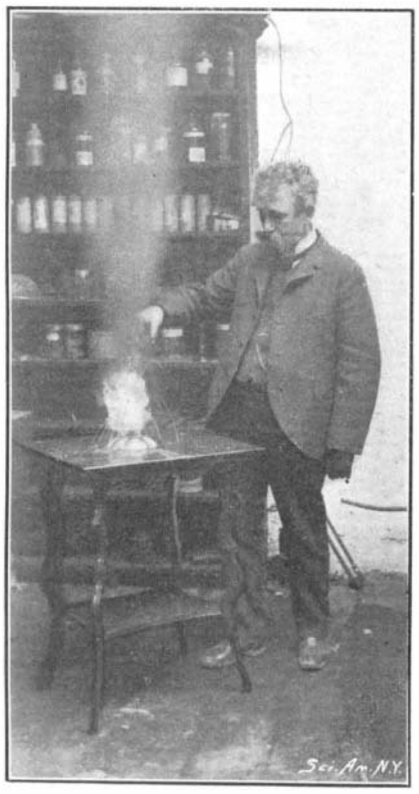
final filing away of the superfluous spelter, the thickness of the steel tubing is further reduced. It is computed by engineers that the brazing process weakens the steel to the extent of 45 per cent in the best class of work, and consequently this percentage is far greater where the work is imperfectly performed. Of course, care is exercised to guard against this deficiency in strength by the utilization of extra metal, but even such a precaution does not adequately compensate the reduction in the strength of the material.

In view of these drawbacks, the invention of Mr. Birtwhistle, of Manchester, England, by which the various portions of the bicycle frame are joined together by a hydraulic process, instead of by brazing, should prove highly valuable. In this method the metal does not have to be heated at all, but is treated



The Inventor Pouring Molten Iron Upon Maximite.

in its cold state, so that the strength of the steel is not affected in the slightest degree. A number of small slots are cut in the outer tube and the metal of the inner tube forced outward so as to occupy the space in the slots. How this is accomplished may be comprehensively realized by referring to the sectional diagram of a joint.

This figure illustrates the joining together of the two tubes forming the pillar lug, together with the simple hydraulic appliance for performing the operation. The lug is represented by *A*, and the small slots which have been cut through the metal tube are marked *B*. The two sections of the tubes of the frame which are to fit into and to be attached to this lug are marked *C*. These inner tubes are inserted, and then the hydraulic tool attached. This consists of a small pipe, *D*, of sufficient strength to withstand the high-water pressure that is necessary to force the metal into the slots. To this pipe are fitted two cup leathers, at either end of the lug, marked *E*, inserted inside the end of the inner tube. The pipe at *F* is pierced with a number of holes through which the water passes, as it is forced from the hydraulic pump to which it is attached, into the chamber between the two cup leathers. The lug and tube are then placed in a strong clamp which prevents the outer tube from bursting. A pressure of 7 tons to the square inch is exerted, and the metal of the inner tube immediately beneath the slots of the lug is forced by the pressure into the holes of the outer tube until the whole cavity is filled. The stretched metal cannot protrude above the level of the lug, owing to the outer clamp. The operation also serves to expand the inner tube until it presses tightly against the inner surface of the lug. By this means the two sections, to all intents and purposes, are converted into one homogeneous whole.

The operation is extremely simple, and one salient characteristic of the process which should recommend its adoption is that it is not essential that skilled labor should be employed to accomplish the work, as in the case of brazing, since it is almost impossible to attach the parts imperfectly. The parts can also be fitted much more quickly than heretofore. Several tests have been carried out with frames joined together in this manner, and they have proved to be stronger than those frames which were attached by the brazing process. Some sections of the frame are modified in design somewhat, in order to permit the hydraulic tool to be inserted.

