

Bottom Layer.

Silica	10·60
Alumina	5·00
Carbonate of iron	31·27
Peroxide of iron	51·13
Moisture and loss	2·00
	<hr/>
	100·00

Metallic iron 50·88.

Crust which adheres to all these layers, until exposed to the air:—

Silica	10·40
Alumina	7·60
Carbonate of iron	39·54
Peroxide of iron	40·46
Moisture and loss	2·00
	<hr/>
	100·00

Metallic iron 47·4.

*Top lost in roasting . . .	16·4 per cent.
Hard grey do. . . .	22·8 do.
Bottom do. . . .	18·0 do.
Crust do. . . .	17·0 do.

November 25, 1851.

SIR WILLIAM CUBITT, President, in the Chair.

No. 862.—“ On the application of Machinery to the manufacture of Rotating Chambered-Breech Fire-Arms, and the peculiarities of those Arms.”* By COLONEL SAMUEL COLT (U. S. America), Assoc. Inst. C. E.†

AMONG the various departments of practical science, there is perhaps none in which more rapid advancement has been made within the present century, than in the manufacture of fire-arms, and great ingenuity has been displayed in devising improvements in them; but it is the extent to which machinery may be used in their construction, that must render the subject interesting to Engineers.

It is not the design of this paper, to enter upon a history of the first employment of fire-arms, nor yet to trace all the gradations of improvement that have taken place, since their introduction as

* The discussion upon this subject was extended over a portion of two evenings, but an abstract of the whole is given consecutively.

† The Author was subsequently elected Assoc. Inst. C. E. May 4, 1852.

weapons of war, such a subject being somewhat foreign to the scientific views, and peaceful occupations of Civil Engineers; but as experience has shown, that perfect weapons of defence are indispensable for the pioneers of civilization in new countries, and still as necessary for the preservation of peace in old countries, the best means of producing them by the aid of machinery, must be interesting; it is therefore intended, briefly to examine, chronologically, as far as recent researches extend, the gradual advances in the form and construction of fire-arms with magazines, or chambers, for repeated discharges, and to contrast them with the modern repeating chambered-breech arms introduced by the Author.

The principal collections of arms examined for this purpose are those in the Tower of London, the United Service Museum, the Rotunda at Woolwich, Warwick Castle, in England, and the Musée d'Artillerie, and the Hotel Cluny, at Paris; all these show that at all times and in all countries, the attention of armourers has been constantly directed to the subject, and much ingenuity has been displayed in the improvement of these engines of destruction, and as the use of gunpowder became better understood, and fire-arms were more generally employed, the desire to improve them increased, and their construction was materially changed. The chief progressive steps, after their first introduction, were, the hand-gun, the match-lock, the pyrites, or wheel-lock, the flint-lock, and the percussion lock.*

The Author had been aware since the year 1835, of the existence of ancient examples of repeating fire-arms, but it has only been on the occasion of his present visit to Europe in 1851, that he has been able to devote any attention to their chronological history, as exhibited in the specimens, existing in the museums, and private collections, to which he has recently obtained access. These specimens it is necessary to describe briefly, in order to render apparent the simplicity of design, the superiority of workmanship, the uniformity of construction by means of machinery, and the thorough efficiency of the repeating arms now submitted to the Institution.

* The first small fire-arms were called Hand Cannons and were fired from a rest, by the application of a match; when their weight was further reduced and a match-lock was added, they were called Calivers. In a short time they were mounted on a stock, rendered more portable, and termed Arquebuse; the shorter arms of this kind being called Petronel, or Poitrinal, from their being fired from the shoulder, without a rest. The German Reiters introduced the Pistol, named from Pistoia, in Etruria, a place celebrated for the manufacture of that species of arms. The introduction of the Musket, the Rifle, and the various modifications of them, has been very gradual, but has been accelerated latterly, by the general determination to give long-range arms to the troops.

The earliest specimen, which the Author has been enabled to discover, is a match-lock gun now in the Armoury of the Tower of London, supposed to be of the fifteenth century, (Fig. 1, Plate 2.) It has a revolving breech with four chambers, mounted on an arbor parallel with, and welded to the barrel. The hinder end of the arbor is attached to the gunstock, by a transverse pin, or nail. Notches are made in a flange, at the fore end of the breech, to receive the end of a spring, fixed to the stock, and extending across the breech, for the purpose of locking it, when a chamber is brought up into a line with the barrel. The antiquity of this arm is evident, from the match-lock contrivance for igniting the charge, and the fittings, and mounting indicate an Eastern origin. Each charge chamber is provided with a priming pan, with a swing cover, which, before firing, would require to be pushed aside by the finger, to present the priming powder to the match. A repetition of the fire is effected by throwing back the match-holder, and turning the breech by hand, to bring up another loaded chamber.

In the collection at the *Musée d'Artillerie*, at Paris, there are two specimens of match-lock guns, with revolving breeches, both of them being very similar to that which has been described; these have each eight chambers rotating by hand, and the covers of the priming magazines require to be pushed back by the finger before firing.

The next match-lock arm (Fig. 2, Plate 2,) was found, by the Author, in the possession of Messrs. Forsyth and Co., who obtained it, about twenty-four years ago, from the late Lord William Bentinck, the Governor-General of India, whence it was brought, with other curious weapons. The construction of this arm closely resembles that shown in Fig. 1, just described; but the workmanship is superior, and it is more elaborately ornamented. The breech, which requires to be moved by hand, has five chambers, each having a priming pan with a swing cover. The arbor is attached to the barrel, which, at the end adjoining the breech, is enlarged to correspond with the diameter of the revolving chamber, to which it forms a kind of shield.

But in order to mitigate the danger, which was, no doubt, apprehended, from the simultaneous discharge of all the chambers, by the spreading of the fire, from the exploding chamber, which would be the inevitable effect of this shield, the maker has provided vents for the charges, by boring holes through the enlargement of the barrel, corresponding to the charge chambers in the revolving breech. In one respect this gun gives evidence of progress, inasmuch as the breech-arbor is more firmly secured to the stock by two square pins, thus ensuring a firmer connexion between the

parts. The method of locking the breech is similar to that of the first arm described (Fig. 1), except, that the spring for securing the breech is fastened to the barrel instead of to the stock. The thinness of the metal of the barrels and the extreme length of the revolving chambers, in both these specimens of arms, would seem to indicate the bad quality of the gunpowder used at the period of the irconstruction.

The third specimen is a decided advance on the preceding guns. This arm (Fig. 3, Plate 2), which was found in the Armoury at the Tower, is furnished with a Pyrites wheel lock, and one priming pan is common to all the six chambers of the revolving breech; this pan is fitted with a sliding cover, and is so arranged that the serrated edge of a vertical wheel may project into it, amongst the loose powder in the pan; to this wheel a rapid rotary motion is given, by means of a trigger spring, acting upon a link lever, attached to the arbor of the wheel, the teeth of which, striking upon the pyrites, create the sparks which ignite the priming powder. The fire is then communicated laterally to a train of powder about $2\frac{1}{2}$ inches long, before it reaches the charge in the breech, and which train of powder and priming require to be renewed, each time, before the charge in the adjoining chambers can be exploded. A stop-pin is made to enter the orifices in the wheel, to stay its action, until the proper time, and on pulling the trigger the firing is effected.

In this instance, also, the breech is rotated by hand, and the barrel and breech are brought into contact, by a nut working upon the threaded end of the breech arbor. By the employment of one priming pan for all the chambers, and from the apparent necessity for closing the rear end of the breech with a cap, so as to leave but one small opening for the passage of the fire, from the priming-pan to the breech, the liability of the several chambers to be simultaneously fired was greatly increased; for the cap, which covers the rear end of the breech, prevents the escape of the fire laterally, and forms, in fact, a channel for guiding the deflected fire to the touch-holes of all the charges. This gun has no stock in front of the breech; but, unlike the previous specimens, the barrel is cut away on each side, so as to allow the balls to escape, in case of premature explosion. A pistol of nearly identical construction (Fig. 4, Plate 2) is in the collection at the Rotunda, at Woolwich.

