United States Patent

[11] 3,628,415

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[54] **MORTAR**
8 Claims, 12 Drawing Figs.

[52] **U.S. Cl.** ..... **89/1 F,** 89/14 R, 89/37 C
[51] **Int. Cl.** **F41f 1/06**
[50] **Field of Search** ..... 89/1, 37 C, 1.3, 1.34, 1.703, 1.816, 14; 42/76

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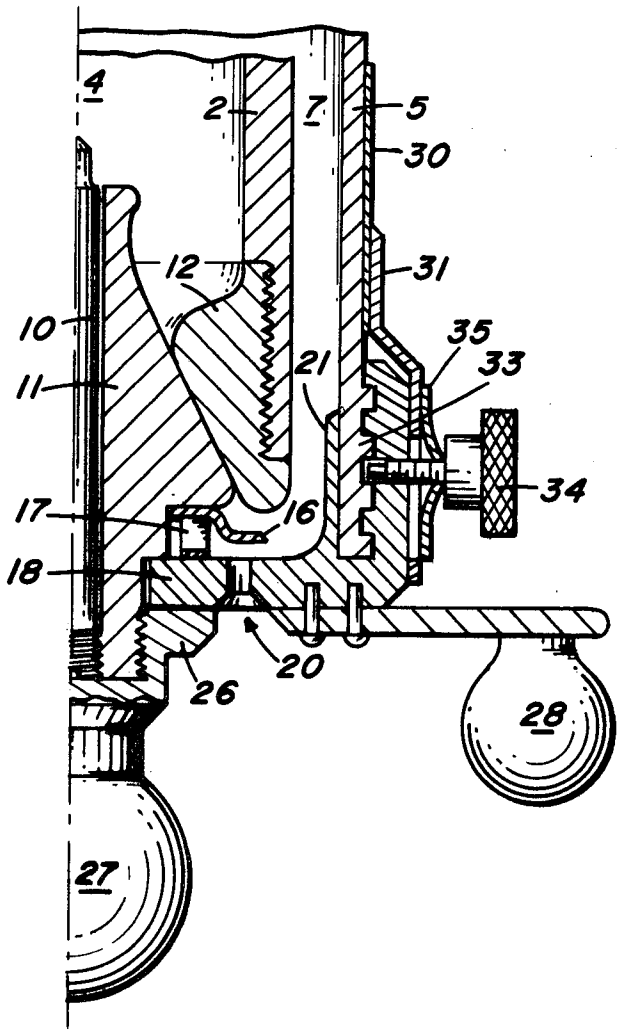
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ABSTRACT: A method and apparatus for setting and continuously changing the range of a mortar. The mortar is provided with a variable vent that acts to regulate chamber pressure. The vent setting is determined by a range matrix plate located on the mortar barrel. A drain path is provided for trapped rain water and the same opening allows a cooling airflow into the interior of the barrel. Combustion residue is carried out through the open variable vent by exhaust gases.



