construction personnel for technical requirements.

3. Calibrate the position of the calibration drug holes.

1. Inspect the quality of explosives and ignition tools; conduct tests if necessary.

1. Provide technical guidance for construction and promptly resolve technical issues arising during construction.

(3) Construction Team: The team leader shall be the commander of the construction squad; the team's task

1. In accordance with the blasting design requirements, implement the drilling operation.

2 Measure the resistance of the electric detonator and the lead wire.

3. Make cartridges, perform loading and packing.

4. Connect and check the detonation network.

1. Check the power supply and initiate detonation.

(4) Equipment Group: The group leader shall be appointed from relevant personnel in the equipment department; the group's term of office

1. Collect explosives and fire tools.

2 Prepare, transport, and store various non-explosive equipment and operational tools, and ensure each

种油料供应。

③筹备各种安全防护材料。

(5) 安全小组：组长由熟悉爆破安全规则、责任心强的人员担任；小组内应指定熟悉炸药、火具性能及保管、搬运注意事项的炸药保管员和火具保管员各 1 名。小组的任务是：

①负责炸药、火具的搬运与保管，建立雷管的专用登记本，严格领发手续。

②组织实施安全防护作业。

③负责爆破时的警戒、爆破后的险情排除或险情标志的设置。

④在城市内实施爆破时，负责事先向当地公安部门办理报批手续（临时切断公共交通亦须经公安部门许可）。

⑤负责向爆破目标附近的单位和人员（特别是在居民区）进行宣传 and 解释工作。

各小组的人数，根据爆破作业的规模和要求确定。

2. 器材准备：爆破施工使用的器材可分为 4 类。

- (1) 炸药、火具；
- (2) 起爆器材及检测仪表；
- (3) 施工机械、工具；
- (4) 防护材料等。

各类器材必须按照器材计划进行筹备。

3. 现场准备：为减少施工中各工序的相互干扰，提高作业效率，应根据爆破目标周围的情况，按照有利安全、方便施工的原则进行现场准备。

(1) 确定空压机的工作位置。其位置必须有利于穿孔作业、保证机械安全和进出方便。在可能的条件下，宜停放在距爆破目标 30~40 米的室内。如在室外停放，应加以防护或在起爆前拖走。

(2) 确定加工装药的位置。其位置应利于炸药防潮、作业方

Seed oil supply.

3 Prepare various safety protection materials

(5) Safety and Enterprise Group: The group leader shall be a person familiar with blasting safety regulations and possessing strong responsibility; within the group, one explosives custodian and one pyrotechnic device custodian, each familiar with the performance of explosives and pyrotechnic devices and the precautions for their storage and handling, shall be designated. The group's tasks are:

1. Responsible for the transportation and storage of explosives and pyrotechnics, and establish a dedicated registration book for detonators,

Strict issuance procedures

2 Organize and implement security protection operations

3 is responsible for security during blasting, hazard elimination after blasting, or setting up hazard warning signs.

1. When conducting blasting within the city, the person in charge must notify the local public security

Submit the application for approval to the relevant department.

Procedures (temporary interruption of public transportation also requires approval from the public security department).

Responsible for blasting

Units and near the mark and

is conducted in residential areas) for publicity and explanation.

The number of personnel in each group shall be determined based on the scale and requirements of the blasting operation.

2. Equipment preparation: The equipment used for blasting operations can be divided into four categories.

(1) Explosives,

pyrotechnic devices;

(2) Blasting equipment and testing

instruments;

(3) Construction machinery and tools;

(4) Protective materials,

etc.

All equipment must be prepared in accordance with the

equipment plan

3. Site Preparation: To minimize mutual interference between various construction processes and improve operational efficiency, site preparation should be carried out in accordance with the conditions surrounding the blasting target, following the principles of ensuring safety and facilitating construction.

(1) Determine the working location of the air compressor. Its location must be conducive to piercing operations,

Ensure mechanical safety and convenient access. Wherever possible, the vehicle should be parked indoors at a distance of 30~40 meters from the blasting target. If parked outdoors, it should be protected or towed before detonation.

(2) Determine the location of the explosive charge. Its position should facilitate moisture protection for the explosive and be convenient for the operator.

便和安全。在可能的条件下，应选择在爆破目标附近的独立房屋内。

(3) 确定检测电雷管和设置点火站的位置。其位置应避开高压线和照明线路。

(4) 确定安全警戒的具体位置和施工人员撤离到达的安全地点。

(5) 确定各类车辆的停放位置和行驶路线，以及爆破时撤离到达的安全地点。

(6) 确定工具器材和防护材料的存放地点。

(二) 标孔与穿孔。

1. 标孔：标孔是按照爆破设计，将药孔位置准确地标定在目标上。

标孔前，必须先清除爆破目标表面的积土和破碎层，然后在预定的各个药孔具体位置做出明显标记。标孔时应注意以下事项：

(1) 不能随意变动药孔的设计位置。遇有与原设计情况不符时，应同技术人员研究处理。

(2) 破碎混凝土、钢筋混凝土时，应先标边孔，后标其他孔。标定边孔应先从主要防护方向上标起，以保证这些孔的准确位置。

(3) 标定主要方向上的边孔或在梁、柱上标孔时，应校核最小抵抗线和构件的实际尺寸，使实际的最小抵抗线与设计的最小抵抗线基本相符，避免出现较大偏差。

(4) 在钢筋混凝土上标孔时，如果设计孔位处于暴露的钢筋上（或虽未暴露，但能准确判断出），可在垂直最小抵抗线方向稍作移动，以避免钢筋。

(5) 在切割混凝土等或实施预裂爆破时，对不装药的孔应做出特殊标记，以防与装药孔混淆。

2. 穿孔：药孔可使用风动凿岩机、内然凿岩机和电钻开设。

And safety: under possible conditions, select independent houses near the blasting target.

(3) Confirm the detection of electric detonators and the location of the firing station. Its location should avoid high

Wire and lighting circuits

(4) Determine the specific location of the safety perimeter and the safe area where construction personnel must evacuate to.

(5) Determine the parking locations for all types of vehicles and their routes, as well as evacuation procedures during blasting.

Safe arrival point.

(6) Determine the storage location for [equipment and protective materials].

(2) Hole sizing and perforation

I. Marked holes: Marked holes are accurately marked according to the blasting design, positioning the charge holes at the target:

Before marking the holes, first clear the accumulated soil and broken layers in front of the blasting self-marking area, then make obvious marks at the specific locations of the pre-determined drug holes. When marking the holes, pay attention to the following items:

(1) Do not arbitrarily change the design position of the medicine holes. In case of discrepancies with the source design, consult with technical personnel for resolution.

(2) For broken concrete 1: reinforced concrete, first mark the edge holes, then mark other holes. When marking edge holes, start from the main protection direction to ensure the accurate position of these holes.

(3) When marking edge holes in the main direction or drilling holes on beams and columns, verify that the actual minimum distance of resistance is substantially consistent with the designed minimum distance of resistance to avoid significant deviations.

(4) When marking holes in reinforced concrete, if the designed hole location is on exposed reinforcement (or even if not exposed but can be accurately determined), you may slightly shift it in the direction of the minimum resistance line to avoid the reinforcement.

(5) When cutting concrete or implementing pre-split blasting, for holes that are not loaded, Make a special mark to avoid confusion with the charge holes.

2. Drilling: The drug holes can be drilled using pneumatic rock drills, internal combustion rock drills, or electric drills.

风动凿岩机与内燃凿岩机的穿孔直径为 34 ~ 42 毫米。拆除爆破施工时的穿孔直径一般取 38 ~ 40 毫米。内燃凿岩机主要用于开设垂直药孔或倾斜角度不大的斜孔。电钻适于在砖砌物体上穿孔。

实施穿孔作业应注意下列事项：

(1) 严格按照标定孔位开设药孔，保证药孔的深度、方向和角度。

(2) 及时堵塞已开设好的药孔口，以防杂物掉入堵住药孔。

(3) 防止漏穿药孔。

(4) 及时检查和验收药孔并对药孔进行编号和登记。

(5) 药孔已全部或大部分穿好后，如遇阴雨等不能装药起爆，应及时采取措施，将药孔覆盖起来，防止雨水流入。

(6) 穿孔作业中，遇有特殊情况，应向指挥员或技术人员及时报告。

(三) 装药与填塞。

1. 制作药卷：制作药卷时，必须首先检查炸药质量；装药的重量要称量准确，小药量应用天平称量。

当药孔潮湿时，应对药卷采取防潮措施。

制作好的药卷应进行编号，注明装药量、起爆时段，并分开存放。

2. 装药：装药作业必须明确分工，按起爆的时段分配到组，落实到人。

实施装药的作业手必须做到明确装填的药孔（位置、数量）；明确装入药孔内的药卷（特别是分段装药时）；明确起爆的时间顺序。

作业手在装药前必须查明孔内有无积水，孔口有无杂物；药孔是否顺直，防止卡住药卷；药孔与药卷编号是否相符，防止错装。

装药时，先将电雷管脚线（或导爆管）展开适当长度，再将

The drilling diameter of the air-driven rock drill and the internal combustion rock drill is 34 ~ 42 mm. During demolition blasting construction, the drilling diameter is generally taken as 38 ~ 40 mm. Internal combustion rock drills are mainly used for opening vertical blast holes or slanted holes with small inclination angles. Electric drills are suitable for drilling through brick masonry objects.

When carrying out perforation operations, pay attention to the following:

(1) Strictly drill blasting holes according to the marked positions, ensuring the depth and direction of the holes are

(2) Timely plug the already opened medicine holes to prevent foreign objects from falling in and blocking the medicine holes.

(3) Prevent leakage through the drug holes.

(4) Conduct timely inspections and acceptances of the drug holes, and assign numbers and register them.

(5) After all or partially all medicine holes are drilled, if it encounters rain or other conditions preventing the loading of medicine, stop.

