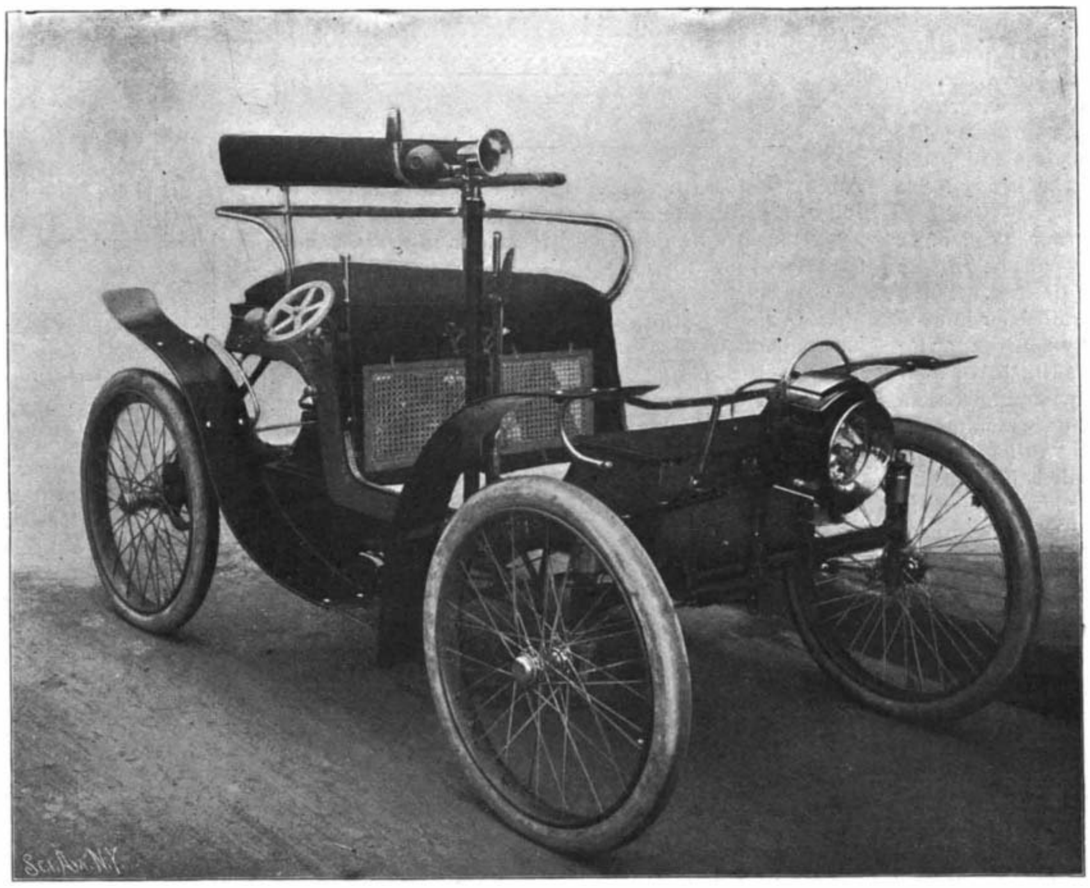
mount much more rapidly, and the whole charge would again be thrown violently backward, to be again thrown forward by a greatly magnified rear pressure.

In the early experiments with prismatic powder in the United States, and which were very extensive, it was found that a charge but partially filling the powder chamber, as shown at *D*, in Fig. 3, would produce very high and erratic pressures, sometimes mounting to seventy or eighty thousand pounds to the square inch; whereas, if the powder were divided and put into three bags, lying end to end, as shown at *E*, *E*, *E*, in Fig. 4, a low and uniform pressure was always the result. The conclusion was that the charge when employed in the shape shown in Fig. 3 was ignited, it was thrown violently forward, more or less crushed, and again backward, setting up violent wave actions of the products of combustion resulting in very high pressure.