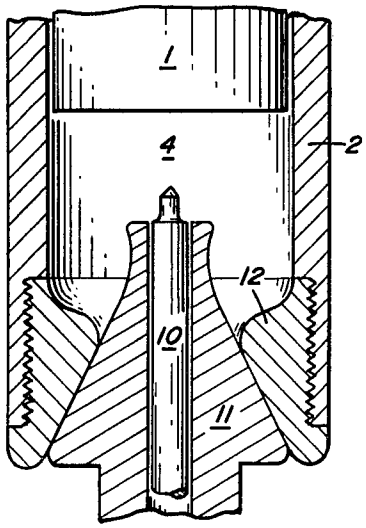


FIG. 1

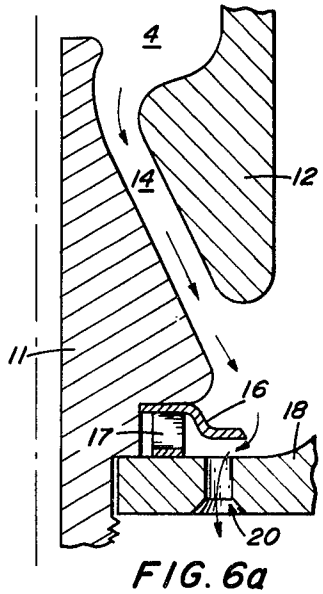


FIG. 6a

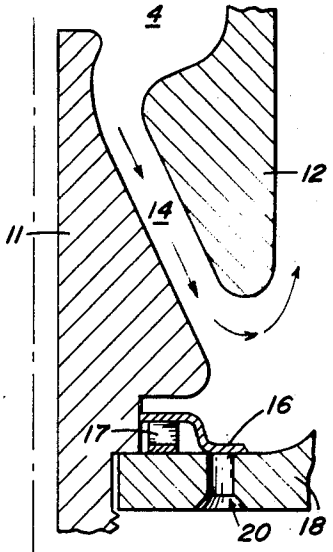


FIG. 6b

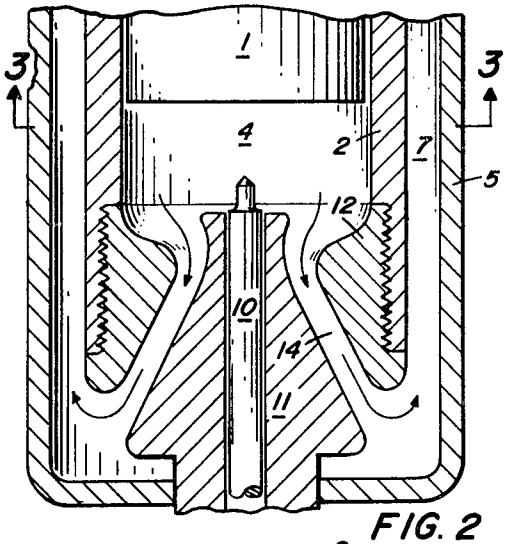


FIG. 2

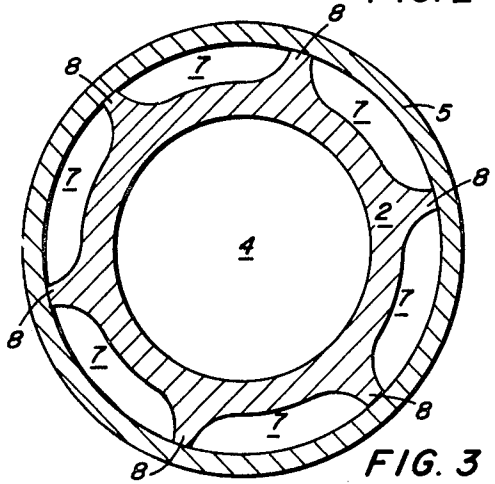


FIG. 3

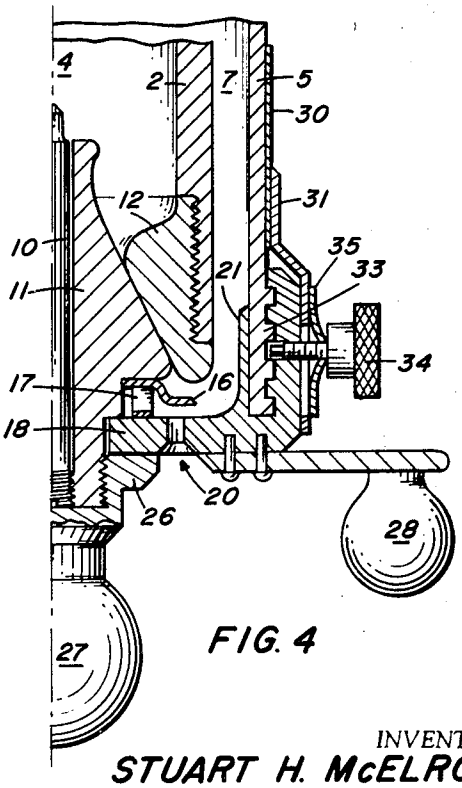


FIG. 4

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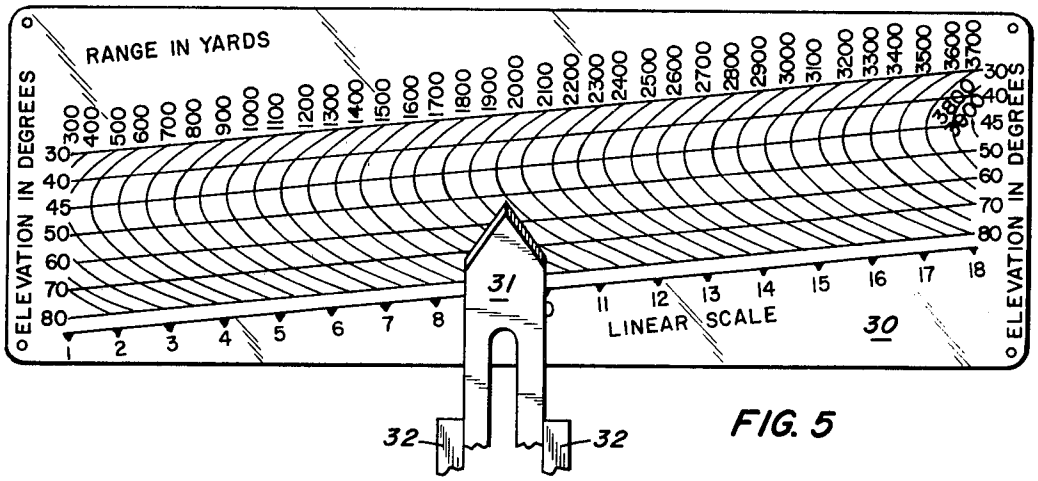


