Innovative and advanced technology in the 100-year-old “Giant”

BY ERNST SAGSTUEN

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This photo of the complete chassis before the bodywork was mounted in 1917 shows the patented structure with suspension that allows the rear axles to move independently of each other. At the top: A drive with the family in an open car
(Photo from the Mustad family)

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In 1917, a unique six-wheeled passenger car was built in Oslo, at that time Christiania. The man behind it was the engineer Clarin Mustad, fourth generation of the Mustad family. After many years in France, where he headed the family corporation's metal goods factory, a large family with eight children were going to move back home. So they needed a big car with a lot of space. He designed it himself in 1915-16, and the car was in use until 1940. In 1960 it was given to the Technical Museum and stored at Bygdøy, and from 1983 it was lent out to the Museum of Vehicle Technology at Lillehammer. Now it is one of the main attractions in the Museum of Vehicle History that was opened at the Norwegian Road Museum on 9 June 2019. It is the only one of its kind, as only one such car was made. But how was it built and from what?

In August 1917, the Norwegian newspaper Tidens Tegn printed an article about an interesting new invention that was attracting attention in the streets of Oslo. This was a six-wheeled passenger car, and the newspaper stated that with the exception of the gearbox, radiator and the electrical system, it had been built in Norway from a design by engineer Clarin Mustad.

The car was large and was soon nicknamed "Giganten" - the Giant. The car is 570 cm long and 198 cm wide. The chassis had been built in the workshop of Mustad og Søn, the bodywork by O. Sørensen's Værksteder.

There is little information to be found about the car in Norwegian publications, but it was exhibited in Paris in 1922. There it attracted great attention and was presented in technical magazines all over the world.

There is also little documentation to be found about technical solutions and manufacturers of components for this car. The car is very unusual in its size and has many expensive, ingenious and well-functioning technical solutions. It seems that Clarin Mustad possessed excellent technical insight into design engineering, as well as an abundance of financial resources for the development work.

In 1916, Mustad took out a patent for the unique turning and propulsion system of this vehicle. It has two rear axles, of which the first one is turnable

Ernst Sagstuen is a retired officer, and a certified vehicle mechanic from the Norwegian Armed Forces School Centre at Helgelandsmoen. He has managed engineering workshops for the Norwegian Armed Forces for many years and is a member of the association of Road Museum supporters.

Axel, Anne and Hans Clarin are grandchildren of Clarin Mustad and remember "the Giant" well from their childhood days at Sjøholmen in Bærum. Here looking at old family albums with pictures of the Giant in use, often filled up with people. (Photo: Håkon Aurlien)

"Grandpa was very interested in cars, but first of all he was a design engineer and developer. I can very well imagine him constantly rebuilding and altering the car, precisely because he had found new technical solutions he wanted to demonstrate."

This was said by his grandson Axel Mustad in an article in the 2017 yearbook. Clarin Mustad was one of five brothers of the fourth generation, and was sent to France, where he first received his education as a design engineer. He then became the manager of the family's horseshoe nail factory in the town of Duclair.

"He probably built the car to take the whole family for a drive. He had a big family, with eight children. He loved his family very much, some would say he absolutely needed to be near family at all the time", Anne Løvenskiold recalled.

"At the same time he also worked as a designer and developer, and technical solutions were constantly on his mind. The minute he had an idea, he had to follow up on it immediately", her brother Hans Clarin recalled. In his bedroom, their grandfather had a blackboard so he could sketch out ideas that woke him up.

As a design engineer, Clarin Mustad was very interested in the development of vehicle technology. He bought his first car in 1902, and in 1906 drove from Kristiansand to Kristiania. He then found that cars needed an easier way to start than using a hand-crank, and invented a self-starter. In 1909 he designed a slide valve engine, a construction he sold to Renault. This engine was produced in large numbers, but was not a commercial success.

