This invention relates to a gas operated autoloading firearm and more particularly to an autoloading shotgun which may be made in any of the various shot shell gauges and which will handle, in any gauge, the numerous powered shot shells commercially available.

For many years, gas operated shotguns have been commercially produced and have been widely accepted by the shooting public even in view of minor deficiencies and shortcomings. Although such shotguns are expensive to manufacture and fairly complicated in construction, the demand for new and better ones has steadily increased. In order to have a gas operated shotgun function properly, with the complete range of high and low powered shot shells commercially available, compensating devices have been incorporated. These compensating devices are sometimes built in the gun to handle the various charges automatically or mechanical selectors have been provided to compensate for the various gas charges delivered to the gas system.

In order to overcome the need for compensating devices, attempts have been made to design a gas operated shotgun which will function with all types of loads. These attempts have included changing the gas ports and the gas cylinder. Also the distance of the gas port from the chamber has been varied. It is now well-known that a gas port distance of between 7 and 9 inches forward of the chamber will result in substantially the same gas pressure delivered to the gas cylinder regardless of the power of the shot shell fired. Therefore by the proper selection of gas port distance from the receiver, combined with proper port size and cylinder size, a shotgun can be made that will properly function with shells of all powers without any compensating devices or mechanical adjustments.

It has been the practice in the industry to position the piston within the magazine tube. Because the magazine tube was cylindrical and adjacent to the barrel it was the easiest place to provide a gas cylinder. Unfortunately this reduced the capacity of the magazine to about one-half. Attempts to increase magazine capacity prompted numerous attempts to locate a gas cylinder and piston outside the magazine tube. Generally these attempts have not been successful and most have ended in failure. By placing the piston around the magazine tube some success has been attained, but until now complete success has not been reached.

It is therefore the main object of this invention to provide a gas system for autoloading shotguns which will reliably function with all commercially available shotguns without the need for compensators or manual adjustments.

It is a further object of this invention to provide such a gas system using an annular ring-shaped piston.

It is still a further object of this invention to provide a gas system for autoloading firearms utilizing an annular piston or a similar element.

Another object of this invention is to provide a gas system for autoloading firearms which is substantially self-cleaning.

Still another object of this invention is to provide a gas-operated shotgun having a greatly increased life.

It is contemplated that these objects best be achieved by providing an annular ring-shaped piston surrounding the magazine with a fairly tight fit but unconnected to any elements in the firearm. Both a barrel seal and piston seal are provided to prevent gas leakage. An inertia weight or action bar sleeve is positioned to be moved by the piston. After a short movement the piston ceases its travel and the inertia weight functions the action.

It is to be understood that the embodiments of the invention to be disclosed are equally applicable to all gas-operated firearms having a tubular magazine coaxial with a barrel. Other objects and advantages of this invention will become apparent as the following description proceeds, and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

In the drawings:

FIGURE 1 is a fragmentary sectional side elevation of a firearm incorporating this invention showing the firearm after firing;

FIGURE 2 is a fragmentary sectional side elevation of a firearm incorporating this invention showing the action closed; and

FIGURE 3 is a perspective view of the piston and seals forming a part of this invention.

The drawings illustrate a gas-operated autoloading shotgun comprising a receiver 1 on which is releasably secured a barrel 2 having a barrel chamber 3. Secured to the receiver below and coaxial with the barrel is a magazine tube 4 having one end 5 in open communication with receiver 1. The opposite end of the magazine is closed by a releasably secured magazine cap 6.

A gas chamber 9 is formed around magazine 4 intermediate the ends thereof. This chamber is formed between tube 4 and a gas cylinder 7 which surrounds tube 4 and is secured to barrel 2. The forward or muzzle of cylinder 7 has a close fit with tube 4 but has enough clearance to be slideable on tube 4 to allow barrels to be changed. By such construction a shooter can use one basic gun and special barrels be equipped for all kinds of hunting and target practice.

In order to close the forward end of cylinder 7 and make it gas tight an annular barrel seal 8 is provided. Seal 8 fits about tube 4 and is positioned within chamber 9 in contact with the forward end of cylinder 7. Annular piston 10 and annular piston seal 11 are positioned about tube 4 and slideable thereon. Rearward of cylinder 7 an action bar sleeve or inertia weight 12 is placed with a loose sliding fit on tube 4.

