

Aug. 31, 1926.

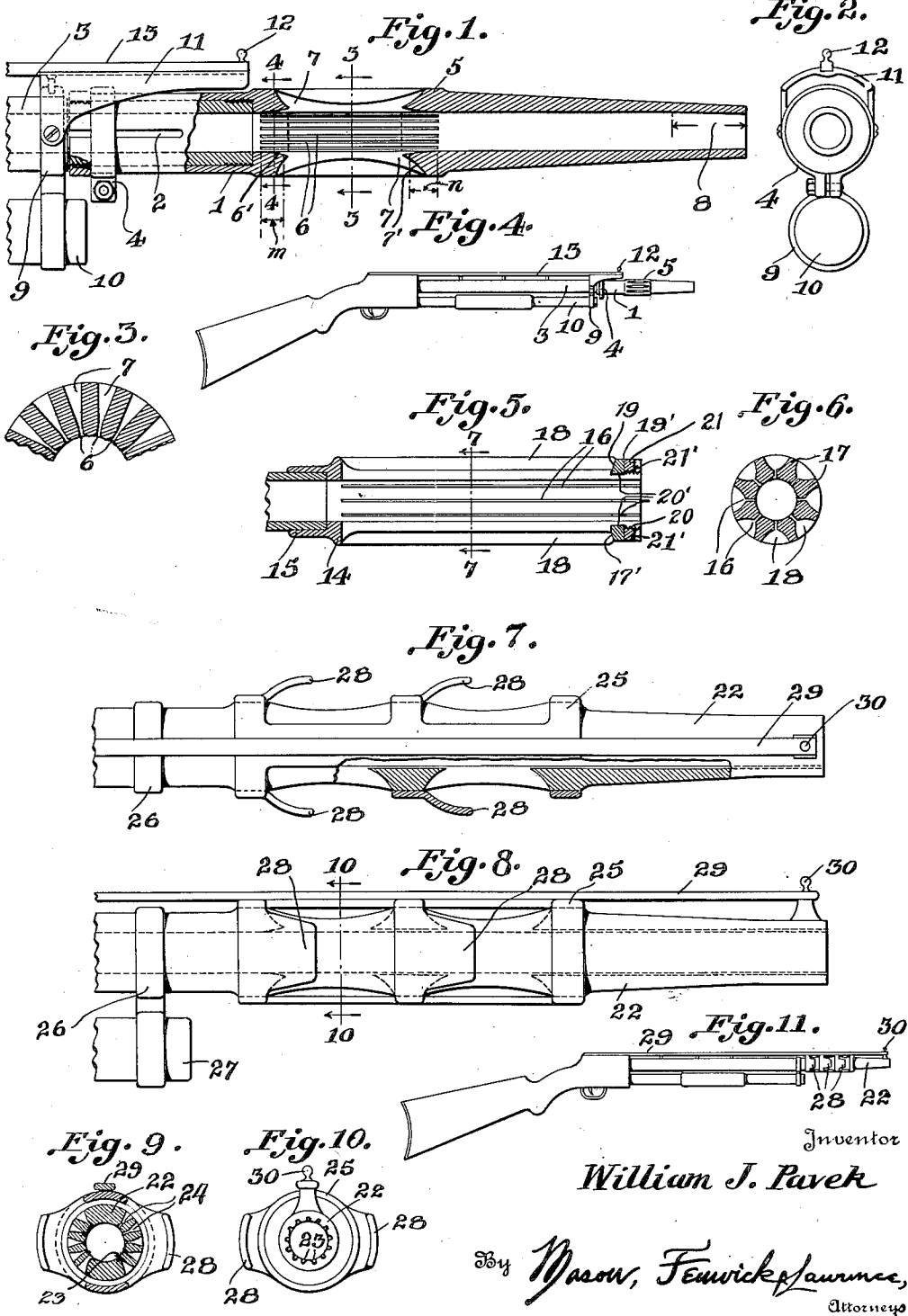
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W. J. PAVEK

