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THE MANUFACTURE OF REVOLVERS.

To trace the development of firearms from the invention of the ponderous and inconvenient matchlock used for the first time successfully in the battle of Pavia, in 1525, to the simple, compact, and efficient little weapon shown in the upper central figure in our engraving on the front page, would be a task of no little magnitude, as it would include not only thousands of improvements in firearms themselves, but also some of the most marvelous machinery devised by man.

Revolving pistols, or revolvers, as they are now called, were first made in their present general form in 1836, but the revolver of to-day is quite a different thing from that of forty years ago. Up to the beginning of the present century arms of all kinds were almost universally made by hand; but the want of competent skilled labor in the industrial arts of this character gave rise to a demand which resulted in the adaptation of machinery to the performance of mechanical operations, and the first quarter of this century saw the present system of arms manufacture thoroughly established, if not fully perfected and developed. To-day feats are performed by machinery that are practically impossible by hand. In the case of revolvers one piece is made entirely independent of another; they might be made in different quarters of the globe for that matter, yet when they are brought together in the assembling room they are found to be absolutely perfect. This truly American method of doing things has placed our manufacturers of firearms far in advance of any of a similar character in the world.

The establishment illustrated by the large engraving in our front page is a representative of its class, being one of the oldest, most perfect, and widely known in the country.

Mr. D. B. Wesson, the present proprietor, has been making pistols ever since he was a boy. As far back as 1849 he began their manufacture on a small scale in Grafton, Mass. Afterward he was superintendent of the Leonard Pistol Factory, at Charlestown. Next, in partnership with Mr. Horace Smith, he established the nucleus of the present large concern at Norwich, Conn., whence they moved to Springfield in 1856; Mr. Smith retired in 1874, and Mr. Wesson has since conducted the business alone, still retaining the old firm name, Smith & Wesson.

The establishment consists of buildings on a quadrangle about 200 feet square, the main structure, four stories high, occupying two sides, the forges and other shops the rest. These buildings are filled with very costly and elaborate machinery of the most perfect kind. The establishment gives employment to about 500 workmen, and has a capacity of producing 400 finished pistols each day.

The Smith & Wesson revolvers are known in every State of the Union, and have reached large sales in every country of Europe, as well as in parts of Asia and South America.

The last large order from foreign governments was from Russia for about 150,000 weapons. One fact which served to bring their arms into notice was, that the manufacturers were the patentees of the metallic cartridge, the first in the world to be used in breech-loading. This feature gave that class of arms a great preference over others in the market, and led to a large demand for them in our late civil war.

These revolvers are made with the greatest care and of the very best materials. All the parts except the stock are composed of fine steel; and they are interchangeable, so that if by any accident a part should be broken, it can be replaced with little expense and without the necessity of sending the weapon to the factory for repairs. The characteristics upon which the reputation of these revolvers is based are simplicity of construction, durability, convenience in loading, force, accuracy, and rapidity in firing.

The latest improvements are combined in the three new models, "32," "38," and No. 3 (shown in the engraving), and which now form the styles of manufacture. These new patterns are central fire, reduced in number of parts, simplified in construction, and arranged so that they may be readily taken apart for cleaning without the use of the screwdriver. In two important particulars these new weapons seem to possess great advantage. These are the "patent automatic ejector," by means of which, through the action of a cam, all of the shells are forced out of the cylinder after using, and the "rebounding lock," a feature found of vast service in the shotgun, but never before applied to the revolver. Revolvers are especially liable to premature discharge, caused by a chance blow upon the hammer when resting upon the head of the cartridge. The rebounding lock is a sure preventive of this class of accidents, being so arranged as to always hold the hammer in a safety catch, away from the cartridge head, except when purposely fired. This is an improvement of great value, as it enables the loaded weapon to be carried and handled with perfect safety.

One of the principal operations in the manufacture of revolvers is drop forging. The frames which receive the stock and contain the lock are made by this process, which is represented in one of the upper views in our engraving. The plates of Bessemer steel used for the frames are first cut into pieces of the required size and form, then heated in furnaces and passed to the pressmen, who place them under the heavy drop hammers, which with a single blow give the steel the required form.

From the forges the parts pass to the milling room, where the steel is given its perfect form by that most indispensable tool—the milling machine. The sides and edges receive their shape at the hands of different workmen, who use machines differing only in their cutters. When the piece is finished by the milling machine it is complete so far as its shape and dimensions are concerned. A clear idea of the appearance of the milling department may be had from our excellent engraving.