Mustad was constantly coming up with new ideas within automobile engineering. "He suggested building a car factory, but he didn't get his family to go for the idea," says Hans Clarin. But he and a nephew built several cars. The best known one is the one-seater nicknamed "the Egoist" which he built to drive alone to work.

In 1912 he bought the property Sjøholmen in Bærum, and hired the great architect Arnstein Arneberg to rebuild the main building so that the family could eventually move home. So they did in 1918. The Giant remained there until the property was sold (it is now a municipal centre for cultural activities). The car was donated to the Technical Museum in 1960, and from 1983 it was exhibited at the Museum of Vehicle Technology at Lillehammer. Now it is in the Road Museum.

6 Tidens Tegn

En bil med seks hjul.

En interessant norsk opfindelse.

On 19 August 1917, the newspaper Tidens Tegn printed an article about an interesting new invention that had attracted attention in the streets of Oslo. This was a 6-wheeled passenger car, built "in this country, based on a drawing drawing by engineer Clarin Mustad."

and follows the turning movement of the front wheels. At the same time, all four rear wheels are powered, with differential axles and a centre differential that enables different speeds on all drive wheels. As mentioned above, only one such car was manufactured and it was altered a number of times. It underwent a major modification in 1927

The car was used by Clarin Mustad for transport between his residence outside Sandvika and his workplace in Oslo, and also when travelling to the corporation's factories abroad.

Clarin had a large family and a number of pictures show the car full of children and adults taking a drive.

"GIANT NIGHT"

In February 2018, the Norwegian Road Museum organised a "special-interest night" where three of Clarin Mustad's grandchildren introduced the car and its designer through photos and funny anecdotes. When the museum management asked for support from interested parties to carry out investigations to find the origins of the vehicle components and technical solutions used in this car, I signalled my interest.

The findings here presented are the results of a few weeks of searching inside, underneath and around the vehicle. They reveal a number of interesting details, but unfortunately there are still unanswered questions.

To examine the vehicle, I was equipped with a car creeper and a lamp. The work took place inside one of the museum's storage facilities, a dry and relatively cool place where the car was stored until it was moved to the new exhibition building.

Since the vehicle is owned by the Norwegian Technical Museum, permission was not given for the disassembly of parts in order to access hidden components or manufacturers' marks.

Searches were later made for documentation about the car. A search in the old archives of the Mustad factories at Gjøvik did not reveal any informa-

The "Giant Night" event in February 2018 attracted many people, and after the meeting with the designer's three grandchildren, those interested were allowed to take a closer look at the car, among them Anders Kråbøl (in blue jacket). (Photo: Håkon Aurlien and (at the top) Morten Reiten)

tion about the manufacturing or design development of the car. All information from the time of construction must be considered lost. Sources have been contacted which may confirm uncertainties related to the origin of the engine.

If readers are in possession of additional information, they are requested to contact the undersigned, or the Norwegian Road Museum.

I would like to express my gratitude to those who have helped me with facilitation and professional support:

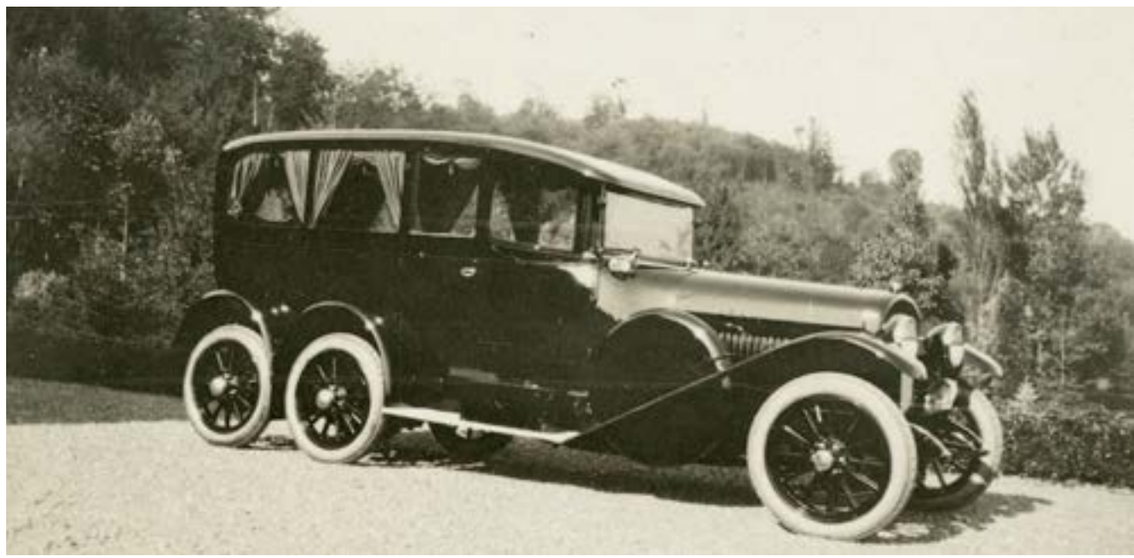
Mass Haugen Facilitating examinations.
Anders Kråbøl Technical support.
Axel Mustad Access to the Mustad archives and documentation.
Håkon Aurlien Source of the request for this study, and sparring partner
Ola-Per Lotten Technical support.
Odd Jarle Løvold Technical support.

11 SEATS

Originally there were seats for 11 people in the car, including the driver. The Giant was equipped with a convertible top, a collapsible hood that could be folded down behind the seats. An attachable hard top had also been manufactured for this vehicle, for use during the cold season.

Its unladen weight was specified to be 2300 kg. Pictures show that the engine was a small liquid-cooled, petrol-driven, four-cylinder in-line engine.

In 1927, the Giant underwent a major modification, where the original



Clarin Mustad's car when it was brand new in 1917. The car was built as an open car but had a detachable roof for the cold season. (Photo from the Mustad collection)

small four-cylinder engine was replaced with a much more powerful six-cylinder engine. At the same time, the radiator, gearbox and tandem axle were replaced, and the wooden-spoked rims were replaced with rims of steel. This was probably necessary to handle the increased engine power. Some time later, the bonnet was replaced, along with the upper part of the bodywork.

After the modification, the Giant was fitted with a new roof that covered the entire cabin. This could be detached during the warm season. Today the car appears to have a fixed roof and fixed tall doors with glass windows.

WITHOUT FRONT BRAKES

The front axle originally did not have brakes. It also did not have an anti-roll bar. When the vehicle was tested, this caused it to tilt sideways so badly when cornering that it seriously scared Clarin's two aunts who were passengers. They thought the car was about to tip over. Clarin then had an anti-roll bar retrofitted to the front axle.

Later, shock absorbers were also retrofitted to all wheels, but these have later been disabled. The mechanical brakes were also improved by means of makeshift return springs that would pull back the brake shoes and thus reduce overheating in the brake drums.

The vehicle's unladen weight was increased from 2300 kg to 3670 kg after the modification, and the car now seats 12 people. Maximum speed is specified to be 110 km/h.

I have made a detailed overview of all observations and findings, and can see that the designer has been creative and ingenious. Here are the findings, some of them in a simplified version:

A picture of Mustad's car under construction in 1917. The chassis was built in the workshop of Mustad og Søn, and then fitted with a body built by O. Sørensens Værksteder. (Photo: H Brinchmann, Kristiania)

BODY/CABIN

The car is constructed as a luxury limousine. The bodywork has black finish and the top has a solid black leather exterior. Inside, the cabin is divided in two, with a partition behind the driver and one passenger who sit in a separate compartment. A window can be opened between the compartments if desired. A voice tube has been installed between the compartments to facilitate communication while on the road. The entire cabin has thick leather upholstery from the floor and up to the windows. All seats are also upholstered in black leather.

Four seats can be folded down into the floor, as in a modern multi-purpose car. The floor has been fitted with a thick blue carpet covering the entire passenger compartment.