When the charge in the 10-inch gun which burst was ignited, it tended to rush forward like a rocket, to follow the projectile out of the gun, but the impacting of the forward end of the charge into the contracted neck of the powder chamber and against the projectile crushed a portion of the grains, and increased the rapidity of combustion enormously, so that the pressure, instead of mounting on the normal wave line, *F*, shown in Fig. 5, rose to an enormous height, on a line something like *G*. This was followed by a wave of reaction on lines something like *I* and *H*, the projectile having in the meantime moved some distance forward. The wave, *H*, impacting upon it, although it rose very high, did not rise to the height of the wave, *I*, which, impinging upon the stationary breech block, and aided by the accelerated combustion of the powder under its influence at the rear, rose beyond the strength of the gun, blowing out the breech with great violence.



FRONT VIEW OF THE DECAUVILLE PETROLEUM MOTOR-CARRIAGE.

As an illustration of the erroneous claim that the powder grains would not be crushed because not capable of being brought in actual contact, let us refer to Fig. 6. Suppose a powder grain, *J*, were to be ignited on the anvil of a steam hammer. When the hammer descended, it would not come in contact with the burning grain. This would be impossible, yet I think no one will doubt that the grain would be crushed all the same.

To carry this illustration a little farther, let us suppose that a large number of grains be placed in a hollow cylinder with a contracted opening similar to that of the powder chamber and bore of a gun, as shown in Fig. 7. Let us ignite the charge and instantly bring forward with great violence a steam plunger, *K*; would not some of the powder grains be crushed into fragments in being pushed forward into the contracted space?

A similar condition certainly existed in the 10-inch gun that exploded, only the powder charge was thrown forward and compressed in, to the narrow space with enormously greater violence than could possibly be effected with a steam plunger.

In closing, I will add that "collodion" cotton is not employed in the Maxim-Schupphaus smokeless powder, and never has been, as stated in the said article. Neither is the soluble guncotton which we do employ unstable. Soluble guncotton is now made which is as stable as tri-nitro-cellulose and contains nearly as much nitrogen. There is, furthermore, hardly any difference in the explosive value of our gelatin guncotton and tri-nitrocellulose. The powder charge did not detonate in the 10-inch gun which burst, as only the breech mechanism was blown out. The body of the gun was not disrupted. Had the charge detonated, the entire rear portion of the gun would have been blown to fragments.

The charge which burst the 10-inch gun was ignited at the rear. Had it been ignited simultaneously throughout, there would not have been any excessive pressure. The Maxim-Schupphaus multi-perforated cylinder which has been adopted by the United States government is not in any sense a failure, but the biggest kind of a success. I recommend transversely perforated grains, because I believe them a still greater improvement. Nevertheless, the present multi-perforated cylinder only requires proper loading to give perfect results. The same is equally true with cordite and all other forms of gunpowder. The powder which burst the 10-inch gun had undergone no chemical change whatever.

The United States government would not have benefited by the suggested "interchange of experiments." The experiments conducted with the Maxim-Schupphaus powder in this country have been very exhaustive, and the results attained with it are far superior in every respect to anything that has been produced elsewhere in the world, and there have been fewer accidents.

Results of experiments with multi-perforated cylinders have shown greater uniformity in velocities and pressures under all circumstances than have been attained by any other form of powder in the world. In many instances, the velocities and pressures during a large number of shots have been practically as uniform as the instruments could measure. The United States government will not abandon multi-perforated powder grains, but instead, other governments must soon follow the lead of the United States in the use of the multi-perforated smokeless powder.

In confirmation of the above statements about the ballistic value of the Maxim-Schupphaus powder, I refer to the report of the Chief of Ordnance of the United States Army, of 1896, page 197. After dwelling upon the numerous advantages of this form of powder, the conclusion is reached that:

"All things considered, the perforated cylinder or disk proposed by General Rodman many years ago, and recently revived in the Maxim-Schupphaus powder, appears to me to be the most suitable and promising form for the colloidal smokeless powders."

HUDSON MAXIM.

219 West Thirty-fourth Street, New York.

THE DECAUVILLE MOTOR-CARRIAGE.

