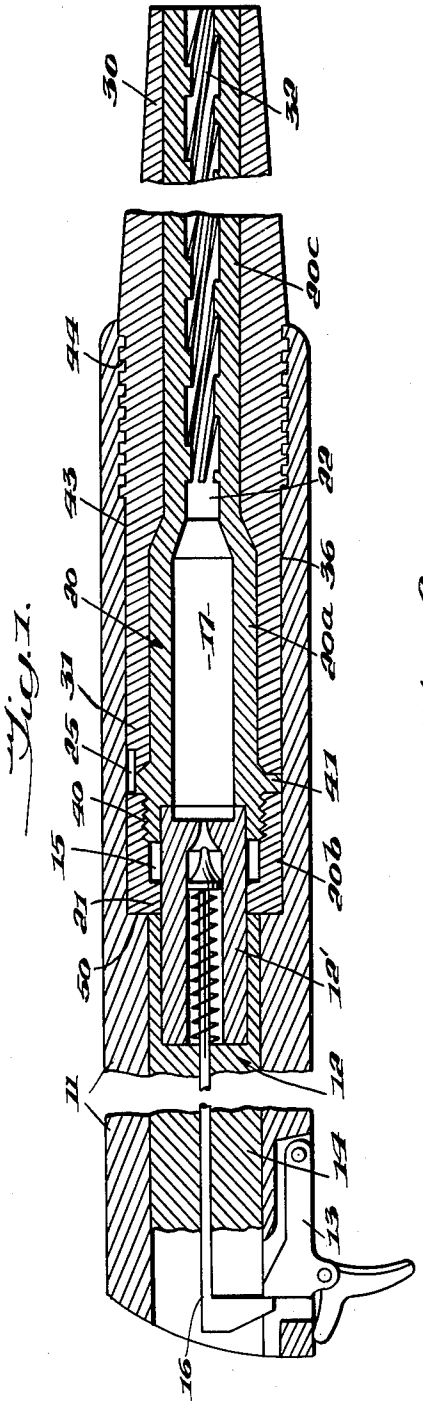
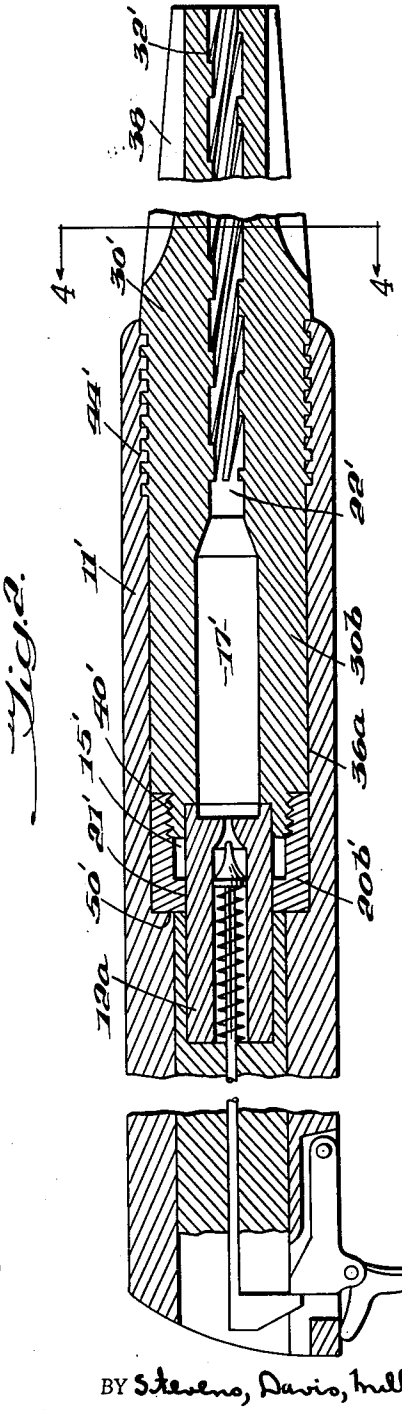
April 3, 1962 G. C. SULLIVAN 3,027,672

