Dec. 24, 1963 C. L. ASHBROOK ETAL 3,115,060

GAS INERTIA CONTROLLER

Filed June 20, 1961 2 Sheets-Sheet 1

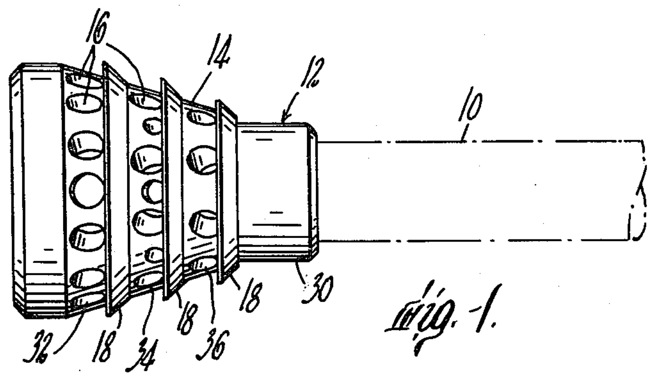

Fig. 1.

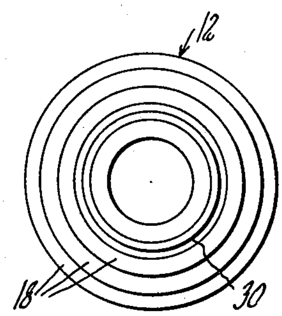

Fig. 2.

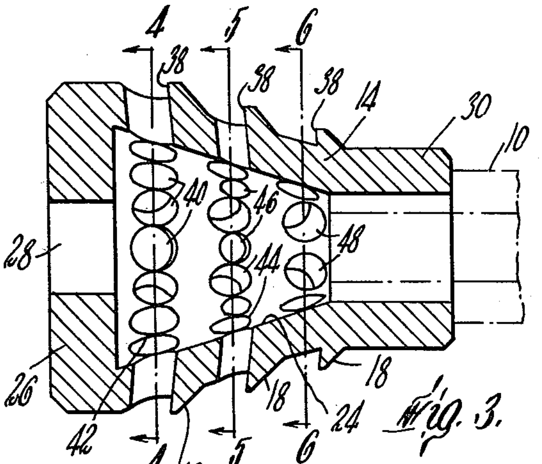

Fig. 3.

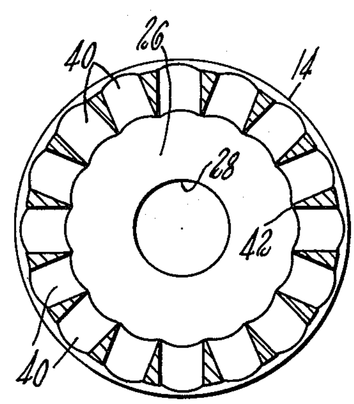

Fig. 4.

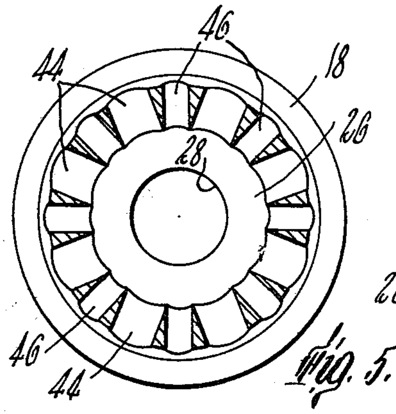

Fig. 5.

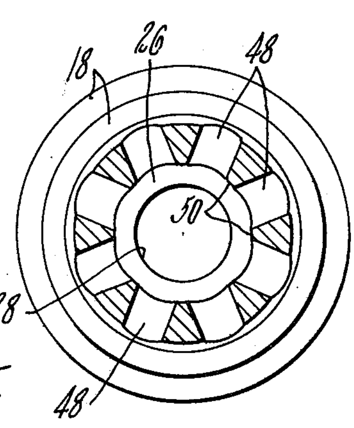

Fig. 6.