VARIABLE AND LOW MUZZLE PRESSURE GUN

Filed March 22, 1924

2 Sheets-Sheet 1



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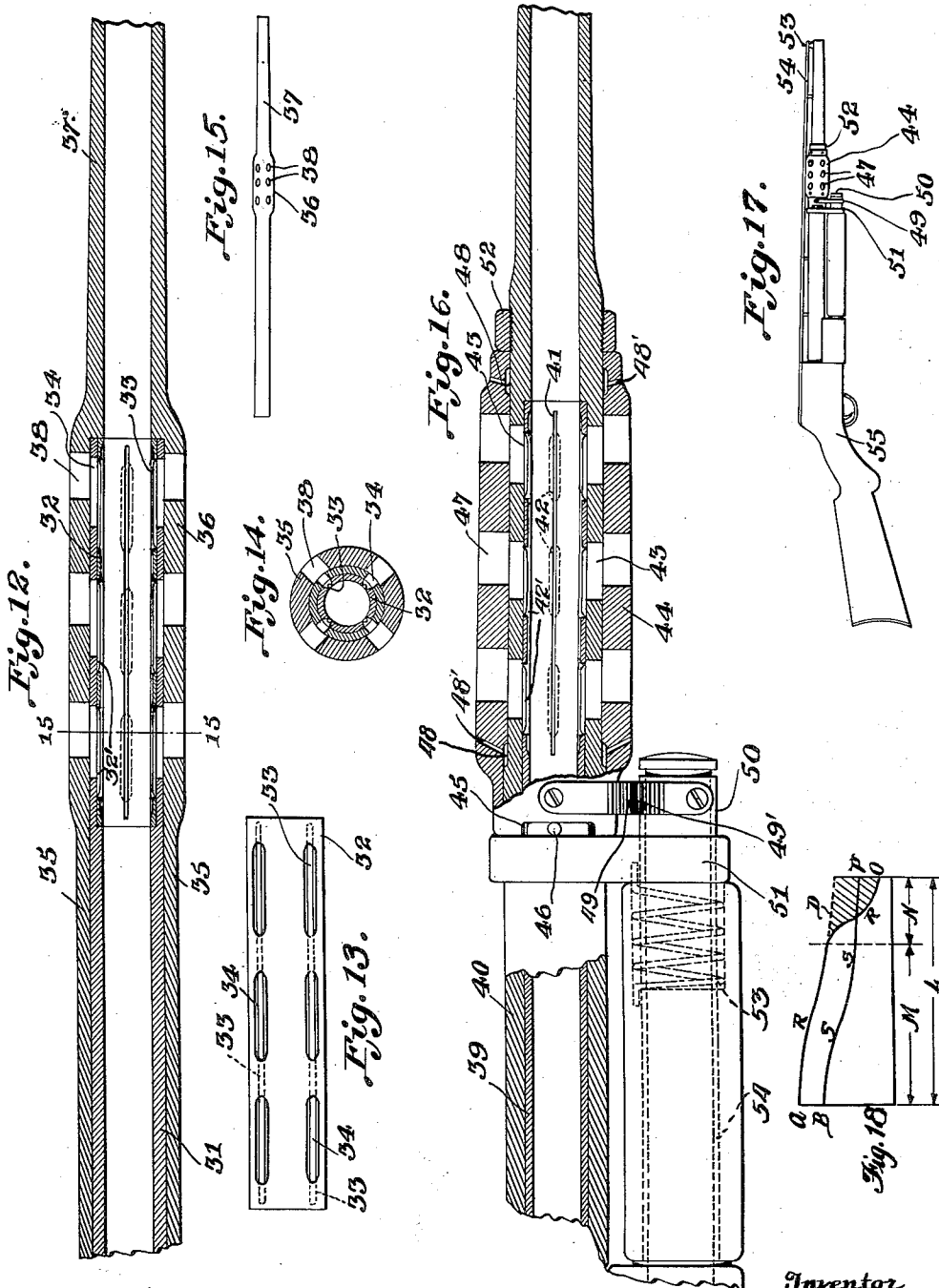
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2 Sheets-Sheet 2



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VARIABLE AND LOW MUZZLE-PRESSURE GUN.

Application filed March 22, 1924. Serial No. 701,113.

This invention relates to fire arms and more particularly to improvements in low or variable muzzle pressure guns and barrels therefor. It consists primarily of a gun barrel intended especially for using ammunition of the kind where more than one missile or pellet is contained in one charge, as for instance, shot-gun shells loaded with common shot, in which the scattering action of the powder gases upon the mass, of shot while they are passing through and away from the muzzle of the gun, is reduced by arrangements which do not introduce any other equivalent dispersing factor, such as agitation of the shot. The result of this is that the shot are kept in a smaller circle or pattern at a given distance from the gun, than can be obtained when using present shotguns. The improvement in pattern is produced more specifically by causing a predetermined portion of the gases to escape through openings or ports in the barrel just before the shot pass through the muzzle, and by providing means for accomplishing this without causing a large percentage of the shot to be damaged or agitated when passing over these openings which would tend to offset the gain due to the reduction of muzzle pressure, and also in some forms of the invention, by providing means of absorbing or reducing any such agitation or disturbance in the shot before they emerge from the muzzle.

The advantages which this invention has are that it enables guns to be constructed which are effective at very long ranges, or again, the construction of guns of small bore which give as dense patterns at closer distances as at present, can be achieved only by larger bore guns. The increase in range is furthered not only by the fact that with this gun a sufficiently "close" or condensed pattern can be attained at the longer distances, but also since the pressure upon the shot is reduced when they reach the muzzle by exhausting the gases through openings, a higher explosion pressure may be developed in the breech end of the barrel without causing any lowering of the patterning qualities of the gun. This means that comparatively higher breech pressures may be permitted so as to develop high velocity in the shot, and this results in more penetration and sufficient killing power at longer ranges, without at the same time, re-

quiring a sacrifice of the pattern which is always the inevitable result when high pressures and high velocities are produced in present shot-guns. This invention is, however, not limited to the use of high breech pressures. It should be understood that any increase in velocity may be obtained, if desired, by reducing the weight of the charge of shot in the cartridge, using the same or somewhat lower breech pressures than are produced by present cartridges. If this is done the low discharge pressure in guns made in accordance with the present invention reduces the scattering of the shot and the effective range of said cartridge is thereby increased. In addition, to improving the pattern as mentioned above, a very desirable form of this invention consists of a construction in which the area of the openings may be varied at will by the gunner. This causes a variation in the density of the patterns and means that the same gun can be instantly adjusted to shoot the proper pattern for all sizes and distances of the target or object shot at.

