March 25, 1969 D. DARDICK 3,434,380

SALVO-FIRING OPEN CHAMBER GUN

Filed Sept. 1, 1967

Fig. 1

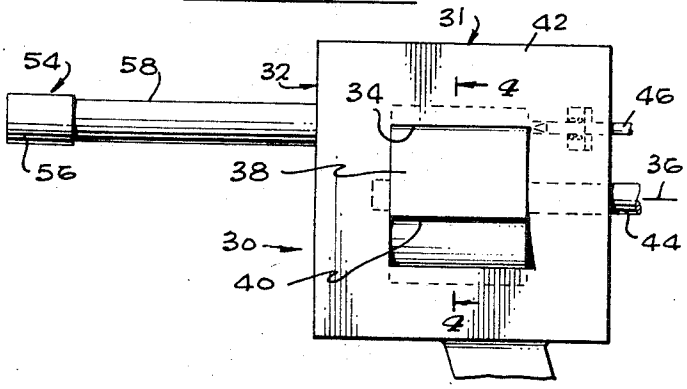
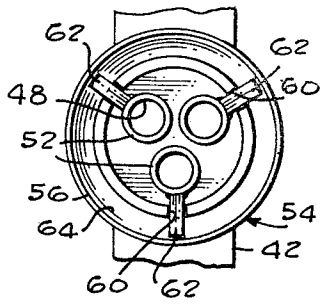


Fig. 5



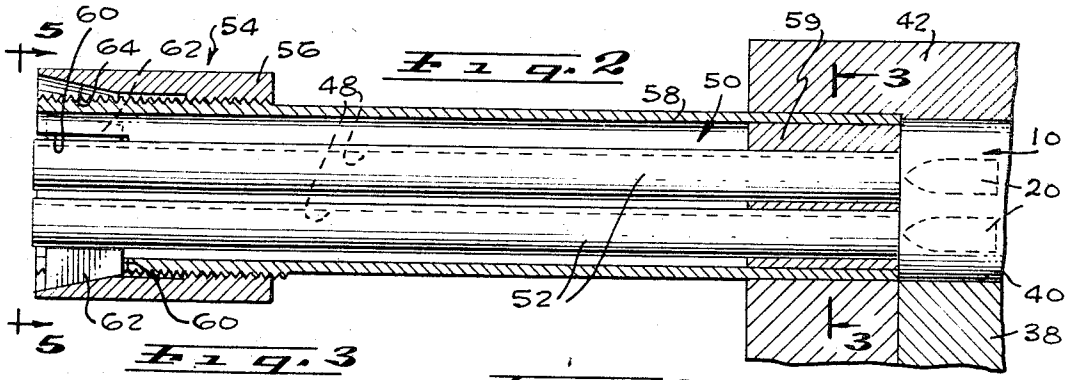


Fig. 2

Fig. 3

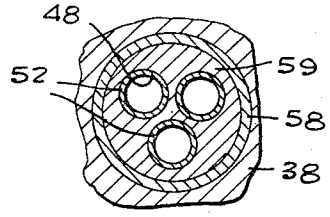


Fig. 4

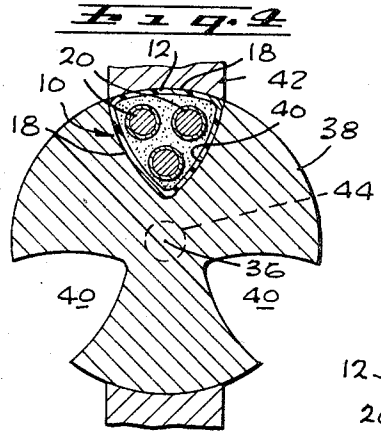


Fig. 8

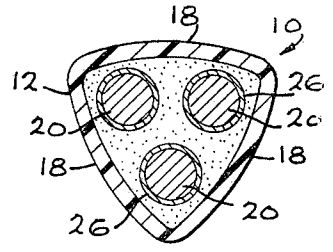


Fig. 6

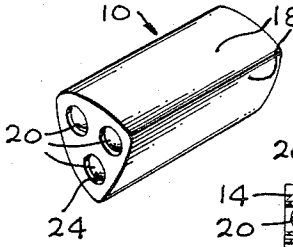
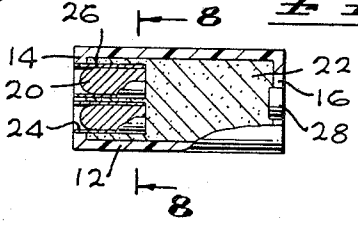