In the Hotel Cluny at Paris, there is an arm of the 17th century, with a pyrites lock, and eight chambers, very similar in general construction to that found in the Tower, but differing materially in the arrangement of the touch-holes. There is one main

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priming tube, extending from the pan to the rear of the revolving chambers, with eight corresponding tubes, extending from the rear, to within a short distance of the front end, where an orifice is pierced into each chamber, for the purpose of igniting the charge immediately behind the bullet; thus obliging the charge to burn backwards, towards the breech. This arrangement, which was evidently made for the purpose of preventing the simultaneous explosion of the charges, has produced a construction of arm, almost identical with that of the modern Prussian needle gun, for which the great feature of the more rapid ignition of the whole of the charge of powder has been claimed. The priming-tube, and the pan, as in the arm at the Tower, require to be filled with gunpowder every time a chamber is discharged.

Fig. 5, Plate 2, represents an elaborately finished Spanish gun of a more recent date, with a flint lock. The breech is rotated by hand, and it is locked in the proper position for firing, by a pin, which enters a hole in the rear end of the breech, and which has to be drawn back, prior to bringing up a fresh chamber in a line with the barrel. The chief peculiarity of this gun is, that a magazine of priming powder is provided, immediately above a fixed priming pan, which serves for the four chambers of the breech. The magazine is hinged to the pan and is fitted with a sliding bottom, which when drawn out, is intended to allow a certain amount of powder to fall into the pan, and when pushed back cuts off the supply. The rear surface of this magazine serves also as the steel, or striking surface for the hammer, and it is ribbed on its face to receive the blow of the descending flint. The fore end of the breech is closed in by a filling piece of wood, attached to the barrel, and the hinder end is enclosed in a cap, as in the last example. This arm is therefore like the others fatally defective, the priming powder in the magazine would inevitably explode; the priming fire would be conducted to all the other touch-holes, and the lateral fire, at the other end of the breech, would be directed into the several chambers, and explode all the charges prematurely.

In the Armoury at Warwick Castle there is a gun which appears to be an attempt to insure greater safety in firing, but at the expense of greater complexity of mechanism. It has a flint lock and a breech with four chambers, to be rotated by hand; each chamber is furnished with a priming-pan, and a steel, which latter forms also the cover. The firing of one charge is not, therefore, so liable to ignite the powder in the other chambers. The stock in front of the breech is very thin, so as not to cover the other three chambers; consequently,

if a premature explosion took place, no material injury could occur to the arm. The chambers would appear to have been fastened by a spring from the end of the barrel.

An arm very similar in construction to the last was found in the Tower of London (Fig. 6, Plate 2). The breech is composed of four distinct tubes, or chambers, attached together by two end plates. Each tube, or chamber, is provided with a priming-pan and steel, and the breech is rotated by hand. It is retained in the required position for firing, by a bolt acting upon the rear end, which is withdrawn, by hand, when the breech is required to be moved round on its arbor.

The specimen (Fig. 7, Plate 2), which appears from its construction, to come next in order of date, was obtained by the Author from Messrs. Forsyth and Co.; it bears the evidence of English construction, as on the lock is inscribed "John Dafte, London," in characters which indicate that it is scarcely more than a century old; it may, however, be a copy of an older arm. There is evidently an attempt, in this arm, to produce a more compact weapon, for instead of having a projecting pan and steel for each chamber, recesses are made in the periphery of the breech, to form pans, and one steel was probably provided to stand over the breech, attached to the barrel. The breech, containing six chambers, is rotated by hand, and is locked when in position for firing, in the same manner as in Fig. 3; priming powder is also placed in a pan for each chamber, whilst the weapon is being loaded; these priming pans are each covered by a sliding plate working in parallel guides affixed to the periphery of the breech, with the intention of protecting, in a more perfect manner, the priming of the adjoining chambers, and thus preventing premature explosion. Connected with the hammer, is a small bar which projects forward, so that when the trigger is pulled, the hammer, in its descent against the steel, brings the small bar into contact with a projection on the cover of the upper priming pan, pushing it forward, and exposing the powder in the pan to the action of the sparks struck from the flint of the hammer. This arrangement has the advantage of compactness, and in this particular it may be considered a mechanical improvement on its predecessors; the stock does not reach beyond the base of the breech, and the barrel is cut out in front of the chambers, to allow the balls to escape, in case of premature explosion. This arm bears evidence of being radically defective; for in consequence of the holder of the steel being fastened over one of the chambers, into which the fire would be deflected, premature explosion necessarily followed, the

steel was broken off and the arm was probably rendered useless by the first discharge.

In the collection at the United Service Museum, London, is a brass model pistol, with six chambers, said to have been constructed in the time of Charles the First. This specimen displays more ingenuity and greater skill, in its design, than any of the early weapons hitherto discovered; but it is, evidently, only a model of a proposed construction, and has never been practically tested, as if it had been used, it would have been blown to pieces by the first discharge. In its general design it greatly resembles the arm last described; each chamber being provided with a similar priming pan and sliding plate to cover it, and attached to the hammer is a bar, for pushing back the cover, and exposing the powder to the fire from the flint. A steel, for the flint to strike on, is jointed to the barrel, in the same place and in the same manner as in the arm, Fig. 7, Plate 2, and is consequently open to the same objections. The arbor, on which the breech turns, is screwed into the barrel and is attached to the stock by a pin passing through it. From this description, it will be understood, that the model under consideration is tolerably free from the defects previously pointed out; but inasmuch as it possesses no means of regulating the contact of the breech and the barrel, so as to prevent the spread of lateral fire, it, like all the preceding specimens, offers no security against the simultaneous discharge of all the chambers.

It is not a little surprising, that the next example of a rotating chambered-breech gun, with a flint lock, Fig. 8, Plate 2, patented by Elisha H. Collier (U. S. America), in 1818, should exhibit nearly all the serious defects which had doubtless been discovered, and had been, to some extent, remedied by the earlier makers. The objectionable parts of this arm are the priming magazine, the flue which would conduct the fire round to the different touch-holes, and the cap in front, which would direct the lateral fire into the adjoining chambers. The breech is made to bear against the barrel, by means of a coiled spring, which would probably be efficient while the gun was clean, and each chamber is recessed to receive the abutting end of the barrel, with the intention of effecting a closer junction. This bearing up of the chambered-breech against the barrel is maintained, during the firing, by a bolt which is thrust forward by a cam on the spindle of the hammer, when the trigger is pulled, and would be effective for a few discharges, until the junction between the cylinder and the barrel, or the arbor on which the cylinder turns, became foul. The valve, which forms the bottom of the priming magazine, is

self-acting and supplies a certain quantity of powder to the pan, when the magazine (which forms at the same time the cover of the pan, and the steel for the hammer to strike upon), is brought into its elevated position. In order to rotate the breech, the hammer is thrown back to half-cock, the breech is then drawn out of contact with the barrel, and another chamber may be turned up by hand into a line with it.

The arrangement of the flint-lock chambered-breech fire-arm, contrived by Wheeler of Boston, and patented by Cornelius Coolidge, in August, 1819,* differs from the arm patented by E. H. Collier (in whose patents Coolidge was interested), in having fastened to the chamber, and to the arbor, a coiled, or spiral spring, which being wound up, is intended to constitute a power for assisting in causing the cylinder chambers to rotate, as by a complicated arrangement in the lock, an escapement motion was effected by the action of the lock itself. This arm possesses all the complication, and the imperfections of the worst of the other arms, with the same liability to premature explosion, and these defects have been admitted, inasmuch as E. H. Collier acknowledged that "in manufacturing these arms he improved the gun as he went on, and left out the spring because he thought it was useless;"—"he wanted to get rid of all superfluous parts, and left the spring out, because he considered the gun was better without it;" thus leaving the chambered-breech to be rotated by hand.

During the latter part of the last century many ingenious persons directed their attention to the improvement of fire-arms, with a view to simplify their construction, to render them more effective, and to combine safety with celerity in firing.

Among some of the most important of these improvements, may be mentioned, the peculiarly-constructed breech, patented by Mr. Henry Nock, in 1787, and the application of fulminating powder for igniting the charge in the chamber of the barrel, for which the Rev. Mr. Forsyth obtained a patent in 1807; the principal objects of this latter invention were to supersede the flint lock, and to obtain the rapid and complete combustion of the whole charge in the barrel, so as to obviate the loss of force which formerly resulted from the escape of air through the touch-hole. Many ingenious contrivances have since been introduced by the manufacturers of

* Vide "Description des Machines et Procédés spécifiés dans les Brevets, d'invention, de perfectionnement et d'importatio ." Tome xi, page 42. Paris, 1825.

fire-arms, of different countries, for simplifying the mechanical arrangement for firing by percussion, the adoption of which has now become general.