The style of openings in the gun barrel which this invention more specifically has reference to and covers, have the appearance, from the inside of the bore, of elongated ports the width of which is sufficiently less than the diameter of the smallest shot which it is intended shall be used in the gun, so as to minimize the disturbance caused in the shot as they are brushed by the rear wads over the openings. In the case of openings made in one piece barrels, they communicate directly with the atmosphere preferably through gradually widening or expanding outlets and there must be no appreciable throttling of the gases taking place, such as would tend to redirect a portion of the gases back into the barrel at some point beyond the powder wads where this reentering blast of gases would cause disturbance in the shot, such as heretofore developed in this art. In the case of built-up or assembled barrels, the first or inner tube shall have the narrow slots, while the others may have openings of various shapes and the passage of the gases outwardly may not necessarily be direct. The point of location of these openings on the barrel depends upon the desired maximum concentration of the pattern, upon the ratio between the area of the bore and the total

area of the slots, upon the ratio of the weight of the powder to the weight of the shot and on the length of the barrel. In general, the larger the area of the openings and the lighter the charge of powder as compared with the weight of the shot, the nearer the openings may be to the muzzle, to obtain a given result as to distance and pattern.

When a gun constructed in accordance with this invention is intended only for using comparatively large shot, such as buck-shot, as a military gun would be, the slots are easily made so narrow compared with the size of the shot that the agitation of the latter is practically nil and can be readily eliminated as the shot pass through the smooth part of the bore between the slots and the muzzle, by the diminishing gas pressure still accelerating the mass and tending to pack the shot tightly together. When smaller shot are used, it is desirable to resort to additional means of counteracting the disturbance. One method which is a part of the invention consists of boring the gun to a smaller diameter where the slots are cut, than the remainder of the bore. As the mass of shot enters upon the slots, the decrease in diameter of the bore offsets the expansion of the lump of shot due to the pellets dropping part way into the slots. The reverse of this takes place when the shot leave the slots, so that the arrangement provides a compensating choke and a compensating recess, at the respective ends of the slots. An additional decrease in the diameter of the bore at proper points may be provided to offset any outward flexure of the ribs of metal between the slots due to the heavy pressure upon them. A further way of minimizing disturbance of shot is to cut properly shaped grooves gradually leading to and away from the openings so the changes in relative positions of the pellets take place more gradually. A preferred construction of this is to have the grooves leading away from the slots, cut clear through to the muzzle end of the barrel so that no more readjustments or agitations take place after the shot once enter upon the grooves. This feature is intended to bring the last point of disturbance sufficiently far away from the muzzle to afford time for the gas pressure to pack the shot together again before they emerge from the muzzle. A still further improvement over this from the stand-point of reducing disturbance is to cut the grooves all the way to the breech or chamber of the barrel. In this case there is no disturbance after the shot enter the barrel from the cartridge except that due to friction caused by the shot rubbing upon the walls of the barrel.

In general a gun constructed to operate on any combination of the above ideas would work in about this manner:—After explosion of the powder a high pressure is generated in the breech end of the gun which imparts a high velocity to the shot. Then as the shot are driven over and past the openings somewhere near the muzzle the gases rapidly begin to escape while the shot are still being accelerated in the muzzle end of the barrel. In the ideal case in which the densest pattern could be obtained the gas pressure in the barrel would become atmospheric as the shot begin to emerge from the muzzle. In actual practice it will generally not be necessary nor desirable, to exhaust the gases as thoroughly as this and some pressure will be exerted upon the shot as they leave the muzzle. In view of this it may usually be desirable to have a choke on the end of the bore to improve the pattern somewhat more than is accomplished by the partial reduction of gas pressure alone. The function of a choke is to suddenly lengthen out the mass of shot so that the front ones begin to race away from the rearward ones with a considerable velocity. In other words the choke by compressing the lump adds to the velocity of shot in the forward portions of the mass and tends to retard those in the rear portions of the mass. Instantly after this happens the shot are out of the barrel and the actions of the powder gases is directed only at the rear pellets which are thereby accelerated and somewhat scattered. Hence the choke accomplishes some improvement in pattern by causing the discharged gas to act only on the rear portions of the charge of shot. When a choke is used on a low muzzle pressure barrel, it should be noted that with all other things being equal the lower the gas discharge pressure the smaller the choke needs to be to offset it a given amount, and also that it has been found that for a given choke there is a velocity of shot beyond which the pellets begin to scatter and the choke begins to defeat its own purpose. Furthermore, the maximum velocity which can be used through a given choke increases as the amount of choke is decreased. Hence a choke on a low muzzle pressure and high velocity gun which would afford the greatest improvement would be a smaller choke than the best choke on a high muzzle pressure and low velocity gun. The use of any kind of choke together with any portion or combination of portions of this invention is covered by this patent.