Fig. 7



INVENTOR.
DAVID DARDICK

BY Donald R. Nykaza

ATTORNEY

United States Patent Office 3,434,380
Patented Mar. 25, 1969

3,434,380

SALVO-FIRING OPEN CHAMBER GUN

David Dardick, Palos Verdes Peninsula, Calif., assignor to TRW Inc., Redondo Beach, Calif., a corporation of Ohio

Filed Sept. 1, 1967, Ser. No. 665,139
Int. Cl. F41d 7/00
U.S. Cl. 89—13 8 Claims

ABSTRACT OF THE DISCLOSURE

An open chamber gun for firing salvo-type ammunition containing a plurality of laterally spaced positionally fixed projectiles, the gun having a cluster of barrels at each firing station through which the projectiles are propelled simultaneously during firing, and adjusting means for relatively angularly displacing the barrels to vary the dispersion pattern of the projectiles in flight.

REFERENCE TO COPENDING APPLICATIONS

Reference is made herein to copending application Ser. No. 665,136, filed Sept. 1, 1967, entitled, "Semi-combustible Ammunition for Open Chamber Breech Mechanism," and Ser. No. 671,910, filed Sept. 1, 1967, entitled, "Sealed Open Chamber Breech Mechanism and Caseless Ammunition Therefor."

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates generally to open chamber guns. More particularly, the invention relates to an open chamber gun for firing salvo-type ammunition characterized by multiple projectiles which are fired simultaneously through separate barrels of the gun.

As will appear from the ensuing description, the features of the invention may be embodied in open chamber guns having either a fixed barrel construction in which each barrel remains stationary at all times and a firing chamber is stationarily aligned with the barrel, at least during firing of an ammunition round in the chamber, or a rotary barrel construction in which each barrel and an aligned firing chamber undergo unified rotation during firing about an axis parallel to and laterally spaced from the barrel. The invention will be disclosed in connection with a fixed barrel open chamber gun.

Prior art

Open chamber guns are known in the art. Typical guns of this type, for example, are disclosed in Patent Nos. 2,983,223, 3,041,938, 2,831,140, 2,847,784, and 3,044,-690. Generally speaking, an open chamber gun is characterized by an open chamber breech mechanism including a breech frame having a chamber containing a rotary carrier or cylinder with one or more firing chambers which open laterally through the circumference of the cylinder. The cylinder is supported on the breech frame for rotation or oscillation on an axis parallel to and spaced from the gun barrel to locate each firing chamber in an ammunition infeed position, wherein the open side of the chamber registers with an ammunition infeed opening in the breech frame to permit lateral infeed movement of an ammunition round into the chamber, and a firing position wherein the breech frame firing strap closes the open side of the firing chamber and the firing chamber opens forwardly to the gun bore to condition the gun for firing of the round in the chamber. Each firing chamber rotates from firing position to infeed position through an intervening cartridge case ejection position wherein the open side of the chamber registers with

a cartridge case ejection opening in the breech frame to permit lateral ejection of the spent cartridge case after firing.

The open chamber guns disclosed in the prior art patents listed above are designed to fire ammunition rounds containing a single projectile. To this end, the guns are characterized by a single barrel at each firing station which is disposed for coaxial alignment with each firing chamber upon rotation of the respective chamber to firing position at the station.

During firing of a round at the firing station, the single projectile of the round is propelled forwardly through the barrel by the expanding, high-pressure propellant gas generated by the propellant charge of the round during firing.

SUMMARY OF THE INVENTION

The present invention provides a gun for firing salvo-type multiple projectile rounds, each containing a plurality of projectiles which are spaced laterally of and positionally fixed with respect to the longitudinal axis of the round. The projectiles of a typical ammunition round, according to the invention, are elongated longitudinally of the round and may have a conventional bullet shape or other projectile shapes.

