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THE EVOLUTION OF

MODERN SMALL ARMS

AND

AMMUNITION.

BY

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PREFACE.

In the autumn of last year the author gave a series of lectures at the Birmingham Municipal Technical School on "Small Arms and Ammunition." The lectures were based upon the patent specifications extending over a period of nearly three hundred years, the object being to place before those engaged or interested in the production or use of fire-arms a concise account of the efforts of inventors to improve such weapons, and of the mechanical means employed to effect the desired results. For the further attainment of such object the author herewith presents the record in book form.

The official numbers of the various patents mentioned are given in each case, for the convenience of readers desiring to refer to the specifications in our public libraries. A name and a subject matter index of patents now in force relating to small arms, and ammunition therefor, will be found at the end of the book.

E. C. R. M.

13, Temple Street, Birmingham,
September 1st, 1898.

CONTENTS.

THE EVOLUTION OF MODERN SMALL ARMS AND AMMUNITION.

CHAPTER I.

Early Fire-arms.

The name, nationality, and period of the actual or original inventor to whom we must ascribe the honour or the responsibility for the first production of the explosive substance known in later times as "gunpowder" are lost in the obscurity of a remote past. Although Roger Bacon in the 13th century is the earliest European writer describing the use of gunpowder, and naming or referring to its three ingredients, saltpetre, charcoal, and sulphur, yet he makes no claim to be the inventor of the explosive, but mentions it as something already known. It may also be noted that Schwartz, a German monk, contemporary with Bacon, seems to have discovered gunpowder quite independently, and apparently without any knowledge of its earlier use. Schwartz made the explosive in the well-known laboratory appliance, the mortar, which probably accounts for the fact that a certain class of early fire-arms were known by the name, and had the appearance of, a mortar.

There is but little reason to doubt that, under another name, gunpowder has been known to the Chinese upwards of 2,000 years, and used by them in the production of fireworks, and for blasting purposes. Further, there is every reason for the conclusion that fire-arms were employed in the East long before they were known in Europe.

Hand fire-arms, or small arms under various names, were not adopted in this country before the fifteenth century. An early type of small arm is described by one writer as consisting of a rudely-formed iron tube secured to a straight piece of wood or a stock, the contents of the tube being discharged by a lighted match applied by hand to priming powder placed around the touch-hole. A pan was next arranged at the side of the touch-hole, and in place of the application of the lighted match or fuse by hand, a simple lock was employed, having a slit cock to hold the match, and so combined with a spring that on operating the trigger the lighted match was lowered on to the priming powder in the pan. This arrangement constituted the "match-lock" musket still to be found in use in remote parts of the world.

The next advance was the "wheel-lock," having its origin in Germany, in the year 1517. This lock consisted of a small steel disc or wheel-plate, with notches or teeth around its periphery, mounted adjacent to the pan containing the priming powder, and arranged in combination with an operating spring wound up by a key, as with a watch spring. The disc was retained in a fixed position by a ratchet, but on pulling the trigger the ratchet was released, and the spring then caused the notched disc to revolve against a piece of iron pyrites held in a cock, and so to produce sparks of fire between the rubbing surfaces.

The Spanish snap-haunce lock, with the use of a flint, was introduced at about the same time as the German wheel-lock.

The well-known flint-lock, so long used in the British army, was first introduced in France about 1640 ; the muskets fitted with such locks were by the French termed "fusils." The flint-lock musket was the leading fire-arm through the 18th century, and remained in general use in the British army until within a few years of the middle of the present century, being superseded by the adoption of rifles with the percussion system of firing.

But though the primitive flint-lock musket so long

remained the general weapon for actual service, inventors were busy in making known their plans for the production of more effective fire-arms. Many such proposals were naturally of a very impractical nature, with the result that high military authorities viewed with a considerable amount of prejudice any and every proposal for the improvement of the existing arm; but the main difficulty experienced in any attempt to produce a more accurate and effective weapon by those who appreciated the defects of the then existing arm was probably to be found in the lack of necessary machinery and appliances to carry their proposals into practice. The following notes on some early inventions and patent specifications relating to fire-arms will sufficiently indicate the fact that certain features of small arms frequently looked upon as very modern are in reality the suggestions of our ancestors.

In the year 1635 A. Rotsipen filed a specification, No. 71, on which he sought letters patent, for, amongst other things, the making of bullets or globes of iron, steel, stone, and glass, and also to draw gun barrels "straight, even, and smooth, and to rifle, cut out, or screw barrels as wide or as close, as deep or as shallow, as required."

A description of a breech-loading and a magazine gun appears in the specification of Abraham Hill, No. 143, of the year 1664, in the following terms: "A new way of making a gun, or pistol, the breech whereof rises upon a hinge by a contrivance of a motion from under it, by which it is also let down again and bolted fast by one and the same motion. Also of another gun or pistol, which hath a hole at the upper end of the breech to receive the charge, which hole is opened or stopped by a piece of iron or steel, movable by a ready and easy motion; also of another gun or pistol, which is charged and primed at a hole under the sight, or visier, at the upper ends of the breech, and shuts within a cartridge, or roundish plate of iron, and without the sight or visier. Further, of another gun, or pistol, which is charged and primed in like manner at a hole below the sight, or visier

which is shut by a screw smaller below than above ; and also of another gun, or pistol, for a small shot, carrying seven or eight charges of the same in the stock of the gun, which is let into the gun by thrusting forward the sight, and by a square cartridge within the piece near the breech, so that the powder being put in by a hole under the sight, both for charging and priming the same, together with a touch-hole, being shut both within and without by thrusting back the sight to its place ; and also of a powder horn, or box, which opens by pressing with the finger the end of the charge, or allowance, and shuts by a spring within it."

James Puckle, in his specification No. 418, of the year 1717, describes a gun mounted on a tripod, and having a single barrel and a revolving chamber piece, consisting of short cylinders fastened round a hollow centre, working on a horizontal pin attached to the barrel. Several sets of

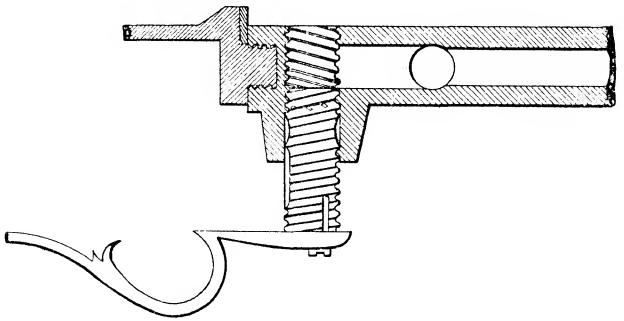


FIG. 1.

chamber pieces, each containing six or more chambers, may be used with the same barrel, so that as soon as all the charges of one set have been fired from one chamber piece, it is unscrewed from the fixed pin, or axis, on which it revolves, and another chamber piece ready charged is put in its place. This inventor has evidently a grudge against a certain nation, for, in referring to the chambers and the bullets for his gun,

he says that the shape of these may be varied, some "for shooting square bullets against Turks," others for shooting "round bullets against Christians."

The adjoining fig. 1 is from an illustration accompanying Captain Ferguson's specification, No. 1139, of the year 1776, for "improvements in breech-loading fire-arms." As seen in the sectional view, the breech is opened and closed by a screw

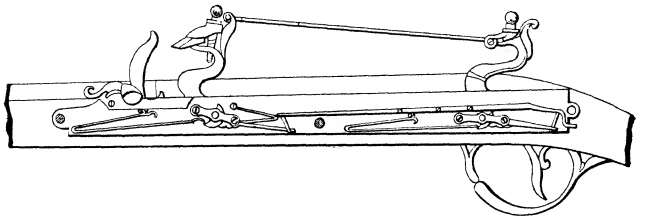


FIG. 2.

plug. The inventor states that something similar had been previously attempted, but had failed. An elevating sight is also described in the specification formed on the breech of the barrel.

Fig. 2 illustrates an improved form of flint-lock, as described in the specification of Richard Webb, No. 2042, of the year 1795. The object of the invention is to prevent accidents arising from the bursting of the gun barrel, and such object is attained by arranging the trigger at a considerable distance from the barrel, enabling the gun to be fired without either hand of the user touching any part of the barrel. Two cocks are employed, as illustrated, operated by the one trigger arranged under the rear cock. The fore cock carries the flint, as shown. The part between the cocks carrying the mechanism of two locks consists of a false barrel, or is made as a part of the stock.

The adjoining illustration, fig. 3, represents the method described in the specification No. 2360 of the year 1799, of Edward Thomason, of Birmingham, for causing the flint of a flint-lock gun or pistol "to present a different angle to the

hen or hammer at every time the gun is fired, which is performed by the action of the double or single locking of the gun lock alone, and does not require any separate movement after the cocking of the lock."

The British flint-lock musket with which Waterloo and many another battle was fought and won had a smooth-bore barrel $\frac{3}{4}$ in. diameter; the spherical leaden bullet which it

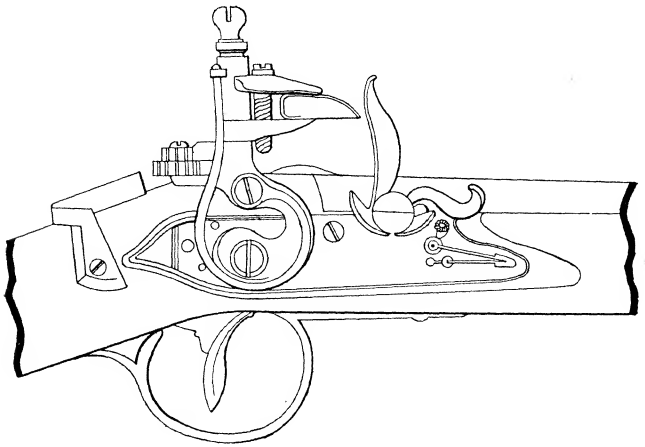


FIG. 3.

discharged had a weight of 483 grains, the powder for each charge amounting to $4\frac{1}{2}$ drachms. This weapon, commonly known as "Brown Bess," although considered to be good for a range of 200 yards, was but indifferently accurate at 100 yards, and indeed we have it recorded that by the men who used such weapons it was agreed that if you "fired at the church" it was to be accounted a stroke of luck to succeed in "hitting the parish."

It should be noted that guns have been made having a combined flint and match lock. A weapon of this class will be found in the Birmingham Art Gallery collection.

CHAPTER II.

PERCUSSION FIRE-ARMS.

THE first patent for a percussion system of firing was obtained by a Scotch clergyman, Alexander John Forsyth, of Belhelvie, Aberdeenshire. The adjoining illustrations, figs. 4, 5, 6, and 7, are from his specification, which is numbered 3032 of the year 1807. Forsyth describes his invention as consisting of "an advantageous method of discharging or giving fire to artillery and all other fire-arms, mines, chambers, cavities, and places in which gunpowder or other combustible material is or may be put for the purpose of explosion." He further states: "Instead of permitting the touch-hole or vent of the pieces of artillery, fire-arms, mines, chambers, cavities, or places to communicate with the open air, and instead of giving fire to the charge by a lighted match, or by flint and steel, or by any other matter in a state of actual combustion applied to a priming in an open pan, I do close the touch-hole or vent by means of a plug, or sliding piece, or other fit piece of metal or suitable material or materials, so as to exclude the open air, and to prevent any sensible escape of the blast, or explosive gas or vapour, outwards, or from the priming or charge, and as much as possible to force the said priming to go in the direction of the charge, and to set fire to the same, and not to be wasted in the open air; and as a priming I do make use of some or one of those chemical compounds which are so easily inflammable as to be capable of taking fire and exploding without any actual fire being applied thereto, and merely by a blow, or by any sudden or strong pressure or friction given or applied thereto without extraordinary violence; that is to say, I do make use of some one of the compounds of combustible matter, such as sulphur or sulphur and charcoal, with an oxymuriatic salt—for example, the salt formed of dephlogisticated marine acid and potash (or potasse), which salt is otherwise called oxymuriate of potash; or I do make

use of such of the fulminating metallic compounds as may be used with safety—for example, fulminating mercury, or of common gunpowder mixed in due quantity with any of the before-mentioned substances, or with an oxymuriatic salt as aforesaid, or of suitable mixtures of any of the before-mentioned compounds; and these compounds or mixtures of compounds I find to be much better for priming than gunpowder used alone, which cannot be made to explode without some sparks or actual fire applied thereto, or else without such a degree of extraordinary and violent percussion as cannot conveniently be made use of in gunnery, or with any of the fire-arms or artillery that are in most general use."

The inventor, in describing his method of priming and exploding, states that he introduces "into the touch-hole or vent, or into a small and strong chamber or place between

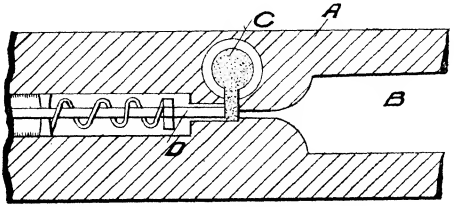


FIG. 4.

the said touch-hole and vent and the plug or sliding piece, or other piece by which the communication with the external air is cut off, a small portion of some or one of the chemical compounds hereinbefore mentioned (for example, as for priming to a musket, about the eighth part of a grain), and when the required discharge is to be made I do cause the said chemical compound or priming to take fire and explode by giving a stroke or sudden and strong pressure to the same, communicated by and through the said plug or sliding piece, or other piece before mentioned or described, in consequence of which the fire of the priming is immediately

communicated to the contents or charge placed within the said piece of artillery, firearm, mine, chamber, cavity, or place, and the discharge accordingly follows."

Fig. 4 represents Forsyth's apparatus as he proposed to arrange it for the priming and discharging of a musket or other fire-arm "a great number of times, even although the breech of the same is under water." A is a section of the barrel of the piece, having its chamber B contracted towards

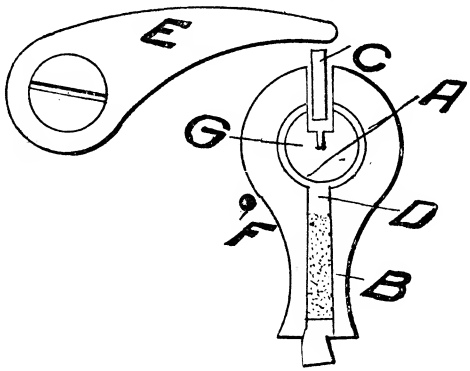


FIG. 5.

the touch-hole. The rotating cylinder or hollow plug C is provided with a lateral aperture connecting, at the proper time, its interior with the touch-hole of the weapon. The cylinder C is charged with the detonating compound, which after passing into the touch-hole is fired by the action of the spring-impelled rod D.

Figs. 5 and 6 represent another form of Forsyth's apparatus. The inner circle A represents "a section of a flat cylindrical piece having a central stem on the opposite side or face to be screwed into the barrel where the touch hole is commonly placed. Fig. 7 shows another section of the cylinder A. The axis or central line of the said stem is perforated or drilled up to half the thickness of the cylindrical

piece to meet another hole drilled in the edge of the piece." The outer circle surrounding A "denotes another flat piece of which the inner part is hollowed out so as very accurately to fit the outside of the first-mentioned cylindrical piece, and to be capable of revolving upon it when turned by the handle B. The plug or punch C is inserted in the hole in the edge

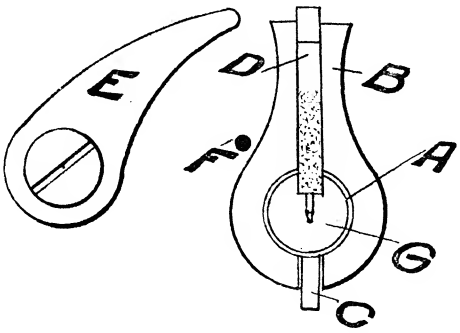


FIG. 6.

of the movable piece, and kept from immediately touching the same by a spring. On the opposite part of the circumference of the movable piece and through the handle B there is bored a hole or cavity D in which a considerable quantity

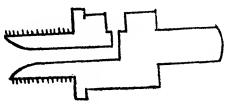


FIG. 7.

of the chemical compound before mentioned is confined. E is a cock or arm for giving a stroke upon C; it may be set, discharged, and impelled by the same machinery and means as are used with respect to the cock of a common gun lock, or the stroke may be given by other means. In the use of the apparatus the hammer (or arm) E is to be raised and

cocked, and the handle B brought round to the position shown at fig. 6, where it is stopped by a pin or projecting piece F. At this instant the hole or cavity D is brought immediately over the channel or hole G, into which a priming falls out of D in consequence of the slight stroke or jar produced by the sudden stoppage of B. Immediately after this operation the handle is to be returned to its first position as at fig. 5, which brings the plug or punch C over the channel or hole G, in which position only it is possible to give the stroke so as to inflame the priming and discharge the piece. When this last effort is required to be produced, the trigger is to be drawn, and then E strikes C, and the contents G taking fire explode through the touch-hole and set fire to the charge, without allowing the escape of the gas or vapour in any direction but into the chamber and towards the muzzle of the piece."

From his profession we should scarcely expect Forsyth to have a sufficiently practical acquaintance with the manufacture of firearms to be able to show anything beyond the somewhat crude methods of carrying his invention into effect, to be found in his patent specification. The validity of the patent was disputed in the case of Forsyth *v.* Riviere, tried before Chief Justice Abbott, in the King's Bench, June 4th, 1819, but it was established, although others had privately used a similar invention before the date of the patent. The judge held that if several persons simultaneously discover the same thing, the party first communicating it to the public is the legal inventor, and entitled to the protection of letters patent.

The illustration, fig. 8 is from the specification No. 3985 of the year 1816, of the well-known Joseph Manton, the London gun maker, who introduced many improvements in fire-arms, and who, in some writings, is affectionately described as "Old Joe Manton." In the specification referred to Manton says: "A piece constructed according to my improvements has no pan or magazine to contain powder for priming, nor any hammer or flint, but instead thereof that

part of the cock which holds the flint in common locks is made with a proper aperture to receive and hold a small tube, which contains a minute quantity of some of those substances which will produce fire and explosion when subjected to a sudden blow or pressure, and which are called detonating or fulminating substances or powders. To fire off or discharge such a piece, the trigger must be drawn as

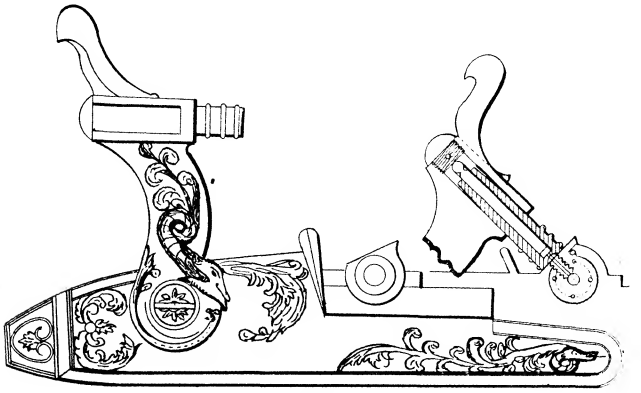


FIG. 8.

usual, and the spring of the lock will throw the cock containing the tube suddenly forwards, by which the perforated end of the small tube, which contains the detonating substance, is made to strike suddenly on that part of the piece in which is the opening of the touch-hole or passage leading to the charge in the barrel, so that the perforated end of the tube will cover the opening of the touch-hole, and by the blow or concussion occasioned by the sudden striking of the tube as aforesaid, a pressure is caused to act suddenly upon the detonating substance with sufficient force to explode it, and the flame produced by the explosion issuing with violence from the perforated end of the tube passes through the touch hole or passage into the barrel of the piece, and gives fire to the charge of gunpowder contained within. When

the piece is re-loaded, the said tube which contained the detonating substance can be readily detached from the cock and replaced by another, which is ready charged with the detonating substance; a sufficient number of such small tubes must be provided and kept ready charged for use."

In the year 1818 the same inventor filed his specification No. 4285, entitled "Locks and Primers of Firearms," from which fig. 9 is taken. In this specification Joseph Manton says: "My primers for fire-arms are small hollow tubes made of very thin metal or other suitable substance. The dimensions of the tubes must be according to the size of the piece

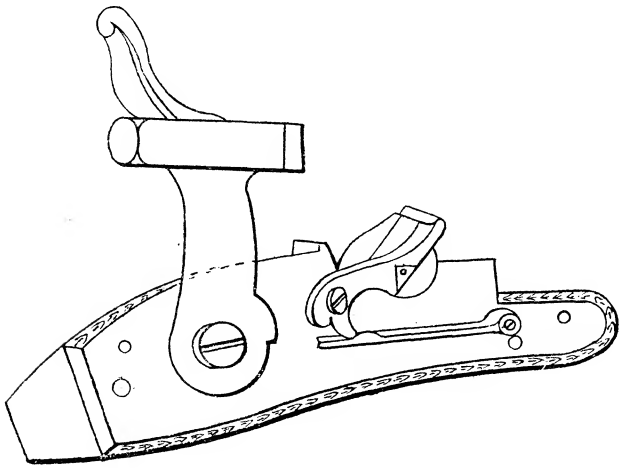


FIG. 9.

to which they are to be applied as primers, but for a musket or fowling piece they should be from half an inch to three-quarters of an inch in length, and from one-tenth to one-eighth of an inch in diameter, and open at both ends. To prepare the primers for use the interior of the tube is filled (or partly filled) with a detonating or fulminating substance or powder, which will explode and produce fire when struck

with a sudden blow, which substance is well known, being already in use for discharging fire-arms by percussion. The open ends of the primer are stopped with beeswax to retain the fulminating substance in the tube and preserve the same from damp. The metal or other substance of which the primer is composed must be thin, because the detonating powder or substance is to be exploded by a blow struck on the outside of the primer, as hereinafter described. The primer being supported against a solid support, the tube is crushed or squeezed up by the blow so as to explode the detonating powder or substance within it. My improvements in the construction of certain of the parts of fire-arms consist in the form and arrangement of certain parts of the lock, which parts are adapted to

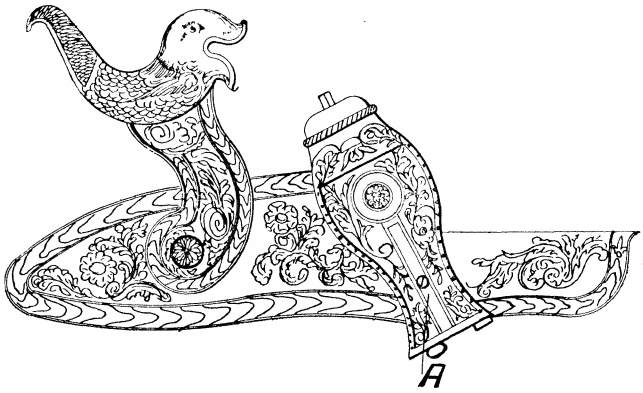


FIG. 10.

receive one of the aforesaid primers and hold it in a proper position to be struck by a projecting part of the cock of the lock, and in which position it will, on exploding or detonating, fire the gunpowder with which the piece is charged. These improvements on the lock are as follow: In place of the pan of the lock is a piece of solid metal projecting from the lock plate, and made with a flat surface,

against which the primer is supported whilst it receives the blow of the cock. In place of the hammer of the lock I apply what I call a primer holder, because it partly covers the primer and holds it by the gentle pressure of a spring against the aforesaid flat surface, in such a position that one end of the primer applies to the touch-hole of the piece, and the length of the primer is nearly in the line or direction

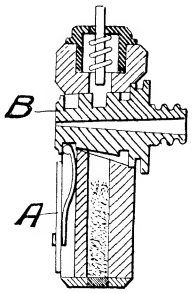


FIG. 11

of the touch-hole. On the underside of the primer holder is a groove, which enables it the better to hold the primer in its said position, and which permits the primer to be introduced between the said primer holder and the said flat surface. The primer holder has an opening cut through it to expose the middle part of the primer which lies beneath it, and when the cock of the lock is let fly the projecting end thereof passes through this opening and strikes suddenly upon the outside of the primer, with sufficient force to explode the fulminating powder or substance contained in the primer. The flash of fire from the end of the primer communicates fire by the touch-hole to the gunpowder contained in the barrel of the gun."

With the early percussion firearms, considerable attention was given to the ornamentation of the lock, and many fanciful and grotesque forms are to be met with in collections of such arms. The adjoining illustrations, figs. 10 and 11,

selected from W. Webster's specification No. 4590, of 1821, represents an ornamental percussion lock, comprising an improvement of the "roller magazine" described in A. J. Forsyth's specification, to which we have previously referred. Fig. 10 is a side elevation of the lock, and fig. 11 a section of the plug and the magazine in which it is fitted. Webster's object was to so construct the magazine as to permit of the removal of the plug "without the trouble of unscrewing any part of the magazine or its appendages." For this purpose he provided a sliding spring bolt A working in a dove-tailed guide groove in the priming magazine, and arranged to engage with a circular groove in the plug B, as illustrated at fig. 11.

Another improvement mentioned by Webster consists of "a magazine which is contrived to deposit its priming, in the

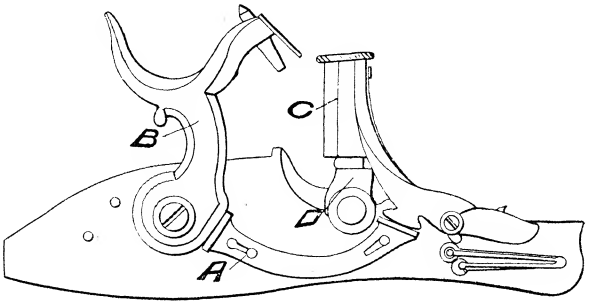


FIG. 12.

act of cocking, into a receptacle placed on the inside of the cock, which priming is effected every time that the lock is brought to full cock."

The illustrations, figs. 12 and 13, are from the specification No. 4611, of 1821, of William Westley Richards, of Birmingham, for "an improved method of displacing or raising the priming magazine which contains the priming or detonating powder, and any cover for protecting or covering the priming, whether loose or enveloped, used

with percussion gun and pistol locks, by means of a movable bar acted upon at one end thereof by the cock or by the tumbler of the lock, and at the other end acting upon the priming magazine or cover." Fig. 12 represents the lock at half cock, and fig. 13 the same lock after the cock has been let down. A is the sliding or propelling bar, connected with the lock plate by pins or screws, the perforations through which such pins or screws pass being of a suitable size and shape to allow a curvilinear, progressive and retrogressive,

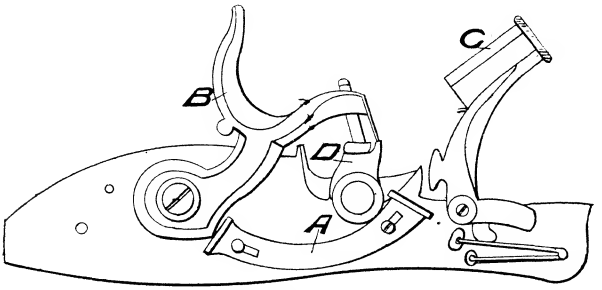


FIG. 13.

motion of the bar A when acted upon at either end by the cock B or the magazine C. As shown at fig. 12, the priming magazine or cover C rests on the pan D, whilst the propelling bar A has one end in contact with the breast of the cock and the other end in contact with the foot of the magazine. If the lock be then full cocked and let down, it will in its descent or motion, by acting at its breast part upon one end of the bar A, propel such bar in a curvilinear direction, causing its opposite end to act on the foot of the priming magazine or cover C, and to raise such part. The relative positions of the parts after firing is shown at fig. 13.

CHAPTER III.

Combined Flint and Percussion Lock.

The fact that nearly forty years elapsed from the date of Forsyth's patent for the percussion system of firing until its first introduction for actual use in the British army affords sufficient evidence as to the prejudice in favour of the flint lock musket. A somewhat similar prejudice doubtless existed in favour of the match lock and against the flint on

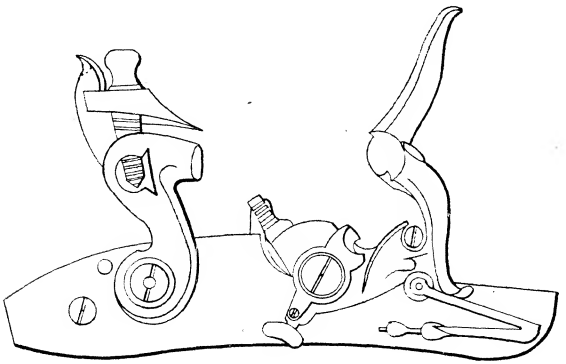


Fig. 14.

the first introduction of the latter; and as we have already indicated, weapons having a combined match and flint lock were produced. The same idea of combining the new lock with the old is carried into effect in connection with the percussion system of firing by Samson Davis, a London gun-lock maker, in his specification No. 4648, of the year 1822, and fig. 14 is an illustration of his combined flint and percussion lock. The illustration is self-explanatory.

Modern Flint Lock Guns.

Before leaving the subject of flint lock guns it should be observed that the manufacture of such weapons is by no

means a thing of the past. Quantities of flint lock muskets are still shipped to Africa and other parts, and in the manufacture of the same the parts of disused percussion lock and other guns are frequently employed. Before the adoption of the existing practice of the British Government of breaking up gun parts prior to the sales of old material, the "knackers" had a plentiful source of supply of old gun parts with which to produce new weapons. The merchants supplying the African and other markets, where such goods are disposed of, will not pay more than a few shillings apiece for a complete flint lock gun, and hence the producer is unable to devote much time in ensuring either the accuracy or the safety of the arm; but under the kind of test or "proof" to which the guns are subjected by the natives such matters are of very secondary importance. If the lock action is stiff and noisy in operation, and will cause the flint to give off a shower of sparks, the native will be delighted with his gun, though the barrel may consist of nothing better than a length of gas pipe with a bend or deflection of about half an inch at the middle. From the reports of various travellers, it is to be feared that no life insurance office would care to accept any native who declined to take a dual pledge to refrain from touching both the drink and the muskets supplied by the "white man."

We are not sorry to learn that in the manufacture of these weapons the British manufacturer is utterly beaten by the competition of his foreign rivals.

Primers for Percussion Fire-arms.

The adjoining illustrations, figs. 15 to 20 inclusive, are from the specification No. 7041, of the year 1836, of Westley Richards, of Birmingham, for "certain improvements in primers for discharging fire-arms by means of percussion." The invention is said to apply to "that kind or description of percussion primers commonly called copper caps, or those in which the detonating powder or priming is contained in a copper cap, or metal shell or case, and have for their object

the transferring or removal of the explosion or discharge of the percussion or detonation powder, whereby the necessity of deep projecting rims or shields round the cavity of the cock is obviated, as no part of the metal cap, case, or shell of those improved primers can be projected from the nipple in firing, and the liability of the head of the cock being broken by the explosion of the priming (which frequently happens with the common copper cap) is also obviated. And another object of these improvements is, the making of the primers much larger than the ordinary copper caps, so as to be more readily handled and easily affixed to the piece ; at the same time they are equally impervious to wet and better adapted for naval and military purposes than the ordinary copper caps or other percussion primers hitherto adopted for such

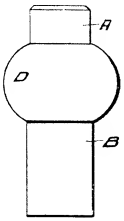


FIG. 15.

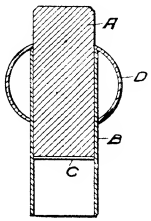


FIG. 16.

purposes, and my improvements consist, first, in removing or transferring the percussion or detonating powder or priming from immediate contact with the inside of the head or top of the copper caps or primer, and placing it nearer to the mouth thereof, so that the explosion or firing of the detonating primer shall not take place at the bottom of the interior or cup of the cap, but nearer to its mouth, whereby the fuse arising from the explosion of the detonating powder will have free vent or escape, and the explosion will only distend or partly open the sides of the cap or primer, the space between the ordinary or old position of the priming or detonating powder, and its position in my improved primers, being occupied by a piece

of hard metal. And, secondly, my improvements consist in protecting the copper cap, or metal case, or shell of the primer, and preventing the possibility of its bursting, and any part or portion thereof being projected or thrown from the nipple on the discharge of the piece, by encompassing it

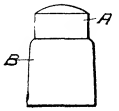


FIG. 17.

