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**INSTRUCTIONS AND OPERATIONS MANUAL FOR
RAPID EMPLACEMENT
AND RETRIEVING DEVICE FOR
GROUND STAKES GP-112/G AND GP-113/G
BALLISTIC HAMMER MX6321()/G**

CONTRACT NO. DA-36-039 SC-90760 (E)

U. S. ARMY ELECTRONICS RESEARCH AND DEVELOPMENT LABORATORY
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AIRCRAFT ARMAMENTS, Inc.

INSTRUCTIONS AND OPERATIONS MANUAL
FOR
RAPID EMPLACEMENT AND RETRIEVING DEVICE
FOR GROUND STAKES GP-112/G AND GP-113/G

BALLISTIC HAMMER MX-6321 ()/G

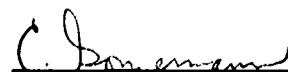
SUMMARY REPORT APPENDIX

Contract No. DA-36-039-SC-90760(E)

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Prepared by:

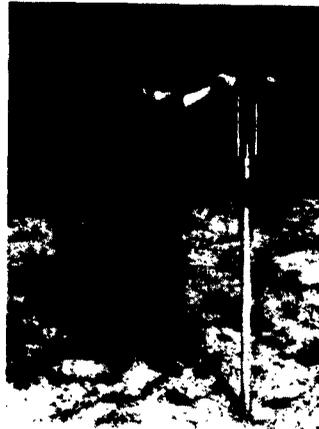

R. G. Strickland, Project Manager


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NOTE: This Appendix has been detached from the Main
Body of AAI Report No. ER-3246 in order that
it may be readily referred to in the field.



AIRCRAFT ARMAMENTS, Inc.



(a)



(b)



(c)



(d)

- a. Emplace Stake GP-113/G
- b. Retrieve Stake GP-113/G
- c. Emplace Stake GP-112/G
- d. Retrieve Stake GP-112/G
- e. Emplace Stake GP-113/G at approximately 30°



(e)

Typical Employment Modes for Ballistic Hammer

Frontispiece



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I. INTRODUCTION

The purpose of these instructions is to completely familiarize the technically oriented operator with the Ballistic Hammer. This device has been developed to enable the rapid, easy emplacement and retrieval of Signal Corps Ground Stakes GP-113/G and GP-112/G. This instruction book contains sections which discuss operating principles, component descriptions and functions, disassembly and cleaning procedures, and detailed operation procedures for the device both when used as an emplacement device and when used as a retrieve device for the two Ground Stakes. Wherever possible, illustrations are used to facilitate the understanding of the operations.



II. EMPLOYMENT INSTRUCTIONS

A. Ground Stake GP-113/G Emplacement

Refer to Figure 1. Ground Stake GP-113/G is a tubular member approximately four feet long. One end of the Stake is pointed, while the other end is caped. The point is provided on the one end to divert the Stake from any rocks or stones it encounters during emplacement. The cap furnishes a strong area which can be impacted by the emplacement blows without damage. This Stake has been designed for emplacement in "normal" soils. These include gravel, compact and loose sand, medium-firm clay, fill, wet clay, silt, swamp and humus.*

The number of impacts required to emplace this Stake varies with the soil type. For example, one would expect medium-firm clay to present more resistance to stake emplacement than fill.

1. Perpendicular Emplacement

The following is the detailed Application Procedure for emplacement of this Stake under this condition.

a. Select appropriate Adaptor.

This would be the Ground Stake GP-113/G Adaptor.

b. Place Adaptor on Device.

Pull Back on the Lock Ring to do this. (See the following page).

c. Drive Stake into soil by hand.

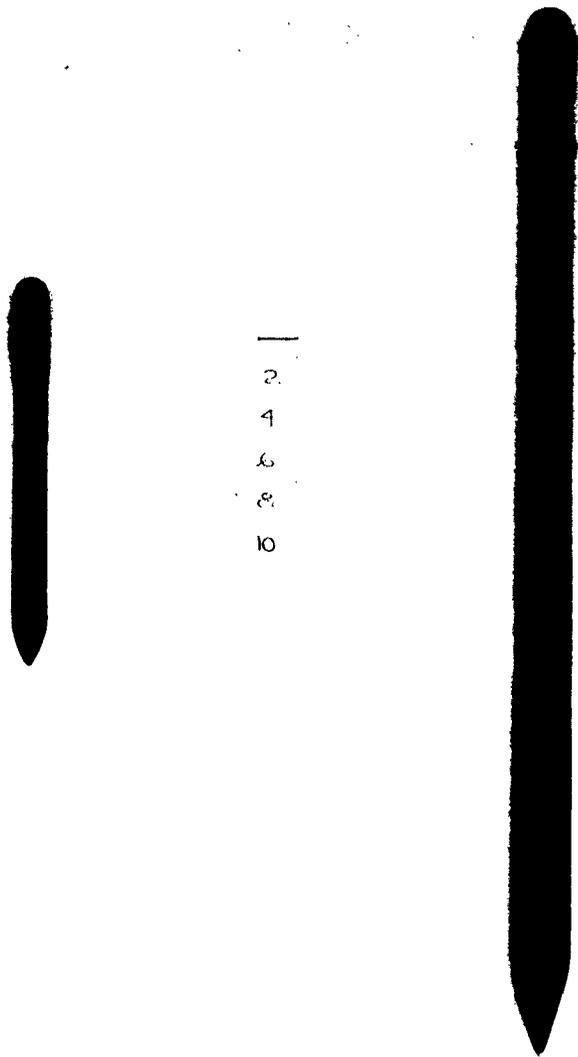
d. Check Safety - "Safe" Position.

The Safety is in the "Safe" Position when its longest dimension is parallel to the centerline of the barrel of the action.

e. Place clip in action.

This is done by pushing on the magazine catch and sliding the magazine into place - the catch is then released, locking the magazine in place.

* This is a partial list which is intended to give the reader and indication of the applicable soils for GP-113/G.



