Aug. 19, 1930. R. M. CUTTS 1,773,260

COMPENSATOR DEVICE

Filed April 26, 1928

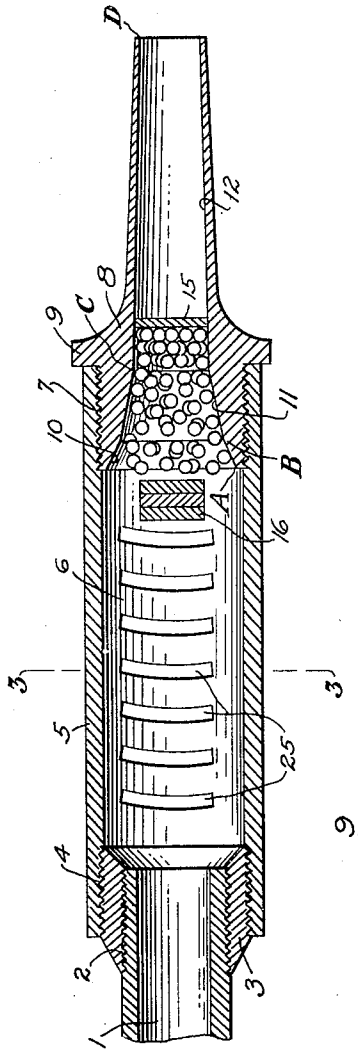

Fig. 1

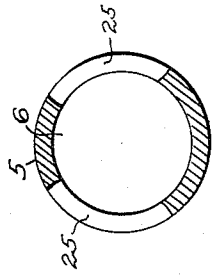

Fig. 3

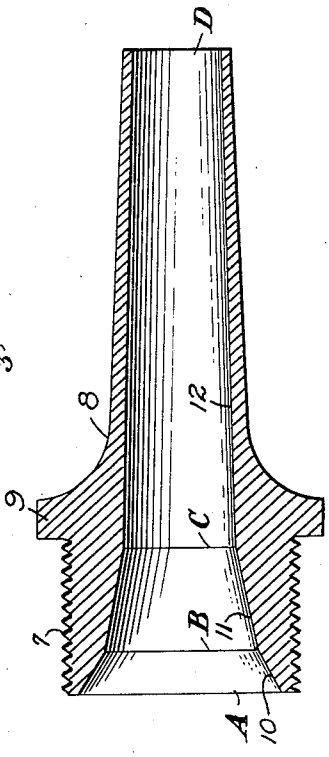

Fig. 2

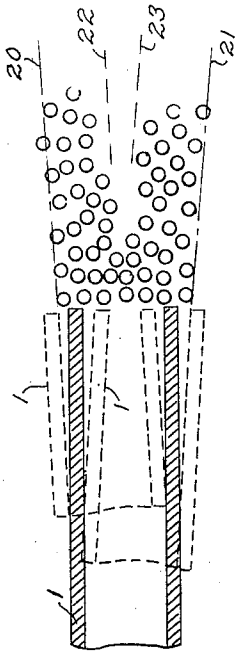

Fig. 4

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UNITED STATES PATENT OFFICE

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COMPENSATOR DEVICE

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This invention relates to compensating devices for fire arms and more particularly to a device of this character designed for application to shot guns, having for its object to produce a construction simple in parts and less costly to manufacture as well as more efficient in use than those heretofore proposed.

With these and other objects in view the invention consists in the novel details of construction and combinations of parts as will be more fully hereinafter disclosed and particularly pointed out in the claims.

Referring to the accompanying drawings forming a part of this specification in which like numerals designate like parts in all the views:

Fig. 1 is a longitudinal vertical sectional view of this device as applied to the end of a shot gun barrel;

Fig. 2 is a vertical longitudinal sectional view of the removable end of the device shown in Fig. 1 and drawn to a larger scale for the sake of clearness;

Fig. 3 is a transverse sectional view taken as on the line 3—3 of Fig. 1; and

Fig. 4 is a diagrammatic view illustrating the effects of firing upon a shot gun barrel.