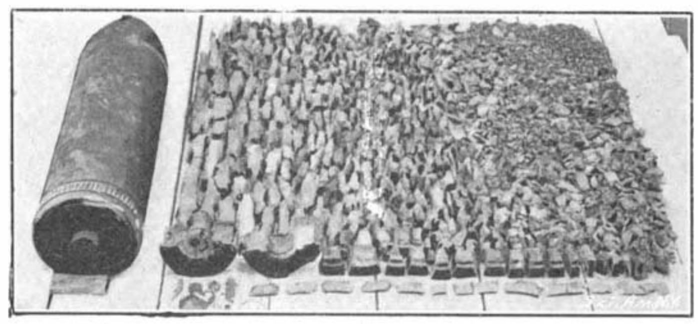
The Birtwhistle Hydraulic Jointing Syndicate, of Manchester, who are operating the invention, have also devised a unique method of prolonging the life of a cycle. The tubes utilized by them for the frames are enameled on the interior as well as externally. Rust is the most insidious foe of the cyclist, since it weakens the metal very rapidly. By this precaution, however, the steel is better protected, and although it does not render the metal absolutely rust-proof, it protects the metal to a considerable extent.

GOVERNMENT TESTS OF MAXIMITE AT SANDY HOOK.

In our last issue we gave a fully illustrated description of the Gathmann gun, and the preliminary tests which have been made of the Gathmann system to determine its military value. We now present an equally interesting set of photographs illustrative of a remarkable and successful series of tests of another method of discharging shells charged with a high explosive. The Gathmann gun is designed to throw an extremely large amount of high explosive from a high-velocity gun of great caliber. The shell is not designed with a view to the penetration of armor-plate, it being judged sufficient to deliver this great quantity of guncotton at the face of the plate and explode it on contact. The Maxim system, which is named after the inventor of the new explosive, Hudson Maxim, seeks to provide a high explosive which can be loaded into a service, armor-piercing shell, and, on account of its insensitiveness to shock, can be carried through any thickness of armor that the shell can penetrate, and be exploded by a time-fuse at the rear of the plate.

The accompanying photographs show results of tests with Maximite, which have been going on for about a year at the Government Proving Grounds at Sandy Hook. The most important of these results have been attained during the last three weeks, and this is the first time that the data have been given to the public. Although the exact composition of Maximite is a government secret, we may say that it is a picric acid compound, consisting mainly of a picrate. Its products of combustion are almost entirely gaseous, and as the heat developed on detonation is very great, it possesses, as the result of its high gravity, a very high explosive value. Some of the qualities of the new compound are remarkable. It may be fused at a temperature considerably below that of boiling water, namely, 174 deg. Fahr. as against 252 deg. Fahr., the fusion point of picric acid. If heat be applied to the explosive, it first melts and then evaporates, until the whole of it has disappeared. A valuable feature is that it is impossible to heat Maximite rapidly enough to produce an explosion. Set on fire in the open, it burns like pitch, and one of the illustrations repre-

Armor-plate 5¾ inches Thick, After Penetration by 12-inch Shell Carrying 70 Pounds of Maximite.

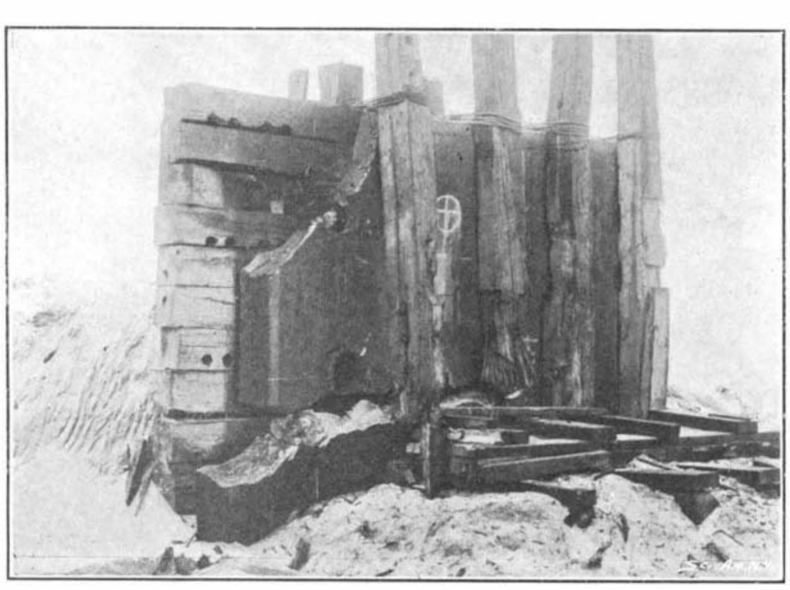


Twelve inch Forged Steel Armor-piercing Shell Before and After Explosion with Maximite; 7,000 Fragments.

sents the inventor pouring molten cast iron upon a block of the explosive.

