This invention relates generally to firearms, and more particularly to semiautomatic or fully automatic firearms with recoil-operated chambers.

The firearm with which the present invention is concerned is of a well-known type having a chamber unit which is separate from the barrel and yieldable from its firing position into the receiver by recoil action to initiate release of the locked breech block from the chamber unit and retraction of the former into open position by recoil of the breech block from front to rear. Release of the breech block from front to rear with the chamber unit and retraction of the former into its open position for automatic discharge of the fired shell from the receiver and for reloading purposes is achieved, after short recoil of the chamber unit with the interlocked breech block, by recoil action of the operating mechanism of the latter.

This firearm is also comprised of a cartridge magazine and a cartridge carrier which is adapted automatically to transfer a cartridge from the magazine into the path of the breech block on its return into closed position for continued transfer of the cartridge by the latter into the chamber proper, hereinafter referred to simply as “chamber.” Since the chamber customarily extends into the bore of the firearm barrel and forms part of the aforementioned chamber unit whose recoil action on firing is imperative for achieving automatic ejection of a fired shell from the receiver and automatic reloading of the chamber with a fresh cartridge, as explained, the chamber is customarily received with a sliding fit in the barrel bore. This sliding fit of the chamber in the barrel bore is relied on to permit the imperative recoil action of the chamber unit, and at the same time prevent the escape therethrough of any appreciable amount of the projectile-propelling gases so as not to suffer any loss in the barrel of the back pressure thereby which is so vital in imparting to fired projectiles their required high velocity for optimum accuracy and effect.

While firearms of this type perform quite satisfactorily in most respects, they have, however, one drawback. Thus, it is inevitable that some residue of the combustion products in the barrel will, under the momentary high pressure necessary to initiate the firing mechanism. A portion of the chamber and that part of the barrel bore in which the latter is received with a sliding fit. This residue of combustion products, in the form of burned and unburned powder, and in the case of shot shells including also pieces of wood and paper particles from the shells, accumulates with every shot in the fine interstices between the chamber and that part of the barrel bore in which it is received. This accumulating residue sooner or later hardens into a film or crust which not only clogs the aforementioned interstices but has sufficient tenacity to bind the chamber to the barrel bore with sufficient force to transmit more and more of the recoil force of the chamber unit to the barrel and in consequence obstruct independent recoil motion of the former more and more, with the result that the chamber unit no longer generates the life force required and relied on for achieving automatic ejection of fired shells from the receiver and automatic loading of the chamber with fresh cartridges, as aforementioned. Once the chamber becomes thus bound to the barrel wall, the firearm is useless, at least for its intended automatic performance, and can be restored to automatic performance only on disassembling the firearm and laboriously removing the hardened residue.

It is the primary aim and object of the present invention to provide a firearm of this type which does not have the aforementioned drawbacks and, instead, may be fired and reloaded automatically for an indefinite length of time, thereby to attain the optimum reliability of the firearms of this type. It is further an object of the present invention to provide a firearm in which the said interstices are cleared and the chamber is kept in its performance and avoid malfunction of the same at any time, and especially when proper performance of the same is of special importance.

Thus, it is among the objects of the present invention to provide a firearm of this type which by jet action induced on firing the arm is self-cleaning in the area between the chamber and that part of the barrel bore in which it is slidable, thereby preventing any lasting deposit of the aforementioned residue of combustion products in this area and, hence, keeping this area at all times free from any obstruction that might interfere with the recoil of the chamber unit which is imperative for reliable automatic ejection of fired shells from the receiver and automatic loading of the chamber with fresh cartridges.

It is another object of the present invention to provide a firearm of this type in which the aforementioned jet action in the area between the chamber and its receiving part of the barrel bore is induced by the pressure of the projectile-propelling gases in the barrel bore, and the jet drives the residual combustion products from this area directly and with the least obstruction of the barrel bore, thereby achieving exceptionally powerful scavenging of this area in a direction in which it will not interfere with the aim of the firearm. It is a further object of the present invention to provide a firearm of this type in which the aforementioned jet action takes place in a relief passage between the chamber and its receiving part of the barrel bore which is in axial alignment with the remainder of the barrel bore and in end communication with the latter and the receiver, and which is over the greater part of its length sufficiently wide ever to preclude its clogging with residual combustion matter from the barrel bore, while a relatively short length of this relief passage is sufficient narrow not only to compel the ineffuse propelling gases from the barrel bore into powerful jet action for most efficient scavenging of the relief passage, but also to act as an effective choke to prevent any appreciable pressure drop of the propelling gases in the barrel bore.