These improvements advanced fire-arms towards perfection; but still they laboured under great disadvantages, chiefly from the waste of time in reloading, which prevented the full extent of the rapidity of discharge, that an ordinary gun constructed of iron and steel could endure, from being taken advantage of.

The Author, living in a country of most extensive frontier, still inhabited by hordes of aborigines, and knowing the insulated position of the enterprising pioneer, and his dependence, sometimes alone, on his personal ability to protect himself and family, had often meditated upon the inefficiency of the ordinary double-barrelled gun and pistol, both involving a loss of time in reloading, which was too frequently fatal, in the peculiar character of Indian border warfare.

By the United States' Government, also, it was considered an object of great importance, to obtain an effective repeating arm, as the peculiar characteristic of the mode of attack by the mounted Indians, was to overwhelm small bodies of American soldiers, by rushing down on them, in greatly superior numbers, after having drawn their fire, and then to despatch them, whilst in a comparatively defenceless state, from the necessity of reloading their arms.

After much reflection and repeated trials, he effected an arrangement in the construction of revolving fire-arms, without having seen, or being aware, at that period (1829) of any arm more effective than a double-barrelled gun having ever been constructed, and it was only during a visit to Europe, in the year 1835, that he discovered he was not the first person who had conceived the idea of repeating fire-arms, with a rotating chambered-breech.

The first arrangement, contrived by the Author, was the combination of a number of long barrels, to rotate upon a spindle, by the act of cocking the lock, and similar in construction to those now generally made; but from the weight and bulk of the arm, it soon appeared better to have only a rotating cylinder containing several chambers, and to discharge through one barrel. For this he took out a patent in 1835, in which he claimed as peculiarly his own, the arrangement, or construction shown in Figs. 9 and 10.

Fig. 9, Plate 2, represents a pistol, exhibiting the mechanical combination of the arm at that early stage; the hammer is hung at the fulcrum A: the key bolt, or catch lever which holds the cylinder, is hung at the fulcrum B. The lifter, to move the ratchet, has a

working connection with the hammer on the left side, at C. The arm, D, of the lifter, works into the teeth of the ratchet, on the left: E, represents the ratchet, when connected with the shackle. F, F, is the middle and forward part of the shackle, on which the ratchet is placed. G, is the arbor on which the cylinder revolves: the end H, is the nut that holds the arbor in its place, when in the shield: I, I, represent the forward end of the arbor, which passes through the plate, and the projection on the lower part of the barrel, and the barrel is secured to the arbor by a key at J. K, represents the fulcrum of the trigger: L, is the spring which forces the connecting rod against the end of the hammer: M, is the spring which forces the key that holds the cylinder: O, is the main spring. By drawing back the hammer, the pin P, operates upon the after end of the key-bolt, or catch-lever, that locks the cylinder and raises it, consequently, the other end R, is drawn from the cylinder, and the arm D, of the lifter begins to act on a tooth S, on the left side of the ratchet, which being connected with the cylinder, by means of the shackle, turns until the next chamber is brought opposite the barrel. When the pin P, is relieved from the key, by passing over its upper end T, the pin allows the end R, of the key, to be forced by means of the spring M, into the succeeding ward of the cylinder: at the same time, by the action of the lower end of the hammer U, upon the connecting rod V, a forward horizontal motion of the rod is produced, when the end W, is brought in contact with the upper projection of the trigger, and forces it down to a proper position for the finger, when the claw X, of the trigger, hooks into the connecting rod, which holds the hammer, when drawn back, or set, by means of the end V, entering the lower catch Y, on the hammer.

On pulling the trigger to discharge the pistol, the connecting rod is drawn from the catch of the hammer, when the main spring forces the hammer forward, the upper end striking the percussion cap; during which operation the lifter, by means of its lateral motion to the left, falls below a succeeding tooth on the ratchet: when by the lateral motion of the after end Q, of the key, which holds the cylinder, the pin P, of the hammer, is permitted again to fall below it. By repetitions of the same motion of the hammer, the same effect is produced until each succeeding chamber is brought round and is discharged.

Fig. 10, Plate 2, represents the principle of the invention as applicable to rifles and muskets. In order to set the lock, the fulcrum of the lever being at A, by drawing down the ring B, the end C, operates upon the rod D, of the hammer, whose fulcrum being at E,

throws back its end F, when the trigger at G, whose fulcrum is at H, operates upon the catches of the hammer, at I, to hold the lock when it is set. When the end F, of the hammer, is removed from the adopter, whose bearings are at J, J, it is drawn back by means of the coiled spring K, until its end L, is drawn back sufficiently to allow the cylinder to turn. After the finger is released from the lever, when the lock is set, a small spring draws it back to its former place, to make room for the end D, of the hammer, so that its force may not be impaired. By pulling the trigger from the catch of the hammer, the main spring, which is connected to the hammer by the stirrup O, forces its end F, forward against the end M, of the adopter, whose end L, is brought in contact with the percussion cap, placed upon the tube N, so as to explode the charge of powder. In loading the arm it is only requisite to draw the key J, which will liberate the barrel; then by drawing the key that locks the cylinder, which is effected by drawing back the hammer to half-cock, the cylinder may be taken from the arbor.

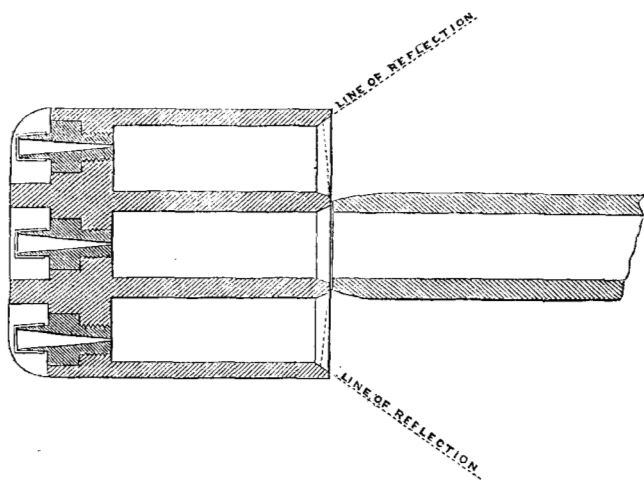
Fig. 11, Plate 2, represents a rifle made by the Author, in 1836, to rotate and fire by the continued action of the lever, or by the use of a trigger.

The arms so constructed, consisting of a large number of pieces, and assembled in a complicated manner, were soon found to possess many practical disadvantages, arising chiefly from the wish of the Author to construct compact and good-looking weapons. His original experiments had all been made on skeleton arms, solely with a view to utility, and in them there was not the liability to premature explosion, from the escape of fire at the mouth of the chamber, or by the inter-communication of the ignited detonating caps; but when he enclosed the rear, and the mouths of the rotating chambers, the fire, being confined beneath the shield and the cap, was communicated successively to the percussion caps, and in front was conveyed into the chambers, so that premature and simultaneous explosion of the charges necessarily took place.

In consequence of these premature explosions, it became necessary to remove the shield, from over the base of the chambers, and to introduce partitions, between the nipples, or cones, to prevent the fire from spreading to and exploding the adjoining caps; but this only partially accomplished the object. There still remained risk of explosion from the spreading of the fire laterally between the base of the barrel and the face of the chamber. To meet this danger, the metal plate which was attached to the barrel, and projected over the chambers, was removed; this obviated to a certain extent, but

did not altogether prevent, the simultaneous explosion of the charges; for during a trial of the arm, by order of the American Government* an accident occurred, from the simultaneous explosion of two chambers, which induced the Author, after much reflection, to give a slight chamfer, or bevel to the orifice of each chamber, so as to deflect, or throw off at an outward angle, the fire which expanded laterally across their mouths. The reason for this alteration was, that when the lateral fire met the rectangular edge of the orifice of the chambers, the angle of incidence being equal to the angle of reflection, the fire was conducted downwards, or inwards to the charge; but when the flame struck the chamfered edge, it was directed outwards away from the charge. This action is shown in Fig. 1, and unimportant as this alteration may appear, it has proved

Fig. 1.



so effectual, that if loose powder is placed over the charge, in the adjoining chambers, it is not now ignited when the pistol is discharged. These and other improvements have brought the fire-arm to its present safe and effective condition, and the Author believes, that no casualty can occur, nor that more than one charge can be fired at one time, if the metal is sound and the arm is properly loaded.

