

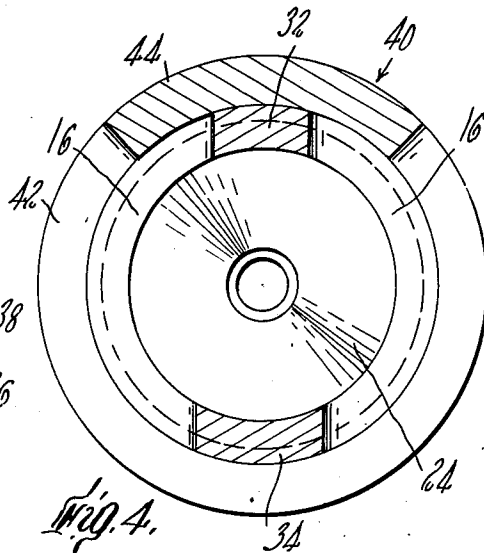
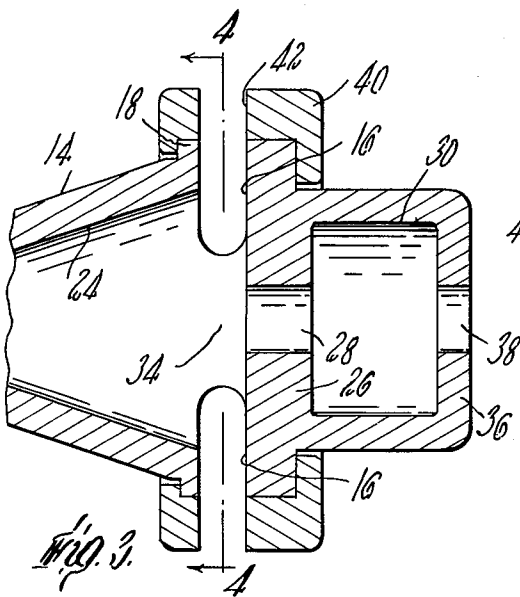
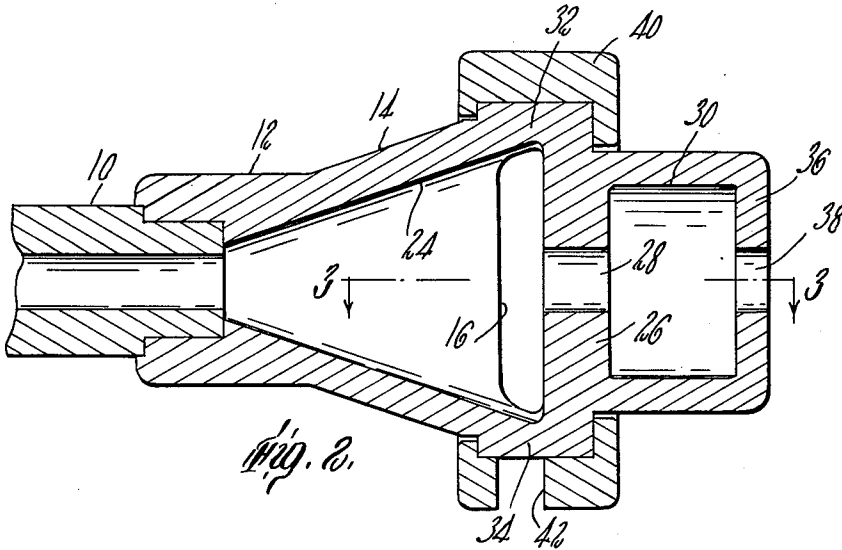
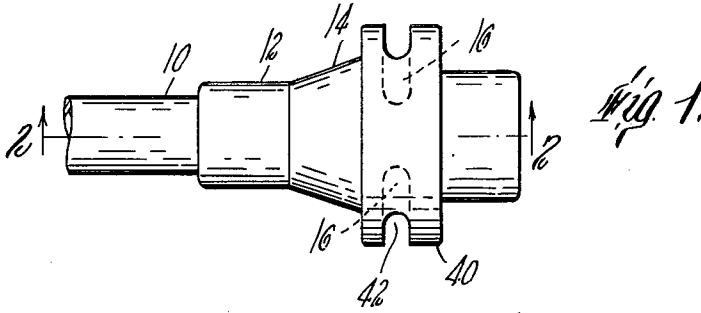
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RECOIL CONTROLLING DEVICE

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RECOIL CONTROLLING DEVICE

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1 Claim. (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, shotguns and similar small arms and which is 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. 118,440, filed June 20, 1961, which is in turn a continuation-in-part of our application Serial No. 46,937, filed August 2, 1960.

A wide variety of devices have previously been 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 missile 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 an 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.

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 with an end wall portion spaced therebeyond at the front end thereof. The casing defines two chambers within it, 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 conical chamber diverging from their axis, being about equal to the bore diameter at their smaller end, terminating at the recoil plate, and a cylindrical chamber therebeyond terminating at the end wall. The recoil plate, which forms the front wall of the conical chamber and the rear wall of the cylindrical 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 preferably at least about equal to the diameter of the bore, and of a diameter slightly greater than the bore. The end wall, which forms the front wall of the cylindrical chamber is spaced from the recoil plate by about twice the bore

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diameter. It is also substantially perpendicular to the longitudinal axis of the bore and has a bullet aperture therein. The inner diameter of the wall of the cylindrical chamber is at least about twice and more preferably about three to four times the diameter of the firearm bore. Positioned in the annular wall of the conical 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. There are no openings in the wall of the cylindrical chamber, so that such is enclosed except for the bullet apertures in its end walls.