Action bars are connected to sleeve 12 and carry the breech bolt 13 at their rearward end. Only one action bar 14 is shown but it is to be understood that there is one action bar on each side of tube 4 and positioned within the space between barrel 2 and tube 4. Bolt 13 contains a locking block 15 which engages notch 16 to lock the action in the battery or ready-to-fire position. The action bars also are connected to a link 17 at their rearward end which in turn is connected to the action spring 18 positioned within the butt stock not shown.

As can be seen in FIG. 2 when the gun is ready to fire spring 18 forces sleeve 12 forward causing bolt 13 to go to the battery or ready-to-fire position. This allows block 15 to engage notch 16 and thereby lock bolt 13 closed. In this condition piston 10 and piston seal 11 are both forced forward in cylinder 7 on the muzzle side of gas relief opening 19 cut in the upper rear portion of cylinder 7. This places piston 10 in contact with gas port 20 which communicates between barrel 2 and chamber 9 through the upper wall of cylinder 7.

After firing the firearm mechanism is opened as shown in FIG. 1 by reason of gas pressure transmitted from barrel 2 to chamber 9. Once the shot charge and wad
3 column of the shot shell has progressed through the barrel past port 20. Gas pressure is taken from barrel 2 to chamber 9. The gas enters chamber 9 and forces piston 10 and piston seal rearward due to the pressure in barrel 2. This action takes place during an extremely short period of time. The gas must enter chamber 9 and exert enough pressure on piston 10 to function the firearm before the shot charge and wad column clears the muzzle and relieves the pressure in barrel 2.

In order to properly function the gun to open the action, eject the fired cartridge case and load a new shot shell from magazine 4 into chamber 3, a minimum amount of force must be applied to piston 10. This force must be sufficient to impart enough energy to sleeve 12 to cause compression of spring 18 a distance necessary to perform the foregoing functions. If not enough pressure is delivered to chamber 9 the gun will fail to function properly and if too much pressure is delivered to chamber 9 the gun can be damaged.

It can therefore be seen that means must be provided to insure that a substantially even pressure is delivered to chamber 9 each and every time the gun is fired. At the present time, a variety of shot shells are commercially available loaded with varying amounts of powder and consequently developing different amounts of gas pressure when fired. It is because of this that all gas-operated autoloaded shotguns in the past have included compensators or have been equipped with manual selection devices or both which devices have been utilized in order to insure that a substantially equal pressure is delivered to the gas system regardless of the type shell fired.

It has been discovered that no matter what power shell is fired in a shotgun, the pressure developed at a certain distance forward of the chamber is essentially equal. This distance is 7 to 9 inches forward and by utilizing this information a gas system has been developed that relies equally for all types of shells without the need for any additional mechanism to equal pressure delivered to the gas system. This distance is so close to the chamber that very little room remains in the magazine for shells if the piston is contained within the magazine. It is therefore necessary to place the piston outside the magazine to take advantage of this information. This also results in the added advantage of having a magazine tube long enough to hold the shells which results in a five shot shotgun such as the recoil operated shotguns.

Magazine tubes are relatively thin and consequently it is extremely difficult to maintain them completely straight and parallel to the barrel. Attempts to use a large heavy piston surrounding the magazine tube have not been completely successful. In order to function the gun a heavy mass must be functioned by the gas system so that enough energy can be developed to compress the action spring which must then expand to close the action. An annular piston of such weight is necessarily quite long and must have a gas tight fit within the magazine tube. Due to irregularities in magazine tubes such a system has not functioned satisfactorily.

In order to take advantage of the fact that gas pressure is fairly constant a set distance from the chamber a new gas system had to be invented. As set forth this system comprises an annular ring-shaped piston, an annular piston seal and barrel seal with a large inertia sleeve which is started in motion by the piston but is heavy enough to then function the action without additional energy being added thereto.

As can be seen in FIG. 1 gas pressure enters chamber 9 through port 20 after firing. As soon as the shot and wad column progress past port 20 after firing gas is taken from barrel 2 into chamber 9. This gas under high pressure is directed against piston 10 causing rapid rearward movement of both piston 10 and piston seal 11. These members are thereby forcibly and rapidly driven against sleeve 12 causing sleeve 12 to move rapidly rearward. Piston 10 and seal 11 are moved a very short distance due to the position of opening 19. The gas pressure in chamber 9 which gives motion to piston 10 and seal 11 is rapidly reduced once these members have moved past opening 19. Due to the friction between tube 4 and piston 10 and seal 11 necessitated by the need to have a gas tight fit once the gas pressure acting on the piston and seal is relieved, these elements slow their movement quite rapidly and move very little after emerging from chamber 9.