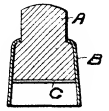


FIG. 18.

with a second cap case or shield, placed around the former, and preventing the expansion or distention of the sides thereof beyond a certain or given distance."

The drawings accompanying the specification (from which the adjoining illustrations have been selected) show several different methods of carrying the said improvements into effect. The views are all drawn to an enlarged scale.

Fig. 15 is an elevation, and fig. 16 a section of a primer intended for naval or military use. A is a hard metal pin secured to the cap case or shell B; the detonating or priming powder is placed at C. The rim D serves to enlarge the

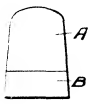


FIG. 19.

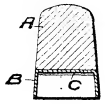


FIG. 20.

primer so that it can be easily handled. The inventor observes that these primers "cannot be exploded by treading on them, which objection has been made to the use of copper caps on board of ships, where they are liable to be dropped upon the deck." Figs 17 and 18 represent one form of Westley Richards' primers without the outer casing; whilst figs. 19 and 20 represent another form. In each case A is the hard metal pin, B the cap itself, and C the priming.

Another "Improved primer for fire-arms" by Westley Richards is set forth in his specification No. 7582, of 1838, from which the illustration at fig. 21 is taken. The invention is really a priming magazine, and is said to consist of "a novel construction and arrangement of apparatus or magazine and primer to be attached to muskets, carbines, pistols, fowling-pieces, and other fire-arms, for the purpose of depositing the priming (as copper percussion caps, &c.), on to the nipple or touch-hole of the piece, such apparatus being constructed to hold a proper quantity of copper percussion caps or other priming for a given number of charges, and is capable of being easily and readily brought

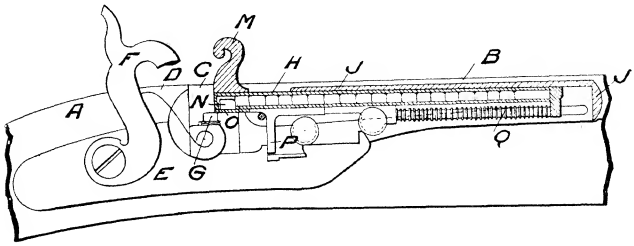


FIG. 21.

forward over the nipple of the piece, and depressed thereon so as to cause a cap or priming to be deposited and left upon the nipple or touch-hole, the magazine or primer returning to its original situation of its own accord immediately it is released from the hand of the person using the fire-arms."

Fig. 21 is a sectional view of a carbine or musket to which the invention is applied. "A is the stock, B the barrel, C the breeching, D the false breech, E the lock plate, F the hammer, and G the nipple, all of which are constructed in the ordinary manner, excepting the lock plate, which in this instance is adapted to receive and act in conjunction with my improved magazine primer H. The primer is secured to the barrel by the shield J, these parts in this mode of affixing it being welded or soldered to the barrel. But the

shield may be formed independent thereof, and secured to the lock plate or stock in any convenient manner, though I prefer attaching the shield to the barrel, as it is a stronger method of securing it, and better adapted to protect the primer from injury by blows from a sword, &c. The magazine of the primer is a hollow tube H, the sides of which project down to cover the other parts or mechanism. Into this tube the copper caps are placed, either singly by hand, or they may be introduced at the end of the primer by emptying them from a tube or larger magazine, or it may be filled in any other convenient manner. M is the thumb piece by which the primer is drawn towards the nipple, and depressed upon it when in the act of priming. The exit aperture for the copper caps, &c., is at N, it being closed by the sliding shutter O at all times, excepting when it is brought immediately under the nipple or touch-hole. The sliding shutter O is attached to the tail piece P, which slides between the sides of the primer. Q is a compressed helical spring, which by its expansive force returns the primer into its position of rest after the priming has been effected."

CHAPTER IV.

Automatic Priming for Percussion Fire-arms—(*Con.*)

The accompanying illustrations, figs. 22 and 23, represent the combination and arrangement of a circular priming magazine constituting the subject matter of letters patent, No. 7965, of 1839, granted to George Henry Manton. Fig. 22 shows the magazine in position on the gun, whilst fig. 23 is a sectional view of the magazine. The patentee describes his invention as consisting "in the mode of constructing and applying a circular magazine, containing a series of copper caps, one of which is constantly kept at the point of the neck by a spring." The lock is so constructed that in bringing it

to full cock the discharged cap is removed and its place filled by another. Such movements are effected by a spring A fixed at the back part of the free or striking end of the cock, the act of withdrawing the cock after firing causing the said spring A to remove the spent cap. A fresh cap from the magazine is placed on the nipple by a projection B on the lower part of the cock acting in a hollow C cut in

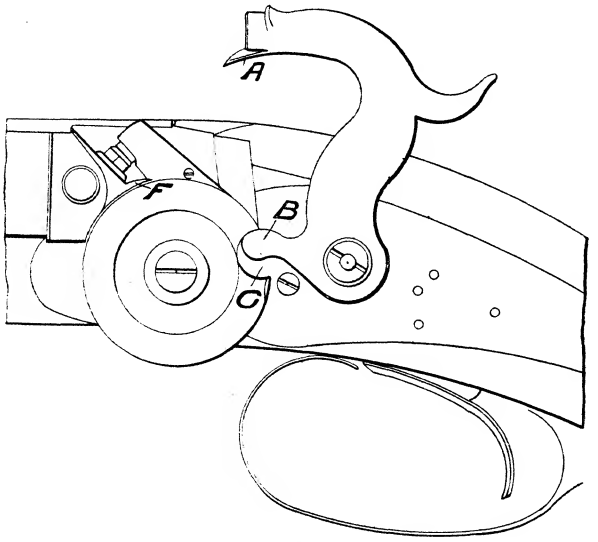


FIG. 22.

the top or cover of the magazine. Thus the gun is automatically primed by the mere act of withdrawing the trigger to full-cock position after each time of firing until the magazine is emptied. The outermost cap in the magazine is kept in its place ready for depositing upon the nipple, and is protected from wet in the short neck of the magazine by a slide D pressed outward by a spring E, the said slide D being moved out of the way by the spring E coming against a projection F at the back of the breech.

In his specification No. 9084, of the year 1841, C. L. S. Heurteloup describes a continuous priming rolled into a coil, a small portion being automatically cut off by the hammer just before percussion takes place.

Cartridges for Percussion Fire-arms.

The cartridges for all the early types of percussion fire-arms had no means of discharge within themselves, but had separate or independent primers. Indeed, cartridges containing their own primers were looked upon as dangerous by

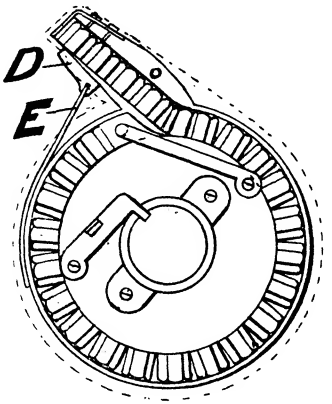


Fig. 23.

the British military authorities, and were considered as quite inadmissible until the Prussians in 1864, with their needle guns, effectually demonstrated the groundless nature of such fears.

For military purposes especially the disadvantages of the old powder horn were apparently so great as to lead to the early adoption of separate packages or cartridges, each containing the required charge of powder, and it is stated that such cartridges were in use before the close of the 16th century.

One of the earliest British patent specifications describing cartridges is that of Jean Samuel Pauly, No. 4026, of the year 1816. Pauly's cartridge, which was especially intended for his gun to be fired by compressed air, described in the same specification, had a boxwood base, shouldered down and attached to a paper or other case.

In his specification No. 5570, of the year 1827, Joshua Jenour, of London, states that his invention consists "in placing or enclosing the shot or other like missiles to be discharged from fire-arms and guns in a reticulated or perforated cartridge or case, being a hollow cylinder of wire or metal, or other material of sufficient strength not to burst by the force of the discharge, but the perforations or meshes of which are to be sufficiently large to permit the free passage of the shot or missiles through them, by which means greater strength and closeness of the said shot or other missiles when discharged is obtained, and the distance to which the same may be thrown is greatly increased by reason that the cartridge or case will keep the shot together much longer than the ordinary method of loading will do, or rather will prevent the shot from spreading so immediately; it being observed that the efficacy of the invention is mainly dependent on the cartridge or case not being burst by the force of the discharge, or by the power of the shot or missiles, and that the smaller the meshes are the greater will be the force and distance to which the shot or missiles are thrown."

The wire case was preferably to be enclosed in a thin paper case, open at the top. After placing the shot in the case, sand or other granular substance, such as bone dust, was to be poured in and shaken down to fill up the interstices between the shot; the open end of the paper was subsequently folded down and the cartridge thus completed. The inventor further added, "wadding may be used at each end of the wire, metal, or other case, and enclosed with it in the paper case, to save time in loading. The wire or metal case may be used without being enclosed in a paper case, for

which purpose, after the ordinary charge of powder is rammed down in the gun or fire-arm, the wire or metal case is dropped into the barrel, and the usual charge of shot is then poured into it, so as to fill it, and wadding is then rammed down upon it."

The accompanying illustrations, figs. 24, 25, and 26, are from the specification No. 5708, of 1828, of Edward Forbes Orson, of London, for "An improved cartridge for sporting purposes." Orson states that his invention consists of "a cartridge so contrived that the charge of powder may be separated at pleasure from the shot without disturbing the shots, which are contained in a hexagonal or other many-sided case, having a circular wadding at both ends somewhat longer than the case; and the case is divided into two or more portions by a card or wadding, and so contrived that

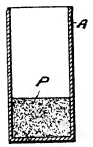


FIG. 24.

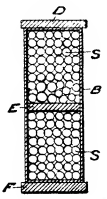


FIG. 25.

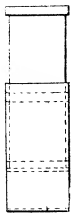


FIG. 26.

the case which holds the shot bursts almost immediately as it leaves the gun, and allows the shot to scatter. A represents a cylindrical paper case, made of cartridge or other paper, open at the top, and with a stiffening card at the bottom; P is a proper charge of powder poured into the bottom of the case; S S is the charge of shot enclosed, also in a case B, and shown here in section firmly closed at both ends, with a card or wadding at each end D and F, and one in the middle E to divide the charge of shot into two portions. The cylinder which encloses the shot must be just so much smaller than that which holds the powder as to slide into it with difficulty when some force is applied for the

purpose. Fig. 26 is a representation of the cartridge complete, the case containing the shot being forced into that containing the powder. In order to make use of my new cartridge, withdraw the case containing the shot from the case A, which contains the powder; pour the powder into the gun barrel and throw away the case A; then drop the case B with the shot into the gun barrel and ram it down upon the powder, when the gun will be ready to be discharged. By this arrangement of cartridge once ramming down is sufficient to complete the charge, while the division in the shot case causes the shot to be carried much farther and in a more direct line."

J. De Burgh, in his specification No. 6139, of 1831, describes a cylindrical cartridge made in twelve pieces, which scatter on firing.

In his specification No. 8143, of the year 1839, Thomas French Berney, of Morton Hall, Norfolk, describes a cartridge consisting "of an outer and inner case, the former made as usual of paper or other suitable substance, and the latter (which immediately encloses the shot) made of wire formed into a spiral spring case."

Fig. 27 is an elevation and fig. 28 a section of Robert Adam's ball cartridge, as described in his specification No. 1, of the year 1852. "A is the ball, which is formed with a projecting tang B passing through the wad C, and into the metal cup or chamber D, where it is riveted so as to combine the three parts together. The chamber D, which I prefer to be raised out of thin sheet copper, is charged with powder, and a disc of thin paper or other material is pasted or cemented over the end of the chamber. In order to protect the end of the chamber D, I employ a cap or cover E, into which the end of the cartridge is placed, and I form such cap or cover with a shank, as shown, by which a number of caps can have a wire passed through them, and thus I prevent their being lost; and for the convenience of stowing or packing cartridges such as above described, I find it convenient to have a plate of metal perforated with holes for

the passage of the shanks of the covers E of the cartridges, so that by passing a wire through the shanks of several cartridges they will be attached to the plate of metal, and the cartridges may be removed out of their end covers or cases E, leaving such end cases or covers attached to the plate."

Starkey's Percussion Caps.

In the specification No. 9188, of the year 1841, Thomas Starkey, of Birmingham, describes his improvements in percussion caps, consisting in the placing of the fulminating powder between a pair of caps, one of which is placed within the other, "the end of the inner cap being perforated with a

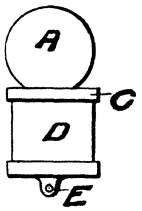


Fig. 27.

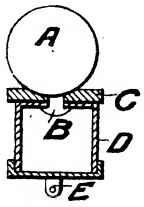


Fig. 28.

small hole, exactly coincident with the touch-hole in the nipple or cone of the gun, in order to allow the fire from the explosion to pass through the breech of the gun into the charge of gunpowder within." By such improvements the primers are "rendered impervious to water, and may, if necessary, be removed from the cone or nipple without any risk or danger of discharging the gun, it being impossible that any portion of the detonating powder contained in these improved caps can escape from the cap and adhere to the nipple, which has frequently been the case with the ordinary caps, when, by letting the hammer fall down too violently upon the cone, explosions have taken place, and serious accidents occurred; such accidents are entirely prevented by my improved cap."

Fig. 29 represents an external view of the outer cap or shell made in the ordinary manner, whilst fig. 30 is a section

of the same, showing the detonating powder enclosed therein. Such detonating powder Starkey covered by a disc A of tin foil or oiled silk, to protect it from damp. The inner cap or shell is made to fit within the outer. The complete cap or primer is shown in section at fig. 31, the split ends of both shells being drawn together and the edges trimmed off. Other forms of these primers are shown and described in the specification.

Discharging Fire-arms by Means of Compressed Air.

Before proceeding to the consideration of percussion rifled arms, we may here refer to a few specifications describing the ignition of the explosive charge by the heat obtained on the compression of air.

It may be noted in this connection that ordinary English black gunpowder, consisting of 75 parts saltpetre, 15 parts charcoal, and 10 parts sulphur, explodes at a temperature of about 600 deg. Fah.

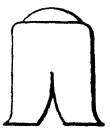


Fig. 29.

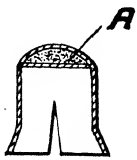


Fig. 30.

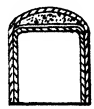


Fig. 31.

Such a method of firing is described in the specification No. 3833, of 1814, of Jean Samuel Pauly, and also in same inventor's specification No. 4026, of 1816.

The illustration at fig. 32 is from the specification No. 5317, of 1826, of Benjamin Newmarch, of Cheltenham, for "Apparatus for discharging fire-arms by means of compressed air." This patentee states that his invention of "an improved method of exploding fire-arms consists in introducing into the charge of gunpowder contained in the barrel of a fowling-piece or other description of fire-arms, when loaded, the fire or sensible heat produced by the sudden

compression of air, which fire or sensible heat I obtain in a similar manner to that commonly practised in igniting the substance called German tinder in the well-known apparatus denominated an instantaneous light machine, constructed in a walking stick—that is, by means of a piston accurately fitted and worked in a cylinder, by the sudden stroke of which the volume of air contained in the cylinder becomes so much compressed as to give out its caloric in the state of

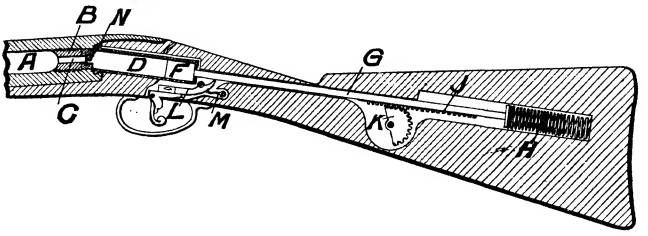


FIG. 32.

sensible heat or fire. There may be various modes devised of bringing this principle into action for the discharge of fire-arms, all of which it would be impossible for me to describe. I shall, therefore, merely exhibit one contrivance adapted to a fowling-piece which I consider to be the most eligible method of igniting the charge of that kind of gun upon the principle above stated, without intending to confine myself to that particular construction of mechanism."

A is the barrel, having what is termed a patent breech B; this is to be loaded with gunpowder and shot in the usual way; C is the touch-hole in the centre at the hinder part of the breech; D is an accurately-formed hollow cylinder, having a small hole for the admission of air; F is a piston, ground to fit the cylinder perfectly air-tight, and to move along it with as little friction as possible; G is a rod affixed to the piston at one end, and to a powerful helical spring H at the other end. A portion of the piston rod is formed into a rack J, and is moved by a key or lever on the outside for the purpose of drawing back the piston and its rod, which

drives the helical spring up to its tension. When the rod has thus been drawn back the point of the sear L is forced into a small notch in the rod by the sear spring N, which prevents the piston from moving forwards, and the piece may then be considered as cocked, ready to be discharged. On bringing the piece into a firing position the trigger is pulled by the finger, as usual, which by raising the long arm of the sear withdraws its point from the notch, and the piston rod being now released from its confinement, the power of the helical spring exerts itself and projects the piston forward in its cylinder with such force as to compress the air contained in the cylinder before the piston, and cause it to give out its caloric in the state of sensible heat or fire at the aperture in front of the cylinder, where the small ball valve N is placed, and, passing by this valve, the fire enters the barrel at the touch-hole in the breech, and instantly ignites the charge of gunpowder.

After the piece has been re-loaded the key or lever of the toothed segment is to be turned round, so as to draw back the piston and force the spring up to its tension as before, when the point of the sear, again falling into the notch, confines the piston rod and leaves the piece in a state ready to be discharged.

CHAPTER V.

Muzzle-loading Rifles.

A shot fired in a direction other than vertical in a space devoid of air, being subjected in its flight to the action of gravitation, will describe a parabolic curve. In actual gunnery, however, the projectile is subjected not only to the action of the force of gravitation, but to the disturbing influence of the air, which, together with a want of absolute uniformity in the distribution of the propelling force, will impart to the shot an irregular rotary motion, and cause it

to deviate from the direct path or line of fire. The object of rifling is to impart a definite rotary motion to the shot before it leaves the barrel, for the purpose of overcoming the forces tending to deviation during its flight.

The rotation of the projectile due to rifling, by its tendency to keep the fore part of it always to the front, also permits of the effective use of solid cylindrical bullets with conical heads, a form which meets with less resistance in its flight through the air, and is better adapted for penetration than a spherical shot or ball.

The period of the invention of rifling for the barrels of firearms cannot be determined, but it was certainly known some centuries prior to the introduction of rifles for service in the British army. Some writers infer that rifled guns were known as early as the fourteenth century. The first English patent specification referring to rifling is that of Arnold Rotsipen, No. 71, of the year 1635.

In his specification No. 1694, of 1789, J. Wilkinson describes a barrel rifled with two spiral grooves, the shot having belts or wings to fit the grooves ; or, conversely, the barrel to have spiral convex ribs for corresponding grooves cut in the projectiles.

Although one British regiment (afterwards known as the Rifle Brigade) appears to have been supplied with rifled firearms in the year 1800, the Brunswick rifle, which was not introduced into the service until 1840, is generally referred to as "the first rifled arm possessed by the British soldier." The barrel of the Brunswick rifle had two grooves ; the bullet, weighing 555 grains, was spherical, but had a belt or annular projection formed with it, the width and thickness of the belt being made to correspond with the width and depth of the rifling. It is said that the grease on the bullet patch employed in the making up of the Brunswick rifle cartridge was a potent factor in the discontent culminating in the outbreak of the Indian Mutiny, the natives objecting, on the ground of caste, to biting off the ends of cartridges, which they alleged were

smeared with pig's grease or cow's fat. The Minié rifle of 1851 had four grooves, and fired a conical leaden ball. The diameter of the bullet was made less than the bore of the barrel to permit of easy loading, but the bullet was expanded into the grooves to prevent "windage" (or the escape of gas after explosion between the bullet and the barrel) by an iron cup fitted into a conical hollow in its base, and which was driven forward into the hollow by the explosion of the charge. As in some cases the iron cup was blown right through the bullet before the latter had left the barrel, it was subsequently displaced by a boxwood plug, and still later, on the suggestion of General Boxer, the boxwood plug, on the ground of cost, was discarded and substituted by a baked clay plug.

The Minié rifle barrel had a bore of ·702 in., but in the famous Enfield rifle, by which it was succeeded in 1853, the barrel was ·577 in. diameter, 33 in. long, and had three rifled grooves, with a pitch of one turn in 78 in.; the bullet (made of pure lead) was 1·81 diameter in length, and weighed 530 grains. The Enfield was the rifle employed by our troops throughout the Crimean War. It was considered an accurate weapon for ranges up to 800 yards.

Bullets for Muzzle-loading Rifles.

In the production of bullets for muzzle-loading rifles it is necessary, in order to permit of loading without the imposition of an undue effort upon the ramrod, that the diameter of the bullet shall be slightly less than the diameter of the barrel. Thus, in the ·577 Enfield rifle barrel the bullet employed had a diameter of but ·568 in.; but as such a difference between the dimensions of the barrel and the bullet would result in great inefficiency from windage, it was necessary to so construct the bullet as to cause it to expand and fill the rifled grooves after firing, and thus act as a gas check.

The expansion of an easily-fitting bullet in a rifle barrel on the explosion of the charge, to such an extent as to cause

it not only to fit tightly in the barrel, but also to cause the soft metal to flow into the grooves, is due to the great suddenness of the explosive force, combined with the inertia of the bullet, for as the bullet cannot be set in motion sufficiently quickly to prevent the driving force unduly "overtaking" it, such force relieves itself by "upsetting" or expanding the base of the bullet.

Some forty-five years since considerable interest was aroused, both in and out of Parliament, in the attempt to decide as to who was the first to comprehend and practically utilise what may be termed the combined principles of impact and inertia in connection with rifled arms. The distinguished Frenchman, Charles Claude Etienne Minié, who devoted much thought and labour to the improvement of firearms, received £20,000 for his expansion bullet as adopted by the British Government, and to which we have already referred in connection with the Minié rifle; but the late W. Greener, of Birmingham, claimed with much persistence and energy that he was the producer of the first perfect expansion bullet, and in 1857 he obtained £1,000 from the British Government, who apparently admitted his claim so far as to accept the statement that he had made the "first public suggestion of the principle of expansion," in the year 1836. It may be observed that it is further claimed that Captain Norton, as far back as 1823, "invented and exhibited an elongated and expanding shot and shell," identical in principle with the Minié bullet. We do not know whether Captain Norton succeeded in obtaining anything substantial from the War Office. Possibly the authorities, in view of the number of applicants, were finally driven to act on the well-established law with regard to British patents, to the effect that a "patent for a principle is invalid," and deduce from the same a rigid rule as to who should be paid in future.

The adjoining illustrations, figs. 33 and 34, are from the specification of John Norton, No. 936, of 1852, for "Improvements in shots or projectiles." The patentee states that his inven-

tion "relates to the construction of hollow expanding shot or projectiles, each containing its own cartridge or explosive charge, and forming what I term my hollow cylindro-conoidal shot. The charge is composed of a safe fulminating powder and common gunpowder in about equal proportions. Various fulminates may be used, the fulminate being *first* put into the hollow of the shot, and a circular piece of thin tissue paper is then placed over it. After this the gunpowder is put in, and over that is fastened a circular patch or disc of thin linen or calico, greased with a preparation of beeswax, spermaceti, and oil, or, instead thereof, oxide of zinc and hog's lard may be used; and the charge may be wholly of gunpowder instead of a compound of fulminates. The patch encloses the base of the shot, and goes half way up its sides.

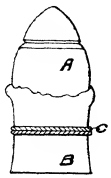


FIG. 33.

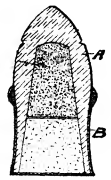


FIG. 34.

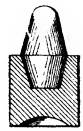


FIG. 35.

The shot may be of varying shapes, but it is preferred to make it cylindro-conoidal, or elongated somewhat like an acorn. The entire charge used is within the shot, and the fire from the percussion cap of the piece penetrates the centre of the greased patch and fires the charge. In using this projectile with the common rifle, a few grains of fine gunpowder are put into the piece, besides the ball charge, merely to fill the nipple and ensure firing; but with Norton's improved model rifle cannon, the nipple being in the centre of the breech, the percussion cap sends its fire direct into the centre of the retaining patch, and fires the charge without other assistance. On firing, the explosion expands the shot to fill up the bore of the piece, or the grooves of the rifle, or, for rifled cannon, the shot may have rifle projections

to begin with, so that the explosion on firing may entirely fill up the grooves."

Referring to the drawings, fig. 33 is an elevation and fig. 34 a section of the shot, drawn to full size. The cylindro-conoidal shot A is made of wrought iron, and has a conical chamber to receive the charge, as shown in the section. The upper part of the charge at the narrow end of the cavity consists of the fulminating substance or compound, and this portion of the charge is separated from the gunpowder at the wider end by a partition, consisting of thin tissue paper. The complete charge is finally secured by the external covering B, consisting of a thin piece of linen or calico, which is tied on at C. The inventor states: "In this shot the percussion fire from the nipple of the piece penetrates right through the fabric of the charge cover, and the consequent internal explosion expands the shot, or containing shell, so as to fill up the bore of the piece to the greatest nicety. The shot is rifled by being flattened off at four sides, but it is equally obvious that the desired effect will be secured as well in smooth-bore shooting. The base of the shot, being, as it were, plastic, is not liable to fracture, but at once fully accommodates itself to the bore of the piece."

Fig. 35 is from Minié's specification No. 1208, of 1854, for "Improvements in projectiles." Such improvements are described as consisting "in certain means of using in rifle or smooth gun barrels cylindrical, oblong, elongated, or spherical bullets of a less diameter than the bore of the barrel, thus allowing to reduce considerably the weight of military ammunition, without necessitating any change in the barrels of the present firearms. Thus, by the improvements which will be described hereinafter, the weight will be reduced in the following proportions: With the common musket the projectile, as at present used, weighs 50 grammes, or one ounce and eight-tenths, and has a diameter of 17 millimetres, or six-tenths six-hundredths of an inch; whilst the improved projectile will only weigh from 15 to 20 grammes, or one-third of an ounce to one ounce and a quarter, and have a diameter

of 10 to 12 millimetres, or four-tenths to five-tenths of an inch. I effect these improvements by means of a cylindrical socket, or bullet carrier, made of any suitable light material, such as rolls of cartridge or other paper cut to the proper length, and pressed or stamped into a suitable form. This cylindrical socket, or bullet carrier, has on its front flat end a recess for receiving the projectile of reduced diameter; on its back end I leave a cavity for allowing the gases generated by the explosion of gunpowder or other explosive matter to spread out the cylindrical socket against the barrel cylinder, and in case of rifle barrels both the socket and ball receive a rotating motion. The front and back recesses may have various shapes given to them, care being taken to make the front recess tapering from front to back, so that the bullet may leave the socket gently as soon as the flight of the latter is retarded by the resistance of the air."

Fig. 35 illustrates a bullet with the socket or bullet carrier in section.

THE ROTATION OF BULLETS FIRED FROM SMOOTH BARRELS.

Figs. 36 and 37 are also from the specification of Minié, just referred to in connection with fig. 35. Fig. 36 illustrates a bullet in a socket, or carrier, having three screw threads formed on its cylindrical surface. The object is to impart a

FIG. 36.

FIG. 37.

rotating motion to the bullet when fired from a smooth or unrifled barrel. Such motion is obtained by the gases "bearing upon the helical surfaces of the threads," thereby setting up a "spinning motion of the projectile, which is kept up in spite of the resistance of the atmosphere, and may be varied according to the pitch of the screw from one to two

turns every six feet." Fig. 37 illustrates the formation of the helical threads upon the projectile itself.

But we find an earlier proposal for the imparting of a rotary motion by the formation of screw threads on the same, in the specification No. 1033, of 1853, of W. H. Sitwell, whose invention had for its object, "firstly, the giving to a projectile or firearm, when forced from any description of cannon, greater accuracy of flight by causing it to rotate on its axis by a peculiar construction of the projectile itself. Secondly, the giving to a projectile fired from any description of cannon or firearm greater accuracy of flight and increased length of range ; also by a peculiar construction of the projectile itself, although it does not rotate on its axis, as aforesaid. I effect the above objects as follows : I make my projectiles of an elongated conical form, nearly similar to the improved balls now making for rifled muskets. Firstly, through the axis of these projectiles, I form a circular passage, or throat, through which during the flight of the projectile the air passes ; and I cause the same to rotate by placing in the said passage or throat a small segment of a screw thread, which, whether counter sunk as a female screw, or as a male screw raised upon the surface of the throat, or by the introduction into the throat of a small portion of a spiral fan, compels the projectile to rotate on its axis by the force of the air acting upon the said screw arrangement. By this rotatory motion I attain improved accuracy of flight for my projectile, as if it were fired from a rifle barrel ; at the same time, by the absence of resistance of the air on the point of the projectile, and also by there being little or no vacuum in its rear, the range of my projectile is much increased. Secondly, I omit the screw arrangements in the throat of my projectile, believing my invention to have great value even when the throat is plain. Over the throat of my projectile (whether it has a screw arrangement in it or not) I place an iron or other wad or button in the top of the chamber in rear of the projectile, which button is slightly fastened to the projectile where the throat

terminates in said chamber. This wad or button protects the throat of the projectile till the projectile is clear of the cannon or fire-arm, and then, becoming powerfully acted on by the air, the said button is forced back and disengaged from the projectile. I make my projectile with a nearly similar chamber in its rear as the improved Woolwich ball for rifled muskets, so that the force of the powder alone expands the projectile when made of any yielding metal, such as lead; but I make no claim whatever to this portion of the construction; I merely adapt this to my other objects."

The sectional illustrations at figs. 38 and 39 are from Sitwell's specification.

Muzzle-loading Needle Gun.

A muzzle-loading gun having many parts of resemblance with the well-known Prussian needle gun of later years, was patented in this country in 1831 by Abraham Adolph Moser,

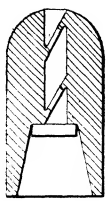


Fig. 38.

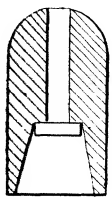


Fig. 39.

and the accompanying sectional view of a fowling piece, fig. 40, is taken from his specification No. 6196. Moser declares the nature of his invention as follows: "First, in causing the charge of powder in fowling-pieces, muskets, carbines, pistols, and other like small firearms to take fire by placing the ordinary fulminating substance used for that purpose, and exploding it within the barrel beyond or forward of the powder in the firearm, in such a manner as to expose the charge of powder to the whole of the flame issuing from

the said substance, and without the intervention of any confined passage whereby the flame could only issue as a narrow stream; and, secondly, in a mode of holding a cartridge in the barrel of such firearm as aforesaid in the proper position for being fired out, by means of a pin pressed through the barrel, whereby I am enabled to use a cartridge of such smaller diameter than the barrél as not to require a ramrod to force it to its place, the mere act of dropping it into the barrel being sufficient for that purpose."

Referring to the illustration, A represents a part of the stock, B the barrel, C the ramrod, D the guard, E the trigger. The fulminating substance is a pellet of "fulminating mercury, introduced into and closely confined in

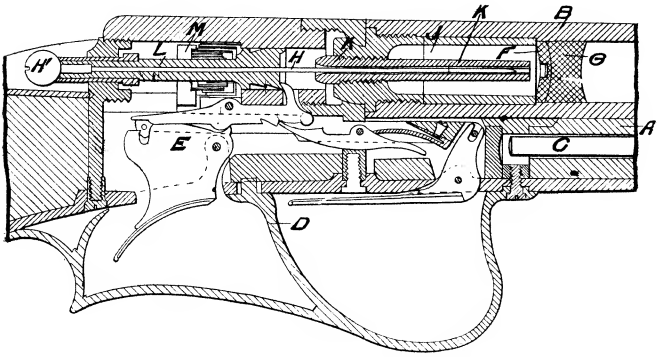


FIG. 40.

a small cavity made for the purpose in a piece of hard pasteboard, as shown at F, cut to the size of the bore of the barrel, and glued on to the bottom of an ordinary wadding G." The wadding and pellet are placed in the barrel at the forward extremity of the powder chamber J. The pellet is exploded "by driving forward the point or end of the steel wire or rod H into it." The tube K serves as a directing tube for the wire or firing needle H. The opposite end of the wire is screwed into the sliding tube L, and is

provided with an external ball head H. The forward and return actions are obtained by two springs arranged one within the other at M.