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GAS INERTIA CONTROLLER

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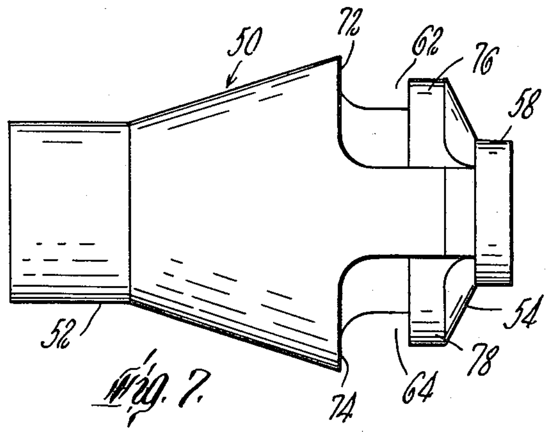

Fig. 7.

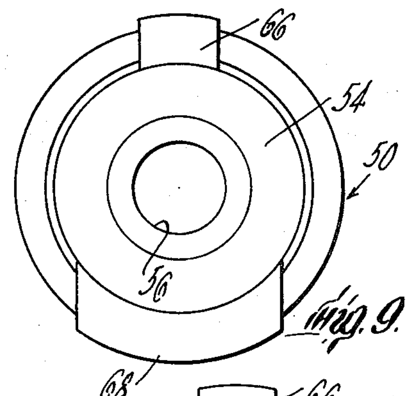

Fig. 9.

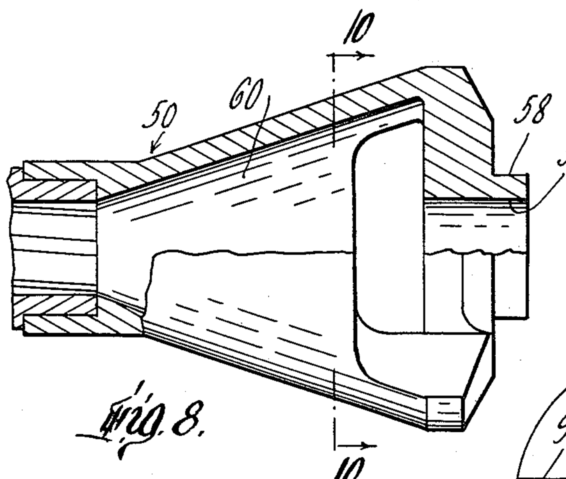

Fig. 8.

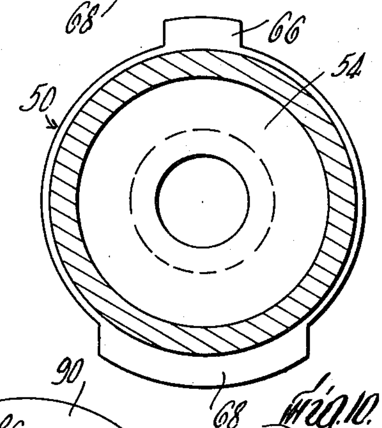

Fig. 10.

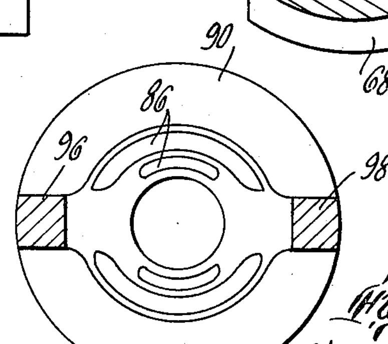

Fig. 13.

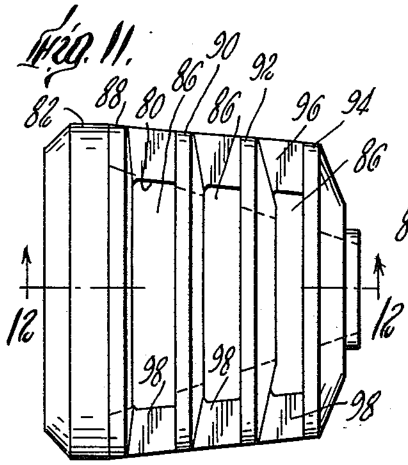

Fig. 11.

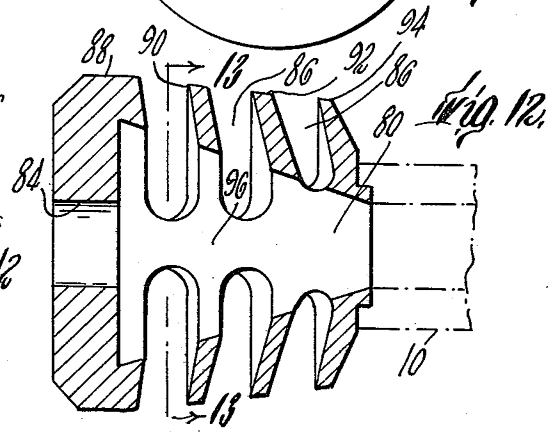

Fig. 12.