Ground Stakes GP-112/G and GP-113/G

Figure 1



Installation of Adaptor on Device

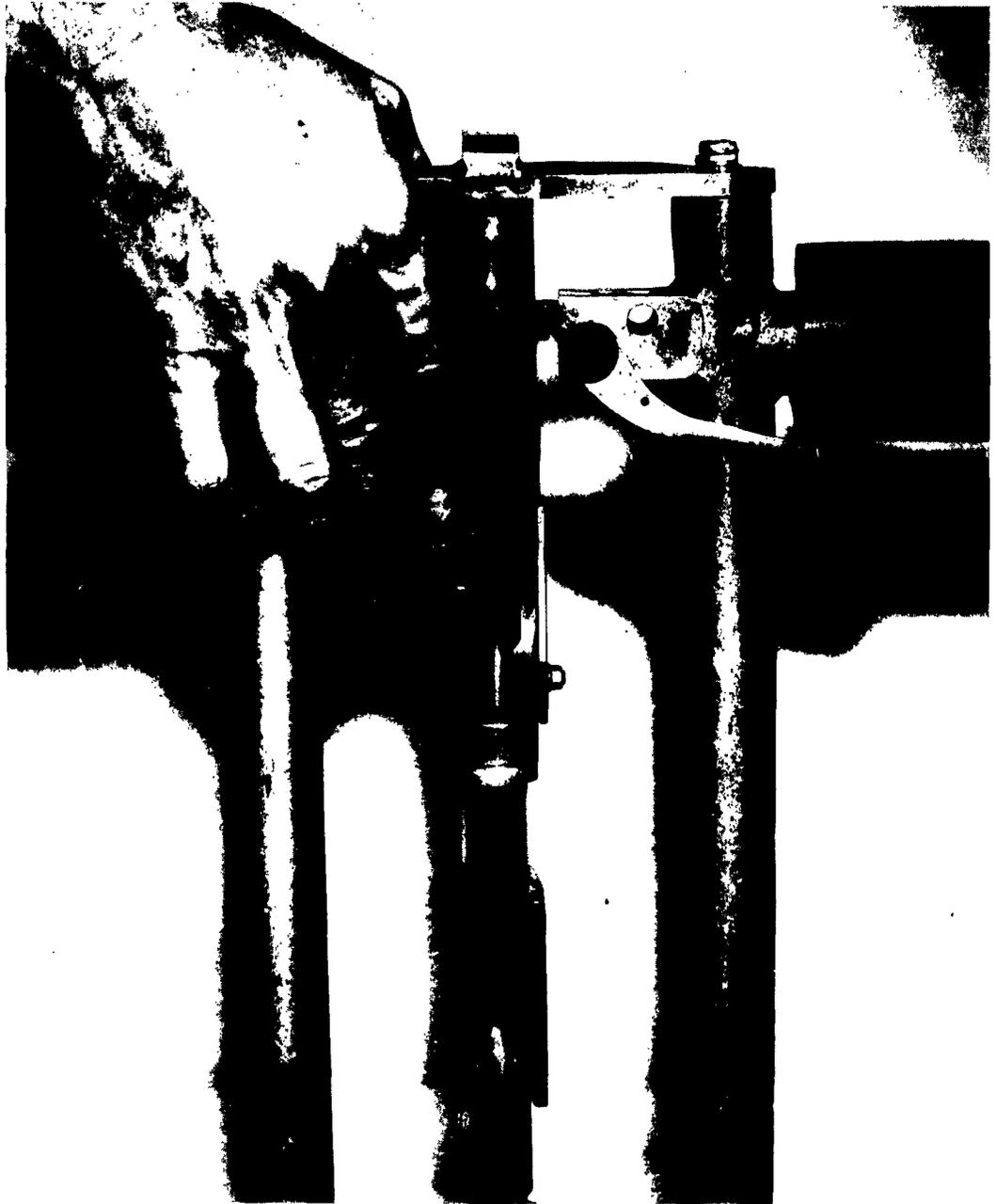
Figure 2

- f. Place tool in position on Stake.
The end of the magazine should be pointed at the operator's chest, lest the cartridges which will subsequently be ejected strike the operator in the face. (The entire procedure up to this point is illustrated in Figure 3).
- g. Move "Safety" to "Fire" position.
The Safety is in the "Fire" position when its longest dimension is perpendicular to the centerline of the barrel of the action.
- h. Apply 10 to 20 pound operator preload.
This is done by pushing on the Handles of the Device. This is essential since when the cartridges are initiated, the Device will recoil. If the operator did not exert this preload, the recoil distance would be larger than the guided length furnished by the Adaptor, resulting in the Device flying off the Stake.
- i. Cycle bolt slide by hand to feed first cartridge. Refer to the following page.
- j. Pull Trigger.
The Trigger must be pulled upward - this initiates the Device. The Device will then recoil 3 to 4 inches and settle back on the Stake.
- k. Continue operating tool by Trigger pull until Stake is emplaced.
- l. Replace clips as rounds are expended.
To fully emplace the Stake, the Trigger initiating cycle may have to be repeated from 6 to 40 times, depending upon the soil type encountered. For this reason, the magazines will have to be replaced as they are expended. The bolt slide will have to be cycled by hand to chamber the first cartridge of each magazine.



Perpendicular Emplacement of Ground Stake GP-113/G

Figure 3



Cycling of Bolt Slide by Hand

Figure 4



- m. Cycle action by hand first time a new clip is emplaced.
- n. When completed, place safety on "Safe", remove cartridge clip, and cycle bolt slide by hand to insure that a cartridge has not been left in the chamber.

(The magazine catch must first be depressed before the magazine can be removed).

- o. Remove Device from Stake.
Remove Adaptor from Device. (The Lock Ring must be engaged to remove the Adaptor).
- p. If, at any time, a Trigger pull fails to produce a "Fire", do the following:
 - (1) Check safety to ensure that it is in the "Fire" position.
 - (2) Cycle bolt slide manually to clear the chamber and feed a new cartridge.
 - (3) Check that magazine is not empty.

2. Angular Emplacement

The general procedures followed by the operator for this case are exactly the same as for perpendicular emplacement. The relative orientations of the Device and operator are different, however. This difference can be seen in Figure 5. This figure should be carefully studied. As a general rule, it can be said that in any case, the best operator position is that at which he feels most comfortable and safe while exerting his 10 to 20 pound preload.

A very satisfactory method of initially positioning the Stake is to proceed exactly as in the case of perpendicular emplacement. After one shot, the stake should then be leaned over to achieve the desired angle of inclination.

B. Ground Stake GP-112/G Emplacement

Refer to Figure 1. Ground Stake GP-112/G is a steel member approximately 1-1/2 feet long. The body of the Stake is fluked with one end



Angular Emplacement of Ground Stake GP-113/G

Figure 5



forming a point and the other end forming a cylinder with a transverse hole drilled through. This stake has been designed to emplacement in "unusual soils". These include sandstone, limestone, and permafrost.*

The general procedure for the emplacement of this Stake is identical to that for GP-113/G. The exceptions to this procedure are discussed below.

The Device is made ready-to-fire, with the Small Stake Adaptor and loaded magazine installed. The action is in the "safe" position. The Stake is then inserted in the Adaptor and the entire set-up raised, using the point of the Stake as a pivot. The safety is then switched "off" and emplacement can commence.

The orientation of the operation with respect to the Device in this case is found in Figure 6.

C. Retrieval of Ground Stake GP-113/G

1. Install Retrieve Device to Stake.

To do this, remove the Lock Pin and swing the Clamp Unit open. Install the Device on the Stake such that the unit is below the Stake's head. Close the Clamp and install the Lock Pin. The device can be held in position at this point by allowing the bottoms of the Arms to rest on the top of the Stake's head.

2. Pick Up Emplacement Device

Pull Lock Ring up and insert the Device into the large hole in the Adaptor. Refer to the following pages. Allow the Lock Ring to return to its original position. The Key System will now engage the Insert groove.

3. Check Safety - "Safe" Position

The Safety is in the "Safe" position when its longest dimension is parallel to the centerline of the barrel of the action.

* This is a partial list which is intended to give the reader an indication of the applicable soils for GP-112/G.



Emplacement of Ground Stake GP-112/G

Figure 6



Installation of Ballistic Hammer Upon Retrieve Device

Figure 7

4. Insert Clip in Action.
This is done by pushing on the magazine catch and sliding the magazine into place - the catch is then released, locking the magazine in place.
5. Put Safety in "Fire" Position.
The Safety is in the "Fire" position when its longest dimension is perpendicular to the barrel of the action.
6. Cycle bolt slide by hand to feed first cartridge and cock Trigger.
7. Pull up on Device until Detents Lock
This is done by exerting an upward pull on the Handles and lifting the entire system until the top of the Clamp unit comes close to the bottom of the head of the Stake. Then give the system an upward jerk to ensure that the Detents engage the dimples in the Arms.
8. Pull Trigger
The Trigger must be pulled upward - this initiates the Device. This will cause a jolt to the operator, but it is not as great as that encountered during emplacement phase.
9. Pull up on tool until Detents lock.
10. Continue to actuate Trigger until Stake is loose in soil.
11. Place Safety on "Safe".
12. Remove Cartridge Clip
(The magazine catch must first be depressed before the magazine can be removed).
13. Cycle bolt manually to be certain chamber is empty.
14. Separate Device from Adaptor.
(Pull on the Lock Ring to accomplish this).



Retrieval of Ground Stake GP-113/G

Figure 8

15. Remove Adaptor from Stake.

This is done by first removing the Lock Pin.

16. Misfire.

If, at any time, a trigger pull fails to produce a "Fire", do the following:

- a. Check the safety - "Fire" position.
- b. Cycle the bolt slide manually to clear the chamber and feed a new cartridge.
- c. Check that magazine is not empty.

D. Retrieval of Ground Stake GP-112/G

Except for the presence of the GP-112/G Adaptor, this retrieval operation is identical to that for GP-113/G. In this case, the Adaptor is installed upon the Stake as shown in Figure 9. The rest of the operating procedure for retrieving this Stake is the same as that for GP-113/G. (Refer to Figure 10).



GP-112/G Adaptor Installed on Stake

Figure 9



Retrieval of Ground Snake GP-112/G

Figure 10



III. DESCRIPTION OF EMPLACEMENT MODE

A. Basic Principles of Operation

A number of methods can be used to emplace Ground Stakes GP-113/G and GP-112/G into their respective mediums.* The most common one, which has been employed up to the introduction of the Ballistic Hammer (hereinafter called the "Device"), consists of hitting the head of the stake with blows from a sledge hammer. While this is a very simple method from an equipment standpoint, it has the disadvantages of inducing rapid operator fatigue and requiring considerably more time to emplace or retrieve any particular stake compared to the Device. In addition, severe soil conditions limit the effectiveness of the sledge. These considerations were the main reasons which motivated the development of the Device.