While the examples shown by most of the drawings relate to repeating or automatic guns of the types used by sportsmen this invention is by no means limited to this class of fire-arms. It may be used on guns of any style and action for both sporting as well as military purposes as for instance a

small bore machine gun. It may be used in building guns of any calibre, not only the sporting calibres but also such as large field guns for military use—preferably of automatic action. In some cases it may be found desirable to manufacture the low muzzle pressure section of the barrel in the form of an attachment to the main barrel, as for instance, a detachable muzzle for existing shot guns. This application covers all such modifications of the invention.

The invention further comprehends means for attaching on to the muzzle of guns of different calibres, but more especially to the muzzles of shot guns and a means for shot guns, which will be applied to the muzzles thereof for permitting the gases of combustion to escape prior to the passage of the pellets or bullets from the muzzle of the guns for the purposes above outlined.

Another object of the invention is to provide barrel or means permanently or detachably mounted thereon for positioning on the muzzle of a shot gun whereby the greater portion of the gases of combustion may be discharged readily from slots formed in the barrel or said permanent or detachable means or members, and means for adjusting the size of the ports or passages so that the desired amount of escape of the gases of combustion may be positively and definitely fixed.

A further object of the invention is to provide a sectional barrel for shot guns, the sections of the barrel being provided with spaced longitudinally extending slots which are tapered toward the outer surface of the section, and the sections being adjustable to vary the size of the slots and means being provided for preventing the gases of combustion from flying back into the face of the person using the gun.

A still further object of the invention is to provide a barrel section for shot guns, which will greatly decrease the muzzle pressure thereof, which will be highly efficient in use, and which will be relatively inexpensive to manufacture.

Other objects will appear as the description proceeds.

In the accompanying drawings which form a part of my application,

Fig. 1 is a side elevation partly in section of one form of my improved low muzzle pressure attachment,

Fig. 2 is a front elevation thereof,

Fig. 3 is an enlarged sectional view taken on the line 3—3 of Fig. 1,

Fig. 4 is a side elevation of a repeating shot gun equipped with the attachment,

Fig. 5 is a vertical sectional view of a modification of my attachment,

Fig. 6 is a sectional view taken on the line 7—7 of Fig. 5,

Fig. 7 is a plan view partly in section of the second modification of the attachment,

Fig. 8 is a side elevation of the second modification,

Fig. 9 is a sectional view taken on the line 10—10 of Fig. 8,

Fig. 10 is a front elevation of the second modification,

Fig. 11 is a side elevation of a repeating shot gun equipped with the second modification of the attachment,

Fig. 12 is a vertical sectional view of a rifle or shot gun barrel equipped with a third modification of my invention,

Fig. 13 is a side elevation of the innermost slotted barrel section,

Fig. 14 is a sectional view taken on the line 15—15 of Fig. 12,

Fig. 15 is a side elevation of my third modification,

Fig. 16 is a side elevation partly in section of an automatic shot gun equipped with a fourth modification of my invention,

Fig. 17 is a side elevation of an automatic shot gun equipped with the fourth embodiment of my invention, and

Fig. 18 is a diagrammatic view showing a graph of pressure curves obtained with an old style simple gun barrel and by the proposed novel barrel of my invention.

Like characters of reference are used throughout the following specification and the accompanying drawings to designate corresponding parts.

In Figures 1 to 4 inclusive, I have illustrated a form of my invention which consists of a detachable muzzle section 1 which is bifurcated as at 2, its inner end, and is adapted to slip over the outer end of a shot gun or gun barrel 3. A clamp 4 is adapted to be positioned about the bifurcated ends of the muzzle section 1 to firmly clamp the same in operative position at the outer end of the gun barrel.

The intermediate portion 5 of the muzzle section 1 is formed with thickened walls, the same being provided with a plurality of longitudinally extending radial slots 6, which are V-shaped in cross-section and flared outwardly as at 7 toward the outer periphery of the muzzle section. The slots 6, are undercut, as at 6' and 7', the breech end 6' being as nearly perpendicular to the axis of the gun as possible, while the muzzle end 7' slopes considerably forwardly so as not to obstruct the forward flow of gases too much and to permit of the more ready escape of the gases of combustion.

The grooves leading to and away from the slots may be of various lengths and shapes and in general, if they are short, they should gradually increase in depth from the ends to the center, or in the direction of or toward the ends which join the slots. These grooves