* Vide "Report of the Secretary of War, 25th Congress, First Session, June 1837."

The early arms of the Author were made from 1836 to 1842, partly by hand labour, and partly by machinery, by the Patent Arms' Company, established at Paterson, United States, where a capital of nearly £30,000 was expended without any beneficial result, except in gaining experience, both in the arms themselves and in the machinery required for their manufacture.

About the year 1837 the Florida war broke out, when the Seminole Indians, retreating into the 'ever-glades,' defied the power of the United States troops, and a comparative handful of savages resisted successfully, for a long time, all the forces sent against them. The Indians were as expert in the use of the rifle as their white invaders, who could make little, or no impression on them; in this strait the Government applied to the Author, who went to the seat of war with a supply of repeating arms, which even in their then comparatively rude state were found so effective, that more were ordered, and in the hands of the hardy-mounted Rangers, commanded by General Harney, who by their aid became the terror of the Red men, the war was soon brought to an end, for when the Indians saw their foes fire six times without lowering their weapons to load, they knew their former tactics were useless and they surrendered. This success, however, though very glorious for the Government, was exactly the reverse for the Author, for by exterminating the Indians and bringing the war rapidly to an end, the market for the arms was destroyed. They were, however, most successfully used by Commodore Moore, of the Texas Navy, as well as by Colonel Jack Hays and other distinguished Texan Rangers, during the wars with Mexico and the Indians from 1837 to 1848.

In consequence of the peace they were scarcely again employed, until the year 1847, when the Mexican campaign commenced, under the command of General Taylor, who having seen the utility of these weapons in Florida, where he was also in command, sent Captain Walker, of the Texan Rangers, to procure from the Author a supply of these arms; not one however could be procured, but by great exertion, commensurate with the exigencies of the period, a number were manufactured, and it has been stated that "those Texan Rangers, with Colt's repeaters, walked right into the towns and hamlets of the Mexicans and drove the population out against all resistance."

Colonel Charles A. May, the celebrated dragoon officer, in giving evidence respecting the arms said, "These arms were used with a great deal of effect, by General Harney, during the Seminole war;

since then I have had them almost constantly; and at the commencement of the Mexican war, was fortunate in procuring some of them; by General Taylor's order I armed one of my squadrons with them, and found them very useful. When I went last into New Mexico, I armed all my force with them. They were used with great effect. They possess very many advantages over the ordinary arms. They have great precision, and are shot with great facility, accuracy, and force. They are much more efficient than the ordinary arms. They can be used very readily while on horseback, while at full speed, with great accuracy. I have found no difficulty in shooting a ball through a buffalo. I do not know whether the Texan Rangers in the Mexican war were armed with these pistols by the Government, but almost every one had them. They were very much dreaded by the Mexicans. The Texans use them with great precision. I have no hesitation in saying, that I consider that ten men with Colt's pistols in their belts, and who understand their use, can go anywhere, and can keep off almost any force. I should not hesitate, with ten men, armed with these pistols, to go anywhere across the plains."

Such is the general history of the weapon, and in the manufacture, numerous improvements naturally suggested themselves, both in the arms and in the tools used in their production, until the former assumed their present shape, and the latter almost entirely superseded hand labour.

Figs. 12, 13, and 14, Plate 2, represent the arms as at present constructed, at the Author's manufactory, at Hartford, Connecticut, U. S. America. They differ from those formerly made, principally in the greater simplicity and the better proportions of the parts of the lock and the framework; important additions and improvements have been made in the loading lever, and rammer for forcing the balls firmly into the cylinder, (Fig. 12, Plate 2,) the employment of the helical, or spiral groove on the arbor, on which the cylinder turns, whose sharp edges are intended to prevent fouling, by scraping off any smoke, or dirt accumulating on the cylinder, from the lateral fire entering the centre opening; and the inclined plane leading to the recesses on the periphery of the cylinder, to direct the bolt below the opposite shoulder in the recesses; thus preventing the cylinder from being accidentally thrown too far, by the sudden action of cocking. The lock (as shown by Fig. 15, Plate 2, which is a skeleton arm, expressly arranged to exhibit the working parts,) is now composed of five working parts, instead of seventeen, as formerly, and it is obvious, that if the several parts of the machinery are made proportionally strong, for the work they have to do, so is

the arm rendered more efficient by the greater simplicity of the general construction.

In all arms having a moveable breech, it is desirable to bring the barrel and cylinder as nearly in contact as possible, in order to prevent the escape of lateral fire, and yet to leave freedom for motion, without friction; this is now effected by the base pin, on which the cylinder turns, entering a corresponding opening in the under part of the barrel, being there held in place by a key, passing through and bearing against the back end of the slot in the barrel, and the fore end of the slot in the base pin, which is thus drawn up to the bottom of the hole, and yet the barrel is prevented from being brought too close upon, or in absolute contact with, the cylinder, whilst its end is still held in its proper position with respect to the cylinder. In the event of any abrasion of the end of the cylinder, or of the barrel, by deepening the cavity, or filing the end of the base pin, the key can be driven further in, and the proper distance for the re-adjustment of those parts be maintained, whilst the essential rigidity of structure is secured.

In loading the present arm, it is necessary to draw back the hammer to the half notch, to allow the cylinder to be rotated freely by hand; a charge of powder is then placed in each chamber, and the balls, without wadding, or patch, are put one at a time upon the mouths of the chambers, turned under the rammer and forced down, by the lever, below the mouth of the chamber. This is repeated until all the chambers are loaded. Percussion caps are then placed on the nipples, when by drawing back the hammer to the full catch, the click, or lever is brought into contact with one of the ratchet teeth, on the base of the cylinder, bringing the nipple into the precise position to receive the blow of the hammer; the arm is then in a condition for being discharged by simply pulling the trigger; and a repetition of the same motion produces the like results, until all the chambers are discharged through the barrel.

Machinery is now employed by the Author, to the extent of about eight-tenths of the whole cost of construction of these fire-arms; he was induced gradually to use machinery to so great an extent, by finding that with hand labour it was not possible to obtain that amount of uniformity, or accuracy in the several parts, which is so desirable, and also because he could not otherwise get the number of arms made, at anything like the same cost, as by machinery. Thus he obtains uniformity as well as cheapness in the production of the various parts, and when a new piece is required, a duplicate can be supplied with greater accuracy and less expense, than could be done by the most skilful manual labour, or on active

service a number of complete arms may be readily made up from portions of broken ones, picked up after an action.

To minutely describe and illustrate the machinery would absorb too much time, and render this paper too voluminous, there being hundreds of distinct operations, involving a great variety of peculiar contrivances and mechanical motions; a general description of the mode in which the various parts of the arm are manufactured, will suffice to render the system clear to engineers, conversant with the effect of machines; and the specimens (placed on the table), which are entirely formed by machinery, will illustrate the description.

The manufacture of arms, both in Great Britain and on the Continent, is carried on almost entirely by manual labour, the various parts being forged, filed and ground into the requisite form, by workmen at their own houses, the barrels alone being forged, bored, and ground, in manufactories established for the purpose, and machinery being employed only for cutting out the stocks. At the Government small arms manufactory, at Enfield, under the intelligent direction of Mr. Lovell, steps onward have, however, been made, in the use of machinery for some portions of the work. Still no general uniformity among the parts can exist, and in America, where manual labour is both scarce and expensive, it was imperative to devise means for producing these arms with the greatest rapidity and economy, and at the same time with such uniform precision, as could only result from the use of self-acting tools.

The machinery requisite for constructing the repeating fire-arms, though at first view, like a cotton, or silk factory, apparently intricate, is in reality composed of the simplest elements, and consists in a repetition of known mechanical actions specially applied. It will suffice to describe the operations on a few parts, commencing with the lock frame, which is the basis of the whole, and to which all the other parts are adapted.

Like all the other parts, the lock frame is forged by swages, and its shape completed by one blow. The action of the machines commences by fixing the centre, and drilling and tapping the base for receiving the arbor, which having been previously prepared,—the helical groove cut on it, and the lower end screwed,—is firmly fixed into its position, furnishing a definite point from which all the operations are performed and to which all the parts bear relation. The facing and hollowing of the recoil shield and frame; the cutting and sinking the central recesses; the cutting out all the grooves and orifices, planing the several flat surfaces, and shaping the curved parts, prepare the frame for being introduced between

hard steel clamps, through which all the holes are drilled, bored and tapped, for the various screws ; so that after passing through twenty-two distinct operations, the lock frame is ready for finishing by hand, which consists in merely removing the rough edge, or burr, left by the machinery, and giving it the last polish and hardening.