THREE HORNS

There was probably a great need to be able to alert other road users at the time when the Giant was made. Three different horns have been installed in the engine compartment. Two horns are electric, and one horn is pneumatically operated. Behind the engine is an air compressor that is operated by a rubber wheel. The air horn is activated as the rubber wheel is pushed against the flywheel by a pedal placed on the floor in front of the driver.

LIGHTS

The giant is equipped with three large headlights, two indicators and a combined taillight and brake light. The middle lamp at the front follows the turning movement of the front wheels.

This picture is probably of one of the daughters checking that a lifting cylinder is back in place after a puncture. Here the car has the steel rims that were added in the 1927 alteration, but it is still open. The folded hood was attached at the rear, to carry the luggage the family would bring on their trips at home and abroad.

LIFTING DEVICE

Punctures were common at the time when there were many horses and a lot of loose horseshoe nails on the roads. Clarin Mustad solved this problem by mounting two spare wheels on the vehicle, and a hydraulic lifting device for lifting the rear wheels. It is uncertain whether this took place at the same time as the main alteration in 1927.

The lifting device consists of four fixed hydraulic cylinders that are pressed down towards the ground by a hydraulic pump. Thus the wheels on either the front or rear axle are lifted and the tyre can be replaced.

The hydraulic pump is located in front of the gearbox, which has a power outlet for the pump.

To fill air into the tyres, compressed air is taken from a cylinder on the engine.

PRESSURE LUBRICATION

A heavy strain is put on transmission joints for spring mounts, steering rods and brake rods. Sealing for rubbing surfaces was poor in those days, and dust and dirt would have access. Regular lubrication was therefore required in a number of places.

Clarin solved this by installing two hand-operated pumps for lubricating oil. From the pumps there are tubes to most points in need of lubrication.

A special hatch that conceals the operation of the pumps was found at the back of the left footboard. I found the place to fill oil when I lifted the carpet in

Ernst Sagstuen volunteered to write the technical report after the "Giant Night" event at the Norwegian Road Museum on 13 February 2018. Central to this event were (from the left) Mass Haugen and Håkon Aurlien from the museum, Mustad's grand children Axe Mustad, Anne Løvenskiold and Hans Clarin Mustad, and Museum Director Geir-Atle Stormbringer. (Photo: Morten Reiten)

front of the left folding seat. This revealed a hatch in the floor, where you can access the filling tanks. The pumps have been marked "Bowen system".

ENGINE
The origin of the engine is the greatest and most interesting mystery today. This story is described towards the end of this article.

DRIVETRAIN
A dry-plate clutch of the finger type is mounted on the flywheel, at the back of the engine. The cover on the pressure plate is marked with the numbers 118259-2, as well as with a round ring symbol with the letter S in it. This may be a clutch made by Sachs.

There is manual transmission from the clutch pedal to operate the dry-plate clutch. The clutch pedal is the left pedal in the driver's cabin.

There is a short drive shaft between the dry-plate clutch and the separately installed gearbox.

The gearbox has 4 gears and reverse, and a power outlet for operation of a hydraulic pump, as well as a rear gearwheel to operate the speedometer. The make of the gearbox is unknown, but an upper cover is marked with the numbers 2826. This number may refer to the cover itself.

Then follows a middle axle between the gearbox and the first axle of the tandem-axle group.. The middle axle seems to have universal joints at both ends.

Finally there is the tandem-axle group, consisting of two wheel shafts with separate differentials. The differentials are of the type that has a crown wheel and pinion. The axles are linked together to form one turnable unit, by means of a strong steel pipe. Inside this pipe is a drive shaft that transfers power to the rear axle.

Originally, this car had a centre differential. This was meant to enable different speeds on the two axles. However, there are no visible signs that the centre differential was continued after the modification. It is possible that the centre differential remains "hidden" inside the connecting pipe between the rear axles, or that it is located within a larger unit in front of the front rear axle.