The Device employs the same operating principle as the sledge hammer - weight moving at a high velocity impacting the head of the stake. The means used to propel the weight up to this velocity, however, varies greatly for the two methods. In the sledge hammer method, human muscles are used to lift the weight above the head and to give the weight speed while it is "falling" through the air on its way toward the stake. In the Device, however, high pressure gas, resulting from the ignition of a propellant charge, is used to get the weight up to speed.

The Device has been designed to emplace stakes by using the effect of rapidly repeating dynamic loadings. Multiple dynamic loadings are employed because a single dynamic load would transmit an intolerably large recoil impulse to the operator and a greater measure of control is introduced by discrete energy pulses rather than a single "one shot" pulse.

B. Description and Functions of Components

While the basic operating principle of the Device is extremely simple, the incorporation of this into the actual device results in a unit of some complexity. The Device incorporates the following features to provide the effects of multiple dynamic loadings:

* Figure 1 illustrates the relative geometry of these stakes.

1. A method to provide rapidly repeating propellant explosions. This has been satisfied by the incorporation of a gas-operated semiautomatic Caliber .30 carbine action which fires Grenade Launcher Cartridges. ("Blanks").

2. A device to return the weight to its starting position so that, upon the occurrence of the next explosion, the associated pressure and energy can again act upon the weight, enabling it to achieve speed; before its next impact with the stake. This has been satisfied by the incorporation of a helical coil spring which pushes the weight back up the chamber after its impact with the stake.

3. A means for routing the exhaust gases from the chamber. Since the device works on the principle of multiple dynamic loadings, the chamber pressure must be very low to enable the spring mentioned above to push the weight up into its original position.

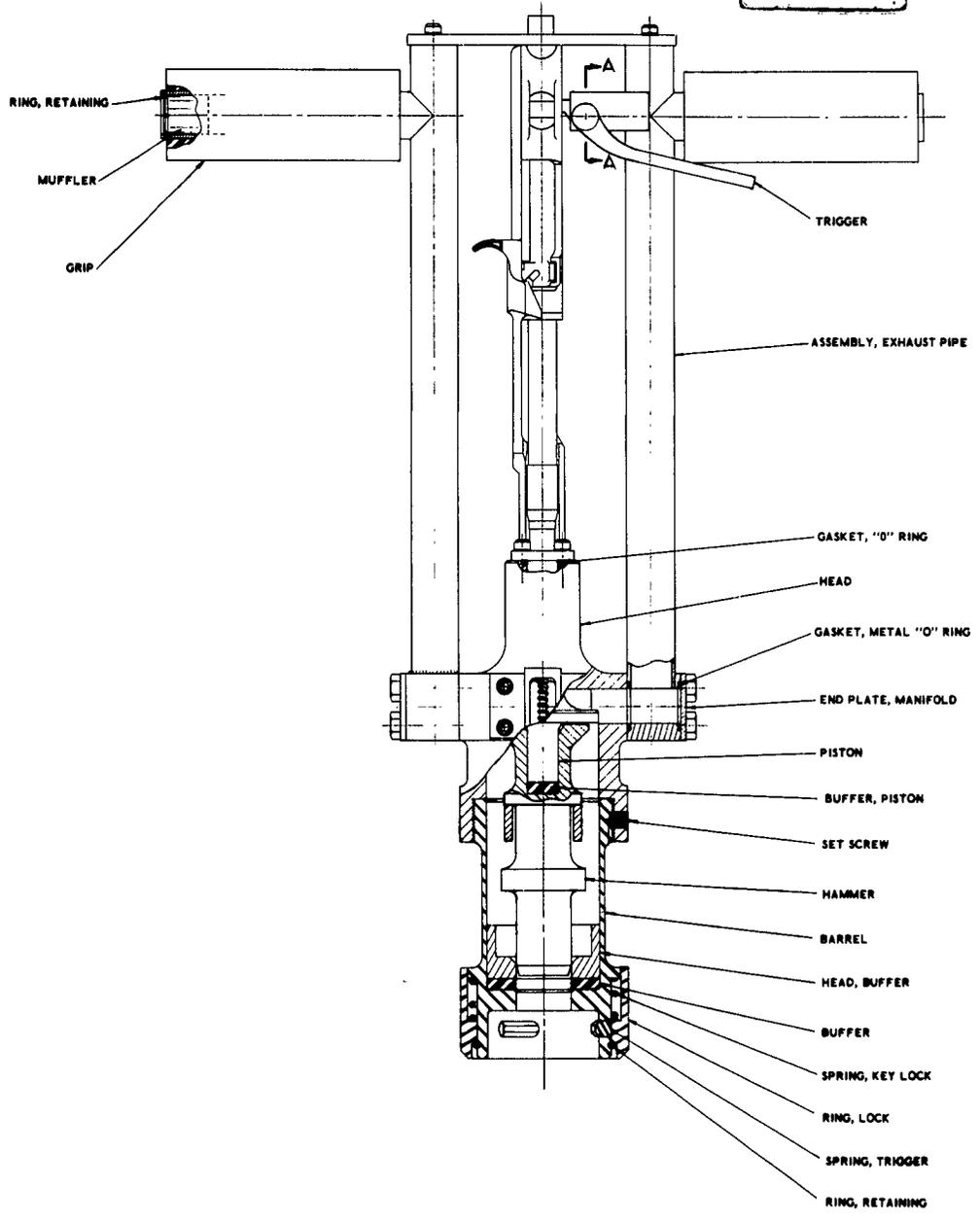
4. A handle system to enable the operator to position and control the device.

The necessity for incorporating the features mentioned above resulted in the design shown in Figure 11 . The tool roll package is illustrated in Figure 12 .