Generally speaking, the present gun is characterized by at least one cluster of separate bores or barrels and a breech mechanism at the breech end of the cluster having a firing chamber for containing each ammunition round in firing position relative to the cluster. In this firing position, the projectiles of the contained round are coaxially aligned with the bores, respectively, in the cluster. The disclosed embodiment of the invention, for example, is an open chamber gun wherein the breech mechanism includes an open chamber carrier or cylinder containing a number of firing chambers which open longitudinally through the front end and laterally through the circumference of the cylinder. The cylinder is supported in a breech frame for rotation to locate each chamber in ammunition infeed, firing, and ejection positions. In infeed and ejection positions, the open sides of the chambers are exposed for lateral movement of rounds into and lateral movement of spent cartridge cases or unfired rounds from the chambers. In firing positions, the open sides of the chambers are closed by the frame.

When a round is fired in the present gun, the projectiles are propelled forwardly in unison through their respective aligned bores whereby the present gun fires a cluster of dispersed projectiles. As will appear from the latter description, the use of separate bores or barrels in the present gun achieves a highly important advantage which is optimum dispersion or spread of the projectile fired from each salvo round. However, the gun may be equipped with adjustable means for relatively angularly displacing the barrels in such a way as to vary the dispersion of the projectiles in flight. In the disclosed embodiment of the invention, for example, the several barrels in the barrel cluster are laterally flexible, and the adjusting means comprise an adjusting member for laterally deflecting the outer ends of the barrels toward and away from one another.

A unique feature of the invention resides in the fact that the firing chamber of the gun and each ammunition round have noncircular shapes in transverse cross-section which complement one another in such a way that the firing chamber automatically orients the round in a position wherein the projectiles of the round are coaxially aligned with the barrels of the breech mechanism when the firing chamber is in firing position. The disclosed embodiment of the invention, for example, is an open chamber gun wherein each firing chamber and ammunition rounds have the same generally triangular shapes in

cross-section as the firing chambers and open chamber ammunition disclosed in the aforementioned patents. As noted in the patents, these shapes have another highly important advantage in connection with cased open chamber ammunition which involves utilization of the cartridge case of the ammunition for sealing the interfaces of the breech mechanism against propellant gas leakage during firing without rupture of the case. In this connection, attention is directed to the fact that the ammunition features or improvements of the invention may be embodied in cased ammunition similar to that disclosed in the aforementioned patents, semi-combustible ammunition similar to that disclosed in the aforementioned copending application entitled "Semicombustible Ammunition for Open Chamber Breech Mechanisms," and in caseless ammunition similar to that disclosed in copending application entitled "Sealed Open Chamber Breech Mechanism and Caseless Ammunition Therefor."

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation of an open chamber gun, according to the invention;

FIG. 2 is an enlarged fragmentary longitudinal section through the gun;

FIG. 3 is a section taken on line 3—3 in FIG. 2;

FIG. 4 is an enlarged section taken on line 4—4 in FIG. 1;

FIG. 5 is a section taken on line 5—5 in FIG. 2;

FIG. 6 is a perspective view of a salvo ammunition round to be fired in the gun;

FIG. 7 is a longitudinal section through the round; and

FIG. 8 is an enlarged section taken on line 8—8 in FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference is made first to FIGS. 6–8 illustrating a salvo-type, multiple projectile open chamber ammunition round **10**, according to the invention. The illustrated ammunition is cased ammunition and comprises an outer yieldable, noncombustible cartridge case **12** which is typically constructed of a suitable noncombustible plastic, such as one of the plastic materials referred to in the earlier mentioned patents. Cartridge case **12** has the preferred, generally triangular round shape in transverse cross-section which characterizes open chamber ammunition and includes front and rear transverse end walls **14** and **16**, respectively, and longitudinal side walls **18**. Contained within the cartridge case **12** are a plurality of projectiles **20** and a propellant charge **22**.