The second part of Moser's invention consists in the retaining of a ball cartridge in its position within the barrel by a stud projecting within the same, the stud being withdrawn by the movement of the cocking lever. The object of this device is to enable a cartridge to be employed so much smaller in diameter than the bore of the barrel as will permit of easy loading.

Whitworth's Experiments on the Enfield Rifle.

At the request of the British Government Sir Joseph (then Mr.) Whitworth, in 1854, conducted a number of experiments with a view to the improvement of the Enfield rifle. As a result of these experiments, Whitworth arrived at the conclusion that the bullet was too short in proportion to its diameter, and the rifling of too great a pitch, or, in other words, of too slow a spiral or twist. He established a rule that the length of a projectile for a rifled arm should be not less than three times its diameter, and in the Whitworth rifle, subsequently produced, he adopted a bullet of such proportions. The bore of the Whitworth rifle was hexagonal, with rounded edges; the mean diameter was ·47, and the rifling had a pitch equal to one turn in 20 in., or nearly four times quicker than the Enfield. Official trials of this weapon, in 1857, proved it to be far superior to the Enfield, but it was never adopted by the Government.

Whitworth's experiments, and the results he established from them, have proved of immense and universal advantage to gun makers, and constitute the foundation for the construction of all modern small-bore rifles. To a large extent Whitworth may be said to have rendered a service in connection with the rifle identical with that which he performed in regard to the adoption of a standard screw thread, for in both cases he found a system of construction, or rather a want of system lacking in uniformity, and based

practically on a "rule of thumb"; but as a result of his labours we have a reliable uniformity in the pitch of screw threads for bolts, studs, and nuts, and, as already indicated, the modern rifle affords ample testimony to the soundness of the conclusion at which he arrived in regard to small arms.

Theory and practice cannot be always made to agree so happily as with the two cases named. An American writer on Ammunition observes, in regard to bullets, that "Science will figure out the size, shape, and weight of a bullet, and the proper portion of a certain grade of powder. It will place this powder and ball in a rifle barrel of a figured length, bore, and twist of rifling. It will set up a turkey 200 yards off, and sight the barrel with the properly-figured elevation to overcome the action of gravity, and the trigger is pulled. Scientifically, that turkey is a dead bird, but when the smoke has cleared we find him alive and kicking."

Whitworth's patent, relating to rifled fire-arms with polygonal bore, is No. 2525, of 1854.

The Lancaster Oval-bore Rifle.

A rifle barrel, with an oval and spiral bore, is described in C. W. Lancaster's specification, No. 13161, of 1850. Some of these rifles were used in the British service.

CHAPTER VI.

Breech-loaders.

The first British patent specification in which breech-loading is mentioned is that of Abraham Hill, No. 143, of 1664, to which we have previously referred; but Hill was by no means the inventor of the breech-loading system.

The earliest breech-loader in the Birmingham Art Gallery collection is a flint-lock gun of the year 1694. The official description reads as follows: "Flint-lock gun, breech-loader, by the celebrated Aqua Fresca, of Bargio. The lock and

barrel of beautifully-chiselled steel, stock of bird's-eye walnut, with chiselled and engraved mounts, slightly inlaid with silver.—*Italian*, 1694."

But in the Tower of London a much older breech-loader is preserved, bearing the date 1537 and the letters "H. R." This weapon is described as the hunting arquebuse of Henry VIII. It has a match lock and a hinged breech block somewhat similar to the modern Snider. It is of interest to note that Henry VIII. can be described as the King of England who, next to Edward III., "seems to have contributed in the greatest degree to the early improvement of fire-arms, to which he personally devoted much attention. He was himself the inventor of several contrivances relating to guns." We do not read that he granted himself patents for these inventions, but if he did so we may take it that he was not troubled by infringers.

The specification No. 1003, of the year 1772, of Thomas Wright and Charles Byrne, shows several methods of loading at the breech. Patrick Ferguson's specification, No. 1139, of 1776, describes, as already stated, and as illustrated in our first article, a breech-loader with a screw closing plug. Carbines on Ferguson's system are stated to have been used in the American War of Independence, by which they became the first breech-loading small arms employed in active service by a British force.

The specification No. 2692, of 1803, of Durs Egg, describes a breech-loader in which the charge is inserted through a slide in the top of the barrel, such slide being made to close the aperture by the action of a lever. The specification No. 2744, of 1803, of J. S. Searles, describes a breech-loading rifle with flint lock, in which "the barrel and stock are made to part in the same manner as the joint of a flute."

In the specification of Jean Samuel Pauly, No. 3833, of 1814, to which we have referred as a gun in which the charge is ignited by means of compressed air, there is described a breech-loading action, comprising a hinged lever which, when raised, permits of the insertion of the cartridge. In

the same inventor's specification, No. 4026, of 1816, the making of a gas-tight joint for breech-loaders is described. A plug is "so placed in the gun as to come between the charge of gunpowder and the movable breeching in all cases, and is formed of lead, copper, or such other ductile materials as will give way to the explosive force of the charge." Such expansion of the material was arranged by the inventor for preventing escape of gas at the joint—in other words, it constituted a gas check.

The prevention of the escape of gas at the breech joint proved the chief difficulty of all the early attempts to produce breech-loading fire-arms, and it was not until the cartridge itself was so constructed as to serve as a gas check that such difficulty was overcome.

In Augustus Demondion's specification, No. 6137, of 1831, a breech-loader is described, in which the breech piece has a concave face, which is movable on the convex end of the barrel by a lever fitting into a groove in the stock. The downward motion of the lever towards the said groove cocks the lock by a pin carrying a roller at its end. The cartridges for this arm have a tube containing detonating powder projecting from the base, which is exploded by a hammer attached to the main spring.

A breech-loading needle gun is described in the specification No. 8513, of 1840, of William Bush.

In Stephen Taylor's specification, No. 11994, of 1847, a breech-loader is described in which conical-shaped projectiles, each having a charge of powder in a rear hollow closed by a cap provided with a touch-hole, are contained in a magazine which consists of a self-acting feeding tube attached to barrel of the piece. As one projectile is discharged another is to be pushed forward into the breech of the barrel and fired in succession.

The adjoining sectional illustrations, figs. 41 and 42, are from Matthew Urlwin Sears' specification, No. 12920, of 1850. Sears states that his invention "consists firstly in a new and improved construction of guns that are loaded at the breech

and fired by the protrusion of a needle or pin into a priming contained in the interior of the cartridge wherewith such gun is charged, this improved construction being applicable to military muskets, rifles, carabines, fowling-pieces, and pistols, and as far as concerns the loading at the breech also to cannons; and, secondly, in an improved cartridge for charging or loading such guns."

Referring to the drawings, A is the stock, B the barrel, which ends in a cone at the breech end, and C the cartridge. The tube D, into which the barrel is screwed, has a longitudinal slot on its upper side; the sliding breech E works

FIG. 41.

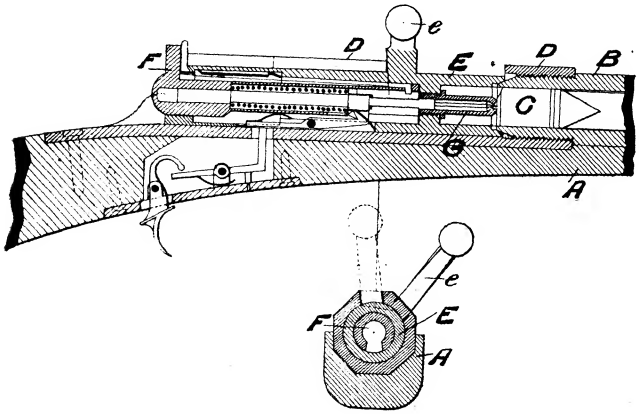


FIG. 42.

within the tube D, such breech being provided with a handle *e*. The dotted lines at fig. 42 represent the unlocked position of the handle. The fore part of the interior of the sliding breech E is enlarged conically, and ground to the conical part of the barrel, "so as to form a kind of valve shutting, and a small ring of copper or soft brass is introduced to improve the shutting." The space at the rear of the ring is termed the back chamber, its use being "not only to

receive the residuum of the burnt powder, but also to contain a quantity of air, which, by its elasticity, eases the recoil of the gun, and being strongly heated, and consequently dilated by the explosion of the powder, augments the force wherewith the bullet is driven out of the barrel." The tube F, at the back part of the sliding breech, the inventor terms the spring barrel. The needle works within the needle guide G. In the cartridges for this weapon, a pasteboard washer containing the percussion cap is disposed between the powder and the bullet, this arrangement of the cartridge, in the

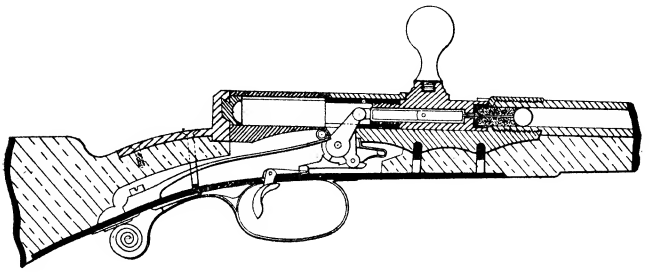


FIG. 43.

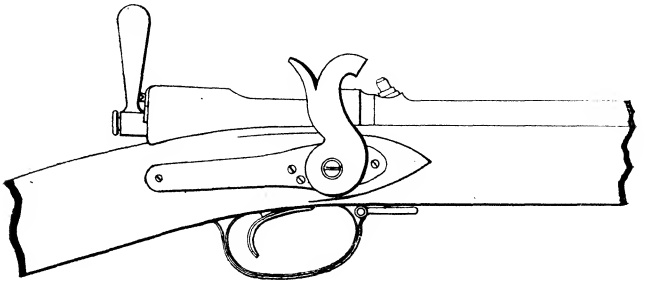
opinion of the inventor, having the advantage that the ignition of the powder is begun at its foremost part, and, consequently, its perfect combustion secured. The cartridge case consists of fine paper.

The sectional illustration at fig. 43 is from the specification of J. W. Schlesinger, of Brixton, No. 14227, of 1852, for "Improvements in fire-arms, in cartridges, and in the manufacture of powder." The improvements in fire-arms are said to "refer to that class of fire-arms known as 'needle-guns'—that is to say, in which the charge is fired by a needle penetrating a cap placed upon the end of the cartridge. The nature of my improvements in this class of fire-arms consists, first, in projecting and withdrawing the needle, by means of levers and springs in combination with one or more curved or inclined planes; and second, in preventing,

as far as may be, windage in such arms, by means of a screwed tube fitting over a continuation of the barrel and tightly held between the breech and an inclining stop."

As will be observed, the gun has some resemblance to that just described and shown at figs. 41 and 42. The percussion cap of the cartridge is of a conical shape, and the patentee states that "the percussion powder, being concentrated at the apex of the cone, instead of being distributed over a

FIG. 44.



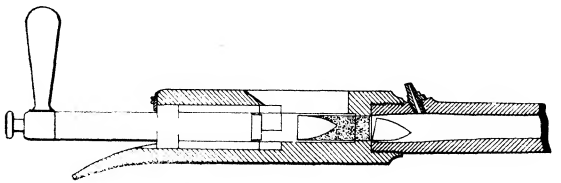


FIG. 45.

large surface, as in ordinary percussion caps, renders a smaller quantity necessary, while ignition is, at the same time, more certain."

Figs. 44 and 45, are from the specification No. 2089, of 1854, of Chas. Wm. Lancaster, of London, who states that his "improvements in fire-arms consist in the construction of a breech-loading gun discharged by an ordinary lock and percussion cap, the aperture of the barrel being closed by a

breech swivelled on to a closing bolt, somewhat similar to that employed in the Prussian needle-gun. The improved cartridge to be employed with these fire-arms consists of a shell of pulp or paper of any thickness required, into the bottom of which a concave perforated wad is inserted, in order to strengthen the base of the cartridge. A piece of tape or other suitable material is attached to the cartridge, for the purpose of removing the remains of the cartridge after discharge. Fire is communicated to the powder in the cartridge from a percussion cap through an orifice or aperture in the wad."

The closing bolt is shown closed at fig. 44, but open at fig. 45. The cartridge is formed by "placing the bullet at the bottom of the paper or other case, and then filling it up with the requisite charge of powder, instead of putting in the

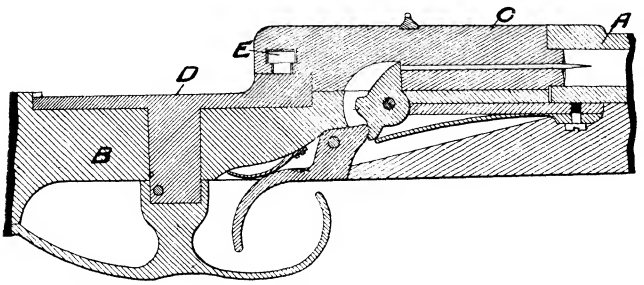


FIG. 46.

powder at the bottom and the bullet at the top, as is usually done. To charge the fire-arm, a cartridge is first inserted into its proper position in the barrel of the gun, and the powder exploded by a percussion cap upon the nipple, when the bullet is left behind, as shown at fig. 45." The bolt is next brought back and another cartridge is inserted, when the bolt is pushed forward, and forces the cartridge and the bullet remaining from the previous charge into the explosive chamber of the barrel. The explosion of the

powder on firing forces back the rear bullet into the small diameter of the hollow in the breech.

The illustration of a portion of a breech-loading needle gun, shown at fig. 46, is from Minié's specification, No. 1121, of 1855. A is the barrel and B a wrought-iron or malleable cast-iron piece for fixing the barrel, and having a recess for securing the slide C, by which the breech end of the barrel is closed. The piece B also holds the swivelling piece D. The slide C is drawn back by the swivelling piece D being turned, and thus caused to act on the slide by means of a stud E, which enters a curved dovetail groove on the under side of C.

In the provisional specification No. 1966, of the year 1853, filed on behalf of a foreign inventor, but never completed, a breech-loader is described with a sliding breech piece, but

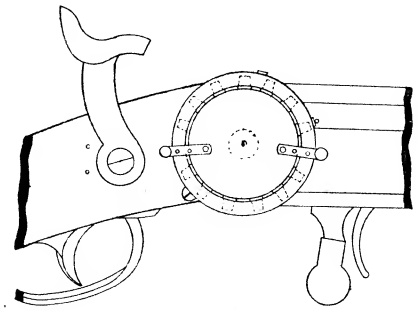


FIG. 47.

fired, as with all the early breech-loading arms, by caps or primers independent of or separate from the cartridge. In this case the inventor employs a "repeating primer" as shown at fig. 47, consisting of a "hollow metal drum or cylinder, which is open at one end and placed outside the barrel near the breech, with its open end turned towards the barrel to receive an ear, which projects from the barrel, and fits to some part of the interior surface of the drum in such a way as to preserve a perfect joint therewith when the

drum revolves upon its axis. This ear contains the vent, which terminates in that part of its surface which fits to the drum, and the drum is furnished with a series of nipples so arranged that if it be made to revolve on its axis their holes may be brought successively into communication with the vent through the ear. The drum is connected with the mechanism of the lock in such a way that when the 'piece' is cocked the hole of one of the nipples is at the same time in communication with the vent through the ear, and in position to be struck by the hammer when the latter is set free; and that the act of cocking moves one nipple away from and brings another opposite to the vent and hammer. Before using the piece, caps are placed upon the whole

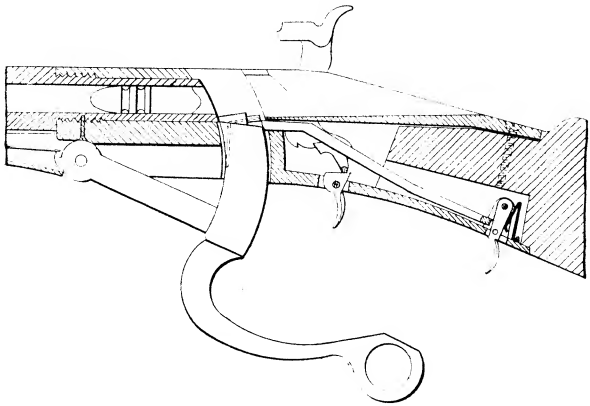


Fig. 48.

series of nipples, or upon any number of them in regular succession; then by bringing one of the capped nipples to a suitable position to be struck by the hammer, the piece may be discharged, and by re-cocking the next capped nipple is brought to the required position for the succeeding discharge."

The breech-loader, with a curved wedge breech or breech-piece (shown at fig. 48) is from the specification No. 748, of

1854, filed on behalf of a foreign applicant. The applicant states that the "front face of the breech is in the form of an arc, and the back of the chamber forms a corresponding arc, so that as the back end of the lever is raised up and down, the front face of the breech works in close contact with the back of the chamber. The back of the breech has also the form of an arc, thus making the breech constitute a curved wedge. The back of the recess in which the breech works is in the form of an arc, and when the breech is in its place to close the chamber, it fits tightly between the back of the chamber and the back of the recess; but as the lever is pulled downwards to expose the chamber, the back of the breech works out of contact with the back of the recess, so as to enable the breech to move easily downwards. When the breech is in place to close the chamber, its face has such an inclination that the explosive force of the powder will tend to draw the breech upwards, and thus draw the wedge tight into the recess, and prevent the escape of the fire in front of the breech. The vent is made through the breech, to which the cap or priming is applied. A spring is applied to the lever in front of its fulcrum in such a manner as to force the breech into the recess, but this spring will yield to the force supplied by the hand to the back end of the lever to withdraw the breech for the exposure or opening of the chamber. When the breech is in place to close the chamber, the back end of the lever is intended to be in contact with the breech supporter or the stock; thus the jamming of the breech is prevented when it is suddenly left free to the action of the spring. Behind the breech a bolt slides within the breech supporter, and has a spring applied to it in such a manner as to force it forward. When the breech is in place the bolt passes against it, but when it is drawn down to expose the chamber the bolt passes over the top of it, and prevents it being returned to its place by the spring, until the bolt is drawn back by a small trigger applied to it for the purpose. The upper part of the breech supporter in rear of the chamber is made of such

form, that a cartridge or a bullet, and a charge of loose powder, may be introduced to the chamber in line with the bore." Describing the bullet employed, the applicant says: "For the greater portion of its length the external form of the bullet is that of a frustrum of a cone whose base is at the back end, and the conical portion is made hollow to receive a portion of the charge. The front part of the frustrum is the same size as the parallel portion of the base of the barrel, and the back part is made of a diameter about one-fourth part greater. The bullet is made of this form, in order that by the projectile force of the explosion of the powder it may be driven very tightly into, and caused to fill or 'slug' very perfectly in the grooves of the barrel, and by the expansion in the hollow part of the gases generated it may be kept spread, so as to fit tightly in the barrel until it leaves it. In order to introduce a ball of this kind, it is obvious that the chamber must be so much larger than the parallel part of the bore as is necessary to admit the largest part of the bullet. To make the bullet slug with the greatest degree of perfection, it is desirable that the conical portion fit tightly to the chamber from back to front, except where grooves are left to contain grease. I therefore make the cone in the chamber to correspond in the angle formed by its sides to its axis with the cone of the bullet, and extend it so far into the barrel that the bullet will fit tightly therein in the position it is desired to occupy when the piece is charged. By thus fitting the bullet to the chamber, either a cartridge or loose powder may be used. If the latter be used, when it is desired to charge, the muzzle of the piece merely requires to be inclined downwards, the bullet dropped into the chamber, and the space behind it filled with powder; if the former be used, it merely requires to be of proper length."

The illustration at fig. 49 is from the specification No. 2530, of 1854, of Thomas Restall, who describes his invention as consisting "in a means of introducing the charge from a turning breech, and of firing the same, both operations

being performed by pushing and pulling the trigger or only by pulling the same. I dispense with the ordinary lock, and substitute therefor an apparatus which works within a tube, which may form a continuation of the barrel A, and is carried on behind the breech ; I mount in the tube a hammer B for exploding the cap." C is the ordinary breech and D the movable breech, the latter being bored out for the reception of the cartridge. E is the spindle on which the movable breech turns, such spindle being cut with a right and left hand screw thread. F is the trigger, which is made free to slide to and fro beneath the stock ; the front end of the trigger is bent upwards and forms a nut for one part of the spindle E. The manner of using the gun is as follows : To charge the movable breech D the trigger F is pushed forward, imparting a rotary motion to the spindle E, and by a suitable projecting key piece turning the breech round upon its centre, thus withdrawing it from its position in line with the barrel shown at fig. 49 into a position in line

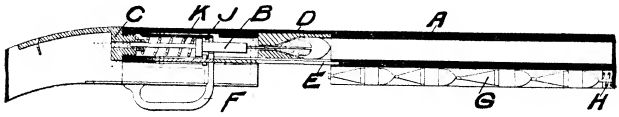


Fig. 49.

with the tube G containing the charges. As it is brought into such position the front edge of the breech D releases a locking spring or catch by which the cartridge in the tube adjacent to the breech is retained in position. The coiled spring H at the back of the charges then comes into action and forces the innermost cartridge into the breech. To restore the breech to its place in the gun the trigger is pulled backwards ; the same movement also releases the catch J, permitting the spring K to drive the hammer B forward for the explosion of the cap upon the end of the cartridge. Each cartridge has a percussion cap fixed on the tail or projecting piece at the rear of the bullet.

A breech-loading magazine gun, as illustrated at fig. 50, is described in the specification of F. H. Maberly, No. 1191, of 1855, who appears to have occupied the position of a Clerk in Holy Orders. The reverend gentleman seems to have considered it necessary to offer some sort of an apology for

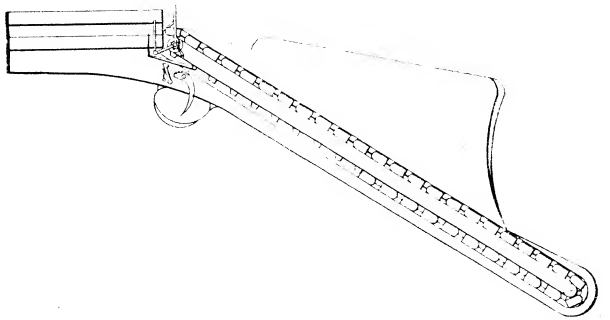


FIG. 50.

dabbling with fire-arms, for we read that he "contemplated this invention years back, as I can prove, if needful, but brought it not forward till the application of steam to the propelling of ships and carriages had destroyed our insular situation; and so it may be called one of my inventions for my country's protection and safety against invasion."

FIG. 51.

FIG. 52.

Maberly's object was to provide "mechanism by which numerous charges can be propelled from fire-arms with great rapidity and without taking the weapon from the shoulder." The cartridges, types of which are shown at figs. 51 and 52, "are fixed on an endless band or chain turned by cogged

rollers which are operated by the drawing back of the cock ; by such means the charges are forced into the breech of the gun and are ready for firing. The artificial portal of the gun is intended to be kept down by a spring and catch, or some proper contrivance when the gun is loaded, which

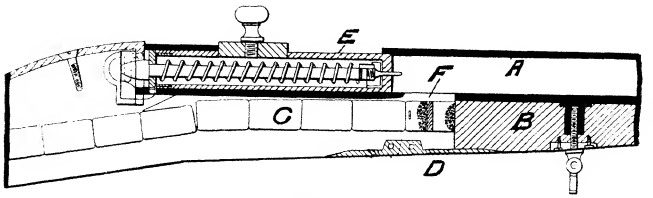


Fig. 53.

artificial breech or portal is brought up and held up by the cock for the loading of the gun. Thus the pulling back of the cock does all that is needful to load the gun, and the pulling of the trigger all that is needful to fire it, though

Fig. 54.

these may be assisted by an extra contrivance in so doing ; a second band may be similarly placed on the same or other rollers within the butt, and so may be similarly made to bring another set of charges into the gun. It may be also

formed with another barrel similarly loaded, to constitute a double-barrelled gun. The charges may be put on the band or chain either at an opening at the butt-end of the butt or at its side. It is evident that in this case the butt of the gun must be hollow, and may be best made of sheet iron or steel."

The illustrations, figs. 53 to 56 inclusive, are from a specification No. 1436, of 1855. The invention was communicated from abroad to an agent named Bellford, by whom the application was lodged. Only a provisional specification was filed, and no patent was obtained on the application. The invention is described as relating to "certain improvements in breech-loading fire-arms belonging to the class called the

FIG. 55.

FIG. 56.

'needle' guns, the object of these improvements being to simplify the construction of said arms, and avoiding the inconveniences needle guns are subject to in practice, such as breaking and bending of the needle, and getting out of order; also to certain improved cartridges or projectiles, in which the powder or explosive matter is contained, these cartridges being fired in a direct line with the needle."

Fig. 53 is a longitudinal section of a part of the improved arm, with a number of cartridges or projectiles in the stock part. A represents the barrel, and B the stock. The cartridges C are placed in a tubular magazine or cartridge holder communicating with the barrel, being inserted through an opening on the underside of the gun, which is closed by the spring piece D. The needle is carried at the fore end of a rod within the cylindrical sliding bolt E. As shown at fig. 53, the bolt E is in position for loading, the

aperture between the barrel and the cartridge holder or magazine being open. By turning the gun round the foremost cartridge in the magazine can be made to fall through the aperture F into the barrel, where it is retained by the closing of the bolt E over the aperture.

In the form of "cartridge ball" or bullet, shown by the views at fig. 54, a hollow cone is provided in the base for the

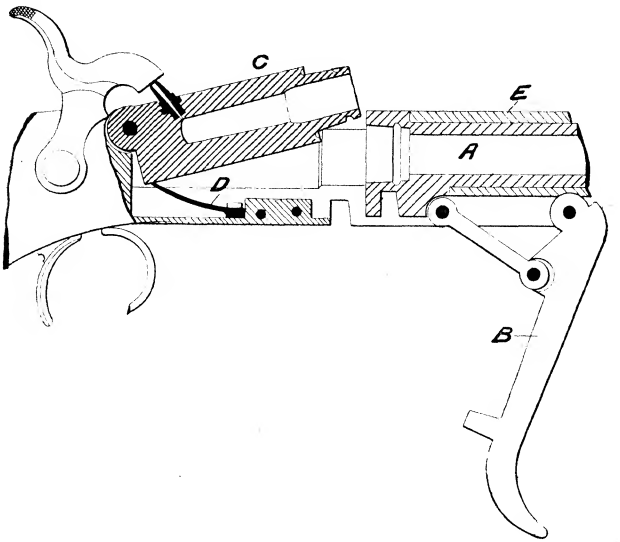


FIG. 57.

reception of powder; whilst in the form shown at fig. 55, a paper case is attached for the powder. A modified form of ball is shown at fig. 56.

The sectional view of a portion of a breech-loading carbine, at fig. 57, is from the specification No. 2693, of 1854, of Wm. Greener, of Birmingham. In this arm a reciprocating motion is imparted to the barrel A by means of a lever B arranged beneath it. The pivoted breech-piece C, when in its closed position, is secured thereat by a suitable retaining

spring. The spring D is for the purpose of throwing up the breech-piece into the charging position, shown at fig. 57. E is an outer tube in which the barrel slides in the operation of the lever B.

Sharps' Breech-loading Carbine.

This well-known American carbine, which was used during the Civil War, forms the subject matter of two British patents, viz., No. 14052, of March 31st, 1852, and No. 712, of November 11th of the same year. The breech end of the barrel is closed by a slide actuated by a lever forming the trigger guard. When the slide is drawn down the breech end of the barrel is exposed to permit of the insertion of a cartridge. On the closing movement of the slide its sharpened top edge cuts off the end of the cartridge for the purpose of exposing the powder to the flash from the percussion cap placed on a nipple fixed in the slide. Two English cavalry regiments were supplied with this arm in 1857, but

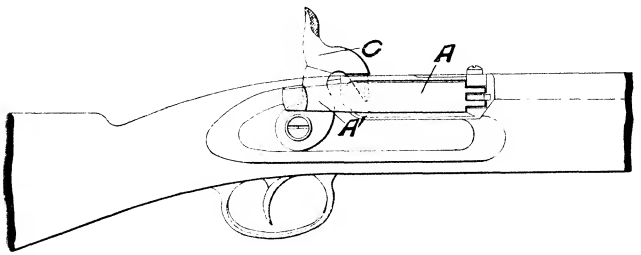


Fig. 58.

the escape of gas at the breech proved a serious objection. When fitted with a priming magazine, automatically operated by the cocking of the hammer, it is stated that Sharp's carbine could be fired ten times per minute.

Fig. 58 is a side elevation and fig. 59 a scetional plan representing a central-fire breech-loading gun, as described in the specification No. 2709, of 1865, of J. N. and G. H. Needham, whilst figs. 60 and 61 illustrate the type of bullet

for this gun. The breech piece A is mounted on the side of the arm, and "is pivoted so as to move laterally ; when open the breech piece is thrown back to the position shown in the plan, where it may be held slightly by a spring, or should move with sufficient stiffness on to its joint pin to retain its position. When this breech piece is closed and the gun is at half cock we prefer it should hold only by the snap of the rear end of its striking rod taking into a cavity B^1 in the abutment B, shown dotted in the plan, but if desired the cock or hammer C may be so arranged with the tail or lever A^1 as to fix it while at full cock. The nose of the cock or hammer in striking enters a recess D, cut in the rear of

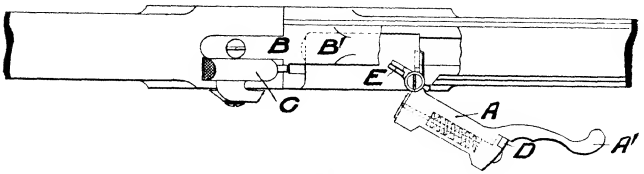


FIG. 59.

the breech piece A ; it is also at the same time received in a recess or notch cut in the solid abutment B, in which position it acts like a bolt to prevent the lateral movement or opening of the breech piece. The nose or projection takes effect on the side of the striker, and discharges the cartridge." In another part of the specification a cartridge extractor is described, and an illustration of the same is given. It consists of a piece (shown at E, fig. 59) "suitably formed for embracing the lip or flange of the metal cartridge, mounted on the breech joint pin and occupying a cavity at the rear of the bore ; it partially embraces the lip or flange of the metal cartridge, and when discharged and the breech opened, the part E is moved on the joint pin and leaves the recess in which it is fitted, assuming the position shown at fig. 59, drawing with it the metal cap and case of the cartridge, which falls out, when the gun may be re-loaded."

The bullet illustrated at figs. 60 and 61 is described as consisting of iron coated with tin, and made hollow to contain the charge of powder. In describing the manufacture of such bullets the patentees state : "We cut off lengths of iron tube and upset, close, and shape the one end, and then tin the bullet, and fill in the charge of powder at the rear end ;

FIG. 60.

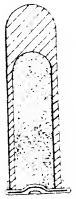


FIG. 61.

we place a metal cap on the rear end, similar to the caps or ends of central-fire cartridges. The charge is thus enclosed impervious to moisture, and will bear rough usage without detriment, and in firing no residue is left in the barrel except the metallic rear cap, which is extracted from the gun, as in

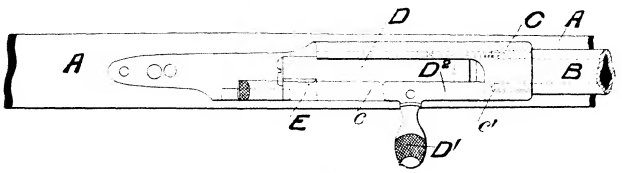


FIG. 62

ordinary. These bullets may also be made of rod iron, cut off, and the charge cavity drilled out, or they may be otherwise formed. Instead of the bullet being entirely of one piece with the receptacle for powder, this may be of thin metal fixed in the forward and bullet part, but which receptacle for powder, being of metal, will be carried out of the barrel by the bullet."

