CARTRIDGES---THEIR HISTORY.

No satisfactory account has come down to us as to when and where cartridges were first employed. Probably they are as old as the invention of gunpowder. Until recently the most common cartridges used for muskets were simple covers of paper, containing the powder and were wrapped around the bullets. Those for cannon generally are formed of bags of red flannel containing the powder. A very great variety of cartridges have been invented and used, and having quite a number of inquiries made lately respecting those formed of compressed powder, we have prepared a brief description of various kinds which have been patented and used at home and abroad.

In England a patent was granted in 1807 to John Dickenson for common cartridge paper formed of two-fifths woolen and three-fifths linen rages. The object of this cartridge paper was to prevent sparks of fire being retained in the gun after the discharge. The common woolen bag is liable to stick to the bore of a gun when burning. This is the cause of frequent premature explosions when loading. In 1827 J. Lenour patented a cartridge case made of wire gauze. It was chiefly intended for shot guns—small arms. In 1831 A. Demondion invented a cartridge case composed of a metallic tube containing detonating powder projecting from its base. It was inserted into the breech end of a breech-loading rifle, and was exploded by a hammer striking it. In the same year the Marquis of Clanricarde invented a cartridge composed of several sections of a cylinder united to form one metallic cylinder. These were for breech loaders, and when fired they scattered so as to act like grape shot. In 1839 Baron Heurteloup, of France, invented a continual primer, which was contained in a tube and fed forward by a wheel actuated from the lock. He used a muslin envelope for the ball and cartridge case. In 1847 John Mollett (England) patented combustible paper for cartridges made by treating it with nitric and sulphuric acids, or those and zulodine. This was the first use of gun cotton paper for cartridges. The some inventor charged his cartridges with two parts fulminating mercury and one of common powder. No residue was left in the barrel of the rifle. In 1850 G. Simpson and J. A. Elmslie formed cartridges of tin-foil. Cartridges filled with percussion powder composed of chlorate of potash 3 parts; sulphuret of antimony 3 and sulphur 1, were used for the Prussian needle gun by J. W. Schlesinger. In 1852 Robert Adams (England) obtained a patent for making cartridges of thin sheet copper charged with powder, and attached to the bullet and wad. Such cases are now in very common use for breech-loading rifles, and are really good for this purpose. In the same year J. Needham obtained a patent for such cartridge cases of soft metal charged with percussion powder at the base, which was ignited by striking it with a needle. The cartridge case expanded and rendered the joint at the breech of the rifle gas tight. This was claimed as an improvement over Adams's cartridge. On May 18th, of the same year, W. W. Marston and F. Goodall, of New York patened a cartridge formed of a pasteboard case, with a wad of perforated leather at the rear. Each wad was driven out by the succeeding charge, and cleaned the barrel. These cartridges were used for the breech-loading rifle illustrated on page 129, Vol. VIII. (old series) of the SCIENTIFIC AMERICAN. In 1853 Mariano Rieva patented a metallic cartridge case in the form of an acorn with the fulminating powder placed at the pointed end. This was struck with a hammer working at right angles to the axis of the barrel. In the same year J. J. Kerr patented cartridge cases for cannon made of tin covered with woolen flock. 