FIREARM WITH ALUMINUM ALLOY RECEIVER

Original Filed April 12, 1957 2 Sheets-Sheet 1





INVENTOR
GEORGE C. SULLIVAN,

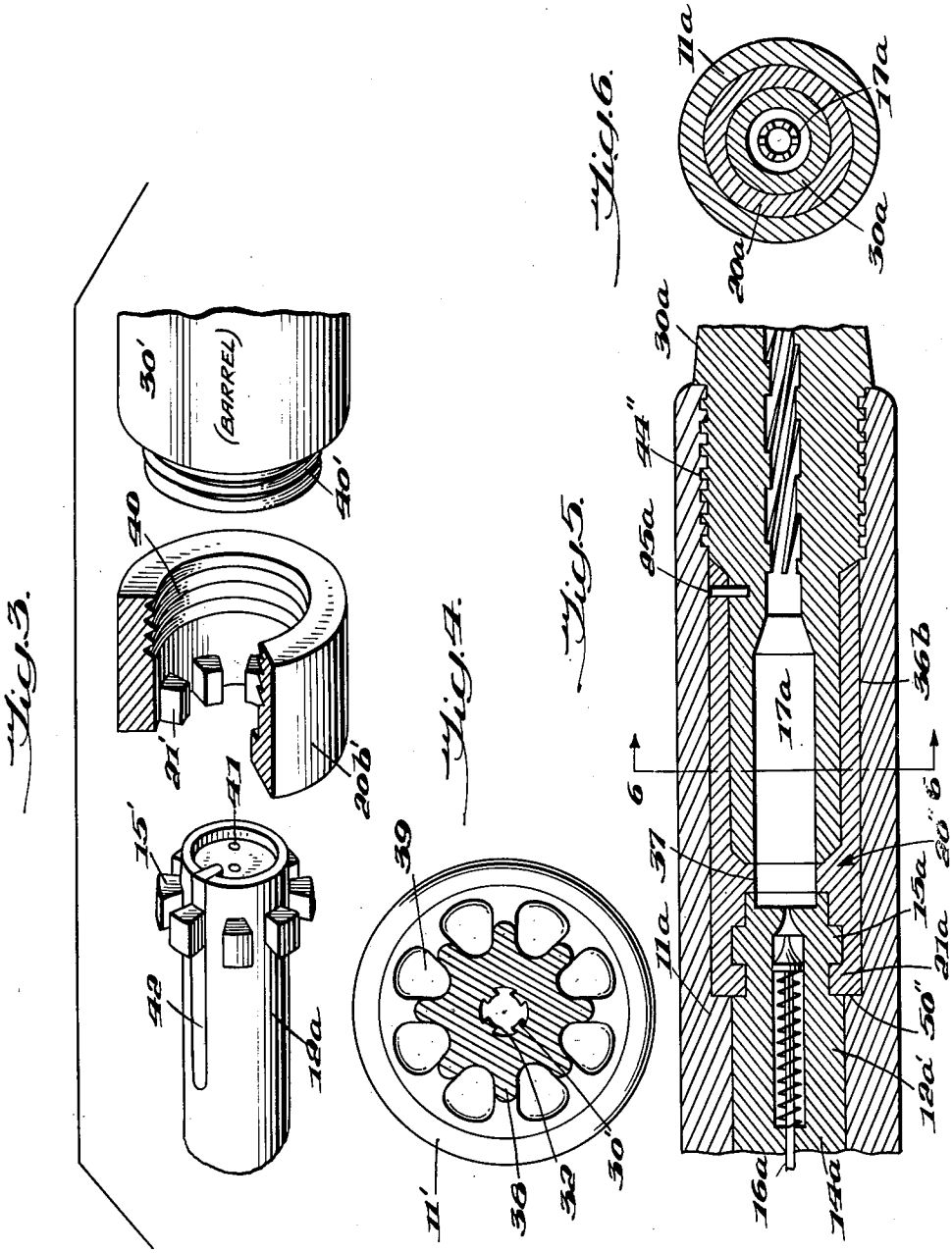
BY Stevens, Davis, Miller & Mosher

ATTORNEYS

April 3, 1962 G. C. SULLIVAN 3,027,672

FIREARM WITH ALUMINUM ALLOY RECEIVER

Original Filed April 12, 1957 2 Sheets-Sheet 2



INVENTOR
GEORGE C. SULLIVAN,

BY Stevens, Davis, Miller & Mosher

ATTORNEYS

United States Patent Office 3,027,672 Patented Apr. 3, 1962

3,027,672

FIREARM WITH ALUMINUM ALLOY RECEIVER

George C. Sullivan, 3085 Lake Hollywood Drive, Hollywood, Calif.

Continuation of application Ser. No. 652,601, Apr. 12, 1957. This application Apr. 26, 1961, Ser. No. 105,812
14 Claims. (Cl. 42—16)

This invention relates to a weapon or firearm having a design and construction of such a nature that the resultant product is of minimum weight. It is constructed in such a manner that the strength, life and other factors necessary in a practical and useful firearm are not impaired.

This application is a continuation of my copending application Serial No. 652,601, filed April 12, 1957, which is a continuation-in-part of my copending application Serial No. 307,606, filed September 3, 1952, now abandoned, which in turn is a continuation-in-part of my application Serial No. 272,428, filed February 19, 1952, now Patent 2,780,019, issued February 5, 1957.

Heretofore I have made several inventions relating to firearms in which lightweight non-ferrous alloys and plastic materials have played an important part. In weapons of extremely high breech pressures, and particularly wherein these materials are employed in weapons of the automatic type, it may be found desirable to provide the firearm with an interchangeable sleeve or liner about the chamber area, the sleeve or liner being fabricated of very high strength alloy materials. This disclosure presents an invention which preferably incorporates such features.

The present invention provides a barrel, receiver and bolt mechanism which may be constructed of a combination of various metals of various weights and strengths; the stronger materials being used in areas of greater stress where bursting pressures are a maximum and the lighter metals in areas of less stress. In the present application I prefer to use a barrel of lightweight non-ferrous alloy, such as an aluminum alloy commonly known as 75ST or 78ST, all as described in my application for Patent Serial No. 272,428 filed February 19, 1952, (now Patent No. 2,780,019), of which application my copending application Serial No. 307,606 is a continuation-in-part.