Figs. 62 and 63 are from the specification No. 2377, of 1868, filed on behalf of Samuel Remington, of New York, the invention being described as "Improvements in breech-loading fire-arms, parts of which improvements are applicable to other fire-arms." The inventor states: "The breech-loading fire-arms to which these improvements relate are of the class wherein the breech aperture is closed by a cylindrical bolt fitted to turn and slide in a suitable chamber in line with the barrel, and in which the cartridges are exploded by means of a pin or rod carried by the said bolt, and actuated by a hammer at the side of the breech shoe, the pin being turned away from the hammer to allow the bolt to be drawn back." The improvements comprise the construction of the firing pin and its arrangement with the bolt and

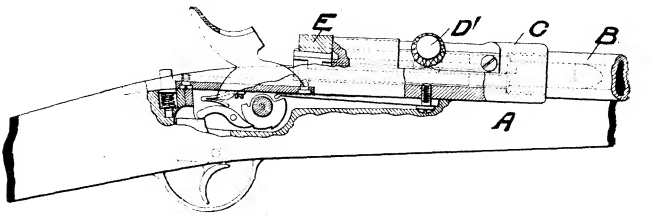


FIG. 63.

breech shoe in such a manner as to obviate the danger of accidental explosion of the cartridges; means for preventing the binding or sticking of the bolt in its chamber; for holding the said bolt in any position in which it may be adjusted, and preventing it from accidentally slipping from such position in whatever way the arm is carried. Fig. 62 is a plan of part of a rifle with Remington's improvements, the breech being closed; whilst fig. 63 is a sectional side view showing the parts in position for firing. The stock A and barrel B can be constructed in any ordinary manner, and the latter may be screwed or otherwise attached to the breech shoe C. The bolt D slides and turns freely in the shoe chamber, and is provided with a manipulating handle

D^1. The bolt has a loose head which slides with it, but does not turn or rotate; an extractor is attached to such loose head. "The piece D^2 forms a stop and guide for the bolt D, as in other arms of this class; the said piece D^2, when the bolt is closed, as at fig. 62, fills the space between the shoulders $c\,c^1$ of the shoe C, and prevents the recoil of the bolt on discharge. I prefer to curve the shoulder c^1 to prevent the striking of the cartridges with the end of the bolt in closing the breech, the said curved shoulder causing the bolt to come gently in contact with the cartridge, and also forming a cam or wedge to start the shells (or cartridge cases) in extracting them from the firing chamber." The striking or firing pin extends through the centre of the bolt, its rear end being arranged in the proper position to be struck by the hammer when the trigger is pulled. The said firing-pin is made from a flat piece of steel, its forward end being reduced to a circular form. The flat part is fitted to work freely in the bolt, and its rear end is provided with a lateral fin or arm which slides through the projecting piece E at the side of the bolt and receives the blow of the hammer, but it is only brought into the right position for receiving such blow when the bolt is closed and the handle D^1 turned into its locked position, shown in the figures.

Inventors and the Crimean War.

From the official publication of the British Patent Office, it appears that from the year 1617 down to the end of the year 1852 not more than about 300 patents were granted for inventions relating to fire-arms of all classes. But just prior to the outbreak of the Crimean War the Patent Office was inundated with applications for letters patent, and within a few years the number of patents obtained for inventions relating to this subject amounted to double the number granted in the two and a half preceding centuries. Tommy Atkins is to be congratulated that he has never been ordered to fire a weapon made in accordance with some of these specifications.

Opposition to Breech-loaders.

The breech-loading gun, before its general adoption, was subjected to a vast amount of prejudice and hostile criticism, not only from the army authorities, but also from well-known gun makers in London and Birmingham. To a considerable extent such criticism was doubtless justified, as many of the breech mechanisms produced by competent men were faulty both in design and workmanship. But the difficulty of producing a satisfactory breech-loading rifle was much increased by the refusal of experienced officers of high rank and authority to entertain the question of the adoption of cartridges containing their own means of ignition, and the strong views on the part of some of them against any form of breech-loader. The argument for the adoption of the extreme antagonistic opinion appears to have been based simply on a fear that, owing to the ease and rapidity of loading at the breech, the men would not use their ammunition to the best advantage, but that in their excitement on approaching an enemy the whole of it might be discharged before reaching an effective fighting range. The opposition to cartridges having their own means of ignition resulted in the adoption in all the early types of breech-loaders employed in the service of independent percussion caps or primers, as with muzzle loaders. But the opposition of both parties had eventually to yield before the unmistakable evidence afforded by the use of breech-loaders with central-fire cartridges on the Continent.

The Prussian Needle Gun.

This famous breech-loading rifle was adopted for the Prussian army as early as 1841, and is stated to have been invented by Dreyse, of Sommerda, in 1838. It had a bore of ·66 in., the bullet was considerably smaller, having a diameter of ·533 in., with a length of 1·08 in. The weight of the bullet was 480 grains, and the charge of powder in the cartridges 66 grains. The bullet does not touch the sides of the barrel, but the spin or rotation is given by the papier-

mach é wad, or sabot, in which it is placed, and which takes the rifling. The sabot is arranged in the cartridge between the charge and the bullet; the detonating substance is placed at the back of the sabot. The breech mechanism in this gun is of the sliding bolt type, the bolt being hollow to receive the needle and the spiral spring, which, when allowed to act, forces the needle forward into the cartridge, through the powder contained therein, and on to the detonating composition in the rear of the sabot. The breech is opened by the drawing back of the bolt, but in the early guns of this type (one of which is to be seen in the Birmingham Art Gallery collection) the needle had to be first withdrawn by a separate movement. The cartridges used for this weapon were for a long time of the "consuming" type, the cases being of paper, which was consumed on firing. Such cartridges, of course, cannot serve as a check, as with cartridges of stiff pasteboard or of metal. Thus the breech mechanism itself had to be depended upon to serve as a gas check, with the result that "spitting of fire" at the breech was a frequent occurrence with these guns. The Prussian soldiers found it to their advantage to fire their faulty weapon from the hip rather than from the shoulder. Further, the passage of the needle through the powder caused it to foul or corrode quickly, and rendered it very liable to breakage. But in spite of its defects the Prussian needle gun proved a very formidable weapon in the Danish war of 1864, the Austrian war of 1866, and the Franco-Prussian war of 1870.

The Chassepot Rifle.

This well-known rifle, with which the French were armed in the Franco-Prussian War, was introduced in 1866. It is a bolt gun, and the bolt carries a needle-striker for the ignition of the cartridge priming; in such respects it is similar to its great rival, the Prussian needle gun; but the Chassepot is, undoubtedly, the superior arm, and this fact seems to have been recognised by the Prussians themselves, for it is stated that they armed their own troops with the French guns

which fell into their hands. The bore of the Chassepot rifle was ·434 in; the bullet was larger, being ·463 in. diameter, with a length of 1 in., and a weight of 380 grains; the charge of powder in the paper cartridge amounted to 85 grains. The charge is fired by a percussion cap placed at the base of the cartridge with the open end outwards; the needle strikes within the cap. A description of the Chassepot rifle will be found in the British patent specification No. 2304, of 1866, which was filed on behalf of the inventor on September 7th of that year. An improvement on the same is described in the specification No. 2076, of 1869.

Westley Richards' Breech-loading Carbine.

This carbine, which has been described as "the best capping breech-loader ever produced," was issued for British cavalry in 1861. It proved itself far superior to the Sharp carbine, but it is probable that this was due more to the cartridge than the arm itself. The cartridge for the Westley Richards carbine was provided with a felt wad, which served as a gas check to prevent escape at the breech. The chief patent specification relating to such a breech-loader is No. 633, of 1858, in the name of Westley Richards.

CHAPTER VII.

The Snider Rifle.

The decision to arm the British infantry regiments with breech-loading rifles was not arrived at until after the recommendation of General Russell's committee in 1864 in favour of such weapons, their recommendation being based upon the experience of the Dano-German War. As the result of an advertisement by the Government in August, 1864, some fifty different systems were submitted for the conversion of the muzzle-loading Enfield rifles into breech-loaders, and after exhaustive trials at Woolwich Arsenal, the

mechanism of Jacob Snider, an American, was finally adopted in 1867. The question of ammunition was considered jointly with that of the rifle, and the committee decided in favour of the Boxer metallic cartridge.

In the Snider rifle the breech block is hinged upon the right-hand side of the barrel, the block being fitted with a striker, the outer end of which is adjacent to the hammer and the inner end to the percussion cap of the cartridge. The striker is arranged in a diagonal or inclined position, and its inner end is normally maintained clear of the cap by the action of a spring, but on pulling the trigger the hammer forces the striker on to the cap to detonate the same, and so explode the charge. The breech block is retained in its closed position by a spring catch stud, but it can be readily opened, on releasing such catch, by turning it on its hinge pin. A claw extractor or "draw cartridge" is attached to the breech block, and after the latter has been opened by turning it on its hinge pin it can be drawn back a short distance on such pin against the action of a spring, and in such movement the extractor withdraws the empty cartridge case, which is then ejected by turning the gun over and so permitting the spent case to fall from the breech.

The Enfield rifle converted into a breech-loader on the Snider system became known as a Snider-Enfield. It proved a very serviceable and reliable weapon, and could be loaded and fired from 12 to 18 times per minute. It is recorded that Snider rifles have been found still serviceable after firing from 50,000 to 70,000 rounds.

Snider's breech-loaders formed the subject matter for several patents, the chief of which are as follow :—

No. 1,828 of 1862, No. 2,156 of 1863, No. 2,741 of 1864, No. 2,912 of 1864, No. 188 of 1865, and No. 2,275 of 1865.

The Boxer Cartridge for the Snider Rifle.

The Boxer cartridge case for the Snider rifle is made from thin rolled sheet brass, the thickness being but ·005 in. It is covered with brown paper, and has an inner lining of shellac

and thin white paper, which serves to prevent the corrosion which would be caused by direct contact of the powder with the metal. The paper-covered metallic strip is rolled into a cylindrical form, with its long edges slightly overlapping. The base of the case is fitted with a pair of telescopic strengthening cups and with an iron disc at its extremity, such disc being made to abut against the breech block of the rifle. The Boxer cartridges form the subject matter of Letters Patent No. 137, of 1866. In this specification Boxer states: "My invention has for its object to construct cartridges having a coiled metal case to fulfil the following conditions, namely, that the body of the cartridge shall readily expand by slightly uncoiling and stretching on firing so as to fill the chamber, and shall contract slightly after firing so as to admit of the empty case being readily removed; secondly, that the bullet should be firmly secured to the case without affecting the proper action of the case on firing, or the proper action of the lubricating matter on the bullet; thirdly, that the powder shall be prevented from escaping at the junction of the case with the bullet by such means as shall not affect the accuracy of fire. For these purposes I construct such cartridges in the following manner: I form the case of thin sheet metal, either alone or in combination with paper, calico, linen, or other similar suitable material, which is coiled upon a suitable 'former' into a cylindrical shape. One end of this coiled case is fixed into the metal cap ordinarily employed for forming the rear end of such cartridges; the cartridge is then filled with powder, and in order to prevent the escape of the powder from between the case and the bullet, I insert a very small portion of loose cotton or other similar fine fibre between the powder and the end of the bullet, which effectually prevents any such escape and does not affect the accuracy of fire. This contrivance is also applicable to other forms of cartridges for breech-loading fire-arms. The bullet, when such is used, is then inserted into the open end of the case, which is fixed thereto by 'choking' the metal case into the rear cannelure of the

bullet, the casing extending beyond that point at which it is choked in so as completely to cover that portion of the bullet which is coated with lubricating material. I prefer to use sheet brass for the metal portion of the casing in combination with waxed cloth or paper, the metal being made to form the inner coil and the cloth or paper the outer coil. If the cloth or paper is not saturated with beeswax, the outer edge of the cloth or paper must be secured with shellac varnish, gum, or paste, so as to prevent the case from uncoiling when it is removed from the 'former.' When sheet metal alone is used I prefer to put a slight coating of beeswax upon its outer surface with French chalk or plumbago, and when paper is used I coat the same with oil. When no bullet or

FIG. 67.

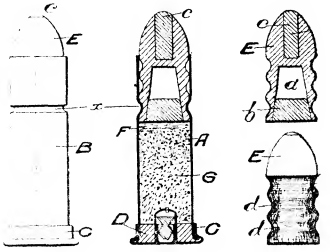


FIG. 64. FIG. 65. FIG. 66.

projectile is fixed into the end of the cartridge, as in cartridges for sporting purposes or for ordnance, I close the end of the cartridge by means of a plug or disc having a cannelure, into which the coiled casing is choked."

The adjoining illustrations, figs. 64 to 67 inclusive, are from Boxer's specification No. 137, of 1866. Fig. 64 is an elevation of the complete cartridge with bullet, and fig. 65 a section of the same. Fig. 66 is an elevation, and fig. 67 a section of the bullet alone. "A is the coiled metal casing covered externally with paper or cloth B, which is made to overlap the outer edge of the metal somewhat for the purpose of fixing it down with gum, shellac paste, or by means of

the wax or other material with which it is saturated. This case is fixed into the ordinary metal cap C with central fire which when taken separate and apart from the combination described forms no part of my present invention, into which cap the casing is fixed by a plug D. The bullet E is fixed in the casing by the latter being 'choked' into the rear cannelure of the former, as shown at X (figs. 4 and 5), the casing being made to extend to the end of the cylindrical part of the bullet, so as to protect the wax coating of the same; F is the small portion of loose cotton or other fibre interposed between the bullet and the powder G, in order to prevent any escape of the latter; *a* is a conical recess in the rear of the bullet E, in which is placed the conical plug *b*, and *c* is a wooden plug inserted in another recess formed in the front of the bullet; *d d* are cannelures serving to hold on the coating of wax. The bullet is made slightly smaller in diameter than the bore of the gun, so that when fired, thereby becoming a naked bullet, it is expanded by the plug *b* so as to take the grooves of the rifle, whilst a coating of beeswax is retained between the metal of the bullet and that of the barrel during the whole of the passage of the bullet through the barrel, whereby the fouling of the gun is prevented in a remarkable degree." The wood plug *c* at the front or conical end of the bullet fills up the space or aperture formed for the purpose of lightening the bullet, thereby permitting of its being made of a greater length in proportion to its diameter without excessive weight. In the service bullets, which were made of pure lead and weighed 480 grains, the hollow in the head was closed by simply spinning over the lead, and thus completely concealing the hole; the base plug was made of compressed clay. Length of bullet 1·065, diameter ·573 (the bore of rifle being ·577), charge of powder 70 grains.

In addition to the advantage in rapidity of fire obtained with the Snider as compared with the Enfield rifle, the former also proved superior in its shooting qualities, but this advantage must be credited to the ammunition, and

especially to the cartridge case which we have just considered. The Enfield rifle rendered valuable service in its time, but within a few years after the general adoption of breech-loaders, the discarded Enfield appears to have been contemptuously nicknamed "the gaspipe" by our volunteer crack shots of the past generation. We need not stay to consider what is thought of the best performances of such past crack shots by their present-day successors, armed with small-bore magazine rifles.

Kynoch and Ely Cartridges for Breech-loaders.

The above-named well-known ammunition manufacturers have at various times obtained patents for several inventions relating to cartridges for breech-loading small arms.

The adjoining illustration, fig. 68, is from the specification No. 1,107, of 1868, in the names of George Kynoch and William Whitehill. The inventors state that their object is "to simplify the construction of metallic cartridges. To this end we form a metal cup in the ordinary way, and draw it down to the required length to form the case. In this

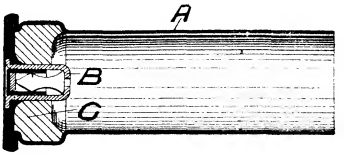


Fig. 68.

process of drawing we leave the metal forming the base and a short length of the case of a greater thickness than the remainder of the case. Then by the application of pressure we double (outwards) upon itself the thick portion of the periphery of the case, so as to form a solid flange for the cartridge extractor of the rifle to lay hold of (after the cartridge is fired), and at the same time, or it may be after this operation, we pierce the base of the cartridge to receive

the cap chamber. When the cap chamber is inserted in its place the paper wad is dropped over it, and, pressure being applied to the washer, the case is allowed to yield laterally, and thus an enlarged chamber will be formed to receive the compressed wad, which, fitting tightly therein, will be effectually held in place."

Fig. 68 shows in section "the case A fitted with the cap chamber B. When the cap chamber is inserted in its place a hollow paper wad C, made in the usual way, is dropped over it. The case is then placed in a suitably-shaped divided die or mould, and pressure is applied to the wad by means of a plunger that enters the open end of the case, and descending on the wad serves to compress it, increasing its diameter

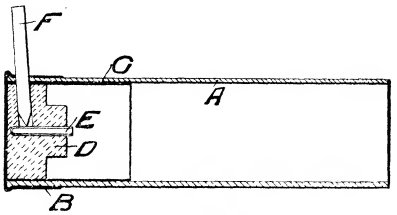


Fig. 69.

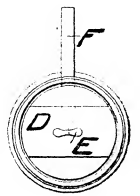


Fig. 70.

at the expense of its thickness. The die or mould containing the case is so shaped as to allow of the case yielding laterally to the inward pressure of the wad, and thus the compressed wad forms for itself an enlarged chamber, and the wad fitting tightly therein will be effectually held in place. The flanged case, formed as above described, may be fitted with the charge of powder and ball and the percussion cap and anvil in the usual manner."

Pin-fire Cartridges.

Pin-fire cartridges were first made by a Paris gunsmith named Lefaucheux, in 1836, for use with his breech-loading gun, having hinged or "drop-down" barrels. The original Lefaucheux pin-fire cartridge case was made of paper, with a metal base.

Figs. 69 and 70 represent a pin-fire cartridge such as described in W. T. Eley's specification No. 916, of 1861. The invention is described as having for its object "Improvements in the manufacture of cartridges for breech-loading fire-arms; and one of my improvements consists in igniting the percussion powder contained in a case (made by preference of paper and metal) by means of a peg or pin so arranged that neither the percussion powder so ignited nor the charge of gunpowder has access to the pin so as to cause it to blow out of the case. For this purpose I make a case (by preference of paper and metal) similar in shape to those known as the Lefaucheux cases, having a pin or peg passing through the solid base of the case, and projecting outwards so as—on being struck by the hammer—to act on the percussion powder placed in the cap. In the interior of the case I place a metallic cap with a flange upon it, and embed it in the paper in such a manner that the flange and mouth of the cap is flush with the face or bottom of the interior of the case. In constructing this cap I prefer to form it out of solid metal, having two of its sides flattened; this cap I fill with a detonating composition in the usual manner. The pin or peg is inserted through the base of the cartridge until it reaches the flattened side of the metal cap which contains the detonating composition, but I do not allow it to perforate the cap or come into contact with the detonating composition. By this arrangement, when the cap is exploded by the pin being struck on the outer end by the hammer of the gun, the charge has no access to the pin, and consequently the pin cannot be blown out or displaced by the force of the gunpowder, nor can any escape of gas take place round the pin. Although, as above stated, I prefer to use a cap, yet I do not confine myself to any particular form or shape; one of very simple form may be made by bending a piece or strip of metal with or without forming a flange on it, and embedding it in the case so as to hold the detonating composition. Another part of my invention consists in

placing a cap, entering endways, into the solid end of the cartridge, and at the outside edge of it a hole is made from the bottom of the recess on which the cap is placed of smaller size than the recess through the solid part of the cartridge, and coming out at the opposite side to that where the cap is inserted ; the recess where the cap is placed is in communication with the interior of the cartridge. I make the pin for exploding this cap with a shoulder or collar at the end where it is in contact with the cap, and I insert it into the cartridge, so that the shoulder on the pin comes in contact with the bottom of the recess, and on the cap and charge being being exploded the flange effectually prevents any chance of the pin being blown out of the cartridge case."

Referring to the illustrations, "A represents the ordinary tubular paper case, and B the metallic cap or cover which closes the base thereof ; C is a lining of thin brass or other metal, and D is a solid base formed of paper or other suitable material, in which the tube or cap E, containing the percussion powder or detonating composition, is embedded, as shown. F is the pin employed for exploding the detonating composition contained in the tube or cap E when struck by the hammer of the gun lock, and it will be seen that the point of the pin passes through the solid base of the cartridge and rests on the exterior surface of the tube or cap E, so that when it explodes the force of the explosion is directed into the interior of the cartridge, in place of upwards as heretofore, by which all risk of blowing out the pin F is avoided."

CHAPTER VIII.

Eley Central-fire Cartridge.

Fig. 71 is a section to an enlarged scale of a portion of a central-fire breech-loading cartridge, having the anvil formed in two parts, in accordance with the invention of W. T. Eley, as set forth in his specification No. 880, of the year 1866. Fig. 72 is a plan of the cap, showing the two parts a, a^1 of the anvil. By so forming the anvil in two or more parts Eley states that "the flame from the percussion powder passes between the several parts of the anvil as well as round the sides before escaping through the hole in the centre of the chamber. This arrangement of the anvil and cap also has the effect of

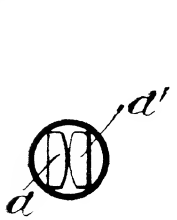


Fig. 72.

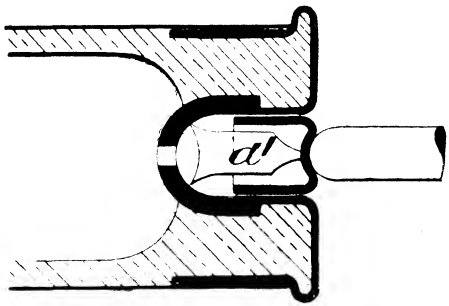


Fig. 71.

expanding the copper cap tightly within the chamber, and preventing an escape of gas at the breech end of the cartridge; it is also more certain of ignition and cheaper to manufacture than an anvil made of one piece of metal only."

Mr. G. H. Daw, who purchased the patent rights of the central-fire cartridge described in the specification No. 2203, of 1861, in the name of F. E. Schneider, alleged that the two-part anvil described in the specification of W. T. Eley we have just considered was an infringement of his patent.

Full particulars of Mr. Daw's claim in this matter, as also of his case against the Boxer cartridge for the Snider rifle, can be obtained by perusing a pamphlet published in 1867 by Mr. Daw, under the following title, "The Central-fire Cartridge before the Law Courts, the Government, and the Public, showing who has improved it, who has profited by it, and who ought to be rewarded for it." It should be noted, however, in connection with this matter, that the use of an anvil was described by Pottet in his French patent specification, in 1857, or four years prior to the date of Schneider's patent.

Rim-fire Cartridges.

In the rim-fire or annular cartridges, which appear to have been introduced in Paris in 1847, the fulminate priming is placed in a recess in the rim or flanged base of the case. Fig. 73, to be hereinafter referred to in detail, shows the Martini breech mechanism arranged for rim fire.

The Martini-Henry Rifle.

The conversion of the muzzle-loading Enfields into Snider breech-loading rifles having been effected by the recommendation of the special committee, the Government directed the attention of such committee to the consideration of the best military rifle for future adoption and manufacture.

The experiments of Sir Joseph Whitworth, to which we have previously referred, clearly indicated that a reduction in the bore or calibre of military rifles would increase the efficiency of the weapons. The Martini-Henry rifle, which was selected by the committee and definitely adopted in 1871, had a bore of ·45 in., as against the ·577 in. of the Snider-Enfield. The bullet for the Martini-Henry has the same weight as that of the Snider, viz, 480 grains; its length is 1·27 in., or nearly three diameters. It is made of 12 parts lead and one part tin; no plug is used, as with the Snider bullet, the expansive action being obtained by the back end

overtaking the front end, due to the inertia of the bullet and the impact of the explosive force, which upsets the back end of the bullet and so fills the grooves. The Boxer central-fire cartridge for the Martini-Henry consists of a rolled or coiled case of thin brass strip, and is of a bottle-necked shape to fit within the firing chamber of the rifle. The base of the cartridge is strengthened by brass cups, and terminates with a wrought-iron disc. The paper pellet in the interior of the

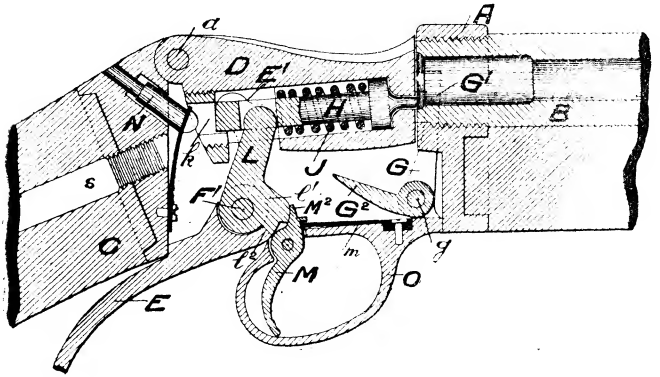


FIG. 73.

cartridge adjacent to the base is secured to the disc by the brass cap chamber. The powder charge is 85 grains, and between a glazed paper disc on the top of the powder in the cartridge case and the base of the bullet there is placed a beeswax wad. The total length of the complete cartridge is 3·15 in. The unwinding of the cartridge case after firing and its pressure against the bore of the rifle barrel prevents escape of gas at the breech.

The Martini-Henry rifle is a combination of the breech action invented by Frederich Von Martini, of Frauenfeld, Switzerland, with a barrel rifled in accordance with the system invented by Mr. Alexander Henry, of Edinburgh, and for which he obtained letters patent No. 2802, of 1860.

The Henry barrel, like the Whitworth, has a polygonal bore, but at the angles ridges or "lands" are formed, and as a circle tangential with the centres of the grooves is also tangential with the apexes of the lands, additional bearings or supports are provided for the projectile. In his specification Henry states that the "angular ridges also fill up to a great extent the spaces between the angles of the planes and the periphery of the projectile, thus reducing windage by lessening the amount of expansion necessary to cause the projectile to fit the grooves of the rifle, so that the rotary or spiral motion of the projectile is obtained with greater certainty, and consequently its flight is rendered more accurate." In the Martini-Henry as adopted and made for the service there are seven grooves with a uniform right-hand twist or spiral of 1 turn in 22 in., the grooves are ·009 in. deep at breech, and ·007 in. at muzzle; the width of lands between grooves is ·03 in. The weight of the rifle is 8 lb. 10 oz.

The adjoining sectional elevation, fig. 73, is from the specification No. 2305, of 1838, describing Martini's "improvements in breech-loading fire-arms," upon which the breech action of the Martini-Henry rifle is founded. In such specification the invention is said to relate "to breech-loading fire-arms of that class in which the breech end of the barrel is closed by a block whose rear end works on a horizontal pin, having its axis at right angles to the axis of the bore of the barrel, and consists of a peculiar combination of mechanism whereby the arm is made stronger, more easy to operate, simpler in construction, and more economical to manufacture than other fire-arms of its class."

The illustration at fig. 73 shows the mechanism as arranged for "rim-fire" cartridges. "A is the breech frame into which is screwed the barrel B, the rear end of which is enlarged to receive the cartridge, which may be of any desired shape. The barrel B is fixed to the fore part of the stock C in any ordinary manner, the 'butt' end of the stock C being by preference secured to the breech frame by the screw *s*; D is the breech block, whose upper surface is hollowed to facilitate

the insertion of the cartridge into the barrel, and in the rear upper part of the block is a hinge pin *a* on which it works. The breech block D contains the firing mechanism, which is the same (excepting as to position) for rim fire as for central fire, and consists of the exploding pin H, spiral spring J, tubular screw *k*, and tumbler lever L. The tumbler lever L at its upper end is of a circular form in one view with straight sides, and takes into a mortise cut through the exploding pin H. The lower part or fulcrum of the tumbler lever L works freely upon the pin F^1. The exploding pin H has a rear support or bearing in the tubular screw *k*, which is slotted to admit the tumbler L, and is an abutment for the spiral spring J. The tumbler lever L has a short arm provided with a ratchet tooth for the purpose of receiving the upper end of the trigger lever M, which is pressed therein when in suitable position by the spring *m*. Below this tooth, and on the same short arm, is a face of metal l^2, which forms an abutment for a corresponding face on the hand lever E. The trigger may be locked in position when the piece is cocked by means of a bolt inserted under the projection M^2, or by any other well-known device, so as to prevent the possibility of accidental or other discharge till the said bolt is withdrawn. The hand lever E has its fulcrum F^1 behind the trigger and is a forked lever—that is to say, consists of a long arm, to which the hand is applied, and two short arms, as E^1, each of which takes into a cam recess formed in its own side of the breech block D. The form of the two recesses is the same ; they are of irregular shape, and so formed that the breech block is lowered, raised, and retained, or locked by the hand lever E in the proper positions for loading and firing the piece. At N is shown the indicating pin, which passes obliquely upwards through the breech frame A, with whose upper surface the upper end of the pin N coincides, excepting when the exploding pin is drawn back ready for firing, in which latter position its rear end comes in contact with the front end of the pin N, thus causing its upper end to protrude above the surface of the

breech frame A, so as to indicate that the piece has not been discharged. G is a bell-crank lever for expelling the cartridge case, and is forked at its upper end G^1, so as to embrace the two opposite sides of the cartridge base. The short arm G^2 is at a right angle, or nearly so, with the long arm G, and its upper surface radiates from the fulcrum pin *g*. In descending, the breech block D comes at first in contact with the extreme end of the short arm G^2 of the bell-crank lever, and causes it to turn slowly on its fulcrum pin *g*, so as to loosen the cartridge case from the barrel, and the continued downward movement of the breech block brings its extreme end against that part of the arm G^2 which is nearest to the fulcrum pin *g* of the bell-crank lever G, thereby accelerating the speed of the lever and suddenly expelling the cartridge case. The trigger M is provided for safety with a fixed guard O, as in ordinary muzzle-loading fire-arms, such guard being fixed to the breech frame."

Describing the operation of the mechanism, the patentee says : "Referring to the figure, it will be seen that the breech-loading mechanism is in that position which obtains when the piece has been discharged. To open the breech for a fresh cartridge the hand lever E is depressed, thus causing the upper end of the tumbler lever L to move in the direction of the rear end of the arm, and carry the exploding pin H and spring J with it until the ratchet tooth of the short arm of the lever L receives the upper end of the trigger lever M. Simultaneously with this withdrawal of the firing mechanism from the position shown, the breech block is caused to descend by the forked end of the hand lever E acting in the cam recesses shown in dotted lines, as before described. The parts are now in position for the insertion of the cartridge. The piece having been loaded, the lever E is then to be returned to its position against the under part of the stock, which operation will cause the block D to be moved upward into the position for firing, leaving the tumbler lever, exploding pin, and spring still held back by the short arm of the trigger lever. After the lever E has been returned to the position

in which it is shown in the figure, then, on the trigger being pulled so as to release the tumbler lever L and spring, the exploding pin H will be forced forward by the spring J until it strikes the cartridge so as to explode it." Martini makes the following claim as his invention : "The combination forming a breech-loading action either for rim-fire or central-fire cartridges, in which the entire series of operations for opening and closing the breech, releasing and expelling the cartridge, and cocking the gun are performed by the hand of the operator on one lever, this lever being so arranged as to keep the breech block in firing position."

Improvements on this, the original Martini specification, forms the subject matter of the following patents : No. 603, of 1870 ; No. 1144, of 1871 ; and No. 2925, of 1871.

CHAPTER IX.

Hotchkiss Breech-loader.

The breech mechanism illustrated by the sectional elevation at fig. 74 and the plan, fig. 75, is from the specification No. 519, of 1868, filed on behalf of Benjamin B. Hotchkiss, of New York. Amongst other improvements the applicant states that he gives "such a form to the slot in which the bolt is drawn in a straight line and then turned on its axis for opening and closing the arm, that by curving the extremity of such guiding slot the rectilinear motion is gradually blended into the rotary one, by which means the closing and opening are effected much more rapidly and easily, whilst when using metallic cartridges the danger of explosion by rapidly closing the bolt is avoided."