1854 C. W. Lancaster used a perforated wad for the cartridges used with his rifled guns. In 1854 L. W. Greener made cartridge cases of an alloy of zinc, lead and bismuth—a fusible metal. In August of the same year Smith & Wesson, of Norwich, Conn., obtained a patent for a cartridge having a seat plate of metal and percussion priming at its rear. This cartridge is illustrated on page 8, Vol. V. (new series) of the SCIENTIFIC AMERICAN. In 1855 F. Prince (England) repatented the employment of guncotton made with sulphuric and nitric acids for cartridges. In the same year waterproof cartridges made of paper coated with india rubber and varnish were patented by H. G. Bursell. W. Beales also patented oiled paper and cloth for cartridges, so as to render them waterproof and capable of lubricating the barrel. Paper coated with gutta percha or india rubber dissolved in rectified spirits was patented in 1855 for cartridges by E. Davis. In the same year Capt. J. Norton patented a cartridge made with a paper case charged at the back end with a little guncotton which discharged without bursting the paper. J. J. Imbs (France) obtained a patent in 1855 for cartridge cases made of compressed floss, or waste silk, said to be proof against damp. M. Minié (France) obtained a patent in the same year for making a bullet with a recess in the rear end, in which the powder was packed and covered with a disk of gutta percha. The bullet and cartridge were thus combined in one. In this year Samuel Colt and W. T. Ely patented a combined cartridge and bullet. The bullet was cast with a rebate in the rear, and the powder case was made of sheet foil secured by waterproof cement and pressure to the bullet, and the whole then coated with grease. Gilbert Smith, of Buttermilk Falls, N. Y., secured a patent in 1857 for cartridge cases made of vulcanized india-rubber cloth. Its object was to expand and close the joint of a breech-loading rifle. In 1859 Dr. Maynard, of Washington, patented a cartridge case made of a brass cup and a steel disk in the rear. The method of packing cartridges for Colt's firearms—between two small blocks—so that they may be most safely conveyed to any distance, was patented by E. K. Root, of Hartford (partner in the Colt Company), January, 1859. A patent was granted to J. H. Brown, of Romsey, England, Oct. 15, 1859, for cartridges formed of compressed powder, without a case. It was patented in the United States, August 20, 1861. The claim is published on page 156, Vol. V. (new series) of the SCIENTIFIC AMERICAN. A gun cartridge containing two distinct charges—the one to start the projectile before the other is ignited was patented by J. W. Cochrane, of New York, January, 1860. In July of the same year B. B. Hotchkiss, of Sharon, Conn., patented a metallic cartridge case with a strong front end to be blown out with the discharge. On the same date C. Sharp, of Philadelphia, patented the packing of hollow metallic cartridge cases with detonating powder by means of a wad. In September, 1860, E. Allen, of Worcester, Mass., secured a patent for making metallic cartridge cones with a lip for the reception of the fulminating powder. On May 21, 1861, a patent was granted to Robert Bartholomew, U. S. A., for a compressed cartridge of powder, the latter being composed of nitrate of potassa 75 parts, charcoal 12, sulphur 10, chlorate of postassa 3. These ingredients (in powder) are incorporated with collodion, &c., and finally coated with collodion. In the same year B. C. English, of Hartford, Conn., obtained a patent for a metallic bushing applied to the india rubber cartridge case of G. Smith —an improvement for breech-loading rifles. A. K. Johnston, of Connecticut, and L. Dow., of Topeka, Kansas, also obtained a patent, in the same year, for making a cartridge having an envelope of guncotton, or paper treated with an oxygenizing salt and by a waterproof coating. Also R. White, of Iowa, secured a patent for fastening a percussion cap or pellet to the cartridge case. A most ingenious application of such cartridge cases is illustrated on page 136, Vol. V. (new series) of the SCIENTIFIC AMERICAN. W. M. Storm patented a spiral fillet of gut for cartridge case, Oct. 29, 1861.