In order to insure complete and reliable functioning of the action, inertia weight or sleeve 12 has a loose sliding fit on magazine 4. It can be seen that once sleeve 12 is started in motion its very mass continues in motion to compress spring 18 and retract bolt 13 from the battery position. This action removes the fired shell from the chamber and positions a new shell for proper loading. When sleeve 12 has been brought to a stop spring 18 will then function to close the action returning the elements to the position shown in FIG. 2. The firearm is now ready to be fired once again.

Due to the extremely small size of the piston and seal, and also because of their very short travel, malfunction will not occur if tube 4 is not completely straight or parallel with barrel 2. It should be evident that if sleeve 12 had a gas fit with tube 4 any irregularities in tube 4 would restrict movement of the sleeve and quite likely result in a malfunction. It can therefore be seen that the present invention has provided a gas system which is reliable in operation and free of deficiencies contained in previous gas-operated shotguns. It has been found that the life of a shotgun with this system and buffer elements not shown has resulted in a gun with a greatly increased life.

Another advantage of this system which is not readily apparent is its self-cleaning property. The use of an annular piston and a chamber surrounding the magazine tube allows the gas to rapidly leave the chamber when the piston leaves the chamber. The rapid expansion of gas out of the chamber cleans powder and other residue out of the chamber. This prohibits building up of lead deposits and the like which cause malfunctions in other gas-operated shotguns.

What is claimed is:
1. In an autoloaded firearm having a barrel, a receiver to which said barrel is secured, a tubular magazine mounted in said receiver beneath and coaxial with said barrel, a breech bolt reciprocally mounted in said receiver, and locking means to releasably secure said bolt as a closure for said barrel, the improvement in autoloaded operating mechanism comprising a cylindrical member secured to said barrel and encircling a portion of said magazine, said cylindrical member and said magazine forming a gas chamber, an annular piston slidably mounted on said magazine normally within said chamber, gas ports connecting said gas barrel and said chamber, an annular inertia weight loosely mounted on said magazine for reciprocation thereon, action bar means connecting said weight to said bolt, spring means urging said weight toward said barrel, said gas engaging said chamber through said ports momentarily for said piston against said weight whereby said weight actuates said bolt.
2. The combination described in claim 1 in which said piston is ring shaped, and is free mounted on said magazine without attachment to any other element.
3. The combination described in claim 1 in which said chamber is provided with a gas relief opening to limit the movement of said piston.
4. The combination described in claim 1 in which said chamber is provided with an annular ring-shaped gas seal at the forward end thereof.
5. The combination described in claim 1 in which an annular ring-shaped piston seal is mounted on said magazine rearward of said piston and normally within said chamber.
6. The combination described in claim 2 in which a barrel seal is positioned at the forward end of said chamber and a piston seal is mounted on said magazine rearward of said piston.

7. In a gas-operated firearm having a barrel, a receiver to which said barrel is releasably mounted, a tubular magazine permanently mounted in said receiver beneath and in parallelism with said barrel, a breech bolt reciprocally mounted in said receiver, the improvement in a gas system comprising a cylindrical member secured to said barrel and encircling said magazine intermediate the ends thereof, said cylindrical member and said magazine forming an annular gas chamber therebetween, an annular ring-shaped seal positioned on said magazine to seal the forward end of said chamber, an annular ring-shaped piston slidably mounted on said magazine free of other connections and normally within said gas chamber, an annular ring-shaped piston seal slidably mounted on said magazine free of other connections positioned rearward of said piston and normally within said gas chamber, at least one gas port communicating between the interior of said barrel and the interior of said chamber, an action bar sleeve mounted for reciprocation on said magazine, action bars connecting said sleeve to said bolt, an action spring in the butt stock of said firearm urging said sleeve toward said gas chamber, said piston driven rearward by gas entering said chamber from said barrel, a gas relief opening in said chamber to rapidly reduce gas pressure once said piston clears said chamber, said piston imparting sufficient energy to said sleeve to cause said sleeve to fully reciprocate thereby functioning said firearm.

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