The illustrations show the parts in their position after firing. To open the breech "the bolt A is held by the handle A^1, and turned on its axis about a quarter of a revolution. The first part of this rotation is made without progression, and this fraction of the rotation corresponds to the distance

necessary for the bar A^2, fixed on the bolt A, to disengage itself from the groove cut in the straight side of the breech piece B, where it is lodged, and of which the shoulder C serves as the resistance for the bolt at the time of explosion. During the second part of the rotation the bolt, guided by the two curves D and D^1, between which the bar is held, is moved simultaneously backwards a distance equal to the length of the two curves, and when the bar has penetrated the opening D^2 the bolt is moved in a straight line to the completely open position. To charge the arm it suffices to

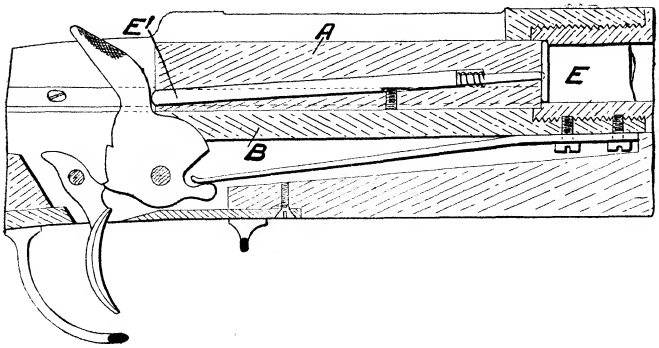


FIG. 74.

place the cartridge E in the cavity of the breech piece B, and to push the bolt home as shown in the figures. In decomposing this motion of the bolt it will be seen that its first part is a straight progression ; that, secondly, at the time when the bar A^2 meets the curves D and D^1 it consists of a double movement of progression and rotation, and that the third and last is a rotative movement only, which has the effect of lodging the bar solidly against the shoulder. The result of this action is that, however violently the bolt is pushed into the gun, it can never fire the cartridge by the blow, for at the moment when this danger might be expected—that is to say, when the cartridge is pushed home—the

forward motion of the bolt is reduced to its minimum by the action of the curves D and D^1."

The curving of the bolt guides, as described, has some resemblance to the curved shoulder of the breech shoe of the Remington breech-loader, previously described, and as shown at fig. 62. It should be observed, however, that Hotchkiss applied for letters patent in this country a few months prior to the date of Remington's application.

Referring again to figs. 74 and 75, Hotchkiss states that, "in order to avoid accidental discharge when the bolt is not entirely driven home, I avail myself of the rotation of the bolt. To this end I place the extremity of the striking pin to be met by the hammer eccentrically on the end of said bolt in such a manner that the said hammer on falling can only strike the pin when the arm is completely closed. As one illustration of my system, I will refer to fig. 74, where the

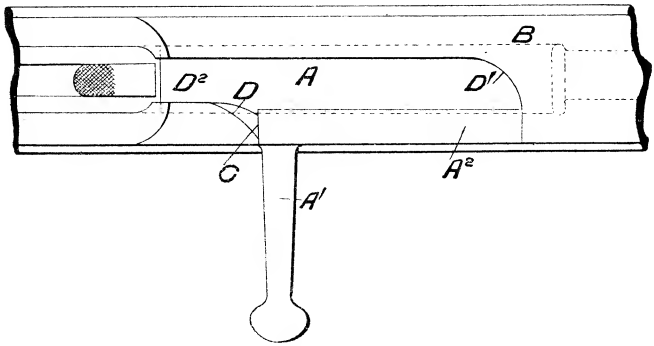


FIG. 75.

striking pin E^1 in the bolt A follows a diagonal direction—that is to say, that whilst its point is in the centre of the bolt, its other extremity receiving the blow of the hammer presents itself on the outer circle; when the arm is closed the said pin presents itself immediately under the hammer."

In other parts of this specification Hotchkiss describes fully his method of opening and cocking the gun by the one

draw-back motion of the bolt, and also the arrangement of his extractor and the construction of cartridges.

Repeating Rifles.

We have already considered some early forms of magazine or repeating breech-loading guns and illustrated the same by the figs. 49, 50, and 53. But the American Spencer rifle of 1860 may be considered as the first successful breech-loading repeating rifle. The tubular magazine of this arm is formed in the stock, and the cartridges employed contain their own ignition priming; the breech is closed by a block operated by the pivoted trigger guard. On the opening of the breech, projections from the lever or pivoted trigger guard withdraw the spent cartridge. Spencer's magazine rifles are described in the British specifications No. 843, of 1861, and No. 2590, of 1864.

Winchester Repeating Rifles.

The specification No. 1223, of 1863, filed on behalf of O. F. Winchester, of New Haven, Connecticut, U.S.A., describes a repeating fire-arm, in which the cartridges, containing their own means of ignition, are placed in a tubular magazine fitted under the barrel, and parallel with the same. From the mouth of the magazine the cartridges are carried "to a position in the rear of the barrel by a carrier block working vertically within a mortise in the frame of the arm, and are afterwards pushed into the barrel by means of a sliding breech pin." A lever arranged under the stock operates both the block and the breech pin.

The sectional illustration at fig. 76 is from Winchester's specification No. 3284, of 1865, which is described as relating to improvements in repeating fire-arms, as set forth in the earlier specification to which we have just referred. The barrel A is secured to the forward end of the frame B, the wooden stock (not shown) being fixed in the rear end. The carrier block D is placed in the mortise or chamber E, the office of such carrier block being to receive a cartridge from

the magazine and raise it for insertion into the barrel, and to throw the spent or empty cartridge case or shell from the arm after its withdrawal from the barrel. The operation of the block is effected by the lever F pivoted on the pin G; the lever H, also pivoted on G, serves both as a trigger guard and as the means by which the several mechanical parts of the arm are made to operate. As shown in the figure, the lever H has been depressed to raise the carrier block. The hollow breech pin or bolt L, having the rod M passing through it, is connected at its rear end to the links, as N, of toggle joints; the opposite, or lower end of the

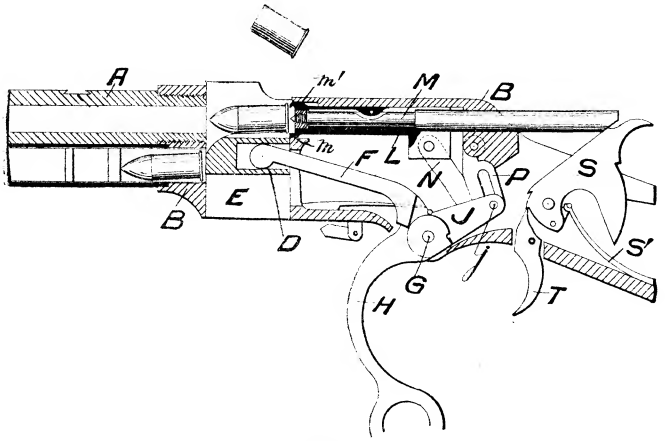


FIG. 76.

links N, are connected to the other links P of the toggles, such links being pivoted to the frame as shown. The upper arm J, of the lever H, extends up between the toggle joints; and the pin *j*, extending on either side, projects into the slots of links P. The cartridge is removed from the carrier block, and conveyed to the firing chamber in the rear of the barrel by the closing movement of the bolt L; the empty case is withdrawn on the opening movement of

the bolt by the lip m and the spring latch m^1 ; the opening movement of the bolt also causes the rod M to force the hammer S back to full cock. A collar, with projecting points, is fixed on the inner end of the rod M for the purpose of exploding the fulminate by the percussive action of the hammer S on the rod M, set up by the spring S^1 on the release of the trigger T.

The specification No. 2224, of 1866, filed on behalf of Winchester, also relates to repeating fire-arms ; whilst cartridges for use with such weapons, as also with other small arms, are described in his specification No. 2009, of 1868. Other patents for improvements in the details of the Winchester rifle have been obtained in more recent years.

The Lee-Metford Magazine Rifle.

Throughout the whole of the "flint-lock" period but little change was made in military fire-arms ; the muskets carried by the soldiers under Marlborough were of the same type as those with which our troops were armed a century later under Wellington at Waterloo. But in the Victorian era several changes of a radical character have been effected in the design and manufacture of small arms for the British army. A period of less than fifty years (from 1840 to 1889) has witnessed the rejection of "Brown Bess," and also what may be termed the rise and fall of the Brunswick, the Minié, and the Enfield muzzle-loading rifles, and the Snider and Martini-Henry breech-loaders, the last named having been superseded in 1889 by the Lee-Metford magazine rifle. The complete arming of the volunteer and auxiliary forces with the small bore magazine rifle has yet to be accomplished, such services having in the meantime retained the Martini-Henry. The Lee-Metford being not only a much more accurate weapon, but one which can be fired with far less inconvenience than its predecessor, a recent comparison of the shooting of the regular army, as a whole, with that of the volunteer army, appears to have resulted to the disadvantage of the latter. It must be remembered, however,

that although the Martini-Henry has been described as one of the best of the non-repeating breech-loading rifles, yet, as compared with the Lee-Metford, a high authority had ample justification in describing it as a "beastly weapon." A recent writer has well put it: "The Martini-Henry always hits the shooter though it misses the target, for it kicks like a horse. . . . The Lee-Metford is as harmless to the recruit as the other is dreadful."

The Lee-Metford rifle is based upon the invention of an American, James P. Lee, of Ilion, New York, his first English specification relating to the magazine rifle being No. 1786, of 1879, entitled "Improvements in magazine and other fire-arms." Such improvements, which though said to "embrace some features applicable to any fire-arms of the class commonly termed bolt guns," especially relate to magazine guns in which cartridges are successively delivered into the receiver through a slot in the bottom or wall thereof, by a sidewise movement from a magazine detachably affixed to the gun, and holding a number of cartridges placed laterally one upon another. The said invention consists, first, in the combination with the magazine of a spring catch, which serves to secure the said magazine to the gun immediately in front of the trigger guard, and which may be withdrawn to release the magazine, and permit it to be thrown out or to be removed from its seat in or upon the bottom of the receiver.

Another feature of the said invention consists in making the magazine deeper in its rear than in its front portion, for the purpose of permitting such inclination in the position of the cartridges that the flange of each superposed cartridge will bear upon the body of the cartridge immediately beneath it.

Furthermore, I so construct the magazine that the outermost cartridge may be pushed slightly forward, so that its point will enter a hemispherical cavity at the upper end of the front wall of the magazine, and its base will abut against the ends of two flanges projecting inwardly and upwardly

from the rear portions of the opposite side walls of the magazine, and will be partially embraced by narrower flanges immediately in front of the wider flanges, against the ends of which the base of the cartridge abuts. When occupying this position, in which it is maintained by the upward thrust of the ejecting spring in the bottom of the magazine, the outermost cartridge serves as a guard to prevent the escape of cartridges from the magazine, and the said magazine filled with cartridges is hence adapted for safe and convenient handling and transportation when detached from the gun.

The said invention also consists in so combining a magazine, substantially such as herein described, with a bolt, that the forward movement of the bolt completes the disengagement of the outermost cartridge from the said magazine, and thrusts it forward into the chamber, the operation being substantially as follows, that is to say: "The under surface of the bolt depresses the base of the cartridge below the under surface of the rear flanges; hence as the said bolt is withdrawn the thrust of the ejecting spring in the bottom of the magazine tilts the forward end of the cartridge upward, the base of the cartridge being free to slide under the wider flange in obedience to the backward movement, resulting from the riding of the point of the cartridge against the inwardly-inclined upper portion of the cavity in which it has been resting. When the bolt has been fully withdrawn, the ejecting spring pushes the base of the cartridge upward between the wider flanges, and brings its upper portion into the path of movement of the said bolt. When, therefore, the bolt is pushed forward its forward end strikes the upper part of the base of the cartridge, which then occupies an inclined position with its point bearing against the overhanging upper wall of the chamber. As the bolt moves forward the point of the cartridge enters the chamber, and its base, as soon as it has been pushed beyond the flanges at the rear end of the magazine, is pressed upward by the ejecting spring against the upper end of the curved wall of

the receiver on one side, and on the other side against an extractor, which is secured to and projects forward from the end of the bolt. The continued forward movement of the bolt drives the cartridge into the said chamber."

Various other details in the construction of magazine guns are set forth in Lee's specification.

CHAPTER X.

THE LEE-METFORD MAGAZINE RIFLE.—*Continued.*

THE adjoining fig. 77 is a side elevation with part in section of the breech and magazine as shown in Lee's specification No. 1786, of 1879. The inventor states that the barrel of the gun is fixed in the usual manner to the frame or receiver B. The sliding bolt C, instead of having affixed to it a spring hook to act as an extractor, is provided with a rigid extractor *c*, whose rear portion is concave and seats upon the periphery of the bolt, being held against it with a yielding pressure by means of a spring secured at one end by the screw D. The spring is sufficiently strong to keep the extractor in place, but yields to allow the inclined forward end of the extractor to slide over the flange of the cartridge when the breech is closed. A projecting shoulder from the extractor engages with a corresponding groove in the bolt, and the two parts are thereby caused to move together. When the bolt is pushed forward the extractor is caught in a longitudinal groove in the forward part of the wall of the receiver, and is thus held stationary when the bolt is turned to lock or unlock it.

Through the bottom of the frame or receiver B a slot is cut of sufficient dimensions to permit a cartridge to pass bodily into the receiver endwise, as shown at fig. 77. The receiver has the usual opening in the top, and immediately in the rear of the firing chamber an overhanging guard

b is provided which extends backwards sufficiently to catch the forward end of each cartridge as it is thrust upward from the mouth of the magazine into the said chamber. The guard is cut away on the right side, as shown at b^1, to permit the forward end of the cartridge to be tilted laterally out of the receiver when withdrawn from the firing chamber by the breech bolt. The adjustable curved shield E (which

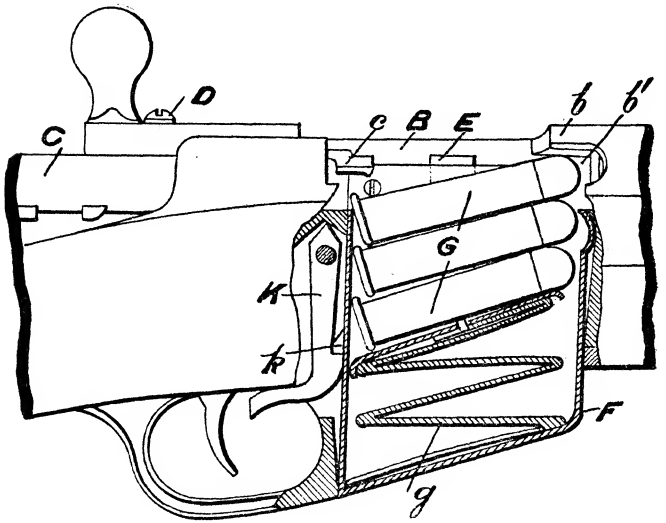


FIG. 77.

is also shown at fig. 78) enables the mouth of the magazine to be closed for adapting the gun for use as a "single loader."

The magazine F, which is attached to the under side of the gun immediately in front of the trigger guard, is provided with a device for retaining the outermost cartridge at the mouth of the magazine until it is released by the closing movement of the bolt, which pushes it forward into the firing chamber. The rear end of the magazine is made

deeper than the front end in order that the cartridges G shall lie in inclined positions, and that the flange of each superposed cartridge shall bear upon the body of the cartridge immediately beneath it. The cartridges are all pressed upward by the action of the ejecting spring *g* at the bottom of the magazine. One method of retaining the outermost cartridge in the mouth of the magazine consists in the provision of inwardly-curved spring flanges, or lips, as shown in the separate view of the magazine at fig. 79. In another method a spring tongue is employed in the rear end of the magazine in place of the retaining lips or flanges; the

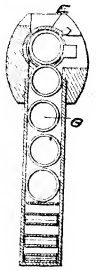


FIG. 78.

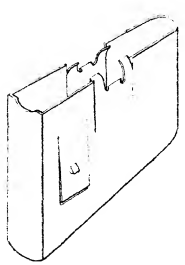


FIG. 79.

magazine, shown by the end section at fig. 78, is provided with such a device for retaining the cartridges G.

The means employed for detachably securing the magazine to the gun comprise a spring catch K, which snaps under a projection *k* from the magazine. The fore end of the catch K projects beneath the stock into the space immediately in front of the trigger, in a convenient position to be pressed back by the trigger finger when it is desired to release the magazine from the gun. The magazine can, if desired, be made for permanent attachment to the gun; the cartridges in such a case would be passed through the opening in the top of the receiver.

Fig. 80 illustrates a cheaper type of magazine, designed by Lee with a view to the throwing away of each empty magazine on detachment from the gun, to be replaced by another containing a fresh supply of cartridges.

Fig. 81 is a transverse section through a Lee magazine, modified in construction by being U-shaped, as shown, and which delivers cartridges through a slot in the side wall of the receiver, instead of through a slot in the bottom of the latter.

Metford Rifling.

The Metford system of rifling which is used with the Lee repeating mechanism to produce the Lee-Metford rifle, is founded upon the portion of the specification No. 2488, of 1865, of William Ellis Metford, relating "to an improved spiral or twist in the barrels of rifles, muskets, or cannon, of such a character as shall impart to the

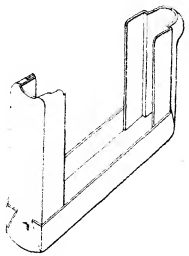


Fig. 80.

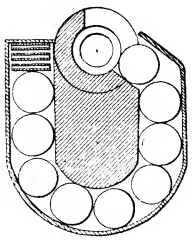


Fig. 81.

bullet its spiral rate of rotation under some definite law of development for the torsional force." The inventor goes on to state that the "present system of cutting the twist in barrels would only be correct if the propelling force of the powder was uniform throughout the length of the barrel, for then only would the torsional force applied to the bullet be uniform throughout—that is, the growth of the linear velocity of the bullet would take place exactly on the same law on which a falling body moves; it

will then be found that the torsional movement will at every point be exactly proportional to its linear movement. The propelling force of gunpowder is such that the decrease of pressure towards the muzzle is governed by the law that the elastic force of vapour varies inversely as the space it occupies. In the usual system of twist, the spiral, as developed on a flat surface, becomes a straight line ; and in cases where the correct principles have been roughly guessed at, the proper development of the curve has not been attempted, so that little attention has been paid to the true principles of the curve so as to meet the conditions required by the graduated force that impels the bullet. In my improved construction I propose a spiral of such a character that the rotation shall be given under the most economical

FIG. 82.

conditions—that is, this curve shall be such that the bullet shall receive equal increments of rotation in equal times, beginning this rotation at its starting, and ending it at or near the muzzle of the piece ; therefore the intention of 'stripping' being equal only to the amount due to the pitch of the starting slope, which will be reduced to a minimum, as also the friction. I do not, however, confine myself to this position, as I may wish to impart to the bullet either increasing or decreasing increments of rotation in equal times, the amount being governed by a definite mathematical law of increase or decrease. If the spiral be developed on a flat surface, as before described, and the pressure of the bullet against the grooved edge be taken into account, it will be compressed thus : That if a tangent be drawn to the curve at any point P (see fig. 82), and we speak of the angle of twist as the angle included between the tangent and the

axis $a\,x$, then the angle of twist must be such that the product of its secant and its tangent shall always be in inverse proportion to the pressure of the gas at that instant, which will be fully understood by the following formula and diagram :—

P = required constant pressure.
n = some constant multiplier depending on the starting value of P.
f = local force of powder.
θ = angle which gives the result.

Then we obtain $\frac{n\,\mathrm{P}}{f} = \tan\theta\ x\ \sec\theta$."

Another part of Metford's specification relates to the guide bar for the rifling machine for describing the desired curve.

A Metford rifle, referred to by the late Sir Joseph Whitworth in his notes on "Guns and Steel," published in 1873, has a barrel with a series of cylindrical portions concentric with the axes of the bore, and alternating in size. This provides a series of grooves, five in number, and cylindrical in section, with sharp sloping edges. The maximum diameter is ·47 in., the minimum diameter being ·462 in. The bullet is 3·02 diameters in length. The barrel is rifled, with an increasing twist, commencing at the breech end with one turn in 48 in., and terminating at the muzzle with one turn in 16 in.

The increasing spiral has been discarded by the Government in the manufacture of the Lee-Metford rifle, a uniform pitch of one turn in 10 in. being adopted, with a left-handed spiral.

The ·303 Lee-Metford Magazine Rifle.

By effecting various modifications in the details of the Lee mechanism and in the Metford system of rifling, the British Government have produced the well-known ·303 in. Lee-Metford magazine rifle. The length of the rifle is about

50 in., having a barrel 30 in. long, made from a solid steel bar. In the earlier patterns the rifling consisted of seven grooves, with a width of ·098 in. and a depth of ·004 in., the twist being left-handed, with one turn in 10 in., width of lands ·023 in. As first made the magazine held eight cartridges in one row or column, but in a later pattern the magazine is arranged to contain ten cartridges in two rows. The weight of the rifle with the magazine empty is 9¼ lb. The sight bed is graduated from 200 to 500 yards, the leaf from 600 to 1,800 yards, and the dial sight from 1,600 to 2,800 yards. The bullet is ·311 in. in diameter and 1¼ in. long. It is made of pure lead, with a cover of cupro-nickel. The explosive charge consists of 30 grains of cordite. The brass cartridge case is solid drawn.

The following official figures will give some idea of the capabilities of the Lee-Metford rifle: The mean extreme range of the bullet may be taken as about 3,500 yards, although, with a strong rear wind, 3,760 yards has been observed. The bullets find their way through joints of walls, unless the walls are made very fine and set in cement. About 150 rounds, concentrated on nearly the same spot at 200 yards, will breach a 9 in. brick wall, and about 800 rounds at the same range will breach a 14 in. brick wall. When fired into sand the bullet is found to be always turned aside after it has entered a little way. The following thicknesses of material (in inches) are usually necessary to stop the regulation ·303 bullet: Shingle between boards, 4; hardened steel plate, ¼; good brick work, 9; sack of coal, 12; hard, dry mud wall, 14; peat earth, 60; compressed cotton bales, 22; oak, 27; elm, 33; teak, 36; fir, 48; and clay, 48.

The Lee-Enfield Rifle.

In the latest form of British magazine rifle, known as the "Lee-Enfield," the barrel is rifled with five grooves, and the width of the five lands is equal to the width of the grooves.

CHAPTER XI.

Lee's Improved Magazine for Repeating Fire-arms.

The adjoining illustrations, figs. 83, 84, and 85, illustrate the improved magazine as described by J. P. Lee, in his specification No. 8117, of 1889, such magazine being arranged to contain two rows or columns of cartridges, which are fed into the barrel by the breech-bolt alternately from the said rows or columns. As already stated, this type of magazine has been adopted by the British Government in the construction of the Lee-Metford rifle.

Referring to the drawings, fig. 83 is a vertical longitudinal section of the magazine ; fig. 84 a transverse section on line X X^1 (fig. 83), and fig. 85 an end elevation. A is the box or case of the magazine, B the follower or platform, and C the spring for elevating the cartridges. The cartridges are arranged side by side in two distinct vertical rows, as illustrated, "each cartridge being in contact with the cartridges next above and below it in the same column. That is to say, the cartridges in my improved magazine are not arranged in a zigzag column so that the force of the spring has to be transmitted through the cartridges in one column to those in the other column, but in two distinct columns, the force of the spring being transmitted through the follower directly to both of the said columns. By this arrangement, the raising of the cartridges by the spring is greatly facilitated, the friction between the cartridges and the walls of the magazine being much less than in cases where the cartridges are arranged in a zigzag column, or where the elevating force is applied through the cartridges in one column to those in the other column."

"When the magazine is full of cartridges, the space between the lip or flange A^1 and the cartridge D is of such width that the uppermost cartridge D^1 cannot pass between them, the line of contact of the cartridge D^1 with the

cartridge D being slightly below a plane extending through the longitudinal axis of the cartridge D and through the edge of the lip or flange A^1 ; the cartridges will therefore be held in place in the magazine, and cannot be pushed upward

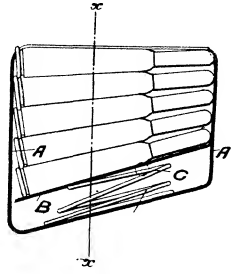


FIG. 83.

therein by the spring C until the uppermost cartridge is fed into the chamber of the gun by the breech-bolt. Each cartridge in the magazine will, however, until thus transferred from the magazine, continue to occupy such a position

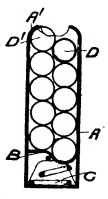


FIG. 84.

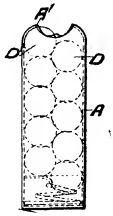


FIG 85.

that its axis is in the same vertical plane as the axes of the cartridges below it in the same column—that is to say, there will be no lateral displacement of the cartridges towards the centre of the magazine as they are elevated therein."

The Magazine Rifles of Foreign Armies.

The magazine rifles now in use by the armies of the world are similar to the Lee-Metford in that they are all provided with a sliding bolt, which, in addition to forming the means for opening and closing the breech, serves also for feeding the cartridges from the magazine into the firing chamber, and for their subsequent extraction after firing. This arrangement of the breech-bolt, in combination with the magazine, constitutes the latter a part of the repeating mechanism of the rifle.

The Mauser Magazine Rifle.

The Prussian needle gun was succeeded by the breech-loading rifle of Mauser, having a bore of ·42 and using a brass solid-drawn cartridge. Mauser has made many improvements from time to time in his weapons, and in the repeating rifle now in use in the German army he has adopted a magazine immediately in front of the trigger guard and in combination with the breech-bolt, very similar to the Lee magazine.

Paul Mauser has obtained many English patents. In his specification No. 1343, of 1881, a magazine or repeating bolt gun is described, in which the magazine is beneath and parallel with the barrel. A cartridge carrier oscillating on its rear end receives the cartridge from the magazine whilst in a downwardly inclined position, and delivers it into the barrel when raised into an upwardly-inclined position. The carrier is raised or depressed by the movements of the lock.

Various improvements on the Mauser gun are described in the specification No. 3654, of 1881, and No. 2109, of 1882. In his specification No. 16274, of 1887, Mauser describes a sliding breech-block magazine gun having a cartridge carrier suspended by two springs, the cartridges descending by gravity.

In his specification No. 5641, of 1888, describing the extraction of the cartridge when the bolt head is drawn back,

and the engagement of the point of the ejector with the flange of the cartridge case, Mauser makes the following statement: "By constructing the ejector in the manner just described, the bore of the breech case, so far as it constitutes the cartridge rest, is smooth and left unoccupied by grooves, so that the lower part of it may be cut through for the insertion of a cartridge magazine of the 'Lee' type, the detail combination and working of which is so well known that a description thereof is unnecessary." Such a reference to the Lee magazine appears to have some importance as a recognition of the claim that Lee is "the father of the modern magazine rifle."

The adjoining illustrations, figs. 86 and 87, represent the cartridge clip from Mauser's specification No. 12689, of 1888, describing an invention which is said to comprise "a device by which a number of cartridges are united to a package in such way that the magazine of a breech-loading gun,

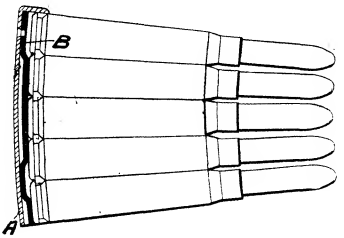


FIG. 86.

whether it is entirely or partially emptied, can be re-filled with cartridges in quite a simple and speedy way, without removal of the magazine from the gun. The object of the invention is to facilitate the charging or filling of the cartridge magazine, to increase the rapidity of the shooting, to avoid augmenting the weight of the equipment of the soldier (or at least only a trifle), and to increase the confidence of the soldier, in his arm being always easily kept in readiness for rapid firing."

The filling or charging device consists of "a curved frame A of sheet steel or of other suitable material. The long sides a^1 of it are bent over inwards, forming guides a^2. The cartridges are pushed into this frame one after the other by means of the bottom edges or rims of the shells entering the grooves a^2, and form thereby a package." The cartridges are secured to the frame elastically by a spring, as B.

Other patents of Mauser (and there are many of them) which are now in force will be found recorded in a list at the close of these articles.

The 1888 pattern of the Mauser rifle, as used in the German army, has a bore of ·311, fires a bullet 1·24 in. in length, and has a magazine holding five cartridges; the

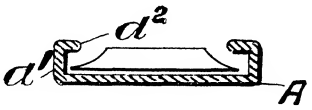


FIG. 87.

complete length of the cartridge is 3·24 in. In a later pattern the bore is reduced to ·276 in. Spain, Belgium, and Turkey have also adopted Mauser magazine rifles.

THE MANNLICHER MAGAZINE RIFLE.

The name of Ferdinand Mannlicher, of Vienna, will be found of frequent recurrence in the official lists of British patents for some few years past. In his specification No. 3774, of 1882, Mannlicher described a repeating rifle having the magazine in the butt end, the cartridges being pressed forward from the magazine by a spring.

The illustrations at figs. 88 and 89 represent a detachable magazine as described in Mannlicher's specification No. 2345, of 1883. As will be observed, the magazine is arranged above the frame.

The magazine casing A "is of rectangular horizontal section, being of a width and depth corresponding to the size of the cartridges; it is made of a parallelogram form,

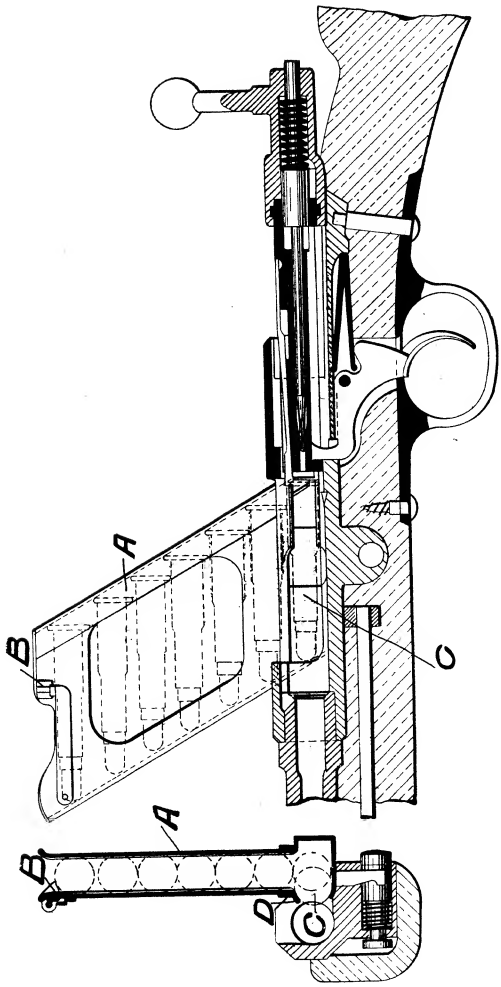


FIG. 88.

FIG. 89.

inclining forwards relatively to the gun as shown, so that the cartridges, which are introduced therein through the open top, lie with their bullet ends resting upon the inclined end surface of the magazine, while at the base ends they rest upon each other, and with their rims situated within a slight enlargement or groove in the rear end of the magazine. By this arrangement the cartridges, piled one on top of the other, as indicated, sink gradually down as they are removed below, with their bullet ends sliding upon the inclined surface of the magazine and their bases guided in the groove, so that there is no possibility of their becoming displaced in such a manner as to become jammed in the magazine; and no matter in what position the magazine or the gun with the magazine attached thereto may be held, nor whether there are many or few cartridges in the latter, these will always assume the correct position indicated as soon as the gun is placed in the horizontal position for firing. Although the magazine is open at top for the introduction of the cartridges, these are prevented from falling out by means of a spring stud B with sloping faces, projecting slightly into the mouth of the magazine. On introducing a cartridge with slight pressure, it will force the stud outwards so as to allow it to pass in, but the spring is of sufficient strength to prevent the cartridge from falling out again. At bottom the magazine has a side opening C, which at the front part is large enough to allow the cartridges to pass out sideways freely, but at the rear part it has projecting lips D, which partly embrace the rear end of the cartridge and prevent it from passing out unless pushed endwise by the breech bolt."

In Mannlicher's specifications No. 6373, of 1885, and 14815, of 1886, he adopts an under-type magazine, the cartridges, being raised therefrom by a spring. The breech is opened and closed by a rectilinear movement of the bolt, or, in other words, the gun has "a straight pull and push bolt."

The Mannlicher rifle, of 1888, for the armies of Austria and Hungary, and which has since been adopted for Greece, and

also for the Bulgarian army, has a bore of ·315, fires a bullet 1·98 in. in length, and is provided with a magazine to hold five cartridges. The Roumanian Mannlicher has a bore as small as ·256, and is a very excellent weapon. Holland also has the Mannlicher rifle with a bore of ·256.

