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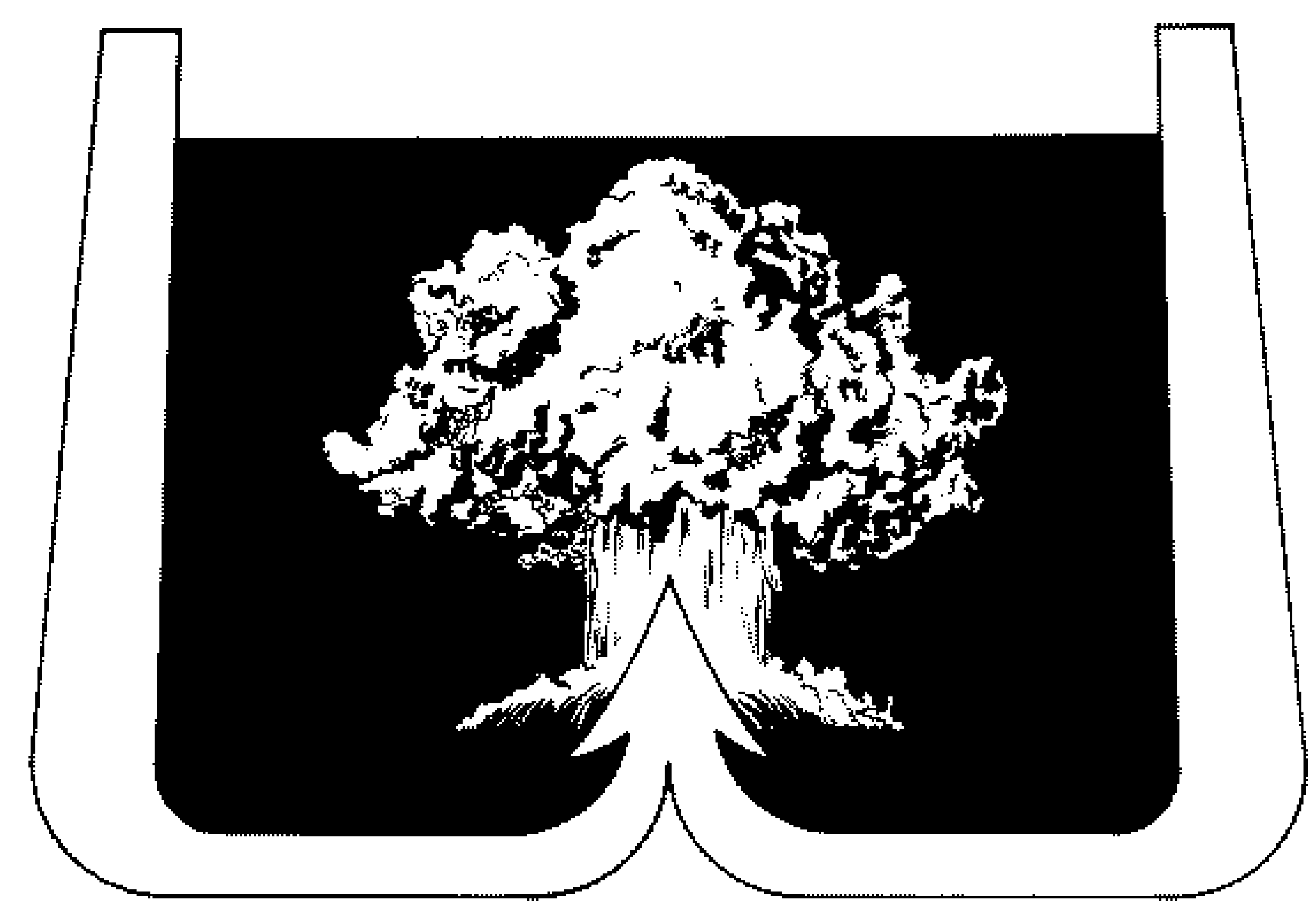
501-862-2077

TWO COMPONENT HIGH EXPLOSIVE MIXTURES



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Two Component High Explosive Mixtures

P.O. Box 1751
El Dorado, AR 71731-1751
501-862-2077

Printed in U. S. A.
ISBN 0-87947-251-0
10 9 8 7 6 5 4 5

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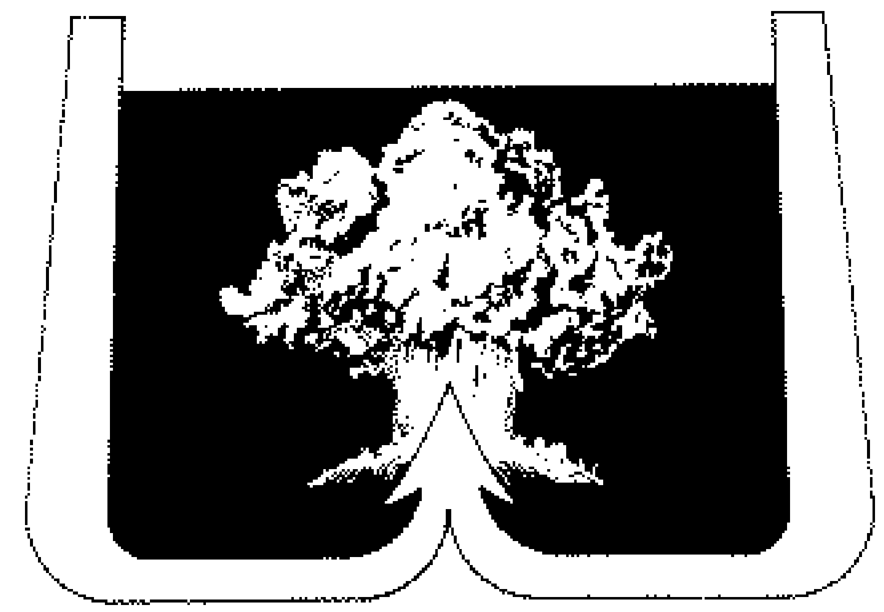

Two Component Compound Explosives

When the decision has been made to use improvised explosives against a target, the target should dictate what type to use. There are three basic types of targets:

1. Soft (earth and personnel)
2. Medium (timber and concrete)
3. Hard (reinforced concrete and steel)

Explosives can also be classified into basic types. These are Low explosives that have the ability to burn (deflagrate) when ignited by a spark or flame (e.g. black powder) and High explosives that have the ability to detonate when ignited by a detonator (e.g. TNT).

High explosives can be further divided into low velocity, medium velocity and high velocity types. Velocity is the speed it takes to change a solid or liquid explosive into gaseous byproducts. The velocity of this transformation is called brisance. It is measured in meters per second (MPS). Another, interrelated, characteristic of explosives is the amount of heat and gas produced by the explosive transformation. This is measured in degrees of power.

To conserve explosives and maximize potential, the correct explosive should be used with the proper target. Soft targets require explosives that have high power and low brisance (low explosives and low velocity high explosives of 300-3,000 MPS). Medium targets require medium to high power and medium brisance (medium velocity high explosives of 3,000-6,000 MPS). Hard targets require low to high power and high brisance (high velocity high explosives of 6,000-9,000 MPS).

After deciding on what type of explosive to use (based upon the type of target) personnel then have to manufacture the explosive in sufficient quantity to destroy or disable the target. To manufacture explosives in a hostile environment, the following points have to apply:

1. There is no elaborate chemical procedure to follow to produce the explosive.
2. The separate components are in most cases readily available and at little cost.
3. The separate components, if not available, are so basic a chemical compound that they can be readily produced with little or no effort.

Composite explosives are generally two or three component systems which are mixed together just prior to use, and when simply mixed together, form powerful and/or brisant explosives. In most all cases involving composite explosives the individual components are not explosive until mixed together, thereby allowing complete safety in storage and transportation. Composite explosives in the past have consisted of various oxidizing agents (e.g. potassium nitrate, potassium chlorate, potassium perchlorate, ammonium

nitrate and ammonium perchlorate) mixed with various reducing agents (e.g. charcoal, sulfur, sugar, red phosphorous, aluminum and magnesium). These mixtures form powerful explosives, yet in most all cases they do not produce high brisance (6,000-9,000 MPS) which is required to defeat hard targets.

This book and the accompanying photos will deal with only the newer, high power/high brisance explosives which are a byproduct of the advanced rocket research programs conducted by various commercial companies over a period of approximately thirty years.