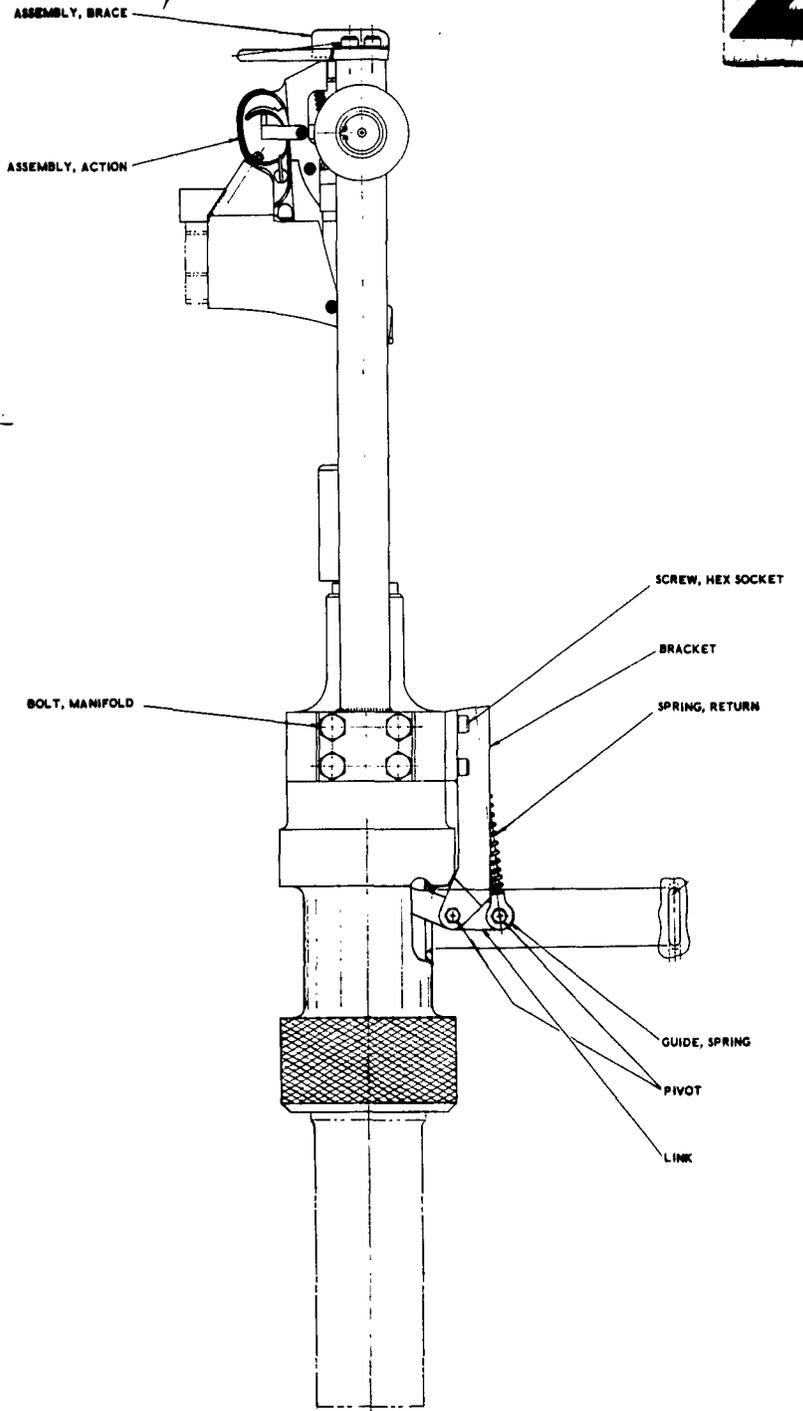
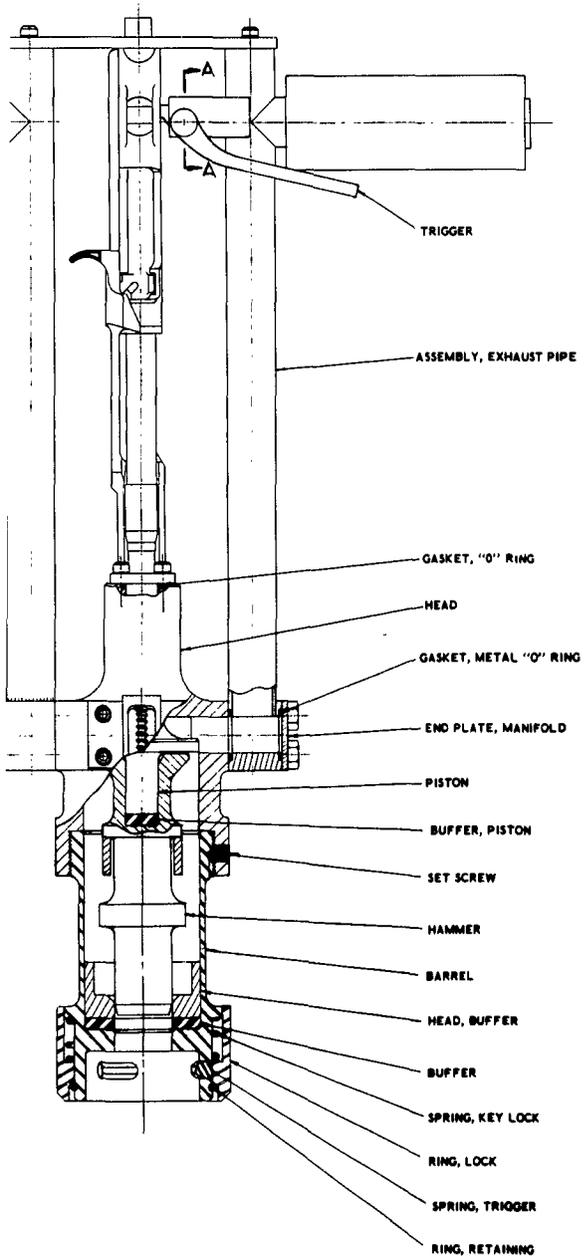
The following both physically and functionally describes the major components and subassemblies of the Device. Reference should be made to Figure 11 during this description, since a number of the components are rather complex.

The standard Caliber 30 Carbine Action M1, with the majority of the barrel removed. Provision is made at the barrel end to adapt the Action to the Head. Three 1/4" - 20 x 3/4" cap screws accomplish this. Provision is also made to restrain the opposite end of the action by the Brace in order that the action be rigidly fixed relative to the overall Device. Incorporated into this action is the standard safety provisions furnished on every action of this type. The Device has been designed such that the safety is readily accessible. The function of the safety is as usual -- to prevent trigger actuation when it is not desired. As with any firearm, the safety should be engaged when the firearm is not in use.

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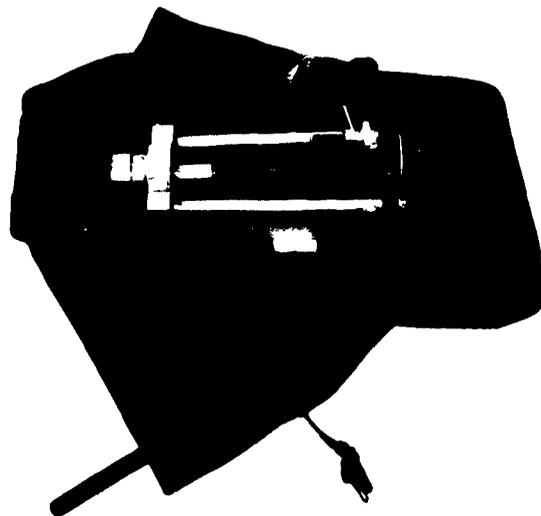


Assembly Drawing, Ballistic Hammer (Emplacement Mode)
Figure 11



Technical Drawing, Ballistic Hammer (Emplacement Mode)

Figure 11



Ballistic Hammer MX-6321()/G Showing Tool Roll
in Open and Carrying Modes

Figure 12



An addition to the action is the Magazine Support. This is essentially a long, rectangular box which encases the magazine to protect it during recoil. The Magazine Support is bolted to the action in two places - at the trigger guard and the point of attachment of the receiver and the trigger assembly.

The Head: Externally, the Head is essentially a cubical piece of steel with its top and bottom ends machined to cylindrical shapes. Provision is made at one end to adapt the action to the Head, as previously mentioned. Internal threads on the other end adapt the Barrel to the Head. A set screw is provided in this piece to prevent rotation of the Barrel with respect to the Head. Internally, the Head has provisions for allowing the propellant gases produced by the explosion of the cartridge to act against the top of the Hammer, provisions for guiding the Hammer in its travel at its smallest diameter, and provisions for allowing the propellant gases to exhaust after the piston has traveled one inch.

The Barrel: This is a hollow, cylindrically shaped steel piece with a shoulder at its bottom end and threads at its top end. The shoulder at the Barrel's bottom end provides a rigid support for the Buffer and Buffer Head. The external thread at the other end enables the Barrel to be mounted to the Head. Provision is made to engage the set screw previously mentioned.

The Buffer and Buffer Head: The Buffer is a disc of Butyl rubber with a hole in its center through which the bottom end of the Hammer can pass on its way to the stake. The Buffer Head is a cylindrical piece of steel which has a shoulder on one end. In normal operation, the Buffer and Buffer Head serve no purpose. If the Device were actuated with the stake not in place, however, the lower flange of the Hammer would impact the Buffer Head and Buffer, thus cushioning the impact of the Hammer and Barrel. The Barrel would be damaged under these circumstances if it were not for the presence of this shock absorbing system.

The Hammer: This unit is composed of two separate steel pieces, the shapes of which can best be described by reference to Figure 11. The center lines of the Hammer and Barrel coincide. While in motion along its center line, the Hammer is guided at its largest diameter by the Barrel and at its smallest diameter by the Head. Note that, upon ignition, the propellant charge exerts its pressure and energy at the Hammer's smallest diameter. After the Hammer travels one inch, it uncovers the scalloped portion of the Head, exhausting the gases. Upon impact with the stake, the bottom end of the Hammer decelerates more quickly than its top end. The rubber cushion between these two ends tends to cushion the Hammer's impact with the stake. This tends to lengthen the time of contact of the Hammer with the stake, and damps the dynamic shock wave which travels through the piston as a result of Hammer-Stake impact.

The Exhaust Manifolds: These are cubical pieces of steel with holes drilled in them such that the flow direction of the incoming exhaust gases is changed by 90°. Also included are bolt holes for connecting the manifolds to the sides of the Head. Affiliated with the Exhaust Manifolds are the Manifold End Plates which are rectangular pieces of steel with holes for the bolts mentioned above. These stop the exhaust gases from escaping to the outside. Two Manifold Gaskets seal each Exhaust Manifold from exhaust leakage between the Head and Manifold End Plates. It should be pointed out that each Exhaust Manifold is welded to an Exhaust Pipe Handle. Each Exhaust Pipe-Handle Assembly consists of two pieces of thin-walled 1-1/8" O.D. steel tubing which are welded together to form the shape of an inverted "L". The lower end of each inverted "L" is welded to its respective Exhaust Manifold. The other end has a plug welded in to accommodate the cap screws fastening the Brace to the Assembly. The remaining horizontal bar of each "L" is the handle with which the operator guides the Device. At the open end of each Handle is a Muffler to silence the propellant ignition. Each Muffler consists of a steel cylinder with a small hole drilled through the center. These are pressed into their respective



Handles and are each held in place with a retaining ring. Notice that the exhaust gases travel from the Head, to the Exhaust Manifolds, where their direction is changed by 90° , up the Exhaust Pipes, and out through the Handles.