should preferably be V-shaped in cross-section, with rounded corners at the inside and the bottom cut on an arc or radius as clearly shown in Fig. 3 of the drawings. The round corners of the grooves prevent the shot from being cut or mutilated in traveling along the grooves and the latter therefore guide the shot in such a manner as to prevent agitation or internal disturbance within the mass, such as would tend to scatter the shot when they leave the barrel. Obviously, the grooves may extend entirely throughout the bore of the barrel to the muzzle, to continue the guiding action to the end. In addition to the choke 8 near the outer end of the muzzle section 1 of the barrel, a compensating choke *m* is provided at the inner ends of the grooves at 7', to compensate for the expansion of the charge of shot as the enlarging effect due to some of the shot partly entering the slots or grooves. A corresponding recess *n* may be provided at the other ends of the slots or grooves as at 6' to compensate for the compression of the charge of shot when leaving or coming out from the grooves, especially when they are constructed in the manner shown in Fig. 1 of the drawing. The size of the compensating choke and the size of the compensating recess, *m* and *n* respectively, would be determined by the size of the shot the gun would usually be expected to use, and the size of the openings or slots through the barrel. By this improvement, the only movement which could take place in the shot, would be a certain amount of shifting of the shot to the sides when passing over the ribs, and this motion will be absorbed while the shot travel the remaining length of the barrel. The length between the compensating recess *n* and the choke 8 is great enough to afford the pressure behind the shot a chance to pack them into a dense lump and absorb all internal commotion which may have been started while the shot were passing over the slots. If the shot leave the muzzle packed closely together and with only a forward velocity, there is no spreading or scattering of the pattern, except such as is due to gas discharge pressure, which in this gun is materially reduced.

The bore of the barrel on the other hand, may be cylindrical throughout, except where the choke 8 is provided to improve the pattern, on guns in which the gases are not completely exhausted before the shot reached the end. It should be understood that the lower the final pressure and the higher the exit velocity, the smaller the final choke 8 would have to be to give the closest pattern, which is in line with the theory underlying the principle of the present invention. On guns of a cheaper grade and those using only very large shot, or when the advantage gained by the low pressure

muzzle are considered good enough without the additional refinement of a choke, or grooves, these features may be omitted. The feature of the gradual sloping or tapering of the grooves is to make the expansion and compression of the mass of shot at the front and back ends of the slots, respectively, more gradual and to cause the shot to enter part way into the openings and to pass therefrom more gradually. The bottom of the grooves at the places or points where they join the slots should be deep enough so as to clear the smallest shot to be used in the gun. From this point the grooves should gradually decrease in depth until the bottom becomes flushed with the bore of the gun except in such cases where the grooves continue clear through the barrel. In addition to the above, the barrel may be bored so as to neutralize the outward flexure of the ribs of metal between the slots, and reinforcing rings or perforated sleeves may be forced over the ribs to strengthen them and overcome flexure.

A double clamp 9 is adapted to fit over the outer end of the rifle barrel 3 and also over the ammunition magazine 10. To increase the grip of the bifurcated portion on the barrel the extreme end of the attachment may be threaded and the corresponding portion of the main barrel may likewise be threaded so that the connection afforded by these threads, after the clamp is tightened, will not allow the attachment to be blown off by the force of the discharge. A shield or guard 11 is attached to the clamp 9 and is adapted to extend up to a point approximately flush with the outer end of the rifle barrel 3 and slightly to the rear of the slots 6, and serves to prevent the burned powder and particles or gases of combustion from flying back and burning the face of the person using the gun, and to keep dirt out of the slots 6 when the gun is laid down. A front sight 12 is positioned on the sighting track 13; which extends the full length of the rifle barrel.

It should be evident that one gun may be furnished with several muzzle attachments each having a different patterning characteristic so as to make the gun adaptable to various uses, and so that it could produce a confined or a scattered pattern. The portion of the barrel through which the slots are made, is somewhat larger in diameter than the rest of the barrel, to increase the strength thereof and of the ribs between the slots or openings, as otherwise the barrel would be weakened at this point. The V-shaped cross-section of the openings improves the efficiency and facilitates the free discharge of the gases through the slots or openings, in order to reduce the pressure for the purpose heretofore explained. These openings may be made by using a

V-shaped-milling cutter with a large diameter to make the tapered cut and a narrow saw of small diameter to cut the slots through into the barrel. However, I do not desire to be restricted to this particular method of production.

The first modification of my invention is illustrated in Figs 5 and 6 of the drawings and comprises a short detachable or permanently attached muzzle section 14 which is provided at its inner end with a counter bore 15, the same being adapted to fit over or fasten on the outer end of the shot gun barrel. The muzzle section 14 is provided with a plurality of longitudinally extending radial slots 16 which extend from a point adjacent the inner end of the muzzle section to the outer end of the same, thereby providing adjoining spaced sections or ribs 17. Longitudinally extending V-grooves 18 are formed from the top of the slot 16 to the periphery of the muzzle section and provide for the ready escape and expansion of the gases of combustion after they have passed through the said slots. The outer ends of the sections 17 are reduced or turned down and the ends provided with sloping or cam surfaces 19 against which a tapered ring 19' fits, said ring being driven over the low or reduced ends of the ribs so that its sloping side will fit against the sloping or cam surfaces 19. The ring 19' has projections 20' on the inside, which are of the same width as the slots or saw cuts 16 and enter the latter to prevent the ribs from coming together while the ring prevents the sections 17 from bending outwardly, thus resulting in a simple and rigid assembly which will withstand the internal pressure of gases as well as rough handling externally. The sections 17 are also provided with screw threads 20, which are adapted to cooperate with an interiorly screw threaded collar or locking ring 21 in such a manner that the said ring will screw down over the threads 20 and holds the ring 19' against the cam surfaces 19, thereby holding the several parts in operative position. The locking ring has notches 21' to receive a tool or spanner wrench to tighten or remove the locking ring 21. The muzzle section 14 may be either removable or permanently secured into position or integral with the rest of the barrel, and a final choke may be provided if desired, such as to produce a smaller or more concentrated pattern. A compensating choke and grooves may also be provided at the breech ends of the slots. This type of barrel muzzle is desirable when only a smaller concentration of the shot is desired, or where the charge of powder is very light compared with the weight of the shot. For these purposes, it would probably be the cheapest and most satisfactory design.