Among the first tests of this material by the Ordnance Board was the firing of a 5-inch, armor-piercing projectile through a 3½-inch, nickel-steel, armor-plate. The projectile was recovered intact from the sandbutt behind the plate. It was then armed with a fuse, buried in the sand, and exploded for fragmentation. The sand was sifted, and over 800 fragments recovered.

About the same time, a 12-inch armor-piercing shell was filled with Maximite, buried in the sand, and exploded for fragmentation. The shell, before and after explosion, is shown in the accompanying photographs. More than 7,000 fragments were recovered. Following this test, a 12-inch, armor-piercing forged steel shell, containing 70 pounds of Maximite, was fired through a 7-inch Harveyized nickel steel plate, and was recovered from the sand behind the plate. This 12-inch shell and the 5-inch shell above-mentioned were, of



Twelve-inch Armor-plate and Support, Before Firing 12-inch Armor-piercing Shell, with Fuse, Carrying 23 Pounds of Maximite.

Wreck of 12-inch Plate After Penetration and Explosion of 12-inch Shell.

GOVERNMENT TESTS OF MAXIMITE AT SANDY HOOK.

course, fired from the gun without a fuse, as the test was one for insensitiveness only, to ascertain if the explosive would stand the shock of penetration of armorplate.

The next test was to fire a 12-inch, armor-piercing shell, carrying 70 pounds of Maximite, and armed with a fuse, through a 5¾-inch, Harveyized, nickel-steel plate. The fuse used in these tests is the invention of an army officer, and it has shown itself capable of standing the shock of penetration of armor-plate as thick as the projectile itself will stand to pass through. But it is difficult to always get just the exact amount of delay action, so that the shell will explode the moment that it has passed through the plate, and not either in the plate or 100 yards beyond. The timing is gaged to hundredths of a second. It is better to explode when half or two-thirds of the way through the plate than to explode too far beyond it. Hence it is preferable that the shell should go off a little too soon than too late. This 12-inch shell exploded when it was about half way through the plate. The violent effect of the explosion upon the plate, shattering it into fragments, with the destruction of the abutment where it was supported, is shown in the accompanying photograph, in which the deep scoring of the rear face by the flying fragments of the shell should be noted.

It should have been stated that preceding the last two tests above-mentioned, something like half a dozen six-pounder armor-piercing shells filled with Maximite, and without a fuse, were fired, in competition with shells similarly filled with fused picric acid, against plates of varying thickness. The picric acid detonated on impact when fired at a plate 1½ inches in thickness, while the Maximite shells, of course, did not explode. The Maximite shells were then fired at a plate three inches thick, some of them passing through and others sticking in the plate. The accompanying photograph shows the points of two of these shells, one just through the plate, and the other about half way through. None of the Maximite shells exploded, and they still remain in the plate, filled with the explosive. One of the Maximite shells which struck this plate penetrated about half way through, upset so that it was shortened nearly two inches, and burst open at the side, the Maximite unexploded, being forced through the rupture, and the shell rebounded from the plate about 200 feet and struck in front of the gun, without exploding. In an accompanying photograph this distorted shell is shown beside one in its original shape and length.

Perhaps the most remarkable of all these tests that have been made at Sandy Hook were the last three, as described below.

On May 1st a 12-inch, armor-piercing projectile, known as the armor-piercing shot, and carrying 23 pounds of Maximite, was fired, without a fuse, through a 30-ton Harveyized nickel-steel plate, 12 inches thick. The shot was recovered in perfect condition, its load of explosive having stood this terrific shock without explosion.

Following this test, a similar shot, also holding 23 pounds of Maximite, and armed with a fuse, was fired through the same plate, exploding when about two-thirds through, the fuse being about the two-hundredth part of a second too quick. Two of the accompanying photographs show the abutment before and after the projectile exploded in the plate, the second showing the plate broken, the fragments strewn around, and one, weighing several tons, resting upon the top of the structure.