FIG. 5

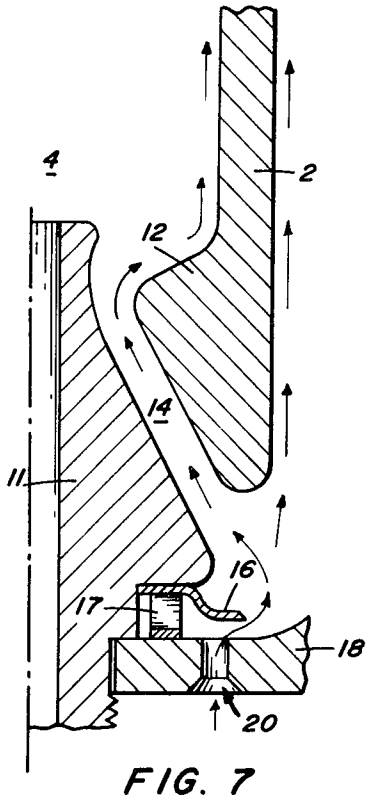


FIG. 7

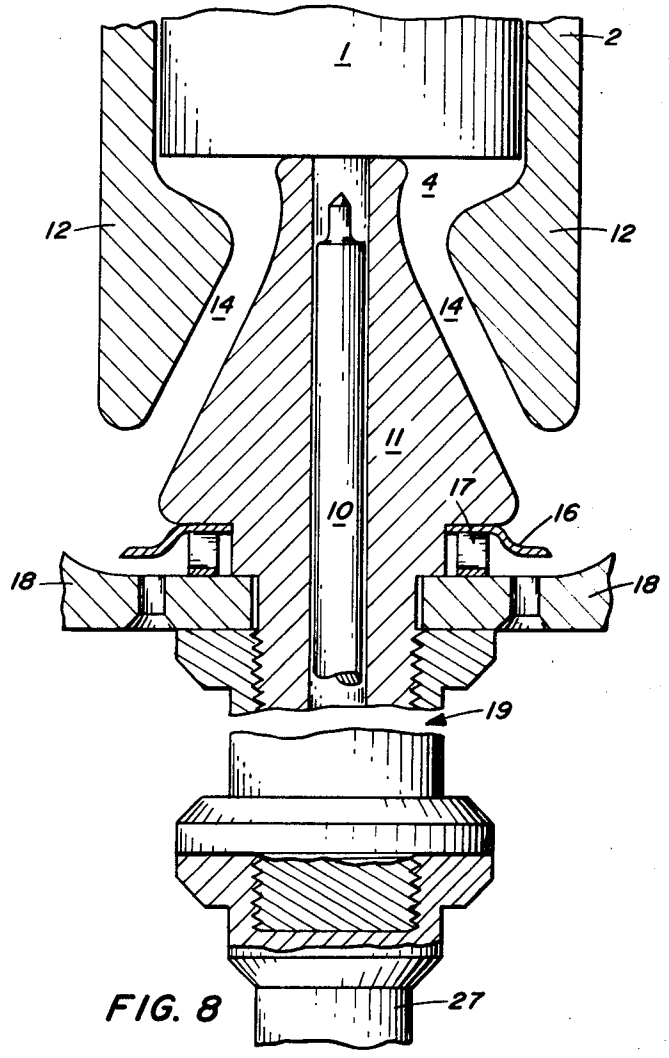


FIG. 8

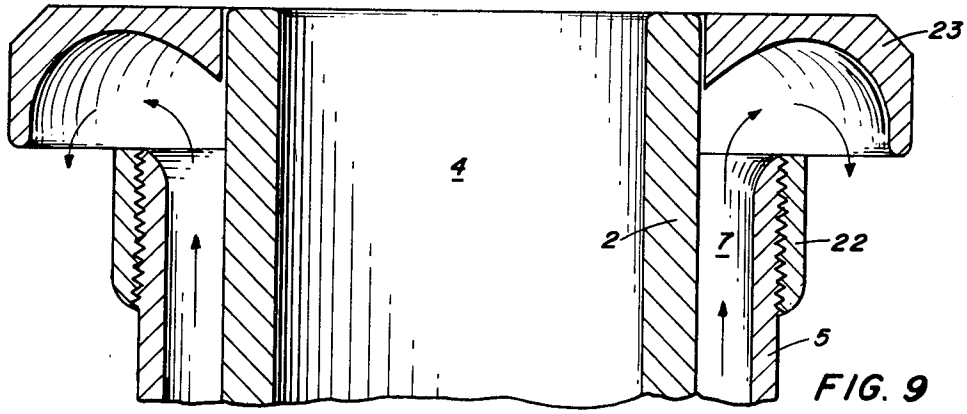


FIG. 9

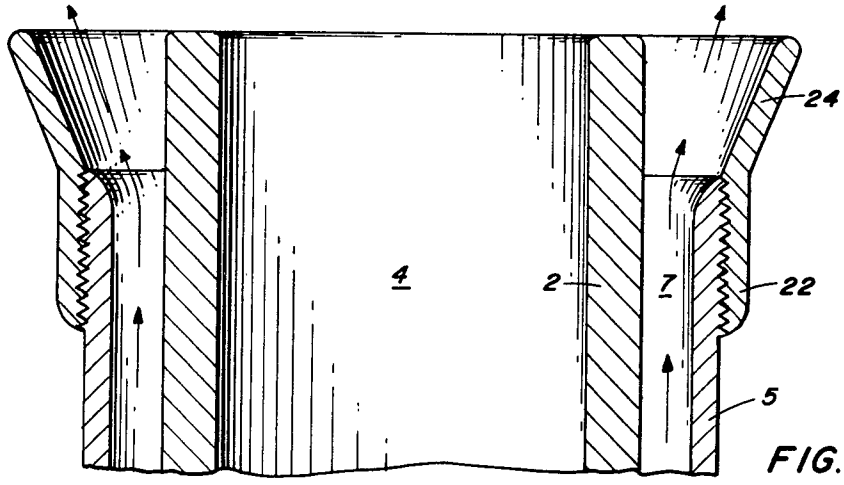


FIG. 10

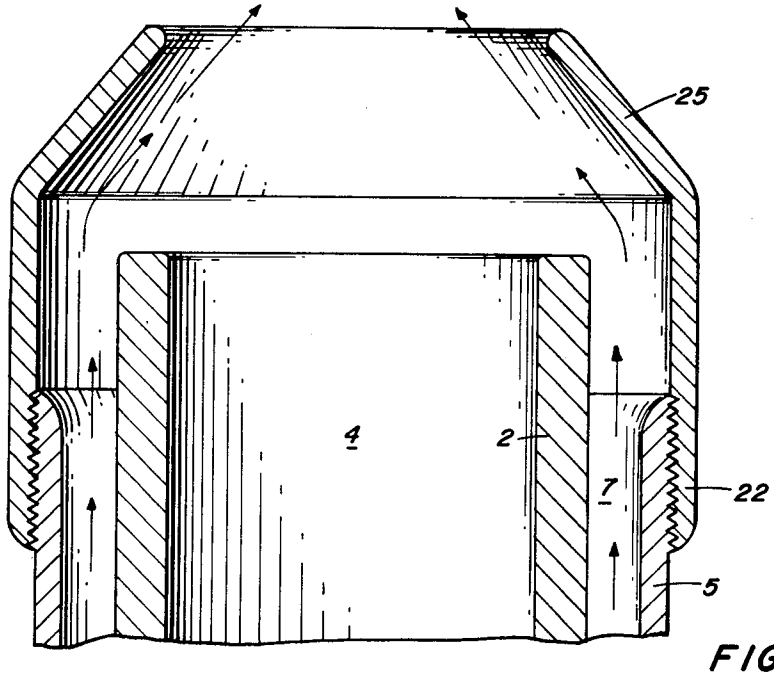


FIG. 11

MORTAR

STATEMENT OF GOVERNMENT INTEREST

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

This invention relates generally to mortars and more specifically to a new method and apparatus for mortar range determination.

The range of prior art mortar projectiles is determined by selecting the proper elevation and controlling chamber pressure by using a predetermined number of propellant increments. The cartridge may be fired with a full number of increments, as received, or with a lesser number.

By removing increments from the cartridge, the chamber pressure is reduced. The chamber pressure determines the muzzle velocity and this together with the elevation (and other less significant factors) determines the range of the projectile. The proper elevation and number of increments to be used are determined from range tables which must be consulted for each range desired.

The use of range tables and removal of increments may, under some combat conditions, decrease the effectiveness of the weapons system by decreasing the rate of fire and increasing the time from cartridge unpacking to firing. The longer the interval from unpacking to firing, the longer the exposure period and consequently, the greater the chances are for malfunction. The removed increments must be disposed of and, once increments are removed, it may be difficult or impossible to use these cartridges immediately should a change in range be necessary.

