

Jan. 11, 1955

Filed Feb. 19, 1947

C. W. MUSSEY
RIFLED FIREARM WHICH AUTOMATICALLY
INDEXES PREENGRAVED PROJECTILES

2,699,094

4 Sheets-Sheet 1

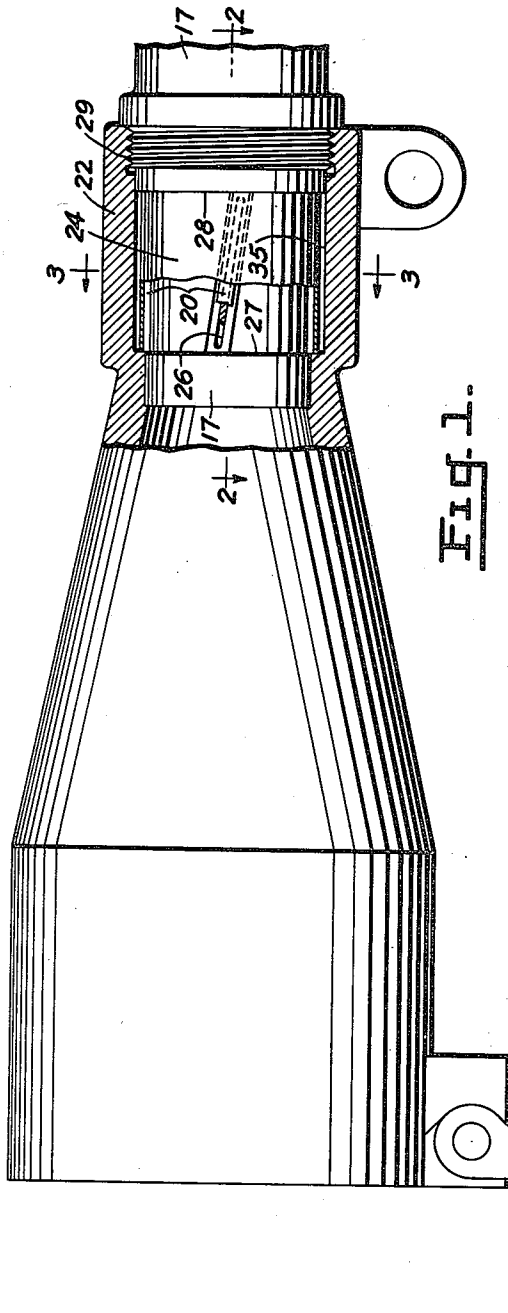


Fig. 3.

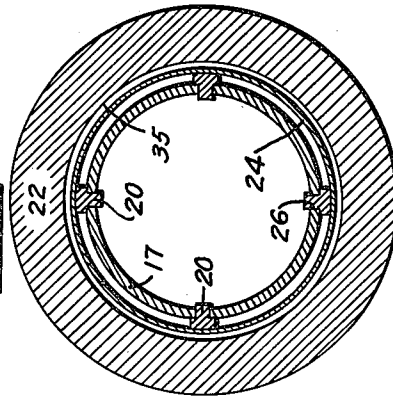
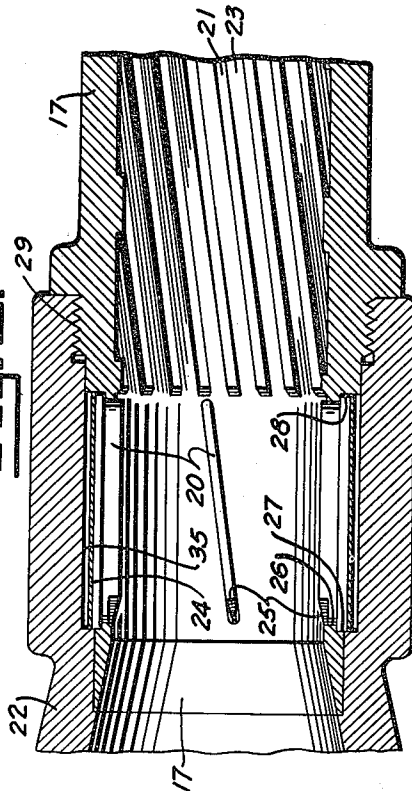


Fig. 2.



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4 Sheets-Sheet 2

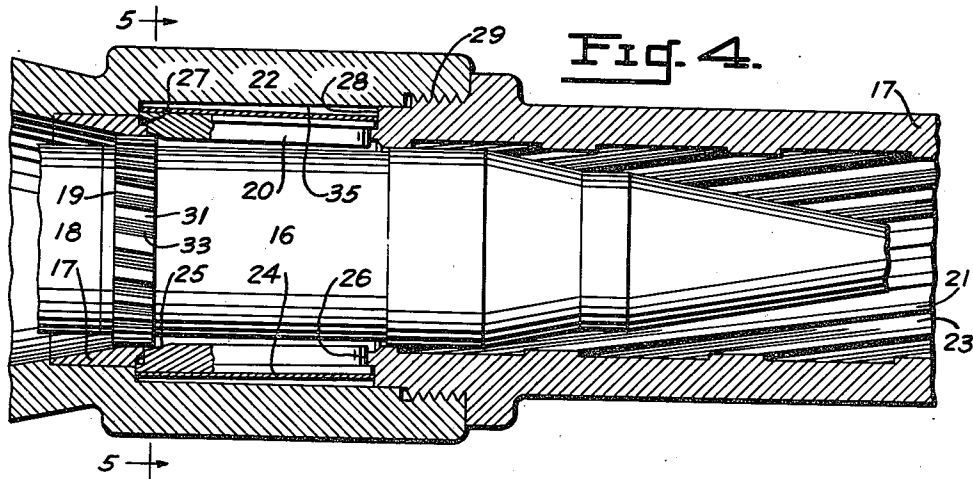


Fig. 4.

