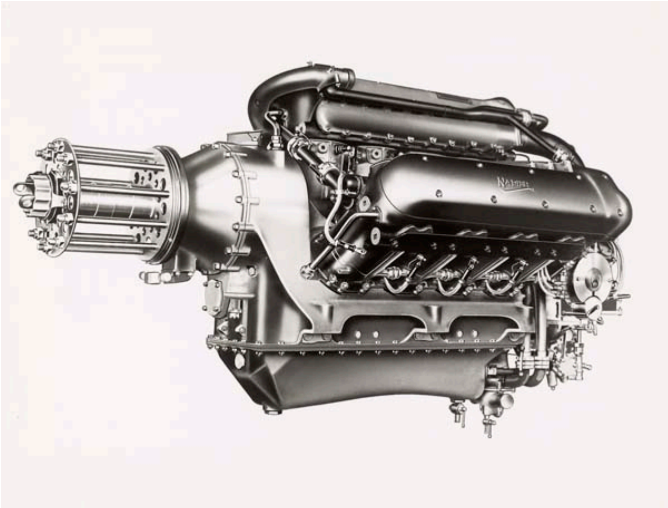
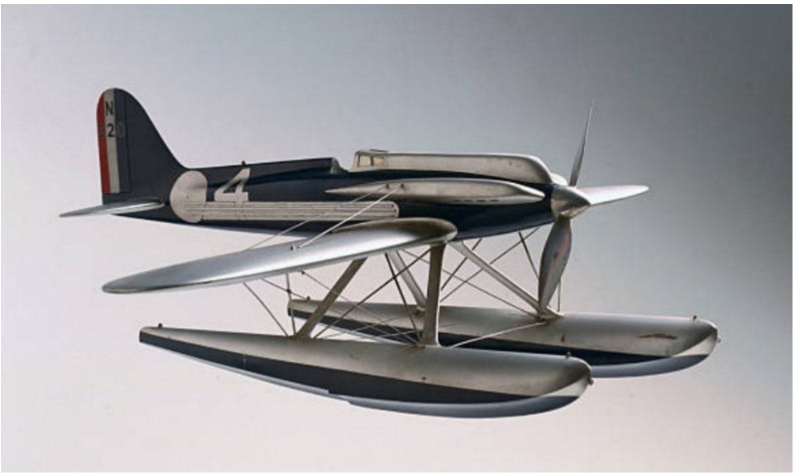
Building a 1:8 Scale
Napier-Railton Race Car

Introduction

From 1917 through the early 1930s, the Napier Lion Aero Engine was at the core of British aircraft developments. It was a twelve cylinder 'W' arrangement of three rows of four cylinders which, in its basic form developed over 450 HP. But in racing form it could deliver in excess of 1,300 HP. It was the most powerful engine of is day and was used in a number of racing designs, not just for aircraft but also for boats and cars.



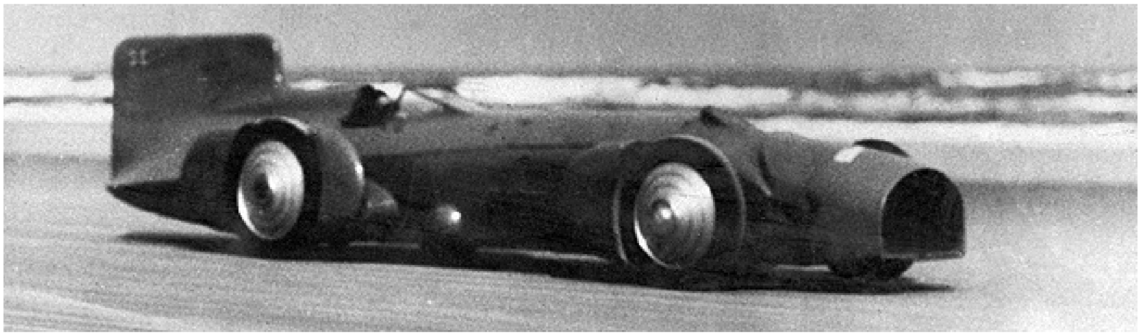
Napier Lion engines powered the two Supermarine S.5s which were Britain's 1927 entry in the very popular Schneider Trophy race for seaplanes and flying boats. The international race was flown around a fixed course and attracted large crowds. The two Supermarines came first and second. Over the next five years, there were two more races which Britain also won. Under the rules of the contest, that meant that Britain go to keep the trophy permanently.



Napier Lion powered Supermarine S.5

The Supermarine S.5 really is a beautiful design and I have to think it contributed to the streamlined design thinking that really came into vogue in the 1930s.

In 1931 Malcolm Campbell set a new land speed record of 246 mph driving his Blue Bird car powered by a supercharged Napier Lion engine. For his efforts Malcolm Campbell was knighted.



Blue Bird 1931

Between 1933 and 1935, John Cobb's Napier Lion engined Napier-Railton race car achieved a number of lap records at Brooklands, including a one lap record of 143 mph that was never beaten. The car also broke many endurance speed records.

Napier-Railton at Brooklands
Top speed was almost 170 mph.

Both the Supermarine S.5 and the Napier-Railton race car seemed like excellent candidates for 1:8 scale models. Each would fit well with my suite of 1930s car models that showcased the transformation of transportation in the 1930s. The common denominator was, of course, the Napier Lion engine. So, if I could build a model of the engine then models of the Supermarine S.5 and the Napier-Railton might be possible. Of course, since the engine is enclosed by bodywork, it would always be possible to build models of the plane and of the car without modeling the engine. But my interest is in building a 1:8 scale replicas rather than just representational models.
However, to complicate things, the engine could be built in several different configurations. The version for the Supermarine S.5 dispensed with the large gear reducer and housing on the front of the engine and opted, instead, for a direct drive off the crankshaft. That, together with shorter con rods and lower camshafts, helped lower the profile. The Napier-Railton race car also used direct drive, but the housing for the large gear reducer was kept and simply blanked off. There were other differences too in the type of magneto used, the type of carburetor used and where they were located.

Starting Point

As with almost all scratch-built models, the starting point is getting or creating a set of drawings. But drawings from the early part of the 20th century aren't easy to find and the Napier Lion engine was no exception. Eventually, however, I was able to find an instruction book that included basic drawings of the engine. They were enough to get started.

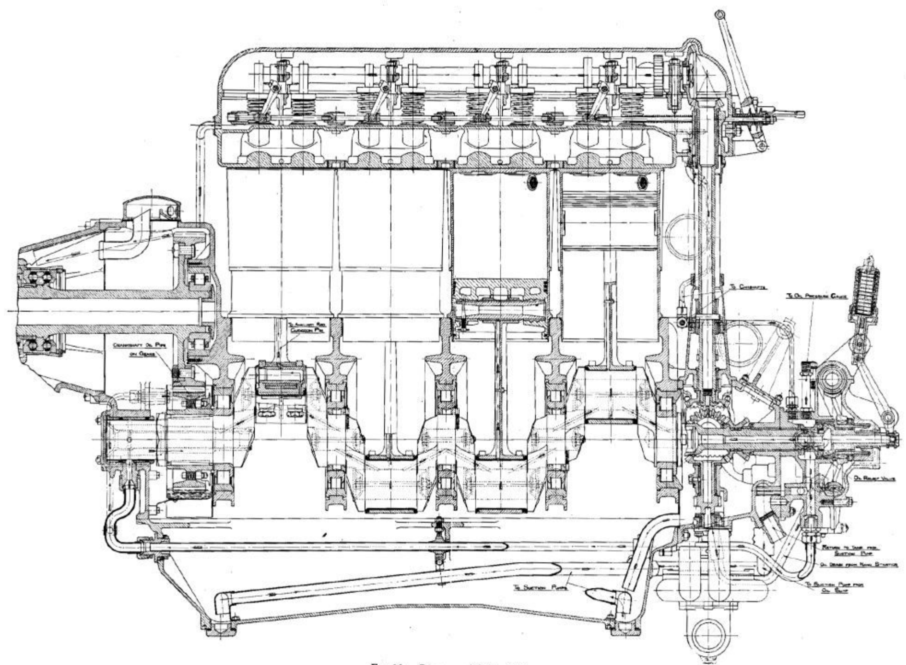


Fig. 10.—Diagram of Oiling System.