We have found it important to control gas flow in order that the sound produced upon firing be reduced as to the operator of the firearm. This may be provided by the forward cylindrical chamber, and be aided as well 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.

With this arrangement, when the gun is fired the slug of air in the barrel is expelled ahead of the bullet or other missile and passes through the two chambers. The expanding gases generated by the explosion of the charge, behind the bullet, 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 conical 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 through the 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 conical 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 into the forward, cylindrical chamber is then provided. The rate of discharge of gases through the aperture of the recoil plate is reduced, however, by virtue of the bullet blocking the aperture in the end plate during its passage therethrough. This provides an important and substantial decrease in sound. After the bullet clears the end plate, the entire release of gas occurs quite rapidly. This successive discharge of gases from the two successive chambers, one ported and one enclosed, over a comparatively extended period of time re-

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duces the magnitude of sound and also the temperature of the gases, which in turn tends to reduce the volume of gas by cooling, 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 of the conical chamber 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, while the second chamber can effectively operate as a temporary compression chamber.

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. When used with a shotgun, the shot pattern distribution is much improved, both as to pattern size and uniformity of the shot distribution in the pattern.

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

FIG. 1 is a top view of a gas inertia controller device according to the invention;

FIG. 2 is a side cross-sectional elevational view of the device shown in FIG. 1 taken on the line 2—2 thereof;

FIG. 3 is a sectional view of the controller device taken along the line 3—3 of FIG. 2; and

FIG. 4 is a sectional view of the device taken along the line 4—4 of FIG. 3.

With reference to the drawing there is shown in FIGS. 1 and 2 the muzzle end of a rifle or shotgun barrel 10 on which is mounted one embodiment of the gas inertia controller device in accordance with the invention. This device is secured to the necked down end of the barrel by silver solder or other suitable well-known means. The chambers of the controller device are defined by a casing 14 having a plurality of ports 16 therein disposed in a single annular row. Positioned immediately to the rear of the row of ports is an outer ridge 18. Thus the controller device 12 comprises an annular conical interior wall 24 and cylindrical wall 30 of casing 14 with a recoil plate 26 and an end plate 36 both disposed as vertical surfaces. The recoil plate 26 is spaced about five times the bore diameter from the muzzle end, while the end plate 36 is spaced about twice the bore diameter from the recoil plate 26. 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 12 which is arranged to contact and to be secured to the rifle barrel 10.

The conical chamber defined by conical surface 24 has two side gas discharge ports 16 therein arranged in an annular row. They are of a longitudinal dimension about equal to bore diameter, and have a peripheral dimension of about 120° between upper web 32 and lower web 34. Each cylindrical port is disposed in a radial direction to discharge gases outwardly from the interior of the chamber defined by conical surface 24. Disposed immediately to the rear of the row of ports is a baffle ridge 18 which in combination with the recoil plate 26 tends to

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provide an effective somewhat forward discharge of gases. The total port area is about 30% of the conical surface area of the conical chamber.

The conical chamber portion of the casing 14 is supported by webs 32, 34 and includes the cylindrical inner wall 30 and the transverse end wall 36. The annular cylindrical casing surface 30 is of a diameter at least about twice the bore diameter and more preferably about three to four times the bore diameter as shown. Its length is preferably about twice the bore diameter. The end plate 36 has a cylindrical bullet passageway 38 therein of a diameter but slightly larger than the bore diameter so that it will remain substantially closed when a bullet is passing therethrough.

Preferably, surrounding the ports 16 is a ring member 40 mounted for adjustable positioning on casing 14, such member having a port 42 about 270 degrees in extent and of a length at least as great as that of the ports. Ring member 40 has a tight enough frictional fit so that it will be maintained in its adjusted position, conventionally with its web 44 upwards as shown in the drawings.

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. As the bullet leaves the recoil plate aperture 28 and passes into end plate aperture 38, pressure will build up in the enclosed cylindrical chamber and so further delay the release of gases, and hence further reduce the noise and recoil. During the entire operation, however, gases are gradually but continually being released through the ports 16. Due to the slight forward gas discharge from 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 is much reduced. 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. The ring member permits adjustment for bullet spin compensation, by turning it to the side as desired. Also, for ground effect compensation, it may be turned over so that its web 44 is downward.

These devices render themselves readily to mass production as they are preferably precision cast and a hole is drilled in the recoil and end plates to a suitable di-

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mention 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 gases are directed forwardly, they 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 a preferred embodiment of the invention has 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 claim.

What is claimed is:

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 and an end plate portion spaced from said recoil plate, said plates being 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 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 recoil plate cylindrical portion is substantially closed to the flow of gases therethrough during the interval that the bullet is in said recoil plate cylindrical portion, a cylindrical portion disposed in said end

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plate portion having a diameter sufficient to permit free passage of the bullet therethrough but being dimensioned such that the end plate is substantially closed to the flow of gases therethrough during the interval that the bullet is in said end plate portion, an enclosed conical chamber intermediate said rear and recoil plate portions, the interior wall of said conical chamber being disposed at an angle 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 being enclosed throughout its length and having at its end adjacent said recoil plate peripheral slot means extending through the wall of said chamber and for a minor proportion of the length of said conical chamber along said axis, and an enclosed cylindrical chamber intermediate said recoil plate and end plate portions, such that gases expelled from the firearm muzzle upon explosion of the charge tend to impinge first on said recoil plate and to be reflected therefrom back into said conical chamber and then to be released into said enclosed chamber for gradual release over a significant period of time through said slot means in a recoil controlling operation, said gases being baffled and reflected within said conical chamber and during the release therefrom and compressed in said enclosed chamber so that the resultant noise level is substantially reduced.

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