In one embodiment of the invention, I prefer to combine with the aforesaid lightweight barrel a chamber sleeve or liner which is constructed of a higher strength ferrous alloy, such as steel, and which incorporates integrally therewith a means of locking the bolt mechanism securely thereto in such a manner that the weapon may be fired without rupture and with complete safety. In this way the receiver can be constructed of a lightweight metal, such as an aluminum alloy, and when combined with a lightweight barrel the resultant weight of the weapon is materially reduced. Such a lightweight weapon or firearm is recognized as being of great advantage and importance to sportsmen, law enforcement officers and to military personnel.

Thus it will be seen that the primary object of this invention is to provide a weapon or firearm of minimized weight, yet of maximum strength in areas of maximum pressures and stress.

A further object is to provide a firearm in which a relatively low strength but lightweight non-ferrous alloy, such as an aluminum alloy, is largely employed in the receiver structure in conjunction with a gun barrel sleeve or liner and rotary bolt element all fabricated of relatively high strength steel.

A further object is to provide a construction which permits the ready removal and replacement of parts most subject to wear, such as the sleeve means, or barrel.

A further object is to provide a firearm having a removable and replaceable barrel liner or sleeve whereby

the same firearm is adapted for use with cartridges or ammunition of various caliber sizes.

A further object is the provision of a strong, rigid and rugged connection between the barrel and receiver components of a gun structure wherein at least one of the components is constructed of relatively low strength aluminum alloy or the like.

A further object is the provision of a gun barrel the cartridge chambered end of which is cylindrical and of substantially constant diameter throughout the length of its cartridge or firing chamber and wherein a barrel sleeve extension of substantially the same constant diameter and uninterrupted outer cylindrical surface has an internal locking mechanism adapted to interengage with a similar locking means on the rotary portion of a multi-part bolt mechanism disposed adjacent to it.