The French Lebel Rifle.

In common with all the modern military magazine rifles, the Lebel of the French army can be used as a single loader, the cartridges being then fed in from the top side. In a recent pattern the calibre is ·256, and the gun is provided with a detachable magazine capable of holding twelve cartridges.

The Russian Rifle.

The Russian breech-loading magazine rifle, known as the Mouzin, has a ·3 in. calibre, and fires a bullet 1·2 in. in length, the complete cartridge being 3·05 in. long. The magazine holds five cartridges.

America.

The United States infantry regiments are provided with a rifle having a calibre of ·3 in., and fitted with a magazine to contain five cartridges. But for the United States navy, what is known as the Lee straight-pull gun has been adopted, having an exceptionally small calibre, viz., ·236 in. The bullet fired from this weapon attains a muzzle velocity of 2,500 ft. per second ; it is stated that with the use of cartridge clips or holders the gun can be fired upwards of fifty times per minute. Such rapidity of firing would certainly not permit of any very great accuracy of aim, and the fractional percentage of bullets that would "find a billet" might possibly prove to be even lower than the record attained in a certain engagement, when, it is recorded by a military officer of distinction, 80,000 (eighty thousand) cartridges were fired, and as a result 25 (twenty-five) of the enemy fell ; this works out at 3,200 (three thousand two hundred) bullets per man. With these figures before us, we might almost prefer a battle to a football match.

CHAPTER XII.

Ammunition for Small-bore Magazine Rifles.

Explosives.

Black gunpowder, consisting of 75 parts saltpetre, 15 parts charcoal, and 10 parts sulphur, has been displaced by the various forms of "smokeless powders" for all modern military rifles. The following notes, however, may be of service, as indicating the leading properties of this well-known and for long years the only explosive :—

The explosive temperature of gunpowder is about 600 deg. Fah., but this will be modified by, amongst other causes, the temperature at which the charcoal is produced. Powder made with charcoal burnt at a low heat will ignite at a lower temperature than powder made from charcoal produced at a greater heat. Gunpowder may be in the form of a meal or fine dust, or in grains or prisms. Mealed powder will ignite more readily than the prism or grain powder. Several varieties of black powder have been employed in the manufacture of ammunition. The property of the powder is much affected by the size of grain. A large-grained powder will in general burn slower than a powder of small grain.

Gunpowder will deteriorate at a temperature far below the exploding point. At a temperature of 212 deg. Fah., the ordinary boiling point of water, it will commence to lose its sulphur. The explosion of gunpowder in a closed vessel will generate a pressure as high as 43 tons per square inch ; but in a rifle barrel, where the bullet moves before the complete ignition of the charge occurs, a much lower pressure is attained. It should be remembered that the rate of combustion will very materially affect the result attained. Rapid combustion will give a greater intensity of pressure, whereas a slower combustion will produce a more sustained force, although of less intensity. The rate of

combustion according to its rapidity is styled a burning, an explosion, or a detonation. Such terms have been defined as "the positive, comparative, and superlative degrees of rapidity of the same process."

Smokeless Powders.

The modern smokeless powders, by whatever fancy name they may be known, consist in almost all cases of nitro-compounds. As regards the use of such powders, a note of warning by an American writer has much significance: "Those who have been accustomed to black powder (which has served us all so long and well) must not think for a moment that they can purchase any of the nitro or smokeless powders and proceed to use them the same as they have been accustomed to use the standard black powders. Black powders ordinarily require compression, or at least to be packed firmly, to secure the best results. Not so with most of the smokeless powders. The charge of black powder may be increased to expel a heavier bullet from an ordinary barrel. To do so with some nitro-powders might cause the whole charge to burst out sideways, shattering the arm, and preparing the shooter for burial."

Cordite.

The smokeless powder adopted by the British Government is known as "cordite," from the string-like form in which it is produced, such strings or threads for the ·303 rifle cartridge being ·0375 in. diameter. The charge of cordite for the Lee-Metford cartridges is 30 grains.

In a paper on "The Machinery Used in the Manufacture of Cordite," read at a recent meeting of the Institution of Civil Engineers, Mr. E. W. Anderson, of Erith, gave the following particulars concerning this explosive: "Cordite consists of 58 parts of nitro-glycerine, 37 parts of gun cotton, and 5 parts of mineral jelly, with 20·83 parts of acetone, which acts as a solvent, and is ultimately driven off again in the drying process. The form in which the explosive is

generally produced is that of cords or strings of various diameters, cut into various lengths, the dimensions being adapted to suit different guns in which it is to be used. The charge for a gun consists of a number of lengths bundled together, sufficient to make up the required weight. It is also made in thin wafers for use in blank ammunition and for pistols, and in short tubes for the primers of cartridges. The manufacture of cordite, as conducted at Waltham Abbey, divides itself into seven stages: (1) Mixing the gun cotton and nitro-glycerine; (2) incorporation and introduction of the acetone and mineral jelly; (3) pressing; (4) reeling, or cutting up; (5) drying; (6) blending; and (7) cartridge filling. The gun cotton and nitro-glycerine are always mixed by hand. The gun cotton, which comes from the drying stoves in the form of loosely-compressed cylinders, is broken roughly into a pan, and the proper quantity of nitro-glycerine is poured on to it, the two being incorporated by hand until complete admixture or solution takes place.' This "paste," as it is now called, is a comparatively safe material to deal with, and might be transported, if necessary, without danger. Incorporation and introduction of the acetone and mineral jelly is effected in kneading machines. The proper quantity of paste is placed in the machine, and the acetone is gradually added to it while running. After three and a half hours the mineral jelly is added, and the process is continued for three and a half hours more, at the end of which time the contents are turned out and removed in covered pans to await the next operation. The incorporated material is placed in a cylinder having a closed bottom and a well-fitting plunger, which can be forced down into it. In the centre of the closed end is a nozzle, having a hole of suitable size, through which the explosive is pressed out, and delivered in the form of a string, from which the name "cordite" is derived.

The cordite, as it comes from the presses, is wound on reels in a special machine attached to the press. Each reel holds one charge, and when filled it is taken away to the drying

house, an empty one being placed in the press ready for the next charge. Each press thus requires a great number of reels to keep it fully occupied. The next larger size of cordite is also reeled as it comes from the press. The contents of each reel are then cut longitudinally in halves at opposite ends of a diameter, removed from the reel, and laid out flat in trays with perforated bottoms, which when full are taken to the drying house. All remaining sizes are cut at once into suitable lengths—14 in. and upwards—as they leave the press, by means of a special machine. The cut pieces are placed in perforated trays and dried. The reels from the rifle cordite presses, and the trays from the others, are placed in racks in drying chambers and left for the necessary time, which varies between $3\frac{1}{2}$ and 15 days, according to the size of the cordite. The temperature is kept at from 98 deg. Fah. to 100 deg. Fah. After drying the manufacture is completed, but to secure uniformity in the results blending is necessary. The cordite for the rifle cartridge is blended by taking the cords from ten of the press reels, after drying, and winding them on to one larger reel by means of a special machine. Then the contents of six of these reels are wound by a similar machine to a still larger one, to form an untwisted rope of sixty strands. By judicious selection of the press reels a rope of perfect average quality can thus be obtained. This rope is now ready for storing—on the reels—in the magazines, or for filling at once into cartridges. The blending of the larger sizes is performed entirely by hand in a systematic manner, which is also productive of great average uniformity. The sixty-strand rope is filled into the rifle cartridges by a special machine worked by hand and foot, the function of which is to feed uniform lengths of the rope into the cartridges and cut each length off. After filling, the cartridges are wadded by an ingenious machine designed at Woolwich, and then necked and bulleted. The charges for the larger guns are all made up by hand into suitable bundles, and fitted with primers. For blank cartridges the round cords are cut up by a machine

into very thin transverse slices, which are simply measured into the cartridge cases.

It will be observed that the main constituents of cordite are nitro-glycerine (which is obtained by the action of strong nitric acid on glycerine) and gun cotton. The latter is produced from the best cotton waste, which when thoroughly cleansed and cleaned of all fatty matter becomes practically pure cellulose ($C_6H_{10}O_5$). By steeping in strong nitric acid (with the addition of sulphuric acid to take up the water formed by the action of the nitric acid) the cellulose is converted into gun cotton. Gun cotton was first manufactured in 1846. Its ignition when dry will occur at a temperature as low as 277 deg. Fah., and it burns with very great rapidity.

The relative pressures produced by the explosion in a closed vessel of nitro-glycerine, gun cotton, and black gunpowder has been given as 10 : $7\frac{1}{2}$: 1. In the manufacture of cordite the high explosives are so combined that they are caused to burn only at such a rate as will render them suitable for service with small arms. The maximum pressure in a Lee-Metford rifle barrel may be taken at about 18 tons per square inch.

In addition to the absence of smoke after firing, the nitro-powders have a great advantage over black gunpowder in the small quantity of solid residue, or "fouling," formed in the barrel.

Bullets.

With the high pressures obtained by the use of the nitro or smokeless powders in the modern small-bore rifles, the bullets must be provided with a hard metal jacket to make them keep to the rifling. The leaden bullet for the Lee-Metford rifle has a nickel case completely covering all but the base of the bullet. In other countries we find jackets or mantles in composite bullets formed of steel, copper, and of other hard metals or compounds. The life of the rifling of the barrel will be affected by the hardness of the bullet, and

by one American writer such life has been calculated to be as low as from 1,000 to 5,000 rounds for mantle bullets, although, as he states, "by using leaden bullets for target practice the life of the barrel will be prolonged." We understand that the Lee-Metford barrel is good for 10,000 rounds without returning to the works.

We have previously given some official figures as to the range and penetration of the Lee-Metford bullet. The muzzle velocity of the bullet is 2,000 ft. per second, as against 1,365 ft. for the Martini-Henry, and 1,260 ft. for the Snider. The weight of the Lee-Metford bullet is 215 grains, as against 480 grains for the Martini-Henry and for the Snider bullets, whilst, as already stated, its length is 1·25 in. and its diameter ·311 in., the latter value being equal to the bore (·303) plus the depth of each groove (·004).

The Dum-dum Bullet.

Everybody has recently heard much (and some people far too much) of the Dum-dum bullet. By the use of such missiles in the campaign against the Afridis, certain German authorities have alleged that England has broken what is known as the St. Petersburg Convention of 1868, under which the Great Powers agreed to refrain from the use of an explosive bullet. As we shall presently see, the Dum-dum bullet is certainly not an explosive bullet, although what has been termed its "man-stopping" qualities of necessity make it compare unfavourably with the ordinary Lee-Metford bullet in the nature of the wound which it inflicts. Mechanically, the difference in the two bullets is very small. In the ordinary ·303 bullet the whole of the lead interior, with the exception of the base, is covered with the nickel jacket or mantle. In the modified ·303 bullet, as made after the experience gained in the Chitral campaign, at Dum-dum (a British cantonment near Calcutta, famous as the scene of the outbreak of the Indian mutiny), the only part left uncovered by the nickel is the rounded nose end. When such a bullet strikes, the lead detrudes from the opening in the jacket, and

thus, by assuming a mushroom-like shape, inflicts a serious wound.

In reply to recent questions in the House of Commons, Lord George Hamilton stated that "according to information supplied to him the effects of the Dum-dum bullet were not more serious than those of the Snider bullet, nor than those of the Martini-Henry bullet; but, on the other hand, it was clearly shown that during the Chitral expedition the Lee-Metford bullet frequently failed to attain the object for which all missiles were discharged in war, viz., that of disabling the enemy with the least possible suffering. The Dum-dum bullet fulfilled this object, as did the bullets previously used by the English army, and fulfilled it in the same way. That the Dum-dum bullet was consonant with international law, as set forth by the terms of the St. Petersburg Convention of 1868, was perfectly clear, inasmuch as what the convention forbade was the use of any explosive projectile beyond a certain weight charged with fulminating or inflammatory matter. He had received as yet no medical reports from India as to the effect of the Dum-dum bullets in the recent frontier engagements, but he had asked the Indian Government to expedite this information." To a further question the Secretary for India replied: "There is no doubt that the so-called Dum-dum bullet inflicts a more serious wound than the bullet previously used with the Lee-Metford rifle, but I believe anybody can convert the bullet previously in use into a Dum-dum by simply flattening its head." As to the conversion mentioned in the latter part of this answer, an illustration has appeared in one of the London weekly journals, showing the men of the Warwickshire regiment, now in the Soudan, busily engaged in converting the ·303 service bullets into Dum-dum bullets by the simple expedient of filing away the nose of the nickel case or jacket.

In an article on the Dum-dum bullet published in the issue of March 4th, 1898, the *Engineer* says: "The nickel case small-bore bullet is liable to go through man and beast

almost without making its passage felt at the time, and the small hole it makes is said generally to heal on first intention, and with great rapidity. The Chinese, it is true, when marching away before the Japanese—which was their chief operation in the field—generally quickened their pace after receiving a shower of bullets into them, but the bullets would not always have even this effect. In the coal riots at Lord Masham's pits, in the afternoon, after the troops fired, one pitman said he felt his thigh a bit uncomfortable as he walked, and on examination it was found that a bullet had passed through it. A bullet should do more than make a man rub his leg for some hours afterwards. Consequently, efforts have been directed to causing bullets to set up on impact. The Dum-dum and the Tweedie bullets resemble each other in the fact that the point is left uncovered by the nickel. The bullet sets up on impact, but unfortunately the nickel breaks and flies about, which is undesirable. Our own Mark III. bullet, designed in the Royal Laboratory, has a hollow in the head, into which the nickel case enters, lining it, as it were, with nickel. This bullet sets up a little on impact, but not enough to give it the stopping power that belonged to the old-fashioned heavy ball. The nickel case, however, remains intact, and probably this bullet, which is regularly adopted, may be our service one, possibly in a modified form. There is a great difference between a bullet that sets up, and whose case accidentally splits and flies more than could be wished, and bullets purposely made to contain explosives and to act as a shell. It seems curious that all nations should have adopted bullets that hurt so little on impact as to create an obstacle to their use."

The illustrations, figs. 90 to 95 inclusive, are from the specification No. 22173, of 1891, of Major-General Tweedie. The invention is said to relate "more particularly to the method of constructing compound projectiles for small arms described in the specification to C. D. Abel's (Lorenz's) patent, No. 9577, of 1844, wherein a hard metal casing was securely united to a soft metal core by soldering the two

parts together. According to my present invention, instead of constructing the hard metal shell with a closed head and an open base, through which the soft metal core was introduced, as described in the said specification, I construct the shell with a closed base and with a small opening in the head, through which the soft metal for the core is introduced. By this means certain inconveniences are avoided which arise when the projectiles of present construction are used with charges of smokeless or other powder giving high initial velocities. In addition, the improved construction also has the advantage of causing the front end of the projectile to flatten out or spread more or less when hitting a hard resisting substance, such as a bone of an animal or human being, and thus effectually disabling the object struck, instead of passing right through and making a comparatively small wound."

The patentee continues: "According to my present invention, instead of constructing the hard metal shell with a closed head and an open base, through which the soft metal core was introduced, as has heretofore been done, I construct the shell with a closed base and with an opening in the head, through which the soft metal for the core is introduced. By this same means certain inconveniencies are avoided which arise when the projectile of present construction is used with charges of smokeless or other powder giving high initial velocities. In addition, the improved construction has also the advantage of causing the front end of the projectile to flatten out or spread more or less when hitting resisting objects, such as an animal or human being, and thus effectually disabling the object struck, instead of passing right through and making a comparatively small wound, as is the case with the compound projectiles of present construction. This effect will be obtained to an increased extent if the soft core is made to project more or less beyond the hard metal case, as will be presently described."

Referring to the drawings, fig. 90 is a vertical section of the case, and fig. 91 a similar view of the case when fitted with the core. Fig. 92 is a vertical section of the compound projectile when completed, and fig. 93 an elevation of the same. Figs. 94 and 95 show respectively a vertical section and an elevation of a modified form of the bullet.

The cylindrical hard metal case A has a closed rear end A^1, but an open front end. After tapering the said front end the soft metal core B is introduced, and the projectile is then subjected "to pressure in a mould of such form as to impart to the head the requisite approximately original form, as shown in figs. 92 and 93, thereby reducing the opening at that end to a comparatively small hole C. To facilitate such formation of the head I may, in the first instance, form a central longitudinal perforation B^1, extending down some

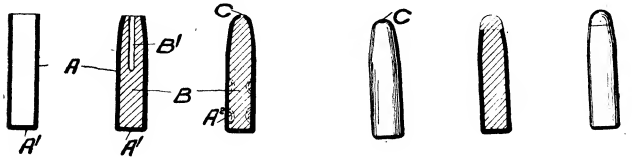


FIG. 90. FIG. 91. FIG. 92. FIG. 93. FIG. 94. FIG. 95.

distance from the front end of the core, as shown at fig. 91, which may facilitate the compression of the latter when subjected to pressure, as described." "In some cases, instead of more or less entirely enclosing the soft metal core by the case at the front end, as described, I remove a portion of the front end of the case after the core has been filled in; or I make the case shorter than the core in the first instance, and I then subject them to pressure, so as to give to the projecting end of the core the necessary ogival configuration, as shown at figs. 94 and 95, while at the same time contracting the end of the case to a certain extent. The soft head thus formed on the projectile will, on impact with the object fired at, expand considerably, and will consequently form a much larger hole on penetrating an iron plate, while at the

same time it will prevent the tendency of the projectile to glance off plates, to which the head covered with the hard metal case is subjected."

General Tweedie states that he prefers "to unite the core B to the case A by soldering;" but it may also be simply secured by the closing in of the head, as described; or it may be held in addition by one or more circular grooves or neckings formed in the case, as indicated by dotted lines at A^2, fig. 92.

CHAPTER XIII.

Sporting Guns.

The modern military guns of the various nations of the world have a marked resemblance, which is not surprising when we consider the similarity in the nature of the work they are called upon to perform. But with sporting guns we find, as we should expect to find, a much greater variety, for the gun and ammunition which would prove eminently suitable for big game in Africa or India would be scarcely suitable for rabbit shooting on Exmoor. As in this series of articles we are more concerned with military weapons, we can only briefly refer to a few leading features relating to sporting guns.

Shot Guns.

The bore or calibre of a shot gun is usually denoted by a figure or figures representing the number of solid spherical lead balls of a size corresponding with the bore that are required to make up one pound avoirdupois. Thus, a 10-bore gun, or ·775 in. diameter, will receive a solid spherical ball ten of which are required to make up a pound; a 16-bore gun (·662 in. diameter) will take balls of sixteen to the pound; and an 8-bore (·835 in. diameter) balls of eight to the pound.

The standard gun for game and pigeon shooting is a 12-bore (·729 in.), with a barrel 30 in. long and a weight of about 7 lb. A good shot will prefer to use a game gun of a less calibre than the standard 12-bore or gauge. In capable hands a 28-bore (·550 in.) has proved an excellent sporting gun ; its light weight enables the user to carry it with great ease. In a recent issue of the *Field*, a correspondent expatiated upon the virtues of the 10-bore as a sporting gun, but a brother sportsman, in a succeeding issue of the same journal, pertinently suggested that a man who found it necessary to use such a murderous bore would be well advised to confine himself to crow scaring. Old-time sportsmen appear to have considered that if a man failed to kill in a single shot, the bird should be allowed to profit by its good luck, and escape with its life.

The ordinary sporting gun is constructed for firing a charge of small shots or pellets produced by the dropping of molten lead in a shot tower. Such "drop shot," as it is termed, varies from about 25 pellets to the ounce to so fine a size that upwards of 3,000 pellets are required to make up one ounce. A larger variety, known as "buck shot," is produced in moulds.

The perforations or impressions formed by the pellets on a given area at a given range form what is known as the "pattern" of a shot gun. The aim of the gunmaker is to ensure a close "pattern," as an undue spread or lateral deviation from the central line of fire will render the charge ineffective. A circle enclosing a "pattern" which is sufficiently close to kill a bird at any position within the circle is known as the "killing circle." The killing circle will vary with the bore of the gun and the charge employed. Mr. W. W. Greener, in his excellent work on "The Gun and its Development," states that the ordinary double-barrelled game gun should have a killing circle of 30 in. at 30 yards with the first barrel, and a similar circle at 40 yards with the second barrel.

Choke Boring for Shot-gun Barrels.

The first British patent specification referring to the choke boring of gun barrels is that of William Rochester Pape, in 1866, the number of his specification being 1501 of that year. Describing his improvement "in the manufacture and construction of the bore of barrels of breech-loading and other shot guns," Pape says that, "instead of making the bore cylindrical throughout, I propose firstly to bore the barrel or barrels through and through one size or number smaller than the true bore to be formed; I then re-bore the barrel with one full size or number larger than the former, beginning at the breech or open end, but continuing only to within one inch or thereabouts of the muzzle end; I then finish the bore by a taper from the conclusion of the larger bore direct to the very extremity of the muzzle. By this improved construction of bore stronger and closer shooting will be acquired, besides other advantages."

Bullets for Shot Guns.

A shot gun can be used at short ranges for firing a solid ball or spherical bullet with satisfactory results, although unequal to smooth-bore guns expressly constructed for ball. Projectiles especially designed for service with shot guns have been produced. In his specification No. 2705, of 1874, A. C. MacLeod describes an invention having for its object "to construct a projectile which can be fired from a smooth-bore gun with the same effect and precision that an ordinary projectile can be fired from a rifled gun. I construct my projectile with the fore part larger and heavier than the rear part, which is the reverse of the present mode of construction—that is to say, my projectile leaves the gun as an arrow leaves a bow, with the heavier end foremost, and I combine with this mode of construction any suitable contrivance, such, for example, as the formation of spiral or oblique grooves or ridges on the surface, or spiral internal channelling, or an oblique or twisted conformation of the

surface generally, to give a spinning or rotary motion to the projectile, as is also produced in an arrow by the feathers spirally arranged on its shaft.

"The accompanying drawings (figs. 96 and 97) show, by way of example, one form of bullet constructed according to my invention. Fig. 96 being a side view, and fig. 97 a cross section through the line *x x*, *a* is the head, which is made larger and heavier than the rear part *b* ; *c c* are spiral grooves on the surface for the purpose hereinbefore described."

MacLeod is careful to state that it was not new at the time of filing his specification to form projectiles with spiral grooves for the purpose of giving them a rotary motion when fired from a smooth-bore gun, and he also declares

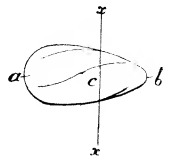


FIG. 96.

FIG. 97.

that he is aware of previous proposals to make bullets with their heavier ends in front; but what he claims is the combination of the spiral grooving with projectiles having the fore part larger and heavier than the rear part.

COMBINED RIFLES AND SHOT GUNS.

To enable a sportsman to use the one weapon against either large or small game, double-barrelled guns are constructed, having one barrel smooth bore, and the other rifled; or a double-barrelled gun with interchangeable barrels can be obtained, one pair of the barrels being rifled and the other pair smooth bore.

HAMMERLESS AND EJECTOR GUNS.

Hammerless guns were known in the flint-lock period, and such weapons made during the last century are preserved

in varous collections of fire-arms. Coming to the percussion system of firing and to breech-loaders, we find that the gun described in the specification No. 6137, of 1831, of Augustus Demondion (to which we have previously referred under the heading of "Breech-loaders"), is of the hammerless type.

Many patent specifications have been filed descriptive of improvements relating to the well-known double-barrel hammerless breach-loaders of the "drop-down" type. Of these we will first refer to the specifications of Theophilus Murcott, No. 1003, of 1871. In opening the breech of Murcott's gun, as described in his specification, the head of a small lever carried by the tang is caused, on the opening of the breech, to bear against pins projecting from the tumblers, to compress the main springs, the strikers being drawn back at the same time and held at full cock by the sears taking into the full bents.

In Joseph Needham's specification, No. 1295, of 1874, the tumbler is cocked, and acts upon the sear to force it into the bent at the moment of opening the breech, by means of a projection or link on the internal hammer or tumbler, which is acted upon by an incline on the lump ; or the tumbler may be cocked in the usual way by hand. For the ejection of the spent cartridge cases of a double-barrelled gun two extractors are employed, which are each capable of being acted on separately by a lever pivoted on the lump, and such levers are themselves capable of being separately acted upon by a projection from each tumbler. On opening the breech the projection or link from the tumbler or internal hammer, which has just acted, will give a sharp blow on the tail end of one of the levers, and thus act upon the extractor to throw the spent cartridge out of the barrel ; but the live cartridge will be moved only a slight distance out of the breech end of its barrel, but will not be ejected, as the projection or link from the tumbler, which is at full cock, will be out of the way of acting upon its corresponding lever. Further improvements relating to such ejector guns are

described in the same inventor's specification No. 2793, of 1875.

In the Anson and Deeley hammerless ejector gun, as described in their specification No. 1756, of 1875, the lock mechanism is also so arranged that the cocking of the gun is effected by the raising of the breech ends of the barrels for charging. The fore end is prolonged backwards beyond the joint on which the barrels turn, and such prolonged part enters and works in a groove in the body of the gun. "The fore end thus constitutes the long arm of a lever, and the part of the fore end prolonged backwards the short arm of the same lever, the ordinary joint of the fore end constituting its fulcrum. The internal hammer, or striker, is provided with a main spring, and a sear is pressed by a sear spring against the under side of the end of the striker lever within the groove. The other end of the striker lever projects out of the body of the arm, and is turned upwards at the back of the break-off into a nearly semi-circular form, its end entering into and working in a hole in the break-off in a line with the axis of the barrel when the latter is shut down for firing." On the raising of the breech end of the barrels the fore end is depressed, and its short arm rises and lifts the end of the striker lever bearing upon it. The opposite or striking end of the lever is thereby drawn back, the sear taking into the bent and retaining the hammer or striker in its cocked position on the shutting down of the barrels for firing. "The cocking of the arm may be effected by the motion of an under lever acting directly on the hammer lever, instead of by the motion of the fore end."

Fig. 98 is a section of the breech end of a double-barrel drop-down gun, containing the extracting mechanism of John Deeley, jun., as described and illustrated in his specification, No. 14526, of 1884. The inventor states that "in the ordinary extractor of drop-down guns the case of the exploded cartridge is 'started' or drawn a short distance from the end of the barrel on the raising of the breech ends of the barrels, the complete removal of the case being effected

by hand. I employ the ordinary mechanism for starting the cartridge case, but supplement it by the mechanism hereinafter described, whereby the 'started' cartridge case is ejected from the barrel."

Each extractor consists of a rod a, with a hook part a^2, with which the rim of the cartridge engages. The cartridge is started by an ordinary projection or lifter attached to the fore end c. The mechanism for fully extracting or ejecting the spent cartridge case comprises the following: "The fore end c carries a short vertical arm d, turning upon a pin or centre supported by the plate c^2 fixed to the side of the fore

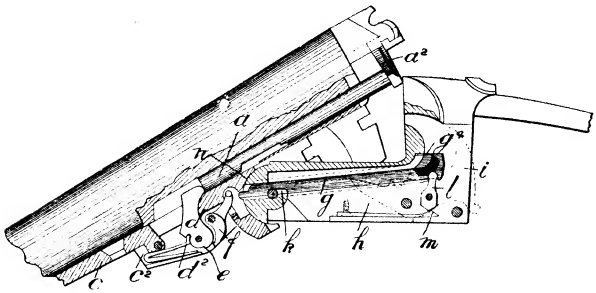


FIG. 98.

end c, the said arm d being forced when at liberty to move towards the break-off by means of the strong spring d^2 pressing under a shoulder on the said arm, as represented. The upper end of the arm d bears against the rod a of the divided extractor. The said arm d has a bent e at front, with which a lever f, similar to an ordinary sear, engages, the said sear-like lever f being carried by the same plate c^2 which carries the nearly vertical arm d. The upper arm of the lever f is bent out of the plane of the sear arm f; g is the oblique sliding rod working in and guided by a dovetailed groove in the body h of the gun. The front end of the sliding rod g has a nose piece, and adjoining the said nose piece is a curved part or incline, and the back end of the

sliding rod g has a projection at its side for the breast of the falling hammer i to strike against for giving the said rod a forward motion. The oblique sliding rod g is limited in its motion by the stop pin and slot at k, and the top end of the rod is supported upon the rocking arm l, the upper end of which engages in a recess in the said rod. Upon the V-shaped bottom of the rocking arm l the V-shaped end of the spring m acts. By means of the said spring m the sliding rod g is held in its forward and back positions respectively, according as the spring m bears upon one or other side of the V-shaped bottom of the rocking arm l. The said spring m also tends to force the rod g forward or backward, after it has been started, by the upper end of the rocking arm l being carried beyond one or other side of its centre; n is an inclined shoulder on the abutment of the fore end c for giving the starting backward motion to the sliding rod g by acting upon the incline on the said rod.

"When the gun has been discharged the sliding rod g has a forward position, the said rod having been brought into that position by the breast of the hammer i when discharged striking the side projection g^4, so as to start the said rod forward for a short distance for bringing the spring rocking arm l into operation, as before described. On lifting the barrels for re-charging the gun, the sear-like lever f strikes against the nose of the sliding rod g, and the said lever f is disengaged from the bent in the vertical arm d. The said arm d, being now urged forward by its spring d^2, strikes against the end of the extractor rod a, urging forward the extractor hook a^2 with a sudden motion, and thereby ejects the spent cartridge from the barrel. As the breech ends of the barrels are lifted the inclined projection on the abutment of the fore end c, acting on the incline on the rod g, forces the said rod slightly backward, so as to cause the spring rocking arm l to take it into the position represented in the figure 98. When the rod g is in the position at figure 98 its front end is not within the range of the motion of the crank arm of the sear-like lever f, and hence the ejecting mechanism is not

operated by the raising of the barrels; but the descent of the hammer *i* causes the sliding rod *g* to be brought into its advanced position, ready for releasing the ejecting mechanism on raising the barrels. On closing the barrels after discharge the extractor rod *a* forces back the arm *d* and compresses the spring d^2, the said arm *d* being held in its back position by the engagement of the sear-like lever *f* with the bent *e* in the said arm *d*."

Particulars as to the names and numbers of patents now in force relating to drop-down small arms will be found in the list given after our final article.

Express Rifles.

The term "Express" as indicating a rifle using a cartridge with a heavy charge of powder and a short light bullet for attaining high velocity and a flat trajectory, appears to have been first employed in 1856. Express rifles are used for big game shooting at close quarters, and a long point blank range is essential to enable the sportsman to fire without first calculating the distance of the animal. To ensure the expansion of the bullet on striking, the point is made hollow; on hitting the animal such a bullet will "mushroom" or flatten out, thereby increasing the shock. An American writer states that "hunters of elephants, tigers, &c., frequently insert a ·22 calibre blank cartridge in the cavity, making the missive explosive. There is always an element of danger about such ammunition. It should never be run through the magazine of a repeating rifle. When dangerous animals are hunted, it might impart a feeling of safety to the shooter to know that the cartridge in the chamber of his rifle ready for use was a miniature bombshell. The hole in the hollow ball should be of the proper depth and proportion to ensure penetration and spread when striking, and not fly to pieces, which is commonly the case."

CHAPTER XIV.

Pistols and Revolvers.

The word "pistol" has been said to be obtained from Pistoja, in Italy, on the assumption that such weapons were first made there, but another statement to the effect that it is derived from the word *pistallo*, meaning pommel, seems to be the more probable. In the collection of fire-arms at the Birmingham Art Gallery, a club pistol of early 15th century is exhibited; it appears to have been made prior to the invention of the matchlock, the weapon having to be held with one hand and fire applied with the other. The name pistol was first used as descriptive of short hand fire-arms in the middle of the 16th century. Pistols with wheel locks were largely produced during the 16th and 17th centuries, including a short heavy type known as the *dag*.

Revolver pistols existed in the 17th century, and revolver guns much earlier. A revolving arquebus is exhibited in the Tower of London as having belonged to Henry VIII.; it has a matchlock, and is provided with four chambers.