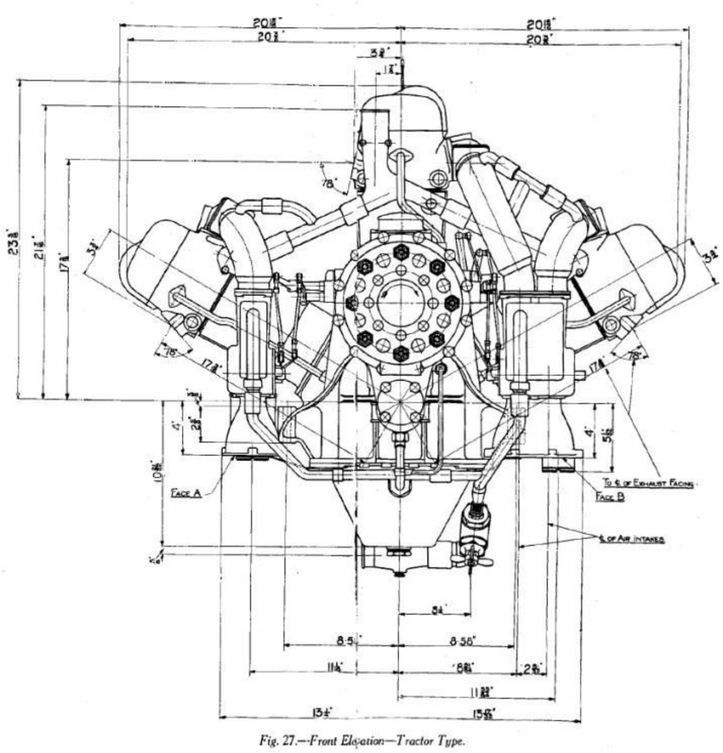
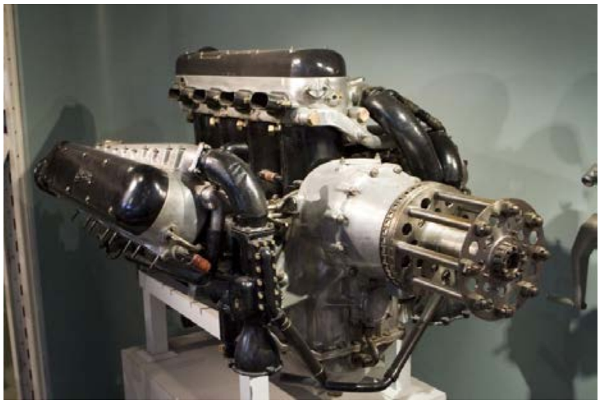


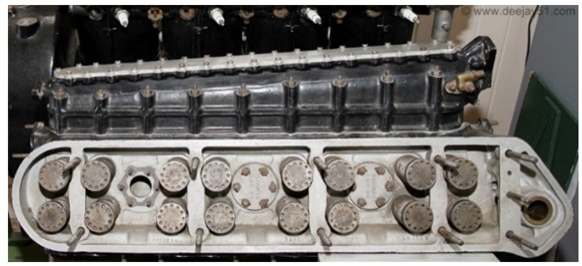
Fig. 27.—Front Elevation—Tractor Type.

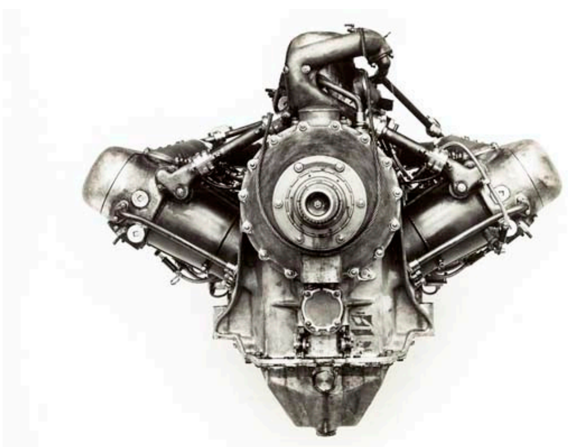
Fortunately, it was easier to find photographs of the engine and some of its critical components. They would be crucial in helping convert the 2D drawings into 3D CAD drawings and renderings. The challenge would be matching the various photos with the different versions of the Lion engine.
Once the CAD drawings had been created, my goal was to 3D print the critical parts.

Photographs

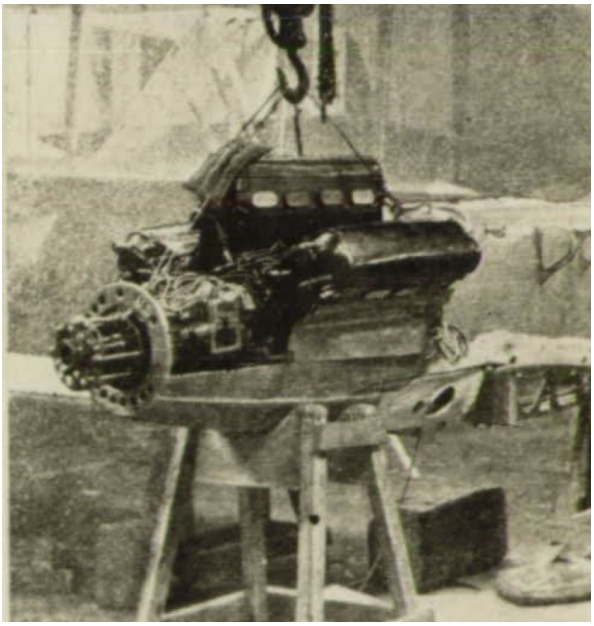
Here are just a few of the photographs I found:

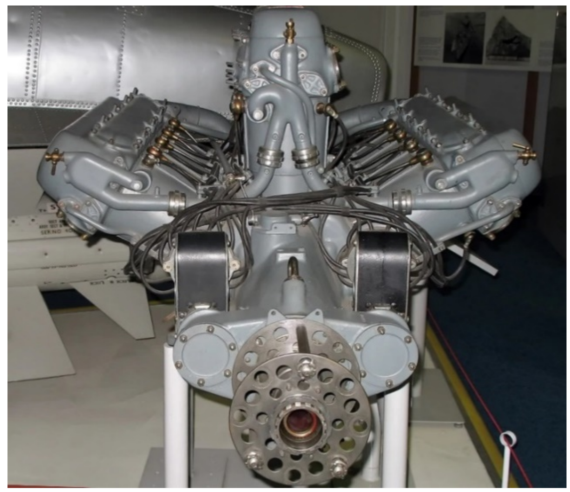




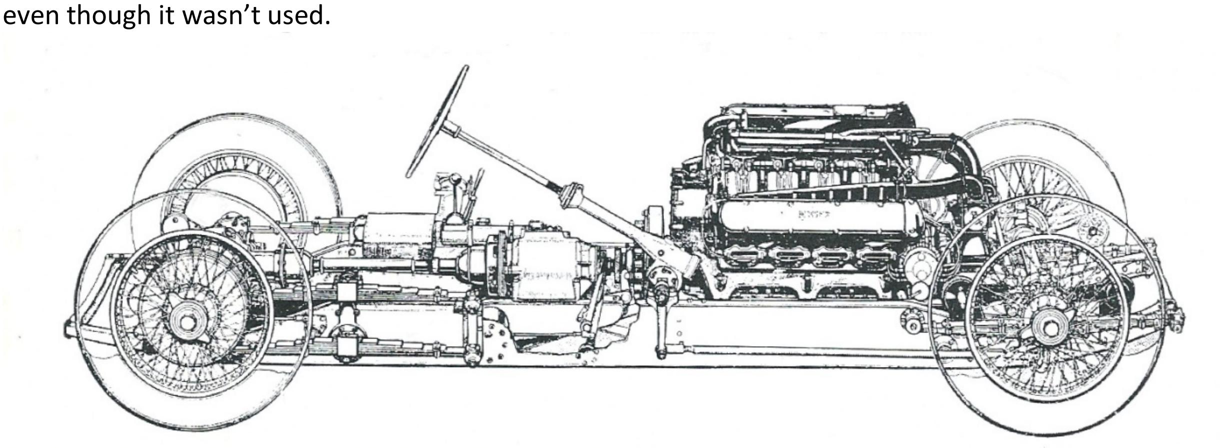


Different photographs and drawings show several configurations for the Lion engine; e.g. offset drive vs. direct drive, carburetors at front or rear, magnetos at front or rear. In the traditional aircraft arrangement a large reduction gearbox was mounted on the front of the engine. This moved the centerline of the propeller approximately 8” above the crankshaft. This is the arrangement shown in the cross-section drawings I found. However, both the Supermarine S.5 and the Napier-Railton race car used a direct drive arrangement where the power was taken off directly in line with the crankshaft. Here are some more pertinent photographs, the first showing the Lion engine being installed in the S.5;





And here’s a sketch of the Napier-Railton racecar chassis. Although it featured direct drive, the distinctive housing for the large gear reducer, commonly used in aircraft applications, is clearly visible even though it wasn’t used.