This invention constitutes an improvement of the devices shown in U. S. Letters Patent No. 1,605,393 dated November 2, 1926, and No. 1,636,357 dated July 19, 1927, both granted to Richard M. Cutts, Jr., and which are directed to compensating devices for the muzzle ends of rifles or the like. As contradistinguished from the invention of said patents, this device is particularly applicable to the muzzle ends of shot gun barrels, or in other words, to weapons designed to fire projectiles, not considered as a unit mass.

It has been found by analysis and research that the vibrations of a gun barrel will cause the bullet to depart from the axial direction established by the bore when the gun is at rest. The two most important of these vibrations are the fundamental and the first overtone, which will cause the barrel to be actually bent in an undetermined direction at the time of the emission of the bullet, and which usually work in algebraic combination, causing what is known as the bend error. The muzzle while travelling from one limit of the vibration to the other limit has a definite lateral velocity which is greatest halfway between the limits of the vibration, so that if the bullet emerges at a period of the vibration between the limits thereof, said bullet will have a definte lateral velocity in addition to its forward velocity. This is known as the swing error, and the combination of the bend and swing errors causes the bullet to strike to one side, above, or below the desired point of impact. This actual point of hit will vary according to conditions of powder charge as well as other known conditions, all of which cause alterations in the amplitude and frequency of the vibrations, but the bullet being a solid is affected as a whole.

Greater accuracy has been shown on the range by the use of the above mentioned patented compensator on solid projectiles due to the dampening to a great extent of both the frequency and amplitude of these vibrations. The check of the kinetic energy of the gas in the compensator, caused by the compression chamber and the almost closure of the compensator exit by the bullet, causes a reaction of this kinetic energy against the following gas column, resulting in a heavy increase in pressure in the compensator compression chamber. This increase in pressure has been shown on the chronograph to definitely increase the velocity of the projectile of small arms or field guns, over the velocity it had on its departure from the gun muzzle. The above is necessary explanation to elaborate the claims of this improvement of the compensator for shot guns, and guns in which the projectile is not a unit mass.

The vibration of a shot gun barrel, owing to its form and structure, is much greater than that of a barrel of a rifle or field gun, and is infinitely more variable owing to the various charges of shot and powder used. It has always been a difficult matter to maintain the shot group in the densities desired for the various ranges, and to control these densities, since outside influences such as wind, air resistance, etc. are common to all.

The shot column in a shot gun, ballistically speaking, is traveling at a comparatively slow

velocity and, as it emerges from the usual gun barrel, is subjected to the bend and swing errors. However, as the shot column is not a solid it does not respond as a mass, with the result that different sections of the shot column are subjected to different angular departures caused by the bend error. Further, different and separate parts of the same column are given different and separate lateral velocities caused by the swing error.

Further, it has been established by photographic means that the leakage of gas beyond the powder wads establishes a high gas pressure in the interstices of the shot column, during its progress through the barrel. On reaching the muzzle, this gas is no longer confined by the barrel walls and expands laterally from within the shot column, imparting lateral velocities particularly to the outer layers of shot, which materially add to the dispersion of said shot with resultant undesirable shot patterns. The effect, therefore, is a too great opening out of the pattern which is viciously increased when the heavier long range loads increase not only the vibration both as to amplitude and frequency but the gas pressure within the barrel and shot column. It thus results that when a decreased pattern area is desired, a hollow pattern of large area is secured instead. The compensator when applied to a shot gun will dampen the vibrations referred to and thus diminish the effects of these errors, but the bend and swing still have effects on the shot dispersion.

A further cause of undesired shot expansion, has been shown, photographically, to lie in the powder wads driving the shot column from the rear under pressure of the following gases, after the shot column has left the barrel and is no longer supported by the barrel walls, the effect being to expand the base of the said column, and this expansion is assisted by the beforementioned interior gases, with resultant and considerable lateral velocities to the part of the column so affected. The compensator when applied to the shotgun will remove this error, and by releasing the pressure from behind the powder wads before the wads have cleared the compensator muzzle, will prevent any further action of this nature.