A further object is the provision of interengageable locking lugs on a barrel sleeve or liner member and rotary bolt member, the lugs being uniformly spaced in a single annular series throughout the entire circular extent of each member.

A further object is the provision of a pivoted cartridge extractor on the bolt means also partially functioning as integral support for one of the spaced locking lugs on the bolt mechanism.

A further object is to provide a construction which is not troubled with such problems as head spacing and the like.

Other objects will become apparent upon reading the specification.

With the above and other objects in view, those skilled in the art will appreciate the advantages and the invention as disclosed when reviewing the accompanying drawings wherein:

FIGURE 1 is a longitudinal cross-sectional view of a gun barrel and receiver construction incorporating the present invention.

FIGURE 2 is a longitudinal cross-sectional view of a modified form of the invention.

FIGURE 3 is an exploded view of the rear portion of the barrel fitted with a sleeve surrounding the chamber portion adapted to engage the locking lugs on the bolt.

FIGURE 4 is a section taken on line 4—4 of FIGURE 2.

FIGURE 5 is a longitudinal cross-sectional view of an alternative sleeve or liner arrangement in which the present invention is incorporated, and

FIGURE 6 is a sectional view taken on line 6—6 of FIGURE 5 to show the barrel, sleeve or liner and receiver details thereof.

As shown in FIGURE 1 of the drawings, the composite firearm of the present invention includes a construction consisting primarily of a receiver **11**, a multi-part bolt mechanism **12** slidably mounted therein and a trigger mechanism **13**, a barrel liner **20** and a barrel **30**. The bolt mechanism **12** includes essentially the usual bolt frame **14** and rotary head **12'**, the rotary locking lugs **15** on head **12'** and the firing mechanism **16**, while the barrel includes the usual breech end area or section **31** in which is provided a cartridge or firing chamber **17**. However, the annular series of locking lugs **15** on rotary bolt head **12'** are disposed near to but appreciably spaced from its forward end in order to obtain a substantial overlap between the forward end of the bolt head and the barrel liner to provide an effective gas seal around the end of the cartridge chamber **17**.

The fixed barrel sleeve construction **20** in FIGURE 1 consists of a liner or sleeve portion **20***a* disposed within the barrel **30** and formed in liner or sleeve portion **20***a* is the cartridge or firing chamber **17**. A liner or sleeve portion **20***c*, of smaller diameter than portion **20***a*, extends to the barrel muzzle and within its bore **22** is rifling **32**.

At its rearward or breech end liner section 20*a* is of reduced outer diameter and threaded at 40. A cylindrical sleeve portion 20*b*, imperforate in its outer surface, of relatively short length and forming a rearward extension of the barrel structure, is fixedly mounted on and held against a flange 41 of liner portion 20*a*, thus providing proper and fixed head spacing. A pin 25, or equivalent means, is disposed in matching and alined peripheral notches on flange 41 and barrel 30 to prevent the tendency of the sleeve structure to rotate relative to the barrel during firing.

Sleeve portion 20*b*, flange section 41 of liner portion 20*a* and the outer cylindrical surface of barrel 30 extending forwardly of the cartridge chamber 17 provide a smooth cylindrical surface 43 of a constant or uniform diameter supportingly received in counterbore 36 of the part of the receiver 11 forming a sleeve which has the internal annular shoulder 50 at its innermost end. The barrel structure having the sleeve portion 20*b*, is rigidly held within receiver bore 36 in abutting relation to shoulder 50 by securing means preferably disposed forwardly of both the cylindrical surface 43 and the sleeve portion 20*b*, the securing means being a threaded connection at 44. Thus the combination of the securing means 44 and the internal annular shoulder 50 rigidly fixes the barrel 30 or sleeve portion 20*b* to the receiver 11.