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3,115,060

GAS INERTIA CONTROLLER

Clifford L. Ashbrook, 5027 Cheena St., and Wilson G. Wing, 33 E. Rivercrest, both of Houston, Tex.
Filed June 20, 1961, Ser. No. 118,440
7 Claims. (Cl. 89—14)

This invention relates to recoil controlling devices or muzzle brakes adapted for attachment to gun barrels and particularly to a gas inertia controller particularly adapted for use with rifles, pistols and similar small arms and which are designed to check the energy of gun recoil by utilizing the gases generated on the firing thereof. It is a continuation-in-part of our application Serial No. 46,-937, filed August 2, 1960, now abandoned.

A wide variety of devices have been previously proposed for the purposes of controlling the recoil of the firearm. In the usual device some type of means is provided to divert the blast of gases radially of the longitudinal axis of the gun barrel, this change in direction of the gases creating forces which are utilized to overcome the recoil due to the rearward reaction which results from the generation of the gases for propulsion of the missle upon firing of the gun. While certain of the prior art muzzle brake devices have reduced recoil somewhat the resulting deafening increase in noise due to the use of such devices causes far greater discomfort to the marksman such that it is completely inadequate compensation for the advantages as obtained in recoil reduction.

Accordingly, it is object of the invention to provide a novel recoil controlling device suitable for use with firearms in which the recoil is controlled in a manner that it does not raise but rather diminishes the resultant noise level.

Another object of the invention is to provide an improved and reliable recoil controlling device capable of simple manufacture and which is of simple but rigid construction.

Still another object of the invention is to provide a novel and improved recoil controlling device which improves the accuracy of the firearm with which it is used.

A further object of the invention is to provide a novel and improved recoil controlling device for a firearm which reduces the intensity of the flash produced by the firearm.

Still another object of the invention is to provide an improved recoil controlling device which reduces muzzle whip, the tendency of the muzzle to rise after the gun has been fired.

The gas inertia controller of the invention is adapted for use with a firearm having a predetermined bore terminating at a muzzle to be attached by suitable means to the muzzle end of the cooperating firearm. It comprises a casing having a vertical recoil plate portion at the front end thereof. The casing defines a generally conical recoil control chamber of increasing cross-sectional area from the muzzle of the associated firearm to the recoil plate, with the conical walls of the chamber diverging from their axis, being about equal to the bore diameter at their smaller end, at an angle of about 17 degrees as has been found to be important to the proper functioning of the device in most instances. The recoil plate, which forms the front wall of the chamber, is spaced from the muzzle at least about three times the diameter of the said bore. It is disposed substantially perpendicularly to the longitudinal axis of the firearm bore and has an aperture therein aligned with the bore which functions as a passageway for the bullet, of a length equal to the diameter of the bore, and of a diameter slightly greater than the bore. Positioned in the annular wall of the chamber are a plurality of radially disposed ports. These ports may represent upwards of 25–50% of the total conical wall area of the chamber depending in part on the quantity of gas that is available for use in the device.

We have found it important to establish gas flow somewhat forwardly in order that the sound produced upon firing be reduced as to the operator of the firearm. This may be provided by inclining the ports forwardly, when possible, or by providing, immediately behind each port, an outwardly extending baffle member or rib having a forward lip portion aligned with the rear edge of the associated port, and preferably with a lower, and hence relieved edge forward of each port to cause forward gas flow.