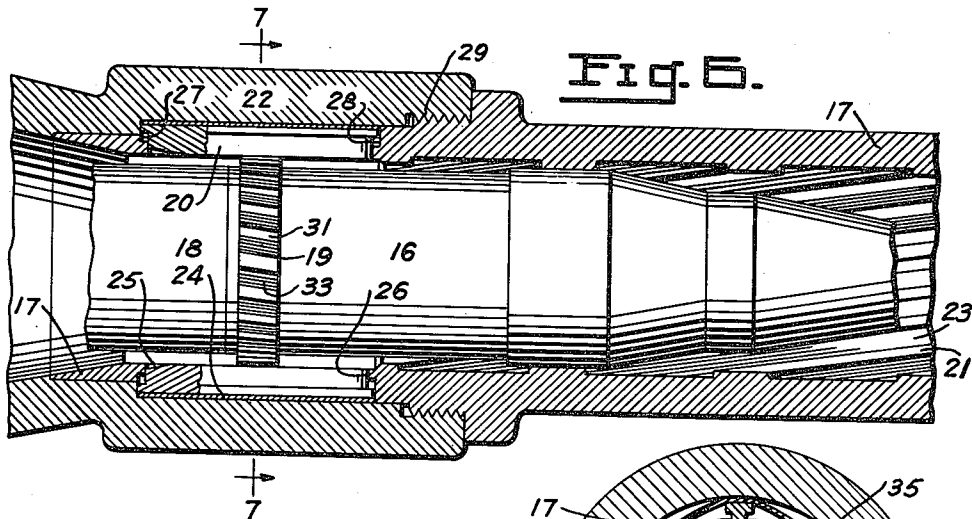


Fig. 6.

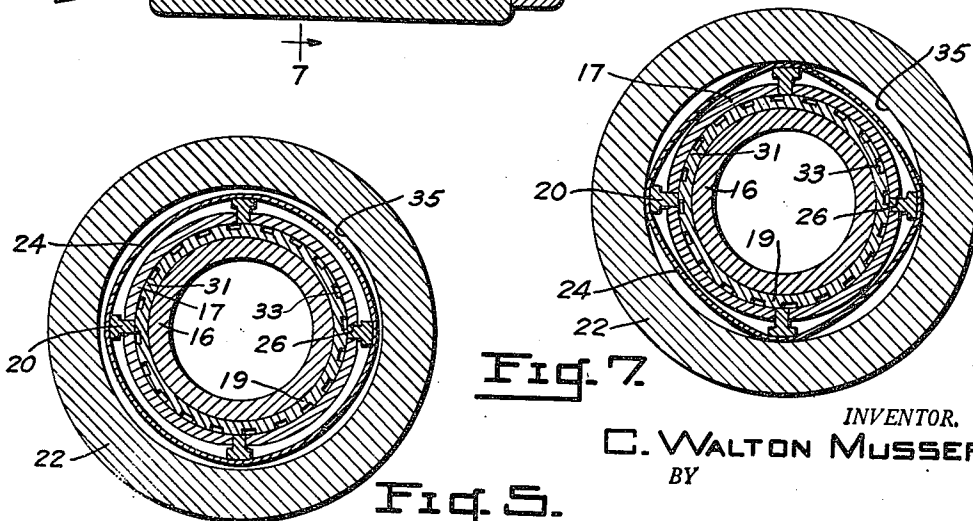


Fig. 7.

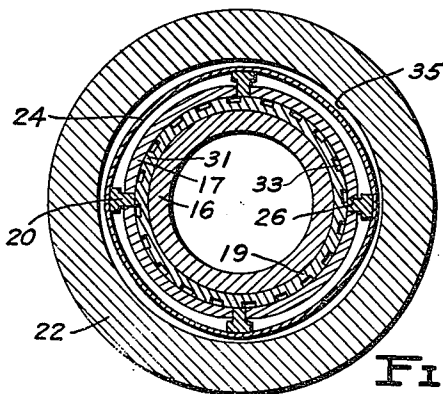


Fig. 5.

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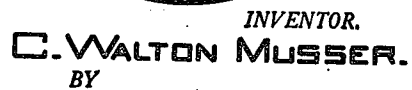


Fig. 9.

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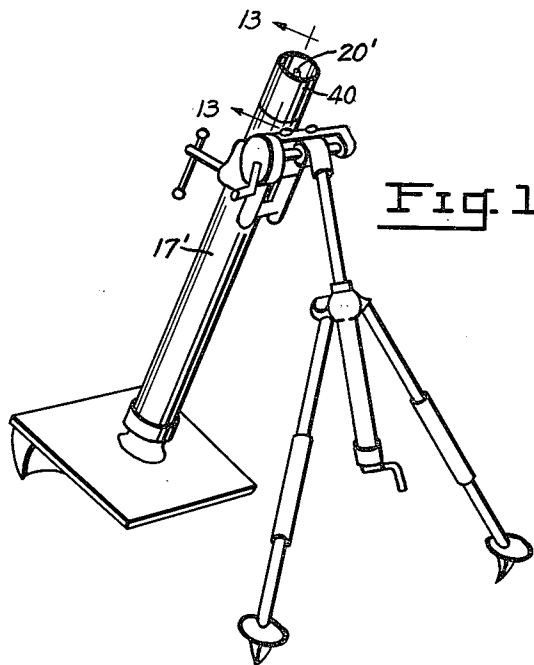


Fig. 12.