In this department the barrels are drilled, and in one of the rooms represented in the lower part of the engraving they are placed in the rifling machines which form the spiral that gives to the bullet its rotary motion. In these machines the twist is imparted to the tool by a rack moved vertically by an inclined guide, and rotating a pinion on the tool carrier alternately in opposite directions as the tool advances and recedes. This machine does its work as if it were possessed of brain and muscle, but unlike animate machines it is constant and regular in its operation, a marvel of mechanical skill. Most of the machinery used in this establishment is designed and used for special purposes, and is as perfect as human ingenuity can make it.

In one of the upper views is represented the stocking room, where the stocks are fitted and shaped. The machines shown in the foreground are employed in making the small diagonal grooves which cross each other, forming the roughened or checked stock seen in the detail view of the revolver No. 3.

One of the lower views shows the fitting and assembling room, where the proof of perfect workmanship is found, as all of the parts coming from different portions of the great establishment are brought here to be put together to form a complete revolver. If any part has been slighted, or is in any way imperfect, it is made manifest here, and any such part is rejected.

The revolvers are blued or plated, finished with pearl, ivory, or rubber, either with or without the extension stock. Government officials and dealers in firearms in every part of the world will be furnished with full particulars and price list, by addressing Smith & Wesson, Springfield, Mass., or to the agent in New York city, M. W. Robinson, office 79 Chambers street.

Progress of Electric Lighting in London.

A further extension of the Jablochkoff system of electric lighting has recently been made from the central station at Charing Cross on the Thames Embankment. It will be remembered that rather more than twelve months ago, says *Engineering*, that part of the Embankment between Westminster and Waterloo Bridges was lighted by 20 Jablochkoff lamps supplied by two Gramme machines, the motive power being one of Messrs. Ransomes, Sims, and Head's portable engines of 20 nominal horse power. After some months, an extension was made to Blackfriars Bridge, the number of lamps being increased to 40, and still more recently Waterloo Bridge was illuminated by ten lamps, which with five others fitted up in the board room of the Board of Works, made the total number of lamps driven from the center of Charing Cross no less than 55. and the length of conducting wires of over 18 miles. The latest addition was made on December 15, on the afternoon of which day ten lamps which had been fitted up in the Victoria Station of the Metropolitan Railway were lighted. The space illuminated is 300 feet long, 50 feet wide, and 40 feet high. The ten lights are distributed as follows: Over the down platform there are five lamps placed at equal distances apart; over the up platform there are four alternating with them, and there is one placed centrally against the bridge crossing the station; all of these lamps are placed at a height of 13 feet above the ground. The arrangement of the lamps is the same as that employed on the Embankment, and the candles are inclosed in opal globes 16 inches in diameter. The ten lights are worked on the two spare circuits of the machines employed for illuminating Waterloo Bridge. In brilliancy and steadiness the light within the station leaves little to be desired, although the pulsations and changes of color, which hitherto have been inseparable from the system, are apparent here as elsewhere. Of course any comparison between the effect produced by these ten lamps, and the ordinary gas-lighting of the station, is impossible, and the fog which has been prevalent since the experiment began seems rather to diffuse than to obscure the light. This is the first occasion, in connection with the Embankment experiment, that the system has been seen to its full advantage. On the Embankment and Waterloo Bridge a very large proportion of the light produced is lost by dispersion, but within the Victoria Station almost the whole of it is utilized.

One feature of remarkable interest connected with these protracted trials is that the distance through which the current is transmitted appears to affect but little either the power required to produce the light or its brilliancy. The engine at Charing Cross is now supplying power for sixty lights, and does not appear to be approaching the limits of its actual power. Indeed, a fourth battery of 20-light Gramme machines is now being put up at the center station, and will be in operation shortly, so that the engine will then be working 80 lights, and still a further addition is contemplated. With regard to the length of circuits, the distance from Charing Cross Station to Victoria Station is 2,383 yards, and the length of wire and connections is 1·65 mile, which may be taken as the radius of a circle within which it has been shown to be easy to supply the currents from one center; this must not be assumed, however, to represent the limit, and the experiment will shortly be made of lighting the Sloane Square Station of the Metropolitan District Railway. The wires for this last instalatilon are similar to those used on the Thames Embankment, namely, a cable of seven strands of copper wire of 19 B. W. G. This cable is fixed along the side of the tunnel, and, as above stated, its length is 1·65 mile, making the whole circuit 3·30 miles long. The Société Générale d'Electricité, acting through their engineer, Mr. J. A. Berly, deserve much credit for the enterprise and ability shown in conducting these prolonged and constantly extending experiments, inaugurated by the Metropolitan Board of Works.