The projectiles **20** are elongated longitudinally of the round, and, in this instance, have conventional bullet shapes. In the particular salvo ammunition illustrated, the projectiles are three in number and are uniformly spaced about the longitudinally axis of the round in such a way that the projectiles are disposed in radial planes, respectively, containing the axis and the three longitudinal apex edges of the cartridge case **12**. Extending through the front end wall **14** of the cartridge case, in coaxial alignment with the projectiles, are bores **24**. Sealed to the walls of these bores are obturating sleeves **26** frictionally receiving the projectiles. The propellant charge **22** fills the remaining interior volume of the cartridge case **12** in such manner that the propellant encapsulates the projectiles and their obturating sleeves. Mounted in the rear end wall **16** of the cartridge case **12** is a primer **28**.

Turning now to FIGS. 1–5, there is illustrated an open chamber gun **30** according to the invention for firing the salvo-type, multiprojectile round **10**. Gun **30** is conventional, in most respects, and for this reason has been illustrated in simplified fashion. The gun comprises an open chamber breech mechanism **31**, including a breech frame **32** having the usual flat rectangular shape and containing a chamber **34**. Chamber **34** opens laterally through opposite sides of the breech frame **32** to form ammunition infeed and cartridge case ejection openings to the chamber.

Rotatably supported on the breech frame **32** within the chamber **34**, for turning on an axis **36**, is an open chamber carrier or cylinder **38**. This cylinder contains at least one (and in this instance three) firing chambers **40** which open laterally through the circumference of the cylinder and longitudinally through the ends of the cylinder. Cylinder **38** is rotatable in the chamber **34** to locate each firing chamber **40** in an ammunition infeed position, a firing position, and a cartridge case ejection position. The open side of each firing chamber, when in infeed position, registers with the ammunition infeed opening in the breech frame to permt lateral infeed movement of a present salvo round **10** into the firing chamber. When in firing position, the open side of each firing chamber is closed by the firing strap **42** of the breech frame **32** to permit firing of the round in the chamber. When a firing chamber occupies its ejection position, the open side of the chamber registers with the breech frame ejection opening to permit lateral ejection of spent cartridge case **12** of the round **10** from the chamber after firing. Extending coaxially from the rear end of the cylinder **38**, and rotatably through the rear end of the breech frame **32**, is a shaft **44** by which the cylinder may be driven to infeed, firing and ejection positions. In this regard, attention is directed to the fact that the cylinder may be driven in unidirectional rotation or oscillation through infeed, firing, and ejection positions. A conventional firing means or pin **46** is provided for firing a round **10** in a firing chamber **40** when the latter occupies firing position.

The illustrated open chamber gun **30**, as it is thus far described, is conventional. According to the present invention, the gun is equipped with a number of bores **48** equal to the number of projectiles **20** in a salvo round **10**. In this instance, the bores are defined by a cluster **50** of separate barrels **52** which are secured to and extend forwardly from the front end of the breech frame **32**, in line with the firing station of the breech mechanism **31**. The barrels are disposed in spaced, generally parallel relation to the rotation axis **36** of the breech cylinder **38** in such a way that the projectiles **20** of a present ammunition round **10**, when contained within a cylinder firing chamber **40** with the latter in firing position, are coaxially aligned with the bores **48**, respectively. Accordingly, when the round is fired, the projectiles are propelled by propellant gas pressure, forwardly in unison through their respective barrels. The present breech mechanism, therefore, is effective to fire a group or cluster of projectiles.

According to an important feature of the invention, the open chamber gun **30** is equipped with adjusting means **54** for relatively angularly displacing the barrels **52** in such a way to vary the dispersion pattern of the fired projectiles **20** in flight. To this end, the barrels of the illustrated gun are designed to have limited lateral flexibility and the adjusting means **54** is adjustable to effect lateral bending or deflection of the front ends of the barrels toward and away from one another. The particular adjusting means illustrated comprises a collar **56** threaded on the forward end of a barrel sleeve or shroud **58** which is secured at its rear end to and extends forwardly from the front end of the breech frame **32** in surrounding relation to the barrels **52**. The rear ends of the barrels extend through and are secured to a cylindrical plug **59** which is fixed within the rear end of the barrel sleeve. The internal diameter of the sleeve **58** is sufficiently large to provide clearance between the sleeve and the barrels, and the barrels are stressed to normally diverge toward their forward ends. Secured to and extending radially from the front ends of the barrels and through longitudinal clearance slots **60** in the front end of sleeve **58** are tapered cams **62**. The barrel adjusting collar **56** has an internal conical camming surface **64** engaging the barrel cams **62**