This invention is directed to an improvement in the compensator, resulting in a reducton of these errors to a negligible point and, as will presently be shown, giving a very high degree of control over the shot pattern. With the compensator fitted, the shot still tends to expand or disperse to a lesser extent on leaving the gun muzzle on account of vibration, but the full force and effect of the gas pressure remains.

During the period of time the shot column is traversing the expansion chamber of the compensator the vibrations are being reduced and have substantially no effect upon the shot, but the damage due chiefly to the gas effect has been done. This improved device receives the column of shot expanded by the gas pressure and vibration, recompresses and realigns the same to any degree desired, and then delivers it to the choke desired. While travelling through the choke chamber said shot column contains such a slight internal gas pressure as to be negligible in effect when said shot leaves said chamber. When the shot column is passing from the end of the compensator choke it is but little affected by the very slight residual vibrations, thus permitting the shot to fly true in normal angular direction, subject to dispersion only by the normal outside conditions and resistances found in the course of travel from the compensator muzzle to the target.

Referring more particularly to Fig. 1 the shot gun barrel which is indicated by the numeral 1 is exteriorly threaded as at 2 to receive a collar 3 in turn exteriorly threaded as at 4 to engage one end of the cylindrical casing 5 constituting the expansion chamber 6 of this device. The other end of the cylinder 5 is in threaded engagement as at 7 with a removable compensator and member 8 provided with a transverse outwardly extending flange portion 9 serving as a stop against the end of the cylinder 5 as well as a means by which the member 8 may be screwed into or out of said cylinder.

The member 8 is axially bored to provide a conical surface 10 extending from the extreme inner end A of said member to a point B. There is also provided a second conical surface 11 joining said surface 10 and extending from the point B to a point C, the slope of the surface 11 being different from the slope of the surface 10. Lastly the member 8 is provided with a third internal surface 12 which may be conical or cylindrical according to whether the choke is desired or not, said surface 12 extending from the point C to the outer end D of said member 8.

The conical surface 10 creates between the points A and B the compression chamber of the compensator, the surface 11 between the points B and C creates a recompression chamber for the shot, and the surface 12 creates between the points C and D the desired choke. It has been found by test that the degree of taper and length of the recompression chamber B—C has a very marked impression on the behavior of the normal choke or chokes C—D, and as a result of which the member 8 has been made removable from the compensator expansion chamber or cylinder 5 in order that any degree of shot performance may be secured by substituting one unit member 8 for another having a different recompression slope.

The length of the slope B—C may be varied under differing conditions but it is an important feature that said slope is of sufficient length to coactively engage the shot

without detrimental effects thereon. That is to say, if this length is too short and the degree too sharp, the shot will forcibly impact said slope with resultant deformation of the shot units, which will interfere with their true flight, as well as create what is termed a welding together of the shot mass. On the other hand if this slope is too long and the degree not sharp enough the shot will be but little affected with the result that there will be a loss of pressure behind the shot column as it leaves the choke. Therefore it remains to establish a slope conforming to the above which will permit the seating of the powder wads at the earliest possible moment in order to utilize the greatest gas pressure.

It will be understood that the shot recompression chamber acts entirely independent of the choke. Its shape and slope can be altered deliberately, to cause variations in pattern delivered by the same choke, in accordance with the charge and size of shot used, and these variations are all in a desirable direction and greatly enhance the value of the combination of said chamber and choke. To illustrate, from a large number of range firings, the maximum recompression chamber with a so called full choke in combination therewith will deliver an average of 84% of its shot charge in a 30" circle at forty yards, with heavy duck loads such as 3¾ drams of powder, 1¼ ounces of number 6 shot. At the other end of its range, with 3 drams of powder 1¼ ounces of number 7½ shot it will deliver an average of 71.1% in the same circle at the same range. With 3¼ drams of powder, 1¼ ounces of number 7 size shot it will deliver an average of 73.1% in the same area at the same range. Other variations are obtained in accordance with varying loads.