Only two solid compressed cartridges having no cases have been patented; the one by Mr. Brown, of England, and the other by R. Bartholomew. From the foregoing descriptive history it is noticeable that almost every substance has been applied to form the cases of cartridges, paper, plain and guncottonized, silk, wool, cloth, tin, zinc, copper and alloys in profusion.

BY the report, for 1861, of the Chief Engineer— U. F. Harris—of the Chicago Fire Department we learn that there are eight steam fire engines in that city. Each engine has a hose cart drawn by horse, carrying 650 feet of hose. There are ten men to each company who are on duty all the time, and sleep in the engine house. There were 170 fires in Chicago last year; the loss but $167,410.

W. FAIRBAIRN, by his experiments with English iron, found that with a strain of 12,320 pounds per square inch, on cast-iron, and 28,000 pounds on wrought iron, the sets and elongations are nearly equal to each other.

Strength of Boiler Iron.

The iron of boilers like the iron of machines or structures is capable of withstanding a tensile strain of from 50,000 to 60,000 lbs. upon every square inch of section, but it will only bear a third of this strain without permanent derangement of structure, and it does not appear expedient in any boiler to let the strain exceed 4,000 lbs. upon the square inch of sectional area of metal, and 3,000 lbs. on the square inch of section, is a preferable proportion. The question of the strength of boilers was investigated very elaborately a few years ago, by a Committee of the Franklin Institute, in Philadelphia, and it was found that the tenacity of boiler plate increased with the temperature up to 550°, at which point the tenacity began to diminish. At 32° the cohesive force of a square inch of section was 56,000 lbs.; at 570° it was 66,500 lbs.; at 720°, 55,000 lbs.; at 1,050°, 32,000 lbs.; at 1,240°, 22,000 lbs; and at 1,317°, 9,000 lbs. Copper follows a different law and appears to be diminished in strength by every addition to the temperature. At 32° the cohesion of copper was found to be 32,800 lbs. per square inch of section, which exceeds the cohesive force at any higher temperature, and the square of the diminution of strength seems to keep pace with the cube of the increased temperature. Strips of iron cut in the direction of the fiber were found to be about 6 per cent stronger than when cut across the grain. Repeated piling and welding was found to increase the tenacity of the iron, but the result of welding together different kinds of iron was not found to be favorable. The accidental overheating of a boiler was found to reduce the ultimate or maximum strength of the plates from 65,000 lbs. to 45,000 lbs. per square inch of section, and riveting the plates was found to occasion a diminution in their strength, to the extent of one-third. In some boilers, which are worked with a pressure of 80 lbs. upon the square inch, the thickness of the plates is only $\frac{5}{16}$ths of an inch, while the barrel of the boiler is 39 inches in diameter. It will require a length of 3.2 inches of the boiler when the plates are $\frac{5}{16}$ths thick to make up a sectional area of one square inch, and the separating force will be 39 times 3.2 multiplied by 80, which makes the separating force 9.984 lbs. sustained by two square inches of sectional area—one on each side; or the strain is 4,992 lbs. per square inch of sectional area, which is a greater strain than is advisable. The accession of strength derived from the boiler ends is not here taken into account, but neither is the weakening effect counted that is caused by the rivets which certainly would not be less in amount. The proper thickness for cylindrical boilers or other cylindrical vessels, exposed to an internal pressure, may be found by the following rule:—Multiply 2.54 times the internal diamater of the cylinder in inches by the greatest pressure within the cylinder per circular inch, and divide by the tensile force that the metal will bear without permanent derangement of structure, which for malleable iron is 17,800 lbs., per square inch of section; the result is the thickness in inches. Where the sides of the boiler are flat, instead of being cylindrical, a sufficient number of stays must be introduced to withstand the pressure, and it is expedient not to let the strain upon these stays be more than 3,000 lbs. per square inch of section, as the strength of internal stays in boilers is generally soon diminished by corrosion. It is expedient also that the stays should be small and numerous rather than large and few in number, as when large stays are employed it is difficult to keep them tight at the ends, and oxidation of the shell follows from leakage at the end of the stays. A strain at all approaching that upon locomotive boilers would be very unsafe in the case of marine boilers, on account of the corrosion, both internal and external, to which marine boilers are subject. All boilers should be proved when new to three or four times the pressure they are intended to bear, and they should be proved occasionally by the hand pump when in use, to detect any weakness which corrosion may have occasioned.

IF horses' hoofs were frequentty smeared with a composition of beeswax and good beef tallow, they would be protected in a great measure from the evils arising from salted snow-slush in the streets.

THE Britannia tubular bridge has a double railway track, a span of 460 feet, and weighs 3,000 tuns.