The carburetors and magnetos are mounted on the rear of the engine (i.e. the front of the car). This version is the Lion XIA.

Below is a history of the various versions of the Lion engine:

NAPIER LION VARIANTS

Model	Date	Desig.	Power		Drive	Magnetos	Carbs	Exhaust Takeoff			Cam Drive			Notes	Notable uses
			BHP	At RPM	Type			Left	Cntr	Rght	Left	Cntr	Rght		
I	1918	E64	450	1,950							I	E	I	Geared, also related IA and 1AY	
II	1919	E64	480	2,200	Reducer	Rear	Front	L	R	R	I	E	I		
IIII			experimental geared		Reducer	Rear	Front	L	R	R	I	E	I	Gloster Gorcock	
V			470 500	2,000 2,250										VA had increased CR to 5.8	Mainstay engine of RAF in the late 1920s, replaced by Lion XI
VS		E79												Turbocharged, intercooled	
VIS	1927													Turbocharged	Gloster Guan
VII	1925		700 (racing)		Direct	Front	Rear	L	L	R	E	E	E		Gloster III (Schneider Trophy entrant) Supermarine S.4
VIIA	1927	E86	898 (racing)		Direct	Front	Rear	L	L	R	E	E	E	Con rods shortened and camshafts lowered, each by 1" CR 10:1	Golden Arrow Blue Bird (1927) Miss England I Supermarine S.5 (Schneider) Gloster IV
VIIB	1927	E90	875 (racing)		In-line 'coaxial' reducer	Front	Rear	L	L	R	E	E	E	Geared Otherwise as VIIA	Supermarine S.5 (Schneider) Gloster IV
VIID	1929	E91	1,350 (racing)	3,600	Direct	?	Rear	L	R	R				Supercharged, about 6–8 built	Blue Bird (1931) Fred H Stewarts Enterprise Betty Carstairs' Estelle V powerboat Miss Britain III Gloster VI (Schneider Trophy entrant) Railton Special (John Cobb's land speed record car)
VIII	1927													Direct drive	Gloster Gorcock
XIA	1928		580 (6:1 CR)	2,585	Direct Rdcr Fairng	Rear	Rear	L	R	R	E	I	E	RAF production model	Napier-Railton
Lioness		E71												Inverted layout, for better visibility. At least some were built turbocharged, for racing.	
Sea Lion	1933		500 & 600											Marine version of Lion XI	British Power Boat Company Type Two 63 ft HSL
								L= Left			E = Exhaust Side				
								R = Right			I = Inlet Side				

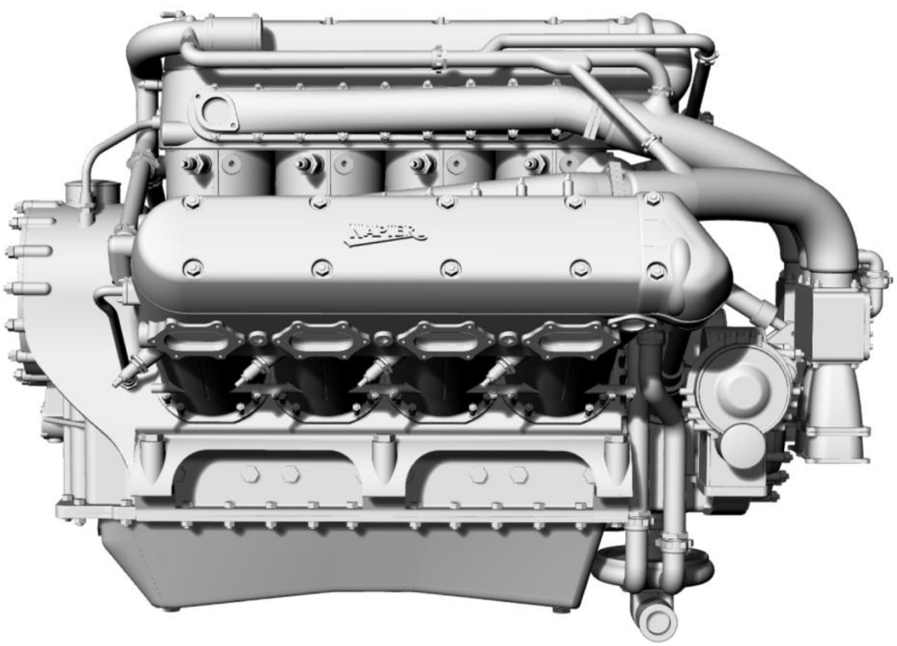
Originally, I thought (hoped) that the differences between the engine used for the 1927 Schneider race and the engine used for the Napier-Railton race car would be relatively minor. Instead, it is clear from the above that the differences would be substantial. In reality, drawings for two separate engines would be required and two different sets of 3D printed parts.

Given that, I decided to focus first on the XIA engine of the Napier-Railton.

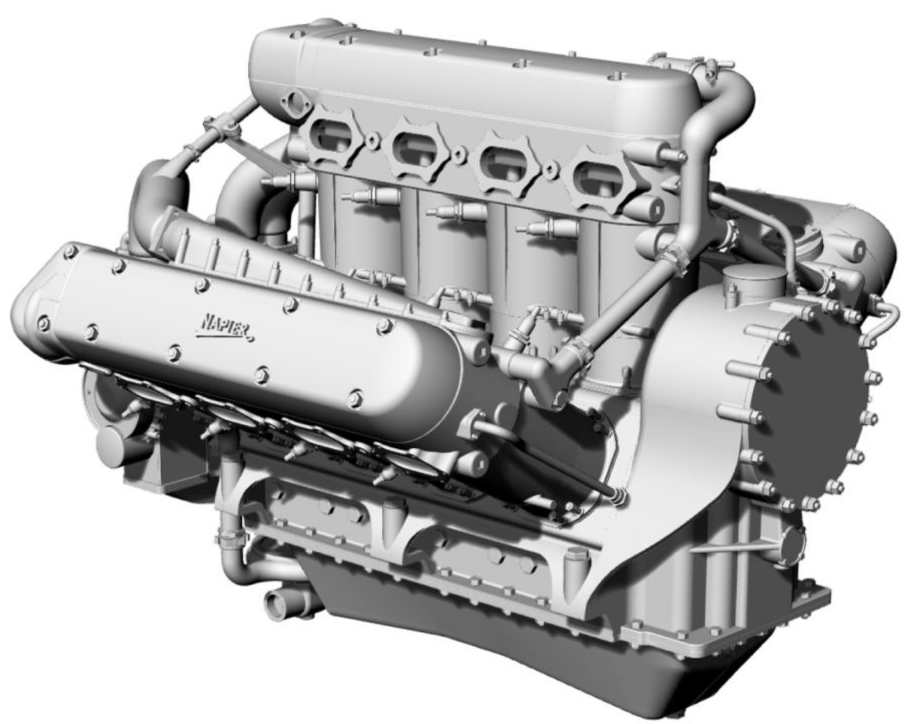
Renderings

At every step, the goal was to produce drawings from which parts could be 3D printed. That is what you will see in all of the renderings. My CAD skills are somewhat limited, (I use it only for hobby work, after all) but I felt they were adequate enough for this project. Purists and experts will likely find lots of places for improvement. I wouldn't argue with their assessment!

To give you an idea of the scope of the project, the following two renderings show the completed engine drawings. All the pieces shown are designed for 3D printing. The first rendering has the same aspect as that of the Napier-Railton chassis drawing.