In case of rain, take timely measures to cover the drug holes and prevent rainwater from entering. (6) During drilling operations, if any special circumstances arise, report to the commander or technical personnel and

() Charge and packing. 1, Prepare charge cartridges: When preparing charge cartridges, the explosive quality must be inspected first; charge

The weight must be weighed accurately; small quantities should be weighed using a balance. When the drug hole is damp

Take moisture-proof measures for the medicine roll.

Prepared cartridges shall be numbered, indicating the charge quantity and detonation time, and stored separately.

2, Charge: Charge operations must be clearly divided by T, and groups must be assigned according to the blasting time slots.

The operator performing the charge installation must clearly identify the charge holes (position, quantity); clearly identify the cartridges placed in the charge holes (especially during segmented charging); and clearly determine the initiation sequence.

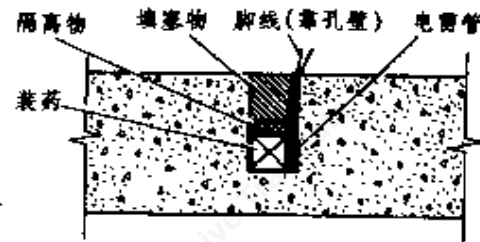
The loader must check before loading whether there is water accumulation in the borehole or debris at the mouth; ensure the borehole is straight to prevent the charge cartridge from getting stuck; and verify that the borehole number matches the charge cartridge number to avoid misloading.

When loading the charge, first unfold the detonator lead (or detonating tube) to an appropriate length, then

药卷置于孔口，一只手握住脚线（或导爆管），另一只手用带有尺寸刻度的填塞杆轻轻推送药卷到规定位置。

实施分层装药时，先装入底层药卷，按规定长度填塞后，再装第二个药卷。从里向外，按同样方法，依次装填其它药卷。

对于深度小于 30 厘米的垂直浅孔，填塞长度有限，宜采用散装密实装药，以便缩短装药长度，保证填塞长度（附图 10）。



附图 10 垂直浅孔的装药方法

装药时应注意以下事项：

(1) 装药必须认真、细致，严防错拿、错装。

(2) 向孔内装入小直径药卷时，必须防止偏斜，以免填塞时折断、卡住。

(3) 向孔内推送药卷时，严防电雷管脚线与孔口摩擦，以免损伤脚线。

(4) 装药时，要防止电雷管脚线在孔内绕圈或全部掉入孔内。

(5) 分层装药的电雷管脚线较多，应作出明显标记，以防连线时接错。

3. 填塞：

(1) 填塞物一般用粘土和细砂按照 1:2 ~ 1:3 的比例加水拌合而成。用水量根据粘土和砂的干、湿程度确定。用水适量的填塞物具有以下特征：用手握住略用力能够成型；松手后不散，手上不粘水迹，有一定的摩擦力。为使用方便，可做成直径约 3 厘米，长度 10 厘米左右的泥条。在不漏水的垂直药孔中使用防水炸药或经防水处理的药卷时，也可用水作填塞物。

(2) 填塞长度不得小于最小抵抗线（或列距），一般应为最小抵抗线的 1.0 ~ 1.2 倍。

Place the charge in the hole! With one hand hold the fuse (or detonating cord), and with the other hand gently push the rammer with a ruler scale into the charge to the specified position.

When implementing staged charging, first load the bottom charge cartridge, pack it to the specified length, then load the next cartridge. Proceed outward from the inside, using the same method, to sequentially load the remaining cartridges.

For vertical shallow holes with a depth less than 30 cm, the filling length is limited, so loose packing of charges is recommended to shorten the charge length and ensure the filling length (see Figure 10)a

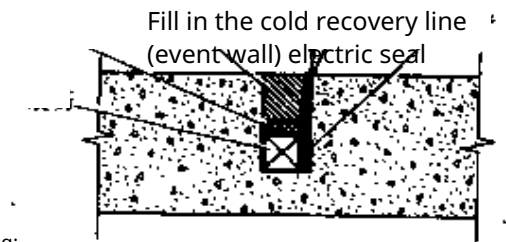


Figure 10: Method of placing charges in vertical shallow holes

When loading the charge, pay attention to the following:

(1) The charge must be handled carefully and meticulously, strictly preventing any mistakes in selection or installation.

(2) Load small-diameter charges into the borehole.

When winding, prevent skewing to avoid breakage or jamming during filling.

(3) When pushing the cartridge into the borehole, strictly prevent the electric detonator lead from rubbing against the borehole mouth to avoid damaging the lead.

(4) When loading the charge, prevent the detonator leads from being coiled inside the borehole or completely dropped into it.

(5) The detonator leads of layered charges are numerous and should be clearly marked to prevent accidental detonation.

Line connection error.

3. Packing:

(1) The ramming material is typically made by mixing clay and fine sand in a 1:2 ~ 1:3 ratio with water, with the water content adjusted based on the dry or wet state of the clay and sand. A properly hydrated ramming material exhibits the following characteristics: it can be molded with slight pressure, does not crumble upon release of the hand, leaves no water marks, and possesses a certain degree of friction. For convenience of use, it can be formed into mud strips approximately 3 cm in diameter and 10 cm in length. Waterproof explosives or water-treated cartridges shall be used in non-leaking vertical boreholes.

Water can also be used as a packing material.

(2) The length of the fill must not be less than the minimum charge (or column spacing) and should generally be 1.0 ~ 1.2 times the minimum charge.

(3) 填塞时应注意以下事项:

①不得损伤或捣断电雷管脚线、导爆管。

②对非密实装药进行填塞时,要防止将小直径药卷折断。

③对分层装药间的填塞长度要注意检查,防止改变药卷位置。

④对垂直浅孔的散装炸药,在开始填塞时,禁止用力挤压。

⑤填塞时,填塞物之间必须密实,防止出现空隙。

(四) 连接起爆线路。

(五) 安全防护。对飞散碎块的防护是保障爆破安全的重要手段,防护措施主要是采取覆盖或遮挡。

1. 防护材料:应具有较高的强度和韧性,具有一定的厚度和重量,并且易于固定。通常使用用环索连接的旧汽车轮胎、旧胶垫、废旧传送机胶带、荆芭或厚度在2毫米以上的钢板等。

2. 防护方法:根据不同的爆破目标或周围环境的情况,对飞散碎块可采取全面防护或重点防护,也可将二者结合起来。

对爆破的目标不大,附近有重要设施或人员经常活动的场合,可实施全面防护。爆破拆除建筑物时,为防止建筑物内的碎块向外飞散,可将门窗封闭,建筑物的外围应酌情进行全面防护或重点防护。

重点防护是在碎块的主要飞散方向或有重要保护目标的次要方向上进行的局部防护。其防护材料应设置在距离爆破目标墙壁2~3米处,其高度应能完全遮挡住飞散的碎块,并应牢固固定。

进行防护时,应防止损坏起爆网路。当使用金属防护材料时,应将导线接头用胶布包缠,以免与金属材料接触造成短路。

附录二 爆破作业能力计算

爆破作业能力是指爆破分队用爆破手段完成规定爆破工程量的能力。它取决于爆破目标的性质和作业量的大小。通常以投入

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(3) Pay special attention to the following when packing:

1. Do not damage the detonator fuse wires or blasting bridgewires of the warhead.

When packing 3 non-compact charges, prevent breaking small-diameter charge cartridges. When packing 3 layered charges, pay attention to the packing length between layers to prevent altering the cartridge position.

4 loose explosives in vertical shallow holes, do not squeeze hard when starting to pack.

When packing, the packing material must be compacted tightly between each other to prevent voids.

(4) Connect the blasting circuit.

(5) Safety protection. Protection against flying debris is an important measure to ensure blasting safety, and protective measures mainly involve covering or shielding.

1. Protective material: Should have high strength and toughness, possess certain thickness and weight, and be easy to fix. Common materials include old car tires connected by ring ropes, rubber mats, scrap conveyor belts, or steel plates with a thickness of more than 2 mm.

2. Protection methods: Depending on the blasting target or surrounding conditions, scattered fragments can be protected comprehensively or selectively, or both methods can be combined. For blasting targets that are small, or where important facilities are nearby or areas where people frequently gather, comprehensive protection should be implemented. When demolishing buildings by blasting, to prevent fragments inside the building from scattering outward, doors and windows should be sealed, and comprehensive or selective protection of the building's exterior should be applied as appropriate.

重点防护是在碎块的主要飞散方向或有重要保护目标的次要方向上进行的局部防护。其防护材料应设置在距离爆破目标墙壁2~3米处,其高度应能完全遮挡住飞散的碎块,并应牢固固定。进行防护时,应防止损坏起爆网络。当使用金属防护材料时,应将导线接头用胶布包缠,以免与金属材料接触造成短路。

Appendix II: Calculation of Explosive Operation Capability

Explosive operation capability refers to the ability of an explosive squad to complete specified explosive engineering tasks using blasting methods. It depends on the nature of the blasting target and the magnitude of the work volume. It is usually measured by the input

的作业人数和完成一定工程量所需的时间表示,即以人时(日)、班时(H)、排时(日)、连时(日)等单位。工程量的单位,根据爆破目标的种类不同分别采用米、米²、个、座或条表示。

一、单位作业力

单位作业力是指完成一定工程量所需的爆破作业能力。根据不同的目标种类,爆破作业通常分为爆破基础、土石爆破和破坏作业三部分,见附表7、附表8、附表9和附表10。

附表7 爆破基础作业单位作业力概算

作业类型	工程量	作业力(人时)
敷设1条电起爆线路	装药10~40个,干线长200m,构筑点火站	3~5
敷设1条导爆索线路	装药10~40个,干线长100m	2~4
敷设1条电起爆与导爆索(管)起爆的混合线路		5~10
捆包1个集团装药	粉状炸药 5kg	0.2
	块状炸药 5kg	0.15
捆包1个直列装药	长度2m,块状炸药,4kg/m	0.2

附表8 土壤爆破单位作业力与装药量概算

工程种类	工程量	作业力(人时)	附注
构筑防坦克壕	100m	20	
构筑路堑	100m	45	
构筑坦克掩体平底坑	1个	7	
构筑斜坡路	1条	6	坡高3m以下
构筑人员崖孔	1个	5	压缩爆破
构筑避弹所	1个	10	

The number of workers and the time required to complete a certain amount of work, expressed in units such as man-hours (days), shift-hours (H), crew-hours (days), or continuous hours (days). The unit for the volume of work depends on the type of blasting target and is expressed in meters, square meters, units, structures, or lines.