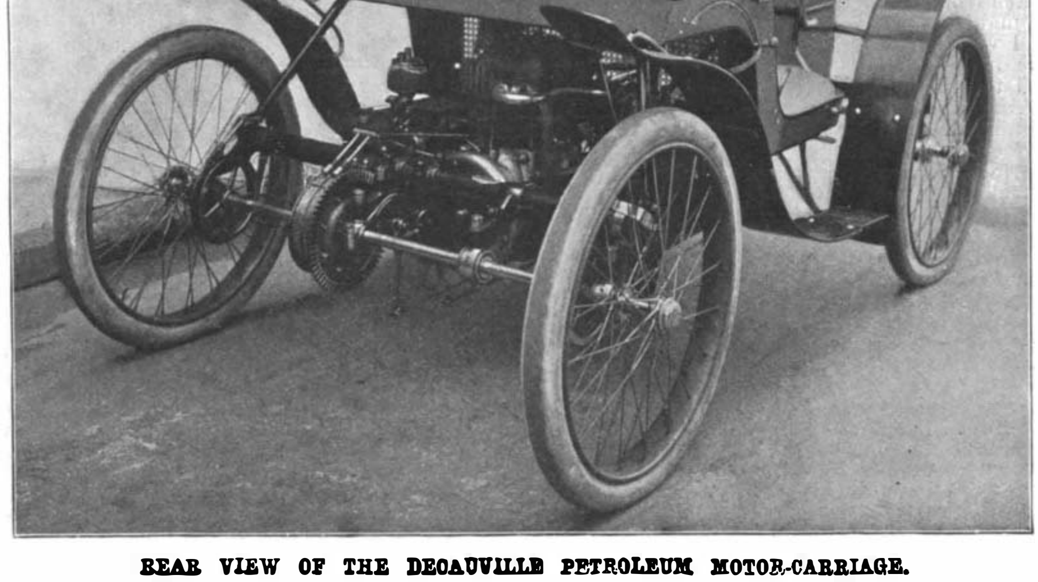
In the 1898 automobile race from Paris to Amsterdam, a distance of 1664 kilometers (1023 miles), the first prize in its class was won by the Decauville "voiturelle," in fifty-four hours.

The Decauville carriage is driven by a two-cylinder, four-cycle gas engine of the Otto type. The motive agent employed is naphtha, contained in two vaporizing-chambers or carbureters of a capacity to enable the carriage to run fifty miles without replenishing its supply. The air admitted to these chambers forms, with the naphtha vapor, an explosive mixture which is conducted to the cylinders. As in the De Dion-Bouton motor tricycle, the naphtha is prevented from cooling by evaporation, by conveying a part of the hot, exhausted gases through a small tube passing through the carbureters. The two cylinders of the motor have external flanges or ribs so as to obtain a large radiating surface and to prevent overheating. The mixture of air and gas is exploded by means of an electric spark. The pistons are single-acting trunk-pistons, which drive the rear axle of the carriage by means of gearing.

The engine, as before mentioned, is of the four-cycle type. When a piston descends, the intake is opened and the explosive mixture of air and vapor is admitted into the cylinder. When the piston rises, the intake closes and the gas is compressed. Just as the piston is about to descend for the second time, an electric spark explodes the gaseous mixture and drives the piston suddenly down. On the following up-stroke the exploded gases are exhausted. When the first cylinder is in its third period (that of explosion), the second cylinder begins its first period (that of admission), so that the two pistons act alternately on the motor shaft.

The accompanying illustrations represent two views of the automobile. Beneath the front edge of the carriage-seat three small levers are mounted, which, by means of connecting mechanism, respectively control the admission of gas to the cylinders, regulate the time of ignition, and control the compression. Like all gas engines, this motor must be started by hand; for which purpose a crank wheel is mounted on one side of the carriage. A lever mounted below the crank wheel on the side of the carriage controls the admission of air to the vaporizing chambers, and, therefore, regulates the carburization. By means of a pedal in the floor of the carriage and a long lever mounted in front of the driver's seat, the motor can be thrown in and out of gear with the rear axle.

The carriage is provided with two changes of speed and is steered by means of a handle bar in front of the seat. The automobile weighs about 500 pounds and has a maximum speed of 20 miles per hour. This handsome vehicle has recently been imported to this country by Mr. P. Cooper Hewitt, of New York, and it is now being tested.



REAR VIEW OF THE DECAUVILLE PETROLEUM MOTOR-CARRIAGE.

IN three years the cost of running an Atlantic steamer exceeds the cost of construction.