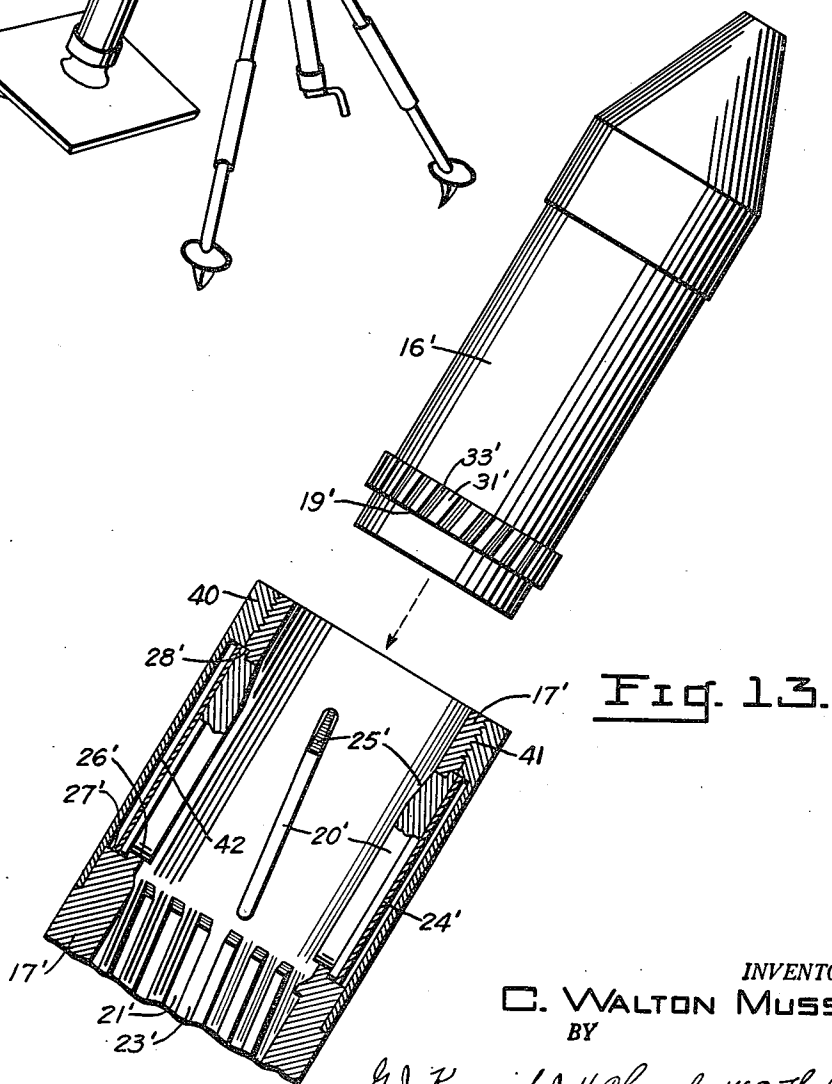


Fig. 13.

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2,699,094

RIFLED FIREARM WHICH AUTOMATICALLY INDEXES PREENGRAVED PROJECTILES

Clarence Walton Musser, Philadelphia, Pa.

Application February 19, 1947, Serial No. 729,638

7 Claims. (Cl. 89—1.7)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described in the foregoing specification and claims may be manufactured and used by or for the Government for governmental purposes without the payment to me of any royalty thereon.

My invention is a continuation-in-part of application Serial No. 605,614, filed July 17, 1945, now Patent No. 2,456,011 for "Method and Apparatus for Aligning Pre-Engraved Projectiles in Rifled Firearms"; and relates to means operative during insertion of pre-engraved projectiles into rifled gun barrels for bringing the projectile's engravings into correct registry with the lands and grooves of the barrel's rifling.

Broadly stated, the object of my invention is to simplify the insertion of pre-engraved projectiles into the rifled barrels of both breech loading and muzzle loading firearms.

A more specific object is to diminish the effort and time required to effect such insertion.

Another object is to make pre-engraved projectiles more readily usable in rifled weapons of the automatic re-loading type.

A further object is to impart to rifled gun barrels the capability of receiving and engaging a pre-engraved projectile in substantially instantaneous alignment and without necessitating special rotative manipulation.

A still further object is to provide a unique method and novel apparatus for accomplishing the foregoing.

In practicing my invention I attain the stated and other objects by supplementing the interior walls of rifled gun barrels with novel indexing detents that engage the projectile's pre-engraved spiral grooves and thereby lead the projectile's pre-engraved teeth into the rifling grooves of the barrel in the automatic and uniquely effective manner presently to be described. A proven form and illustrative application of such detents is shown by the accompanying drawings wherein:

Fig. 1 illustrates the chamber and part of the barrel of a conventional recoilless gun, a section of the barrel wall having been removed to expose an indexer detent applied in accordance with my invention to the interior or bore wall of the barrel at the rear or breech end of a breech loading firearm;

Fig. 2 is an enlarged view taken from line 2—2 of Fig. 1 to show the top of one indexer detent and a side-sectional view of two more of my novel detents. For ease of drawing and understanding, the two sectional showings of the detents have been represented as if their longitudinal axes paralleled the axis of the gun; actually of course, as Figs. 1 and 2 show, the detents follow a spiral path continuous with and having the same twist as a gun bore rifling land.

Fig. 3 is a cross-sectional illustration taken from line 3—3 of Fig. 1 (completed to represent the entire barrel's circumference) to depict the construction and mounting of my novel indexing means in the gun barrel prior to the insertion of a projectile therein.

Fig. 4 is a longitudinal section of the Fig. 1 firearm in which a pre-engraved projectile has been inserted, illustrating the manner in which the projectile's pre-engraved teeth contact my novel indexing device in the gun barrel's bore.

Fig. 5 is a cross-section taken along line 5—5 of Fig. 4 (completed to represent the entire barrel's circumference) to show how contact by the projectile's pre-engraved teeth has caused the indexing detents to be completely withdrawn from the bore of the gun barrel into

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a recess therefor between the external wall of the barrel and the interior wall of the surrounding gun chamber.

Fig. 6 is a longitudinal section of the firearm similar to that of Fig. 4 but showing the action of the indexer detents when the projectile is further advanced into the barrel so that the full width of the pre-engraved rotating band contacts the indexing detents.

Fig. 7 is a cross-sectional illustration taken from line 7—7 of Fig. 6 (completed to represent the entire barrel's circumference) to show, as does Fig. 5, how the indexing detents have been forced radially out of the gun bore away from the path of the projectile and, in addition, illustrates (somewhat exaggeratedly) the manner of deformation undergone by a resilient means used to urge the detents radially inward towards the barrel's bore.