I. Unit Workforce

Unit blasting capacity refers to the blasting capability required to complete a specific quantity of work. Depending on the type of target, blasting operations are generally divided into foundation blasting, rock and soil blasting, and demolition blasting, as shown in Appendix 7, Appendix 8, Appendix 9, and Appendix 10.

Appendix 72: Budget Estimate for Explosive Foundation Workforce of Construction Units

Lay 1 electric blasting circuit	Charge 10~40, main line length 200m, construct firing station	
Lay 1 detonating cord line	Charge 10~40, main line length 100m	
Lay 1 electric detonation and blasting		
Mixed circuit initiated by (or) blasting fuse		
Bundle 1 Group Charge	Powdered explosives 5kg	
	Block explosives	
Bundle 1 straight charge	5kg	
	Length 2m, block explosive, 4kg/m	

Estimate of Blasting Unit Effort and Charge Quantity for Soil Blasting

	作业力(人时)	
Construct anti-tank ditches		
Construct tank fortification flat-bottomed pit		
Construct a ramp road		Slope height 3m or less
Constructors Cliff Hole		
Construct a bulletproof shelter		

续 表

工 程 种 类	工程量	作业力(人时)	附 注
构筑垂坑道	1 条	8	压缩爆破;直径 1m,深 5m
说 明	1.爆破地质为中等硬度土壤;所用炸药为硝铵炸药; 2.穿孔工具为土钻或带垫圈的凸榫钢钎,扩爆药洞药壶爆破。		

附表 9 破坏交通设施单位作业力

目 标 种 类	工 程 量	作 业 力	
		人 时	班 日
木 桥 爆 破	破坏木桥上部 1 纵长米	0.8~1.2	
钢 桥 爆 破	1.破坏 1 个桥跨 20m 2.破坏 1 个桥跨和两个桥台 3.破坏上部结构 1 纵长米	24 35 1.2~1.5	3 跨 9 处
钢筋混凝土桥爆	1.破坏 1 跨上部结构和 1 个桥墩 2.破坏双曲拱桥的 1 个桥跨 3.破坏柱式桥脚 1 根	28 20 8	7 根
石拱桥爆破	1.破坏拱顶 2.破坏 1 个桥跨 10m	7 15	8 跨
破 坏 涵 洞	1 座	8	7 个
破 坏 公 路	1.在路基上开设漏斗坑 深 2m $n=2$ $h=1.5m$ 2.破坏路基 100m	4 50	150m
破 坏 铁 路	破坏道轨 1000m 两条钢轨每节炸断 1 处	20	1200m
说 明	所有爆破均采用外部装药		

Project
TypeConstruct
vertical shafts

作业力(人时)

Compressed blasting; diameter 1m,
depth 5m

1. The blasting geology is medium-hard soil; the explosive used is ammonium nitrate explosive; 2. The drilling tool is a drill or a convex steel chisel with a washer, used for blasting with expanded explosive holes and explosive pots.

Unit Operation Force for Damaging Traffic Facilities

Bad wooden bridge.e longitudinal meters COn	0.8~1.2	
1. Destroy one bridge span of 120m 2. Destroy one bridge span and two abutments 3. Destroy the superstructure of one longitudinal span	35 24 1.2~1.5	3 cross 9 places
Reinforced concrete bridge explosion		
1. Destroy 1 superstructure and 1 pier 2. Destroy 1 span of a double-curved arch bridge 3. Destroy 1 column-type bridge pier		
arch bridge blasting		
1. Destroy the arch vault 2. Destroy 1 bridge span 10m		
1. Open a funnel pit on the subgrade with a depth of 2m2 =2 h=1.5m2. Damage the subgrade for 100m		
Destroying the track by 1000m: two rails, one explosion per carriage.		1200m
All blasting uses external charges.		

附表 10 破坏军事设施单位作业力

目标种类	工 程 量	作 业 力		附 注
		人时	班工作量	
房屋等建筑物爆破	1. 破坏发电站 1 座 2. 破坏库房每立方米容积 3. 破坏烟囱 1 座 4. 破坏水塔 1 座	20 0.1 2~3 3~4		建筑物内部 集团装药
码头爆破	1. 破坏框架码头 1 纵长米 2. 破坏方块码头 1 纵长米	12 20		集团装药 穿孔爆破
机场爆破	破坏机场跑道, 横向炸断 1 处	8	1 处/班时	炸药运至现场
水坝爆破	1. 破坏土质拦水坝 1 座 2. 破坏钢筋混凝土拦水坝 1 座	7 30	1 座/班时 2 座/班日	炸药、器材运 至作业现场
障碍物爆破	1. 在铁丝网中开辟通路 1 纵长米 2. 破坏混凝土三角锥 10 个 3. 破坏钢筋混凝土桩 10 个 4. 破坏木桩 10 个 5. 破坏轨条 10 个 6. 破坏带混凝土墩的轨条 10 个	0.5 2 2 2 2 5	50 个/班时	

二、爆破作业能力

爆破作业能力取决于单位作业力和工程量, 通常按下式计算:

$$F = KWf$$

式中: F ——爆破作业能力

K ——影响系数, 主要有人员素质 $k_{人}$ 、光照条件 $k_{光}$ 、气象条件 $k_{气}$ 和敌情因素 $k_{敌}$ 等, 见附表 11、附表 12、附表 13 和附表 14:

$$K = k_{人} k_{光} k_{气} k_{敌}$$

W ——爆破工程量, 根据目标种类分别取米、米²、个、座或条

Appendix 10 破坏军事设施单位作业力

House 等 Building Demolition	1. Destroy 1 power plant 2. Destroy 1 cubic meter of storage capacity 3. Destroy 1 chimney 4. Destroy 1 water tower	200.12~33~4		Inside the building, group charge
	1. Destroy the pier, 1 longitudinal meter 2. Destroy block dock 1 longitudinal meter Destroy airport runway, horizontally blast one section			
	1. Dam destruction: 1 earth dam 2. Reinforced concrete dam destruction: 1 dam		1 place/shift	Explosives transported to the site
	1. Open a path through the barbed wire " long" 2. 10 broken concrete pyramids 3. 10 destroyed reinforced concrete pillars	0.52222 5	1 s eat/class 2 seats/class day	Explosives and equipment shall be transported to the work site.
	Break 4. Destroy 10 end posts. 5. Destroy 0 rail sections. 6. Destroy 10 rail sections adjacent to concrete piers.		50 per class	

II. Explosive Operation Capability

Explosive operation capability depends on the unit operation force and the volume of work, and is generally calculated according to the following formula:

In which: F —explosive operation capability

Influence coefficient, mainly personnel quality $k_{人}$, lighting conditions

$k_{光}$, meteorological conditions $k_{气}$ and enemy situation factors $k_{敌}$, see appendix

11, Annex 12, Annex 13 and Annex 14:

$k_{人}$ $k_{光}$ $k_{气}$ $k_{敌}$ blasting quantity, measured in meters, square
meters, pieces, units, or lines depending on the target type.

f——单位作业力，人时/（目标单位）。

附表 11 人员素质影响系数

作业手等级	熟 练	一 般	差
影 响 系 数	1.0	0.8	0.5

附表 12 光照条件影响系数

光照条件	白 天	夜 间
影响系数	1.0	0.6~0.7

附表 13 气象条件影响系数

气象条件	晴 天	中雨及浓雾天气
影响系数	1.0	0.7~0.8

附表 14 敌情因素影响系数

敌情因素	无 敌 情	敌情顾虑	敌火威胁
影响系数	1.0	0.8	0.5~0.6

三、爆破作业时间的计算

实施爆破作业所需时间取决于爆破目标的性质和作业量，以及投入作业的兵力数量等，通常按下式计算：

$$T_{\text{作}} = \frac{F}{m}$$

式中：T_作——完成爆破作业所需时间（日或小时）

f—1-Unit labor productivity, man-hours/(target unit)

Appendix 11 Personnel Quality Influence Coefficient

Operator Level			

Illumination Condition Influence Factor

		0.6~0.7

1 Weather condition influence coefficient Table 13

		Moderate rain and dense fog atmosphere
		0.7~0.8

Enemy Situation Factor Influence Coefficient

			0.5~0.6

III. Calculation of blasting operation time

The time required for blasting operations depends on the nature of the blasting target, the volume of work, and the number of personnel deployed, and is generally calculated using the following formula:

$$T_{\text{作}} = \frac{F}{m}$$

In the formula: T is

Time required to complete blasting operations (days or hours)

F——爆破目标所需作业力，单位以人时（日）、班时（日）、排时（日）、连时（日）表示

m——参加作业的兵力（人、班、排或连）

以上爆破作业时间仅指阵地作业时间，实际计算时还应考虑组织准备阶段的时间，包括组织现地侦察、拟制爆破计划、传达任务、进行动员、准备器材和捆包装药、由配置地域向作业地点开进及现地明确任务等。准备阶段时间，根据爆破工程量的大小确定，一般为阵地作业时间的 2~3 倍。因此，爆破分队完成一项爆破作业的总时间为：

$$T = T_{\text{作}} + T_{\text{准}}$$

式中：T——爆破作业总时间

$T_{\text{作}}$ ——阵地作业时间

$T_{\text{准}}$ ——组织准备阶段的时间， $T_{\text{准}} = (2 \sim 3) T_{\text{作}}$

附录三 外军炸药与火具

外军的炸药与火具，在主要性能、保管和处理方法方面，与我军的基本相同，只是在颜色、包装和某些性能上略有差别。

一、美军炸药与火具

（一）炸药

1. 梯恩梯：通常制成药块，如附图 11 所示。

2. 特屈陀尔（附图 12）：由特屈尔和梯恩梯混合制成的药块，用纸或布包裹。每块重 1.134 千克，其威力相当于 1.36 千克梯恩梯炸药，用于各种爆破作业；每 8 个药块用导爆索联接起来，放在一个帆布袋里。使用时，将点火管或电雷管接续在药块末端的导爆索上起爆。如一次爆破不需 8 个药块时，则根据需要，将药块间的导爆索截断。

3. 塑性炸药（附图 13）：按其成分不同分为 C₂、C₃ 和 C₄ 三种。C₂ 炸药是黑索金、硝化棉及胶质物的混合体，呈橙黄色；

F: manpower required for blasting operations, expressed in man-hours (day), shift-hours (day), platoon-hours (day), or company-hours (day)

m - Number of personnel (person, squad, platoon, or company) participating in the mission.