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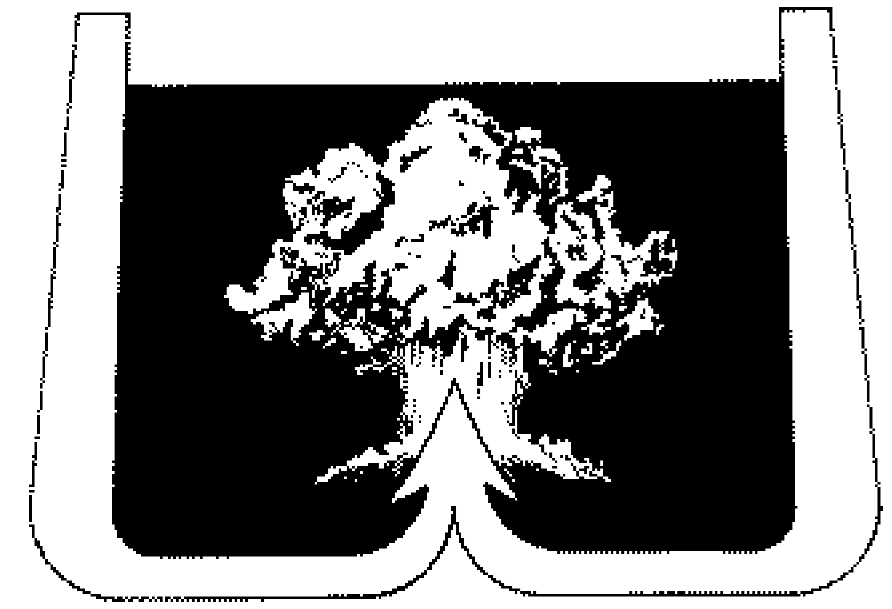


Nitromethane Liquid Explosives

Early in 1945, Aerojet-General Corporation conducted a program aimed at finding a desensitizer for a liquid monopropellant (nitromethane) which occasionally detonated in the firing chamber of liquid rocket motors. During the course of this investigation, some of the additives used turned out to be excellent sensitizers instead of desensitizers. This discovery marked the start of a development program on liquid explosives that continues today.

Liquid explosives have several major advantages over solid explosives. The most important property associated with liquid explosives is that every liquid has a uniform density. Uniform density is one of the major factors affecting the performance of any explosive. The more compressed a solid explosive becomes, the higher the density it achieves. With higher densities the solid explosive loses its ability to be detonated by other explosives (e.g. detonating caps). In other words, it decreases in sensitivity to detonation with an increase in density.

Another important point about density is that most solid explosives have a peak velocity of detonation (brisance) at a certain density. If this density is increased beyond that certain point, a decrease in velocity of detonation will result.

Uniform density is especially important when preparing improvised shaped charges and other special charges. For these special charges to be effective, the explosive used has to attain its highest possible velocity of detonation quickly, and in a uniform manner. Solid explosives have to be carefully packed into a container in order to maintain proper density whereas liquid explosives can be simply poured. Liquid explosives have the added advantage of disguisibility either as a clear liquid or dyed with food coloring.

Nitromethane is one of the safest and cheapest of the medium boiling point organic liquids from the standpoint of chemical and explosive stability. It can be ignited by an open flame with very little danger that it will explode. Nitromethane is relatively insensitive to shock at ordinary temperatures. It becomes somewhat more sensitive as its temperature rises. Nitromethane subjected to an impact test exploded

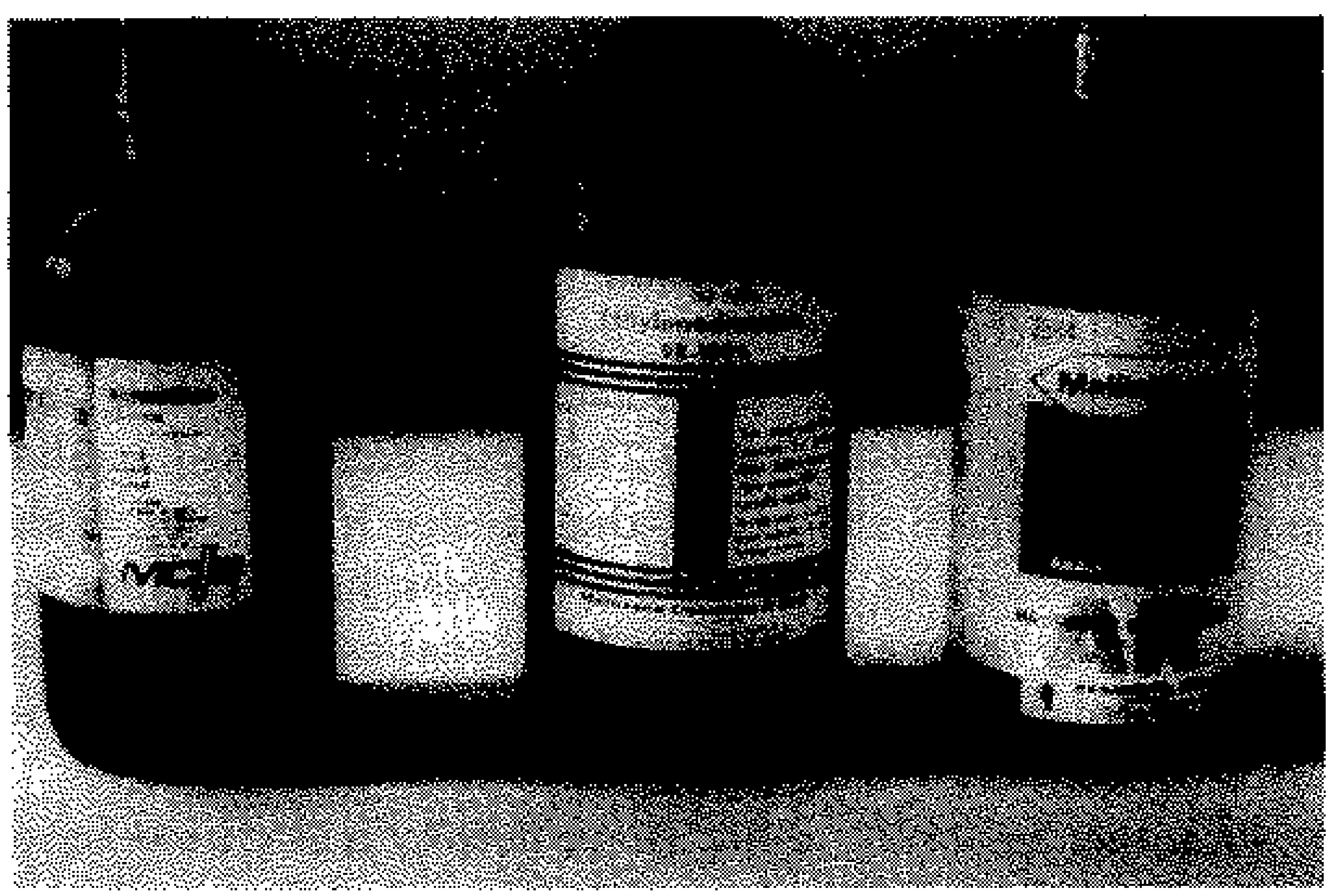


FIGURE 1
Compounds which render nitromethane more sensitive to detonation.

under the impact of a 2 kg weight falling from a height greater than 2 meters. Nitroglycerine explodes under similar conditions when the dropping height is only 35 centimeters.

Desensitized nitromethane will detonate only when a very strong detonator is used. It cannot be detonated completely by means of a No. 8 detonating cap (2 grams of mercury fulminate) or with the addition of 1-8 grams of booster explosive (tetryl). The insensitivity of nitromethane to induced detonation has been the major reason why it was not considered to be a worthwhile explosive. However, the addition of certain compounds (Figure 1) can render nitromethane more sensitive to detonation by a No. 8 detonating cap. For instance, strong ammonia-based compounds such as aqueous ammonia (household glass cleaning liquids), aniline, ethylenediamine and triethylamine are found to be strong sensitizers when used in small amounts of five to six percent by weight.

When sensitized nitromethane is detonated, it proves to be a very powerful explosive. The power output is 22 to 24 percent more powerful than TNT. The velocity of detonation is 6,200 MPS as compared to 6,900 MPS for TNT. As a point of reference, nitroglycerine is 40 to 80 percent more powerful than TNT and has a velocity of detonation of 7,700 MPS.

The first agency to use sensitized nitromethane explosives was Picatinny Arsenal. They needed a liquid explosive with uniform density properties that could be loaded into shaped charge containers and, when detonated, produced consistent results, shot after shot. These results were then compared against the same containers filled with various solid explosives that did not exhibit the same uniform density properties. The explosive used was called PLX (Picatinny Liquid Explosive). It consisted of a mixture of 95% by weight nitromethane and 5% by weight ethylenediamine. When these two liquids are mixed together they

FIGURE 2
When mixed together, nitromethane and ethylenediamine form a colorless liquid explosive that at a glance could be mistaken for water.

produce a colorless liquid explosive that resembles water in appearance (Figure 2). This explosive can be handled and disposed of more safely than any other military or commercial explosive.

In 1965 a second liquid explosive (AEREX) was introduced to Special Forces personnel. It consisted of a mixture of 94% by weight nitromethane and 6% by weight aniline. In simpler terms, 1 gallon of nitromethane is activated by adding 1/2 pint of aniline, or 50 pounds of nitromethane is activated by 3.2 pounds of aniline. Figures 3 and 4 show the results of the detonation of 4 ounces of AEREX on a wooden storage shed.