Barrel sleeve portion 20*b* has a plurality of evenly spaced inwardly extending locking lugs 21, of any desired number, however, eight lugs are preferred giving a 22½ degree locking or unlocking motion. The lugs are disposed in a singular annular series about its inner cylindrical surface at its end adjacent the cylindrical rotary bolt head 12' of the multi-part bolt mechanism 12. The corresponding number of radially-extending complementary locking lugs 15, disposed in a corresponding singular annular series, are provided about the outer cylindrical surface of the rotary bolt head 12' near to but spaced from its forward end adjacent to barrel sleeve portion 20*b* to provide adequate sealing overlap. The diameter of the cylindrical body portion of the rotary bolt head 12' is such as to be freely movable, by its frame 14, into telescopic engagement with barrel sleeve 20*b* whereby its lugs 15 pass between barrel sleeve lugs 21 to a position just forward of the latter to close chamber 17. The bolt head 12' is then rotated, by means not disclosed, to lock it in chamber-closing position by placing locking lugs 15 in abutting or locking alinement with barrel sleeve lugs 21.

The barrel 30 may be constructed of a non-ferrous alloy and in the case of an aluminum alloy being used it is preferably treated in accordance with the invention of my copending application Serial No. 272,428. I also consider it desirable to treat the receiver 11, the material adjacent the frame 14 and the like in the same manner. A lightweight receiver 11 fabricated of an aluminum alloy, for instance, can be constructed very inexpensively by starting with an extruded section of material which contains integral guide channels whereby locking lugs 15 of the bolt mechanism 12 are guided into engagement with the locking lugs 21 of the sleeve 20*b*. The hard coating treatment, carried out in accordance with the teaching of Patent No. 2,692,851 and Patent No. 2,692,-852, issued October 26, 1954 to C. F. Burrows, for the hard, abrasion-resistant coating of aluminum alloys, provides a surface which is very durable and non-corrosive, yet very light in weight.

In view of the use of relatively low strength aluminum alloy in the fabrication particularly of receiver 11 the elongated bearing or supporting surface 43 of barrel 30, rigidly secured within the sleeve bore 36 of the receiver by means of the securing means 44, provides a very rugged and strong gun barrel-receiver construction that tends to minimize vibration during firing and is therefore conducive to providing greater firing accuracy. Further, it enables the gun construction to absorb greater abuse in handling without damage to alinement between the component parts thereof. Also, as is apparent in FIGURE 1 wherein the barrel is of the composite or laminated type, the confinement of the entire cartridge chamber 17 within the sleeve portion of the receiver inclusive of bore 36 preferably provides additional reinforcement about the cartridge chamber, an area exposed to high explosive breech pressures and stresses.

Assuming a cartridge is injected into chamber 17 the bolt mechanism 12 then slides to the right in FIGURE 1 until it is in the position shown wherein bolt locking lugs 15 on rotary head 12' have moved to the right of lugs 21 of sleeve member portion 20*b*. While bolt head 12' has been only referred to as having rotary movement it is to be understood that after being rotated to unlock its lugs 15 from sleeve lugs 21 the head 12' is carried rearwardly with the carrier 14 which moves or slides linearly under recoil or other forces. By mechanism, not disclosed, bolt head 12', when returned to the position shown, is partially rotated causing its lugs 15 to be moved into locking alingment with sleeve lugs 21 thereby tightly and sealingly closing the cartridge chamber behind the cartridge. It will be noted that the breech end wall of chamber 17 thus formed by members 12', 20*b* and 20*a* are of high strength steel alloy capable of withstanding the high explosive stress loads imposed thereon by firing of the cartridge.

As parts of the receiver or barrel structure may become worn through long usage, or damaged through careless handling, any of the receiver or barrel sleeve components are readily replaceable. Likewise the gun may be used with cartridges of different caliber simply by removing the barrel sleeve structure by any means well known in the art and substituting a sleeve structure having a cartridge chamber and bore of the desired caliber.