On the other hand, a so called modified cylinder choke with a shot recompression chamber designed for the lighter loads, for short range bird shooting will throw in this combination with 3 drams of powder 1¼ ounces of number 7½ shot 58.4% of its load of shot in a 30" circle at forty yards, while if the above mentioned heavy duck load is fired in this combination the pattern will average 80%. Another combination for very short ranges permits a pattern with the light loads of 71% at twenty-five yards, and thus it will be obvious that the combinations are infinite. It will thus be seen by those skilled in the art that in addition to its other advantages, increases in loads, when subjected to the action of the shot recompression chamber increase the density of the dispersion while it is well known that with the ordinary shotgun, of no matter what choke, an increase on the load tends to decrease the density of the dispersion, and extra heavy loads frequently "blow up" the pattern. This action of the shot recompression chamber is in combination with the general effect of the compensator as a whole, as before outlined.

The shot on emerging from the gun barrel 1 into the cylinder, even though compensated, tends to expand laterally to a known extent as hereinbefore stated. The shot column then traverses the compensator expansion chamber 6 and enters the compression chamber A—B and then the recompression chamber B—C. The internal diameter of the large end of this recompression chamber is at all times greater than the diameter of the gun barrel and is made sufficiently large to include the outside perimeter of the expanded shot column. The shot is recompressed and realigned so that said shot is correctly delivered to the beginning of the choke at C. By the time the shot emerges from the choke at D, the vibrations hereinbefore mentioned have been so dampened that the swing and bend errors are negligible and the internal gas pressure reduced with the result that the shot will fly substantially true to its mark.

In Fig. 1 the shot wad 15 of the fired load is shown just within the choke chamber C—D, the shot are shown expanded within the compression chamber A—B, and the shot in the recompression chamber B—C are shown being contracted into realignment and compacted position behind said wad 15. 16 is the usual wad used to separate the shot from the powder charge in the shell and is shown following the shot.

From the foregoing it will therefore be readily understood that the gases of combustion reaching the chamber 6 are under terrific pressure and high velocity with the shot and associated wads travelling to and into the compression, recompression and choke chambers. The internal diameters of the portion C—D of the choke chamber is such that all of the wads will form mechanical seals or plugs therein. When the rearmost three wads 16 reach and enter the portion C—D the following gas, still under tremenduous pressure, will strike the slopes 10 and 11 which, being tapered forwardly and inwardly, will cause eddyings of said gas into whirls creating myriad vortices, which, after the last wad 16 has left the compensator at D, are sufficient to effect a seal substantially preventing further exit of gases through the device at D. Therefore the gases must escape from the device through the lateral ports 25.

It will be understood that the degree of slope and length of the shot compression and recompression chambers, all have a direct action on the final effect of the choke. In other words, the slope degree and length of the chamber will be different for the heavier loads and close choke, from those for the light loads and more open choke. A further advantage of this improvement lies in the fact shown from range work that if a gun,

equipped with a compensator having a shot recompression chamber and choke design for light loads, is fired with a heavy load the additional velocity will increase the effect of the recompression slope and chamber, resulting in a closing of the density of the shot pattern frequently as much as 20% in a 30" circle at 40 yards with certain loads. This is an effect much to be desired in a quick change of a game target presented, as will be readily understood.

Another great advantage of this new form of construction lies in additional recoil reduction obtained by its functioning without loss in shot velocity since, as previously stated, compensators of this design when fitted to guns produce an increase in velocity by the raising of the pressure through reaction in the compensator compression chamber.

It is not desirable to raise the velocity of the small shot units beyond a certain point, as the additional velocity is of little use owing to its rapid loss due to the very light projectile, from air resistance. The additional velocity which would be gained by the shot through the use of the compensator is converted by this improvement into recompression and realignment of the expanded shot column. In other words, the energy expanded on the anvil for this recompression is applied to the gun in a counter recoil direction. In actual practice it has been found that the generation of extra power is sufficient to permit a reduction in the length of the shot gun barrel to 24" without definite loss of velocity as shown on the chronograph, as well as to effect the recompression and realignment of the shot column. Thus there is obtained a saving in gun weight of from 6" to 8" of the length of the gun barrel.