Nitromethane liquid explosives are easily prepared by thoroughly mixing the sensitizer with nitromethane. After mixing, the explosive can be poured through water and

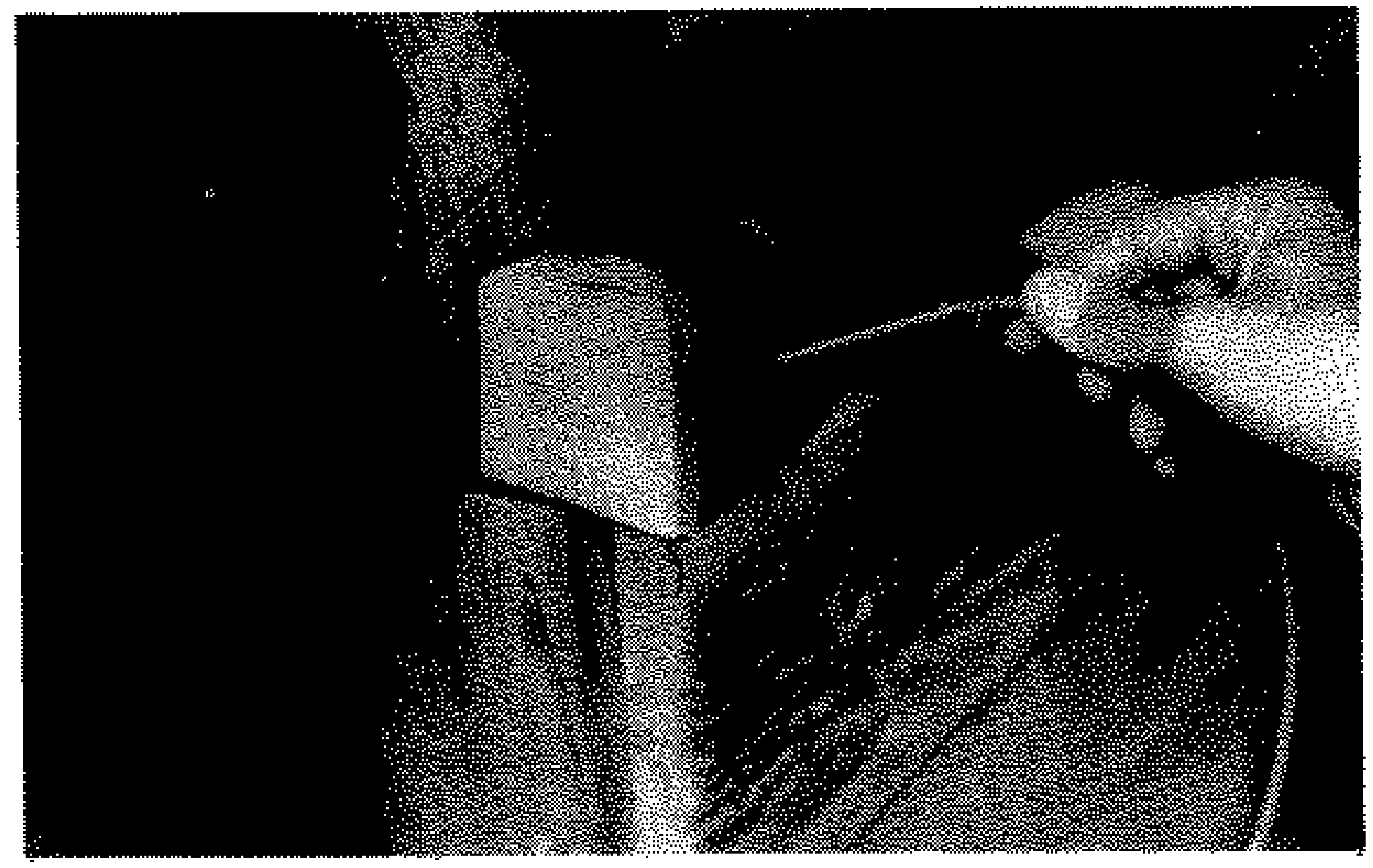


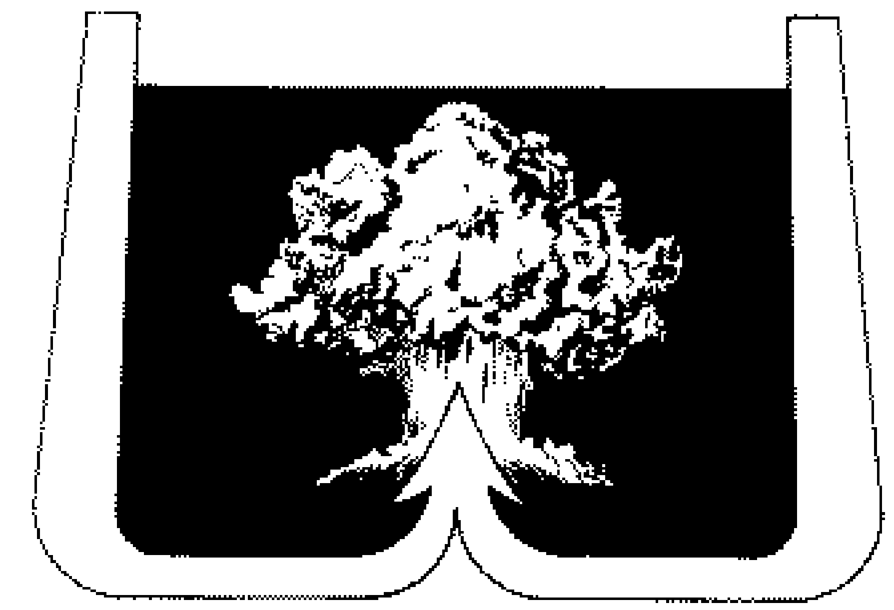
FIGURE 3
Special Forces instructor places a 4 ounce charge of AEREX against a wooden storage shed.

FIGURE 4
Remains of wooden storage shed following detonation of AEREX charge.

detonated after it settles on the bottom. Since nitromethane liquid explosives are heavier than water, they should not be disposed of by flushing them down a drain. A potential hazard could exist because the heavier explosive would tend to settle in the drain traps rather than be flushed away.

Priming is one of the most important factors governing the proper functioning of explosives. PLX and AEREX when properly detonated have considerable power. However, this energy can be wasted through incorrect priming. To obtain maximum efficiency from any explosive, it is essential that the peak velocity of detonation be reached as soon as possible. This is accomplished by using the proper detonating device with sufficient power to completely initiate the explosive being used. It is recommended that an Engineer Special blasting cap or an improvised compound detonator of equivalent strength be used to initiate PLX and AEREX liquid explosives.

Reliability of detonating cap initiation of PLX and AEREX is increased by positioning and immersing the detonator centrally with respect to the wall of the container. By so doing, the output energy of the detonator is transmitted to the explosive instead of being partially dissipated through the wall of the container. Confinement is another factor governing good performance. Essentially more confinement facilitates the initiation and increases the effectiveness of any explosive including PLX and AEREX liquid explosives.



Nitromethane Solid Explosives

KIC Kinetics Corporation in the 1970's developed a solid explosive based upon nitromethane and ammonium nitrate which generates at least 30% greater power than 60% dynamite and has 25% more brisance. Unlike PLX and AEREX liquid explosives, this solid explosive is far more sensitive to detonation. It can be completely detonated by a No. 6 detonating cap, making it easier to produce the detonators. Another important factor which makes this solid explosive unique is that the sensitizer, ammonium nitrate, is also an explosive which adds its power to the power of the nitromethane for a far more destructive effect on the target. Also, lesser amounts of nitromethane can be used to produce the same results as PLX and AEREX liquid explosives.

Nitromethane solid explosives are easily prepared by pouring the nitromethane into the ammonium nitrate and allowing sufficient time (3 to 5 minutes) for the nitromethane to soak completely into the ammonium nitrate. Since ammonium nitrate is extremely hygroscopic, it should be stored in a sealed container both before and after mixing with the nitromethane. The commercial explosive (KINEPAK) has a pink dye mixed with the liquid nitromethane to indicate by color change when the two explosives are completely mixed.

To produce a 1/2 pound quantity of explosive, 64 grams of nitromethane are poured into 160 grams of ammonium nitrate which has been ground to a fine powder. An important factor to observe when pouring the nitromethane into the ammonium nitrate is to not allow the ammonium nitrate to be disturbed after it has been soaked with nitromethane. Whenever a liquid is poured into a powdered substance, a natural "caking" action will result, producing a fairly uniform density throughout the solid material. Since uniform density has a direct effect on final results, the ammonium nitrate should always be mixed in a rigid container and not in a plastic bag.

Figure 5 shows two prepared samples of nitromethane solid explosive. The sample on the left is from a 1/2 pound charge of commercial KINEPAK (note the darker color of

FIGURE 5
Commercially prepared KINEPAK nitromethane solid explosive at left edge of photo appears darker than homemade equivalent at right because of the pink dye it contains.

FIGURE 6
A scale for weighing the separate components and a mortar and pestle for grinding the ammonium nitrate are the only equipment needed to produce the nitromethane solid explosive.

FIGURE 7
Special Forces instructor pours nitromethane into the ammonium nitrate.