In addition to the complicated range setting procedure outlined above, the closed bottom design of prior art mortars has other disadvantages that may become critical under combat conditions. The removal of increments reduces the chamber pressure thereby reducing the heating of the barrel. Barrel cooling, however, is dependent primarily on airflow over the exterior surface of the barrel. For this reason the barrel heats up quickly possibly requiring reduction in rate of fire.

The bottom of the closed barrel also acts as a trap. Combustion residue may accumulate and prevent proper contact of the cartridge and the firing pin. Rain water may also collect in the barrel causing the cooling of the gases of the next round fired. This in turn causes a short trajectory which may jeopardize friendly forces.

Although muzzle caps or covers may be used when the mortar is not in use, experience with prior art mortars indicates that muzzle caps or covers are not always available. When caps are available, they must be removed for extended periods of time during firing or when firings appear imminent.

Improvements in the packaging or waterproofing of the cartridges cannot solve the water accumulation problem. Mortars are presently tilted to remove water but frequent tilting can disturb the aim of the weapon.

SUMMARY OF THE INVENTION

The mortar of the present invention uses the same basic accessories as the corresponding prior art mortar with little or no modifications. The present method of varying range by changing elevation has been retained in the new design. Instead of using the second method—selecting the number of propellant increments to be used—the new design employs a reduction in chamber pressure through the venting off of excess gases. All cartridges are therefore fired with a full increment charge as received.