The above blasting operation time refers to the time spent at the firing position. When calculating the actual time, the preparation phase must also be considered, which includes organizing on-site reconnaissance, formulating the blasting plan, conveying orders, conducting mobilization, preparing equipment and bundling explosives, advancing from the deployment area to the firing position, and clarifying tasks on-site. The duration of the preparation phase is determined by the magnitude of the blasting work and is generally 2~3 times the time spent at the firing position. Therefore, the total time required for a blasting squad to complete a blasting operation is:

$$T = T_{\text{作}} + T_{\text{准}}$$

In which: T is the total blasting operation time.

$T_{\text{准}} = (2 \sim 3) T_{\text{作}}$

Appendix 3 Foreign Military Explosives and Pyrotechnics

Foreign military explosives and pyrotechnic devices are essentially the same as those of our forces in terms of main characteristics, storage, and handling methods, differing only slightly in color, packaging, and certain performance attributes.

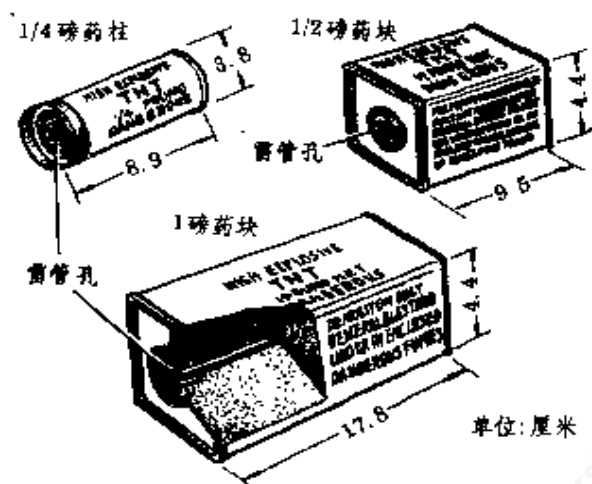
I. US Military Explosives and Fire

(1) Explosives

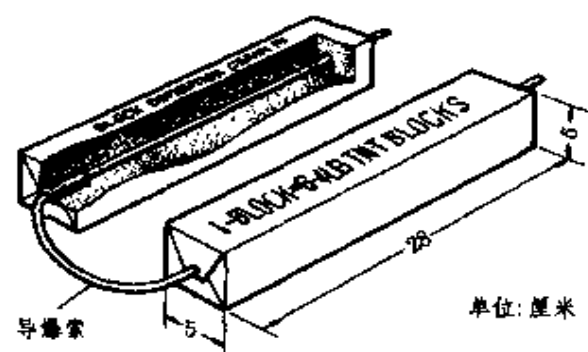
1. TNT: Usually manufactured in tablet form, as shown in Figure 11.

2. Torpedite (see Figure 12): A block of explosive made from a mixture of Torpex and TNT, wrapped in paper or cloth. Each block weighs 1.134 kg and has an explosive power equivalent to 1.36 kg of TNT, used for various blasting operations. Eight blocks are connected together with detonating cord and placed in a canvas bag. For initiation, the firing fuse or electric detonator is connected to the detonating cord at the end of the block. If only fewer than eight blocks are required for a single blasting operation, the detonating cord between the blocks is cut as needed.

3. Plastic explosive (see Figure 13): Classified into C₂, C₃, and C₄ types based on their composition. C₂ explosive is a mixture of RDX, nitrocellulose, and gum, appearing orange-yellow;



附图 11 梯恩梯药块



附图 12 特屈陀尔药块

C₃ 炸药是黑索金、特屈尔、硝化棉及胶质物的混合物，呈棕色；C₄ 炸药是以黑索金为主，加入不同成分的增塑剂而制成。在温度为 -11 ~ +52℃ 时，这三种塑性炸药均柔软如泥；当温度低于 -29℃ 时则变硬且脆；高于 +52℃ 时则软化而渗出油状物。感度与梯恩梯相似，少量遇火燃烧，量多则会爆炸；受潮后性能不受影响，故可在水中使用。

塑性炸药的威力与梯恩梯相比为 1.34:1；爆速为 7620 ~

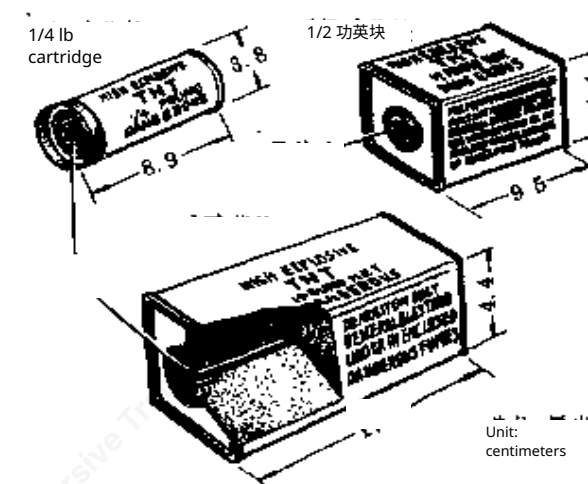


Figure 11 Ladder Drug Block 81tech.com

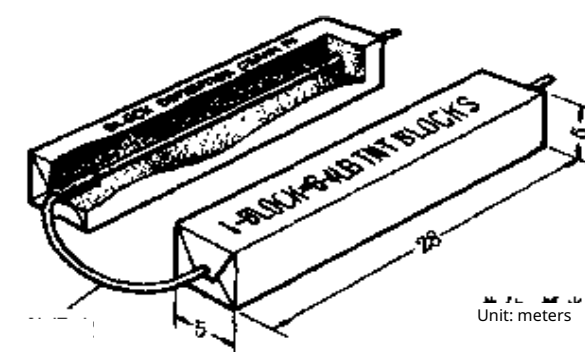
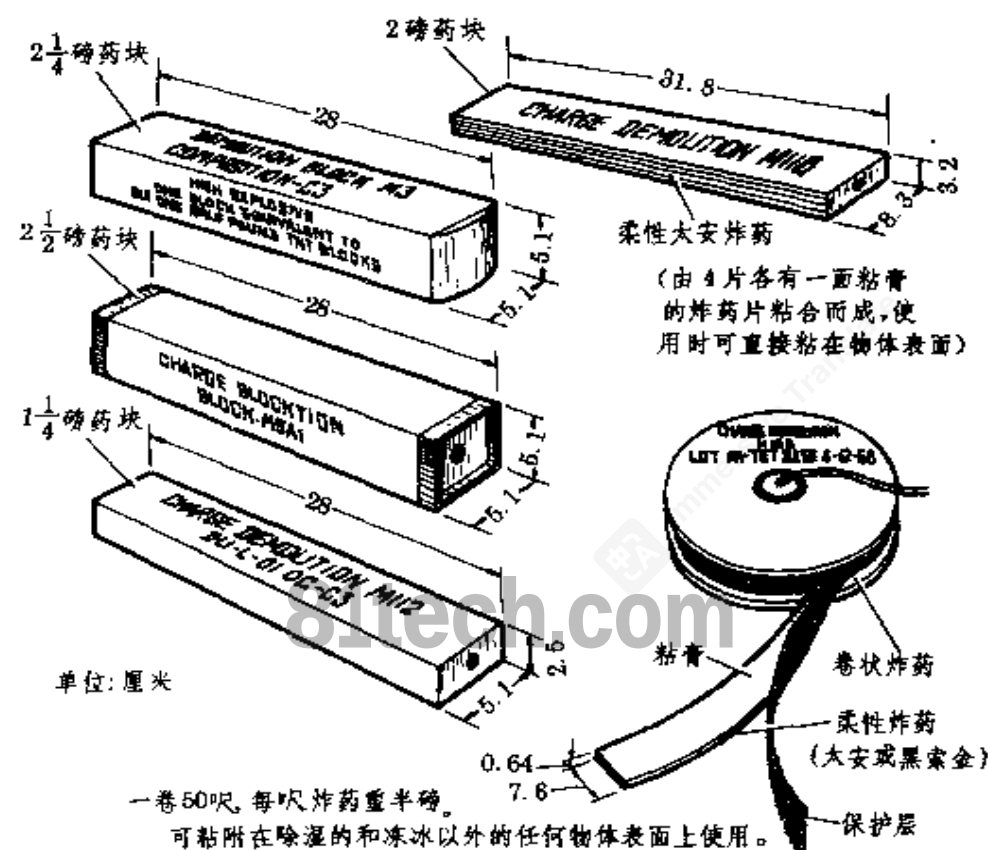


Figure 12: Triclosan tablets

C explosive is a mixture of RDX, TATB, nitrocellulose, and gum, star brown: C4 explosive is made primarily of RDX with plasticizers added. At a temperature of -11 ~ +52 °C, these plastic explosives are soft as mud; when the temperature drops below -29°C, they become hard and brittle; above +52°C, they soften and exude an oily substance. Their sensitivity is similar to TNT: small amounts burn upon contact with fire, while larger quantities explode; their performance is unaffected by moisture, making them suitable for use in water.