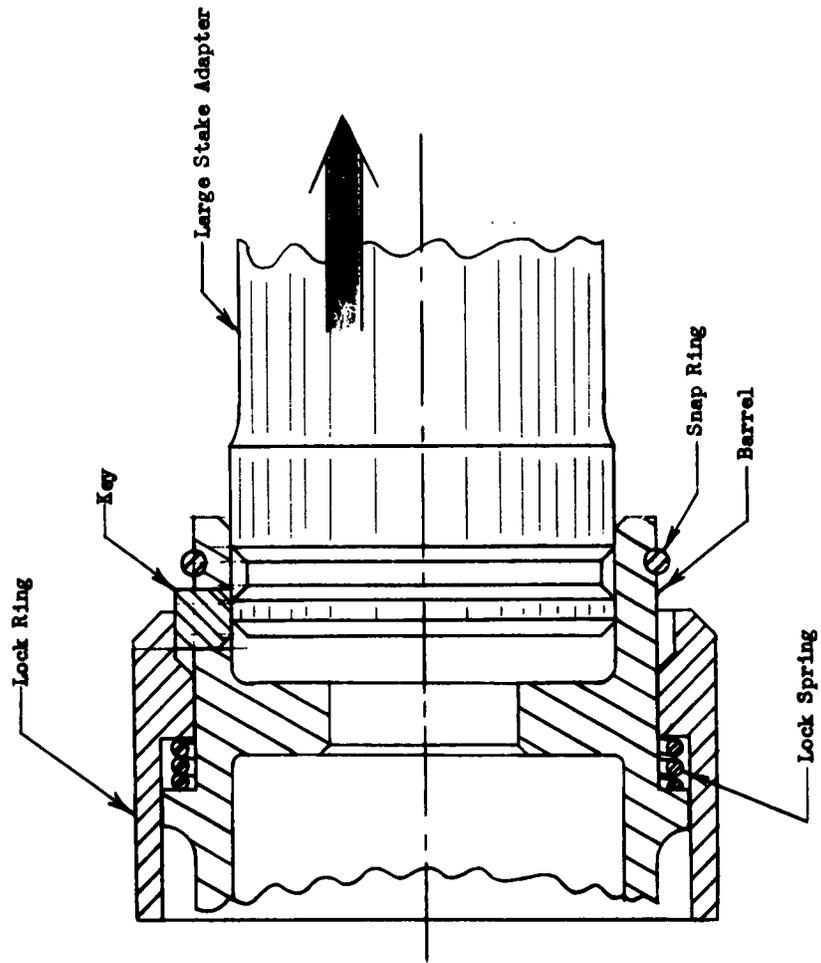
The Brace: This is a rectangular piece of steel plate. A square hole under the small piece of steel bar welded to the top of the brace adapts the caliber 30 action to it. Notice the semi-circular, round steel rod welded to the side of the Brace. The purpose of this rod is to protect the trigger assembly of the action should the Device fall over. The Brace is attached to the Exhaust Pipes by four $1/4"$ - 20 x $3/4"$ cap screws which screw into the welded plugs in each Exhaust Pipe.

The Trigger: This is a piece of sheet steel formed into a channel shape and pivoted on a block welded to an Exhaust Pipe. There is a square hole in one side of the channel. This accommodates the Trigger Spring which is a torsion bar, one end of which is attached to the Trigger by the above square hole. The other end of the Trigger Spring is attached to the block welded to the Exhaust Pipe. The Trigger extends out to contact the Trigger Actuator. This is a piece of rectangular steel bar which is formed in a "U" shape. It is pivoted through both legs on the same pin as the trigger of the caliber 30 action. Pulling the Trigger causes one end of the Trigger Actuator to depress and, because of the pivot, the other end rises, which actuates the trigger of the caliber 30 action.

Key System: In the end of the Barrel farthest from the caliber 30 action are three rectangular holes, each approximately $1-1/4$ inches long. Three curved Keys, each having a square cross-section with beveled edges, fit into these rectangular holes. In the usual operation these Keys mesh with a groove in the Stake Adaptors. As can be seen in Figure 11, this Adapter cannot be moved by pulling or pushing, since this radially pushes the Keys tight against the Lock Ring. The Lock Ring is a hollow, cylindrical piece of steel. It is restrained from movement in one direction

by the Snap Ring, which engages a semi-circular groove in the Barrel. Its movement in the other direction is restrained by the helical Lock Spring only, enabling a total movement of the Lock Ring of approximately 1/2 inch. If this is done and the Adaptor is pulled upon, the Keys will move radially outward into the space created by the Lock Ring movement (see Figure 13). The Adaptor can then be removed from the Device.

Hammer Return Assembly: This Assembly consists of four components, the Link, Bracket, Hammer Return Spring, and Spring Guide. The Bracket has the shape of an open rectangular box with a hole through the sides at one end to provide a pivot for the Link. Another hole is provided at the other end perpendicular to this. The tubular end of the Spring Guide passes through this hole during the Guide's travel. Notice the four holes provided for four 1/4" - 20 x 3/4" cap screws which secure the Bracket to the Head. The Link is a piece of steel having the shape of a yoke. A hole is provided near its middle to connect the Link and the Bracket, using the Link Pin. At one end of the Link is a hole to enable the Link and Spring Guide to be pin-connected. The other yoked end of the Link fits under the shoulder on the Hammer. This is the means by which the Link engages the Hammer to push it up to its original position. The Spring Guide consists of a slender steel tube with a small yoke on one end. The yoke end of the Guide engages the hole at the one end of the Link. The two components are connected with the Guide Pin. The other end passes through that hole in the Bracket which is perpendicular to the hole about which the Link pivots. A shoulder is provided on the yoke end of the Guide to accommodate the Hammer Return Spring, a long, slender helical compression spring. One end of the Spring contacts the Bracket while the other contacts the shoulder on the Guide. The operation of the overall Hammer Return Assembly is as follows: Before ignition of the cartridge, the Hammer is held in its extreme upward position by the preload in the Spring. Upon ignition, the Hammer begins to move down toward the Stake. This motion causes the yoke end of the Link which pushes against the shoulder of the Hammer to move



Key System Operation During Removal of Large Stake Adaptor

Figure 13

down also. This, in turn, causes the end of the Link which is connected to the Guide to move up, since the Link is pivoted near its center at the Bracket. This Guide motion relative to the Bracket causes the Spring to compress farther. When the Hammer eventually impacts the Stake, its energy is completely dissipated and downward motion ceases. The fully compressed spring then pushes against the Bracket and Guide which moves the Guide end of the Link down. Because of the Bracket pivot, the Hammer end of the Link moves up, pushing the Hammer up to its original position. The cycle is repeated when the next cartridge is initiated.

The Large Stake Adaptor: This consists of a tubular member constructed of aluminum. There are grooves in one end of the Adaptor. This, in conjunction with the Key System, is the means by which the Adaptor is attached to the Device. The purpose of the Adaptor is to furnish a means of guiding the tool with respect to Ground Stake GP 113/G during emplacement. The Adaptor has been designed such that, before firing, the top of the Stake head butts against the lower side of the shoulder in the Barrel of the Device. This Adaptor, mounted on Ground Stake GP 113/G, may be seen on the following page. (Figure 14).

The Small Stake Adaptor: This encompasses every feature of the Large Stake Adaptor, except its configuration has been altered to accommodate Stake GP 112/G. (See the following page). (Figure 15)

Operating Cycle of Device

The previous discussion was concerned with the physical and functional description of each component and subassembly of the Device. The following discussion is concerned with their interrelation in the operation of the overall Device.