There is not much point in a turnable tandem-axle group without a centre differential. Without the centre differential, cornering will place heavy strains on the four rear wheels.

The wheels on the first axle of the tandem-axle group are turnable, and follow the steering wheel movements synchronously with the front wheels.

BRAKES
All wheels have mechanical drum brakes with cooling ribs. Brake power is enhanced by a brake booster. This is powered by the underpressure in the engine's inlet manifold.

It seems that there may have been problems with the return of the brake bands. This causes the brakes to drag, and creates overheating in the braking mechanism. This seems to have been solved by retrofitting makeshift return springs to all wheels, attached with wire.

At the back of the gearbox there is a brake drum that serves as a parking brake.

WHEELS
The rims are made in steel and the word "Michelin" and manufacturing number have been engraved on them. The tyre dimensions are 7.00 x 20.

ELECTRICAL SYSTEM
The charging system provides 12 volts. The self-starter, the ignition system and possibly the charging system were made by Bosch. Lamps and indicators were manufactured in various factories in the United States.

The engine compartment is illuminated by two lamps. The passenger compartment is illuminated by three lamps, one in the ceiling and two in the rear corners. A light switch is installed on the right side of the compartment.

The brake light switch is installed centrally underneath the vehicle.

There are two large headlights at the front, as well as a smaller lamp in front that is turnable and follows the impact of the steering wheel.

FUEL STYSTEM
The fuel tank is installed at the rear, externally, and has a specified capacity of 65 litres.

Carburetor: 1 Stromberg UX-3 carburetor. Labeled "Chicago-USA". There is a flange on the air inlet on the carburetor, but there is no sign that there has ever been an air filter here.

Fuel pumps and petrol filters: There is a total of four units for cleansing the fuel, two of which are electric fuel pumps

To examine the vehicle, Ernst Sagstuen was equipped with a car creeper and a lamp. The work took place inside one of the museum's storage facilities, administered by Mass Haugen. Here with the constructors grandson Axel Mustad. (Photo: Håkon Aurlien)

with clear glass for visual checking and for expulsion of water. These units are installed on the right side of the firewall.

Choke: A mechanical choke has been installed, with a wire connection to the carburetor through a lever marked "Choke" on the dashboard.

STEERING SYSTEM: The steering wheel is on the right side, and the steering gear has a worm drive. The front wheels and the wheels on the first axle of the tandem-axle group can turn.

Steering input is transmitted to the front wheels, and via steering arms and a long jointed steering shaft, to the swivel arms and steering shaft on the first axle of the tandem-axle group.

The reason why the car has the wheel on the right side is allegedly that the designer believed traffic in the future would be running on the left side of the road.

HEATER AND VENTILATION

There is a small switch device on the left side of the dashboard. This indicates that a heater has been installed to heat the cabin.

There are no signs elsewhere in the car of where the heater was installed. But in a luxury car of this calibre, where no expense has been spared, it is very likely there has been a heater.

In the engine cooling system there are two cut-off tubes, where it is likely that cooling water was taken out to heat the heater register. It is likely that the above-mentioned switch controlled the heating of the passenger compartment with two options for effect or air speed.

Ventilation has been taken care of by enabling the side windows on all doors to be rolled down, and by installing two large hatches under the windscreen which can be opened and closed. These are operated by two small wheels on the dashboard.

ENGINE

The origin of the engine is not documented. The investigations have revealed no manufacturer's mark on the engine block.

The documents that do exist provide different information about the manufacture. One document claims that this is a Mustad product, but elsewhere it is claimed to be a Fiat product or a Maybach product.

General: 6-cylinder, petrol-driven, liquid-cooled in-line engine. Overhead valve engine with 2 valves per cylinder and double valve springs, low camshaft and external push rods for the rocker arms.

A wide metal plate mounted between the engine block and the oil sump serves as an engine mount and platform for the engine's electrical components. The platform extends across the frame of the car.