Definite and extended range pattern firings show that this improvement permits exceedingly high pattern densities, fully controllable, and that these lack the hollow centers up to the maximum range of the shot used. Further these results may be secured on guns of light weight and indifferent workmanship, the entire pattern control lying in the compensator and this improvement.

In Fig. 4 is shown the effect upon the shot of firing a gun not equipped with this improved compensator, the figure being somewhat exaggerated for the purpose of better illustration of the principles. The gun barrel is indicated by the number 1 and shown in full lines in true normal or axial position.

The vibrations hereinbefore mentioned set up a movement of the barrel causing the muzzle thereof to swing to the dotted line positions indicated. Since the period of vibration is fast, the oscillation of the muzzle continues during the emission of the shot from the barrel and, as the shot occur in column, there results a divergent dispersion as indicated.

In other words, the shot will disperse from the axial line of the barrel due to said vibrations plus the action of the gas pressure within the shot column expanding outwardly as said column leaves the muzzle, and the dot and dash lines 20 and 21 are indicative of the limits of this lateral movement of the shot. As a result there will be created a cone of shot travelling towards the target, and this cone will have a hollow center as indicated by the dash lines 22 and 23. By employing the improved compensator above described, the vibrations are materially reduced and the expanded shot column recontracted to a more unified mass, resulting in denser target patterns.

The plurality of openings 25 in the walls of the expansion chamber 6 are in accordance with the similarly disposed ports described in the above mentioned patents, and are for the purpose of releasing the gases of combustion as they emerge from the muzzle of the gun. By disposing these ports above the horizontal center of the chamber 6 a combinative effect of overcoming recoil and preventing climb of the muzzle is obtained. In addition thereto these ports 25 permit an escape of the gases to an extent where little effective pressure is left within the shot column as it enters the choke chamber C—D to produce the undesirable lateral shot velocities at the exit end thereof.

From all of the foregoing it will thus be seen that by this invention there is produced a device not only tending to overcome recoil of a gun, but to translate lateral velocities of the shot, after leaving the muzzle of the gun, into longitudinal velocities. That is to say, the shot as they leave the muzzle of the gun are subjected to longitudinal and lateral velocities imparted thereto by the gases of explosion, the lateral velocities created by the expansion of said gases, as they emerge from the muzzle. Were this device not utilized, the continued flight of the shot would be such that those shot which were affected by the lateral velocities imparted by said gases would materially diverge from the axial path of the shot not so affected, with the result that an enlarged pattern would be obtained at the target, said pattern in most cases having hollow centers. The removable end member 8 of this invention is provided with a bore coaxial with the gun barrel, said bore having a conical surface B—C constituting the means for arresting the lateral dispersion of the shot and translating the lateral velocities thereof into longitudinal velocities by directing said shot to the shot which were not subjected to lateral dispersion. In accomplishing this the impact of the shot against the surface B—C is appreciable and therefore partially overcomes the recoil of the gun. All of the shot are compressed by the surfaces B—C and C—D so that they are compacted into a

more unified mass, or a mass with few if any spaces between the individual shot.

It is obvious that those skilled in the art may vary the details of construction as well as arrangements of parts without departing from the spirit of the invention and it is therefore not desired to be limited to the foregoing disclosure except as may be required by the claims.

What is claimed is:—

1. In a gun adapted to fire a plurality of projectiles with a single powder charge and provided with a muzzle the combination of an expansion chamber to receive the gases of explosion as they emerge from said muzzle together with the projectiles said chamber permitting a deviation of said projectiles from the established line of flight; means associated with said chamber to increase the pressure of the expanded gases and to realign the deviated projectiles into a mass of any desired diameter; and means to release the expanded gases under pressure to produce movement of said muzzle in a predetermined direction.