in such a manner that forward axial adjustment of the collar relative to the barrel sleeve **58**, i.e., axial adjustment of the collar away from the breech frame **32**, cams the forward ends of the barrels **52** inwardly toward one another to reduce the relative angular divergence of the barrels. Rearward adjustment of the collar permits the barrels to spring outwardly away from one another and thereby increase the relative angular divergence of the barrels. It will not be understood, therefore, that forward axial adjustment of the collar **56** reduces the dispersion of the projectiles **20** which are discharged through the barrels **52** during firing of each salvo round **10** in the gun **30**. Rearward axial adjustment of the collar increases the dispersion of the fired projectiles.

It will be recalled that the illustrated salvo rounds **10** of the invention have the preferred, generally triangular round shape in cross-section which characterizes the open chamber ammunition disclosed in the earlier mentioned patents. Each round contains three projectiles **20** which are uniformly spaced about the longitudinal axis of the round and located in radial planes containing the axis and the three longitudinal apex edges, respectively, of the round. Accordingly, the projectiles are effectively arranged in a triangular pattern. The barrels **52** of the gun **30** are arranged in the same triangular pattern and are uniformly spaced about an axis which concides with the longitudinal axis of each cylinder firing chamber **40** when the latter occupies its firing position. The barrels are thus located in three uniformly spaced radial planes containing the firing chamber axis and the longitudinal axes of the respective barrels. Axial adjustment of the collar **56** is thus effective to relatively displace the barrels toward and away from one another in their respective radial planes.

The illustrated equilateral triangular round shape of the ammunition rounds **10** and cylinder firing chambers **40** has a unique advantage in the present open chamber gun **30**. Thus, this particular shape permits each round to be positioned in a firing chamber with any one of the side walls **18** of its cartridge case **12** exposed at the open side of the chamber. In this regard, it will be evident that because of the illustrated arrangement of the projectiles **20** in each round, the projectiles **20** in the round are automatically coaxially aligned with the bores **48** in each of the three positions which the round may occupy in the firing chamber. As is conventional in open chamber ammunition of this type, the side walls **18** of the cartridge case **12** of each ammunition round **10** are cylindrically curved to the same radius as the breech cylinder **38** so that when the round is positioned in a cylinder firing chamber **40**, the exposed side of the round is flush with the circumference of the cylinder. As noted earlier, the cartridge case of each round is constructed of a yieldable, non-combustible material, such as a plastic material, which expands outwardly against the walls of the firing chamber and the confronting surface of the breech frame firing strap **42** during firing of the round to seal the breech interfaces against propellant gas leakage.

It will be immediately evident to those skilled in the art that while the illustrated ammunition round **10** of the invention contains three projectiles, each round may contain a lesser number or a greater number of projectiles. The number of barrels **52** in the gun, of course, will be reduced or increased accordingly and will be arranged to coincide with the projectiles of each round when in firing position. Obviously, other means than the illustrated collar **56** may be employed for adjusting the relative divergence of the barrels. For example, the barrel adjusting means may comprise a conical tapered wedge supported for axial adjustment between the barrels in such a way as to cam the barrels radially outward away from one another. In this case, the barrels will be stressed to normally spring inwardly toward one another.

The operation of the open chamber gun **30** is now believed to be obvious. Thus, during such operation, the breech cylinder **38** is initially rotated to locate a firing chamber **40** in ammunition feed position, wherein the chamber registers with the breech frame infeed opening to permit lateral infeed movement of an ammunition round **10** into the chamber. The cylinder is then rotated to locate the firing chamber in firing position and the firing means **46** are actuated to fire the round. The several projectiles **20** of the round are propelled forwardly in unison, by propellant gas pressure, through the barrels **52**. The dispersion of the projectiles in flight is determined by the relative divergence of the barrels. This divergence, and hence the dispersion pattern of the projectiles, are varied by axial adjustment of the barrel adjusting collar **56**.

After firing, the cylinder **38** is rotated to locate the firing chamber in case ejection position to effect lateral ejection of the spent cartridge case **12** of the fired round from the chamber.