OBJECTS OF THE INVENTION

An object of the present invention is the provision of a mortar having a simplified range setting procedure.

Another object is to provide a mortar having improved barrel cooling capabilities.

A further object of the invention is the provision of means to automatically remove combustion residue and rain water which has collected at the bottom of the mortar barrel.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a preferred embodiment of the invention with the variable vent in a closed position;

FIG. 2 shows the embodiment of FIG. 1 with the variable vent in an open position;

FIG. 3 is a section taken along line 3—3 of FIG. 2;

FIG. 4 shows the detail of the end cap;

FIG. 5 shows the range matrix plate;

FIG. 6*a* shows the method of water drainage;

FIG. 6*b* shows sealing of the drain hole;

FIG. 7 shows the barrel cooling air flow;

FIG. 8 shows the invention as applied to a retractable pin mortar;

FIG. 9 shows a muzzle brake attachment;

FIG. 10 shows a gas divergence attachment; and

FIG. 11 shows a choke.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIGS. 1 and/or 2 there is shown a firing pin 10 supported in an enclosure cone 11. When a nozzle 12 is seated against closure cone 11 maximum chamber pressure is developed upon the firing of a cartridge 1. Opening of variable vent 14, as shown in FIG. 2, will relieve some of the pressure in barrel bore 4 by venting off the excess gases through ducts 7.