A second modification of my invention is illustrated in Figs. 7 to 10 inclusive, and comprises a one piece barrel 22 which is formed at its opposite sides with longitudinally extending radial slots 23, which merge into the V-grooves 24, which extend out to the periphery of the barrel 22. A guard member 25 is adapted to slide up over the barrel 22, being forced over the bands on the barrel at the ends of and between the rings of slots so as to hold the bands and consequently the ribs of metal between the slots, in alignment. This support is desirable as the ribs of metal have been made considerably weaker in the middle to permit the arbor of the cutting saws and V-cutters to make the ends of the slots more nearly perpendicular to the axis of the bore, by enabling the arbor to approach close to the center of the bore. The slots 23 are not cut entirely around the entire circumference, but cores are provided at the top and bottom or other diametrically opposite points, this material being left to add stiffness and strength to the barrel, in other words, to function somewhat like the guard member or yoke 25. The magazine 26 is held in position in the usual manner, or by means of a suitable double clamp or yoke 26, which is adapted to bind about the ammunition magazine 27, and the muzzle section or barrel 22, but any other suitable means may be employed independently or in conjunction therewith, to hold the magazine 27 in position in connection with the guard member. In the preferred construction, the grooves are cut clear through the muzzle, and if desired, they may be cut toward the breech end of the barrel. The grooves are provided with rounded corners and the bottom portions thereof are cut on arcs or curved in the manner and for the purpose heretofore explained. These grooves may be cut around the entire surface or periphery of the bore as shown, to balance the disturbances from all sides, but slots may be cut only part way around as shown and described. The guard member is further provided with spaced outwardly and forwardly extending wings or baffles 28 which are positioned to the rear of the slots 23 and grooves 24 so as to deflect the particles or gases of combustion forwardly so that the persons using the gun will not be burned thereby. A suitable sighting track 29 and front-sight 30 are positioned on the gun in the usual manner. The barrel in this form of the invention is made in one piece and a series of slots are cut around the barrel, Figs. 8 and 9 showing two series of slots with three rings and three bands, thus permitting the slots to be made shorter and still allow the proper escape of the compressed gases, while also preventing the weakening of the barrel with

slots which are too long. The total area of the slots or openings is controlled by the number of sets of slots or openings and the size thereof, this controlling the pattern as heretofore described. In Fig. 11 of the drawings a side elevation of an automatic shot gun is shown equipped with the second modification, except that in lieu of two sets of openings and three bands, three sets of openings and four bands are illustrated. The bands are connected at the sides to provide rigidity, thus maintaining the strength of the barrel even though the ribs are of small cross-section. This permits the barrel to be turned down between the enlargements or bands so as to allow the saw arbor to approach closer to the axis of the gun, and yet there is sufficient strength to withstand the internal pressure. The grooves also run from end to end of the slots so as to connect all the slots in a row, and may be continued clear through the final choke if desired. This construction is especially adapted to very long range guns, and to the use of heavy powder charges.

In Figs. 12 to 15 inclusive, I have shown an assembly of several parts or tubes to form a shot gun barrel. An inner tube 31 extends practically the whole length of the barrel, and is enlarged at its outer end to receive an internal tube 32 which fits in the enlargement. Radial slots 33 formed in the internal tube 32 are flared outwardly and merge with the radially extending slots 34 formed at the outer end of the tube 31. An outer tube 35 is formed with an enlarged or thickened portion 36 and terminates in an outer portion 37 at the outer end of the gun barrel. Radial slots 38 are formed through the wall of the thickened portion of the barrel 35 and are in radial alignment with the slots 33 and 34. The slots 33 and 34 and 38 are so disposed that the inner slots are positioned to the rear of the slots 38. This construction permits of the escape of the gases of combustion in an outwardly and forwardly direction, so that the same and the particles of burnt powder will not fly back into the face of the person using the firearm. This construction is especially adapted to large guns, though not necessarily or entirely, and the advantage thereof is that it permits the thickness of the tubes to be reduced, so that they may be perforated instead of being cut with saws and milling cutters. Also, the ratio of length to width of these slots through the different tubes may vary so that the outer tubes do not have such narrow slots which are more difficult to make. In the illustration shown, the outer holes 38, above referred to as slots, would probably be drilled, the slots or holes 34 can be perforated and the inner ones 33 would be sawed and beveled with milling cutters. However, the innermost tube

might be made thin enough so that the slots or holes 33 could be perforated, in which case (according to ordinary practice) the thickness of the metal forming the tube should not be more than the width of the slots. The inner slots 33 are preferably made even at their forward ends with the forward ends of the slots 34 in the middle tube 31 at the forward or muzzle end, thus avoiding an offset or the leaving of a web of metal beneath the groove which is too thin to be left unsupported by the metal of the next tube, although the openings in the outer tube or barrel are set a little forward to permit the free escape or flow of gases through the same. In the latter case beveling of the slots may be omitted, as the slots may be easily made large enough to afford proper escape or take care of the flow thereof without throttling of the gases. The widths of the slots are increased outwardly but not exaggerated in such a manner as to cause overhanging metal which must be strong enough and have sufficient tensile strength to withstand the shearing and bending action of the internal pressure.