FIGURE 8

A rigid container, such as the glass jar at left, is preferable for storing the prepared explosive as handling will change the density of the explosive in the baggie, thus affecting its performance.

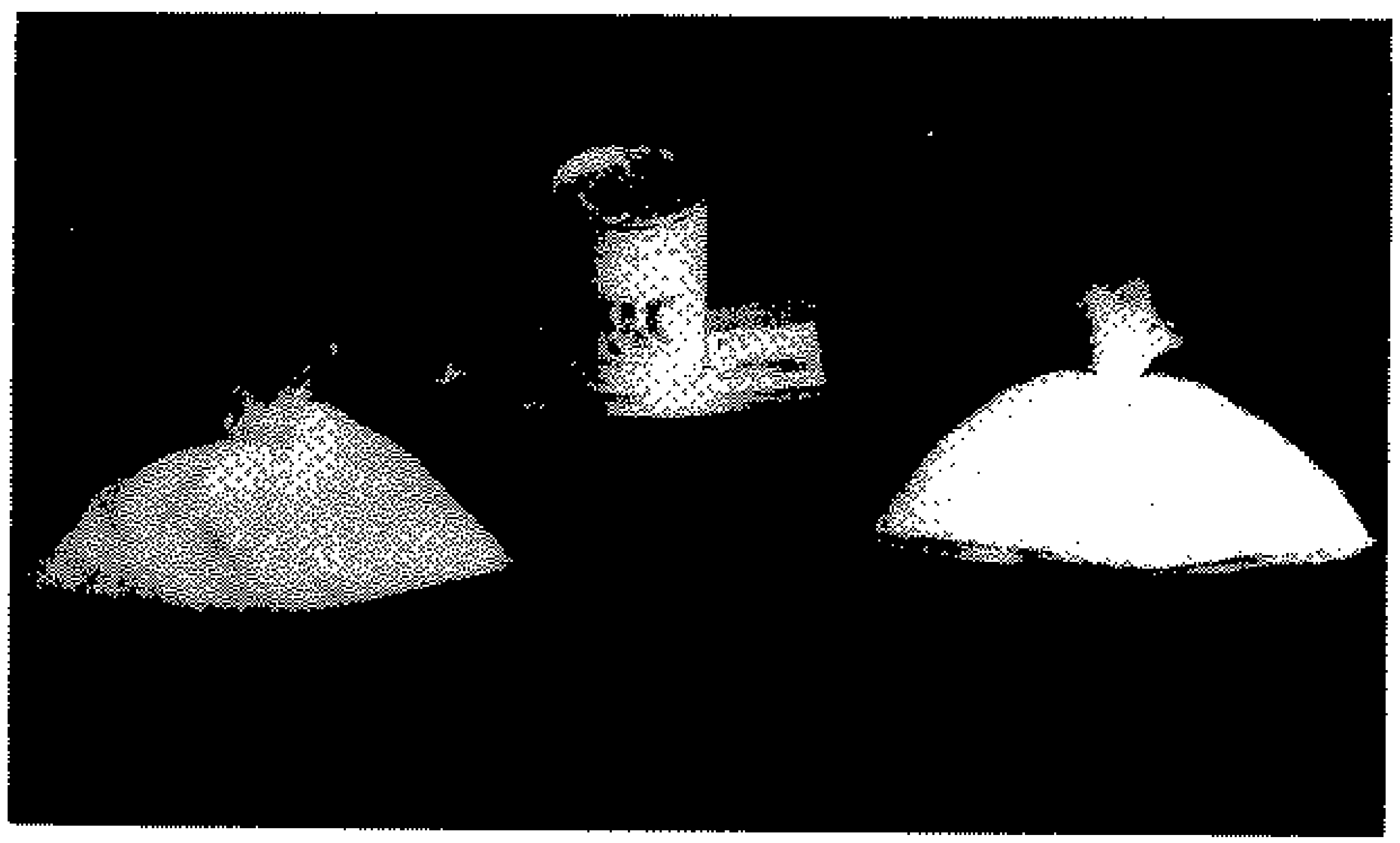


FIGURE 9

1/2 pound charge of commercial nitromethane solid explosive at left is identical in appearance to the homemade charge at right except for color.

the mixed explosive). The sample on the right is homemade nitromethane solid explosive.

Figure 6 shows the materials needed to produce the explosive. These materials simply consist of a scale to weigh the separate components and a mortar and pestle to grind the ammonium nitrate into a fine powder.

Figure 7 shows that all that is required to produce the explosive is to pour the nitromethane into the ammonium nitrate.

Figure 8 shows two types of containers used to store the mixed explosive. Whenever the baggie container is handled the density will be disturbed. However, this problem can be solved by using a rigid container such as a glass jar.

Figure 9 shows a 1/2 pound charge of commercial nitromethane solid explosive on the left and a 1/2 pound home-

FIGURE 10

Bumper and fender of a car prior to detonation of a 1/2 pound charge of commercially prepared nitromethane solid explosive.

made charge on the right. They are practically identical in appearance, but the commercial charge is recognizable because of the pink dye (it appears darker in the photo) which is included in the package.

Figure 10 shows the undamaged left rear bumper and fender of a car prior to the detonation of a 1/2 pound charge of commercial nitromethane explosive while Figure 11 shows the explosive force of that charge. Note the extensive damage to both bumper and fender.

Figures 12 and 13 show the right rear fender of the same car before and after detonation of a 1/2 pound charge of homemade nitromethane solid explosive.

Figure 14 show a 1 pound charge of homemade nitromethane solid explosive placed beneath the corner of a house. Figure 15 shows the wreckage of the house following detonation of the charge.

FIGURE 11
The same bumper and fender shown in Figure 10 after detonation of the charge.

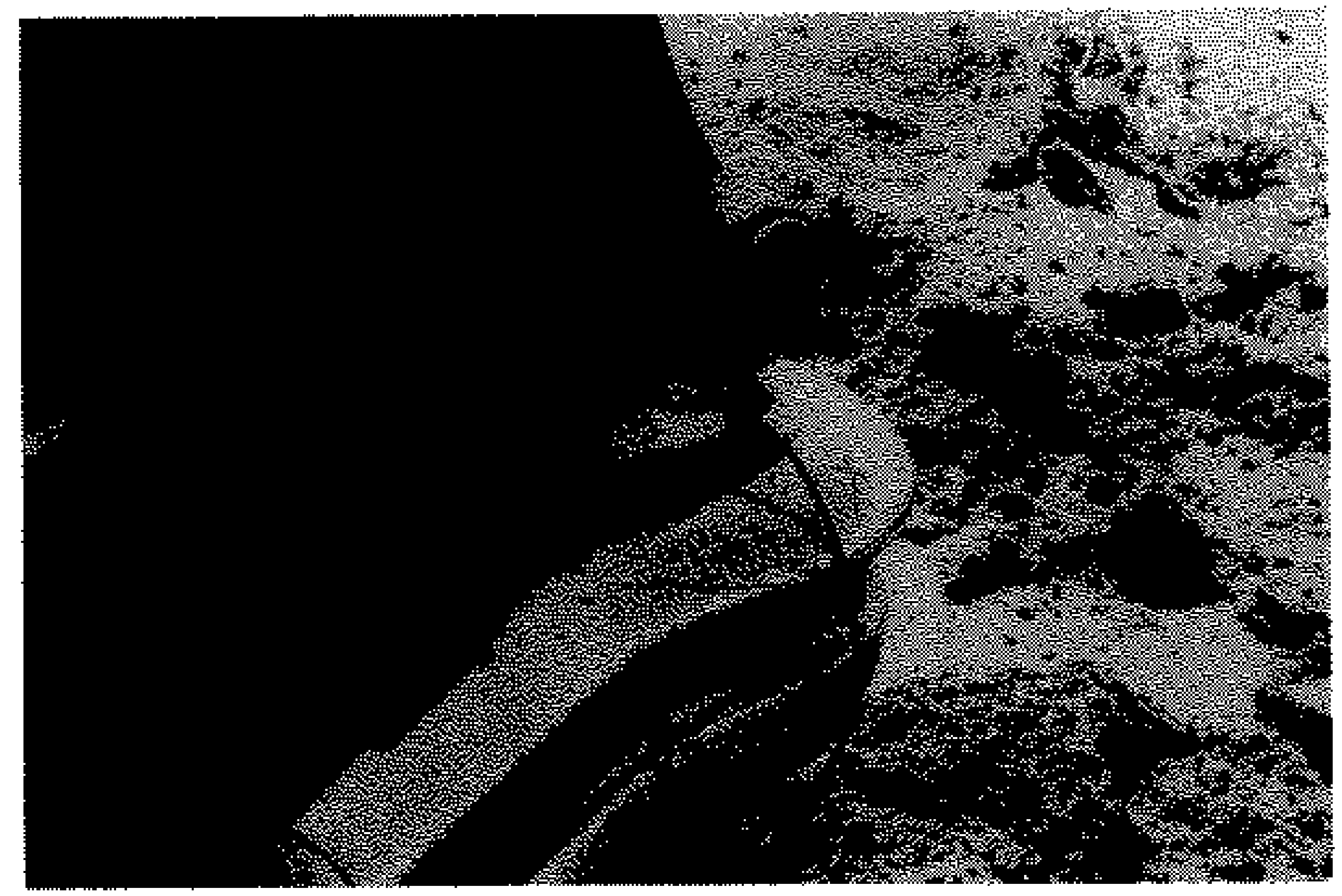


FIGURE 12
Opposite bumper and fender of the same car prior to detonation of a homemade charge of nitromethane solid explosive.