Fig. 8 is a longitudinal section of the gun showing, as a sequence to Figs. 4 and 6, a third step in the axial advancement of the projectile into the gun barrel, the indexing detents having by this time mated with the grooves in the projectile's rotating band.

Fig. 9 is a section on line 9—9 of Fig. 8 through four projectile groove-registered indexing elements, the illustration having been completed to represent the entire barrel circumference, with portions of the barrel broken away to show its relationship with the teeth and grooves on the pre-engraved rotating band.

Fig. 10 illustrates the accompanying registration of the projectile's rotating band with the barrel rifling which my novel indexing device automatically effects upon full forward thrust of the projectile into position for firing the ammunition from the gun.

Fig. 11 is a section on line 11—11 through the so-indexed rotating band of Fig. 10, the illustration having been completed to represent the entire barrel's circumference, with portions of the barrel and of the projectile broken away to show the projectile pre-engraved teeth and grooves and the barrel's rifling lands and grooves which have become registered with each other.

Fig. 12 is a view in perspective of a muzzle loading trench mortar.

Fig. 13 is a view taken from line 13—13 of Fig. 12 to show in longitudinal section the muzzle of a mortar bearing my novel indexing device and further showing a pre-engraved projectile about to be fed into the muzzle loading weapon.

Firearms and ammunition with which improvement is usable

Pre-engraved projectiles for rifling weapons of a wide variety of types or calibers may be benefited by my improved self-indexing mechanism. The projectile and breech loading firearm shown by the drawings are illustrative of these. The firearm there represented is a 75 mm. recoilless weapon substantially duplicating that shown and described by Kroeger-Musser patent application Ser. No. 577,830 filed February 14, 1945, for "Recoilless Firearm and Ammunition Therefor," and likewise shown in my aforementioned co-pending application Ser. No. 605,614 of which this application is a continuation-in-part.

Because of the considerable detail with which the illustrative 75 mm. weapon has been described in that Kroeger-Musser and my own earlier application, it will not be necessary to give the dimensional and other specifications therefor at this time. Reference to either or both of those co-pending applications will supply the data such as size of the chamber, number of lands and grooves, rifling twist steepnesses, and other mechanical details. A certain amount of modifications to the firearm disclosed by those earlier applications have been made to accommodate my present invention, and these alterations will adequately be described herein for a complete understanding of the operation of my present invention.

It will become evident that my invention is applicable to any rifled firearm, and need not be restricted to the recoilless type shown by the drawings. Moreover, my invention is adaptable for use in either the breech or muzzle loading type of weapon. As will later become evident, the only prerequisite in designing a firearm to accom-

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modate and make use of my invention is that an adequate unrifled length of the gun barrel, in addition to the length of barrel necessary to accommodate the rifling lands and grooves, should be provided at the rear or breech end of the barrel for breech loading guns or at the front or muzzle end for muzzle loading guns. This extra barrel length, as will later become clear, is required for the installation and proper functioning of my unique rifling indexing device.

The ammunition round usable with the illustrated 75 mm. recoilless firearm and also shown by the drawings is a counterpart of the ammunition round shown by the above identified applications Serial Nos. 577,830 and 604,614. The ammunition round includes a pre-engraved projectile 16 insertable into the rifled gun barrel 17 plus a cartridge case 18 preferably perforated in the manner (not here shown) and for the purpose stated by Kroeger-Musser application Serial No. 577,830 and by an earlier Kroeger-Musser application Serial No. 536,590, filed May 20, 1944, for "Recoilless Firearms, Ammunition Therefor, and Ballistic Design Thereof."

The represented projectile 16 makes use of a rotating band 19 pre-engraved to enable the projectile to pass more readily through the rifled bore of barrel 17. This band 19 may be conventional in all respects. As shown by the drawings, it is located close to the rear of the projectile body, and it has cut therein a number of grooves and intervening teeth for mating with an equivalent number of lands and grooves in the bore of barrel 17 when the projectile 16 has been fully loaded therein.

As the description proceeds it will become apparent that my self-indexing improvements may form a part of firearms which employ ammunition other than the perforated case type earlier described, or ammunition having calibers either larger or smaller than 75 mm., or that carry the pre-engraving directly on the projectile body (rear portion for breech loading and forward portion for muzzle loading) instead of on a separate rotating band, or that are designed for use in rifled barrels having either more or less lands and grooves, or having steepnesses and directions of twists which differ from those shown in the accompanying illustrations.

The problem to be solved

As co-pending Kroeger-Musser Serial No. 536,590 more fully brings out, pre-engraving of projectiles tends to increase the overall efficiency of the weapons in which they are used. Important advantages including a lowering of the force needed to advance the projectile through the barrel plus elimination of engraving pressures behind the projectile and of attendant swedging erosion of the barrel's land. In the case of recoilless type weapons (illustratively here shown) which are fast becoming highly important for military use, projectile pre-engraving is especially valuable as it makes recoil neutralization relatively more easy and reliable.

Heretofore, however, these obvious advantages of pre-engraved projectiles have been attended by substantial extra time and effort required to load same into rifled barrels. In military gunnery, particularly, loading time and effort are of paramount importance and must be minimized before full benefit of the pre-engraving virtues can be realized.

Specifically, the handicap heretofore suffered by the pre-engraved projectiles has been the necessity for matching the projectiles engraved teeth and grooves with the complementary grooves and lands of the barrel's rifling. The process of effecting this registration is time consuming and in the heat of battle may be most troublesome. Moreover, this registration requirement has thus far precluded widespread use of pre-engraved projectiles in weapons of the automatic reloading type.