The power of plastic explosives is 1.34:1 compared to TNT; the detonation velocity is 7620~.

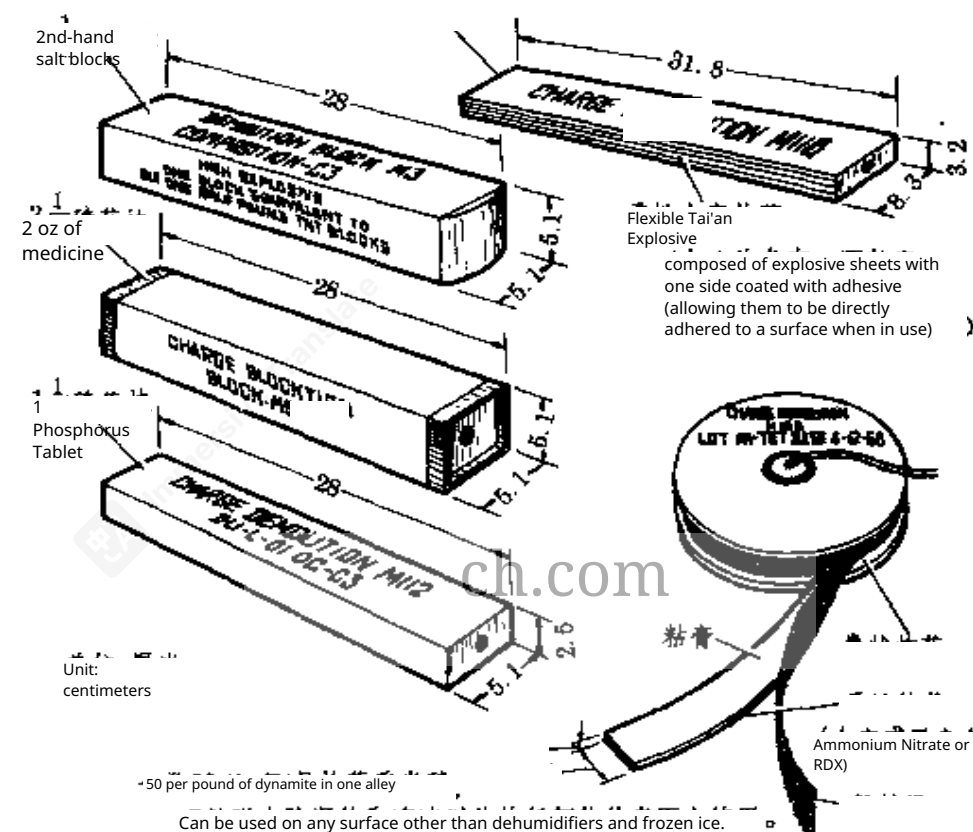


附图 13 塑性炸药

7925 米/秒。

4. 第奈米特 (硝化甘油) 炸药: 是以硝化甘油为主的混合炸药。将硝化甘油与硝化棉 (或硝化淀粉) 先行胶化, 再以梯恩梯与棉药共热, 而后混合压制成各种定量的装药。第奈米特炸药受潮后性能不受影响, 故可在水中使用。军用第奈米特 (型号 M₁) 炸药的威力与梯恩梯相比为 0.92:1, 爆速为 6100 米/秒。60% 格里田第奈米特炸药的威力与梯恩梯相比为 0.76:1, 爆速为 4880 米/秒。

5. 硝铵炸药: 将 80% 硝酸铵与 20% 梯恩梯混合, 制成阿梅陀, 威力与梯恩梯相比为 1.17:1, 爆速为 4880 米/秒; 将硝酸



7925 m/s.

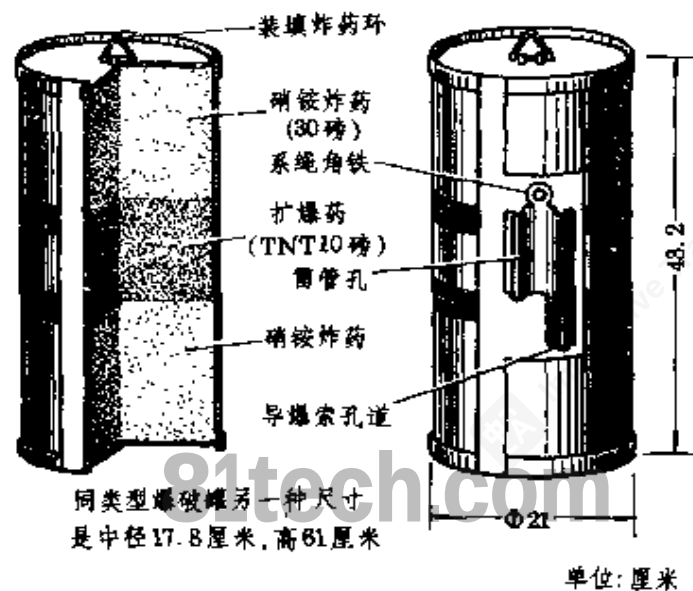
4. Dynamite (nitroglycerin) explosive: A mixed explosive primarily based on nitroglycerin. Nitroglycerin is first gelatinized with nitrocellulose (or nitrocellulose starch), then heated together with TNT and cotton powder, and finally mixed and pressed into various quantitatively measured charges. Dynamite explosive is unaffected by moisture, making it suitable for use in water. The power of military dynamite (model M₁) compared to TNT is 0.92:1, and its detonation velocity is 6100 meters per second. The power of 60% gelatin dynamite compared to TNT is 0.76:1, and its detonation velocity

For 4880 meters
per second.

5. Ammonium nitrate explosive: Mix 80% ammonium nitrate with 20% TNT to make Amme.

TNT, with a power-to-TNT ratio of 1.17:1 and a detonation velocity of 4880 m/s; nitric acid

铵与铝粉、木炭混合后，再加入 15% 梯恩梯，制成阿莫那。美军用于土壤爆破的制式 40 磅爆破罐（附图 14），所装硝铵炸药的威力与梯恩梯相比为 0.42:1，爆速为 4514 米/秒。



附图 14 40 磅硝铵爆破罐

(二) 爆破器材

1. 聚能爆破罐。常用的有下列两种：

(1) M₂A₃ 聚能爆破罐（附图 15），内装 6.8 千克炸药，外壳是特制的纸筒，炸药顶端有雷管室，可贯穿 914 毫米厚的钢筋混凝土。

(2) M₂ 聚能爆破罐（附图 16），内装 18.14 千克炸药，钢质外壳，另有三角架固定在铁箍上，使用时套在爆破罐底部，旋紧箍旁的螺钉，使爆破罐与三角架箍紧。爆破罐爆炸后，可贯穿 1524 毫米厚的钢筋混凝土。

2. 爆破筒。每套 M₁A₁ 和 M₁A₂ “彭格乐” 爆破筒由 10 节组成。每节爆破筒长 1524 毫米，直径 54 毫米，两端有螺纹雷管孔；每套爆破筒还附有连接套管和锥形帽（附图 17）。可在防步

Ammonium nitrate mixed with aluminum powder and charcoal, then with 15% TNT, is made into Ammonal. The standard 40-pound blasting canister used by the U.S. military for underground blasting (see Figure 14) contains ammonium nitrate explosive with a power-to-TNT ratio of 0.42:1 and a detonation velocity of 4,514 meters per second.

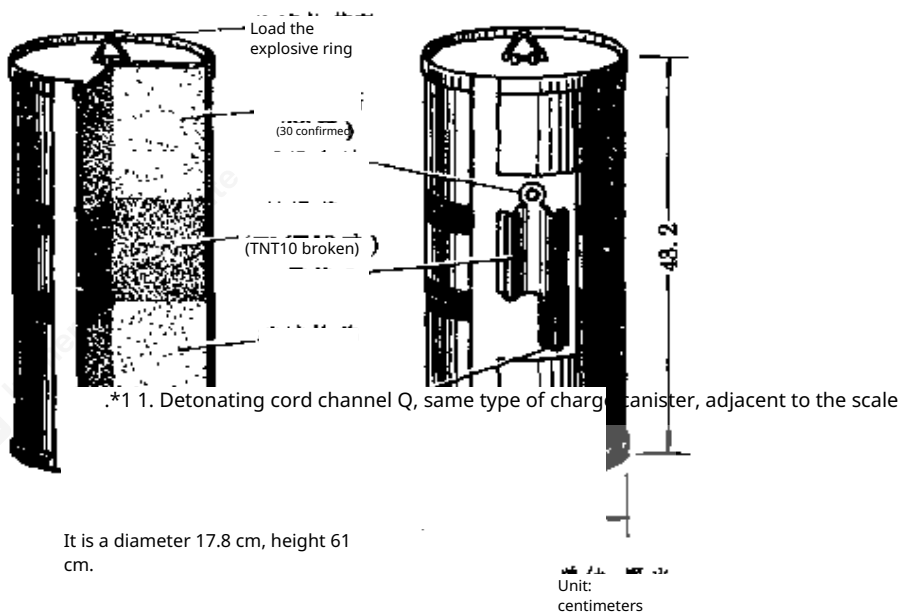


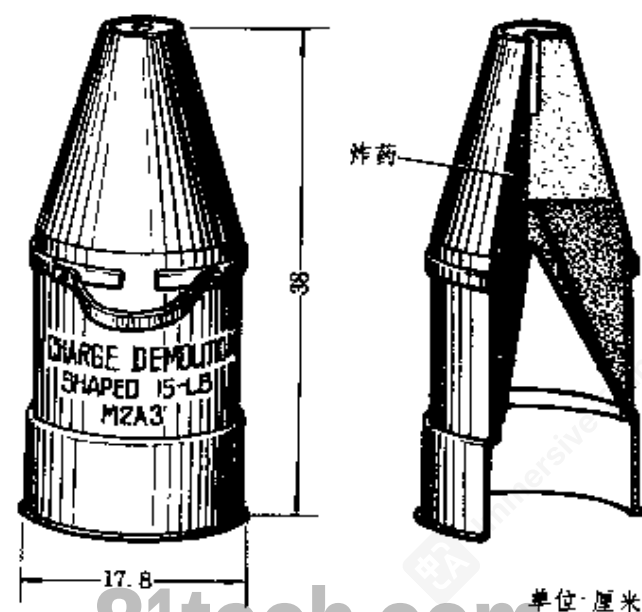
Figure 14 40 lb ammonium nitrate blasting can

(-2) Explosive Devices

1. Capacitor Explosive Canister. Common types include the following:

(1) M₂A shaped charge explosive canister (see Figure 15), containing 6.8 kg of explosive. The casing is a specially made paper tube. The detonator chamber is at the top of the explosive and can penetrate 914 mm of reinforced concrete.)