With this arrangement when the gun is fired the slug of air in the barrel is expelled ahead of the bullet and the expanding gases, generated by the explosion of the charge, which accelerate the bullet to supersonic velocity (frequently in the order of 3,000 feet per second as it leaves the muzzle), are forced into the chamber of the gas inertia controller device. These gases, which have tremendous forward velocity as they enter the chamber, impinge on the recoil plate but are prevented from passing through the exit aperture in the plate because of the bullet therein. Hence a substantial portion is reflected backward, creating a forward force on the firearm assembly which counteracts the rearward force exerted on the firearm due to the explosion of the charge. This action alone substantially reduces the recoil of the weapon. This initial buildup in pressure, in the area the bullet enters as it leaves the muzzle, is believed to enable the bullet to more rapidly acquire spin stabilization and reduces the yawing of the bullet, thus resulting in increased accuracy. Shortly after the initial contact of the gases with the plate there is an abrupt buildup in pressure during the time (in the order of 35 microseconds) that the bullet is passing throught he exit aperture and the gases are sharply reflected from the recoil plate during this interval. This gas pressure buildup time is accurately controlled by reason of the length of the long aperture passageway. The gas inertia controller chamber is arranged so that as the gases are reflected backwards they are in part ported to the atmosphere and in part compressed as they move in a direction countercurrent to the gas components following the bullet. This countercurrent action acts to reduce the energy in the following gases and the tapered configuration of the chamber tends to increase the effectiveness of this countercurrent action due to its compressing effect. As these reflected gases pass the radially disposed ports they are gradually expelled outwardly generally radially but slightly forwardly to reduce the noise transmitted to the operator, as is determined by the axes of the ports and their baffles. The pressure in the chamber is further reduced as soon as the bullet leaves the exit aperture in the recoil plate as another discharge port is then provided so that the entire release of gas occurs quite rapidly after that time. This discharge of gases from the chamber over a comparatively extended period of time reduces the magnitude of sound and also the temperature of the gases so that the flash is sharply reduced. The abrupt changes in direction of movement of portions of the gases caused by the baffling effects of the ports are believed to create small shock waves which tend to break up the larger shock waves created by the initial contact of the gases with the recoil plate and thus serve to further reduce the amount of noise generated in this recoil controlling operation.

The gas inertia controlling device of the invention thus provides control of the gases generated as a result of the firing of the weapon so that the tremendous pressure built up is dissipated over a substantially greater period and the maximum magnitude of pressure as released to the atmosphere is much less than values resulting from the use of prior art devices. Thus the noise generated as a result of the use of this recoil controlling device which is a small fraction of the noise generated by the heretofore utilized types of muzzle brake devices and the resultant increased accuracy of the weapon are marked additional improvements over the prior art devices.

Other objects and advantages of the invention will be seen as the following description of preferred embodiments thereof progresses in conjunction with the drawings, in which:

FIG. 1 is a side elevational view of a gas inertia controller device according to one embodiment of the invention;

FIG. 2 is an end elevational view of the device shown in FIG. 1 unsecured to a firearm barrel;

FIG. 3 is a sectional view of the controller device taken along the line **3—3** of FIG. 2 showing the interior of the chamber and the rings of discharge ports;

FIG. 4 is a sectional view of the device taken along the line **4—4** of FIG. 3 showing a first ring of discharge ports;

FIG. 5 is a sectional view taken along the line **5—5** of FIG. 3 showing a second ring of discharge ports;

FIG. 6 is a sectional view taken along the line **6—6** of FIG. 3 showing a third ring of discharge ports;

FIG. 7 is a top view of a second simplified embodiment of the gas inertia controller of the invention;

FIG. 8 is a sectional side view of the controller of FIG. 7;

FIG. 9 is a front view of the controller of FIG. 7;

FIG. 10 is a sectional view taken along the line **10—10** of FIG. 8;

FIG. 11 is a side elevational view of a third embodiment of the gas inertia controller of the invention;

FIG. 12 is a sectional view taken along the line **12—12** of FIG. 11; and

FIG. 13 is a sectional view taken along the line **13—13** of FIG. 12.

With reference to the drawing there is shown in dashed lines in FIG. 1 the muzzle end of a rifle barrel **10** on which is mounted one embodiment of the gas inertia concontroller device **12** in accordance to the invention. This device is secured to the necked down end of the rifle barrel by silver solder or other suitable well-known means as indicated generally in FIG. 3. The conical chamber of the controller device is defined by a casing **14** having a plurality of ports **16** therein disposed in three annular rows. Positioned immediately to the rear of each row of ports is an outer ridge or baffle ring **18**. As best illustrated in FIG. 3 the controller device **12** comprises an annular interior wall **24** of casing **14** with a recoil plate **26** disposed as a vertical end surface at the front end thereof spaced about three times the bore diameter from the muzzle end. The recoil plate is of substantial thickness for a cylindrical passageway **28** of length equal to the bore which permits blocking by the bullet when the rifle is fired. The annular casing surface **24** is tapered rearwardly at an angle of 17° to the longitudinal axis of the controller device (which is aligned with the axis of the rifle barrel) from the recoil plate **26** to the rearwardly extending cylindrical portion **30** which is arranged to contact and to be secured to the rifle barrel **10**.