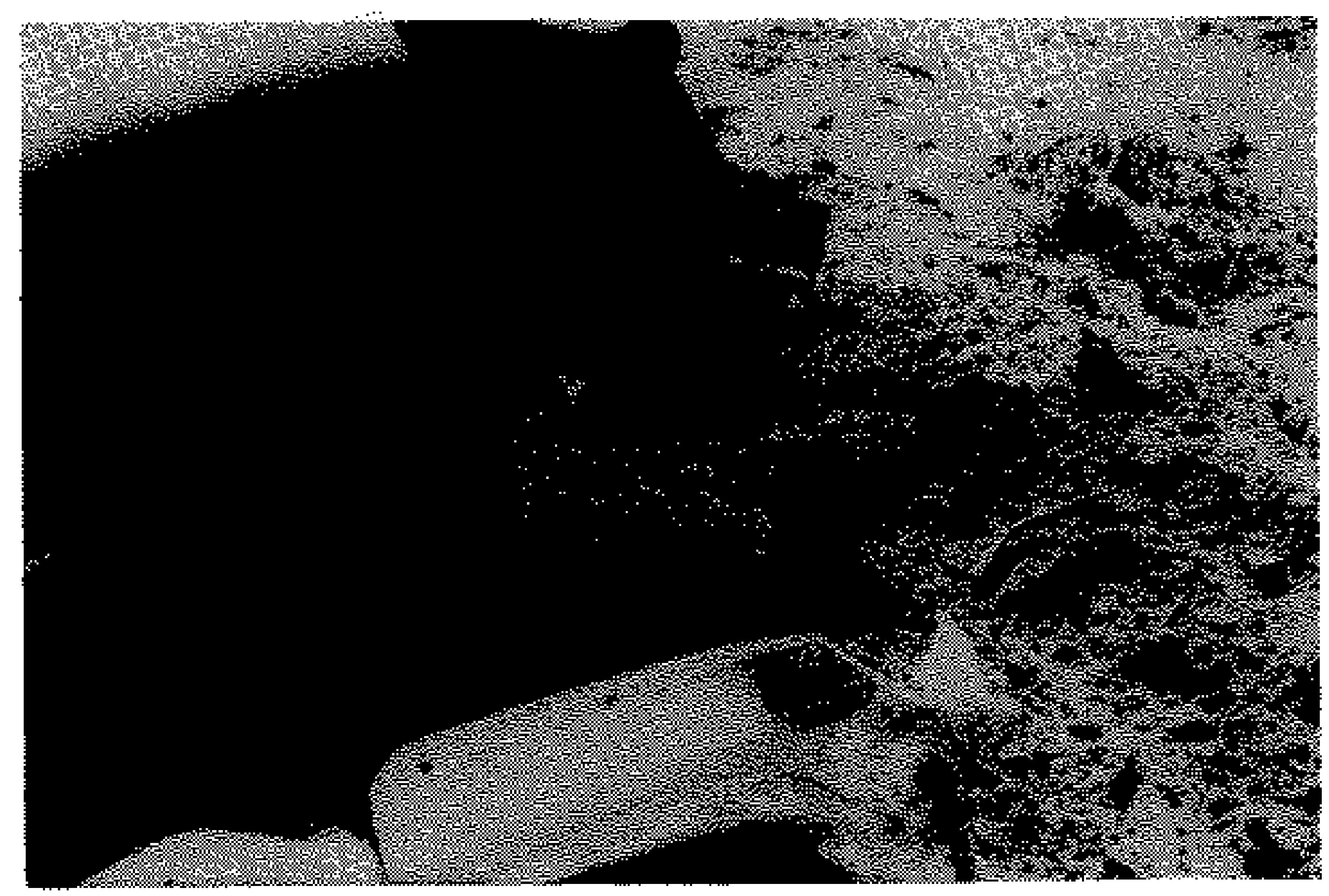


FIGURE 13
Bumper and fender following detonation of the charge.

FIGURE 14
A 1 pound charge, practically invisible in this photo, is placed beneath a house.

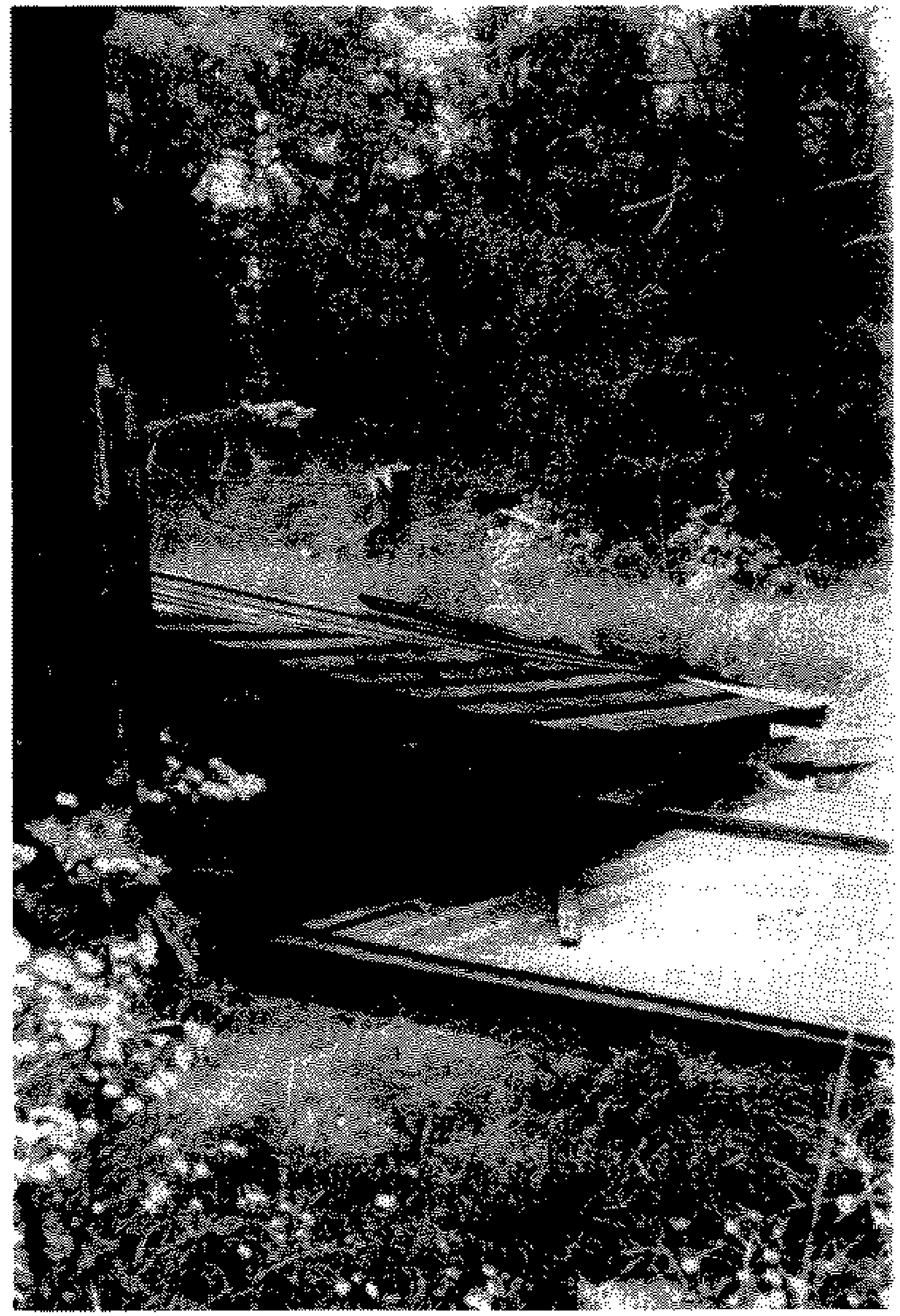
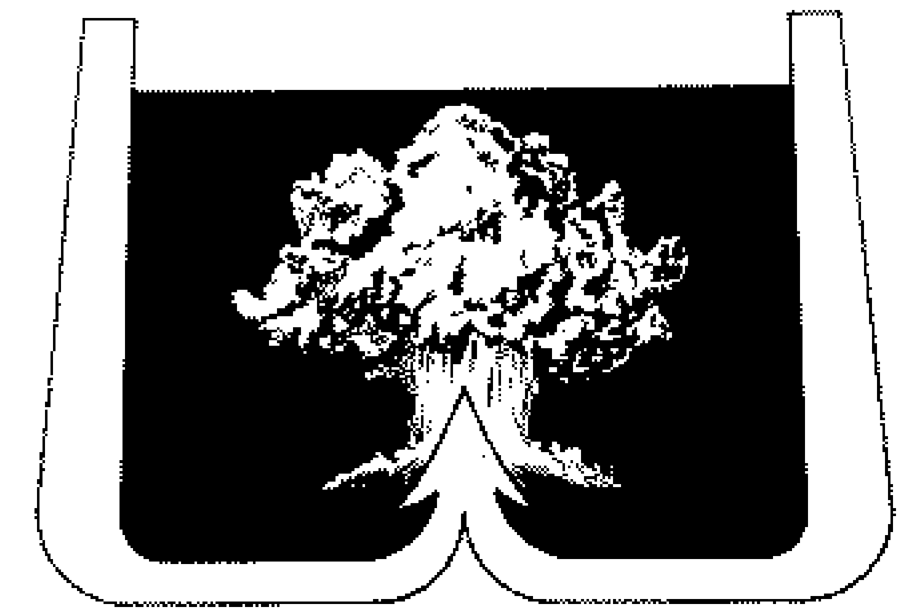


FIGURE 15
Extensive damage to the house resulted from detonation of the charge of homemade explosive.