In the modification shown in FIGURE 2, which is similar in many respects to the first described embodiment, the cartridge chamber 17' and bore 22' having rifling 32' are formed integrally within an all steel barrel 30*b* an externally threaded section 40' being formed integrally on the breech end of the barrel. Forwardly of the section 40', the steel barrel can be externally threaded to engage a correspondingly threaded section on the aluminum alloy receiver structure 11' at 44', or other securing means, and be employed to fixedly mount the barrel and receiver together. A barrel sleeve 20*b*', corresponding to sleeve portion 20*b* in the preceding embodiment, threadedly engages the barrel threaded section at 40' in fixed rigid final position as determined by the annular shoulder 50' in the inner end of the receiver counterbore 36*a* when the receiver and barrel are tightly secured together at 44', as in the first embodiment. As shown in FIGURE 3 the locking lugs 15', disposed in a single series in evenly spaced relation around the entire circumference of rotary bolt head 12*a* and disposed near to but spaced from the front of the bolt head, are adapted to engage and lock with complementary inwardly extending lugs 21' on sleeve 20*b*' to effectively close the breech end of cartridge chamber 17'. One of the lugs 15' is integrally formed on a cartridge extractor 42 intermediate its length which is pivotally mounted on bolt head 12*a* so as to normally lie flush in its outer cylindrical surface. This extractor and lug mounting is applicable to all of the embodiments disclosed. In FIGURES 2 and 4 the portion of the gun barrel extending between its muzzle and the receiver is exteriorly fluted at 38 for cooling purposes and to minimize against distortion due to heat generated during firing.

In FIGURES 5 and 6 is shown another embodiment wherein the major portion of cartridge chamber 17*a* is formed directly in barrel 30*a*. The cylindrical exterior of the inner end portion of the gun barrel 30*a*, which extends substantially throughout the length of the cartridge chamber 17*a* therein, is of reduced constant diameter and mounted thereon is the steel alloy sleeve structure 20'' which may be pinned in position by means of a pin 25*a*

or the like at its forward end. The sleeve structure 20'' completes the barrel cartridge confining cylindrical wall of chamber 17*a* at 37 and an extension of the sleeve extends rearwardly to form, with rotary bolt head 12*a'*, also fabricated of steel, a closure for the cartridge chamber with the interengageable locking lugs 15*a* and 21*a* being provided on the bolt head and sleeve, respectively. The rear or inner end of sleeve 20'', as in the preceding embodiments, abuts against an annular shoulder 50'' in the sleeve bore portion 36*b* of receiver 11*a* when the threaded sections of the receiver and gun barrel are tightly screwed together at 44''.

In the case of the all steel barrel 30' and 30*a*, the securing means 44' and 44'' can be located in a closer relationship to the annular shoulder 50' and 50'' with good results; it being necessary that at least sleeve portion 20*b* and 20*b'* be rigidly confined and fixed to the receiver.

With the construction disclosed in each of the embodiments the problem of "excessive head space" is minimized. Head space is defined as the space between the front face of the breech closing means and the rear end of the cartridge. Were this space to become excessive, the cartridge would not be fully forward in position in the chamber. This would constitute a dangerous condition which could cause malfunctioning of the gun due to the unsupported portion of the cartridge being liable to burst or crack. However, it will be noted that this condition cannot arise in any of the embodiments disclosed due to the interlocking barrel sleeves and rotary bolt members, which receive the high firing stresses, being fabricated of high strength steel alloy of a nature to withstand any appreciable deformation during firing. Also the head spacing and sealing problem is minimized due to the very desirable locating of the locking lugs in an area spaced outwardly from the rear of the cartridge chamber.

By the use of both relatively low strength non-ferrous and high strength ferrous alloys as disclosed in the fabrication of the gun components, applicant has achieved a novel and inventive gun construction relatively light in weight and economical in its manufacturing costs.

While a rifle barrel has been chosen for illustration, it is to be understood that the invention is equally adaptable to any type of firearm including shotguns and the like firing any desired type of projectile.

It should be understood that the present disclosure is for the purpose of illustration only and that the invention includes all modifications and equivalents which fall within the scope of the appended claims.