The engine is specified to have a 7-litre cylinder volume. Based on the dimensions of the engine block, this seems right.

Power: Engine power is specified as 40 hp. A plate underneath the left front seat documents this. However, this probably refers to the old "French tax horsepower" of the time, where 1 "regular" hp corresponds to 4.5 "French" hp. Engine power would then be 180 hp.

The size, weight and load capacity of the car indicate that this would be an appropriately powerful engine.

Fuel gas heating: Exhaust gas is led from the exhaust manifold through a pipe, to the inlet manifold. Here the hot fumes are led through an outer tube, in order to preheat the fuel gases that pass through an inner pipe in the inlet manifold.

Two pipes run from the back and the front of the inlet manifold, down through the engine platform, and under the car where the exhaust fumes are let out.

Carburetor heating: A heating jacket envelops the exhaust pipe just below the exhaust manifold. A pipe runs from the heating jacket to the other side of the engine, to the carburetor.

The purpose is for the underpressure in the carburetor to draw in heated air from the heating jacket, and thus provide heated fuel gases for the combustion. This will also reduce the risk of carburetor icing on cold days. This mechanism is equipped with a metal grid for a rough filtering of combustion air.

However, the original carburetor has more recently been replaced with a carburetor of a more modern type. This carburetor has the air inlet turned towards the rear, and uses neither preheating nor air filtering. We must assume that replacing the carburetor increased the power of the engine.

Crankcase ventilation: The crankcase has four vent valves, to release excess pressure. These are located one in each corner of the engine.

Oil filling and checking the oil level: The front right vent valve for the crankcase can be used as a pipe for oil filling. The amount of oil affects a float on the right side of the engine, and the oil level is visible through a transparent level gauge on the platform.

Valve cover: The engine valve cover is marked "Mustad E-1". The valve cover

Ernst Sagstuen and Axel Mustad discussing the perforated pipe he studied for a long time before he realised its purpose and function. This is one of Clarin Mustad's creative devices and is described below. (Photo: Håkon Aurlien)

seems to have ben made for this cylinder head. This is an indication that the engine is manufactured or modified at a Mustad factory. No other manufacturer's marks are visible to confirm the origins.

Compressed air outlet: The engine cylinder head has been prepared for the installation of two spark plugs for each cylinder, but each cylinder is still only equipped with one spark plug.

The spark plugs are located on the right side of the engine. On the left side, slots for the spark plugs have been plugged shut. In the closed spark plug slot of cylinder no. 1, an outlet has been installed for the connection of a compressed air hose. The purpose is to allow filling air in the tyres, as the cylinder in such cases can be used as an air compressor.

My theory is that the combustion pressure thus led out into an air tube is so high that any air tube would explode. This has probably been solved in that fuel gases to cylinder no. 1 are removed by adding controlled fake air to the combustion in this cylinder.

At the back of the left side of the engine there is a mounting bracket where a perforated pipe has been installed. This pipe can be easily unscrewed and replaced with a pipe mounted in the front part of the inlet manifold. The purpose of the perforated pipe is that the perforations let in clean air with a lower underpressure than the fuel gases being drawn in from the carburetor. There will then be no combustion of fuel gases in cylinder no. 1, and the pressure it transmits will be much lower. In principle, cylinder no. 1 becomes an air compressor until the perforated pipe is once again replaced with the original, airtight pipe.

The procedure for air filling will then be to stop the engine, switch the two above-mentioned pipes, attach the air tube at the connection point, open the vent valve, start the engine and let it idle. The engine will now be running on a maximum of 5 cylinders, of which cylinder 1 is producing compressed air without fuel gases.

When the air filling is finished, the same actions are performed in reverse order.

Oil circulation: At the back, on the right side of the engine platform, a large pipe has been installed. This pipe leads to the engine oil pump, located on the left side of the engine, under the platform. The oil pump is driven by the camshaft.