The rotating chambered cylinder is forged from a solid piece of steel, turned, channelled, tapped, polished, and engraved, and then the chambers are bored out by a machine, which insures the most perfect precision of dimensions and uniformity of relative position.

In the same manner, the barrel, forged solidly from a bar of cast steel, is bored and completed to calibre and is then submitted to the various operations of planing, grooving the lower projection, beneath the barrel, with which the base pin is ultimately connected, tapped, and then rifled by a self-adjusting machine, which gives to the longitudinal grooves, the form of a contracting pitch spiral, commencing nearly straight at the lower end and terminating at the muzzle in a curve of much smaller radius.

All the various parts of the lock are made by machinery, each having its relative initial point to work from, and on the correctness of which the perfection depends.

So with the stock and the mountings, the ramrod lever, &c., all are formed and worked by different sets of machines.

In fact, all the separate parts travel independently through the manufactory, arriving at last, in an almost complete condition, in the hands of the finishing workmen, by whom they are assembled, from promiscuous heaps, and formed into fire-arms, requiring only the polishing and fitting demanded for ornament.

A large number of machines is necessarily required for these operations ; as it has been found advantageous to confine each one to its peculiar province, rather than to employ any more comprehensive machine, for several operations.

By this system the machines become almost automatons, performing certain labour under the guidance of women, or children, and thus the economy and precision of the manufacture are insured.

The improvements which time and experience have gradually introduced, have at length brought this fire-arm to its present state and have rendered it the reliable and efficient weapon for field service which it has proved to be, in the actions between the American and Mexican armies.

The official reports to Congress from the officers serving in that war, establish the reputation of the arm, and this is confirmed by Major-General Taylor, late President of the United States, who

whilst commanding the American Army in Mexico, wrote in these terms to the Author :

“ I have been much pleased with an examination which I have made of your new modelled repeating pistols and feel satisfied, that under all circumstances, they may be safely relied on ;” and this opinion is universally concurred in by the officers of the United States’ Army and Navy, who have had ample opportunity of proving their efficiency in active service. Among others, Major Thornton, the Inspector of Fire-arms for the United States Army, stated, that “ After much firing and examination, the Board of Ordnance adopted Colonel Colt’s pistol for the service, as the best weapon presented for their consideration. Experiments showed, that six rounds of the pistol could be loaded and fired in a minute, with much greater accuracy and penetration than he had ever thought necessary for a pistol. A horseman could use it with one hand and have the other free to manage his horse. The dragoons and mounted riflemen should all be armed with these weapons, as in the hands of men accustomed to wield them, he considered them most efficient arms both for attack or defence.” *

* The “ New Quarterly Review ” for July 1852, contains the following apposite remarks:—“ We must now advert to the ‘ repeating principle,’ as applied to fire-arms in general, but more especially to pistols and carbines. It is to our transatlantic friends that we are indebted for the perfection of these weapons, for though, more than two centuries ago, various attempts were made to produce a series of successive discharges from one arm, without the necessity for re-loading, it is to Colonel Colt’s perseverance, energy, and mechanical skill, that the merit is due of having successfully vanquished all the difficulties that presented themselves in their construction.

“ Innumerable were the objections he had to contend with at the outset. Military men sneered at the idea as preposterous. ‘ They would always be liable to get out of order ’—‘ They would take too long to re-load ’—‘ They would besides always be missing fire,’ &c. &c. The Colonel did not, as many under the circumstances would have done, sit down and wage an idle paper war with his opponents. He did better—he set to work and demonstrated, that they none of them knew anything whatever of the subject on which they were all so confident. It was, however, natural that prejudice should be roused against an innovation of the kind—no invention of any value was ever yet otherwise received.

“ As regards the liability of the revolving pistol to get out of order, this was satisfactorily disproved, by a severe trial instituted by order of the Board of Ordnance of the United States, who directed a holster pistol to be discharged twelve hundred, and a belt pistol fifteen hundred times, cleaning them but once a day : after which ordeal neither of the pistols appeared to be in the slightest degree injured.

“ With respect to the cost of production, as almost every part is formed by machinery, hand-labour being only required in the finishing department,

Colonel Chalmers, R.A., has kindly furnished the diagrams of practice at Woolwich (Plate 3), made in the absence of the Author ;

Colonel Colt seems likely permanently to retain in his own hands the business which his ingenuity has created, for he will, of course, always be in a position to undersell any imitators that may appear. Greater security is also obtained from the same cause, for we find that, upon 'proof,' only one barrel and one cylinder burst out of 2,082 manufactured in the year 1850. The most perfect uniformity of detail is attained from the mechanism employed, for the several parts of each class of weapon are precisely similar, so that if any become damaged on service, a great number of available arms can be immediately compounded of those which have been partially injured.

"The ramrod attached to these pistols consists of a very clever but simple compound lever, which, forcing the ball effectually home, hermetically seals the chamber containing the powder, and by the application of a small quantity of wax to the nipple before capping, the pistol may be immersed for hours in water without the chance of a miss-fire.

"The movements of the revolving chamber and hammer are admirably provided for. The breech, containing six cylindrical cells for holding the powder and ball, moves one-sixth of a revolution at a time ; it can therefore only be fired when the chamber and the barrel are in a direct line. The base of the cylindrical breech being cut externally into a circular ratchet of six teeth (the lever which moves the ratchet being attached to the hammer), as the hammer is raised in the act of cocking, the cylinder is made to revolve, and to revolve in one direction only. While the hammer is falling, the chamber is firmly held in its position by a lever fitted for the purpose ; when the hammer is raised, the lever is removed and the chamber released.

"So long as the hammer remains at half-cock the chamber is free, and can be loaded at pleasure. The rapidity with which these arms can be loaded is one of their great recommendations, the powder being merely poured into each receptacle in succession, and the balls being then dropped in upon it, without any wadding and driven home by the ramrod, which of course is never required to enter the barrel.

"While carried in the pocket, or belt, there is no possibility of an accidental discharge of these pistols. Whenever it is required to clean the barrel and chamber, they can be taken to pieces in a moment, wiped out, oiled, and replaced.

"The hammer at full cock forms the sight by which aim is taken. The pistol is readily cocked by the thumb of the right hand, a plan in every way far superior to the arrangement whereby the hammer is raised by a pull on the trigger ; this is in every respect most objectionable, the pull materially interfering with the correctness of aim, and the sear-spring having the duty of the main-spring to perform as well, is apt constantly to be getting out of order. Not so Colonel Colt's ; as regards the purposes for which they are intended they may be pronounced in every respect perfect.*

* Since this article was in type, we have been informed that Colonel Colt has just established here a manufactory for his revolvers. The building he has fitted up for the purpose is the one at Thames-Bank, near Vauxhall Bridge, lately in the occupation of the workmen engaged in making the mouldings, &c., for the New Palace at Westminster.

with pistols taken indiscriminately from the Great Exhibition. They extend from the 13th to the 21st of October 1851, and exhibit extraordinary force and precision of firing.

With a large revolving pistol, at a distance of 50 yards, out of sixty shots, five shots traversed the bull's-eye of 6 inches diameter, and thirty-nine shots hit within a square of 2 feet. Fig. 1.

In another case, at 50 yards, out of fifty-four shots, forty-six shots were placed within 2 feet square, of which six were in the bull's-eye. Fig. 2.

In the next case, at a distance of 100 yards, out of sixty-four shots, thirty-seven balls hit the target, of which two traversed the bull's-eye, twenty-seven missing the target; indicating that the sights were arranged for a shorter distance. Fig. 3.

With the small revolving belt pistol, out of forty-eight shots, at a distance of 50 yards, twenty-five shots hit within 1 foot square, of which thirteen were in the bull's-eye. Fig. 4.

"The gallant Colonel has applied the same principle to a carbine, which, from the facility it offers for loading, is admirably adapted for cavalry.