The operating cycle of the Device is as follows: (Refer to Figure 11). Upon ignition of the propellant charge (standard Caliber 30 grenade cartridge) by actuation of Trigger on the semi-automatic Caliber 30 carbine action, the pressure and energy of the burning propellant gases acts



Adaptor for Ground Stake GP-113/G

Figure 14



Adaptor for Ground Stake GP-112/G

Figure 15



upon the top of the Hammer. This causes the Hammer to move toward the stake. Notice that at the start of its motion, the Hammer begins to compress the small diameter helical coil spring because of the movement of the connecting link system. After the piston has traveled 1 inch, it will have reached its design velocity. At this point the propellant gases are exhausted. This occurs when the top end of the Hammer uncovers the scalloped portion of the Head. (See Figure 16). This routes the exhaust gases out through the Exhaust Pipes and Handles. After this occurs, the Hammer impacts the stake. This drives the stake a certain distance into the ground. The Hammer continues to drive the stake into the ground until they either lose contact or the Hammer's kinetic energy is decreased to nearly zero. At this point, the helical compression spring is fully compressed and, through the link system, it pushes the Hammer to its initial starting position.

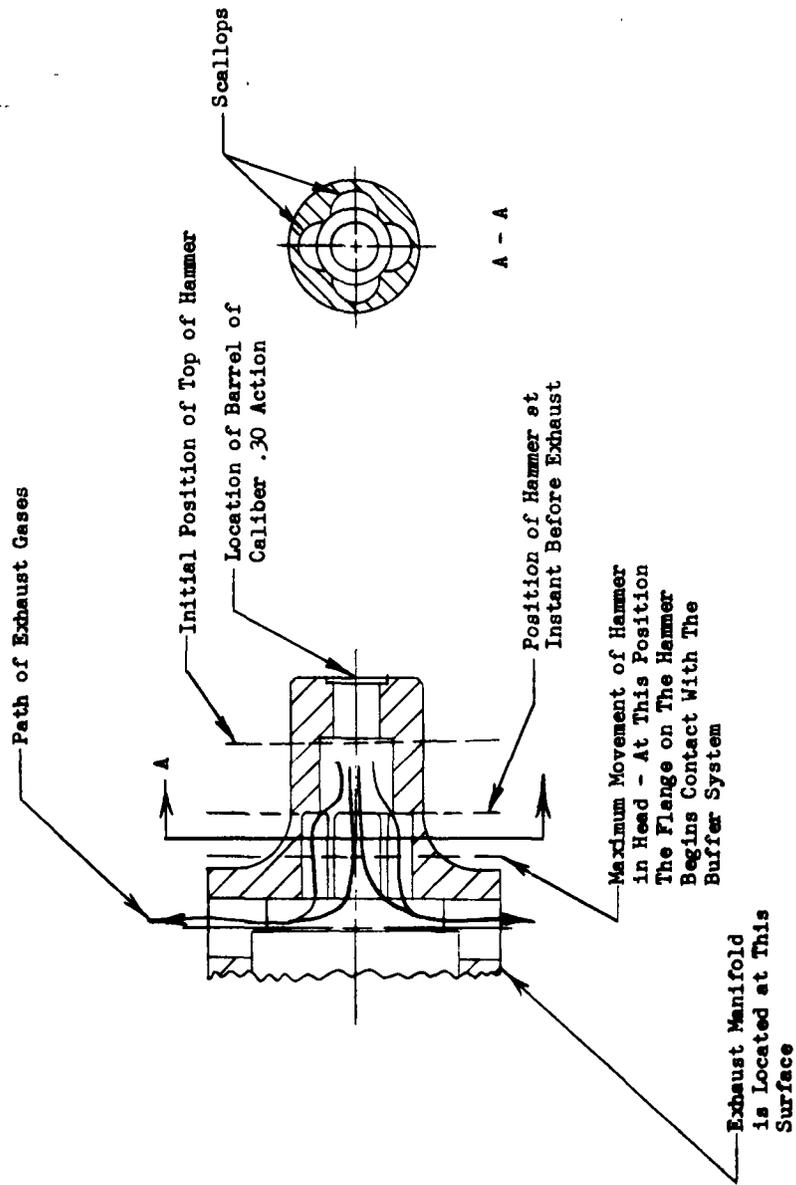
While the above was occurring, the pressure in the barrel of the carbine action was sufficient to enable it to extract and eject the spent case and strip another cartridge from the magazine into its receiver. When the trigger of the action is again actuated by the operator, the operating cycle will occur again.

C. Complete Disassembly Procedure

The following is concerned with the complete disassembly procedure to be followed with the Emplacement Device, should such disassembly be necessary. By utilizing the pertinent sections of this procedure, any particular component can be removed from the Device.

a. Remove Brace: Remove the Lock Wire associated with the four 1/4" - 20 x 3/4" cap screws which connect the Brace to the Exhaust Pipes. Unscrew these cap screws. The Brace can then be removed from the Device.

b. Remove Exhaust System: Remove the Lock Wire associated with the eight 3/8" - 24 x 2-1/8" bolts which connect the Exhaust Manifold to the head. Unscrew these bolts. The Manifold End Plates and Manifold



Sections Through Head Illustrating Gas Exhaustion

Figure 16



End Plate Washers can then be removed, followed by the Exhaust Pipes and the Exhaust Pipe Washers.

c. Remove Action: Remove the Lock Wire associated with the three 1/4" - 20 x 3/4" cap screws which hold the caliber 30 action to the Head. Unscrew these cap screws. The Action and its O-Ring can then be removed.

d. Remove Key System: Pull the Lock Ring back against the Lock Spring until the Lock Ring moves approximately 1/2 inch. Remove any Adaptor which may be attached to the Device. Remove the Snap Ring from its groove in the Barrel. The Lock Ring and Lock Spring can then be removed.

e. Remove Hammer:

1. Remove the Bracket, Spring and Spring Guide.

(a) Remove the Link Pin and Guide Pin.

(b) Unscrew the four 1/4" - 20 x 3/4" cap screws which hold the Bracket to the Head. The Bracket, Spring, and Spring Guide can then be removed from the Device.

2. Remove the Barrel and Link. Unscrew the set screw located in the side of the Head. The Barrel can then be unscrewed. The Link will come off with barrel.

3. Remove the Hammer: Pull the Hammer from the Head. The Device is now completely disassembled.

Assembly Procedure:

While the general assembly procedure is essentially the reverse of the disassembly procedure, the method of assembling the Barrel, Link, and Hammer should be mentioned:

1. Position the Link in the Barrel. Be sure that the curved portion of the Link is oriented so as to correctly engage the bottom flange of the Hammer.

2. Insert the Hammer in the Barrel such that its bottom flange engages the Link. The Stake end of the Hammer should protrude slightly from the end of the Barrel.
3. Screw the Barrel into the Head. Secure with 3/8" - 24 set screw. Be sure that the tip of the set screw properly engages the countersink in the Barrel threads. The Barrel and Head are scribed to facilitate this alignment. Tighten this set screw to 60^{+10} in-lb. torque.

The remainder of the assembly is the reverse of the disassembly. Upon the completion of the overall Assembly of the Device, it is absolutely imperative that all bolts be torqued to the following specifications:

1. Brace cap screws (1/4" - 20 x 3/4") -- 100^{+10} in-lb.
2. Action and Bracket cap screws (1/4" - 20 x 3/4") -- 150^{+10} in-lb.
3. Exhaust Manifold bolts (3/8" - 12 x 2-1/8") -- 400^{+10} in-lb.
4. Head Set Screw (3/8" - 24) -- 60^{+10} in-lb.

After the above has been completed, install Lock Wire on the Brace, Action, and Bracket cap screws and the Exhaust Manifold bolts.

D. Cleaning and Inspection Procedures

Periodic cleaning of the Emplacement Device is recommended to insure that it operates at peak efficiency. At one time during the course of its development, over 500 rounds were fired from the Device over a 4-day period. When disassembled, the Device was found to contain considerable propellant waste products, but they were not sufficient to impair the operation of the Device. On the basis of this experience, it is recommended that the Device be thoroughly cleaned after 500 rounds are fired, or after



1 day of use elapses since the last cleaning, whichever occurs last. This is considered a very conservative requirement and should not be considered indicative of cleaning requirement for a more sophisticated development. The actual cleaning procedure is explained below.

The first step in this procedure is to partially disassemble the Device to the extent that the Hammer may be removed. Upon the completion of this, the components requiring cleaning will be readily accessible.

Those components which will require cleaning are listed below. Commercial powder solvent is used - "Hoppe's Powder Solvent - No. 9."