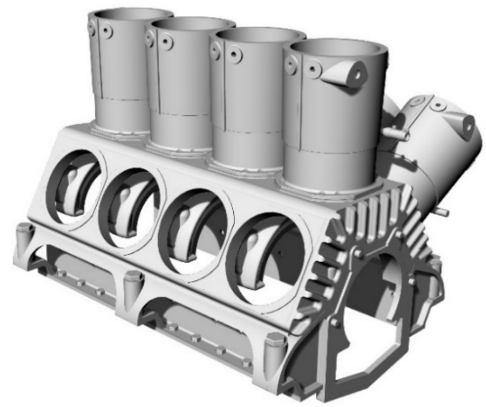


And this is a front three-quarter view …

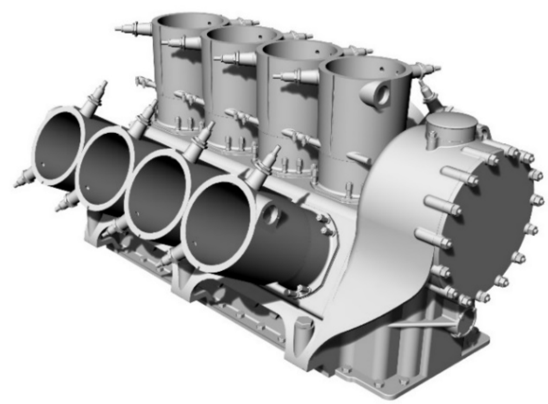


Crankcase & Cylinders

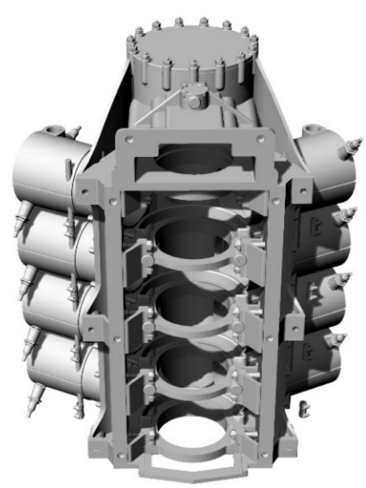
My starting point was the crankcase and the cylinder blocks with their distinctive 'W' arrangement. Everything hung off the crankcase.
This picture is a rear three-quarter view. Visible through the holes for the cylinders are the upper supports for the crankshaft bearings. Although the internal parts of the engine would be hidden on the model, I wanted the model design to allow for crankshaft, connecting rods, pistons, and a full set of camshafts and valve gear.
The cylinders are water-jacketed. Also, water was used to heat the air passing through the carburetors and inlet manifolds. As you can imagine, and will see later, the water piping gets quite complicated



Each of the twelve cylinders had two spark plugs, arranged on opposite sides of the cylinder. They were fired by two separate magnetos.
This three-quarter right hand side front view shows the spark plugs and the water connections between the cylinders. Also, very prominent, is the gear reduction housing and the distinctive aprons that anchor the housing to the crankcase. The direct drive takeoff comes out through the large boss underneath the gear reduction housing.
On prototype engines, the gear reducer housing and crankshaft were made from one large casting. However, for the model the two were separated to make 3D printing easier.

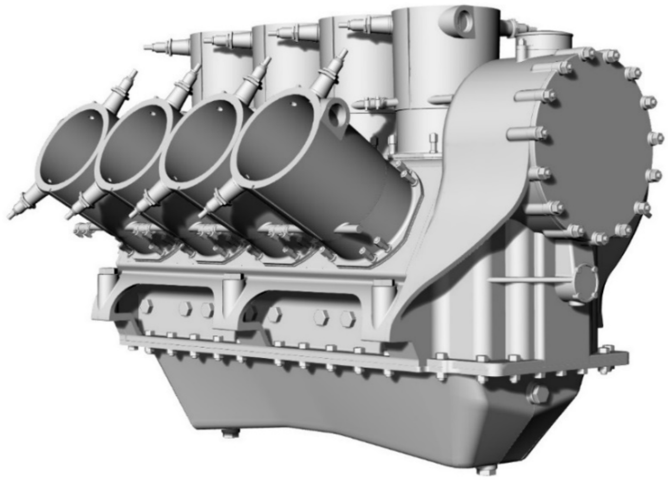


A view from underneath showing the lower crankshaft bearing supports. On the model, the lower supports are removable and will be bolted into place.
Although the crankshaft, connecting rods and pistons have yet to be drawn, it will be no problem to add them to the model. The three large bolts low on the side of the crankcase (and three additional bolts on the other side) mount the engine to its frame.



Sump

Here the sump has been added. This creates the core of the engine.

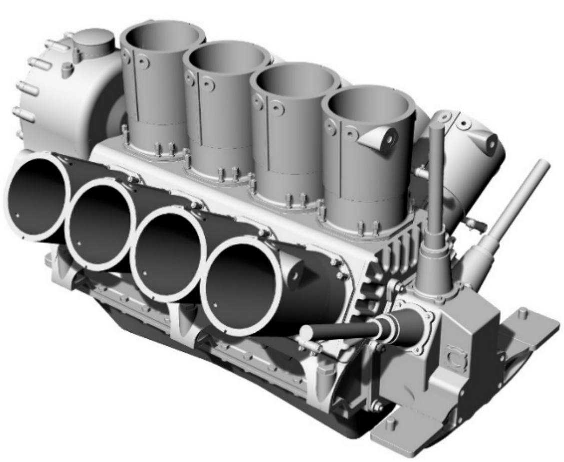


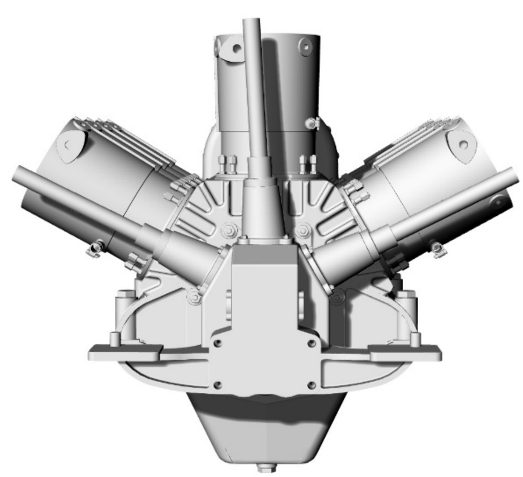
Camshaft Drives

The next challenge was to create the cylinder heads, one for each bank of cylinders. Each cylinder head housed two overhead camshafts which operated two inlet and two exhaust valves per cylinder. The camshafts were gear driven through a drive box mounted on the rear of the engine. Shafts connected the drive box to the cylinder heads. So, the drive box was the place to start.

One of the benefits of a CAD-based model is that the interfaces between the various parts can be tested before parts are produced. This was going to be particularly important for the Lion model since the engine is such a compact design. Obviously. the location of the drive shafts would dictate the final dimensions of the rear of the cylinder heads

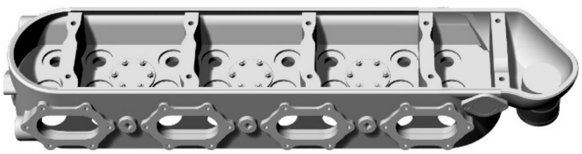
Here the drive box has been added … mounted to the flange on the rear of the crankcase.
On the rear of the drive box are the platforms for the magnetos, one on each side of the engine. Also visible on the platforms are the pegs that will help properly locate the magnetos when mounted to the model.
The camshaft drive shafts align directly with one of the camshafts and, as you can see in the right-hand photo, they are skewed off the centerline of the cylinders, just like on the prototypes.



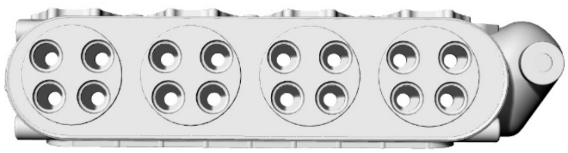


Cylinder Heads

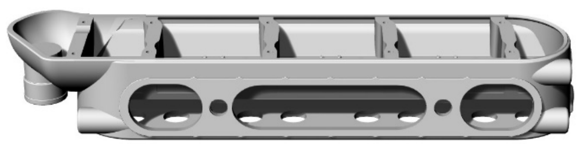
Here are details of the left-hand side cylinder head showing the complexity of design that 3D printing can produce. In 1:8 scale the cylinder head is approximately 100mm long and 20mm wide.



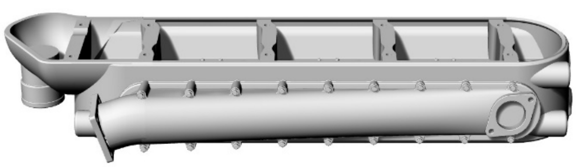
This side of the cylinder head shows the exhaust ports.
The cross pieces are the platforms for the camshaft support blocks.



Here the four-valve arrangement is very clear.