What has been needed, therefore, were indexing facilities which are self-aligning and automatic, and which may also be relied upon to lead the engraved portion of the projectile into accurate registry with the barrel's rifling. This need has previously been met by my invention disclosed in my earlier mentioned application Ser. No. 605,614 of which this present application is a continuation-in-part. In this previously disclosed invention, I provided such indexing facilities which were designed for installation upon the projectile. In my here disclosed invention, I have further provided similar indexing facilities which are designed for installation upon the firearm. Both inventions accomplish the same novel purpose, each

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embodying basic design principles and methods of operation that are unique and distinct from each other as well as from the prior art.

Of course, the fundamental principle underlying both inventions which I have originated and which I have claimed in original application Ser. No. 605,614 is that of a means for automatically indexing pre-engraved projectiles for registry within rifled gun barrels. This means, as I have shown in that original and this present application, can be applied to either the projectile or the firearm; possibly, this means may be independent of both. In any event my inventions, as disclosed and claimed in both applications, involve a novel 3-element combination comprising a projectile, gun and indexing means.

Indexing detents applied to breech loading firearms

In the illustrative construction for indexer-improved breech loading firearms which Figs. 1 through 11 show, my new projectile-to-gun barrel aligning mechanism takes the form of the four detents 20 there shown (more or less than four may be used). These indexing detents are resiliently mounted on the outer wall of the gun barrel 17 with one face of the detents radially protruding through slots 26 in the barrel wall into the barrel's bore, and the opposite face of the detent radially projecting outwardly from the barrel wall towards the interior wall surface of the firearm's chamber 22 (see Figs. 1 thru 10). The indexing detents may satisfactorily be made of a hardenable material, such as steel, and preferably arcuate in form following the spiral curve of the gun's rifling and having a T-shaped cross-section as shown by Figs. 3, 5, 7, 9.

As will be more fully brought out presently, the simple and inexpensive rotative-positioning detents 20 are capable of automatically indexing the engravings (teeth 31 and grooves 33) on rotating band 19 of projectile 16 into accurate registry with the riflings (lands 21 and grooves 23) of barrel 17 instantaneously upon forward thrust of the projectile into the barrel and without necessitating special rotative manipulation. Since the illustrated 75 mm. ammunition round thus rotatively positioned weighs over 20 pounds, an exceedingly high degree of effectiveness is achieved.

Operation of self-aligning indexing detents

Loading pre-engraved projectiles into rifled barrels of firearms bearing my unique indexing detent improvement is a relatively simple and automatic process. To effect this loading, a gunner merely thrusts a complete ammunition round into the rear end of the gun chamber 22, and then forwardly rams the projectile home in the gun barrel 17 by exerting simple axial pressure on the rear end of the cartridge case 18.

In the course of thus inserting the projectile into the barrel, the rotating band 19 is brought into a position adjacent the indexing detents 20 as shown by Fig. 4. Should the grooves of rotating band 19 register with detents 20 upon entering barrel 17, immediate indexing of the projectile's pre-engravings 31—33 with the barrel's riflings 21—23 occurs.

Should, however, the pre-engraved teeth 31 of rotating band 19 come in contact with the chamfered leading ends 25 of indexing detents 20 as shown in Fig. 4, the detents will be forced radially outward. As the projectile is advanced forward into the gun, the rotating band's teeth ride on the indexing detents 20 so contacted (see Fig. 6). This state continues until the forward movement of the projectile advances the rotating band teeth 31 out of contact with the indexing detents 20, and brings the indexing detents opposite the pre-engraved grooves adjacent the just contacted rotating band teeth. Immediately, then, detents 20 are forced to re-extend radially inwardly under pressure exerted by a resilient means 24 (see Figs. 3 thru 10), resulting in registration between detents 20 and the pre-engraved grooves 33 of rotating band 19 at that particular point in barrel 17, as represented by Figs. 8 and 9.

Upon such registration of one or more of the barrel's detents 20 with one or more of the grooves 33 of rotating band 19 forward progress of projectile 16 in barrel 20 will take place in a spiral motion. Since, as Fig. 2 most clearly shows, my novel indexing devices are in effect extensions of the gun barrel's corresponding rifling lands, the grooves on rotating band 19 which have been registered with my indexers 20 obviously will become automatically indexed with the corresponding rifle lands of

barrel 17 upon forwardly feeding the projectile into the barrel. Likewise, the pre-engraved teeth 31 in rotating band 19 will be indexed with the rifling grooves 21 of barrel 17.

Should, however, the pre-engravings 31—33 on rotating band 19 initially be out of alignment with riflings 21—23 of barrel 17 when the ammunition round is inserted, the above described automatic registration of the rotating band grooves 33 with indexing detents 20 will cause projectile 16 to be rotated as it is thrust forward into the gun barrel 17. This rotation will continue until accurate registration of the projectile band's pre-engravings 31—33 with the gun barrel's riflings 21—23 will take place in the step just described. This resulting accurate registry is shown by Figs. 10 and 11, the projectile 16 having been loaded into the gun barrel 17 and the pre-engravings automatically aligned with the barrel's riflings without requiring any rotative manipulation of projectile or gun barrel by the operator loading the weapon. The thus-loaded projectile 16 is then ready for firing.

The just explained automatic operation of my detent indexer facilities thus accomplishes the desired matching of the projectile's rotating band pre-engravings 31—33 with the barrel riflings 21—23 without the special manipulation and time consuming efforts which heretofore have been an accepted "necessary evil" in the use of pre-engraved projectiles and rifled guns.

Construction and installation of my novel indexing detents

The construction and installation of my inventive indexers will now be described with reference to the breech loading weapons shown in the drawings. Near the rear entrance to the firearm's barrel 17 there are four slots 26 in the barrel wall penetrating as aforesaid from the exterior surface to the interior or parallel bore. These slots 26 follow a spiral path continuous with a spiralled barrel rifling land 21 as shown by Fig. 2. Slots 26 are, moreover, positioned on a portion of barrel 17 having an overall diameter somewhat less than that of the barrel portions immediately preceding and following that portion which bears the slots, as the drawings clearly show. Thus slots 26 are confined between two flanged portions or external wall shoulders 27 and 28 of gun barrel 17. The utility of these shoulders 27 and 28 shortly will become apparent.