2. In a gun adapted to fire a plurality of projectiles with a single powder charge and provided with a muzzle the combination of a chamber secured to said muzzle to permit said projectiles to disperse as the gases of explosion expand in said chamber; means to receive the dispersed projectiles and direct them into a compression chamber to form them into a compacted unit column; means to control the unit column formation between said compression chamber and the point where the projectiles leave the gun; and means to release the expanded gases under pressure laterally from said first named chamber.

3. In a gun adapted to fire a plurality of projectiles with a single powder charge and provided with a muzzle the combination of a chamber secured to said muzzle to permit said projectiles to disperse as the gases of explosion expand in said chamber; and a removable end member for said chamber having common means to increase the pressure of the expanded gases and direct the dispersed projectiles into a compression chamber to form them into a compacted unit column, as well as means to control the unit column formation between said compression chamber and the end of said member.

4. A compensating device of the character described which when attached to the muzzle of a shot gun provides means for receiving the dispersed shot after leaving said muzzle, for compressing said dispersed shot into a compacted formation, and for realigning said shot after said formation with the axis of the gun barrel; as well as means for placing the gases of explosion under pressure and releasing the same to produce movement of said muzzle in a predetermined direction.

5. A compensating device of the character described adapted to be attached to the muzzle of a shot gun or the like said device provided with lateral apertures to release the gases of explosion to produce a movement of said muzzle in a predetermined direction, said device provided with a removable end member having an axial bore comprising surfaces of different slopes coactingly affecting the projected shot.

6. A compensating device of the character described adapted to be attached to the muzzle of a shot gun or the like said device provided with lateral apertures to release the gases of explosion to produce a movement of said muzzle in a predetermined direction, said device provided with a removable end member having an axial bore comprising surfaces of different slopes coactingly affecting the projected shot, one of said slopes to increase the pressure of the gases of explosion.

7. A compensating device of the character described adapted to be attached to the muzzle of a shot gun or the like said device provided with lateral apertures to release the gases of explosion to produce a movement of said muzzle in a predetermined direction, said device provided with a removable end member having an axial bore comprising surfaces of different slopes coactingly affecting the projected shot, one of said slopes to increase the pressure of the gases of explosion, and another of said slopes to form the shot into a compacted column.

8. A compensating device of the character described adapted to be attached to the muzzle of a shot gun or the like said device provided with lateral apertures to release the gases of explosion to produce a movement of said muzzle in a predetermined direction, said device provided with a removable end member having an axial bore comprising surfaces of different slopes coactingly affecting the projected shot, one of said slopes to increase the pressure of the gases of explosion, another of said slopes to form the shot into a compacted column, and another of said axial surfaces to control the formation of the compacted column.

9. In a gun adapted to fire a plurality of projectiles with a single powder charge with resultant lateral dispersion of said projectiles upon leaving the muzzle of said gun due to the presence between said projectiles in the barrel of the gun of some of the gases of explosion and the expansion of said gases upon leaving said muzzle, the combination of a chamber associated with the muzzle of said gun to receive the gases of explosion as they leave said muzzle together with the projectiles including those to which a lateral velocity has been imparted by a portion of said gases; means to arrest the lateral dispersion of those projectiles so affected by said gases and return them to the other of said projectiles; and means to compress all of said projectiles.

10. In a gun adapted to fire a plurality of projectiles with a single powder charge with resultant lateral dispersion of said projectiles upon leaving the muzzle of said gun due to the presence between said projectiles in the barrel of the gun of some of the gases of explosion and the expansion of said gases upon leaving said muzzle, the combination of a chamber associated with the muzzle of said gun to receive the gases of explosion as they leave said muzzle together with the projectiles including those to which a lateral velocity has been imparted by a portion of said gases; tapered means to arrest the lateral dispersion of those projectiles so affected by said gases and return them to the other of said projectiles; and additional tapered means to compress all of said projectiles.