Another object of the present invention is to provide a firearm of this type in which the aforementioned relief passage between the chamber and its receiving part of the barrel bore is wide over the greater part of its length intermediate the ends thereof and is narrow over relatively short opposite ends thereof, thereby obtaining jet action of the inefficient propelling gases at the entry and exit ends of the relief passage and, hence, not only optimum scavenging of the latter throughout its expense but also maximum choke control over the pressure of the gases in the barrel bore with the shortest possible constriction of the relief passage.
A further object of the present invention is to provide a firearm of this type in which the constricted exit end of the aforementioned relief passage extends to the usual reception groove in the chamber unit for the shell extractor, to which it immediately communicates therewith. It further includes a diverting subjection, if not most, of the scavenged matter from the residue passage through this groove and directs it to and through the usual shell ejection port in the side of the receiver next to the extractor groove, rather than among the usual operating parts in the receiver.

It is another object of the present invention to provide a firearm of this type in which the aforementioned relief passage between the chamber and its receiving part of the barrel bore is obtained by simply providing for an adequate sliding fit between short end lengths of the chamber and its receiving bore part and undercutting either or both over the intermediate length or lengths thereof, thereby achieving the aforementioned self-cleaning feature of the firearm without requiring any additional parts, but merely a simple machining operation at the most.

Other objects and advantages will appear to those skilled in the art from the following, considered in conjunction with the accompanying drawings.

In the accompanying drawings, in which certain modes of carrying out the present invention are shown for illustrative purposes:

Fig. 1 is a fragmentary side view of a firearm embodying the present invention;

Fig. 2 is a fragmentary view, partly in longitudinal section and partly in elevation, of the firearm;

Fig. 3 is a fragmentary perspective view, partly in section, of the same firearm;

Fig. 3A is a cross section through the firearm, taken substantially on the line 3A—3A of Fig. 2;

Figs. 4 and 5 are fragmentary longitudinal sections through the firearm, showing certain operating parts thereof in positions before and during firing, respectively;

Fig. 6 is a fragmentary perspective view, partly in section and partly in elevation, of a part of the firearm corresponding to that of Fig. 4; and

Fig. 7 is a fragmentary perspective view, partly in section and partly in elevation, of a part of a firearm embodying the present invention in a modified manner.

Referring to the drawings, and more particularly to Figs. 1 to 3 thereof, the reference numeral 10 designates an exemplary firearm which in all essential respects is like the shown and described in my aforementioned Patent No. 2,476,232. Thus, the instant firearm comprises a receiver 12, a chamber unit 16, a breech block 18, breech block operating mechanism 20 and fire control mechanism 22. Suitably secured to the rear end of the receiver 12 is a buttstock 24, and removably mounted as at 26 in the front wall 28 of the receiver is the barrel 14. The receiver 12 is recessed at 30 over most of its length, and is open at its bottom as at 32 and provided with an internal shoulder 34 intermediate the length of the recess 30. Guided for axial movement in a part-cylindrical forward length 36 of the recess 30 in the receiver 12 is a part-tubular rearward extension 38 of the chamber unit 16 (Figs. 2 and 3) having a chamber 40 which extends into the barrel 14 and is adapted for the reception of a cartridge c to be fired. The chamber unit 16 is normally urged forwardly into firing position, i.e. in abutting engagement with the barrel 14, by a spring-urged plunger 42 which is received by the rearward extension 38 of the chamber unit and bears against the internal shoulder 34 in the recessed receiver 12.