Astrolite Liquid Explosives

A completely new family of explosives has been developed with entirely new properties, giving rise to revolutionary application concepts that never before have been possible with conventional explosives.

The most significant of the new explosives are Astrolite A-1-5, said to be the world's most powerful non-nuclear explosive, and Astrolite G, claimed to be the world's highest detonation-velocity liquid explosive. Both explosives are remarkably safe to handle and are unusually versatile. Both also can be mixed from nondetonable components in the field, which simplifies logistics and increases safety.

Astrolite explosives are a product of advanced rocket propellant technology. They were discovered quite by accident in the 1960's by research personnel investigating a so-called rocket propellant that proved so powerful that it consistently destroyed rockets on the test stand.

Astrolite explosives are formed when ammonium nitrate is mixed wth anhydrous hydrazine. Extensive solvolysis occurs with the liberation of large amounts of ammonia gas and a new chemical compound (hydrazonium nitrate) is formed and remains in solution. This produces a clear liquid

FIGURE 16
When ammonium nitrate and anhydrous hydrazine are mixed, they form Astrolite G (center container).

explosive (Figure 16) called Astrolite G. When aluminum powder (100 mesh or finer) is added it forms Astrolite A-1-5. The proportions of the components are as follows:

1. Two parts by weight of ammonium nitrate is mixed with one part by weight of anhydrous hydrazine, producing Astrolite G explosive.
2. Astrolite A-1-5 is formed when 20 percent by weight of aluminum powder is added to the ammonium nitrate before mixing with anhydrous hydrazine.

The aluminum powder in the A-1-5 does not react with the two main components but remains in solution to give added power to the explosive when it is detonated by a compound detonator. Straight detonators (No. 8 in strength) can be used, but the velocity of detonation will be reduced. The

tremendous explosive power stems from Astrolite's amine-based chemistry which releases nitrogen and hydrogen gases. These expand more forcefully than the gases produced by the usual hydrocarbon explosives.

Anhydrous hydrazine is classified as corrosive and is flammable. It should be kept away from any source of fire, flame or sparks. It is also mildly toxic and should be handled in well ventilated areas. Harmful effects may result from swallowing, inhalation of vapors or contact with the skin or eyes. In case of accidental spilling, wash the affected area immediately with large quantities of water. Remove contaminated clothing and wash with water. Eyes should be flushed with water for 15 minutes.

Ammonium nitrate is an oxidizing agent and should be kept away from any source of fire, flame or sparks.

The mixed explosive has a lower toxicity than the hydrazine. However, it is recommended that the same handling precautions be applied when handling the mixed explosive: Flush spills of Astrolite immediately with large quantities of water to neutralize; handle Astrolite only in well ventilated areas. The mixed explosive is relatively insensitive to shock and can be safely used in both Arctic and desert climates.

Figure 17 shows the separate components needed to prepare Astrolite G liquid explosive. Rubber gloves are worn to protect against accidental spillage.

Figure 18 shows the actual mixing of the two components. The mixing container should be fairly large because the chemical reaction is extremely effervescent and can easily bubble over the top. Because of the effervescent reaction, the liquid hydrazine should be added very slowly so as not to create accidental spilling. The person doing the mixing should be upwind of the mixing process so as not to inhale the poisonous ammonia gas which is liberated during the reaction. After all the hydrazine is added, stirring should continue for

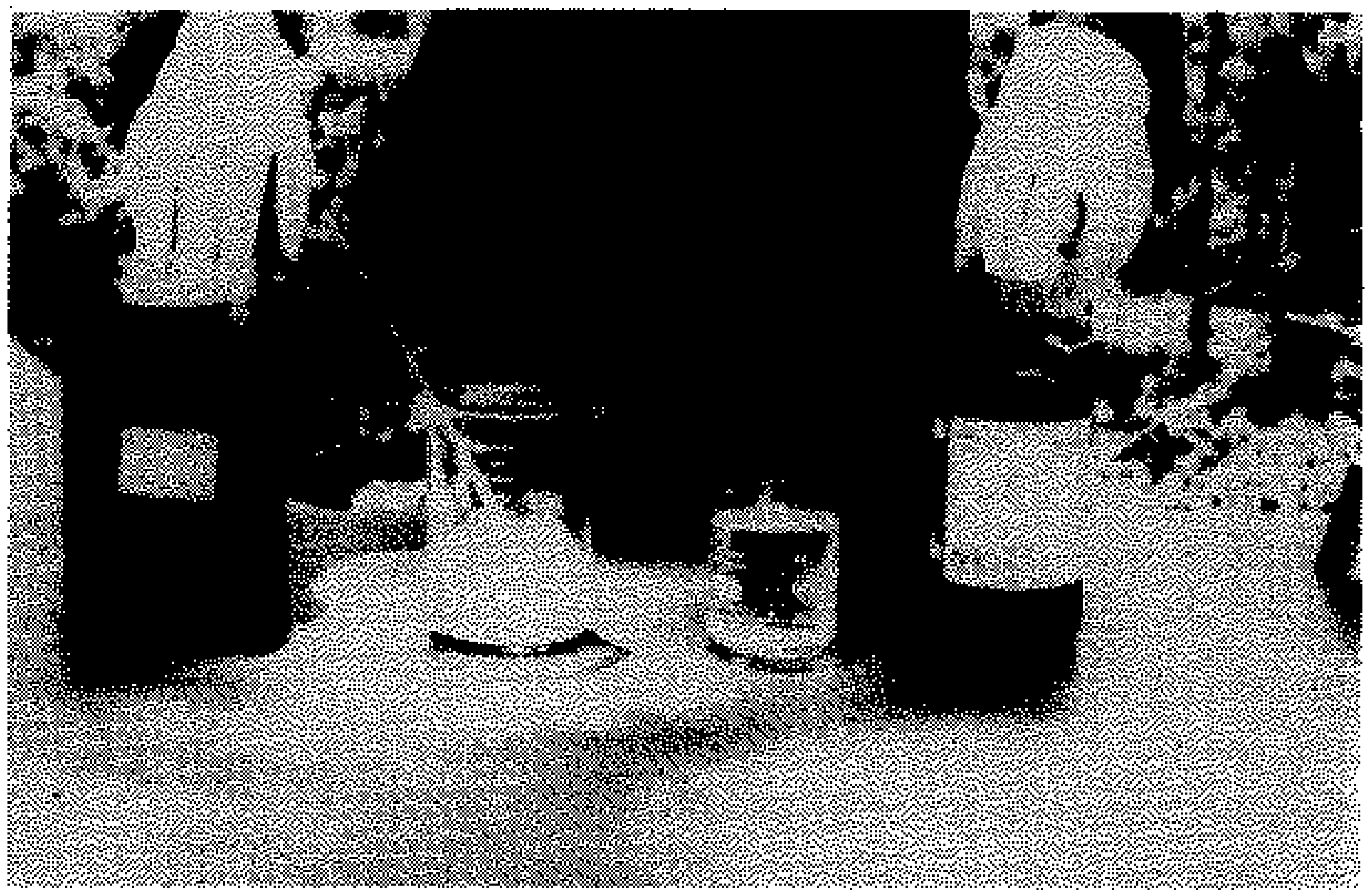


FIGURE 17
Special Forces instructor prepares to mix the two components of Astrolite G.

FIGURE 18
The actual mixing process begins.

an additional five minutes. A small amount of solid residue may appear. This residue is inert and will not affect the explosive.

Astrolite liquid explosives have several unique characteristics which permit great versatility of application in the field.

The Astrolite A family of explosives, of which A-1-5 has proved the most powerful and adaptable for military use, is totally unrelated to any existing explosive compounds. Side-by-side field tests in both dirt and clay cratering and in hard-rock blasting have revealed that Astrolite A outperforms 60% blasting gelatin by 3 to 5 times, and that it is 1.8 to 2 times more powerful than TNT – greater than any other non-nuclear explosive. Yet the Astrolite A family of explosives is 40 times safer than nitroglycerin explosives under adiabatic compression and impact shock. In demolition, Astrolite A produces crater volumes 3 times greater than C-4 plastic explosive, and 1.5 times greater than PBXN-1, an existing high power military explosive.