The indexing detents 20 are mounted in slots 26 before barrel 17 is fitted into and connected with the firearm's chamber 22. As earlier mentioned, the form of the detents is arcuate in its axial length, having the same curve as do the barrel's riflings 21—23. Further, the detents are T-shaped in cross-section comprising two parts which hereinafter will be referred to as the outer or "cross-bar" portion and an inner or "stem" portion. The stem part of the detents is just wide enough to removably fill the width of slots 26 and just deep enough to radially penetrate through and just beyond those slots into the bore of barrel 17 (see Fig. 3). The portion of these indexer detent stems that protrudes into the gun barrel bore is of a width and depth which permits ready registration thereof with the grooves 33 in the pre-engraved rotating band 19 as shown by Figs. 8 and 9. This same stem portion bears the earlier mentioned leading end 25 (see Figs. 2, 4, 6, 8, 10) which may conveniently and preferably be narrowed down (see Figs. 2, 8, 10) to assist in registry with projectile grooves 33, and chamfered from the inner side radially outward (as shown in Figs. 2, 4, 6, 8, 10).

The outer or cross-bar part of indexing detents 20 is flange-like and sufficiently wide to prevent the detents from falling through slots 26 into the bore of barrel 17. This cross-bar portion is on the flats provided therefor on the outer wall surface of barrel 17 (as shown in Figs. 1, 3, 8, 9) when there is no projectile in the barrel's bore to cause indexing detents 20 to move radially outward. Serving to urge indexing detents 20 radially inward toward this "rest" position, in order that they may be in a proper position at all times to effect their indexing function, is a completely circular spring 24 (see Figs. 1 thru 10) having a tubular cross-section. This tubular spring 24 (or other suitable resilient means) may be fitted over the rear or breech end of barrel 17 (see Fig. 1) and allowed to compress onto the detents 20 which it encircles and serves to confine.

As should now be clear, the indexing detents 20 are so mounted that they can move radially inward towards the barrel's bore a limited distance determined by the

depth of the T-shaped indexers' stem portions. These indexers cannot appreciably move axially along the barrel because of the limiting length of the slots 26 plus the restrictions against such movement offered by the earlier mentioned flanged portions or shoulders 27 and 28 provided on the outer wall of the barrel (see Fig. 1).

Barrel 17, bearing indexing detents 20 as described, may now be fitted into chamber 22 and threadedly connected therewith as shown at 29 in Figs. 1, 2, 4, 6, 8, 10. As will be seen by these illustrations, as well as by Figs. 3, 5, 7 and 9, a restriction will be applied by the chamber's interior wall to limit the amount of travel through which the indexers can extend radially outward. It should be noted, however, that the interior chamber wall is recessed to provide room for this radially outward travel of detents 20. This recess, identified as 35 in the drawings, accommodates the detents when they are forced out of the barrel's bore by contact therewith of a projectile's rotating band teeth 31 as earlier explained. The sequence of entry by detents 20 (naturally preceded by spring 24) into recess 35 and later exit therefrom can best be observed by successively comparing Figs. 4 thru 10.

Size, positioning and number of indexing detents

As already indicated, indexing detents 20 have a T-shaped cross section; the outer or cross-bar portion of the detents must be wide enough to prevent them from falling through slots 26, and the detents' stem portions must be of a width less than that of the grooves 33 in the pre-engraved rotating band 19. Of course, the dimensions for indexing detents 20 will vary with different caliber projectiles and the measurements of a projectile's pre-engravings which are to register with a particular weapon's riflings. The narrowmost or inwardly projecting stem portion of the detents will, however, always be of a width which can enable the detents radially to fall into and substantially fill in depth the grooves 33 on rotating band 19. Such registration will permit the so-indexed projectile readily to travel forward into gun barrel 17 and into alignment therein with the riflings 21—23 for which the pre-engraved projectile 19 is intended.

The drawings show the use of four indexing detents 20 in the illustrative weapon. Actually, however, more or less may be used. One detent would be ample; or the number can be increased to insure positive registration, the maximum limitation being a number equivalent to the number of lands 21 in the riflings of gun barrel 17. It should therefore be understood that the illustration, showing four detents set apart at 90° intervals, is not a limiting factor but merely convenient for use in the drawings to explain the operation of my invention.

Axial length requirements of my indexing detents

From the foregoing description of the operation of my invention, it will be obvious that indexing detents 20 must function to correctly index a pre-engraved rotating band with a gun barrel's riflings by the time forward advancement of projectile 16 brings its rotating band 19 to a point of entry into the barrel riflings. In order to assure this result, it is necessary to have the rotating band grooves 33 registered with the indexing detents 20 before the rotating band teeth 31 meet barrel rifling lands 21. If this is accomplished, as should by now be clear, the rotating band teeth 31 will be aligned and therefore accurately registered with the barrel rifling grooves 23.

It may sometimes happen that the grooves 33 on rotating band 19 will immediately, or shortly thereafter, register with the rear or breech end of detents 20 when the projectile 16 is being loaded into a breech-loading weapon (or the front or muzzle end of the detents in a muzzle-loading weapon). This is a mere matter of chance upon which my invention does not have to rely. Instead, my improvement makes possible absolutely positive and accurate rotating band-to-riflings registration under any circumstances.

To test this statement, consideration may be given to the most difficult indexing situation which can possibly arise. It will be apparent that this situation occurs when the teeth 31 of rotating band 19 chance first to contact the rear end of indexing detents 20 upon initially entering the rear or loading end of barrel 17. Under this condition, the projectile will be required to travel forward its greatest lengthwise distance before the axially advancing rotating band teeth 31 move away from detents 20 which are

initially contacted and were thereby compressed radially outward. When the rotating band teeth 31 no longer contact detents 20, return of the detents radially inward (under the urging force of tubular spring 24 as aforesaid) causes the detents to register with the spiral grooves 33 in rotating band 19 adjoining the band's teeth which have been moved forward out of contact with the detents as just described.