"'Modern fire-arms,' observes an able contemporary, 'as used for purposes of war, are just now in a transition state. Since the invention of the percussion lock, but little attention has been paid in this country to their improvement. The ill-concealed contempt with which purely scientific attempts are received, by those who make their only boast of being "practical men," is nowhere so prevalent as in England, and accordingly we find, that while we have remained stationary, the great continental military powers and the United States have not only availed themselves of each improvement as it appeared, but have stimulated invention by liberal patronage. The result of this obstinate adherence to an antiquated system has, fortunately, not yet been tested by an European war. Can we doubt what would be the result of an engagement between two bodies of troops, one armed with the English musket and the other with the needle-gun, which, taking the number of shots only into account, is $3\frac{1}{2}$ times as effective? Or, in the case of a frigate engagement, what would be the fate of any boarding party having to face a body of men armed with Colt's "six-shooters?" What an eager rush would there be to wipe off the burning disgrace! What sums would be squandered in trying to do that in a few months, which had occupied other nations years! The "practical men," no doubt, would attempt to console us, by calculating how many needle-guns and revolvers had got out of order during the campaign, and how bravely English soldiers stood up to be shot at by an almost invisible enemy.'

"As might be imagined, Colonel Colt's invention has called forth a host of imitations. We have examined and carefully tested these successively, and with the exception of two, or three, found them to be all decidedly inferior to the American original, which, of course, being protected by patent, cannot be copied in its main essentials. Consequently, none of the English revolvers have either the lever ramrod, or the separation between the nipples, which Colonel Colt regards as most essential."

[1851-52.]

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In another case out of eighteen shots, at a distance of 50 yards, five traversed the bull's-eye, and all were lodged within 2 feet square. Fig. 5.

Further experiments will be made with these fire-arms, after being adapted to the standard percussion cap of the service, which the Author is preparing at the suggestion of the Board of Ordnance, as the present state of border warfare at the Cape, in India, and in other parts of the British Colonies, demands the adoption of repeating arms, and they must necessarily be adapted to the ordinary ammunition of the service.

The paper is illustrated by a series of diagrams from which Plates 2 and 3 are compiled.

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Plate 3.

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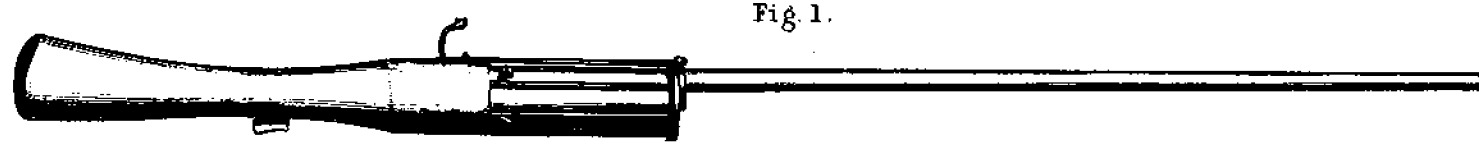


Fig. 1.

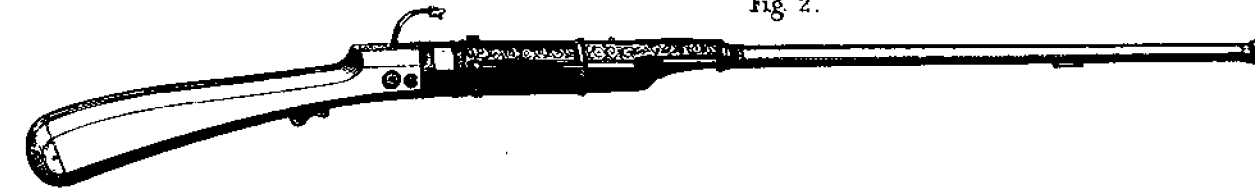


Fig. 2.

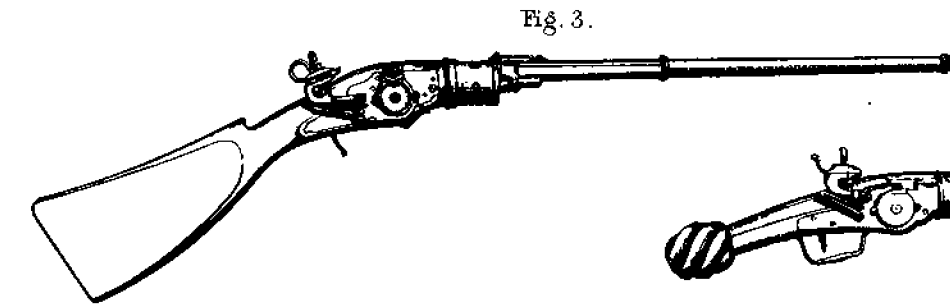


Fig. 3.

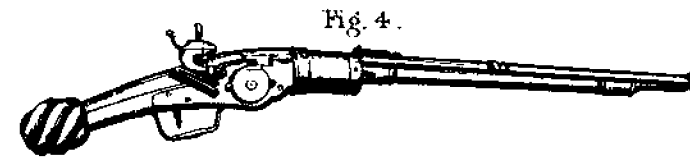


Fig. 4.

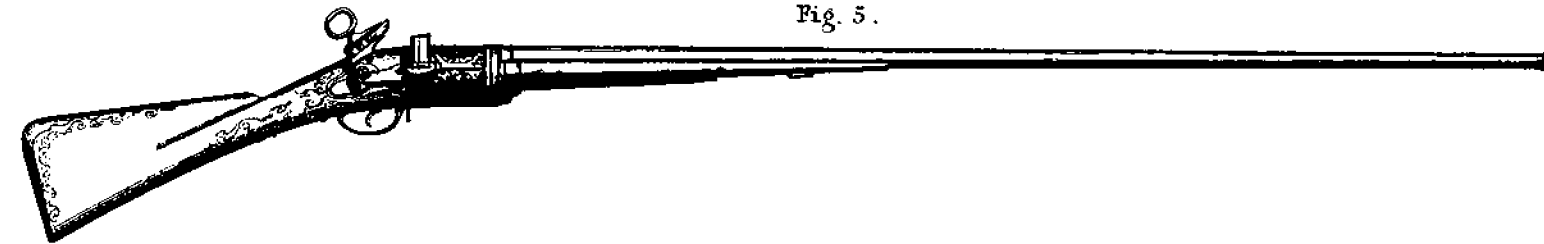


Fig. 5.

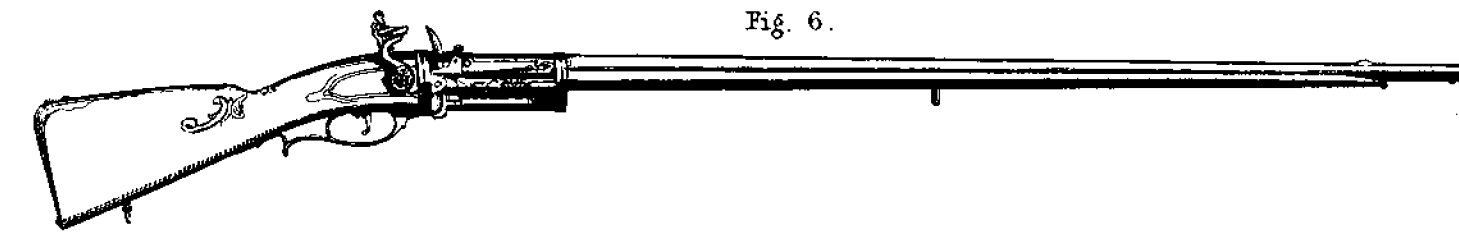


Fig. 6.

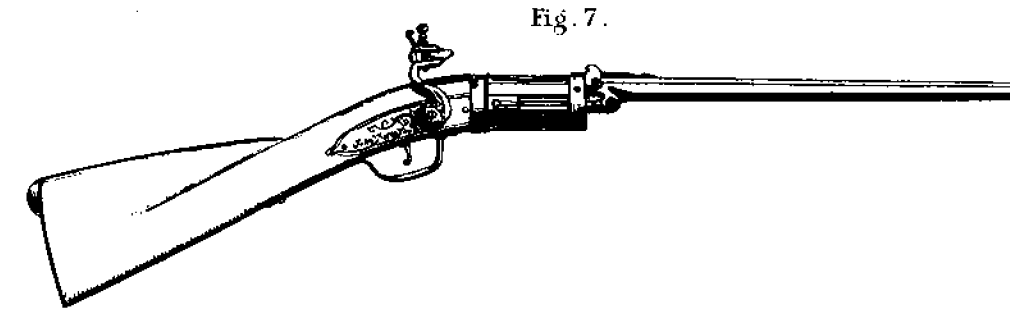


Fig. 7.