The conical chamber has forty cylindrical gas discharge ports therein arranged in three annular rows **32, 34, 36**. The rows of ports are shown in section in FIGS. 4, 5, and 6 respectively. Each cylindrical port is disposed in a radial direction to discharge gases outwardly from the interior of the chamber but the axis thereof is inclined forwardly at an angle of approximately 5° as best seen in FIG. 3. Disposed immediately to the rear of each row of ports is a baffle ring **18** which has a forward lip portion **38** disposed immediately adjacent the rear edge of the ports. This forward lip portion forms an extension of the port wall and thus also is slanted forwardly at the 5° angle as seen in FIG. 3.

The front row **32** of ports have sixteen cylindrical ports **40** of the same diameter equally spaced therein such that the interior surface of the chamber wall between the holes is cut away or relieved so that an interrupted annular groove at **42** is formed around the interior of the chamber. The middle row **34** of ports has eight ports **44** of the same dimensions as the front row equally spaced therearound and seven smaller ports **46** spaced between the eight principal ports **44** so that there is provided a second annular groove within the chamber which is similar and parallel to the groove **42** associated with port row **32**. The third or rear row **36** of ports has eight equally spaced ports **48** of the same size as the front row ports. The spacing of these ports however is such that there is a small land **50** in the interior of the chamber between the walls of the adjacent ports and thus no continuous baffle groove is associated with this row. The total port area is approximately 30% of the conical surface area of the gas inertia controller.

In operation, the explosion of the charge generates gases which force the slug of air in front of the bullet and the bullet from the barrel. The bullet emerges from the barrel of the firearm into a zone of intermediate pressure, rather than a zone of substantially zero pressure as is the case where no gas inertia controller is utilized, and the bullet becomes spin stabilized much more rapidly. A portion of these expelled gases precedes and follows the bullet through the aperture **28** in the recoil plate **26** but the majority of the gases form an expanding shock front which impinges on the vertical recoil plate surface. Upon contact these gases are violently reflected rearwardly into the conical chamber as a multitude of shock waves. This rapid change in direction of the mass of gases breaks the shock front and absorbs a portion of the recoil energy of the firearm so that the rearward force on the gun barrel is markedly reduced. Since the angle of incidence of the gas blast on the recoil plate is equal to the angle of reflection the high velocity gases are reflected back at varying angles on the various portions of the conical chamber wall for ultimate expulsion through the ports. However at each point of contact with the chamber wall there is further reflection which reduces the magnitude of the shock wave and acts so that the force is dissipated over a longer period of time. Further, the gases moving rearwardly are somewhat compressed and are forced toward the main stream of gases to act thereon in countercurrent action and reduce the energy therein. As the bullet moves into the aperture **28** there is a significant increase of pressure in the controller chamber as a port of substantial area is then closed. This increase in pressure accentuates the above-mentioned effects. During the entire operation however gases are gradually but continually being released through the ports **16**. Due to the slight forward inclination of the ports in the chamber wall the gases are controlledly expelled in a direction away from the operator and at a rate so that the noise created by the recoil controlling action is not sensed. In fact the magnitude of the sensed noise when the gas inertia controller is used is less than that sensed without it due to the extended period of gas release and to the baffling of the several shock fronts. Further, due to the comparatively long passageways through which the gases are ported, upon release they are not luminous so that the device has the additional advantage of being a flash reducer.

Actual tests on rifles with and without the above described gas inertia controller of the invention have demonstrated its remarkable effectiveness in increasing accuracy and in reducing recoil. With a 30.06 caliber rifle using a 200 grain bullet the vertical grouping of test series of shots at 1000 yards without the device was 20" and with the device, 14"—improvement by a factor of 30%; 300 yards the grouping was 4" and 2" respectively—an improvement factor of 50%. The recoil force was reduced by 35%. Similar tests with a 300 Atley also showed a significant improvement in accuracy and a 55% reduction in recoil force.