Unlike Astrolite A, Astrolite G represents an entirely new approach in the ordnance field. Applications of Astrolite G are so revolutionary that its acceptance by the military – which already is occuring – will mark the introduction of new concepts rather than the replacement of military explosives.

Astrolite G is a clear liquid explosive especially designed to produce a very high detonation velocity, 8,600 MPS, compared with 7,700 MPS for nitroglycerin and 6,900 MPS for TNT. Astrolite A has a velocity of detonation of 7,800 MPS.

Astrolite G has excellent propagation characteristics, propagating in tube diameters below one-half inch. In addition, a very unusual characteristic is that the liquid explosive has the ability to be absorbed easily into the ground while remaining detonable. No other safe military or commercial explosive has this property. In field tests, Astrolite G has

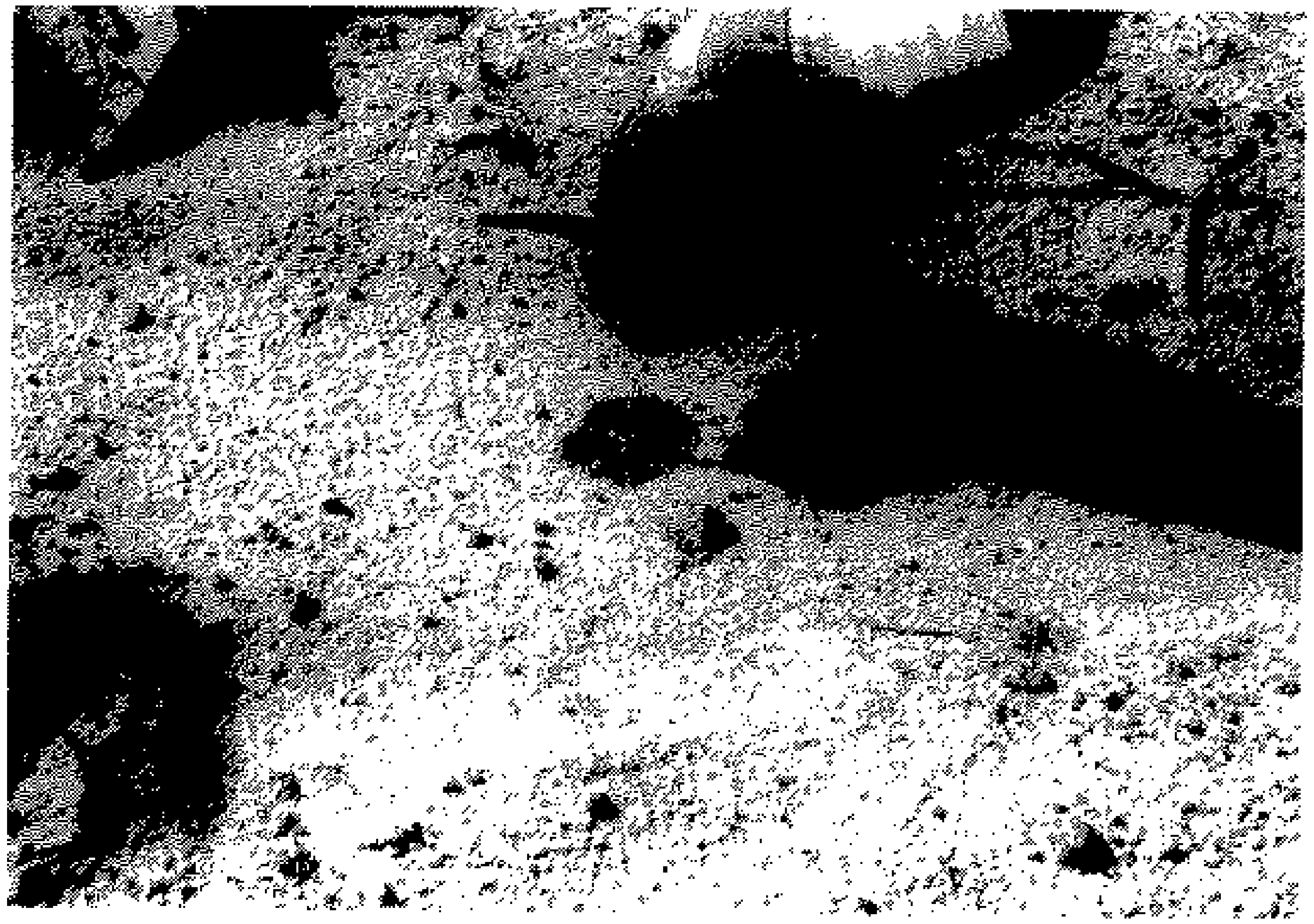


FIGURE 19
Special Forces instructor pours Astrolite G onto the ground.

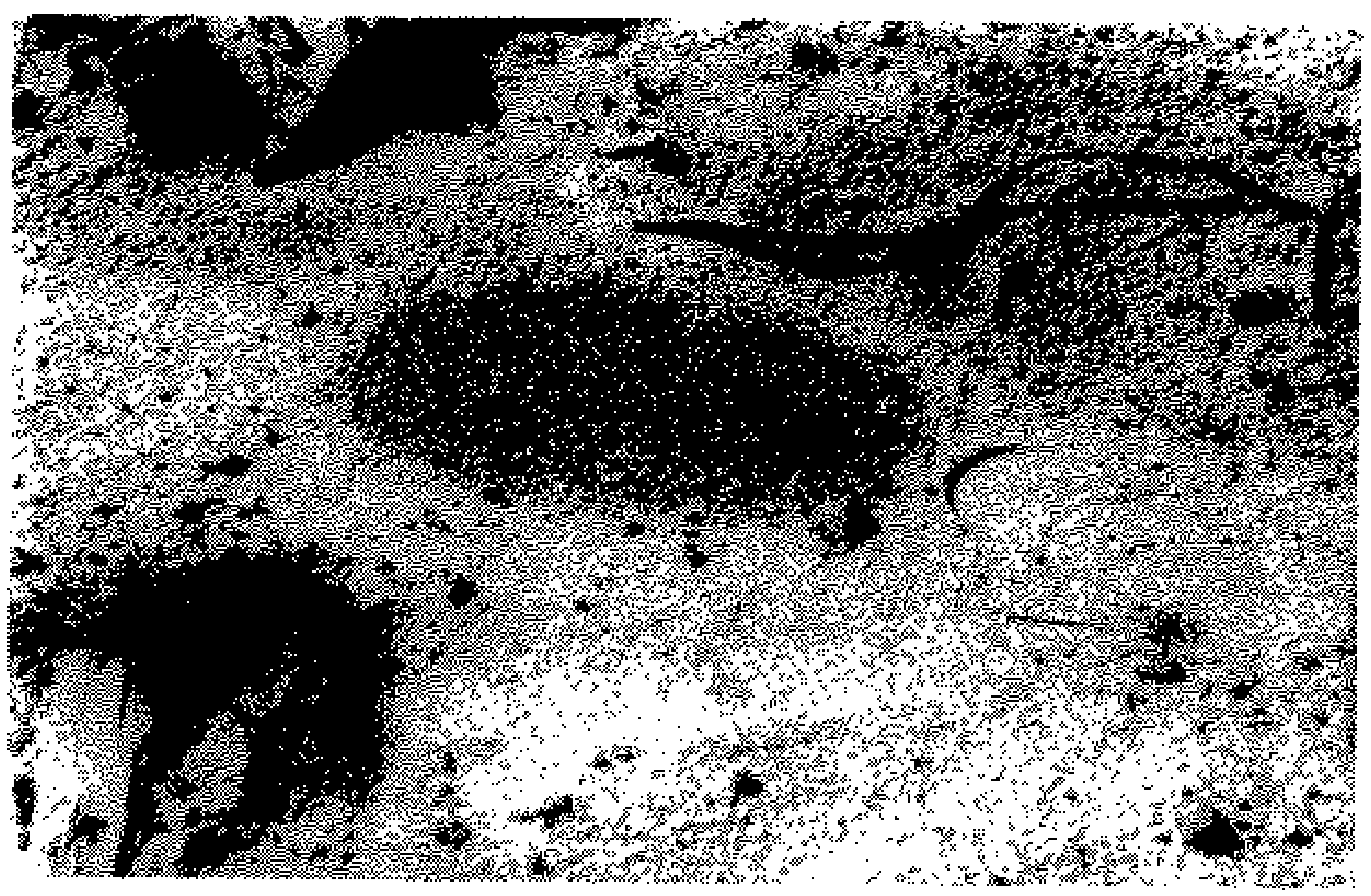


FIGURE 20
Astrolite G-soaked ground appears to be merely a damp spot.

remained detonable for 4 days in the ground, even when the soil was soaked due to rainy weather.