The breech block 18 is at its top 35 semicylindrical (Figs. 3A, 4 and 5) for fitted reception in the part-tubular rearward extension 38 of the chamber unit 16 when the breech block is in its closed position in which the same is interlocked with the chamber unit 16 and engages the chambered cartridge c (Figs. 2 and 3). The breech block 18 is reciprocable in the recessed receiver 12 into its open and closed positions, and in this position described hereinafter, with a pin 46 which is carried by opposite guides 48 and 50 received in ways 52 and 54, respectively, which extend longitudinally of the receiver and may appropriately be machined in the opposite side walls 56 and 58, respectively, of the latter (Figs. 3A, 3B). The breech block operating mechanism 20, which in the instant exemplary firearm is recoil-operated for releasing the breech block 18 from interlock with the chamber unit 16 and retracting the former into its open position for reloading purposes, comprises an inertia bar 60 or plunger 62 which at its rear end is backed by a preloaded compression-type spring 62 (Fig. 3) and is at its forward end pivotally connected at 64 with one end of a link 66 that extends with its other end into a bottom recess 68 in the breech block 18 and is pivotally connected with the pin 46 (Figs. 2, 3 and 3A). The inertia bar 60 is axially slidable in a guide sleeve 70 which extends in the buttstock 24 and carries at its forward end a threaded collar 72 by means of which it is mounted in the rear of the receiver 12. The rear end of the guide sleeve 70 is connected, in this instance threaded as at 74 (Fig. 3), with the adjacent forward end of another sleeve 76 in the buttstock 24 which holds the compression spring 62 that serves to close the breech block. The rear end (not shown) of the sleeve 76 is closed and the adjacent end of the spring 62 bears thereagainst, while the opposite end of the latter bears against an end collar 78 of the inertia bar 60 and normally urges the latter forward in the direction of the arrows 80 (Figs. 2 and 3) so as to force the breech block 18 into its closed position through intermediate of the link 66. The aforementioned floating pivotal or lost-motion connection between the pin 46 and the breech block 18 is obtained by identical slots 82 in the opposite side walls 84 of the latter through which the pin 46 extends (Figs. 2, 3 and 3A). The slots 82 have forward lengths 86 which extend parallel to the longitudinal axis of the breech block 18, and rearwardly continuing cam lengths 88 which are inclined to this axis. For the interlock of the breech block 18 in its closed position with the chamber unit 16, the breech block has at its top a key formation 90 and the rearward extension 38 of the chamber unit 16 is provided with a longitudinal slot 92 in the end wall 94 of which serves as a lock shoulder for the key formation 90 of the breech block.

After firing the chambered cartridge c, in a manner hereinafter explained, while the breech block 18 is in its closed position and interlocked with the chamber unit 16 (Fig. 2), the ensuing full recoil force of the shell of the fired cartridge will instantaneously be imparted to the breech block 18 and also to the chamber unit 16 by virtue of the interlock of the latter with the former, with the result that both are thrown backwards until the rearward extension 38 of the chamber unit engages the internal stop shoulder 34 in the receiver 12 (Fig. 5). The recoil of the interlocked chamber unit 16 and breech block 18 is at its very inception also transmitted to the breech block operating mechanism 20 by virtue of the then-prevailing engagement of the pin 46 with the ends 98 of the forward lengths 86 of the slots 82 in the breech block (Fig. 2), with the result that the link 66 and the inertia bar 60 are thrown backwards with a force of sufficient magnitude to compress the preloaded spring 62 (Fig. 3). The breech block operating mechanism, though resisted in its recoil by the spring 62, is never otherwise gain sufficient inertia to cause the recilearly traveling pin 46, after its traverse of the forward lengths 86 of the slots 82 in the breech block 18, to cooperate with the inclined cam lengths 88 of these slots, first to tilt the breech block counterclockwise as viewed in Fig. 3 and thereby withdraw the key formation 90 of the latter.
from the locking shoulder 34 in the chamber unit 16 as the rearward extension 38 of the latter is still in engagement with the internal stop shoulder 34 in the receiver 12, and then to retract the released breech block to its fully open position. Due to the floating pivotal connection of the pin 46 with the breech block 18 and the inclined cam characteristics of the rear lengths 88 of the slots 82 in the latter, and further, due to the inertia bar 60 of the pin 46 in a rectilinear path by the side guides 48 and 50 in the ways 52 and 54 in the receiver (Fig. 3A), the pin 46 and the inclined cam lengths 88 of the slots 82 in the breech block will, during the retraction of the latter to its fully open position, also cooperate to tilt the breech block sufficiently so that the same will readily be accommodated in the rearward and downwardly slanting part 100 of the recess 30 in the receiver, as fully shown in my aforementioned prior Patent No. 2,476,352. As already mentioned, the spring 62, compressed as it is to a maximum extent when the breech block 18 is in its fully open position, will return the latter into its closed position (Figs. 2 and 3) through intermediation of the inertia bar 60 and link 66. The breech block 18 will during its entire forward motion be in abutment with the inertia bar 60 and link 66 and the pin 46 until the key formation 99 on the breech block interlocks with the shoulder 94 in the chamber unit 16 at the time the breech block reaches its closed position. Accordingly, the spring urged forward motion of the breech block 18 by the pin 46 while the same cooperates with the inclined cam lengths 88 of the slots 82 in the breech block, and it is only after the breech block reaches its closed position and its key formation 99 is in position with the slot 92 in the side chamber unit 16 that the inclined cam lengths 88 of the slots 82 cooperate with the pin 46 to rock the breech block, clockwise as viewed in Fig. 2, into interlock with the chamber unit. After thus camming the breech block 18 into interlock with the chamber unit 16, the pin 46 reaches the forward lengths 56 of the slots 82 in the breech block and is moved forwards therein by the spring urged inertia bar 60 and link 66 until it comes to bear against the ends 98 of the slot portions 86 and yielding holds the interlocked breech block and chamber unit 16 in their engaged status within the receiver 12.