If gases were vented radially normal to the barrel centerline or downward toward the ground, the firing personnel would be endangered by blast gases and ejecta from the mortar or the ground. To preclude this, gases are vented upward along outer wall of the barrel, exhausting to the atmosphere in a ring pattern around the muzzle of the barrel. To direct the blasts, the barrel sleeve 5 is provided. The barrel sleeve 5 is attached rigidly to the barrel 2 by means of spacer-fins 8. Gases flow through ducts 7, formed by the spacer-fins 8, barrel 2, and sleeve 5. When assembled, barrel 2, sleeve 5 and nozzle 12 form an integral barrel sleeve assembly unit. This unit is then attached to the end cap assembly shown in FIG. 4 which contains closure cone 11, firing pin 10, firing pin operating mechanism (not shown) and other components to be described later. The end cap assembly and the barrel-sleeve assembly are attached by means of course thread 33 as shown in FIG. 4. The pitch of thread 33 is such that a 180° turn of the end cap adjusts the variable vent from fully closed to fully open. The thumb screw 34 is provided on the end cap assembly to lock it in any position.

A sealing skirt 21 is provided at the inner surface of the sleeve 5 to prevent gas from leaking around the lower end of the sleeve 5 and through the threads 33 between the sleeve 5 and the end cap 18. The end cap assembly contains two handles 28 (one shown) spaced 180° apart. These handles 28 are used to rotate the end cap assembly. When rotating the end cap assembly, the barrel-sleeve assembly is prevented from rotating by the mortar bipod (not shown). The amount of rotation, for the range desired, is determined through the use of range matrix plate 30 (FIG. 5) which is mounted upon the outer surface of barrel sleeve 5. The correct use of range matrix plate 30 is explained below. To select the proper range, the following procedure is used:

a. the elevation of the mortar is determined using a quadrant or any other alternative means available;

b. the barrel sleeve assembly is rotated in the mortar bipod until the range matrix plate **30** is completely visible. The barrel sleeve is then locked in this position;

c. the thumbscrew **34** is loosened and range pointer **31** is slid up or down until the top of the pointer is at the sloping line of the range matrix plate **30** corresponding to the elevation of the mortar. The thumbscrew **34** is then tightened down sufficiently to lock range pointer **31** in place. When fully turned this thumbscrew also locks the end cap assembly in place.

d. the end cap **18** is then rotated by handles **28** until the pointer **31** indicates the range desired;

e. the thumbscrew **34** is then tightened down fully to lock the end cap assembly. The mortar is now set to fire cartridges at the range indicated by pointer **31** on range matrix plate **30**.

Several range matrix plates could be placed around the circumference of the barrel sleeve **5** to accommodate different types of cartridges. To fire a second type of cartridge the barrel sleeve assembly is rotated until the proper range matrix plate is brought into view. The procedure outlined above is then followed.

For cartridges other than those for which the mortar is calibrated or for more accurate range determinations, range tables are used which equate the linear scale on the matrix plate and the mortar elevation to range.

During all firings, except at maximum range, variable vent **14** will be opened. It is therefore expected that a large percentage of the combustion residue solids that normally collect in the bottom of the barrel of the prior art mortar will be carried out with the exhaust gases and will be expelled, with the gases, to the atmosphere.

A series of holes **20** in end cap **18** will allow water to drain from the barrel bore **4** past annular plate **16**. Annular plate **16** is held up (away from its seats) by a washer spring **17**. The differential pressure that is developed, upon ignition of a cartridge, will automatically seal the plate so that gases do not exhaust through the holes **20**.

When there is no water flowing through the holes **20**, air will flow, as shown in FIG. **7**, into the barrel bore **4** and through the duct **7** between the barrel **2** and barrel sleeve **5**. Both the interior and exterior surfaces of the barrel **2** and the barrel sleeve **5** will therefore be cooled by a draft. This leads to an increase to the life of the barrel and an increase in firing rate.