I claim:

1. A lightweight firearm comprising in combination a gun barrel having a firing chamber, a receiver fixedly mounted on said gun barrel, a bolt mechanism including a rotary head slidably mounted in said receiver, said receiver being farbricated of a lightweight non-ferrous alloy, said barrel having replaceable sleeve means fixedly secured to the breech end thereof and forming a stationary rearward cylindrical barrel extension having an imperforate outer surface throughout its entire length within the receiver, said rearward barrel sleeve extension being of a length to telescopically engage only the adjacent end of the rotary bolt head therein, said rotary bolt head and said barrel rear extension sleeve means both being fabricated of a ferrous alloy of greater strength than the lightweight non-ferrous alloy of the receiver, uniformly spaced locking lugs on the forward end of said rotary bolt head interengageable with complementary locking lugs on said rearward barrel rear extension sleeve in said receiver, said stationary barrel rear extension sleeve and rotary bolt head when locked together by their interengaging locking lugs closing said firing chamber and substantially isolating all firing chamber impact pressures from said receiver to provide firing security.

2. A lightweight firearm comprising in combination a gun barrel having a firing chamber and sleeve means fixedly mounted thereon at its breech end, a receiver fixedly mounted on and supporting said gun barrel, said receiver being fabricated of an aluminum alloy, said barrel sleeve means being fixedly secured to the breech end thereof and forming a rearward barrel extension in said receiver, said barrel extension having an imperforate outer surface throughout its length, a bolt mechanism in said receiver and having a rotary bolt head portion, said barrel sleeve extension and said rotary bolt head being fabricated of a ferrous alloy of greater strength than the aluminum alloy of said receiver, the said rearward barrel sleeve extension being of a length to telescopically engage only the forward end of said rotary bolt head, said rearward barrel sleeve extension and said rotary bolt head each having locking lugs mounted thereon intermediate the ends of each and interlocking together when the rotary bolt head is in firing chamber closing position whereby their overlap provides an effective gas seal to contain firing chamber pressures and provide firing security.

3. In combination a firearm barrel having a firing chamber and sleeve means, said barrel being of circular section and of a substantially constant diameter throughout the breech area inclusive of its sleeve means, said sleeve means being rigidly attached to the barrel at its breech end and forming a rearward cylindrical extension thereof, the outer diameter of said barrel sleeve means being of substantially the same said constant diameter of said gun barrel, a receiver fixedly mounted in circumferential contacting relationship on said barrel sleeve means, said receiver being fabricated of aluminum alloy and having a counterbored portion forming a sleeve means in which said barrel sleeve means is mounted in bearing contact, securing means on said barrel sleeve means and receiver fixedly securing said barrel sleeve means and receiver together, bolt mechanism including a rotary bolt head of circular section mounted in said receiver and disposed adjacent to said barrel rearward sleeve extension means, said barrel sleeve means and rotary bolt head each being fabricated of ferrous metal of higher strength than the aluminum alloy of the receiver, said rotary bolt head and said barrel rearward sleeve extension means having interengageable rotary locking means whereby when interengaged they hold said rotary bolt head in chamber closing position to contain chamber pressures during firing to provide firing security while isolating said pressures from said receiver.

4. The structure as recited in claim 3 wherein said barrel extension sleeve means is unbroken throughout its outer cylindrical surface and the locking lugs thereon extend in a singular annular series throughout its inner circumferential extent, the rotary bolt head locking lugs being complemental to the barrel sleeve means locking lugs and disposed on the outer surface of said rotary bolt head.

5. The structure as defined in claim 3 wherein the interengageable locking lugs of the barrel extension sleeve means and rotary bolt head are all uniformly spaced throughout the said series, and cartridge extractor means flush-mounted on said rotary bolt head, one of said locking lugs on said rotary bolt head being integrally connected with said extractor means intermediate the length of the latter.

6. The structure as defined in claim 3 wherein the rotary bolt head has extractor means pivotally mounted longitudinally in and flush with its outer circular surface, said extractor means having mounted thereon intermediate its length one of the rotary bolt locking lugs.

7. The structure as defined in claim 2 in which cartridge extractor means is mounted flush in the outer surface of said rotary bolt head, said extractor means at a point intermediate its length supporting one of said locking lugs.