As noted earlier, while the invention is disclosed in connection with an open chamber gun having fixed barrels carried by the breech frame, the invention may be embodied in a rotary barrel open chamber gun of the type illustrated in the earlier mentioned Patent 3,041,939. In this latter case, the barrel cluster or clusters of the present gun will be carried by and rotate with the breech cylinder in the same way as do the single barrels in the patent. Moreover, the present salvo ammunition invention may be embodied in semicombustible and caseless open chamber ammunition of the kind disclosed in the earlier mentioned copending applications. Moreover, an actual gun according to the invention may be equipped with ammunition infeed means, breech cylinder drive means, and firing pin actuating means. Such means have been omitted from the drawings in the interest of brevity of illustration and description.

As noted earlier, the use of separate bores or barrels in the present gun achieves a unique and highly important advantage which is optimum dispersion of the projectiles fired from each ammunition round when the barrels are parellel. In this regard, for example, it has been found that when multiple projectiles contained by a sabot are fired through a single bore, a relatively high dispersion of the projectiles is obtained which negates the effectiveness of the salvo. This is due to interference of and expansion of the propellant gas between the projectiles, particularly when the projectiles are finned flechettes. The present use of multiple barrels avoids these problems because of the travel of the several fired projectiles through separate bores. Moreover, it has been found that because of various factors, such as slight variations in bore size, friction forces, projectile size and mass, etc., the projectiles emerge from the barrels, not simultaneously, but at slightly different intervals. This, of course, aids in eliminating interference between and gas pressure induced separation of the projectiles and thus in achieving optimum projectile dispersion.

At this point, attention is directed to the fact that the three projectiles **20** of the ammunition round **10** are uniformly spaced from the longitudinal axis of the round, and the longitudinal axes of the projectiles are disposed in planes which bisect the interior angles of the round. This arrangement places the projectiles within the three interior corners or apices of the round and provides two important advantages. First, it results in optimum chamberage, that is optimum propellant volume for a given projectile diameter and hence gun bore diameter. Secondly, the illustrated projectile placement provides the ammunition with a minimum transverse cross-section for a given projectile diameter and gun bore diameter.

What is claimed is:

1. An open chamber gun for firing salvo-type ammunition rounds each being of generally triangular round shape in transverse cross-section and having a central logitudinal axis and each containing a plurality of mutually axially coextensive elongate projectiles having individual longitudinal axes and arranged in a predetermined array about said central axis with said individual

longitudinal axes of said projectiles substantially parallel to said central axis, said array being characterized by said individual longtudinal axes of said projectiles being substantally equidistant from and agularly spaced about said central axis, comprising:

a breech frame member containing a chamber;

a carrier member supported on said frame member within said chamber for rotation on an axis;

said frame member having a lateral ammunition infeed opening to said chamber between the ends of said carrier member;

said carrier member containing a firing chamber opening laterally through the circumference of said carrier member and having a longitudinal axis parallel to and spaced from said rotation axis;

said carrier member being rotatable in said frame member to locate said firing chamber in an ammunition infeed position, wherein the open side of said firing chamber registers with said ammunition infeed opening to permit lateral infeed movement of an ammunition round into said firing chamber through said opening, and a firing position wherein the open side of said firing chamber is closed by said frame member;

barrel means secured to and extending forwardly from one of said members in spaced generally parallel relation to said rotation axis and containing a cluster of generally parallel and mutually axially coextensive bores which open rearwardly to and are arranged in said predetermined array about said longitudinal axis of said firing chamber in firing position; and

said firing chamber having approximately the same triangular round shape in transverse cross-section as said ammunition rounds such that each ammunition round generally complements said firing chamber, whereby said firing chamber is adapted to receive each said ammunition round in a position wherein said central axis of the respective contained round coincides with said longitudinal axis of said firing chamber and each ammunition round when contained in firing position within said firing chamber is positively oriented by said firing chamber in firing relation to said bores, wherein said bores are simultaneously coaxially aligned in one-to-one projectile receiving relation with said projectiles, respectively, of the projectile array of the respective round.