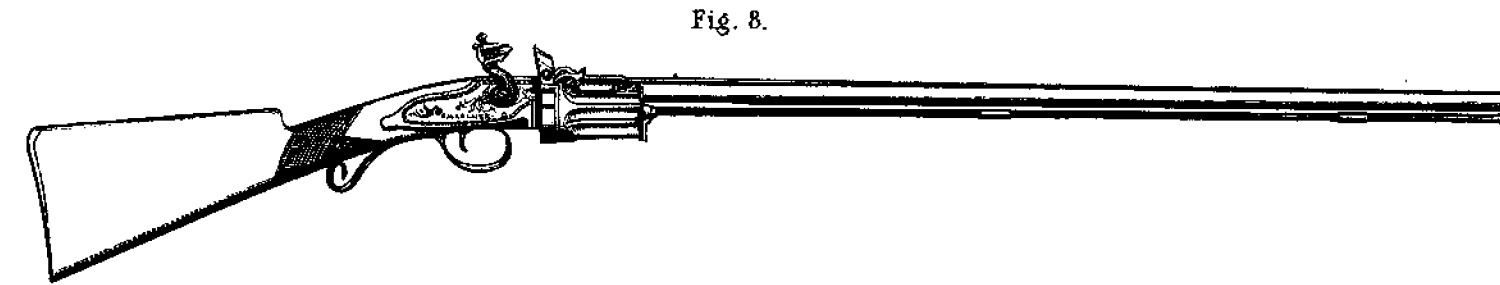


Fig. 8.

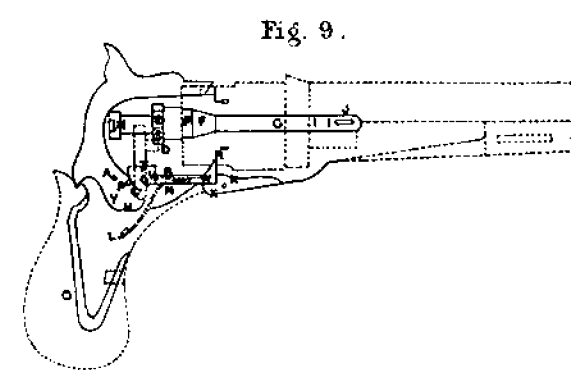


Fig. 9.

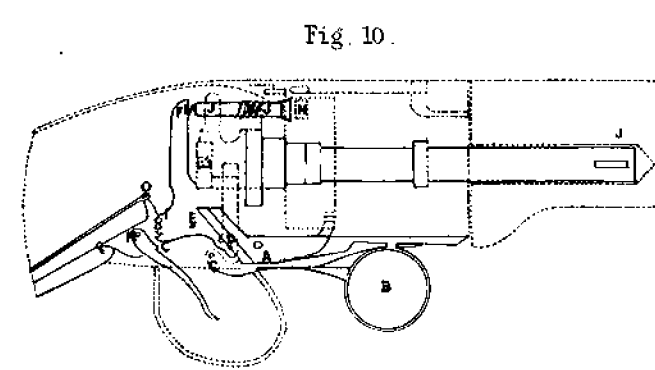


Fig. 10.

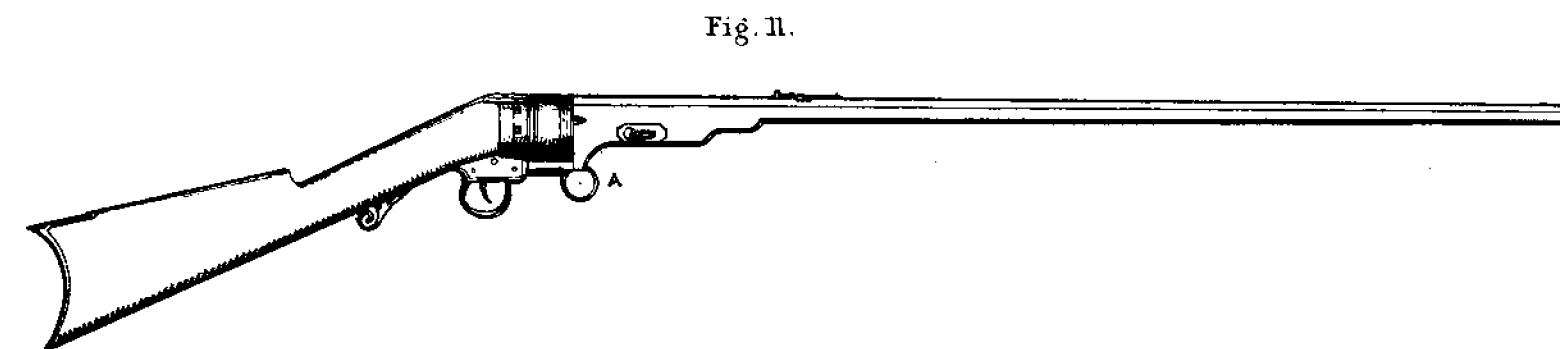


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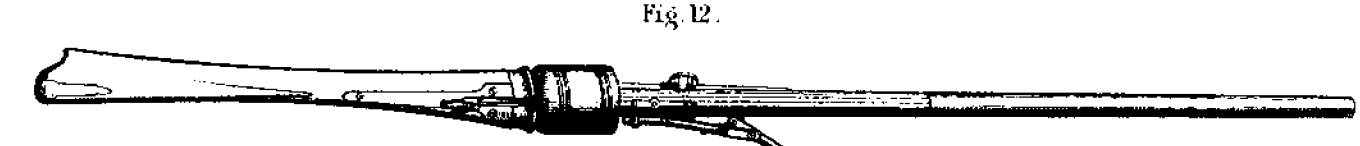


Fig. 12.

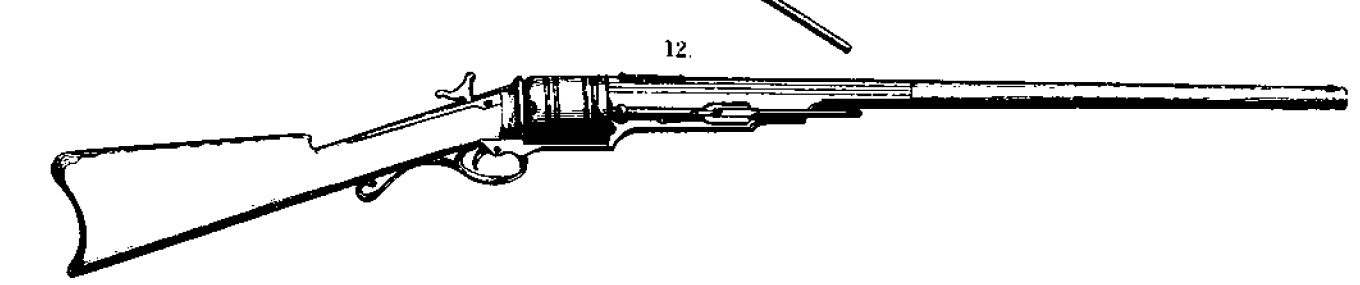


Fig. 13.

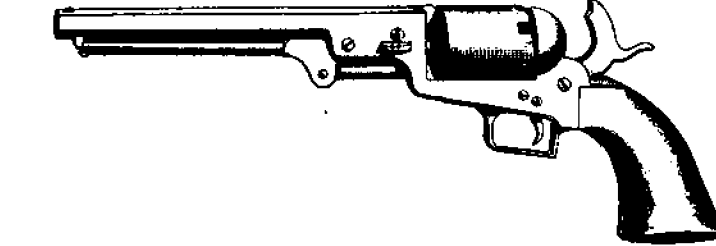


Fig. 14.

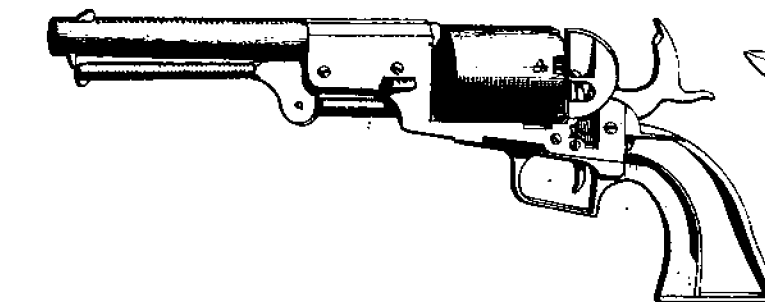


Fig. 15.