In such a case, (since indexing detents 20 are in effect continuations of the gun barrel's spiral rifling lands 21 as shown in Figs. 1 and 2), the axial distance between the rear end of the detents and the rear end of the rifling lands must be equivalent to and preferably greater than the sum of a land and groove width multiplied by the cotangent of the groove helix angle. Therefore, it would be possible to decrease this required distance by increasing the helix angle of slots 26 in the barrel and the detents 20. However, this would necessitate increasing the clearance of the detents' stem portion with the grooves 33 in the rotating band to allow for the difference in helix angle. It is presumed, of course, that the portion of the detent immediately adjacent to the barrel's rifled lands 21 would have to be aligned with this land to assure easy registry.

The just described requirement may further be clarified by reference to the Fig. 2 illustration. Assume that the teeth 31 of the pre-engraved rotating band 19 have contacted the rear end of the barrel's rifling lands 21 (the lands in this example being represented by the resilient extensions thereof characterized by my indexing detents 20). In this example, for the rotating band teeth to pass completely over the rifling lands to register with the adjoining rifling grooves, the leading edge of each rotating band tooth axially must pass completely over one spiral land and completely across to the far side of the adjoining spiral groove.

As above indicated not only must the axial distance between the rear end of rifling land be equivalent to the axial dimension just described in the above example (i. e., the axial distance across one land plus one groove), but the actual length of the detent itself must be equivalent or greater than the same dimension for similar reasons. Preferably, the minimum detent length and the minimum spacing between the rear ends of the detents and the rifling lands can be accomplished by making the detents long enough to accomplish both purposes when installed with their forward ends relatively near the entrance to riflings 21—23 as shown in Fig. 2. Of course, if the minimum dimensional requirements earlier explained are adhered to, the length of detent 20 can be shorter than that represented in the drawings, and it can be placed substantially farther away rearwardly from the barrel riflings than the distance shown in Fig. 2.

Concerning this last point, however, there is a limiting factor too. The distance between the forward ends of detents 20 and the rear ends of the rifling lands 21 must be less than the axial width of rotating band 19. Otherwise, if this distance were greater, a rotating band properly indexed by detents 20 might fall out of proper alignment with riflings 21—23 in the interval when the rear end of the rotating band leaves indexing detents 20 and the forward end of the band contacts the entrance to riflings 21—23. Quite obviously, by keeping the distance between the forward end of detents 20 and the rear end of the riflings 21—23 to a dimension less than the axial length (or width) of rotating band 19, it is possible to assure that a rotating band once properly indexed will be directed into correct registry with riflings 21—23 before the band leaves the guiding contact of the indexing detents.

From the foregoing it will be seen that certain minimum spacing and length requirements of the indexing detents must be observed. These minimum dimensional limitations will vary with the number of lands and grooves in a particular barrel that is rifled with a given twist. The greater the number of lands and grooves for a given helix angle and bore diameter, the less will be the axial spacing required between the forward end of the detents and the rear end of the riflings, and vice versa. Similarly, in a barrel having a given number of lands and grooves, the stated maximum spacing will diminish as the steepness of twist is increased, and vice versa. Thus, the named maximum number of both of these factors should therefore be considered in selecting the placement positions for and size of the indexing detents to be used in a particular rifled gun barrel.

Summary

Still other constructions for my novel, gun-mounted indexer detents 20 are of course possible. Basic requirements to be met are that each installed detent member be aligned spirally with one of the rifling lands 21 of the gun's barrel 17; that each detent member properly be spaced before the entrance to the gun barrel's riflings to assure registry with a pre-engraved projectile's rifling groove 33 before the pre-engravings have been advanced to the gun barrel's riflings; and that the detent member have such radial resilience as to yield outwardly when the projectile's pre-engraved teeth 31 first contact the detent member and then spring inwardly again when registry of that member with the projectile's pre-engraved groove 33 has been established.

Any form of construction which satisfies the foregoing may be applied either to breech loading firearms where the indexer detents are positioned to the rear of the gun's riflings or to muzzle loading weapons where the indexer detents are positioned in front of the riflings.

In fact, pre-engraved objects other than projectiles may have their entrance into spirally grooved bores other than firearm barrels facilitated by the indexer detent facilities which have been invented by me as described herein. In all such applications (loading of ammunition into firearms and other) the process of self-alignment will be entirely automatic and completely independent of former requirements for rotative manipulations.

Speaking of firearm uses only, it will be evident that my herein described improvements have extended the utility and simplified the use of pre-engraved projectiles and rifled weapons of all types; have simplified the insertion of pre-engraved projectiles into the rifled barrels of both breech loading and muzzle loading firearms; have diminished the effort and time required to effect such insertion; have made pre-engraved projectiles more readily usable in rifled weapons of the automatic re-loading type; have imparted to rifled gun barrels the capability of receiving and engaging a pre-engraved projectile in substantially instantaneous alignment and without necessitating special rotative manipulation; and have provided a unique method and novel apparatus for accomplishing the foregoing.

With possibly minor changes that will not depart from the spirit and intent of my invention, the new self-indexing facilities here described may be applied to any pre-engraved projectile that is intended for use in a rifle gun barrel or other equivalent tube. My inventive improvements are therefore extensive in their adaptation and are not to be restricted to the specific form here disclosed by way of illustration.