A very interesting test was the last one of the series, and which took place on Tuesday, the 7th inst., when a 12-inch mortar shell, known as the torpedo shell, was fired from a 12-inch sea-coast rifle at full velocity and pressure, with a charge of brown prismatic gunpowder. This shell carried 143 pounds of Maximite, was armed with a fuse, and fired through a sand-crib faced with heavy timbers. The velocity of the projectile was probably about 2,100 feet per second, and as the column of explosive was four feet long, the shock of acceleration upon the Maximite must have been very severe, although not comparable, of course, with the shock on even a much shorter column in penetrating heavy armor plate. This was the largest charge of high explosive ever thrown from a powder gun in a service shell, and at service pressure and velocity. The projectile exploded just as it emerged from the back side of the crib. The projectile was broken into very small fragments, averaging from the size of a rifle ball to several ounces. A crow and a ground sparrow were struck upon the wing and brought down from the sky by the flying fragments, and fell near the sand crib, the sparrow falling directly into the crater, a result which suggests the completeness of the fragmentation.

Electric power generated on the Yuba River is being transmitted to Oakland, a distance of 140 miles, and street cars were operated with it on April 28. Current is transmitted at a pressure of 40,000 volts and the loss is very slight. Power is also to be transmitted to San Francisco, a distance of 190 miles.

Automobile Week at Nice.

The "Grande Semaine," or automobile week of Nice, is one of the leading events of the year, and this year it was unusually brilliant. The great number of visitors who are assembled at Nice during the season make this event of special interest; it is also one in which many of the records of the year are established. In consequence Nice was filled with a crowd composed of notabilities of all kinds, and all the leading "chauffeurs" made it a point to be present, with the latest types of machines. The series commenced on the 24th of March with a fête in which the automobiles, gayly decorated with flowers, defiled before the throng of spectators. On Monday, the 25th, were run the two races known as the "Speed" and the "Tourists' Race." The former covered the route Nice-Aix-Senas-Nice, or 277 miles. The weather was unfavorable, and the rain had made the roads in a bad condition. The race was run in three series, for motocycles or automobiles up to 550 pounds, vehicles of two places, 550 to 880 pounds, and those above 880 pounds. The first series was won by Demester on a Gladiator motocycle of 8 horse power, in 6h. 54m. 56s., with Gleizes second (De Dion motocycle), in 7h. 11m. 41s. The series of light machines was won by Farman (Darracq machine of 12 horse

3-Inch Plate with 6-Pounder Shells Embedded Without Exploding.

A 6-Pounder Armor-piercing Shell, Filled with Maximite Before and After Firing Through a 3-Inch Armor-plate. The Shell Upset and Rebounded Without Exploding.