Iron Bridges of Long Spans.

Speaking of the recent unexplained bridge disasters, a St. Louis contemporary remarks that half a century ago such spans as the fallen ones of the St. Charles and Tay bridges, for such loads as they were calculated to support, were impossible. Now they are far from being of the first magnitude. There are ten truss bridges across the Mississippi above St. Louis, which are not regarded as very wonderful structures, and yet seven of them have spans as long as those of the Tay bridge. The bridges at Winona, La Crosse, Dubuque, Keokuk, and Hannibal have spans of 240, that at Rock Island of 250, and that of Louisiana of 256 feet. The span which gave way at St. Charles was 320 feet in length, yet the same bridge has two spans 406 feet long. Over the same river is a truss bridge, at Leavenworth, with three spans 340 feet, and another at Glasgow with five of 315 feet.

Across the Ohio there is a truss bridge at Steubenville with a span of 320 feet, one at Parkersburg of 350, one at Cincinnati with a span of 515 feet, the longest truss yet built, and one at Louisville with a span of 400 feet. The truss bridge over the Kentucky river, on the Cincinnati and Southern Railroad, has three spans 375 feet in length, resting on iron piers 175 feet high. The bridge over the Hudson at Poughkeepsie has five spans of 500 feet, with piers 135 feet above high water. In Europe there is a truss bridge over the Vistula at Graudenz with twelve spans of 300 feet. The truss bridge of Lessart, in France, has a span of 314 feet, and was pushed across from one abutment to the other after being put together. The bridge over the Rhine at Wesel has four spans of 313 feet. The Kulenburg bridge in Holland, which was the monarch truss before the construction of the Cincinnati bridge, has a span of 492 feet.

From these examples it would seem that the St. Charles and Tay bridges, instead of being risky engineering ventures, are entirely within the domain of experience. But nevertheless the fact remains that, notwithstanding the boldness with which the engineers of the present day meet the exactions of the locomotive, they are comparatively novices in the use of iron. The first iron bridges were of cast iron, and soon proved to be too lightly proportioned. The first suspension bridges were similarly defective. Does it remain to be proved that the wrought iron work of the past twenty years betrays too great a confidence in the material? Were the St. Charles and Tay disasters unaccountable accidents, or were they fair tests of current engineering theories? These are questions which engineers would do well to discuss.

Presence of Mind.

Many railroad accidents are prevented by a presence of mind on the part of engineers. The *Car Builder* relates the following as among the recent evidences of presence of mind on the part of locomotive engineers:

A passenger train on the C. B. & Q. road was rounding a sharp curve, just under a piece of tall timber. The watchful engineer saw a tree lying across the track 60 feet ahead of the locomotive. The train was running at a rate of 35 miles an hour, and to check its momentum before reaching the obstruction was out of the question The engineer took in the situation at a glance. He threw the throttle wide open, the engine shot ahead with the velocity of an arrow, and with such tremendous force that the tree was picked up by the cow-catcher and flung from the track as if it had been a willow withe. A man with not so cool a head would have made the best possible use of those 60 feet in the way of checking the speed of the train. That would have caused a disaster. Bradford, an engineer, was bringing an express train over the Kankakee line from Indianapolis. As the engine shot out from the deep cut and struck a short piece of straight track leading to a bridge, a herd of colts was discovered running down the road. The distance to the river was only 100 feet. Bradford knew he could not stop the train, and also knew that if the colts beat the locomotive to the bridge they would fall between the timbers, and the obstruction would throw the train off, and probably result in a frightful loss of life. It took him only half a second to think of all this. The other half was utilized in giving his engine such a quantity of steam that it covered that 100 feet of track in about the same time that a bolt of lightning would travel from the tip of a lightning rod to the ground. The colts were struck and hurled down the embankment just as they were entering the bridge.

Motions of the Ground.

It will be remembered that M. Plantamour directed attention some time since to certain displacements of the bubble in a fixed spirit level, indicating movements of the ground. He has now made a year's observations of these phenomena in a cellar at Secheron, with two spirit levels, one directed north and south, the other east and west. The result is the manifestation of periodic movements of rise and sinking of the ground, which, in a general way, appear to be determined by the exterior temperature. After that the configuration, and, perhaps, also the nature of the ground, probably affect the intensity of the movements.