In Figs. 16 and 17, I have illustrated a fourth modification of my invention which consists in forming the shot gun barrel of an inner tube 39 and outer tube 40. Continuous or elongated radially disposed slots 41 are formed through the inner tube 39 and have outwardly flared portions 42 disposed at points along the slots. The radially extending slots 43 are formed through the tube 40 and are in alignment with the slots 41, but disposed slightly to the rear thereof. A tubular collar 44 is provided with a yoke portion or bifurcation 45 at its inner end and is rotatably mounted upon the tube 40. A pin 46 is positioned in the tube 40 and limits the rotation of the collar 44 by engaging with one of the other ends of the slot or bifurcation 45. Radially disposed slots 47 are formed through the collar 44 which construction permits of a portion of the gases of combustion to escape in an outwardly and forwardly direction.

In the form of the invention shown in Figs. 12 to 15 inclusive, as well as the form shown in Figs. 16 and 17, grooves 32' and 42' respectively, are provided in the inner tube 32 and inner tube 39. These grooves extend into the slots or openings in the tubes, and across the walls between the slots to points beyond the end slots, the ends gradually tapering to the interior surfaces, and adapting the grooves to guide the shot in passing through the barrel and across the slots through which the compressed gases escape. The grooves above mentioned may extend to the muzzle end of the barrel in each instance, if so desired. The design shown in Fig. 13 is especially suitable for quantity production, since it may be ar-

ranged to have the slotting done by punching operations.

The construction shown in Figs. 16 and 17 is designed to produce various patterns, and a low muzzle pressure barrel of this type may be adjusted to produce a desired pattern, by regulating the openings or slots in the tubes. This adjusting is done by means of the outer rotatable tube 44. Channels 48 are provided in the inner surfaces of the tube 44 in the form of a collar rotatable on the barrel 40 forming the outer tube of the rifle barrel, these channels being located beyond the slots near each end of the tube or collar 44 beyond the slots 47 and having openings or ports 48' leading forwardly therefrom, that is, in a forward direction and serving to permit some of the gases of combustion to slowly escape there-through. The cross-sectional area of the opening is considerably greater than the area between the contacting surfaces of the tubes 40 and 44, so that the gases will leak out from the channels, thereby keeping the pressure therein low and preventing the gases from escaping or discharging between said surfaces or between the ends of the tube 44 and adjacent rings 51 and 52 under high pressure. This construction also prevents the gases from escaping between the surfaces inwardly toward the openings, and any discharge that takes place will be in a forward direction, away from the user. As previously stated, the collar or tube 44 is loosely mounted so that it may be easily rotated on the tube 40, thus permitting the openings or slots to be varied in size for regulation purposes as previously explained and suitable guards may be provided over the escape openings, as described in connection with other forms of the invention, in order to deflect the gases forwardly and away from the shooter so as not to burn his hands or face. Various devices could be provided for twisting or turning the collar 44 to regulate the amount of open area between the slots and therefore varying the pattern. As shown, gear segments 49 and 49' are mounted upon the opposite sides of the tubular collar 44 and the ammunition magazine 50, the teeth of these gears being in mesh. A yoke or ring 51 connects the barrel 40 and the ammunition magazine 50 and holds the same rigid. A nut 52 is positioned at the outer end of the collar 44 and on the exterior of the tube 40 to hold the several parts in assembled relation and in proper position, so that the collar 44 may be readily turned as desired. A spring 53 has its inner end fastened to a cylindrical member 54 on the ammunition magazine and the other end is anchored in the support formed by the yoke or collar 51 and gives such preliminary tension as to pull the cylindrical member or handle 54

in such a manner as to turn it in one direction and therefore hold the sleeve or collar 44 in one position, either closed or open as desired. By turning the member 54, the operator will turn the gear 49' in mesh with the gear 49 and rotate or adjust the sleeve 44 to any desired position within the limits permitted by the movement of the pin 46 in the slot 45 to regulate the volume of gas discharged and the pattern thus produced. When the handle or cylindrical member 54 is released by the shooter, the spring 53 immediately acts to return the parts to their normal positions automatically. The skill of the shooter is therefore depended upon to properly regulate the escape of the gases, in addition to depending upon accuracy of aim of the shooter.