8. In combination, a firearm barrel having a breech end section of a shape having a substantially constant outer dimension, a receiver and bolt mechanism having a rotary bolt head, said receiver being fabricated of an

aluminum alloy, said barrel breech end section having replaceable annular sleeve means of imperforate outer surface assembled thereto and rigidly secured around the rear portion thereof and having substantially the same constant outer dimension of said barrel, said aluminum alloy receiver having a sleeve portion surrounding in bearing contact and in mounting relation to said annular sleeve means and said barrel breech end section, means to rigidly secure the receiver on the breech end section of said barrel in fixed relationship, said sleeve means having a portion extending rearwardly from the barrel of a length to engage only the forward portion of said bolt mechanism, said bolt mechanism and said sleeve means being fabricated of metal of higher strength than said aluminum alloy and being mounted within said aluminum alloy receiver, and rotary locking means, said rotary locking means comprising a singular annular series of evenly distributed locking lugs disposed around said sleeve means engaging the forward end of said bolt mechanism and cooperating with complementary locking lug means on the forward portion of said bolt mechanism, to hold said rotary head in closing engagement with said barrel sleeve to contain chamber pressures and provide firing security.

9. In combination in a lightweight high rate of fire firearm, a firearm barrel having a cylindrical breech end section of a constant diameter containing a cartridge chamber, a receiver, a slidable bolt mechanism including a rotary head having locking lugs on the forward portion thereof in said receiver, said receiver being fabricated of an aluminum alloy, said barrel having replaceable cylindrical sleeve means rigidly secured around the rear portion thereof, said cylindrical sleeve means being imperforate throughout the length thereof and having substantially the same constant outer diameter as said barrel breech end section, said aluminum alloy receiver having a sleeve portion to surround in bearing contact and mount said sleeve means on said barrel breech end section, means to fixedly secure the receiver on the barrel breech end section, said sleeve means extending rearwardly from the barrel of a length to engage only the forward rotary head portion of said bolt mechanism, said bolt mechanism and said sleeve means being fabricated of metal of higher strength than said aluminum alloy and being mounted within said aluminum alloy receiver, and rotary locking means, said rotary locking means comprising a plurality of evenly spaced locking lugs disposed around said sleeve means engaging the locking lugs on the forward end of said rotary head portion of said bolt mechanism, to interlock said rotary bolt head to said barrel sleeve to close said cartridge chamber for operation of said firearm.

10. The structure as recited in claim 9 wherein said replaceable cylindrical sleeve on said barrel cylindrical breech end section of substantially constant diameter surrounds the cartridge chamber and has a length at least equal to the length of the cartridge chamber, said means to rigidly secure the receiver on said barrel breech end section comprising interengaging threads means on said barrel and said receiver sleeve portion.

11. The structure as recited in claim 10 wherein said rotary lock means includes evenly spaced locking lugs on the rotary bolt head intermediate its length complementary to the locking lugs on said barrel sleeve and interengageable therewith, and cartridge extractor means, said extractor means supporting a portion of said rotary lock means.

12. The structure as recited in claim 11 wherein the locking lugs on the rotary bolt head comprise a singular angular series of evenly, spaced locking lugs around the outer cylindrical surface of said bolt head at its breech closing end, said cartridge extractor being mounted flush in the said outer cylindrical surface of said bolt head, one of said locking lugs being formed integral with said extractor.

13. The structure as recited in claim 9 wherein the barrel replaceable sleeve means further includes a replaceable section extending inwardly of the barrel and forming at least a portion of the cartridge chamber therein.

14. A structure as recited in claim 9 wherein the barrel replaceable sleeve means further includes a replaceable section within which is formed the cartridge chamber.

References Cited in the file of this patent

UNITED STATES PATENTS

1,007,911	Bjorgum	Nov. 7, 1911
1,685,148	Conant	Sept. 25, 1928
2,090,656	Williams	Aug. 24, 1937
2,324,775	Hentschel	July 20, 1943
2,585,195	Walker	Feb. 12, 1952
2,655,837	Johnson	Oct. 20, 1953