2. An open chamber gun, according to claim **1**, wherein:

said firing chamber and each ammunition round have complementary, generally equilateral triangular round shapes in transverse cross-section, whereby each round may occupy any one of three different firing positions in said firing chamber;

said projectiles of each round are uniformly angularly spaced in a predetermined symmetrical array about the central longitudinal axis of the respective round; and

said bores are uniformly angularly spaced in said predetermined symmetrical array about said longitudinal axis of said firing chamber in firing position in such manner that said bores are simultaneously coaxially aligned in said one-to-one projectile receiving relation with said projectiles, respectively, of an ammunition round contained by said firing chamber in firing position in each of the three firing positions which the contained round may occupy in the said firing chamber.

3. An open chamber gun according to claim **2**, wherein:

each ammunition round contains three projectiles which have their longitudinal axes located in planes, respectively, bisecting the three interior angles of the round; and

said barrel means contains three bores.

4. An open chamber gun according to claim **1**, wherein:

each ammunition round contains three projectiles which have their longitudinal axes located in planes, respectively, bisecting the three interior angles of the round; and

said barrel means contains three bores.

5. In combination:

an open chamber ammunition round having a central longitudinal axis and including a plurality of elongate mutually axially coextensive projectiles having individual longitudinal axes and arranged in a predetermined array about said central axis with said individual longitudinal axes of said projectiles substantially parallel to said central axis, said array being characterized by said individual longitudinal axes of said projectiles being substantially equidistant from and angularly spaced about said central axis;

an open chamber gun including a breech frame member containing a chamber, a carrier member supported on said frame member within said chamber for rotation on an axis, said frame member having a lateral ammunition infeed opening to said chamber between the ends of said carrier member, said carrier member containing a firing chamber opening laterally through the circumference of said carrier member and having a longitudinal axis parallel to and spaced from said rotation axis, said carrier member being rotatable in said frame member to locate said firing chamber in an ammunition infeed position, wherein the open side of said firing chamber registers with said ammunition infeed opening to permit lateral infeed movement of said ammunition round into said firing chamber through said opening, and a firing position, wherein the open side of said firing chamber is closed by said frame member to permit firing of the round in said firing chamber, and barrel means secured to and extending forwardly from one of said members in spaced, generally parallel relation to said rotation axis and containing a cluster of generally parallel mutually axially coextensive bores which open rearwardly to and are arranged in said predetermined array about said longitudinal axis of said firing chamber in firing position; and

said ammunition round and firing chamber having complemetary generally triangular round shapes in transverse cross-section, whereby said firing chamber is adapted to receive said ammunition round in a position wherein said central longitudinal axis of the round coincides with said longitudinal axis of said firing chamber, and said firing chamber when in firing position positively orients said round in firing relation to said bores, wherein said bores are simultaneously coaxially aligned in one-to-one projectile receiving relation with the projectiles, respectively, of the projectile array of said ammunition round.

6. The combination according to claim **5**, wherein:

said firing chamber and ammunition round have complementary generally equilateral triangular round shapes in transverse cross-section, said projectiles are uniformly angularly spaced in a predetermined symmetrical array about said central longitudinal axis of said round, and said bores are uniformly angularly spaced in said predetermined symmetrical array about said longitudinal axis of said firing chamber in firing position, whereby said round may occupy any one of three different firing positions in said firing chamber and said bores are simultaneously coaxially aligned in said one-to-one projectile receiving relation with said projectiles, respectively, of said ammunition round in each of the three firing positions which said round may occupy in said firing chamber.

7. The combination according to claim **6**, wherein:

each ammunition round contains three projectiles which have their longitudinal axes located in planes, respectively, bisecting the three interior angles of the round; and

said barrel means contains three bores.

8. The combination according to claim **5**, wherein:

said ammuntion round contains three projectiles which have their longitudinal axes located in planes, respectively, bisecting the three interior angles of said round; and

said barrel means contains three bores.

References Cited

UNITED STATES PATENTS

493,382	3/1893	Hilder	42—39.5
634,826	11/1899	Masini.	
1,448,587	3/1923	Arntzen	89—1
1,809,533	6/1931	Schoonover	42—59
2,847,784	8/1958	Dardick	42—39.5
2,865,126	12/1958	Dardick	42—39.5 X

SAMUEL W. ENGLE, *Primary Examiner.*

U.S. Cl. X.R.

89—155; 42—39.5