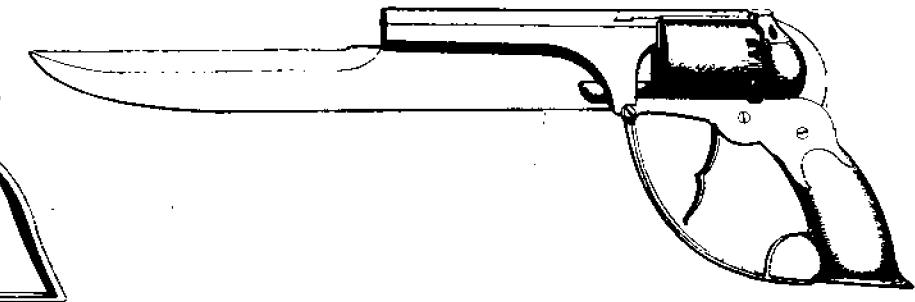


Fig. 16.

ROTATING CHAMBERED-BREECH FIRE-ARMS.

DIAGRAMS OF PRACTICE AT ROYAL ARSENAL, WOOLWICH.

PLATE 3.

FIG. 1.

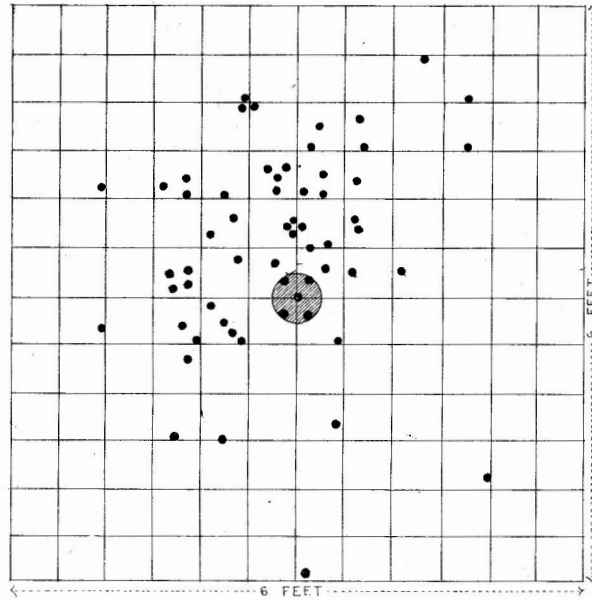


FIG. 2.

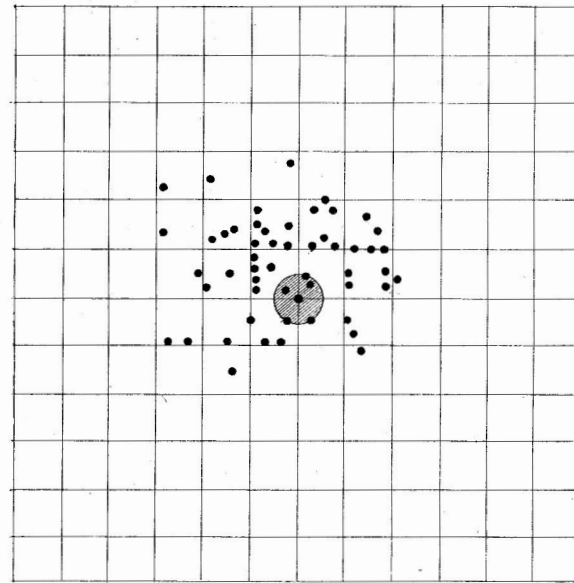


FIG. 3.

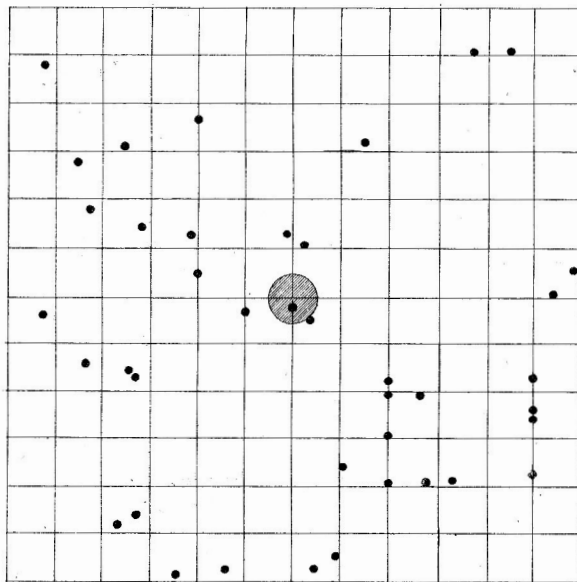


FIG. 4.

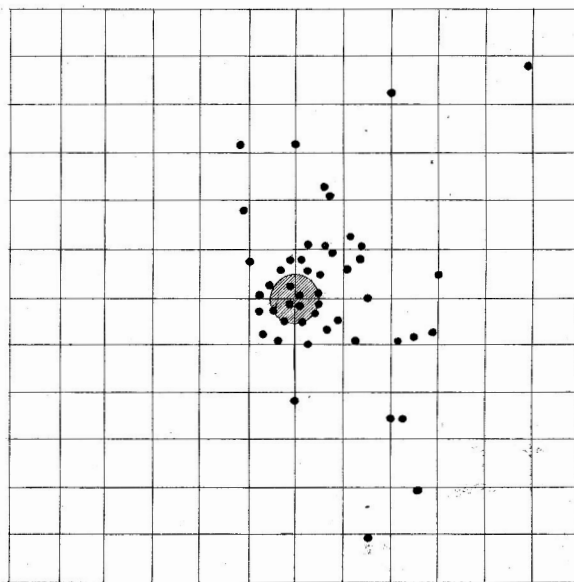


FIG. 1. — ARM. COLT'S LARGE REVOLVING PISTOL.

Range	50 Yards
Number of shots (from a Rest) 60	
Hit	60
Miss	0
Above	44
Below	16
Right	25
Left	35

FIG. 2. — ARM. COLT'S LARGE REVOLVING PISTOL.

Range	50 Yards
Number of shots (from a Rest) 54	
Hit	54
Miss	0
Above	41
Below	13
Right	23
Left	31

FIG. 5.

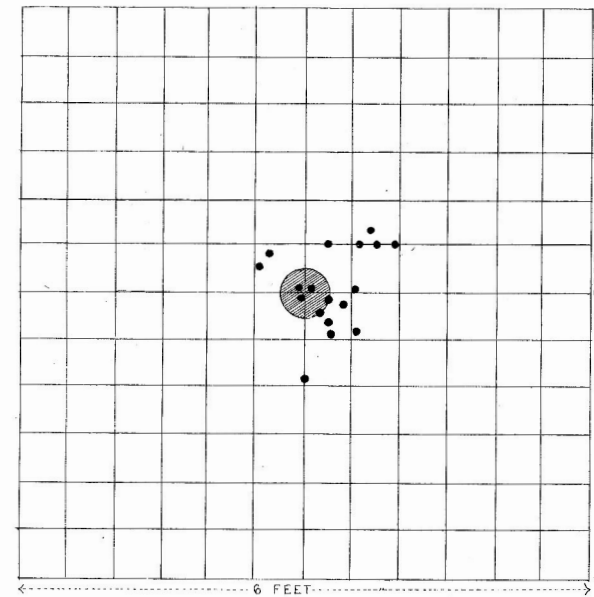


FIG. 3. — ARM. COLT'S LARGE REVOLVING PISTOL.

Range	100 Yards
Number of shots (from a Rest) 64	
Hit	37
Miss	27
Above	15
Below	22
Right	18
Left	19

FIG. 4. — ARM. COLT'S SMALL REVOLVING PISTOL.

Range	50 Yards
Number of shots (from a Rest) 48	
Hit	48
Miss	0
Above	25
Below	23
Right	33
Left	15

FIG. 5. — ARM. COLT'S SMALL REVOLVING PISTOL.

Range	50 Yards
Number of shots (from a Rest) 18	
Hit	18
Miss	0
Above	10
Below	8
Right	13
Left	5