The breech block 18 is on one side provided with a conventional extractor 106 (Figs. 1 and 3) and on its opposite side with a conventional ejector (not shown). The extractor 106 acts to withdraw the shell of a fired cartridge from the chamber 40 and brings it adjacent an ejection port 115 in one side of the receiver 12 (Fig. 1) during the described retraction of the breech block from its closed position to its open position, whereupon the ejector throws the shell out through the port 110. The breech block 18 is also manually retractable from its closed position into its open position, and the side guide 48 is to this end provided with a finger-piece 112 which extends outwardly through the ejection port 115 in the receiver 12 and is conveniently accessible thereat.

The fire-control mechanism 22, forming no part of the present invention, may be of any convenient type and, hence, is largely omitted from the drawings. For an understanding of the operation of the fire-control mechanism it is deemed sufficient to explain that a cocked hammer (not shown) is on pulling of the trigger 120 released to strike a spring-retracted firing pin 122 in the breech block 18 (Fig. 3A) for igniting a cartridge. The trigger 120 is pivoted at 128 between spaced upright lugs 130 of a trigger plate 132 which is suitably mounted in the rear part of the recess 30 in the receiver 12 and provides the conventional trigger guard 134. As previously mentioned, the instant exemplary firearm is of the self-loading type, and the same is to that end provided with a cartridge magazine 180 and a cartridge carrier 182 which latter is actuated by the breech block 18, during an initial part of each spring-return of the latter from its open position into its closed position, to lift a cartridge delivered from the magazine into position to be projected into the chamber 40 by the breech block on its continued spring-return into closed position. The magazine 183 is conventionally positioned at 106 in front wall 28 of the receiver 12 (Fig. 2) and holds a conventional cartridge follower 186 and a magazine spring 188. The spring-backed follower 186 normally urges the cartridges in the magazine 180 toward and out of the opening 196. The cartridge carrier 182 is pivotally mounted at 192 (Fig. 2) on the adjacent upright lug 130 of the trigger plate 132, and has a forward extension 194 which terminates in a spoon-like cartridge elevator 196 that is normally in alignment with the magazine 180 for the reception of a cartridge therefrom. The cartridge carrier 182 has also a rearward extension 198 (Fig. 2) on which a dog 200 is pivoted as at 202. Since the construction and operation of the cartridge carrier 182 does not form any part of the present invention and is, moreover, fully shown and described in my prior Patent No. 2,506,982, dated May 9, 1950, it is sufficient for an understanding of the present invention to explain here that the breech block 18 on its rearward excursion into open position will swing the spring urged dog 200 out of the way without tilting the cartridge carrier for the elevation of a cartridge thereon into position for its chambering by the breech block. Thus, the cartridge carrier 182 will during the rearward excursion of the breech block 18 into open position remain in the position shown in Fig. 2 for the reception of a cartridge from the magazine 180. Suitable provisions (not shown) may be made to control the spring urged discharge of a cartridge from the magazine onto the carrier 182 in timed relation with the retraction of the breech block 18 into its open position, and to prevent the discharge of more than one cartridge at a time from the magazine as well as any jam of the cartridge in the receiver during its transfer by the carrier into position for its subsequent chambering by the breech block. Provisions suitable for these purposes may be like or similar to those shown in my prior Patent No. 2,509,382, dated May 30, 1950. Soon after the breech block 18 has started on its spring-return from open position toward into closed position, the same cooperates with the dog 200 in tilting the carrier 182 to raise the released cartridge thereon into the chamber 40 by the breech block during its continued spring-return into closed position. Soon after the breech block 18 has on its spring-return toward closed position assumed full control over the transfer of the raised cartridge from the carrier 182 into the chamber 40, the cooperation between the breech block 18 and the dog 200 on the carrier 182 ceases and the latter is urged into its normal position (Fig. 2) by the action of a spring 204 which acts on the dog 200. Reloading of the magazine 180 with fresh cartridges may conveniently be undertaken when the breech block is in its closed position, by pressing the spoon-like elevator 196 of the carrier 182 inwardly, against the force of the spring 204, in order to gain access to the magazine 180 through the open bottom 32 of the receiver, and then inserting cartridges into the magazine against the forward force of the spring urged follower 186. A conventional forestock 205 may in any suitable manner be removably mounted on the receiver 12 in covering relation with the magazine 180. The firearm described so far may be conventional in every respect.
in its rear enlarged at 212 and also at 214 for the reception of the exemplary shotgun chamber 40 with a relatively loose fit. However, in accordance with the present invention, the area between the chamber 40 and the enlarged end portions 212 and 214 of the barrel bore 210 is not of a uniform fit throughout, but is rather arranged as an annular relief passage 216 for residual combustion matter blown thereinto from the barrel bore 210. This relief passage 216 is preferably over the greater part 218 of its length of sufficient annular width or gap not only to preclude its clogging with residual combustion matter from the barrel bore 210, while the remaining and preferably much shorter length of this relief passage is of sufficiently narrow annular width or gap not only to compel the intruding projectile-propelling gases from the barrel bore into powerful jet action for most effective scavenging of the relief passage, but also to serve as an effective choke to prevent any appreciable pressure drop of the propelling gases in the barrel bore. Advantageously, the jet-action area of smallest width or gap of the relief passage 216 is divided and provided at the entry and exit ends 218 and 220 thereof as shown in the present example (Figs. 2 to 6) a front sealing sleeve 222 and an external rear collar 224 of the chamber 40 have a relatively loose fit with the enlarged end portions 212 and 214, respectively, of the barrel bore 210. In this dividing the jet-action area of the relief passage 216 over the entry and exit ends thereof, optimum scavenging of the relief passage throughout its expanse and maximum choke control over the pressure of the gases in the barrel bore with the shortest possible constriction of the relief passage are achieved. This is quite important since the maximum constriction of the relief passage required for the desired jet and choke control performance of the same, if extended continually over a substantial length of the relief passage, would in time become inevitably clogged with residual combustion matter, with the result that the chamber would become more and more bound to the barrel and no longer recoil sufficiently to initiate ejection of a fired shell from the receiver and reloading of the chamber with a fresh cartridge.