(2) M₂ shaped-charge blasting canister (see Figure 16), containing 18.14 kg of explosive, with a steel casing. A tripod is fixed to the iron band; during use, the canister is placed over the bottom of the tripod, and the screw next to the band is tightened to secure the canister to the tripod. After the canister explodes, it can penetrate 1524 mm of reinforced concrete. 2. Blasting tube. Each set of M, A, and M A₂ "Pengle" blasting tubes consists of 10 sections. Each section of the blasting tube is 1524 mm long and 54 mm in diameter, with threaded blasting caps at both ends. It also includes connecting sleeves and conical caps (see Figure 17). It can be used in anti-step



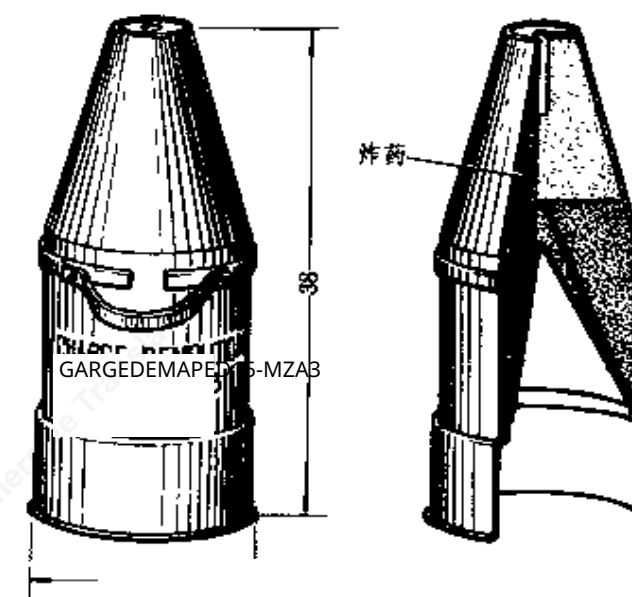
附图 15 M₂A₃ 聚能爆破罐

兵铁丝网中开辟 3~4 米宽的通路，可引爆步兵通路中全部防步兵地雷和大部分防坦克地雷；用于清除茂密的丛林和竹林也很有效（附表 15）。

附表 15 爆破筒性能

种 类	组 件	重 量	爆 破 筒 装 药
M ₁ A ₁	10 节爆破筒 10 个连接套管 1 个锥形帽	约 5.9kg	4.08kg 左右阿梅陀和梯恩梯扩爆药柱
M ₁ A ₂	10 节爆破筒 10 个连接套管 1 个锥形帽	约 6.8kg	4.76kgB ₄ 主装药和 A ₃ 扩爆药柱

(三) 火具



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Figure 15 M2A3 shaped charge mine

A 3~4-meter-wide passage is opened through the barbed wire fence, which can detonate all anti-personnel mines and most anti-tank mines in the infantry passage; it is also effective for clearing dense jungles and bamboo groves (see Table 15).

Burst Grenade Performance

Blast barrel charge

10 Detonators,
10 Couplings, 1
Conical Cap

About
5.9kg

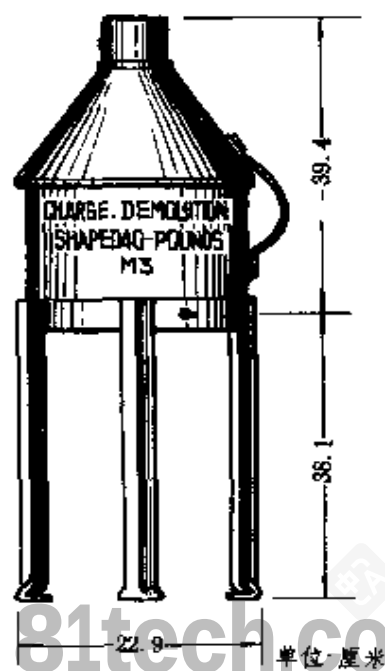
4.08kg approximately Ametho and Tien
Tien expansion explosive charge column

10 explosive
charges, 10
connecting
sleeves, 1 conical
cap

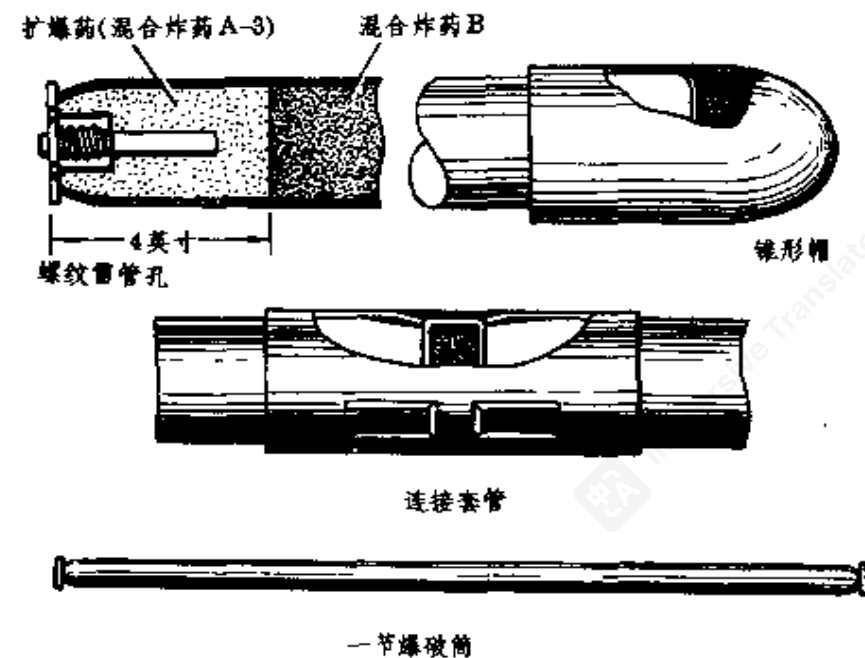
About
6.8kg

4.76kgB₄ main charge and A, booster
columns

(3) Fire Tools



附图 16 M₃ 聚能爆破罐



附图 17 M₁A₂ 爆破筒

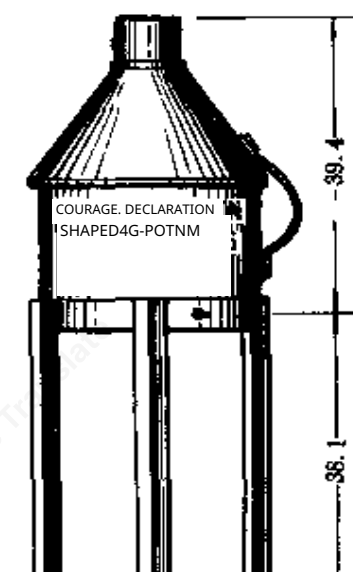
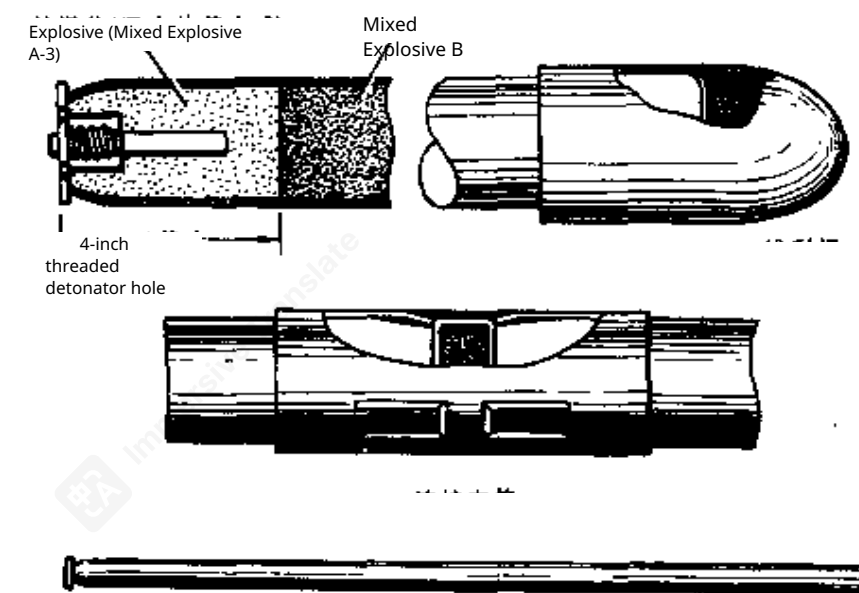