The mortar of the present invention will retain the replaceable and retractable firing pin capabilities of prior art mortars. End caps having one capability or the other will be available. When the firing pin **10** is retracted the cartridge will rest on the blunt end of the cone **11** until the pin is released. As shown in FIG. **8** the cartridge is stopped in a slightly higher position with the vent closed than with the vent open. This has a negligible effect on mortar performance.

Use of the muzzle brake shown in FIG. **9** leads to reduction in trunnion loads when the mortar is set up in mud. As designed, this brake becomes more effective as the variable vent is opened and the range reduced. Other more efficient designs which act with essentially equal effectiveness at all settings are possible but the use of fuzes having bore riding pins precludes such a design.

When the mortar is firing on firm ground and the reduction of trunnion force is unnecessary, the brake may be omitted and another attachment substituted therefore. For example, it might be advantageous to have a degree of divergence or choking of the gas exiting from the duct openings. Such attachments are shown in FIGS. **10** and **11**.

By eliminating the need for removal of propellent increments the design of a simple type cartridge containing only one fully enclosed easily waterproofed propellant charge will be possible. This will eliminate the need to dispose of unused increments. Also, the elimination of the increment removal step should make an increase in the rate of fire possible and a decrease in the length of time prior to firing that unpacking must be accomplished.

With the variable vent design the range can be varied at any time, even on a continuous basis, while firing is in progress.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings.

What is claimed is:

1. In a mortar, the combination which comprises:

a barrel;

a barrel sleeve concentrically attached to said barrel forming exhaust ducts between said sleeve and said barrel, said exhaust ducts extending substantially the entire length of the barrel;

an end cap assembly attached to said barrel sleeve and closing one end therefore;

a series of drainage and cooling holes in the end cap assembly providing a flow path for cooling air through the exhaust ducts as well as drainage for water trapped by the barrel sleeve; and

a variable vent disposed between said barrel and said end cap assembly and adjustable between a closed position and an open position, said vent providing fluid communication from the barrel bore to the exhaust ducts and drainage and cooling holes only when in the open position.

2. The combination of claim **1** and further comprising sealing means cooperating with the drain and cooling holes to temporarily seal them upon the firing of a cartridge thereby causing the exhaust gases flowing through the variable vent to exhaust to the atmosphere through the ducts formed by the barrel and barrel sleeve.

3. The combination according to claim **2** wherein the sealing means comprises:

an annular plate located over the drain and cooling holes; and

a washer spring adapted to hold said annular plate away from its seats.

4. The combination of claim **1** in which the exhaust ducts formed by the barrel and barrel sleeve form a ring pattern in the annular space between said barrel and said barrel sleeve.

5. The combination according ro claim **1** and further comprising:

at least one range matrix plate attached to the exterior surface of the barrel sleeve; and

indicating means cooperating with the range matrix plate such that the range for which the mortar is set may be read directly upon the range matrix plate.

6. The combination according to claim **5** in which the indicating means comprises a range pointer positioned to indicate range in accordance with the position of the variable vent.

7. The combination in accordance with claim **1** and further comprising:

adjusting means operating upon the variable vent to control chamber pressure and thereby mortar range by opening or closing the variable vent; and

indicator means to indicate the range setting of the variable vent.

8. In a mortar, the combination which comprises:

a barrel;

a barrel sleeve concentrically attached to said barrel forming exhaust ducts between said sleeve and said barrel;

an end cap assembly attached to said barrel sleeve and closing one end thereof;

a variable vent disposed between said barrel and said end cap assembly and adjustable between a closed position and an open position providing fluid communication between the barrel bore and said exhaust ducts;

a series of drain and cooling holes in the end cap assembly whereby adjustment of the variable vent to an open position provides a flow path for exhaust gases, trapped water and cooling air between the barrel bore and the atmosphere; and

sealing means cooperating with the drain and cooling holes to temporarily seal them upon the firing of a cartridge

thereby causing the exhaust gases flowing through the variable vent to exhaust to the atmosphere through the ducts formed by the barrel and barrel sleeve, the sealing means comprising an annular plate located over the drain and cooling holes and a washer spring adapted to hold said annular plate away from its seats.

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