A simplified embodiment of the gas inertia controller of the invention is shown in FIGS. 7–10. This controller device is particularly useful on gas operated firearms such as the M–14 automatic rifle in which a portion of the gases generated by the explosion of the charge is used to perform necessary mechanical operations in the firearm and hence the quantity of gases available for use in the controller is reduced. The gas controller **50** casing shown in FIG. 7 is disposed in the same general position as the controller **12** in FIG. 1. That is, the rifle barrel is adapted to be connected to the end portion **52** and the recoil plate **54** is formed in the opposite end and spaced about three times the bore diameter from the muzzle end. The length of the exit aperture **56** shown in FIG. 8 is extended by the provision of a hub **58** so that that aperture is closed by the bullet for a longer time than would be the case without the hub portion, to provide a length equal to bore diameter.

The recoil chamber **60** is conical in shape and tapers rearwardly at an angle of 17° to the axis of the device. Two ports **62, 64** are provided in a single row adjacent the rear face of recoil plate **54**, said plate being supported at its uppermost point by a narrow member **66** and at its lowermost point by a wider member **68**, say of 60 to 90 degrees angular extent which reduces the tendency of the gun to rise when fired in close proximity to the ground or other surface. It should be particularly noted that, in order to provide the requisite forward movement of gases upon firing of the gun, openings or ports **62, 64** are provided with outwardly extending baffle members **72, 74** aligned with the rear edge of their associated port, the forward edges **76, 78** of said ports being positioned radially inwardly of said baffle members **72, 74**. With this arrangement, gas flow is established in a generally radial but slightly forward direction in order that the sound transmitted to the operator be reduced upon firing. This simplified structure, although not as effective as the multiple port structure described above in some respects, is nevertheless highly useful in reducing recoil to a high degree, yet at the same time decreasing the muzzle blast as heard by the operator, such being achieved by the unique conical chamber with means but slightly forwardly directed for so directing gas emerging from the chamber.

A third embodiment is shown in FIGS. 11–13. This gas inertia controller also includes a conical chamber **80**, again having a 17° chamber, bounded at its forward end by a recoil plate structure **82** which has an exit aperture **84** therethrough. Ports **86** from the chamber **80** are provided between a series of dished disk structures **88, 90, 92, 94**. These ports **86** are arcuate in nature, each port being bounded by the spacers **96, 98** (best shown in FIG. 13). The percentage of port area in this device is slightly greater than that of the other two embodiments. It will also be noted that there are fewer baffling surfaces within the conical chamber yet the length of the exit aperture **84** is about the same. This like that of FIGS. 7–9 is a suitable device where the amount of noise generated and the extent of the flash is not as critical a factor such as would dictate the use of devices dimensioned along the lines of the first previously described embodiment.

These devices render themselves readily to mass production as they are preferably precision cast and a hole is drilled in the recoil plate to a suitable dimension somewhat more than the caliber of the weapon on which the device is to be utilized. The length of the exit passageway may be adjusted in accordance with the duration of pressure buildup desired and the percentage of port area in the conical chamber may be varied so that the desired rate of gas release is provided. As the ports or their baffles are directed forwardly, the released gases do not have any substantial components acting in a rearwardly direction towards the marksman and thus the magnitude of the noise produced by the weapon as sensed by the marksman is significantly reduced. Other modifications of the disclosed structures within the spirit and scope of the invention will be obvious to those having ordinary skill in the art. Therefore while preferred embodiments of the invention have been shown and described it will be understood that the invention is not intended to be limited thereto or to details thereof and departures may be made therefrom within the spirit and scope of the invention as defined in the claims.

What is claimed is:

1. A recoil controlling device adapted for attachment to the muzzle end of a firearm barrel comprising a conical casing portion and a front wall portion having an interior surface perpendicular to the axis of the casing, said device having a bullet passageway therethrough, the longitudinal axis of which is adapted to be positioned in alignment with the bore of the gun with a rear cylindrical passageway portion adapted to be secured to the muzzle end at the firearm barrel, a front cylindrical passageway portion aligned with said rear portion and disposed in said front wall portion, and an intermediate passageway portion formed by the interior wall of said conical casing which defines a frusto-conical chamber of substantially uniformly increasing cross section from said rear passageway portion to said front wall, said interior wall being formed by a line element of revolution disposed at an angle of about 17 degrees to said longitudinal axis and said intermediate portion having a plurality of radially disposed chamber ports disposed in the wall thereof providing communication between said chamber and the area outside of said casing, the axes of said chamber ports being inclined forwardly such that gases expelled from the muzzle of the gun upon explosion of the charge tend to impinge on said front wall portion and to be reflected therefrom back into said chamber for selective release in a forward direction through said ports in a recoil controlling operation.