Figure 16 M3 shaped charge blasting tank

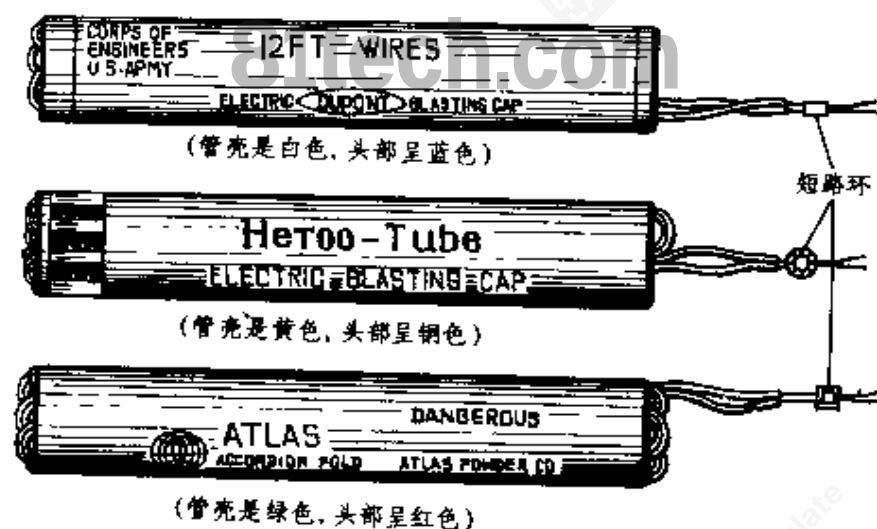


M.A2 Grenade Launcher

1. 导火索：每卷长 15.24 米，每包两卷。其表面颜色各不相同，常见的是橙色，燃速约为 1~1.5 厘米/秒。

2. 导爆索：每卷长 30.48 米，缠绕在木质卷筒上。常见的外皮一种是黄色，缠有一条红线；另一种是黄黑色，呈蛇皮状。芯药为钝化太安，爆速为 6405 米/秒。

3. 电雷管：有三种牌号（附图 18），若在同一电起爆线路中连接两发以上的电雷管，则必须是同一工厂的产品。电雷管有不同长度的脚线（1.22~30.48 米），用于连接电路。脚线一端由短路环构成短路，以防意外；在检查电雷管或连接电起爆线路时必须将短路环取下。



附图 18 电雷管

4. M₆₀ 打火管（附图 19）：用于点燃导火索，可在潮湿环境或水中使用。

二、俄军的炸药与火具

（一）炸药。常用的有梯恩梯、黑索金和硝铵炸药。梯恩梯通常制成药块，有 400 克、200 克、75 克三种，形状与我军的相同。黑索金药块重 250 克（附图 20）。也有用硝铵炸药压制的药

1 Fuse: Each roll is 15.24 meters long, with two rolls per package. The surface colors vary; orange is common. The burning rate is approximately 1~1.5 cm/s.

2. Detonating cord: Each roll is 30.48 meters long and wound on a wooden reel. The common outer sheaths are either yellow with a red stripe or yellow-black with a snake-skin pattern. The core charge is desensitized TNT, with a detonation velocity of 6405 meters per second.

3. Electric detonators: There are three grades (see Figure 18). If two electric detonators are connected in the same electric blasting circuit, they must be products from the same factory. Electric detonators have foot wires of different lengths (1.22~30.48 meters) for circuit connection. One end of the foot wire is short-circuited by a short-circuit ring to prevent accidents; the short-circuit ring must be removed when inspecting electric detonators or connecting the electric blasting circuit.

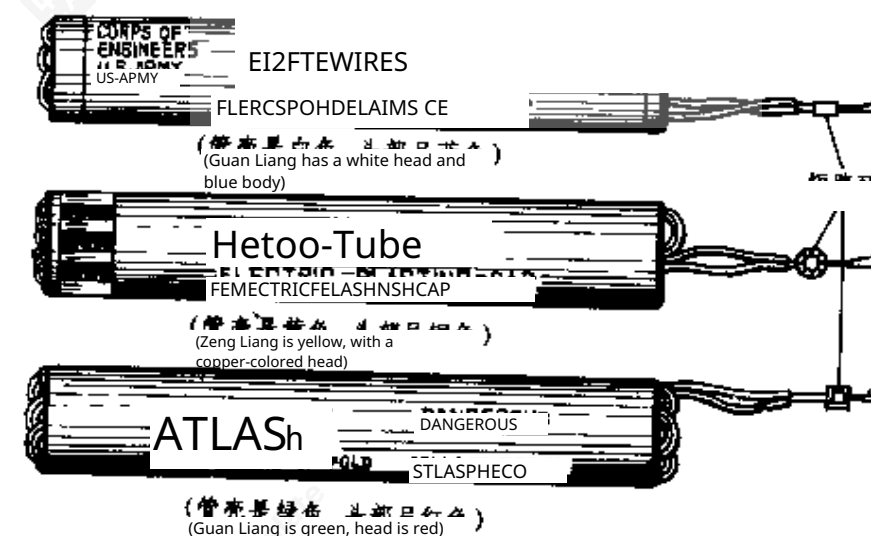


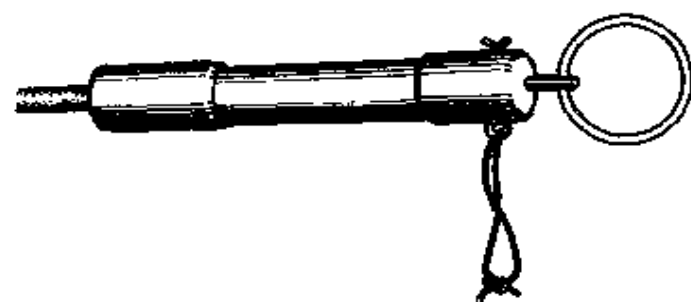
Figure 18 Electric detonator

M₆₀ ignition tube (see Figure 19): Used to ignite the fuse, suitable for use in humid environments.

II. Russian explosives and

pyrotechnics

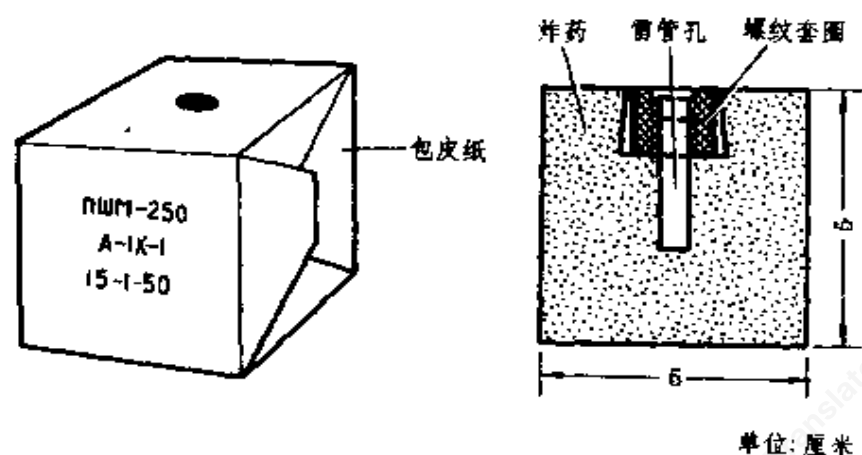
(1) Explosives. Common types include TNT, RDX, and ammonium nitrate explosives. TNT is usually manufactured in blocks, available in 400g, 200g, and 75g sizes, with shapes identical to those used by the Chinese People's Liberation Army. RDX blocks weigh 250g (see Figure 20). Ammonium nitrate explosives are also used in pressed forms.



附图 19 M₆₀打火管

块，其密度可达 1.3 ~ 1.35 克/厘米³，需用梯恩梯作扩爆药起爆。

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附图 20 黑索金药块

(二) 火具

1. 导火索：每卷长 10 米，有三种型号：一种是白色塑料皮的导火索，用于水中爆破；一种是深灰色涂有双层沥青的导火索，用于潮湿地区爆破；一种是深灰色涂有单层沥青的导火索，



Figure 19 M spark tube

block, whose density can reach 1.3 ~ 1.35 g/cm³, requires RDX as a booster for initiation.

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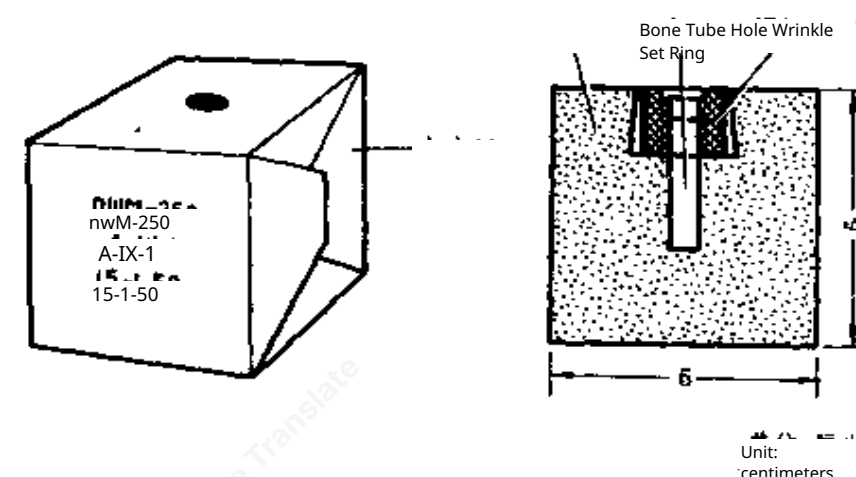


Figure 20 RDX tablets

(II) Fire Tools

1, Fuse: Each roll is 10 meters long and comes in three models: one is a white plastic-coated fuse used for underwater blasting; another is a dark gray fuse with double-layer asphalt coating used for coastal area blasting; the third is a dark gray fuse with single-layer asphalt coating.