power), in 8h. 8m. 35s., followed by Edmond, in 8h. 18m. 41s. In the last series E. Werner came first in a Mercedes machine of 50 horse power, time 6h. 45m. 48s., with Degrais (Rochet, 24 horse power) second, in 7h. 11m. 58s. Out of 23 starters, counting all the series, 14 were able to finish. It is satisfactory to note that all the records of the previous year were beaten. On the same day was run the "Tourists' Race," from Nice to Draguignan and return, a distance of 116 miles; it was divided into five series. The best records in each are as follows: A. Motocycles of less than 550 pounds; winner, Cormer (De Dion machine), in 3h. 24m. 23s. B. Automobiles of two places, from 550 to 880 pounds; winner, Théry (Decauville machine), in 3h. 46m. 19s. C. Four-place machine up to 1,430 pounds; winner, Koechlin, in 3h. 11m. 11s. D. Machines up to 2,200 pounds; winner, Serpollet (steam automobile), in 2h. 42m. 37s. This is the best time of the "Tourist" series and M. Serpollet carried off the honors, showing the good performance of the steam-propelled machines. The last series, heavy machines of six places and above 2,200 pounds, was won by Knapp, in 3h. 40m. 10s. On the whole, of 28 machines in all classes, as many as 20 were able to finish the race, which is a very satisfactory performance. On Tuesday and Wednesday an automobile exhibition was held in the buildings of the Nice Club. On the following day, the 28th, two races were held, the Mile Race and the Kilometer (0.6 mile) Dash for the Henri de Rothschild Cup. The mile race was reserved for the machines which had finished the Speed Race preceding. The records are as follows: Motocycles—First, Osmont, in 1m. 22 3-5s.; second, Demester, in 1m. 27s. Voiturettes—Edmond, 1m. 32 1-5s.; Marcellin, 1m. 37 3-5s. Automobiles—Werner, 1m. 16 4-5s.; Lorraine-Barrow, 1m. 17 2-5s.; Serpollet, 1m. 17 4-5s. The Rothschild Cup was won by M. Serpollet, who made the dash in 35 4-5s., followed by Werner and Prince Lubecki, in 41 4-5s. and Lorraine-Barrow and Knapp, in 42 3-5s. and 42 4-5s., respectively. The latter race was very exciting, and M. Serpollet again carried off the honors. The Nice-Turbie race, which was run on the following day, is one of the principal events of the season. The route from Nice to the fort of Turbie, situated at a considerable elevation, has very steep grades, and is a severe trial for the machines. In consequence, the leading "chauffeurs" have tried to make a record upon this route. The best times for this year are as follows: Series A. Machines below 550 pounds, Beconnais (motocycle), 17m. 21s. B. Two-place machines, to 880 pounds, Barras (Darracq 12 horse power machine), 19m. 40 2-5s. C. Four-place machines, to 1,320 pounds, Koechlin (Peugeot 7 horse power machine), 28m. 35 4-5s. D. Two-place machines, over 880 pounds, Werner (Mercedes, 12 horse power), 18m. 6 1-5s. E. Four-place machines, 880 to 2,200 pounds, Katzenstein (Panhard, 12 horse power), 28m. 20s. F. Machines over 2,200 pounds, six places, Thorn (Mercedes, 35 horse power), 21m. 46s. G. Steam vehicles, Serpollet, 24m. 11s. Nearly all the records previously made over this famous course have been beaten this year, and some of them quite considerably; thus the time of 19m. 2s. for heavy machines, made by Levegh last year, is lowered to 18m. 6 1-5s.; for light machines, last year's record of 31m. 21s. is beaten by Koechlin, in 28m. 35 4-5s. As to motocycles, Beconnais made 17m. 21s., over last year's record by Gaste, 20m. 10s.

Automobile News.

A contract has been awarded for carrying the mails between the Pan-American Exposition grounds and the Buffalo post office to an automobile company. The vehicle used will have a carrying capacity of 1,000 pounds, besides the driver and attendant, and it will be required to cover 60 miles a day.

A novel spectacle is said to be promised London in the near future, when the Chinese Ambassador carries out his intention to use an auto-car for official visits to the Foreign Office. According to the Autocar, Sir Chih Chen Lo-feng-luh has already placed his order for an automobile with one of the leading makers.

Builders of motor cars in France are strongly convinced that the future of the industry lies in the utilization of alcohol, and while nothing can be urged against the economy of the new vehicle, it cannot be overlooked that in Paris, where the octroi duties on petrol are so high, the cost of working an automobile is much greater than it might be. Owners, however, have little hope of petrol being cheapened to any considerable extent. They are looking, says the Auto-Car, for further economy to alcohol, the utilization of which will not only save them a great deal of money, but will revive a languishing national industry at the expense of imported petroleum.

The new machine with which Levegh is to run in the Gordon Bennett cup race has lately been finished. It is of the Mercedes type, and has a petroleum motor of four vertical cylinders, rated at 28 horse power nominally, but it will no doubt give much more. The ignition is by magneto-machine, and the spark-breaking arrangement is worked by a shaft carrying cams and a series of levers. The radiating tubes are placed in front between the wheels. Four speeds are provided for this machine; the second represents 27 miles an hour, while the maximum speed is claimed to be 60 miles an hour. The total weight is about 2,400 pounds. The new machine has made its first trials and has been found quite satisfactory.

Two Englishmen have invented an improved pneumatic tire for auto-cars and other vehicles. The tire comprises an exterior cover of thick, hard rubber vulcanized upon canvas, in the shape of an arch. Inside this is placed the tube which is inflated. The cover is attached to the periphery of the wheel by two detachable flanges of steel or iron, which clamp the cover on to the wheel by bolts fastened on one side of the wheel by countersunk nuts. The outside edges of the wheel and the inside of the flanges are serrated, and this, together with the bolts which go right through rim and cover, prevent the cover and tube moving through friction. It is stated by the inventors that the tire can be manufactured at a price 25 per cent cheaper than any other pneumatic tires, and it is stated to be unpuncturable.