1. The external surfaces of the Hammer.
2. The internal surfaces of the Barrel.

After this is done, turn the Barrel upside down and remove the Buffer Head and Buffer. Clean each of these and the area of the Barrel which they occupy. Care should be exercised to ensure that the holes in the Buffer Head and Barrel, through which the lower end of the Hammer passes, are free from deposits or scale.

3. (a) Using the large end of the special tool furnished with the device, thoroughly clean the bore of the Head in which the small diameter of the Hammer travels.

(b) After "3 (a)" has been completed, thoroughly clean the barrel of the Caliber 30 action using the small end of the tool furnished with the Device. After this has been completed, dry the barrel and the interior of the Head.

The entire Device should be inspected prior to use. Particular attention should be paid to the following areas:

1. The Exhaust System - Inspect the welds near the Exhaust Manifolds, Handles, and Brace. Inspect the Brace thoroughly for any signs of unusual wear.
2. The Caliber 30 action - Attention should be paid to the area where the Trigger Assembly is attached to the Receiver and to

the area where the action is mounted to the Head. Be certain all bolts are tight.

3. The Head - The internal thread, the entire interior, and the exterior should be inspected.

4. The Hammer - This should be inspected for any cracks or irregularities in the radiused areas where it changes cross-section.

5. The Link of the Hammer Return Assembly - This component should be inspected for any permanent deflection.

If any components do not pass this visual inspection, they should be "Magnafluxed" to determine the extent of any unusual wear. As with any device which is exposed to extreme shock loading, it is not advisable to use the Device if any structural components do not pass the above inspection.

After the Device has passed the above inspection, it shall be re-assembled as discussed in the previous section. It is absolutely imperative that the cap screws and bolts employed in the Device be tightened according to the specification presented in the previous section.



IV. DESCRIPTION OF RETRIEVE MODE

A. Basic Principle of Operation

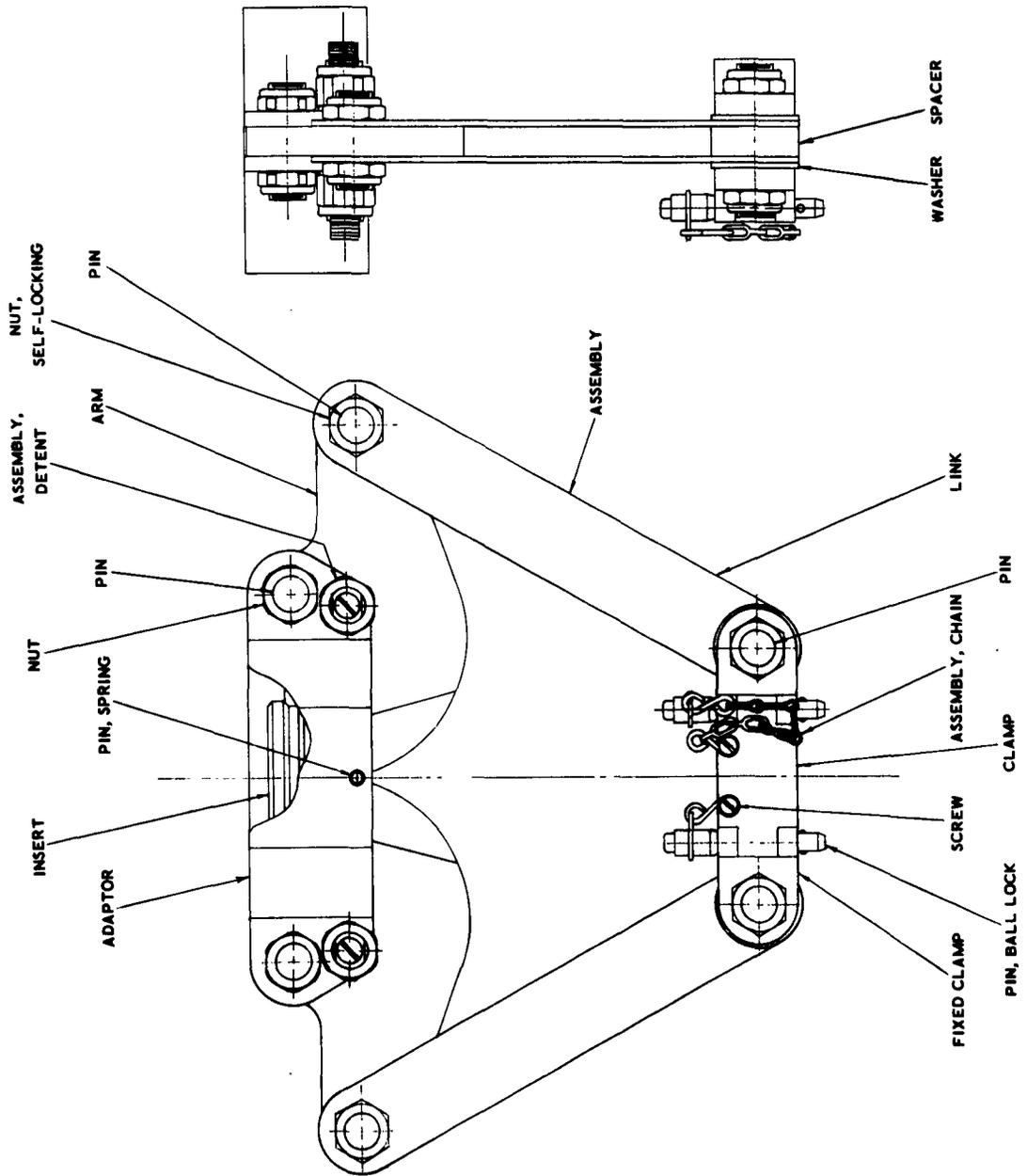
An adaptor which locks to the Device by means of locking keys in the same manner as the Large and Small Stake Adaptors is provided to withdraw emplaced stakes. The adaptor consists of a link system which when actuated by a blow from the Device's Hammer translates the energy of the blow into an axial withdrawal force.

The Retrieve Adaptor is illustrated in Figure 17.

B. Description and Functions of Components

The Adaptor Assembly. This consists of two parts, the Adaptor and the Insert, which are screwed together to form the Adaptor Assembly. The Insert is essentially a short, thick-walled steel cylinder with a flange at its bottom end. This flange is threaded to enable the assembly of the Adaptor and Insert. A groove of the type used in the Stake Adaptors is furnished to rigidly attach the Assembly to the Device. The curved portion of the Arms pass through the hole in the Insert. The significance of these details will be pointed out later. The Adaptor is essentially a short, steel octagon with a large hole through its center. Threads are provided at the bottom of this hole to accommodate the Insert. Four ears, in two pairs, extend from opposite sides of the octagon. There are two holes in each ear. One of these is threaded. Each threaded hole accommodates a Detent Assembly, which holds the assembly in the "Ready" position. The other hole accommodates a Pin which furnishes a pivot for the Arms. The Lock Ring of the Emplacement Device fits inside the large hole in the octagon. This enables the Key Lock System to engage the groove in the Insert.

The Detent Assembly. Each of the four Detent Assemblies associated with the Retrieve Device consists of the Body, Header, Retainer, Ball, and Detent Spring. The Body is a hollow steel cylinder which is threaded externally throughout its length. One end is threaded internally for a short distance. This is to accommodate the external threads of the Retainer. The other end of the Body has an internal radius which enables it to retain



4.02

Assembly Drawing of Retrieve Adaptor
Figure 17



the Ball when inserted. The Retainer is a short steel cylinder with external threads throughout its length. One end of the Retainer is slotted to enable it to be screwed into the Body. Its other end has a short cylindrical portion which fits inside the Detent Spring, positioning it. The Detent Spring is a helical compression spring which fits between the Retainer and Header. It pushes the Header against the Balls, pushing the Balls tight against the internal radius of the Body. (The Header is a short cylindrical steel piece which fits inside the Body between the Ball and the Spring.) While the Body of the Assembly is held fixed, the Ball can be pushed in, if a sufficiently large force is applied.

The Arms. The Arm is essentially a steel plate with two holes - one at one end and the other in the middle. One end of the arm is thicker relative to the other and curves upward. The Arm is a short, high strength lever. It pivots about the Pin which passes through its center hole. This pin connects the Arm to the ears of the Adaptor Assembly. A lock nut on each end of the Pin secures the Pin. The thick, curved portion of the Arm passes through the hole in the Insert of the Adaptor Assembly. When the Arms are positioned before firing, the ends of the curved portion of the Arms are flush with the top of the Insert. They are each held in this position by two Detent Assemblies. The Balls of the Detent Assemblies engage dimples in the Arm located so as to accomplish this. Through the other end of the Arm is a hole which accommodates another Pin. This Pin furnishes a pivot for the Links and Washers.