Several unusual applications are possible through the use of Astrolite G. One such application is that of the liquid land mine. Astrolite G is poured directly into the ground, soaking into and blending with the surrounding earth. The pocket of explosive can then be initiated by a conventional electrically or mechanically actuated detonator. Such pockets of explosives can be dispensed by a foot soldier, motor vehicle, helicopters or airplanes either in individual puddles or along continuous strips. These rapidly emplaced land mines can be used for both antipersonnel and antivehicular purposes.

Due to its high detonation velocity, very small charges of Astrolite G are needed for the liquid land mine. In Figure 19, a Special Forces instructor is shown pouring 4 ounces of explosive onto the ground.

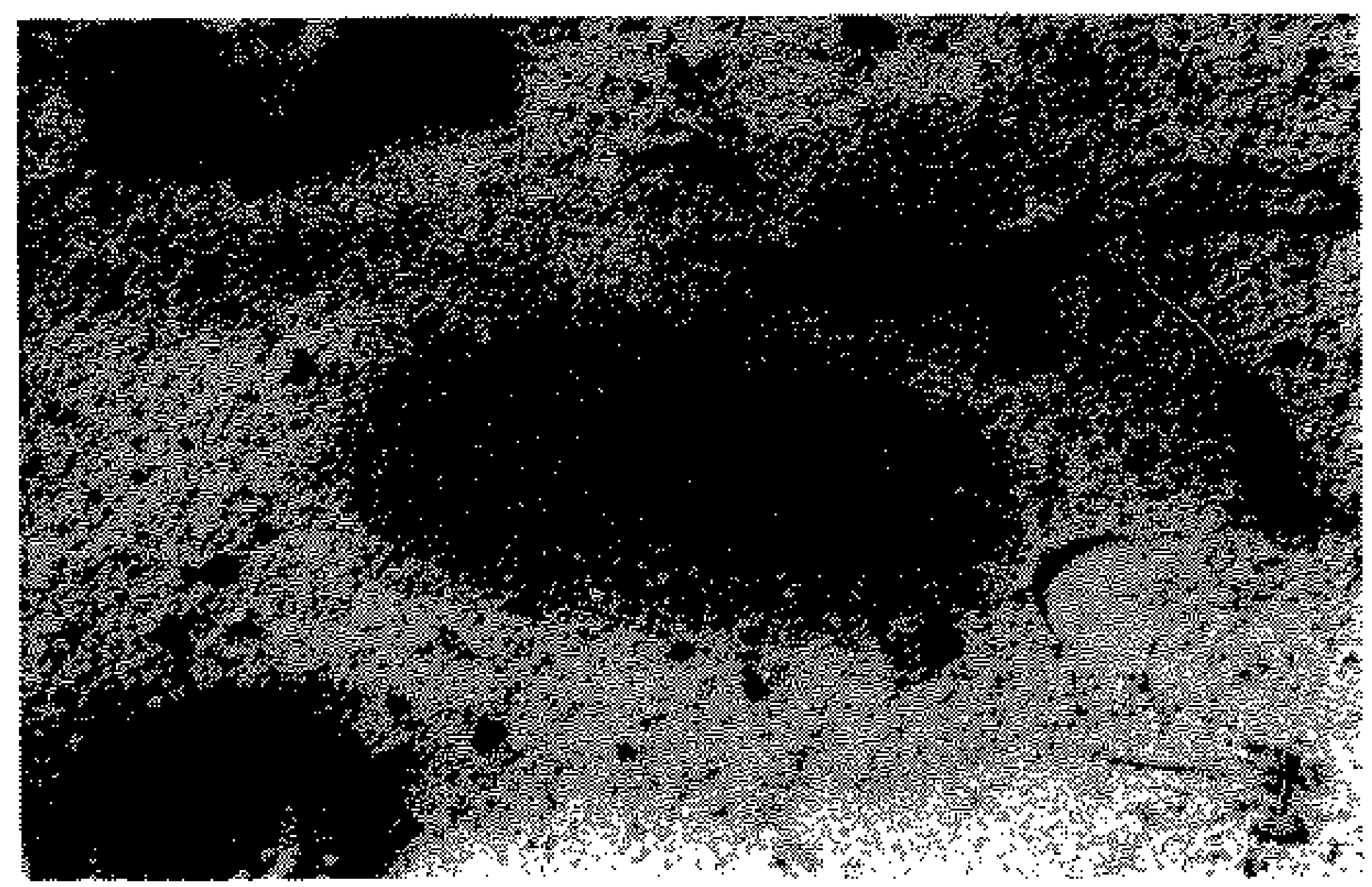


FIGURE 21
Detonating cap with Astrolite G-soaked earth. In actual practice, the cap would be hidden or camouflaged.

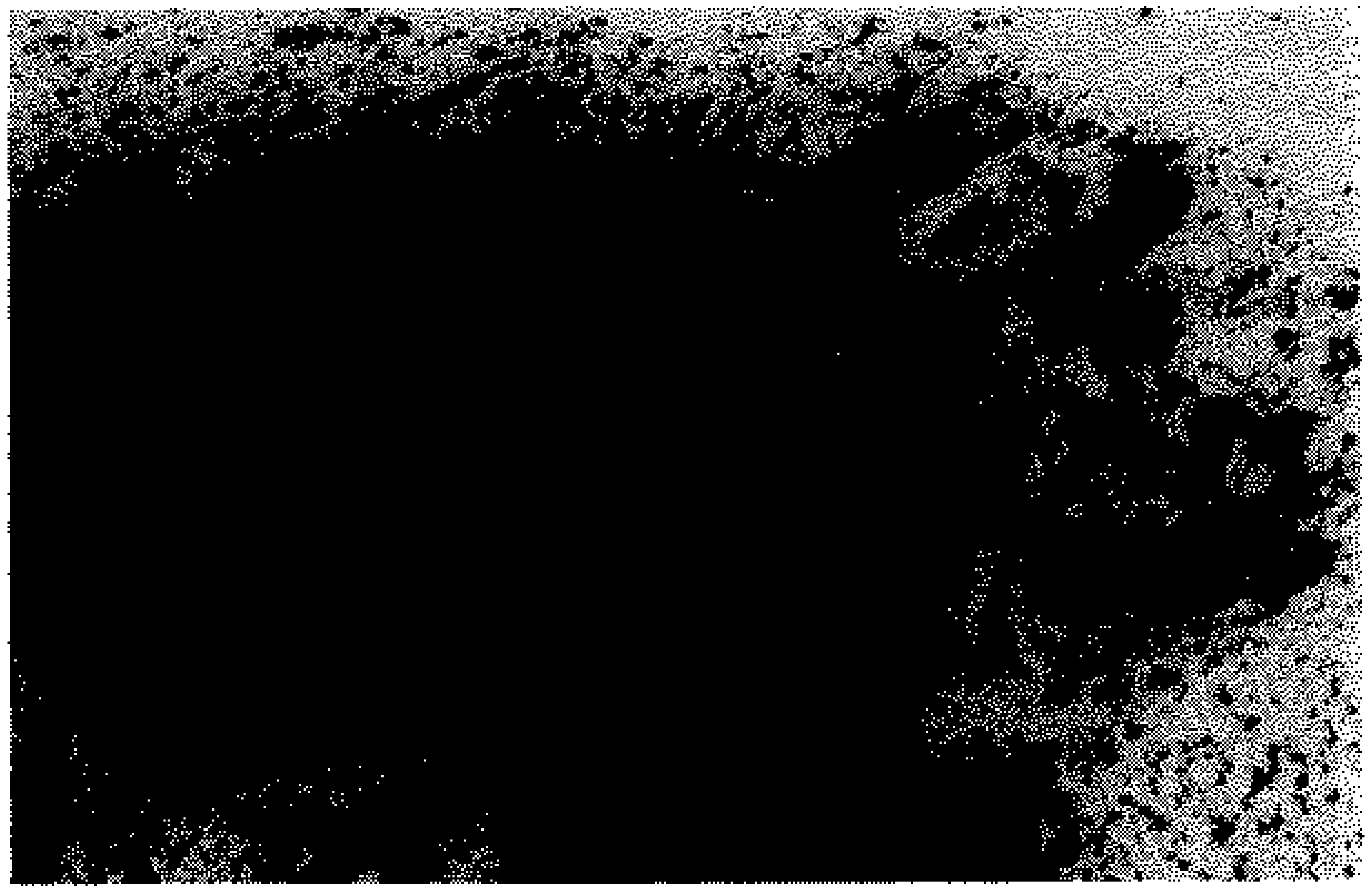


FIGURE 22

Crater made when Astrolite G was detonated. It would have been devastating in an antipersonnel application and would have been highly effective against a vehicle.

Figure 20 shows the Astrolite G-soaked ground, which appears to be merely a damp spot in the earth, possibly from spilled water or an oil leak. Figure 21 shows a detonating cap beside the damp spot. In practical application, the detonating cap would be buried or camouflaged and is shown here for illustrative purposes only.

Figure 22 shows the crater left in the ground following detonation of the 4 ounce charge of Astrolite G. Upward force of the blast, which in this case was expended up into the air, would have been devastating in antipersonnel application and would have been sufficient to disable even a light armored vehicle.