It will be seen from this description that the area of the ports or passages through the tubes may be changed to suit the requirements of the person using the gun. By simply rotating the tubular collar 44 the size of the ports may be varied. A sight 53 and sight track 54 may be positioned on top of the barrel of the gun 55, and is of the usual construction. The application of the invention shown in Fig. 16, to an automatic shot gun, is illustrated in Fig. 17. Other devices may be provided for regulating the slots or openings and to operate the variable pattern sleeve or collar, according to the type of gun to which applied, and after some practice, the gunner could acquire accurate control to produce any desired pattern. Many other minor changes in detail of construction may be resorted to without departure from the spirit of the invention.

As illustrating the advantages and purposes of the invention, it should be noted from Fig. 18 of the drawings wherein is shown a graph of pressure curves obtained with an old style simple barrel and by the proposed novel barrel of the present invention, that the pressure curve of a simple barrel is indicated at S as compared with the curve R obtained in the low muzzle pressure barrel. L is the overall length of both barrels, M is the length of the high pressure part of the new barrel and N is the low pressure part. The curves bring out the fact that the final pressure O from R may be actually lower than the final pressure indicated at P from the curve S of a simple barrel as heretofore constructed or with any other arrangements of openings known in the art. Of course, by relieving this pressure the energy represented by the hatched area D, is lost, but by sacrificing this pressure energy I have been enabled to use higher chamber pressure A, as compared with B and therefore higher velocity, and yet produce a better pattern. As heretofore explained, however, the curve R need not start higher than curve S, and still advantages are gained in pattern-

ing qualities due to the low discharge pressure at O. The above reduction in discharge pressure, in conjunction with the guiding action of the grooves and slots, and the action of the compensating chokes, compensating recesses and final choke, produces new combinations.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a low or a variable muzzle pressure gun, the combination of a main barrel and a detachable muzzle section, a plurality of overlapping slots formed through said barrel and muzzle section, and deflecting means for deflecting the gases of combustion when said gun is fired in a forward direction.

2. In a low or a variable muzzle pressure gun, a barrel of concentric tubes each provided with a plurality of radial slots, the slots in succeeding tubes gradually changing from narrow to wide outwardly.

3. A gun barrel comprising a plurality of concentric tubes with radially aligned slots, the slots increasing in cross-sectional area outwardly.

4. In a variable muzzle pressure gun, the combination of a composite main barrel and a muzzle section therefor, said main barrel and muzzle section being provided with a plurality of radially aligned slots, and means for varying the effective outlet area between said slots.

5. In a variable muzzle pressure gun, a main barrel, a muzzle section fitted thereon, means for securing the muzzle section to the main barrel, said muzzle section being provided with openings, and means to vary the cross-sectional area of the openings simultaneously.

6. A variable muzzle pressure gun, including a barrel having a plurality of radial openings leading through the periphery thereof, and means for adjusting the cross-sectional area of the openings thereby providing means for the adjustment of each individual opening.

7. A variable or a low muzzle pressure gun, including a barrel having a plurality of radial openings leading through the periphery thereof in spaced relation to the muzzle end, and means for guiding the shot along the openings.

8. A gun of the character described including a barrel having a series of longitudinal openings arranged in radial series circumferentially thereof and leading through the periphery of the barrel, all of said openings being in spaced relation to the muzzle end of the barrel, and means on the inner surface of the bore of the barrel to guide the shot over the openings in straight paths.

9. A gun of the character described including a barrel having a series of longitudinal openings arranged in radial series circumferentially thereof, and leading through the periphery of the barrel, all of said openings being in spaced relation to the muzzle end of the barrel, there being grooves along the bore at the inner ends of the openings to receive and guide the shot, and means within the bore to compensate for the expansion and contraction of the mass of shot in passing over and beyond the openings, to control the pattern.

10. A low or a variable muzzle pressure gun having a muzzle section provided with radial openings with beveled ends, and grooves along the bore of said muzzle section within the openings, said openings all leading through the periphery to the exclusion of the muzzle end of the muzzle section.

11. A low or a variable muzzle pressure gun having a muzzle section provided with radial openings with beveled ends, and grooves along the bore of said muzzle section within the openings, said openings all leading through the periphery, and means for deflecting the gases forwardly as the same escape through the openings.

12. A low or a variable muzzle pressure gun having openings for the pre-exhaustion of the powder gases before discharge from the muzzle and of such size and length and such proximity to the muzzle end of the barrel as to materially reduce the muzzle pressure to a possible zero, said barrel having internal means to guide the shot across the openings and prevent internal agitation.

13. A variable or a low muzzle pressure gun having openings in the barrel thereof for the preexhaustion of the powder gases before discharge of the shot and gases from the muzzle to reduce the muzzle pressure from a point near the end, said barrel having internal grooves smaller than the shot to guide the latter across the openings and prevent internal agitation, and means to compress and lengthen the mass of shot to prevent scattering thereof and produce a smaller pattern.

14. A variable or a low muzzle pressure gun having openings in the barrel thereof for the preexhaustion of the powder gases before discharge of the shot and gases from the muzzle to reduce the muzzle pressure from a point near the end, said barrel having internal grooves smaller than the shot to guide the latter across the openings and prevent internal agitation, and a choke at end of the barrel.

In testimony whereof I affix my signature.

WILLIAM J. PAVEK,