Power supply: The engine power/throttle is controlled by a lever in the middle of the steering wheel. A small gas pedal is also located between the clutch and brake pedal. Operation unknown. It seems to have been deactivated.

Exhaust system: The exhaust pipe and silencer are lined with asbestos.

Maximum speed: Maximum speed is specified to be 110 km/h. in "Clarin Mustad - fact" by Torleif Lindtveit.

(Lindtveit was former Director of the Norwegian Technical Museum, and died in the autumn of 2019 after prolonged illness).

ORIGIN OF THE ENGINE

Several alternative manufacturers are mentioned in various articles about the car. For example, the engine is said to be similar to a Maybach engine, manufactured as a boat engine. This has been well documented by Torleif Lindtveit. This theory is supported by the present writer, based on the following arguments:

The cooling fan and water pump arrangement does not appear to be original for this engine. The device for attaching the cooling fan and the water pump seems completely undersized and "home-made" compared to other components of the engine. On the power transmission to the generator there is a flat belt wheel, which may be intended for the operation of a cooling pump in a boat. The belt wheel has no function in this car.

The engine has a square design, and the platform is so wide and large that it covers the width between the frame rails. This makes it so heavy that the present writer considers it unsuitable for use in aircraft. Aircraft engines also turn out to have a much more rounded design.

My theory is that this is a Maybach engine originally manufactured to be used in a boat, and that the water pump and cooling fan are manufactured and retrofitted at a Mustad factory. The original cylinder head has been replaced with a contemporary cylinder head manufactured by a Mustad factory, as the Maybach engine was originally equipped with an old-fashioned side-valve cylinder head. The Giant's engine has a cylinder head with "modern" vertical valves that will help achieve a power boost. The valve cover is marked with the text "Mustad E-1", which is also marked on the frame.

Ernst Sagstuen has not entirely completed the task of finding out what Axel Mustad's grandfather actually used in terms of parts and constructions to build the more-than-100-year-old Norwegian car. (Photo: Håkon Aurlien)

Originally, the power output of the Maybach engine was specified to be 120 hp. The engine power may have been increased to 180 hp as the cylinder head was replaced with a more effective one and the carburetor was replaced by a newer and probably more effective model. Web searches for Maybach engines indicate that this may be the model referred to as Maybach W5. These engines were manufactured between 1926 and 1928 and were also used in Maybach's own large luxury limousines from this era. It remains to be confirmed whether this is the same engine that is used in the Giant.

The engine oil sump and the gearbox are covered by two large metal sheets to protect them from water and dirt from the roadway. It is possible that a factory mark exists on the engine, hidden behind these sheets.

AFTERWORD

It was an interesting and laborious task to examine the Giant to see how a car was constructed in 1917, not to mention trying to uncover the car's "secrets." It is full of impressive, technically well-functioning solutions, and the designer has shown great creativity and drive.

Unfortunately, no more cars were manufactured in the Mustad factory, as the company management was not convinced that there was a future in car manufacturing.

Searching for documents online, I found that in 1926 Mercedes had developed a vehicle with many similarities to the Giant. It had tandem axles, but it is unknown whether the first of the tandem axles could turn. This car was named Mercedes G1 Dinosaur, and was further developed into G2, G3 and G4. Images of the latter from the 1940s show striking similarities to the Giant in terms wheel layout, size and body shape.

Documentation remains to be found of the engine manufacturer, as well as manufacturers of the gearbox, mid-axles and the tandem axles. On these I have found no factory marks, nor any other documentation of their origins.

It was a car clearly affected by the ravages of time that was collected from the Technical Museum's storage facility at Bygdøy and driven to Lillehammer in 1983. There it was given new old tyres, a good cleaning and polishing - and in the years to follow: many an admiring glance. The car was given a second round of polishing before it was taken for a short drive to the new vehicle museum in April 2019. There, Clarin Mustad's car from 1917 has been given a prominent place and once again is getting looks of admiration. (Photos: to the right unknown, the rest Håkon Aurlien)