只适用于在干燥地区的爆破。三种型号导火索在空气中的燃速均为每秒约 1 厘米。

2. 导爆索：每卷长 50 米，有三种型号：一种是白色带红线，另两种均为红色。爆速为 6500 米/秒。防湿性能良好，浸水 10~24 小时不失去爆炸性能。

3. 雷管：常用的为 8 号雷管，外壳用铝、铜、铜或纸制成。雷管全长 45~50 毫米，外径 6.8~7.6 毫米。

4. 电雷管：按发火时间分瞬发的和延期的；按其桥丝材料分为铂铱的和镍铬的。其性能见附表 16。延期电雷管的延期时间分为 0.5、0.75、1.15、2、4、6、8、10 秒数种。还有一类毫秒延期电雷管，其延期时间分为 25、50、75、100、150、250 毫秒段和 15、30、45、60、75、90、105、120 毫秒段。

附表 16 电雷管的性能

电雷管种类	安全 电流 (A)	最小发 火电流 (A)	单发起爆 电流 (A)		串联起爆 电流 (A)		电阻 (Ω)
			直流	交流	直流	交流	
铂铱桥丝瞬发电雷管	0.05	0.2	0.5	1.0	1.0	1.5	2.5
镍铬桥丝瞬发电雷管和延期电雷管	0.05	0.4	0.5	1.3	1.0	2.5	4.0

5. 打火管和拉火管（附图 21）：用于点燃导火索，可在潮湿地区和水中使用。

Only suitable for blasting in arid regions. The burning rate of all three fuse models in air is approximately 1 cm per second.

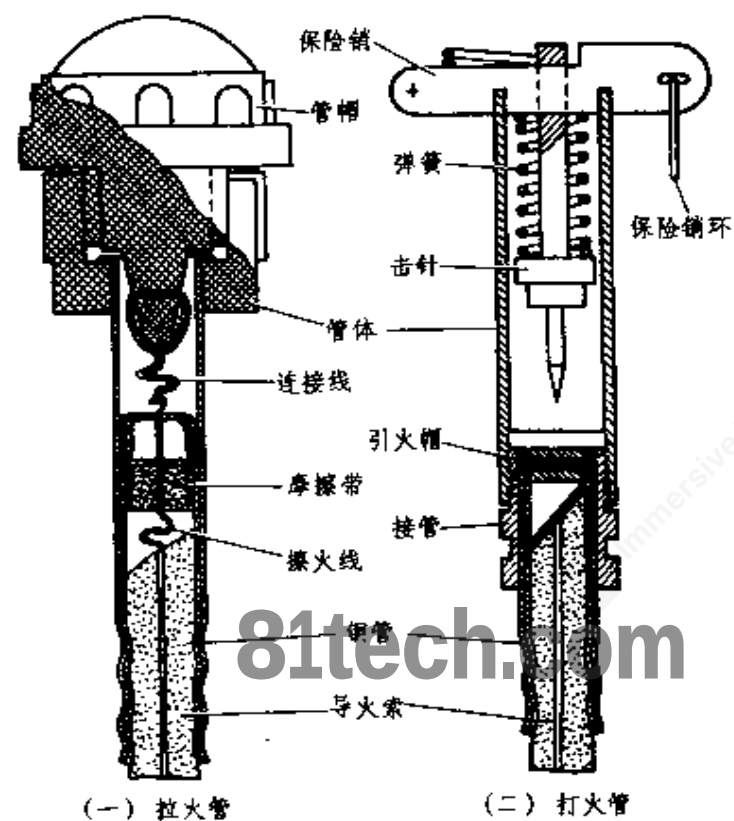
2. Detonating cord: Each roll is 50 meters long, with three models: one is white with a red stripe, and the other two are red. The detonation velocity is 6500 meters per second. It has good moisture resistance and retains its explosive properties after immersion for 10~24 hours.

3. Detonators: The commonly used type is No. 8 detonator, with casings made of aluminum, copper, copper, or paper. The fuse length is 45~50 mm, and the outer diameter is 6.8~7.6 mm.

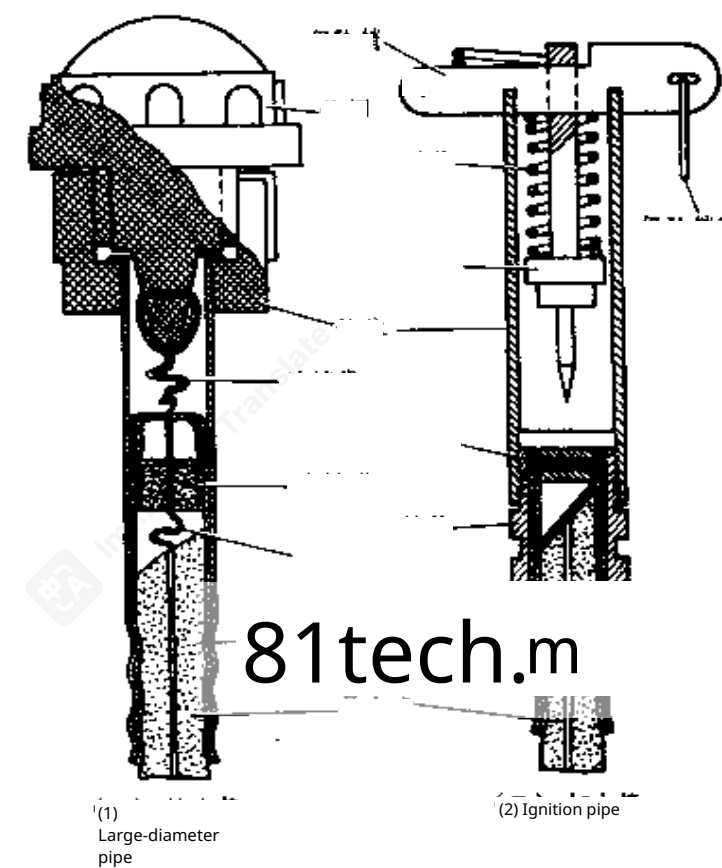
4. Detonating fuse: Classified by ignition time into instantaneous and delayed types; classified by bridge wire material into platinum-iridium and nickel-chromium types. Their performance is shown in Appendix 16. The delay time of delayed electric detonators is divided into 0.5, 0.75, 1.15, 2, 4, 6, 8, and 10 seconds. There is also a category of mill Second-delay electric detonators, with delay times of 25, 50, 75, 100, 150, 250 ms Seconds and 15, 30, 45, 60, 75, 90, 105, 120 millisecond intervals. 81tech.com

Electric detonator types	Performance of electric detonators		Series Detonation Current (A)	Resistance (Ω)
	Minimum ignition current (A)	Single-trigger spark current (A)		
Platinum-Iridium Bridge Wire Instantaneous Electric Detonator				
Nickel-chromium bridge wire instant electric detonator and delay electric detonator				

5. Flare gun and striker tube (see Figure 21): Used to ignite the fuse, suitable for use in humid areas and in water.



附图 21 打火管和拉火管



fire pipe and striker pipe

附录四 装备器材新旧名称对照表

现 名 称	原 名 称
GBP410 型起爆器	66 式点火机
GBP411 型起爆器	70 式点火机
GBP412 型起爆器	78 式点火机
GBP421 型遥控起爆器	82 式遥控起爆器
GBP110 型爆破筒	59 式爆破筒
GBP110-I 型爆破筒	59-2 式爆破筒
GBP111 型爆破筒	68 式爆破筒
GBP112 型爆破筒	柔性爆破筒
GBP113 型爆破筒	刚柔组合爆破筒
GBP122A 型火箭爆破器	74 (改) 火箭爆破器
GBP123 型火箭爆破器	84 式单兵火箭爆破器
GBP124 型火箭爆破器	轻型火箭爆破器
GBP125 型火箭爆破器	班用火箭爆破器
GBP126 型火箭爆破器	84 式车载火箭爆破器
GBP128 型火箭爆破器	组合式火箭爆破器
GGT111 型爆破手背包	79 式爆破手背包
GGT112 型成套爆破工具	79 式成套爆破工具
GCT113 型爆破工具	85 式爆破工具

Equipment and Equipment New and Old Name Reference Table

GBP410 Initiator	66 Model Igniter
GBP411 Initiator	70 Series Igniter
GBP412 Initiator	78 Model Igniter
GBP421 Remote Initiator	82 Model Remote Detonator
CBP110 Explosive Projectile	59mm Mortar
GBP110-I type explosive charge	59-2 type explosive charge
CBP111 Type Explosive Hammer	68 Type Break Barrel
CGBP112 Detonator	Flexible Detonator
GBP113 Detonator	Soft and Hard Combination Detonator
CP122A Rocket Explosive Device	74(Reduced) Rocket Blaster
CBP123 Rocket Explosive Device	Type 84 Individual Rocket Launcher
CBP124 Rocket Explosive Device	Light Rocket Igniter
BP125 Rocket Explosive Device	Handheld Rocket Demolisher
GBP126 Rocket Explosive Device	84 Series Vehicle-Mounted Rocket Demolition Device
GBP128 Pyro-Explosive Device	Modular Rocket Detonator
GGT111 Explosive Handler Backpack	Type 79 Demolition Pack
GGT112 Type Complete Blasting Tool	79 Series Complete Set of Blasting Tools
GCT113 type blasting tool	85 Model Demolition Tools

附录五 常用计量单位对照表

单 位	符 号	单 位	符 号
千米	km	米	m
厘米	cm	毫米	mm
平方米	m ²	平方厘米	cm ²
立方米	m ³	立方厘米	cm ³
千克	kg	克	g
毫克	mg	升	L
毫升	ml	焦耳	J
千焦耳	kJ	角度	°
摄氏温度	℃	安培 (电流强度)	A
伏特 (电压)	V	欧姆 (电阻)	Ω
小时	h	分	min
秒	s	毫秒	ms

Common Unit Conversion Table

The diagram illustrates a three-terminal device, likely a transistor, represented by a central circle with a cross inside. Three terminals are shown extending from the circle:

- Terminal j:** Located at the top, labeled "Waste Cultivation Current Intensity".
- Terminal i:** Located at the bottom-left, labeled "Thin Film (Resistance)".
- Terminal Ω:** Located at the bottom-right, labeled "Volt (Voltage)".

Each terminal is connected to a horizontal line, and the entire device is enclosed in a rectangular frame.