Rearward jet-action scavenging of the relief passage, in a direction in which it will not in the least interfere with the aim of the firearm, and the discharge of the scavenged matter into the receiver 12 is least obstructed in that it will immediately on recoil of the chamber unit 16 pass through the customary extractor-clearing groove 230 in the chamber unit (Fig. 3). This groove 230 extends to the annular shoulder 232 of the chamber unit which in the firing position of the latter (Fig. 2) bears against the adjacent end of the barrel 14, wherefore this groove is in communication with the jet-action exit end 220 of the relief passage 216 immediately on retraction of the shoulder 233 from the adjacent barrel end on recoil of the chamber unit. Moreover, the scavenged matter from the relief passage is by the groove 230 directed toward the nearby ejection port 110 for harmless escape therethrough, thereby protecting the operating parts in the receiver from any harmful effects from the scavenged matter.

The rear collar 224 may be provided on the chamber in any suitable manner. Thus, the chamber 40 may, except at its front sealing sleeve 222, be initially of a uniform outside diameter, whereupon the same may be externally machined to leave the collar 224.

While in the described example the wide portion of the relief passage is formed by peripherally undercutting the chamber in part, the same wide portion of the relief passage may be obtained by undercutting a length of the enlarged barrel bore end 214, as at 234 (Fig. 7), in which case the chamber 40 is without a collar at its rear end and is instead received with a relatively loose fit in the non-undercut end length 236 of the enlarged barrel bore end 214.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

What is claimed is:

1. In an automatic firearm of the type having a movable chamber coaxially mounted and received within the barrel, an annular exterior shoulder formed on one end of the chamber, a sealing sleeve formed on the other end of the chamber, both the shoulder and the sleeve making a relatively loose fit with an interior surface of said barrel, the exterior surface of the chamber intermediate said shoulder and said sealing sleeve being undercut to cooperate with the interior surface of the barrel to define an annular relief passage, the barrel further cooperating with the chamber in the region of the shoulder and the sleeve to define axially spaced annular restrictions communicating with opposite ends of said relief passage.

2. In a firearm of the type having a chamber received within and movable relative to a barrel portion, the improvement comprising a sealing sleeve formed on one end of the chamber, an exterior surface of the opposite end of said chamber and an exterior surface of said sleeve making a relatively loose fit with a corresponding interior surface of said barrel, the interior surface of said barrel in the region thereof intermediate the ends of said chamber being undercut so as to cooperate with the corresponding exterior surface of the chamber to define an annular relief passage, the barrel further cooperating with the chamber at said ends to define a pair of spaced annular restrictions communicating with said relief passage.

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