I claim:

1. In a device whereby a cylindrical member having pre-engraved rifling grooves and teeth therearound may be registered for unimpeded entrance into a tube having counterpart and complementary riflings without requiring preliminary matching thereof, the combination of a tube having portions of its bore rifled with teeth and grooves except the tube's member entrance end which is devoid of all rifling, an indexing detent resiliently mounted on the said member entrance unrifled portion of said tube in conformation with a continuation of the helical line of one of the tube's teeth so as yieldingly to protrude radially from the tube's walls into the said unrifled end portion of the tube's bore, the detent being so shaped and so mounted that it is adapted positively to engage one of said member's rifling grooves which are the pre-engraved counterparts of said tube's rifling grooves and which are inscribed together with alternating rifling teeth upon the cylindrical member that axially has advanced into said tube and so thereby the detent causes that member's rifling grooves and teeth accurately to become registered with the teeth and grooves of said tube's bore without requiring any special rotative manipulation of either the tube or the cylindrical member.

2. In combination, a tube having a bore which is rifled with spiral teeth and grooves, a cylindrical member adapted for passage through said tube's bore having pre-engraved grooves and teeth registrable with their complementary counterparts in the tube's rifling and exteriorly encircling said member towards the end thereof that is last to enter said tube when the member is axially inserted thereinto, and an indexing detent radially protruding into the interior of said tube's bore astride a con-

tinuation of the helical line of one of the bore's said spiral teeth, said detent being there resiliently mounted and adapted to permit outward radial expansion into a recess in the tube's wall upon initial contact by a tooth of the cylindrical member when said member is first axially thrust into said tube but inwardly compressing into a spiral groove on said member upon initial registry therewith and thereafter causing that groove to follow along the detent during further axial advancement of the cylindrical member into the tube whereby then so to rotate the member as to bring the member's said pre-engraved grooves and teeth into accurate registry with said tube's rifled teeth and grooves without requiring any special rotative manipulation of said tube or cylindrical member by the operator.

3. In combination, a gun barrel having a bore which is rifled with spiral lands and grooves, a projectile for firing from said barrel having pre-engaged grooves and lands registrable with their complementary counterparts in the barrel's rifling and encircling said projectile toward the end thereof that is last to enter said barrel during loading, and an indexing detent resiliently mounted on said barrel wall astride a continuation of the helical line of one of the barrel's lands and in such axially spaced relationship to that land as to precede same into registration with a projectile groove during loading, said indexing detent being adapted so as normally to protrude radially inward from said barrel wall for engagement with one of said projectile's spiral grooves upon axial thrusting of the projectile into said barrel whereby the resultant following of that projectile detent by said groove then causes such rotation of the projectile as to bring the projectile's said pre-engraved grooves and lands into accurate registry with said barrel's rifled lands and grooves without requiring rotative manipulation of barrel or projectile by the loader to effect this alignment.

4. In combination, a gun barrel having a bore which is rifled with spiral lands and grooves, a projectile for firing from said barrel having pre-engraved grooves and lands registrable with their complementary counterparts in the barrel's rifling and encircling said projectile towards the end thereof that is last to enter said barrel during loading, and an indexing detent radially protruding into the interior of said gun barrel's bore astride a continuation of the helical line of one of the barrel's lands, said detent being there resiliently mounted under spring tension which constantly urges same radially inward so that if the detent should immediately index a spiral projectile groove into registry therewith when the projectile is axially thrust into said barrel the thus indexed projectile will be caused to follow along the detent during further axial advancement of the projectile into the barrel whereby then so to rotate the projectile as to bring the projectile's said pre-engraved grooves and lands into accurate registry with said barrel's rifled lands and grooves without requiring any rotative manipulation of barrel or projectile.

5. In combination, a gun barrel having a bore which is rifled with spiral lands and grooves, a projectile for firing from said barrel having pre-engraved grooves and lands registrable with their complementary counterparts in the barrel's rifling and encircling said projectile towards the end thereof that is last to enter said barrel during loading, and an indexing detent radially protruding into the interior of said gun barrel's bore astride a

continuation of the helical line of one of the barrel's lands, said detent being there resiliently mounted to permit outward radial expansion into a barrel wall recess upon being initially contacted by a projectile land when said projectile is first axially thrust into said barrel and remaining so expanded while that land passes thereover but inwardly compressing into a spiral projectile groove adjacent that land upon initial registration of the detent therewith and thereafter causing that groove to follow along the detent during further axial advancement of the projectile into the barrel whereby then so to rotate the projectile as to bring the projectile's said pre-engraved grooves and lands into accurate registry with said barrel's rifled lands and grooves without requiring any rotative manipulation of the barrel or projectile by the operator.

6. In combination, a breech-loading gun barrel whose bore is rifled with spiral lands and grooves at some length to a point somewhat short of the rear end, a projectile for firing from said barrel having pre-engraved grooves and lands encircling the rear portion thereof and adapted to register with their complementary counterparts in the barrel's rifling, and an indexing detent resiliently mounted at the rearward unrifled end portion of said barrel astride a continuation of the helical line of one of the barrel's said lands and there yieldingly protruding radially into the barrel's bore for engagement with one of said projectile's pre-engraved grooves upon forward axial thrusting of the projectile into the breech end of said barrel whereby the resultant following of said detent by said projectile groove then so rotates the projectile as to bring the projectile's said rearward pre-engraved grooves and lands into accurate registry with said rifled lands and grooves at said barrel's breech end without requiring any special rotative manipulation of the barrel or projectile by the operator.

7. In combination, a muzzle-loading gun barrel whose bore is rifled with spiral lands and grooves at some length to a point somewhat short of the front end, a projectile for firing from said barrel having pre-engraved grooves and lands encircling the forward portion thereof and registrable with their complementary counterparts in the barrel's rifling, and an indexing detent resiliently mounted at the forward unrifled end portion of said barrel astride a continuation of the helical line of one of the barrel's said lands and there yieldingly protruding radially into the barrel's bore for engagement with one of said projectile's pre-engraved grooves upon rearward axial thrusting of the projectile into the muzzle end of said barrel whereby the resultant following of said detent by said projectile groove then so rotates the projectile as to bring the projectile's said forward pre-engraved grooves and lands into accurate registry with said rifled lands and grooves at said barrel's muzzle end without requiring any special rotative manipulation of the barrel or projectile by the one loading the gun.

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