James Thompson, in his specification No. 3784, of the year 1814, describes a self-acting mechanism for revolving the "poli-chambers" of a single-barrelled flint-lock gun. The said chambers "are fixed in a segmental frame, which turns on a horizontal axis at right angles to the axis of the barrel, and are so constructed that they may be consecutively moved by hand or by apparatus actuated by the cock, so as to be opposite the breech end of the barrel; the outsides of the chambers and of the rear of the barrel are screwed, and when a chamber is opposite the barrel a clip or collar, screwed in its interior with a quick thread, is made by a half turn to move back on the screwed end of the barrel, and so join it with the chamber."

The specification of E. H. Collier, No. 4315, of the year 1818, describes a flint-lock revolver with a single barrel, and

having chambers "made of separate cylinders fastened together or bored out of a solid cylinder, forming a revolving breech piece. This chamber cylinder revolves on a pin and is moved round by a spiral spring like that of a watch, which requires to be wound up from time to time; it acts by means of a toothed wheel and a catch actuated by the lock motions."

Colt's first British patent specification relating to revolvers is No. 6909, of 1835; and the second, No. 12668, of 1849. Colt's specification No. 538, of 1853, also relates to revolvers.

W. Tranter's specifications Nos. 212 and 2921, of 1853, have reference to improvements in revolvers, also his specification No. 1913, of 1856.

The first specification in the name of Webley having reference to revolvers is No. 305, of 1853 (Philip Webley), entitled "Improvements in repeating pistols and other fire-arms." The single barrel of the weapon described in this specification "is attached to the lock frame by a hinge, so that it may be bent downwards in a plane parallel to the axis of the revolving breech piece, to enable the latter to be removed. The sear of the lock is attached to the hammer by a hinge joint instead of being connected with the trigger." Further improvements are described in the same inventor's specification No. 2127, of 1853.

The illustration at fig. 99 is from Webley's first specification, No. 305, of 1853. "A is the rotating cylinder in which are formed the chambers to receive the separate charges, as is common in such like fire-arms. B is the fixed metal part of the framing, which at its outer end at B^1 is formed into a pin or axis, upon which the barrel C is supported, and is capable of turning by means of the projecting arm C^1, so that when a fresh cylinder A has to be substituted for the one in use, or any change of cylinder has to be effected, the barrel C may be turned upon the axis B^1 to admit of such removal or replacing."

The inventor goes on to state that he is "aware that it has heretofore been proposed to arrange pistols of this descrip-

tion—that is, with one fixed barrel, and a series of charge chambers in a rotating cylinder, so that the barrel may be turned as upon a hinge, in order to permit of the withdrawal and replacing of a cylinder; but I believe in every case the part supporting the barrel has been caused to turn upon an axis lying across that of the axis of the rotating cylinder, and I mention this in order to state that one part of my improvements consists in forming an axis upon the framing, so that the main barrel may be permitted to turn thereon in a plane parallel to that of the axis of the rotating cylinder, as shown by the drawing, by which arrangement I have been

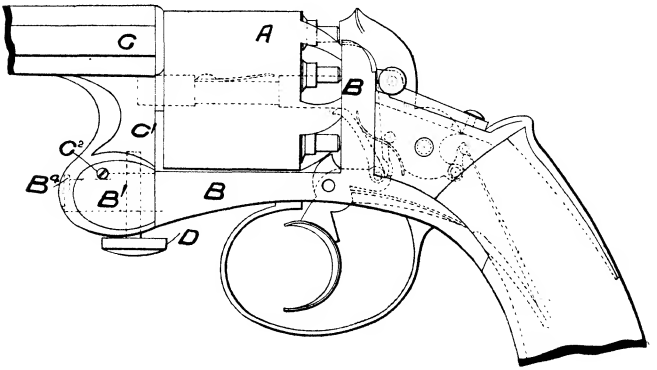


FIG. 99.

enabled to obtain great firmness of the parts during firing, combined with great facility in shifting the charge cylinders. When the parts are in position for firing, as shown at fig. 99, the barrel is held in position by the pin or bolt D, which, passing through the parts B^1, C^1, holds them correctly together. The pin or bolt D has affixed to it a spring, which gives elastic pressure to retain it in position. When a charge or a removal of a cylinder is required, this pin D has to be withdrawn, then the barrel C may be slided slightly along the axis B^1, but is prevented coming entirely off the axis B^1 by the pin C^2 coming against the shoulder

B^4, and the axis B^1 is cut away to admit of this sliding movement, whilst it also serves to guide the barrel correctly to and from its position in relation to the other parts of the fire-arm."

Robert Adams' specification No. 13527, of 1851, describes the construction of revolvers with a single barrel and a revolving cylindrical breech piece containing parallel chambers. "The breech piece revolves on an axis fixed in the rectangular frame, solidly connected with the barrel, and formed by the upper and under parts of the barrel being continued beyond the breech in the form of bars, and being connected with an upright bar in the rear. The axis may be taken out and the breech piece removed when requisite. The nipples are fixed in the rear of the breech

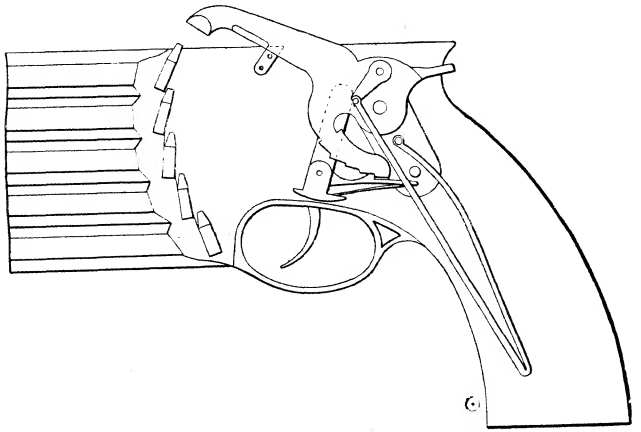


FIG. 100.

piece, and the hammer strikes through an opening in the rear bar of the frame. The breech piece is turned by a ratchet lever, which takes into ratchet teeth formed in its rear surface. The action of the trigger when it is pulled actuates the ratchet lever, and cocks and discharges the hammer. The breech piece is locked when a chamber is

exactly opposite the barrel during discharge by means of a stud fixed upon the trigger." Other improvements in revolvers by Robert Adams are described in the specifications Nos. 2712, of 1853, and 2645, of 1854.

Fig. 100 is an elevation, and fig. 101 an end view, of a repeating pistol, with five barrels arranged over and under each other, in the manner described in the specification (No. 2351, of 1853) of Richard and Charles John Jones, of Ipswich.

FIG. 101.

The nipples are "arranged in a curve, and the hammer or cock is mounted on an arm and connected to both ends of the main spring in such a manner as to strike in succession on the caps on the series of nipples."

Fig. 102 represents a pistol provided with an endless chain of chambers, in accordance with the invention of T. W. G. Treeby, as set forth in his specification No. 1552, of 1855. Treeby states that his invention "consists in substituting an endless chain of chambers for the revolving cylinder of chambers used ordinarily in revolving fire-arms. The endless chain of chambers is formed by hinging the single chambers to each other, side by side, and when in use the chambers are brought up in succession to be fired in the same manner as the chambers of ordinary revolving fire-arms are in succession brought up."

Fig. 103 is a longitudinal section of a Colt's revolver, as described in the specification No. 3981, of 1868, filed on behalf of the Colt's Patent Fire-arms Manufacturing Company. The invention is described as relating to "pistols or

rifles which have a revolving chambered breech or cylinder capable of being loaded from the front, the principal object of the said invention being to produce a device by which a revolver adapted for the use of loose ammunition can at small cost be so changed that cartridges having primed metallic shells may be used. It has for a further object to provide a revolver with means for the ejection at will of the cartridges or empty cases from the chambers of the rotating breech, and also to provide against accidental discharge of

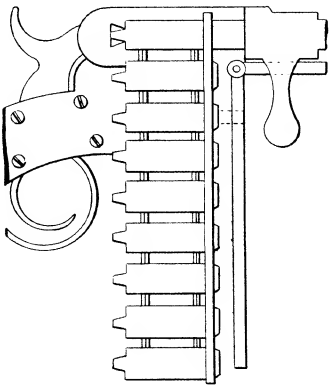


FIG. 102.

the weapon ; it has for a further object the re-loading of the empty cartridge shells by an attachment which can be placed upon and used with the arm, and also the provision of a suitable cartridge for the said arm."

Referring to fig. 103, A represents the frame, B the barrel, C the hammer, D the main spring, and E the cylinder. The rear ends of the chambers in the cylinder are open, and in a space between the frame and the said rear ends of the chambers the ring F is placed, such ring fitting loosely upon the central portion of the cylinder projecting beyond the chambers. The firing pin G is fitted in the ring F. The chambers of the cylinder are loaded from the front with

metal-cased cartridges, and to fire the charges the ring F is turned to bring the firing pin in line with the hammer; the charges may then be successively fired in the usual way

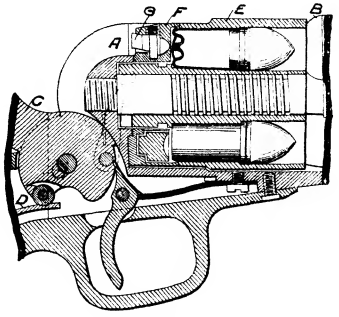


FIG. 103.

by cocking and snapping the hammer. After firing the charges the empty cases may be ejected by turning the ring

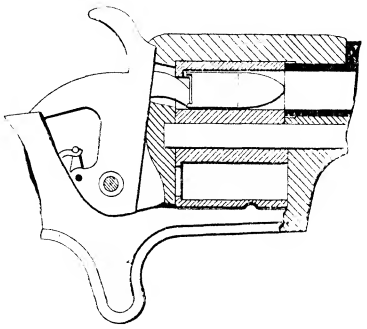


FIG. 104.

F in the reverse direction, and then operating the hammer by cocking and snapping it, as in the act of firing.

The sectional view at fig. 104 is from the specification No. 3987, of 1868, filed on behalf of Alfred Hotchkiss and

other American inventors, describing improvements in revolvers, comprising the provision of means for ready loading, firing, and for the extraction of the spent cartridge cases. The cartridges have a hollow flange at the rear end containing the fulminate priming, which is fired by the hammer striking through an opening in the rear of each chamber of the revolving cylinder.

The longitudinal section at fig. 105 from the specification No. 1510, of 1869, filed on behalf of Messrs. Smith and Wesson, of Springfield, Massachusetts, shows a revolver "in which the act of swinging the barrel forward, away from the recoil block, extracts all the cartridge shells at once." The extractor A has a flat plate or head, which lies in a recess at the rear of the revolving cylinder B, and forms a part of the surface against which the cartridge rims lie. The shank of the extractor extends through the hollow pin C, on which the cylinder turns or revolves. The forward end of the extractor shank is coupled to the rack D in such a manner that the shank can revolve without turning the rack. The toothed wheel E in the joint F engages with the rack D. "The peculiarity of this pinion is that when the barrel is swinging forward the pinion first revolves about one-eighth part of a turn, giving the cartridge shells room to clear the breech block before they are started from the chambers of the revolving cylinder; the pinion is then caught and held by a pawl G at the lower side, the rack being consequently forced back or left behind, and with it the extractor, which as the barrel is turned further forward on the hinge pushes out the shells, the head of the extractor catching under their flanges, as shown at H. A projection is formed on the stock in front of the pinion, and when the barrel is swung far enough for this projection J to strike against the head of the pawl G and push it back, the pinion revolves freely and the rack flies forward to its former position, carrying with it the extractor, and also turning the pinion until it occupies its first place relative to the rack. In order to thus impel the rack forward when the pinion is released any suitably-arranged spring may be used."

The Webley revolver, which is now the Government service weapon, was preceded by the Adams and the Enfield revolvers. The cartridges for the Adams revolver contained a bullet of pure lead, weighing 225 grains, with a charge of

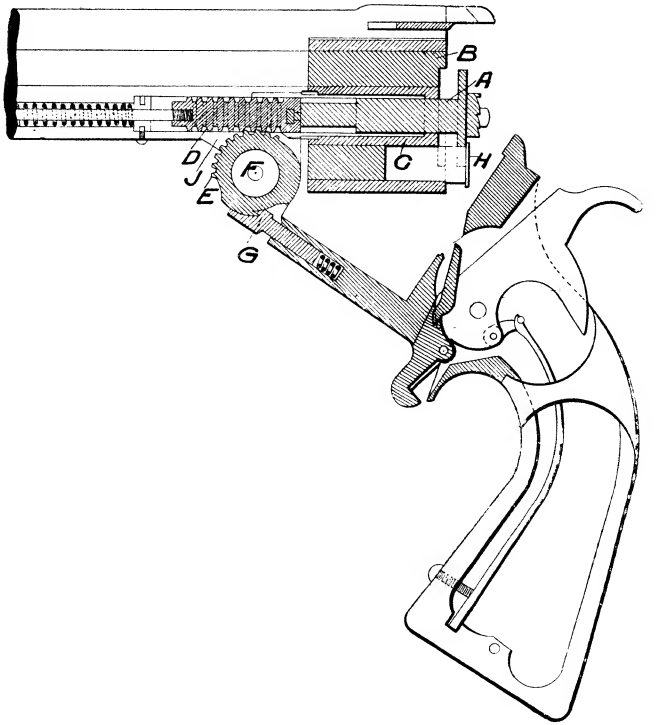


FIG. 105.

13 grains of powder. The Enfield pistol cartridge had a solid drawn brass case containing a charge of 18 grains of powder, and a bullet weighing 265 grains (12 parts lead and one part tin, as with the Martini-Henry bullet), and fitted with a clay plug ; in the early patterns the diameter of the

bullet was ·455 in., but in a later pattern the diameter was increased to ·477.

In the present Webley service revolver the pulling of the trigger automatically raises the hammer and rotates the cylinder until one of the cartridge chambers is brought into line with the barrel. The spent cartridge cases are ejected on the depression of the action lever. The calibre is ·455, the barrel 4 in. long, and the weight of the revolver 2 lb. 3 oz. The revolving cylinder is provided with five chambers. The cartridge, with its conical-headed bullet, weighing 265 grains, is shown at fig. 106; the charge is 18 grains of black powder or six grains of cordite.

But a new bullet for the Webley revolver, known as the "man-stopping bullet," has been invented by Mr. Thomas Webley, and is described in his specification No. 14754, of 1897. At a recent meeting of his company (Webley and

FIG. 106.

FIG. 107.

FIG. 108.

FIG. 109.

Scott), the chairman stated that the Inspector-General of Ordnance had notified on behalf of the War Office the adoption of this bullet for the land service, the question of its adoption for the naval service being still under consideration. Fig. 107 shows Webley's man-stopping bullet, with cartridge, fig. 108 a section of the bullet alone, and fig. 109 the appearance of the bullet after passing through 6 in. of flesh. The *Field*, of August 7th, 1897, in referring to this bullet, says: "Pistols and revolvers are weapons intended for use at close quarters, when it is generally a case of life or death, and where there is no room for sentiment, as the enemy must be instantly placed *hors de combat*. In order to attain this result the weapon should be of large calibre,

and the bullet so formed that, instead of punching a clean hole and passing on with almost undiminished velocity, it must be made to give up the whole of its energy in administering the greatest possible shock. We do not know who is responsible for the design of the Government service bullet for revolvers, but a greater absurdity could not well have been perpetrated. The accompanying illustration of the service bullet, fig. 106, is sufficient to convince even a tyro that the projectile was designed for long-range shooting, and if fired from a rifle it would no doubt give excellent results at a range of 500 yards. To prove that the service bullet is utterly devoid of stopping properties, unless it strikes a vital part, we fired it through 18 in. of solid beef, with the result that the projectile was uninjured, and could have been re-loaded and fired a number of times. After the passage of the projectile the hole in the beef closed up, and an examination had to be made to discover the points of entry and exit. Messrs. P. Webley and Sons' patent man-stopping bullet is made of lead of the form shown, and it will be noticed that the expansive principle has been carried to its greatest extent, and there cannot be the slightest doubt as to its stopping properties. Upon entering the flesh the front of the bullet acts like a wadding punch, cutting out a clean round hole, which does not close up. Expansions commence immediately, and after the bullet has travelled 6 in. it produces a jagged hole from 3 in. to 4 in. in diameter. A wound such as this would doubtless be sufficient to instantly finish even a fanatic. With regard to accuracy, the new bullet is superior to the service bullet; this is due to the lessened recoil and jump of the pistol. The cartridges are lighter, and when packed take up much less space." The weight of the bullet is 220 grains, as against the 265 grains of the service bullet.

CHAPTER XV.

Automatic and Self-loading Fire-arms.

The magazine rifles now in use do not attain the ideal of many people in the matter of rapidity of fire. A Tyneside engineer (Mr. James Judge) has recently described to the representative of a London newspaper a gun he has invented to discharge its missiles by centrifugal force, as with the ancient sling ; when perfected Mr. Judge hopes to discharge his bullets at the rate of 30,000 per minute. From a disc (to be revolved at a great rate either by hand or by mechanism mounted upon a motor car) project what are described by the reporter as "two hands," and as the bullets are poured from a hopper into the casing containing the revolving disc they are "caught by the hands which, in coming round, rain them out in a continuous stream through an orifice. They are guided into a sleeve which may be elevated or depressed and sighted like the muzzle of a rifle." The bullets are to be impelled at a tremendous muzzle velocity, and if all that Mr. Judge claims for his invention can be sustained, his weapon will, as the reporter puts it, "mean absolute annihilation to an enemy at close quarters." It may prove disappointing, however, if, as in a case which will be fresh in the memory of all, the "enemy," after many tons of metal have been discharged at him, officially returns his total loss as but "one mule." The complete specification of Mr. Judge does not yet appear to have been filed ; the number and title of the provisional specification is 8516, of 1898, "Centrifugal gun, quick-firing, for war purposes." The weapon cannot be termed a fire-arm, but may be classed with machine guns.

An automatic repeating rifle, in which the force of the recoil is employed to open the breech, eject the spent cartridge case, cock the firing mechanism, re-charge with a fresh cartridge, and finally to close the breech, appears

likely to be the future small arm, and several inventors are now working in this direction.

The longitudinal section, fig. 110, of a rifle of the Martini type is from the specification No. 22859, of 1891, of Hiram Stevens Maxim, who states that the object of his invention "is to construct an arm which, though capable of being operated by hand, is provided with simple and efficient automatic mechanism which the pressure of the powder gases in the barrel will operate to open the breech after a discharge, eject the spent cartridge and cock the firing pin, and re-close the breech on the insertion of a fresh cartridge in the chamber."

In the illustration the parts of the weapon are shown in the positions they occupy just previous to the firing of the cartridge W.

"When the cartridge is fired the powder gases from the barrel have access through the orifice G^1 to the cylinder G when the projectile has passed the aforesaid orifice in its

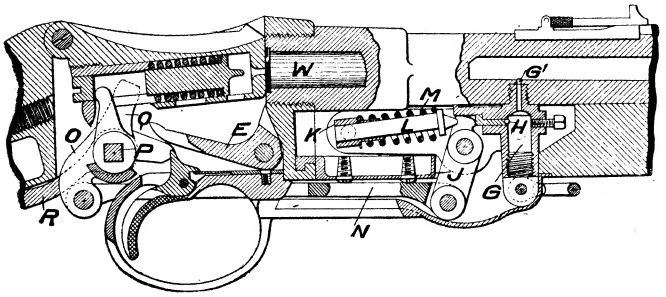


FIG. 110.

passage through the barrel. The powder gases act upon the inner end of the piston or plug H, and force it outward; they may act upon the said piston or plug either directly or through the medium of any suitable fluid or other material, such as tallow, for example, which may be placed in the said cylinder for the purpose of receiving the pressure of the

gases, and transmitting it to the piston or plug H. When the piston or plug H is moved outward, as aforesaid, it turns the lever J upon its pivot pin. The short arm of the said lever compresses the spring M by moving the rod L endwise in the guide K. The long arm simultaneously operates the rod N to turn the action lever O upon the axis pin P, so that the said action lever, by means of the tumblers Q, turns the breech block down, and opens the breech. The action lever, when operated automatically, moves away from the hand lever R, and does not affect it, as the said hand lever is kept stationary by the usual catch, or by any other suitable means. The breech block when lowered effects the cocking of the firing pin and operates the extractor in the customary manner, but the hook on the extractor E engages with the said block and keeps it down, in opposition to the action of the spring M, which, therefore, remains compressed as long as the breech block is down. The said hook releases the breech block when a fresh cartridge is pushed into the chamber, and allows the spring M to extend, and to actuate automatically the two-armed lever J, so that the latter returns the small piston or plug H to its normal position in readiness for further operation, and, through the medium of the rod N and action lever O, raises the block to close the breech."

Mannlicher's specification No. 6787, of 1892, describes an invention relating to "that class of fire-arms in which the force of the recoil of the shot is employed for operating the breech bolt, and has for its object the construction of an improved automatic gun of this description, in which the opening of the breech bolt is effected by the recoil, and closing by a spring."

Mannlicher's specifications Nos. 16548, of 1893, and 2687, of 1894, also relate to automatic fire-arms, the weapon described in the first-named specification being provided with "a so-called double or combined motion breech bolt," whereas the weapon described in the latter specification has "a so-called single-motion or straight-pull breech bolt. In both arms the breech bolt is operated by the recoil of the

shot in its opening or rearward direction, and by a spring in its closing or forward direction, the barrel, contrary to most automatic fire-arms known, being stationary."

Paul Mauser, in his specification No. 959, of 1896, states that the invention described therein has for its object "a magazine repeating fire-arm with a movable barrel, in which the recoil caused by the shot is used to unlock the bolt and open the breech, to eject the empty cartridge case and to cock the firing mechanism, as well as to compress a number of springs arranged in such a manner as to effect the loading of a fresh cartridge, the re-closing of the breech and locking

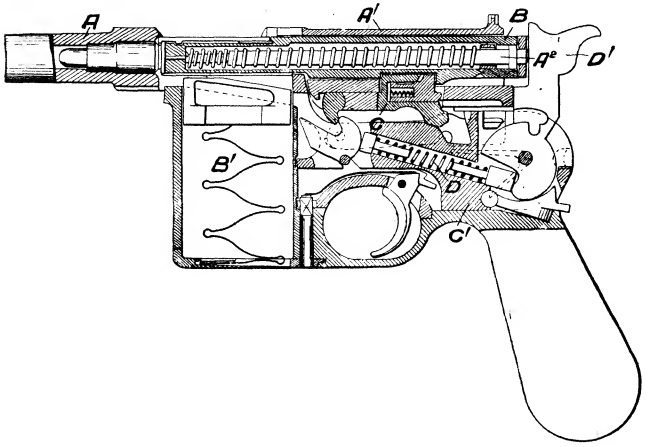


FIG. 111.

of the bolt, and the advancing movement of the barrel. Upon these principles, which are already partly known, I have devised a magazine fire-arm in which all previous experiences in respect to this class of arm have been carefully taken into consideration, not only with regard to its ballistic qualities, but especially by the peculiar skilful construction of the component parts, and the manner of

connecting them without the aid of screws; it may, therefore, be considered that the improved fire-arm is in every way well adapted for military purposes."

Fig. 111 is a vertical longitudinal section of an automatic repeating pistol constructed in accordance with Mauser's invention. The barrel A has an extension A^1 forming a breech casing for the breech bolt B, which is held forward by a spring supported by a pin A^2 passing through a slot in the breech bolt. The breech bolt is locked in its closed position by a hinged locking piece C, having a pivot forming a projection against which the main spring D acts. When the pistol is discharged the barrel recoils a short distance, during which a projection on the locking piece C is drawn down into a recess in the block C^1 by the action of the main spring D, and the breech bolt is thereby unlocked. The barrel then stops, but the breech bolt B continues to recoil, cocking the hammer D^1, opening the breech, extracting the spent cartridge, and allowing a fresh cartridge to rise from the magazine B^1 into line with the breech bolt. The reaction of the breech bolt spring carries the bolt forward again to load the weapon and close the breech. The magazine is similar to that described in Mauser's specification No. 15390, of 1893.

The Mauser automatic pistol as now sold will shoot 1,000 yards, and its rapidity of fire is far superior to the ordinary revolver. Six shots can be fired per second, and eighty shots per minute. Each complete set of cartridges for the magazine is retained in a cartridge holder or clip, and "the time required to fill the magazine is less, and the movements fewer and simpler, than in loading one cartridge into a revolver."

Theodor Bergmann, of Gaggenau, Baden, manager of the Eissenwerke Gaggenau Actiengesellschaft, in his specification No. 11509, of 1893, states that "it has been found, particularly in fire-arms of the Flobert type, that the hammer under the influence of the main spring constitutes of itself, to a certain extent, a breech closure. But if the charge be

increased, then the pressure of the gases generated by the ignition and explosion of the explosive used in the cartridge forces open the said breech closure and throws out the cartridge case to the rear, the projectile nevertheless retaining a certain momentum. Taking advantage of this fact, I construct a breech-closing mechanism which has great advantages, particularly as applied to that class of small arms termed pistols." The general action is described as follows: "When a cartridge is fired in the barrel by pulling the trigger, the pressure of the gases is generated so rapidly and is so great upon the walls of the cartridge case that the latter, in combination with the breech bolt and the breech closure, cannot move back immediately. After the projectile has received a sufficient amount of propelling force, the powder gases, still in excess, open the breech and the breech bolt is forced back to its utmost limit, the spent cartridge being ejected and the lock mechanism cocked anew. During the forward movement of the breech bolt another cartridge is passed in the well-known manner out of the magazine into the barrel. The finger allows the trigger to move back for renewed pulling, and the weapon is again ready for firing." Bergmann states that this construction "is, in comparison with existing automatic fire-arms, extremely simple and is very suitable for military purposes, especially as a substitute for revolvers, because it is even more simple than the latter, and it allows of more accurate and more rapid firing, and it gives most excellent results, more particularly when the explosive used is smokeless powder."

Other improvements relating to automatic small arms by T. Bergmann or his company are described in the following specifications: 13070, of 1894; 10301, of 1895; and 17251, of 1897.

The Bergmann self-loading pistol now on the market is sold as capable of firing 30 shots per minute. Great precision is claimed for the weapon, and a range of 1,000 yards.

A New Service Bullet for the British Army.

The following particulars relating to the above appeared in the *Times* of June 28th, 1898 :—

"A new service bullet, just adopted by the War Office, will be used for the first time in the Khartoum expedition. Several million rounds are being sent out for the use of the infantry who are going out to Egypt. The reason assigned for the change in the service bullet is that the Lee-Metford, though it is more deadly at ten times the range of the old musket ball, does not disable an enemy as effectively as is considered desirable. Soldiers have been known to go on fighting after half a dozen Lee-Metford bullets have gone through them, whilst the bullet itself has passed through two or three men consecutively, shock being sacrificed for penetration. The Dum-dum bullet, now also superseded, came into use for the purpose of stopping the rush of hordes of fanatics, as it had the advantage of spreading out and breaking up whenever it encountered resistance; but there has recently been some discussion in France as to the propriety of remonstrating with the British War Office on the ground that it is contrary to the convention made with other European powers in 1868. The new service bullet is the same diameter, weight, and length as the Lee-Metford bullet, and fits all the service rifles and machine guns. The case is of nickel, the base only being filled with lead. The conical end is left empty, and when it strikes the enemy burrs, opens backward, and lodges in the body, penetration being lessened and shock increased. The new bullet is spoken of as 'the man-killing bullet,' in contradistinction to 'the man-penetrating bullet.'"

The *Engineer* of July 8th, 1898, in referring to the foregoing description given by the *Times*, says: "It is not correct to speak of the new bullet as having a hollow conical nickel head, and only containing lead in the base. The lead runs up to the point inside the nickel to the same extent as the lead in the Snider-Boxer bullet. That is to

say, a bullet with the ordinary form of point has a small cylindrical hollow made in the axis, the nickel being run to the edge, and a disc of nickel being pressed down to the bottom of the cylindrical hollow. As we have often pointed out, it is a matter of some delicacy to make a bullet spread sufficiently to give it stopping power and shock, and yet not to fly and form what is termed a cruel bullet."

CHAPTER XVI.—Patents Now in Force.

Breech Actions and other Details of Automatic, Repeating, and other Guns.

No.	Name.
	1884.
1820	Carter, J.
2555	Carter, J.
5087	Gardner, W.
16948	Francotte, A.
	1885.
6373	Mannlicher, C. F.
	1886.
2610	Quackenbush, H. M.
7354	Maxim, H. S.
14815	Mannlicher, K. F. & T.
	1887.
6335	Speed, J. J.
11319	Lee, J. P.
11335	Speed, J. J.
14916	O'Kelly, J.
	1888.
5709	Mauser, P.

No.	Name.
	1889.
9773	Mannlicher, F.
15371	Mauser, P.
18014	Mauser, P.
	1890.
8672	Daudeteau, L. M. R.
19145	Penn, F. J., and Deeley, J.
20185	Daudeteau, L. M. R.
	1891.
2690	Berthier, A. V. P. M.
2984	Laumann, J.
6840	Ostrander Repeating Gun Co.
11130	Catlin, R. M.
22859	Maxim, H. S.
	1892.
3762	Topham, J. H.
12824	West, D. S.
16730	Woodgate, H. F., and Griffiths, W.
17082	Krag, O. J. H., and Jörgensen, E.
18823	Laumann, J.
	1893.
1941	Mauser, P.
3856	Russell, A. H.
6539	Brun-Latrige, P.
7003	Ricci, C.
7383	Ross, Sir C. H. A. F. L.
11692	Darche, P.
15390	Mauser, P.
16548	Mannlicher, F. R. Von.
19019	Lee, J. P.
25089	Bergmann, T.
	1894.
2491	Mannlicher, F. R. Von.
2687	Mannlicher, F. R. Von.

No.	Name.
3996	Duni, A.
7156	Kaiser, J., and Schneider, A.
7838	Raschein, G.
9537	Mc.Clean, S. N.
10068	Taylor, L. B.
11139	Meig, A.
11205	Ostrander, W. H.
11975	Brighton, W. H.
12857	Browning, J. M. and M. S.
13070	Eisenwerke Gaggenau Actiengesellschaft.
13787	Brun-Latrige, P.
16205	Russell, A. H, and Livermore, W. R.
16470	Dougherty, A. G., and Buskirk, T. B.
16861	Ashton, T. R. R., and Kelly, E. J.
17578	Holland, H. W., and Woodward, T.
18281	Mannlicher, F. R. Von.
19083	Courrier, J.
19965	Luger, G.
20792	Woodgate, H. F.
23726	Lisle, M. C., and Berkey, W. A.

1895.

11349	Hutchinson, J. R.
12578	Bonehill, C. G., and Tunstall, A.
14876	San Francisco Arms Co.
15232	Mauser, P.
15233	Mauser, P.
17084	Luigi, J. F., and Maturié, M. G.
17580	Cei, A.
17882	Taylor, L. B.
18866	Lee, J. P.
20109	Fraser, D.
21547	Waffenfabrick Mauser, and Mauser, P.
22018	Theodorovic, W.
25042	Clausius, C. H. R.

No.	Name.
	1896.
5683	Ross, Sir C. H. A. F. L.
6755	Lundgren, J. W., and Viau, M. Z.
7535	Fell, J.
8182	Schwarzlose, A. W.
8408	Ashton, T. R. R.
9570	The Lee Arms Co.
9925	The Lee Arms Co.
14206	Luger, G.
15238	Putnam, G. H.
17672	Gabbett-Fairfax, H. W.
21546	Gabbett-Fairfax, H. W.
21664	Gabbett-Fairfax, H. W.
26872	Ashton, T. R. R.
28484	Pieper, H.
29836	Maxim, H. S., and Silvermann, L.
	1897.
1328	Lines, A.
5388	Webley, T. W. and H.
9282	White, G. S., and Simpson, W.
9527	San Francisco Arms Co.
9871	Colt's Patent Fire-arms Manufacturing Co.
11646	Johnstone, D. V., and Taylor, L. B.
16968	Sjögren, C. A. T.
17042	Hawksley, A. F., and Jackson, R.
17251	Bergmann's Industriewerke.
	1898.
1934	Schwarzlose, A. W.
6628	Winborg, J. T.

Drop Down Small Arms.