The Link. Each of the four Links employed on the device is a rectangle of steel sheet with a hole near each end. The Link connects the components mentioned above with the Clamp. Each Link is placed over its Pin and then a Washer is installed. A lock nut is then fastened to each end of the Pin.

The Fixed Clamp. This is a "U" shaped steel component with two ears protruding from each side. Through each pair of ears is a hole to

join the two Links, Spacer, and Washers with each ear pair. Provision is also made on the Fixed Clamp to hinge the Clamp to it.

The Clamp. The Clamp is a rectangular steel piece with a circular portion removed. It has provisions for hinging onto the Fixed Clamp by means of the Hinge Pin. When the clamp unit is closed, the Lock Pin retains it in this position. These pins are of the quick release type and may be released by depressing the detent on the head of the pin.

The GP 112/G Adaptor. In the operation of the Retrieve Device while retrieving Ground Stake GP 113/G, the top end of the Clamp unit engages the bottom of the Stake head. To retrieve GP 112/G, an adaptor is needed to adapt to this Stake. The Adaptor is a thick, hollow cylinder with internal and external shoulders. A hole is provided perpendicular to the centerline of the Adaptor to accommodate a Quick Release Pin. This Pin is attached to the Adaptor and connects it and Stake GP 112/G. The Adaptor fits inside the large hole in the Clamp unit. The external shoulder of the Adaptor enables the Retrieve Device to impart the retrieve force to it, while the pin transfers this force to the Stake. Figure 9 illustrates this Adaptor mounted on Stake GP 112/G.

Operating Cycle of Device

The preceding discussion was concerned with a physical and functional description of each component of the Retrieve Device. The interrelation of these in the operation of the overall device is explained in the following discussion. The device is shown in position for the retrieval of Ground Stake GP 113/G in Figure 8. In this position, the Detent Assemblies engage the dimples in the Arms to hold the Retrieve Device to this shape. The operator must lift the entire device until the top of the Clamp Unit engages the bottom of the Head of the Stake. The Emplacement Device is rigidly attached to the Retrieve Device through the use of the Key System mentioned previously. Upon initiation of the Emplacement Device, the Hammer



begins its downward travel. Instead of impacting a Stake, however, it impacts the curved ends of the Arms, which pushes them downward. This, in turn, moves the other end of the Arms upward. The Links subsequently pull on the Clamp unit and retrieval of the Stake begins. The upward load applied to the Stake by the Arm tends to pull the Emplacement Device and the Adaptor portion of the Retrieve Device downward. The inertia of these components, however, is sufficient to hold these parts essentially fixed in space during the time that the maximum upward load on the Stake acts.

To repeat the cycle of the Retrieve Device, the operator must pull it up until the Detent Assemblies again engage the dimples in the Arms. When this occurs, the Clamp unit will be engaging the bottom of the head of the Stake and the Emplacement Device can be initiated again, further retrieving the Stake.

The operating cycle is identical for the retrieval of Ground Stake 112/G except for the presence of the GP 112/G Adaptor. The appearance of the overall Device is shown in Figure 10.

C. Cleaning, Disassembly, and Inspection Procedures

As was the case with the Emplacement Device, the Retrieve Device should be periodically cleaned and inspected to ensure that it operates at peak effectiveness. It is recommended that this be done at the same time as the Emplacement Device.

The Retrieve Device should be partially disassembled according to the following list:

1. Detents
2. Pins

The various components can then be cleaned. It is advised that a kerosene-impregnated cloth be used and then they be wiped dry.

The cleaned components can now be inspected for damage and wear. Particular attention should be paid to the following areas:

1. The pin ends of the Links should be noted for any crushing or tendency to shear at the holes. Each hole in the Device should be so inspected.

2. Each Pin should be checked to ensure that no evidence of crushing exists.

3. The Adaptor Assembly should be inspected with careful attention paid to the following areas:

- a. The groove in the Insert
- b. The base of the Insert, including the portion threaded to the Adaptor.
- c. The junctions between the Adaptor and its ears.

As was explained in the case of the Emplacement Mode, if any of the components do not pass this visual inspection they should be "Magnafluxed" to determine the extent of any damage. As with any device which is exposed to extreme shock loading, it is not advisable to use the device if any structural components do not pass the above inspection.

After the device has passed the above inspection, the following shall be the reassembly procedure.

- (1) Install all Pins
- (2) Install all Detents

It is imperative that each of the Pins be tightened to 400⁺¹⁰ inch-pound torque.



V. PRECAUTIONS

This section of the report outlines some precautions which should be observed when the Device is employed.

1. To insure proper control of the Device when fired, the tool should be firmly gripped with both hands and a 10 to 20 pound downward load should be maintained by the operator.

2. The tool should never be stored or transported with a loaded magazine in place or a cartridge in the chamber.

3. The safety should be left in the "Safe" position except when actually firing.

4. After approximately 50 rounds have been expended in rapid order the action, Head, Exhaust Manifolds, and Exhaust Pipes get sufficiently warm to be uncomfortable to touch. It is not recommended that these components be touched after any rapid, prolonged firing. After firing, handle Device by the Brace or Handles—do not carry by means of the Exhaust Pipes.

5. Do not stand in line with the exhaust ports to a minimum distance of six feet from the Device. Exhaust gases exiting from these ports may contain small particles of propellant residue which could injure face or other unprotected areas.

6. When handling the Retrieve Adaptor, refrain from placing hands into the linkage - a painful pinched finger could result from ignoring this precaution.

7. The set screw between the Barrel and the Head should be checked for tightness after every 200 rounds.

8. The lock nuts on the Retrieve Device Detents should be checked and tightened, if necessary, after every 200 rounds.

In conclusion, it should be noted that observation of normal safety precautions and the several precautions outlined in this section should make this tool a safe and reliable item to handle and operate.



VI. APPLICATION SUMMARY

A. Emplacement Sequence

1. Select appropriate Adaptor.
2. Place Adaptor on Device.
3. Drive Stake (GP 113/G) into soil by hand.
4. Check Safety - "Safe" position.
5. Place clip in action.
6. Place tool in position on Stake. With Stake GP 112/G, insert in Adaptor and swing entire system up, using the point of the Stake as a pivot.
7. Move Safety to "Fire" Position.
8. Apply 10 to 20 pound operator load.
9. Cycle bolt slide by hand to feed first cartridge.
10. Pull Trigger.
11. Continue operating tool by Trigger pull until Stake is emplaced.
12. Replace clips as rounds are expended.
13. Cycle action by hand first time a new clip is emplaced.
14. When completed, place safety on "Safe," - remove cartridge clip and cycle bolt slide by hand to insure that a cartridge has not been left in chamber.
15. Remove Device from Stake - Remove Adaptor from Device.
16. Misfire - If, at any time, a Trigger pull fails to produce a "Fire", do the following:
 - a. Check Safety - "Fire" Position.
 - b. Cycle bolt slide manually to clear chamber and feed new cartridge.
 - c. Check that clip is not empty.

B. Retrieve Sequence

1. Install Retrieve Device to Stake. With Stake GP 112/G, install the GP 112/G Adaptor on Stake and then install Retrieve Device.

2. Pick up Emplacement Device - Pull Lock Ring up and insert the Device into the large hole in the Adaptor.
3. Check safety - "Safe" position.
4. Insert Clip in action.
5. Put safety in fire position.
6. Cycle bolt slide by hand to feed first cartridge and cock Trigger.
7. Pull up on tool so that Detents lock.
8. Pull Trigger.
9. Pull up on tool until Detents lock.
10. Continue to actuate Trigger until Stake is loose in the soil.
11. Place safety on "Safe."
12. Remove cartridge clip.
13. Cycle bolt manually to be certain chamber is empty.
14. Separate Device from Adaptor.
15. Remove Adaptor from Stake.
16. Misfire - If, at any time, a Trigger pull fails to produce a "Fire," do the following:
 - a. Check safety - "Fire" position.
 - b. Cycle bolt slide manually to clear chamber, and feed new cartridge.
 - c. Check that clip is not empty.

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