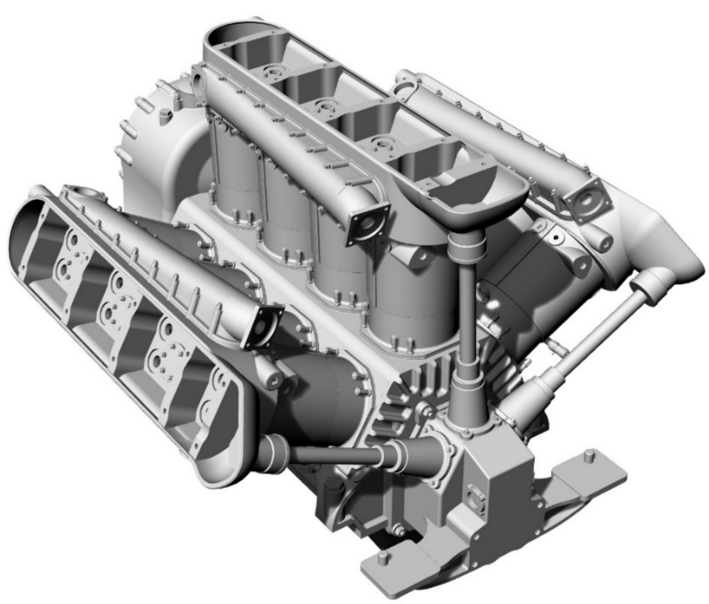


This is the inlet side. The opening to the inlet valves would normally run the length of the cylinder head, but you can see that I've made provision for two large pegs to hold the inlet manifold in place.



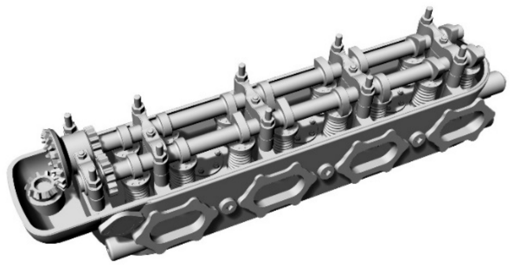
Here the inlet manifold has been added

This is the engine block with all of the three cylinder heads and inlet manifolds:



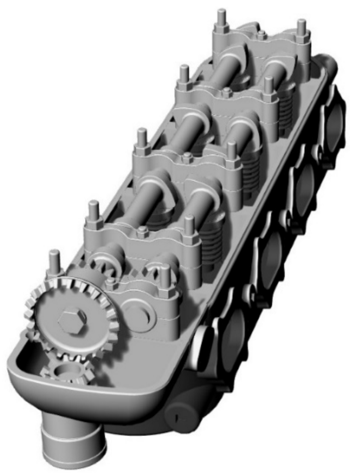
Camshaft & Valves

With the overall cylinder head dimensions and shapes established, the camshafts and valves could be added:



In order to meet 3D printing limitations, the pitch of the gears on the model had to be made significantly bigger than on the prototypes. But the arrangement is the same.

Long studs pass through the camshaft support blocks and anchor the supports in place. Those same studs also pass through the camcase covers to hold the covers down onto the cylinder heads.



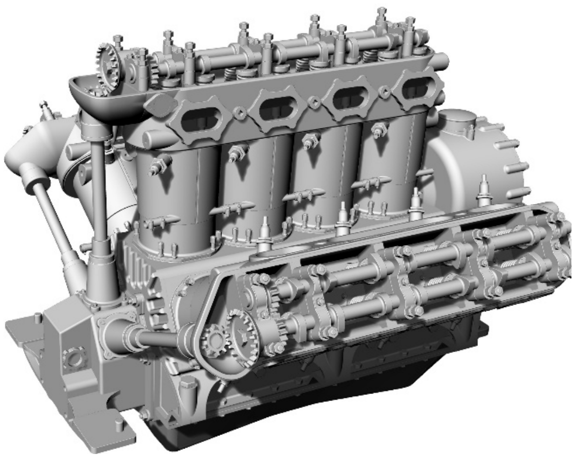
The lobes on the camshaft were set based on the firing order and the typical sequence of a four -stroke engine cycle.
On the Lion engine, the cylinder numbering, from the front of the engine, was:
Left: 12, 11, 10, 9
Center: 5, 6, 7, 8
Right: 4, 3, 2, 1
And the firing order was:
1, 5, 9, 3, 7, 11, 4, 8, 12, 2, 6 , 10

It gets a bit complicated because the inlet and exhaust camshafts counter-rotate and the exhaust ports are on the left of the left cylinder bank and on the right of the center and right banks. So, I treated each camshaft as unique and had them 3D printed accordingly.
Does it really matter? Probably not, but why not try to get it right?

There are two valve springs for each valve, one inside the other. A valve cap sits on top of the springs and is attached to the top of the valve stem. A ratchet system lets the length of the valve assembly be adjusted by rotating the cap relative to the stem. The cam lobe impinges on the top of the cap.
The springs will be hand made from wire, but the valve, stem and cap will be 3D printed.

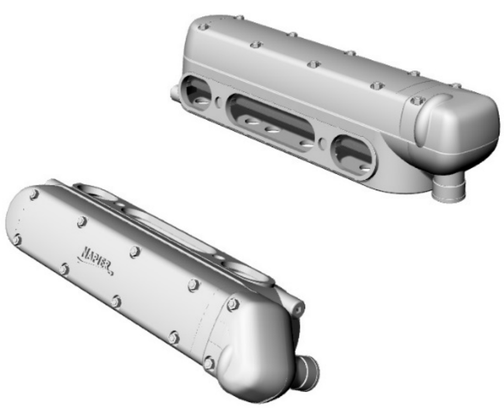
Prototype Valve

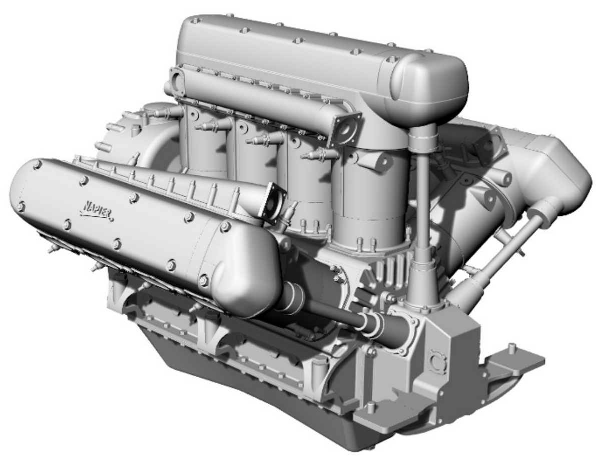
Here’s a rendering showing the engine with its cylinder head and a prototype engine. Note that, in contrast to the model, the prototype has inlet manifolds oriented for front mounted carburetors.



Camcase Covers

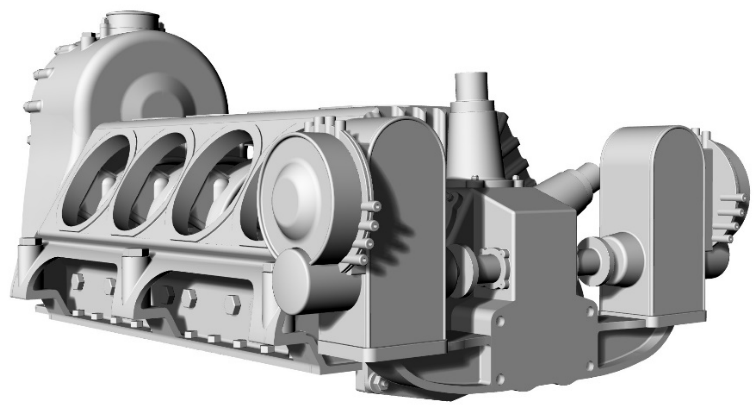
Drawing the camcase covers was relatively straightforward except for the rears where the covers are bulged to accommodate the large camshaft gears. Care also had to be taken to make sure the covers cleared the camshaft supports.
The first photo below shows the left-hand side and center camcase covers installed on their respective cylinder heads. The second photo shows the overall progress with the drawings.