2. The device as claimed in claim 1 wherein said ports are arranged in spaced relationship from one another in a plurality of circumferentially extending rows along said chamber.

3. A recoil controlling device adapted for attachment to the muzzle end of a firearm barrel comprising a body having a passageway therethrough adapted to be disposed in axial alignment with the bore of the gun, said passageway having a rear cylindrical portion adapted to be secured to the muzzle end of the firearm barrel, an intermediate expanding portion having a generally frusto conical shape and a front cylindrical portion, said front cylindrical portion being disposed in a recoil plate which has a surface disposed substantially perpendicular to the axis of said passageway and which connects the walls of the intermediate portion and the front cylindrical portion, said intermediate expanding passageway portion having an interior wall formed by a line element of revolution disposed at an angle of about 17 degrees to said bore and having a plurality of rows of forwardly inclined radially extending ports disposed therein, and a baffling rib extending generally outwardly from said body and positioned immediately behind each row of ports, each rib having a forward lip portion substantially aligned with the rear edge portion of the ports in each row such that gases expelled from the gun barrel upon explosion of the charge tend to impinge on said recoil plate surface and be reflected therefrom for selective release through said ports in a recoil controlling operation.

4. A gas inertia controller adapted for attachment to the muzzle end of a firearm comprising a generally annular body having a recoil plate portion of substantial thickness disposed perpendicularly to the longitudinal axis of said body, a passageway through said body adapted to be positioned in axial alignment with the barrel of the firearm for the passage therethrough of the bullet and the gases expelled from the muzzle upon explosion of the charge, said passageway being defined by a rear cylindrical portion adapted to be secured to the muzzle end of said firearm, a front cylindrical portion disposed in said recoil plate having a diameter sufficient to permit free passage of

the bullet therethrough but being dimensioned such that the front cylindrical portion is substantially closed to the flow of gases therethrough during the interval that the bullet is in said front cylindrical portion, and a conical chamber intermediate said front and rear portions, the interior wall of said conical chamber being disposed at an angle of about 17° to said longitudinal axis so that the cross-sectional area of the chamber increases at a substantially uniform rate from said rear portion to said recoil plate, said chamber having a plurality of radially disposed cylindrical ports extending through the wall thereof, the area of said ports being approximately 30% of the area of the interior surface of said conical chamber and the axes of said cylindrical ports being inclined forwardly, such that gases expelled from the firearm muzzle upon explosion of the charge tend to impinge on said recoil plate and to be reflected therefrom back into said chamber for gradual release over a significant period of time through said ports in a recoil controlling operation, said gases being baffled and reflected within said chamber and during the release therefrom so that the resultant noise level is substantially reduced.

5. The gas inertia controller as claimed in claim 4 wherein said ports are arranged in a plurality of circumferentially extending rows about said chamber and further including an outwardly projecting gas deflecting ridge disposed immediately behind each said row of ports, each said ridge including a lip portion substantially aligned with the rear edge portion of the ports in the associated row for deflecting expelled gases in a forwardly direction.

6. A gas inertia controller for use with a firearm having a predetermined bore terminating at a muzzle, said controller including a casing having a chamber of frusto-

conical shape with its smaller diameter at one end generally equal to the bore of said firearm for attachment at said one end to said muzzle, with the chamber walls extending coaxially of said bore beyond said muzzle and diverging at an angle of about 17 degrees to its axis, a recoil plate spaced from said one end at least about three times the diameter of said bore and disposed substantially perpendicular to said bore, said recoil plate having an aperture therethrough generally equal to but larger than said bore defining a bullet passageway, said chamber having generally radial opening means having baffle means adjacent their outermost rear edges for creating slightly forward flow of gas emitted from said openings upon firing of said firearm.

7. The controller as claimed in claim 6 wherein the area of said radially disposed openings is approximately 30% of the total area of the interior surface of said chamber.

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