No.	Name.
	1884.
1820	Carter, J.
14526	Deeley, J.
	1886.
4289	Deeley, J.
	1887.
1281	Smallman, J. W.
9399	Dickson, J.
10621	Dickson, J.
	1888.
3100	Wem, W.
4360	Grant, S. A.
6913	Penn, F. J., and Deeley, J.
	1889.
2563	Nouvelle, A.
12314	Southgate, T.
	1890.
662	Southgate, T.
17292	Baker, W.
19395	Ross, J.
20880	Lilleyman, G.
	1892.
18805	Perkes, T.
	1893.
800	Holland, H. W.
8239	Southgate, T.
18114	Hollenbeck, F. A.
18558	Greener, W. W.
	1894.
2658	Ford, W., and Hill, R.
5897	Robertson, J.
6228	Conner, J., Barker, F. W., and Moore, J. T.

No.	Name.
6269	Ahlgren, C. F.
7242	Thorn, H. A. A., and Wilkinson, W. F.
9585	Smallman, J. W.
13130	Nobbs, W.
16272	Ricci, C.
19300	Mills, S.
19826	Middleton, H.
22719	Latham, J. F. and H. W.
22894	Robertson, J.
23367	Thorn, H. A. A., and Bodin, W.
23751	Holland, H. W., and Woodward, T.

1895.

228	Greener, W. W.
482	Rider, J.
1844	Jones, W. P., and Baker, W.
4287	Tranter, T. M.
5543	Jones, W. P., and Baker, W.
8648	Beesley, F.
10133	Beesley, F.
10828	Bachmann, F. H.
11750	Mayer and Grammelspacher.
12060	Smallman, J. W.
13063	Hill, R., and Smith, J. V.
13251	Potter, G. D.
17040	Cashmore, W.
18135	Robertson, J., and Adams, W.
20598	Lane, C., J. B., and E.
21346	Penn, F. J., and Deeley, J.
24426	Cashmore, W.

1896.

1415	Bennett, E.
5151	Ellis, C. O., Wilkinson, E. W., and Cashmore F.
6639	Krupp, F.
7570	Haurat, J., and Castaderé, J.

No. Name.

12234 ..... Bouckley, G.
17291 ..... Whiting, W. J.
23865 ..... Baker, J. A.
27326 ..... Clement, B. H., and Johnson E.

1897.

1847 ..... Robertson, J., and Adams, W.
2988 ..... Robertson, J., and Adams, W.
7521 ..... J. Maréchal.
9922 ..... Solodovnikoff, W.

MAGAZINES FOR REPEATING RIFLES.

1884.

606 ..... Maxim, H. S.

1889.

8117 ..... Lee, J. P.
9773 ..... Mannlicher, F.
18430 ..... Krag, O. J. H., and Jörgensen, E.

1890.

8672 ..... Daudeteau, L. M. R.

1891.

2984 ..... Laumann, J.

1892.

10130 ..... Mauser, P.
13550 ..... Mauser, P.
14314 ..... Mauser, P.

1893.

3856 ..... Russell, A. H.
8465 ..... Young, J.
15833 ..... Clair Bros.

1894.

11361 ..... Burgess, A.
16205 ..... Russell, A. H., and Livermore, W. R.
16272 ..... Ricci, C.

No.	Name.
16862	Ashton, T. R. R., and Kelly, E. J.
20792	Woodgate, H. F.
23726	Lisle, M. C., and Berkey, W. A.
	1895.
1905	Chaine, W.
14876	San Francisco Arms Co.
15453	Fosbery, G. V.
17084	Luigi, J. F., and Maturié, M. G.
17580	Cei, A.
18866	Lee, J. P.
22018	Theodorovic, W.
22921	Topham, J. H.
25042	Clausius, C. H. R.
	1896.
7535	Fell, J.
9570	The Lee Arms Co.
9925	The Lee Arms Co.
14206	Luger, G.
15238	Putnam, G. L.
	1896.
17672	Gabbatt-Fairfax, H. W.
26872	Ashton, T. R. R.
28484	Pieper, H.
29836	Maxim, H. S., and Silvermann, L.
	1897.
1328	Lines, A.
	1898.
5917	Wesson, J. H.

MISCELLANEOUS.

	1886.
17054	Silver, H. A., and Fletcher, W.
	1887.
8501	Holland, H. W.
17944	Speed, J. J.

No.	Name.
	1888.
7045	Mauser, P.
	1889.
5372	Jones, W. P.
5485	Morris, R.
	1890.
2307	Morris, R.
5583	Mauser, P.
7076	Morris, R.
18315	Bonnin, E. M. de F.
	1891.
2383	Mauser, P.
2850	Mauser, P.
	1892.
2940	Mauser, P.
7239	Mauser, P.
12324	Penn, F. J., and Deeley, J., senr.
12569	Winans, W.
14613	Jones, E., and Townsend, R.
23249	Boreham, J. S.
23452	Varriale, P.
23456	Wallis, S. J.
23496	Sauer, R. and F.
	1893.
9450	Mansfield, W.
11283	Boynton, F.
19600	Simpson, W. S.
24801	Wyatt, A. J. H.
	1894.
1934	Quinton, A. and W.
3770	Hedges, K. W.
6022	Perkes, T.
7400	Mauser, P.
8446	Parker, A. G., and Browne, H. J.

No.	Name.
8892	James, E.
10986	Watson, T. W. and A. H., and Brain, T.
11096	Holland, H. W.
13802	Batcock, C. E. and J. W.
15108	Granger F. de W.
15602	Fairbanks, M. W.
16615	Nelson, F. T.
24609	Godsal, O. T.

1895.

1394	Gilbert-Russell, T.
3274	Behrens, F.
3420	Perkes, T.
4005	Harrison, E.
5517	Thorn, H. A. A.
5637	Smith, T. H.
6251	Keese, C. J. F., and Meine, F. W.
7269	Stuart, O., and Ashcroft T. H.
7638	Wilson, A. J., and Steward, J. H.
12315	Lyman, W.
13539	Watkin, H. S. S.
14093	Tippet, H. G.
14179	Mullineux, M.
14436	Colts Patent Firearms Manufacturing Co.
15056	Mallock, A.
17605	Carlson, A. G.
19448	Behrens, F.
20158	Sarjeant, W. C. E.
20541	Appleyard, G. P.
21258	Lazard, E.
21745	Merrem, F.
22040	Hanson, N. G.
24536	Kjaer, V., Johansen, C., and Zinn, J.

1896.

1083	King, T.
1772	Kjaer, V., Johansen, C., and Zinn, J.

No.	Name.
2422	Southgate, T.
2769	Holland, H. W., and Woodward, T.
3226	McKoen, G., Lewis, G. and W.
3337	Barratt, L.
7246	Phillips, H. F.
8648	Willis, A.
9397	Gehlich, P.
11068	Holland, H. W., and Mansfield, W.
12642	Scuri, A. G. B.
13492	Smallman, J. W.
16279	Kindersley, C. P. W.
16742	Colbert, C.
16937	Richards, J.
20088	Holland, H. W., and Woodward, T.
21622	Greener, H.
21969	Abella, E. C.
22365	Andrews, H.
25994	Brazier, G., and Cashmore, W.
26282	Heinrich, F. E.
27310	Granger, F. de W.
27997	Pook, J. W.

1897.

301	Rigby, J., and Atkins, L. E.
650	Pieper, H.
2955	Southgate, T.
3548	Martin, J. E.
3982	Watson, T. A.
3988	Smallman, J. W.
4149	Mullineux, M.
4395	Martin, J. E., and Reid, D.
4429	Foulkrod, J.
4893	Holland, H. W., and Woodward, T.
4921	Abella, E. C.
5110	Bland, E. J.
5130	Booth, J. R.

No.	Name.
5304	Jeffery, W. J.
5404	Beesley, F.
6141	Baker, F. T. K.
10082	Francotte, A. and Co.
11312	Duffek, A.
12003	Boger, E.
12573	Johnstone, D. V., and Taylor, L. B.
14523	Schlegelmilch, E.
14592	Nobbs, W.
14876	Taylor, L. B.
14877	Green, E. C. and F.
15065	Woolfson, L. E. G. de, and Smallwood, S.
15066	Woolfson, L. E. G. de, and Smallwood, S.
22624	Woolfson, L. E. G. de, and Smallwood, S.
23964	Jordan, A.
24659	Bernstein, M.
26206	Weston, A.

1898.

8759	King, J.

PISTOLS.

1893.

144	Mimard, E., and Blachon, P.
11509	Bergmann, T.
18774	Borchardt, H.

1894.

1483	Kimball, W. W.
1778	Engh, C., and Paquot, J.
18887	Stier, C.

1895.

9490	Schwarzlose, A. W.
10301	Bergmann, T.
18686	Gabbett-Fairfax, H. W.

No.	Name.
	1896.
959	Mauser, P.
17808	Gabbett-Fairfax, H. W.
17809	Gabbett-Fairfax, H. W.
	1897.
3771	Gordon-Smith, R.
10142	Reble, L.
13345	Francotte, C.

PNEUMATIC SMALL ARMS.

	1889.
11050	Giffard, P.
	1890.
2868	Eichbaum, H.
	1894.
4544	Langenhan, F.
22930	Banks, B. R.
	1895.
4168	Argles, A.
7932	Hornhauer, T.
11750	Mayer and Grammelspacher.
20598	Lane, C., J. B., and E.
23188	Hornhauer, T.
	1896.
11749	Markham, W. F.
12763	Will, O.

REVOLVERS.

	1884.
1820	Carter, J.
2555	Carter, J.
	1885.
4070	Webley, H., and Carter, J.

No.	Name.
	1886.
1923	Whiting, W. J.
	1888.
5778	Carter, J., and Whiting, W. J.
16638	Carter, J.
	1891.
3427	Whiting, W. J.
	1893.
17790	Latham. J. F.
19544	Finnegan, P. H.
19861	Latham, J. F.
	1894.
6184	Wesson, D. B.
14010	Nagant, L.
16308	Paul, E.
	1895.
1905	Chaine, W.
15453	Fosberry, G. V.
	1896.
12470	Fosberry, G. V.
24155	Fosberry, G. V.
25561	Praunegger, F., and Schmidt, L. P.
	1898.
10145	Lines, A.

Name Index of Patentees.

Name.	No.	Year.
Bergmann's Industriewerke	17251	1897
Bergmann, T.	10301	1895
Berkey, W. A., and Lisle M. C.	23726	1894
Bernstein, M.	24659	1897
Berthier, A. V. P. M.	2690	1891
Blacon, P., and Mimard, E.	144	1893
Bland, E. J.	5110	1897
Bodin, W., and Thorn H. A. A.	23367	1894
Böger, E.	12003	1897
Bonehill, C. G., and Tunstall, A.	12578	1895
Bonnin, E. M. de F.	18315	1890
Booth, J. R.	5130	1897
Borchardt, H.	18774	1893
Boreham, J. S.	23249	1892
Bouckley, G.	12234	1896
Boynton, F.	11283	1892
Brain, T., and Watson, T. W. and A. H.	10986	1894
Brazier, G., and Cashmore, W.	25994	1896
Brighton, W. H.	11975	1894
Brown, H. J., and Parker, A. G.	8446	1894
Browning, J. M., and M. S.	12857	1894
Brun-Latrige, P.	6539	1893
Brun-Latrige, P.	13787	1894
Burgess, A.	11361	1894
Buskirk, T. B., and Dougherty, A. G.	16470	1894
Carlson, A. G.	17605	1895
Carter, J.	1820	1884
Carter, J.	2555	1884
Carter, J.	16638	1888
Carter, J., and Webley, H. J.	4070	1885
Carter, J., and Whiting, W. J.	5778	1888
Cashmore, F., Wilkinson, E. W., and Ellis, C. O.	5151	1896
Cashmore, W.	17040	1895
Cashmore, W.	24426	1895

Name.	No.	Year.
Cashmore, W., and Brazier, G.	25994	1896
Castaderé, J., and Haurat, J.	7570	1896
Catlin, R. M.	11130	1891
Cei, A.	17580	1895
Chaine, W.	1905	1895
Clair Bros.	15833	1893
Clausius, C. H. R.	25042	1895
Clement, B. H., and Johnson, E.	27326	1896
Colbert, C.	16742	1896
Colt's Patent Firearms Co.	14436	1895
Colt's Patent Firearms Manufacturing Co.	14436	1895
Colt's Patent Firearms Manufacturing Co.	9871	1897
Conner, J., Barker, F. W., and Moore, J. T.	6228	1894
Courrier, J.	19083	1894
Darche, P.	11692	1893
Daudeteau, L. M. R.	8672	1890
Daudeteau, L. M. R.	20185	1890
Deeley, J.	14526	1884
Deeley, J.	4289	1886
Deeley, J., and Penn, F. J.	6913	1888
Deeley, J., and Penn, F. J.	19145	1890
Deeley, J., and Penn, F. J.	12324	1892
Deeley, J., and Penn, F. J.	21346	1895
Dickson, J.	9399	1887
Dickson, J.	10621	1887
Dougherty, A. G., and Buskirk, T. B.	16470	1894
Duffek, A.	11312	1897
Duni, A.	3996	1894
Eichbaum, H.	2868	1890
Ellis, C. O., Wilkinson, E. W., and Cashmore, F.	5151	1896
Engh, C., and Paquot, J.	1778	1894
Fairbanks, M. W.	15602	1894

Name.	No.	Year.
Fairfax-Gabbett, H. W.	18686	1895
Fairfax-Gabbett, H. W.	17672	1896
Fairfax-Gabbett, H. W.	17808	1896
Fairfax-Gabbett, H. W.	17809	1896
Fairfax-Gabbett, H. W.	21546	1896
Fairfax-Gabbett, H. W.	21664	1896
Fell, J.	7535	1896
Finnegan, P. H.	19544	1893
Fletcher, W., and Silver, H. A.	17054	1886
Ford, W., and Hill, R.	2658	1894
Fosbery, G. V.	15453	1895
Fosbery, G. V.	12479	1896
Fosbery, G. V.	24155	1896
Foulkrod, J.	4429	1897
Francotte, A.	16948	1884
Francotte, A and Co.	10082	1897
Francotte, C.	13345	1897
Fraser, D.	20109	1895
Gabbett-Fairfax, H. W.	18686	1895
Gabbett-Fairfax, H. W.	17672	1896
Gabbett-Fairfax, H. W.	17808	1896
Gabbett-Fairfax, H. W.	17809	1896
Gabbett-Fairfax, H. W.	21546	1896
Gabbett-Fairfax, H. W.	21664	1896
Gaggenau, Eisenwerke Actiengesellschaft	13070	1894
Gardner, W.	5087	1884
Gehlich, P.	9397	1896
Giffard, P.	11050	1889
Gilbert-Russell, T.	1394	1895
Godsal, P. T.	24609	1894
Gordon-Smith, R.	3771	1897
Granger, F. de W.	15018	1894
Granger, F. de W.	27310	1896
Grant, S. A.	4360	1888
Grammelspacher and Mayer	11750	1895

Name.	No.	Year.
Green, E. C. and F.	14877	1897
Greener, H.	21622	1896
Greener, W. W.	18558	1893
Greener, W. W.	228	1895
Griffiths, W., and Woodgate, H. F.	16730	1892
Hanson, N. C.	22040	1895
Harrison, E.	4005	1895
Haurat, J., and Castaderé, J.	7570	1896
Hawksley, A. F., and Jackson R.	17042	1897
Hedges, K. W.	3770	1894
Heinrich, F. E.	26282	1896
Hill, R., and Ford, W.	2658	1894
Hill, R., and Smith, J. V.	13063	1895
Holland, H. W.	8501	1887
Holland, H. W.	800	1893
Holland, H. W.	11096	1894
Holland, H. W., and Mansfield, W.	11068	1896
Holland, H. W., and Woodward, T.	17578	1894
Holland, H. W., and Woodward, T.	23751	1894
Holland, H. W., and Woodward, T.	2769	1896
Holland, H. W., and Woodward, T.	20088	1896
Holland, H. W., and Woodward, T.	4893	1897
Hollenbeck, F. A.	18114	1893
Hornhauer, T.	7932	1895
Hornhauer, T.	23188	1895
Hutchinson, J. R.	11349	1895
Jackson, R., and Hawksley, A. F.	17042	1897
James, E.	8892	1894
Jeffery, W. J.	5304	1896
Johansen, J. C., Kjaer, V., and Zinn, J.	1772	1896
Johansen, J. C., Kjaer, V., and Zinn, J.	24536	1896
Johnson, E., and Clement, B. H.	27326	1896
Johnstone, D. V., and Taylor, L. B.	11646	1897
Johnstone, D. V., and Taylor, L. B.	12573	1897

Name.	No.	Year.
Jones, E., and Townsend, R.	14613	1892
Jones, W. P.	5372	1886
Jones, W. P., and Baker, W.	1844	1895
Jones, W. P., and Baker, W.	5543	1895
Jordan, A.	23964	1897
Jörgensen, E., and Krag, O. J. H.	18430	1889
Jörgensen, E., and Krag, O. J. H.	17082	1892
Kaiser, J., and Schneider, A.	7156	1894
Keese, C. J. F., and Meine, F. W.	6251	1895
Kelly, E. J., and Ashton, T. R. R.	16861	1894
Kelly, E. J., and Ashton, T. R. R.	16862	1894
Krag, O. J. H., and Jörgensen, E.	17082	1892
Krag, O. J. H., and Jörgensen, E.	18430	1889
Kimball, W. W.	1483	1894
Kindersley, C. P. W.	16279	1896
King, J.	8759	1898
King, T.	1083	1896
Kjaer, V., Johansen, J. C., and Zinn, J.	24536	1895
Kjaer, V., Johansen, J. C., and Zinn, J.	1772	1896
Krupp, F.	6639	1896
Lane, C., J. B., and E.	20598	1895
Langenhan, F.	4544	1894
Latham, J. F.	17790	1893
Latham, J. F.	19861	1893
Latham, J. F., and H. W.	22719	1894
Latrige-Brun, P.	6539	1893
Latrige-Brun, P.	13787	1894
Laumann, J.	2984	1891
Laumann, J.	18823	1892
Lazard, E.	21258	1895
Lee Arms Co.	9570	1896
Lee Arms Co.	9925	1896
Lee, J. P.	11319	1887
Lee, J. P.	8117	1889

Name.	No.	Year.
Lee, J. P.	19019	1893
Lee, J. P.	18866	1895
Lewis, G. and W., and McKoen, G.	3226	1896
Lillyman, G.	20880	1890
Lines, A,	1328	1897
Lines, A.	10145	1898
Lisle, M. C., and Berkey, W. A.	23726	1894
Livermore, W. R., and Russell, A. H.	16205	1894
Luger, G.	19965	1894
Luger, G.	14206	1896
Luigi, J. F., and Maturié, M. G.	17084	1895
Lundgren, J., and Viau, M. Z.	6755	1896
Lymann, W.	12315	1895
Mallock, A.	15056	1895
Mannlicher, C. F.	6373	1885
Mannlicher, F.	9773	1889
Mannlicher, F. R. von	16548	1893
Mannlicher, F. R. von	2491	1894
Mannlicher, F. R. von	2687	1894
Mannlicher, F. R. von	18281	1894
Mannlicher, K. F. T.	14815	1886
Mansfield, W.	9450	1893
Mansfield, W., and Holland, H. W.	11068	1896
Maréchal, J.	7521	1897
Markham, W. F.	11749	1896
Martin, J. E.	3548	1897
Martin, J. E., and Reid, D.	4395	1897
Maturié, M. G., and Luigi, J. F.	17084	1895
Mauser, P.	5709	1888
Mauser, P.	7045	1888
Mauser, P.	15371	1889
Mauser, P.	18014	1889
Mauser, P.	5583	1890
Mauser, P.	2383	1891
Mauser, P.	2850	1891

Name.	No.	Year.
Mauser, P.	2940	1892
Mauser, P.	7239	1892
Mauser, P.	10130	1892
Mauser, P.	13550	1892
Mauser, P.	14314	1892
Mauser, P.	1941	1893
Mauser, P.	15390	1893
Mauser, P.	7400	1894
Mauser, P.	15232	1895
Mauser, P.	15233	1895
Mauser, P.	959	1896
Mauser, P., and Mauser Waffenfabrick	21547	1895
Maxim, H. S.	606	1884
Maxim, H. S.	7354	1886
Maxim, H. S.	22859	1889
Maxim, H. S., and Silvermann, L.	29836	1896
Mayer and Grammelspacher	11750	1895
McClean, S. N.	9537	1894
McKoen, G., and Lewis, G. and W.	3226	1896
Meig, A.	11139	1894
Meine, F. W., and Keese, C. J. F.	6251	1895
Merrem, F.	21745	1895
Middleton, H.	19826	1894
Mills, S.	19300	1894
Mimard, E., and Blachon, P.	144	1893
Moore, J. T., Conner, J., and Barker, F. W.	6228	1894
Morris, R.	5485	1889
Morris, R.	2307	1890
Morris, R.	7076	1890
Mullineux, M.	14179	1895
Mullineux, M.	4149	1897
Nagant, L.	14010	1894
Nelson, F. J.	16615	1894
Nobbs, W.	13130	1894
Nobbs, W.	14592	1897

Name.	No.	Year.
Nouvelle, A.	2563	1889
O'Kelly, J.	14916	1887
Ostrander Repeating Gun Co.	6840	1891
Ostrander, W. H.	11205	1894
Parker A. G., and Browne, H. J.	8446	1894
Paquot, J., and Engb, E	1778	1894
Paul, E.	16308	1894
Penn, F. J., and Deeley, J.	6913	1888
Penn, F. J., and Deeley, J.	19145	1890
Penn, F. J., and Deeley, J.	12324	1892
Penn, F. J., and Deeley, J.	21346	1895
Perkes, T.	18805	1892
Perkes, T.	6022	1894
Perkes, T.	3420	1895
Phillips, H. F.	7246	1896
Pieper, H.	28484	1896
Pieper, H.	650	1897
Pook, J. W.	27997	1896
Potter, G. D.	13251	1895
Praunegger, F., and Schmidt, L. P.	25561	1896
Putman, G. L,	15238	1896
Quackenbush, H. M.	2610	1886
Quinton, A., and W. A.	1934	1894
Raschein, C.	7838	1894
Reble, L.	10142	1897
Reid, D., and Martin, J. E.	4395	1897
Ricci, C.	7003	1893
Ricci, C.	16272	1894
Richards, J.	16927	1896
Rider, J.	482	1895
Rigby, J., and Atkins, L. E.	301	1897
Robertson, J.	5897	1894

Name.	No.	Year.
Robertson, J.	22894	1894
Robertson, J., and Adams, W.	18135	1896
Robertson, J., and Adams, W.	1847	1897
Robertson, J., and Adams, W.	2988	1897
Ross, Sir C. H. A. F. L.	7383	1893
Ross, Sir C. H. A. F. L.	5683	1896
Ross, J.	19395	1890
Russell, A. H.	3856	1893
Russell, A. H., and Livermore, W. R.	16205	1894
Russell-Gilbert, T.	1394	1895
San Francisco Arms Co.	14876	1895
San Francisco Arms Co.	9527	1897
Serjeant, W. C. E.	20158	1895
Sauer, R. and F.	23496	1892
Schlegelmilch, E.	14523	1897
Schmidt, L. P., and Praunegger, F.	25561	1896
Schneider, A., and Kaiser, J.	7156	1894
Schwarzlose, A. W.	9490	1895
Schwarzlose, A. W.	8182	1896
Schwarzlose, A. W.	1934	1898
Scuri, A. G. B.	12642	1896
Silver, H. A., and Fletcher, W.	17054	1886
Silermann, L., and Maxim, H. S.	29836	1896
Simpson, W. S.	19600	1893
Simpson, W., and White, G. S.	9282	1897
Sjögren, C. A. T.	16968	1897
Smallman, J. W.	1281	1887
Smallman, J. W.	9585	1894
Smallman, J. W.	12060	1895
Smallman, J. W.	13492	1896
Smallman, J. W.	3988	1897
Smallwood, S., and Woolfson, L. E. G. de	15065	1897
Smallwood, S., and Woolfson, L. E. G. de	15066	1897
Smallwood, S., and Woolfson, L. E. G. de	22624	1897
Smith-Gordon, R.	3771	1897

Name.	No.	Year.
Smith, J. V., and Hill, R.	13063	1895
Smith, T. H.	5637	1895
Solodovnikoff, W.	9922	1897
Southgate, T.	12314	1889
Southgate, T.	662	1890
Southgate, T.	8239	1893
Southgate, T.	2422	1896
Southgate, T.	2955	1897
Speed, J. J.	6335	1887
Speed, J. J.	11335	1887
Speed, J. J.	17944	1887
Steward, J. H., and Wilson, A. J.	7638	1895
Stier, C.	18887	1894
Stuart, O., and Ashcroft, T. H.	7269	1895
Taylor, L. B.	10068	1894
Taylor, L. B.	7882	1895
Taylor, L. B.	14876	1897
Taylor, L. B., and Johnstone, D. V.	11646	1897
Taylor, L. B., and Johnstone, D. V.	12573	1897
Theodorovic, W.	22018	1895
Thorn, H. A. A.	5517	1895
Thorn, H. A. A., and Bodin, W.	23367	1894
Thorn, H. A. A., and Wilkinson, W. F.	7242	1894
Tippett, H. G.	14093	1895
Topham, J. H.	22921	1895
Topham, J. H.	3762	1892
Townsend, R., and Jones, E.	14613	1892
Tranter, T. M.	4287	1895
Tunstall, A., and Bonehill, C. G.	12578	1895
Varriale, P.	23452	1892
Viau, M. Z., and Lundgren, J.	6755	1896
Wallis, S. J.	23456	1892
Watson, T. A.	3982	1897

Name.	No.	Year.
Watson, T. W. and A H., and Brain, T....	10986	1894
Watkin, H. S. S.	13539	1895
Webley, T. W. and H.	5388	1897
Webley, H., and Carter, J.	4070	1885
Webley, H., and Carter, J.	5778	1888
Wem, W.	3100	1888
West, D. S.	12824	1892
Wesson, J. H.	5917	1898
Wesson, D. B.	6184	1894
Weston, A.	26206	1897
White, G. S., and Simpson, W.	9282	1897
Whiting, W. J.	1923	1886
Whiting, W. J., and Carter, J.	5778	1888
Whiting, W. J.	3427	1891
Whiting, W. J.	17291	1896
Will, O.	12763	1896
Willis, A.	8648	1896
Wilson, A. J., and Steward, J. H.	7638	1895
Wilkinson, W. F., and Thorn, H. A. A.	7242	1894
Winans, W.	12569	1892
Winborg, J. T.	6628	1898
Wilkinson, E. W., Ellis, C. O., and Cashmore, F.	5151	1896
Woodgate, H. F.	20792	1894
Woodgate, H. F., and Griffiths, W.	16730	1892
Woolfson, L. E. G. de, and Smallwood S.	15065	1897
Woolfson, L. E. G. de, and Smallwood, S.	15066	1897
Woolfson, L. E. G. de, and Smallwood, S.	22624	1897
Woodward, T., and Holland, H. W.	17578	1894
Woodward, T., and Holland, H. W.	23751	1894
Woodward, T., and Holland, H. W.	2769	1896
Woodward, T., and Holland, H. W.	20088	1896
Woodward, T., and Holland, H. W.	4893	1897
Wyatt, A. J. H.	24801	1893
Young, J.	8465	1893

Name.	No.	Year.
Zinn, J., Johansen, J. C., and Kjaer, V....	24536 ...	1895
Zinn, J., Johansen, J. C., and Kjaer, V....	1772 ...	1896

AMMUNITION, CARTRIDGES, BULLETS, &c.

Accles, J. G., and Pinfold, J.	18824 ...	1894
Andrews, T.	22604 ...	1894
Andrews, T.	4145 ...	1895
Andrews, H.	16836 ...	1895
Baker, G. C.	7704 ...	1895
Banks, B. R.	12742 ...	1892
Banks, B. R.	18642 ...	1894
Baxter, C. H.	14118 ...	1895
Bentner, G. F., and Hickie, D.	6105 ...	1895
Berthon, C. S.	8790 ...	1898
Bertie-Clay, N. S.	17996 ...	1897
Böger, E.	12003 ...	1897
Borchardt, H.	13169 ...	1895
Chatillion et Commentry La Compagnie Anonyme des Forges	11201 ...	1896
Clay-Bertie, N. S.	17996 ...	1897
Clement, L.	8802 ...	1894
Cooper, W. M., and Reetz, G. B.	4827 ...	1896
Coster, J.	5862 ...	1897
Curtis, C. W., and Davies, L.	9869 ...	1890
Dahms, G.	7131 ...	1897
Davies, L., and Curtis, C. W.	9869 ...	1890
Davis, W., and Van, E. S.	7837 ...	1897
Elliott, R. S.	5494 ...	1897
Fidjeland, T. A.	22258 ...	1897
Fletcher, W., and Silver, S. W.	1850 ...	1897

Name.	No.	Year.
Ford, W.	17073	1896
Ford, H. B.	8884	1897
Fraser, D.	4971	1897
Gautier, M.	1841	1894
Gledhill, M.	10637	1887
Grusonwerk Die Actien Gesellschaft.	14611	1892
Grusonwerk Die Actien Gesellschaft.	4132	1893
Güttler, H.	12085	1894
Hebler, W., and Krnka, C.	19912	1893
Hickie, D., and Bentner, G. F.	6105	1895
Holland, H. W.	6880	1895
Holgerson, A. T.	10760	1894
Hookham, G.	22081	1892
Jeffery, W. J.	6588	1896
Jones, H.	9402	1895
Jordan, A.	23964	1897
Kriegeskorte, E.	28369	1897
Krnka, C., and Hebler, W.	19912	1893
Krnka, C., and Roth, G.	6048	1898
Krupp, F. Grusonwerk	4832	1894
Kynoch, G.	5662	1885
Kynoch, G.	2090	1886
Lane, C., J. B., and E.	11711	1894
Lindsay, N. C., and Stanbridge, H.	12491	1894
Long, T. J.	23299	1896
Lower, J. N.	5206	1895
Luciani, J.	989	1896
Lutze, C.	8339	1898
Marga, U.	1706	1893
Martin, H.	2257	1893

Name.	No.	Year.
Martin, H.	15966	1895
Mauser, P.	1281	1898
Maxim, H.	11299	1895
Maxim, H.	16861	1895
Maxim, H. S.	4019	1894
Maxim, H. S., and Symon, R. R.	4780	1893
Meig, A.	3018	1892
Morgan, E. H.	2890	1894
Morris, R.	7076	1890
Mullineaux, M.	538	1888
Mullineaux, M.	10026	1896
Nobel, A.	12307	1889
Nobel, A.	14678	1889
Nordenfelt, T.	3129	1885
O'Kelly, J.	14916	1887
Oliver, F. W.	11666	1894
Picard, A.	20327	1896
Pinfold, J.	5277	1894
Pinfold, J.	24230	1896
Pinfold, J., and Accles, J. G.	18824	1894
Polte, E.	7321	1894
Rabbeth, F. J.	23508	1896
Reetz, G. B., and Cooper, W. M.	4827	1896
Richards, J.	8711	1886
Roth, G.	5592	1891
Roth, G., and Krnka, C.	6048	1898
Rozvoda, O.	7231	1895
Rubin, E.	17307	1894
Russell, P. G.	20447	1891
Silfversparre, A.	8344	1893
Silver, S. W., and Fletcher, W.	1850	1897

Name.	No.	Year.
Stanbridge, H., and Lindsay, N. C.	12491	1894
Stewardson, S. C.	7123	1897
Stuart, C. J.	2887	1894
Stuart, C. J.	2888	1894
Symon, R. R., and Maxim, H. S.	4780	1893
Ternström, E.	6950	1893
Thorn, E. T. G.	15084	1893
Thorn, M., and Witzleben, C. von	12700	1896
Trevor, W. S.	6911	1894
Trossy, C.	12699	1896
Tua, G.	16090	1895
Tweedie, M.	902	1889
Tweedie, M.	22173	1891
Van, E. S., and Davis, W.	7837	1897
Webley, T. W.	14754	1897
Whitney, A. N.	7477	1889
Whitney, A. N.	15049	1896
Witzleben, C. von	23701	1897
Witzleben, C. von, and Thorn, M.	12700	1896

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