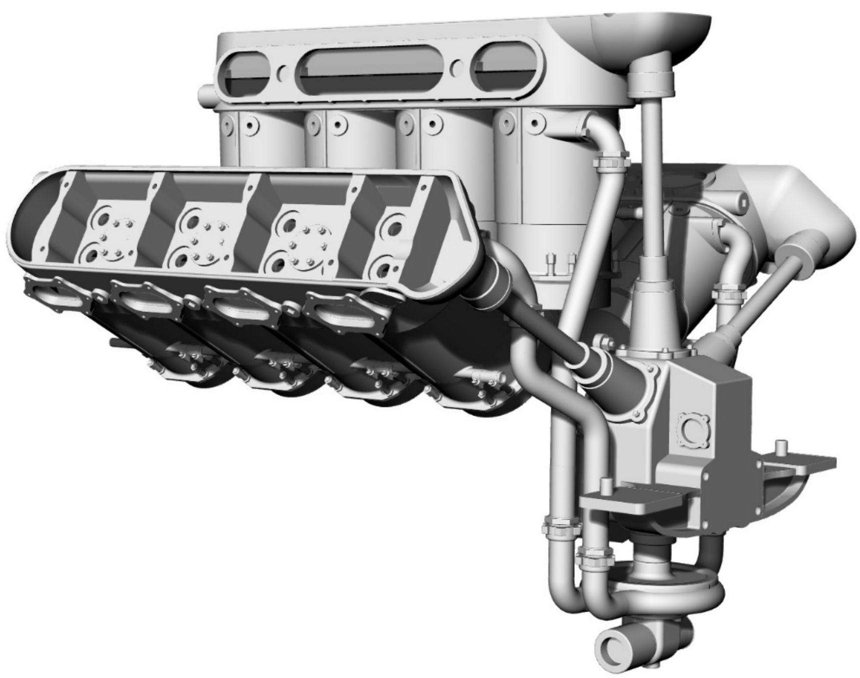
Magnetos

As mentioned before, the magnetos were mounted on platforms extending out from the sides of the camshaft drives housing. Each magneto fired twelve spark plugs. The Magneto design was fairly consistent and dimensions were readily available from the various drawings.



Water Pump

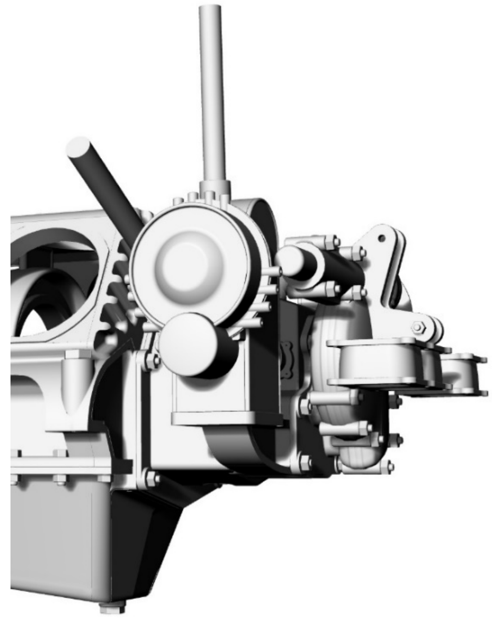
The water pump was mounted on the underside of the camshaft drives housing. Three pipes led from the centrifugal pump to each cylinder bank as shown by this rendering:



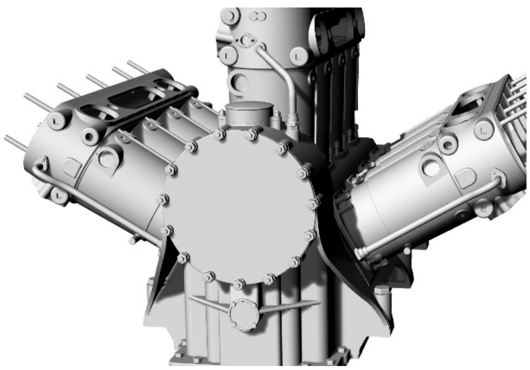
You can see from this rendering how compact and complex the rear of the engine is becoming.

Oil Pump & Oil Lines

The oil pump was attached to the rear of camshaft drives housing. It also provided support for the carburetors. You can see the air intakes and carburetor platforms on the right of the photo.
The large ‘L’ shaped bracket above the carburetor platforms is for a lever that is part of the hand start mechanism.



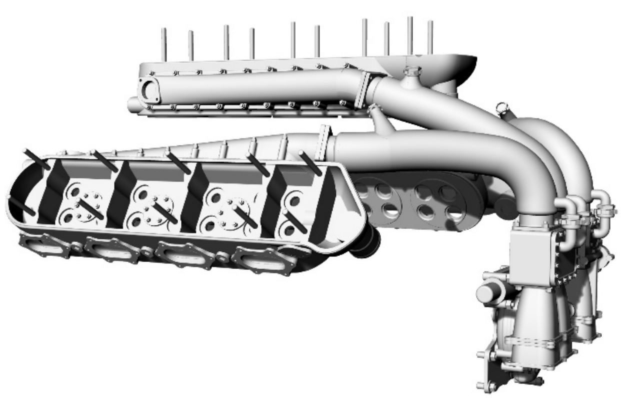
Oil lines at the front of the engine drain oil from each cylinder head into the crankcase, as shown below:



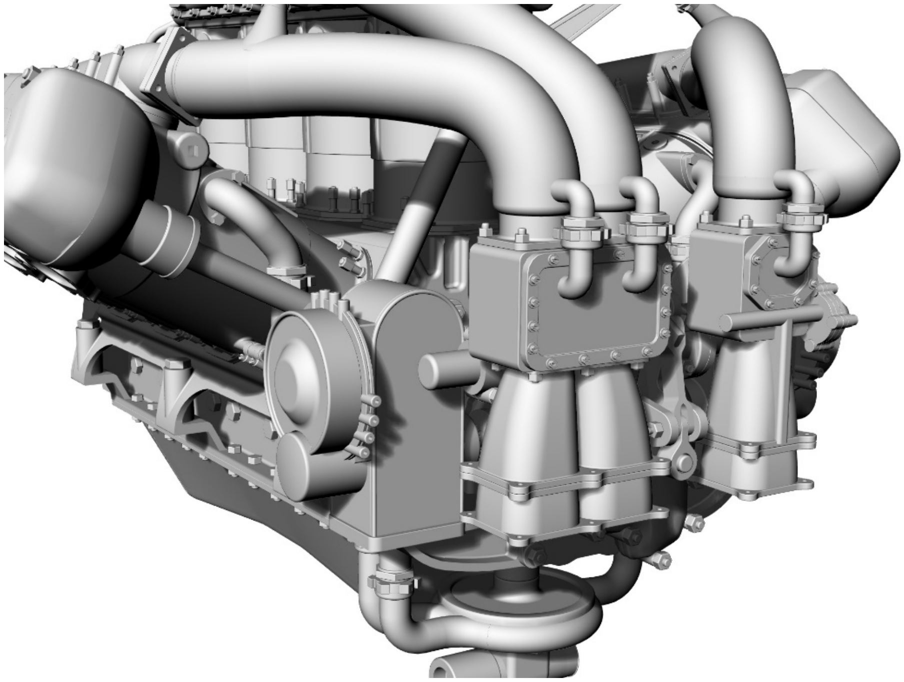
Carburetors & Inlet Tubes

The last major components to add were the carburetors and the water-heated inlet tubes that connected the carburetors to the inlet manifolds. Each of the three banks of four cylinders had its own carburetor. The two on the left were combined into what was called a duplex arrangement and the one on the right into a simplex arrangement. The carburetor design changed significantly during the period the Lion engine was in production and it appeared that the Napier-Railton used a later version of the carburetors. So that’s what I chose to use for the model.
Air flowed up through the carburetors and then the combined air/fuel mixture was fed to the inlet manifolds through water-jacketed tubes. Hot water from the return pipe was used to heat these tubes.

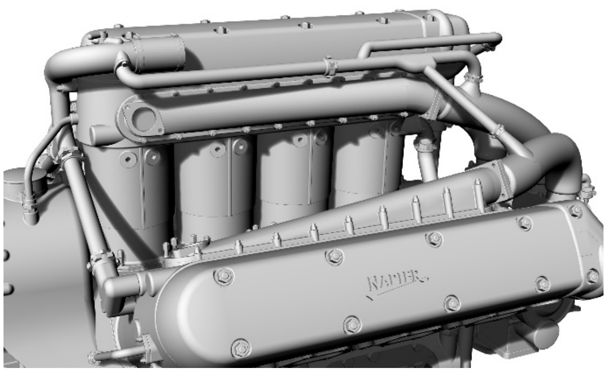
Here’s a rear three-quarter view showing the carburetors and inlet tubes.