11. In a gun adapted to fire a plurality of projectiles with a single powder charge with resultant lateral dispersion of said projectiles upon leaving the muzzle of said gun due to the presence between said projectiles in the barrel of the gun of some of the gases of explosion and the expansion of said gases upon leaving said muzzle, the combination of a chamber associated with the muzzle of said gun to receive the gases of explosion as they leave said muzzle together wth the projectiles including those to which a lateral velocity has been imparted by a portion of said gases; tapered means spaced from said barrel but coaxial therewith to arrest the lateral dispersion of those projectiles so affected by said gases and return them to the other of said projectiles; and means coaxial with said last named means to compress all of said projectiles.

12. In a gun adapted to fire a plurality of projectiles with a single powder charge with resultant lateral dispersion of said projectiles upon leaving the muzzle of said gun due to the presence between said projectiles in the barrel of the gun of some of the gases of explosion and the expansion of said gases upon leaving said muzzle, the combination of a chamber associated with the muzzle of said gun to receive the gases of explosion as they leave said muzzle together with the projectiles including those to which a lateral velocity has been imparted by a portion of said gases; a removable end member for said chamber provided with conical means to arrest the lateral dispersion of those projectiles so affected by said gases and return them to the other of said projectiles, the characteristics of said means being in accordance with the factors of powder charge and size of projectiles; and means codependent upon said last named means to compress all of said projectiles in their continued passage through said end member.

13. In a gun adapted to fire a plurality of projectiles with a single powder charge with resultant lateral dispersion of said projectiles upon leaving the muzzle of said gun due to the presence between said projectiles in the barrel of the gun of some of the gases of explosion and the expansion of said gases upon leaving said muzzle, the combination of a chamber associated with the muzzle of said gun to receive the gases of explosion as they leave said muzzle together with the projectiles including those to which a lateral velocity has been imparted by a portion of said gases; a removable end member for said chamber provided with a bore coaxial with said barrel, said bore having a surface providing means to arrest the lateral dispersion of those projectiles so affected by said gases and return them to the other of said projectiles; and means constituting another surface of said bore to compress all of said projectiles in their continued passage through said end member.

14. In a gun adapted to fire a plurality of projectiles with a single powder charge with resultant lateral dispersion of said projectiles upon leaving the muzzle of said gun due to the presence between said projectiles in the barrel of the gun of some of the gases of explosion and the expansion of said gases upon leaving said muzzle, the combination of a chamber associated with the muzzle of said gun to receive the gases of explosion as they leave said muzzle together with the projectiles including those to which a lateral velocity has been imparted by a portion of said gases; a removable end member for said chamber provided with a bore coaxial with said barrel, said bore having a surface providing means to arrest the lateral dispersion of those projectiles so affected by said gases and return them to the other of said projectiles; and means constituting another surface of said bore joining said first named surface to compress all of said projectiles in their continued passage through said end member.

15. In combination with a shot gun, an expansion chamber to receive the gases of explosion as they leave the muzzle said chamber having means to arrest the lateral dispersion of the shot from the mass leaving said muzzle and to return them to the shot not so dispersed to create a realigned mass having any desired diameter whereby all of said shot are caused to travel in substantial true flight upon leaving said means.

16. In combination with a shot gun, an expansion chamber to receive the gases of explosion as they leave the muzzle said chamber having means to arrest the lateral dispersion of the shot from the mass leaving said muzzle and to return them to the shot not so dispersed to create a realigned mass having any desired diameter whereby all of said shot are caused to travel in substantial true flight upon leaving said means, said chamber further adapted to partially but appreciably overcome recoil of said gun.

17. In combination with a shot gun, a

chamber to receive the gases of explosion as they emerge from the muzzle of said gun together with the shot to which longitudinal and lateral velocities have been imparted by said gases, and a removable end member for said chamber provided with means to arrest the lateral velocity of said shot and translate the same into longitudinal velocity of said shot as well as a force tending to overcome recoil of the gun.

In testimony whereof I affix my signature.

RICHARD M. CUTTS.