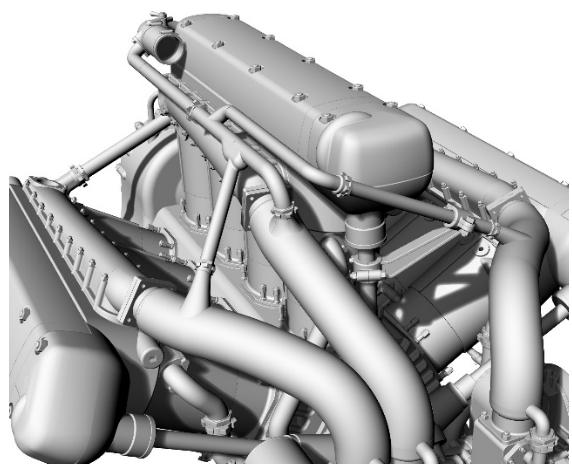


Here is more detail of the carburetors:



And, here, more detail of the water lines to the inlet tubes:



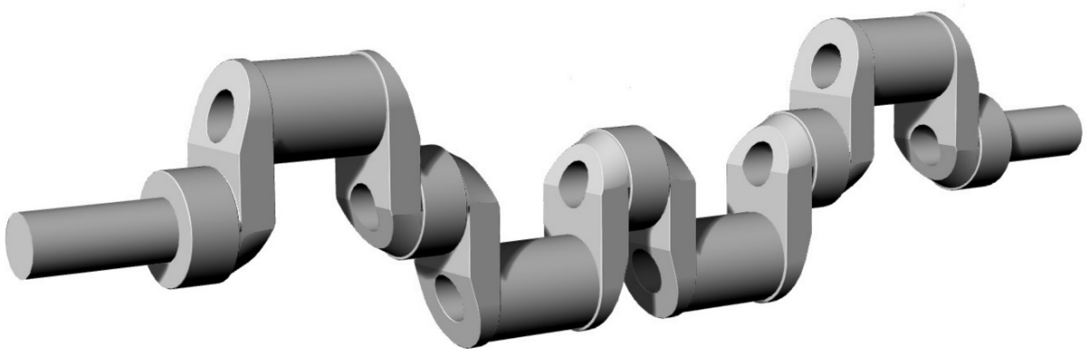


Crankshaft & Pistons

Waiting for the 3D printed parts to arrive was an opportunity to draft up the crankshaft, connecting rods and pistons. They would add an interesting 'working' element to the engine. Those of you familiar with the Rolls-Royce Pocher kits and their troublesome 'working' engines will know this is not as easy as it sounds. However the advantage of 3D printing is that quite complex shapes can be produced as one part.

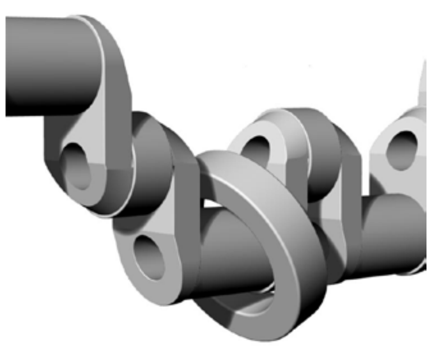
The crankshaft was one such part, and relatively straightforward except for the lands on the crankshaft between the con rods and the main bearings. As you'll see later, the main bearings have to pass over these lands when they are installed, so it was important to dimension them carefully.

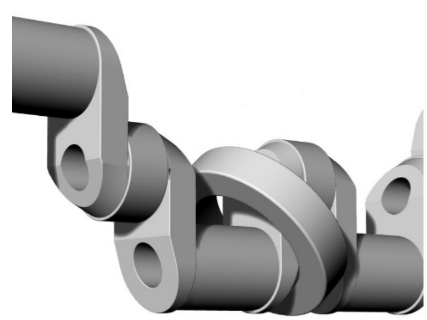
Here's the crankshaft, based on Napier Lion dimensions. The end shafts will need some more work before 3D printing is started but, otherwise, the crankshaft is complete:

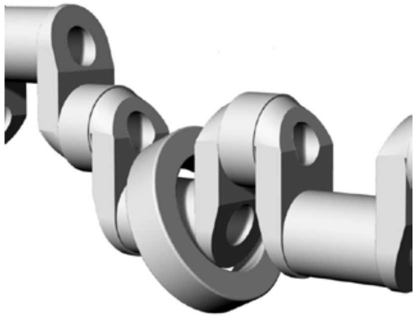
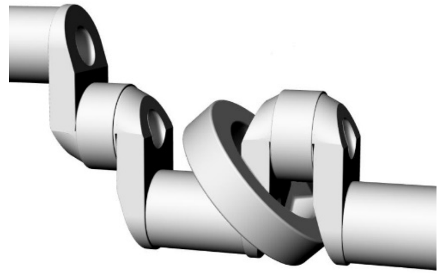
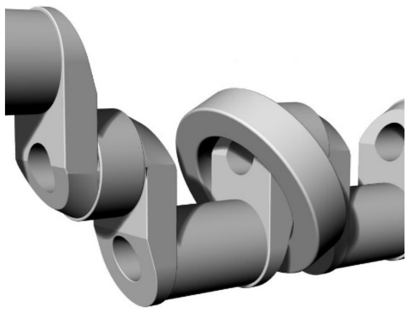


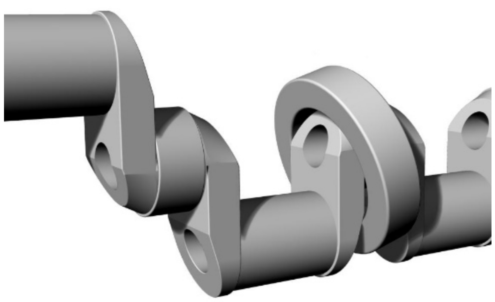
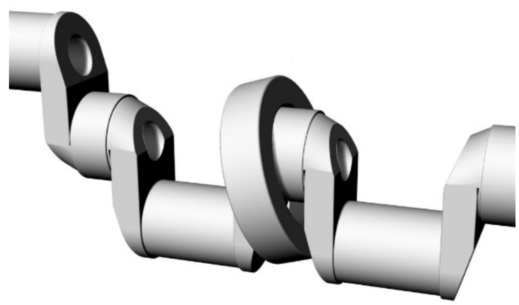
The bigger challenge was finding a suitable main bearing for the crankshaft.
The supports for the main bearings would accept a bearing with an external diameter of up to 20mm, but the minimum internal diameter was somewhat trickier. Since the bearings pass over the lands of the crankshaft, their internal diameter has to be larger than the crankshaft diameter under each bearing. On prototypes, the gap was made up by two half-sleeves which were slotted into place between the crankshaft and the bearing. I decided to take a similar approach. The crankshaft diameter under the bearing was 9mm. So I chose a readily available, affordable bearing with an external diameter of 18mm, internal diameter of 12mm and width of 4mm. It looked like it would work well. The following renderings (left and right views) showed how the bearing will just fit over the lands:

Starting to move the bearing over a land:

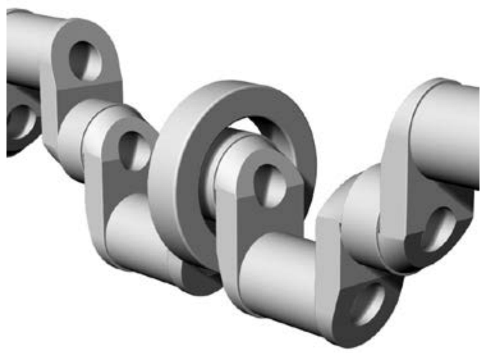




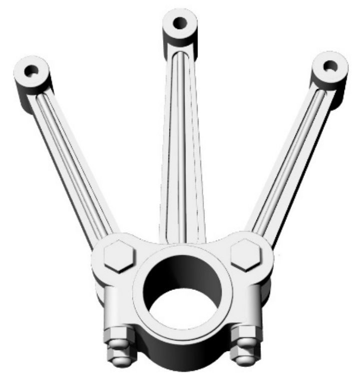



Here the bearing is in position. The half-sleeves still need to be added:



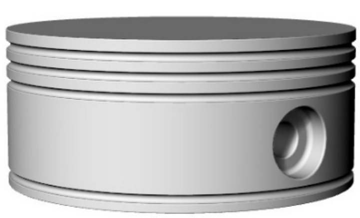
Big Ends and Connecting Rods

Three connecting rods were connected to each of the four big ends. The central rod was part of the big end forging and the other two rods were hinged off each side. The big end was split in two so it could be installed around the crankshaft. It was secured in place by four bolts.
On the left is the prototype big end and rods, on the right a rendering of the CAD drawings:

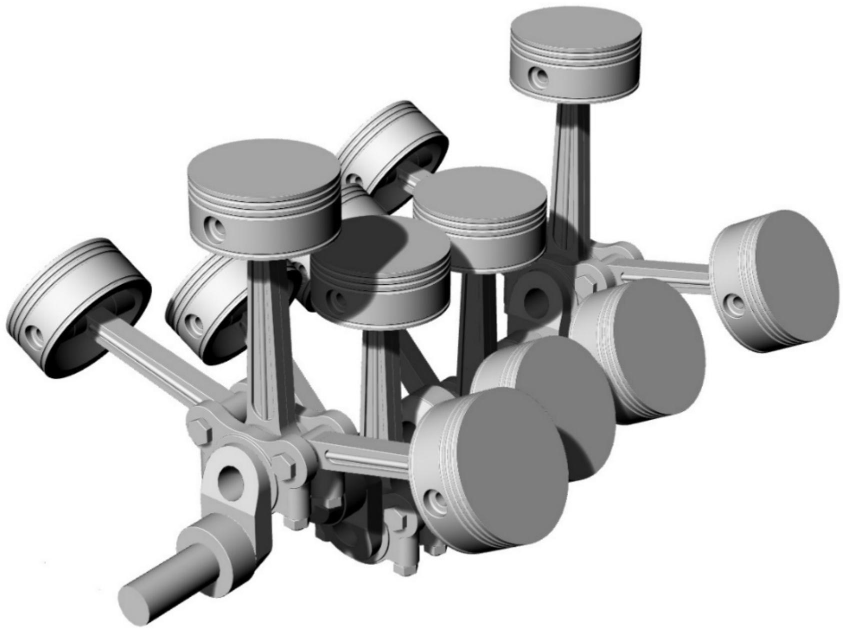


Pistons

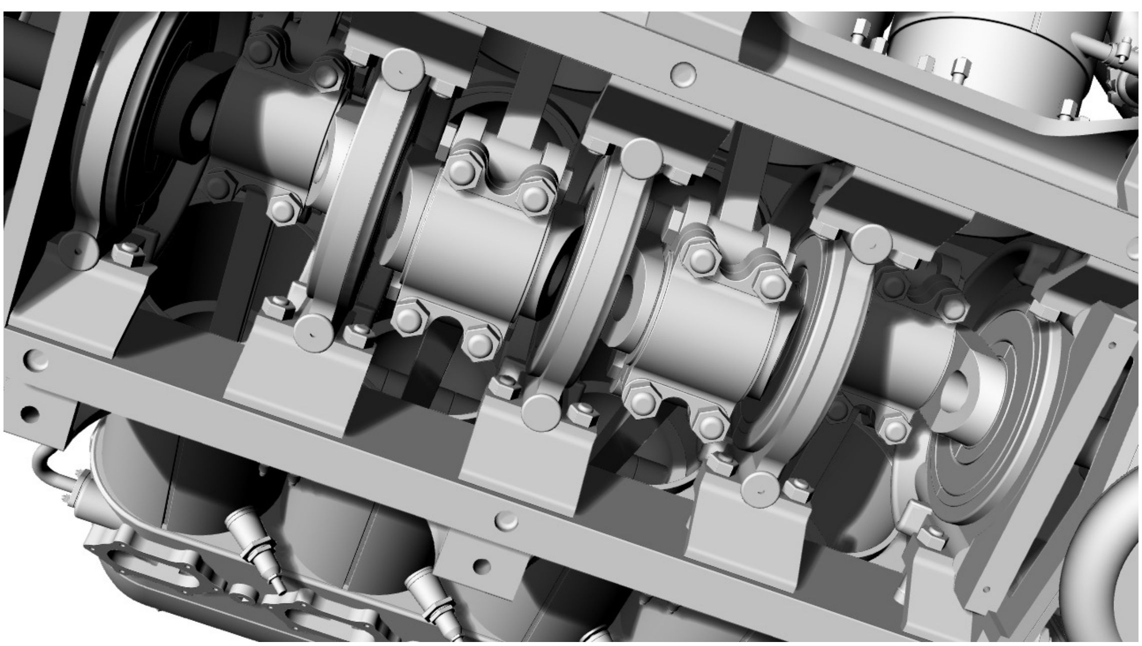
The pistons were relatively straightforward, although I did take some liberties with interior dimensions to give the parts more strength. The piston diameter is also 0.5mm smaller than the bore. Given variabilities in 3D printing this should allow the pistons to move freely in the cylinders but without too much slop. Nevertheless, I did make provision for three piston rings at the top and one at the bottom, consistent with Napier practice. The ring slots are round (0.4mm dia), not rectangular, so piston rings could be made from 26Ga or 28 Ga wire, if they are needed.



Here’s a rendering of the complete crankshaft and piston arrangement:



And here’s a view of the underside of the engine with the sump removed:



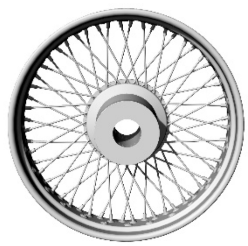
Wheels & Tires

At this point, some of the parts for the engine were in the 3D printing process and others were taking a long time to make their way through the delivery system. So there was an opportunity to start thinking about the Napier-Railton chassis. One of the major challenges would be building the wire wheels and rubber molding appropriate tires. Those seemed like good things to be working on.

The Napier-Railton car used several different wheel and tire combinations. Currently the car is fitted with 21” dia rims and Blockley 6.75/7.00 x 21 crossply tires, so they seemed a good basis for the model. The recommended rim width is 4”.
The wire wheels were a bit tricky, especially as there are many classic wire wheel lacing patterns. Nevertheless, based on several photographs, it was possible to figure out the arrangement of the spokes. On the outside were 28 spokes, and on the inside 56. The total of 84 is a significantly higher than most wheels of that era. But then the four wheels were carrying a vehicle weighing almost 3,500 lbs and designed for endurance racing at speeds of over 150 mph on a bumpy Brooklands track. Wheel strength was obviously very important. The spoke diameter was another unknown. Most vintage spokes have a diameter of between 4mm and 6mm, or 0.016” to 0.025” at 1:8 scale. I chose to use 0.020” piano wire since adding paint will make them look thicker.

Outer

Inner



Complete Arrangement

Helpfully, Blockley provides key dimensions for the tires:

Rim diameter	21”
Tread width	5.40”
Overall width	7.32”

Here are a couple of comparisons of the almost completed wheel and tire combination with the prototype:

With the spokes made from .020” (0.5mm) piano wire I plan to use short pieces of 1 mm thin wall brass tube for the spoke tighteners. The 3D printed rims will have properly aligned holes for the spokes.

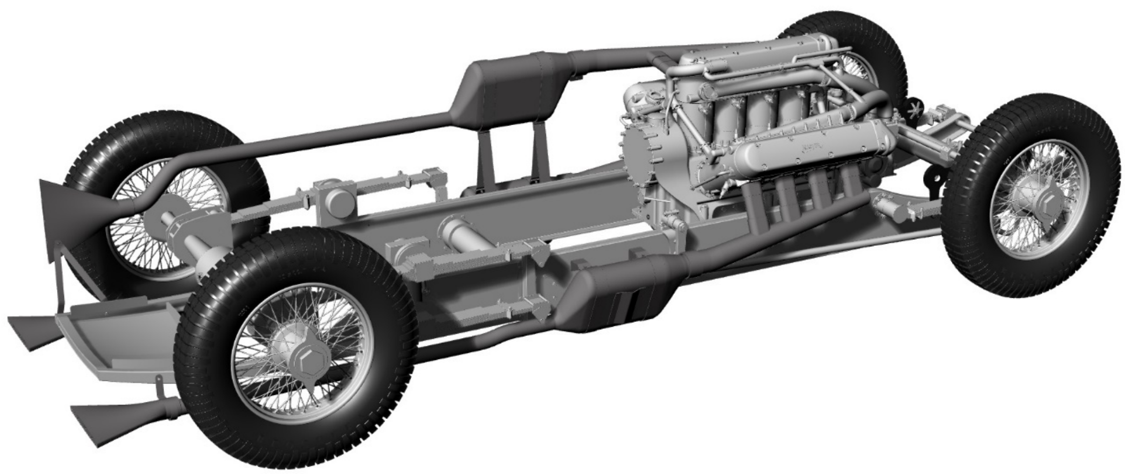
The last major step will be molding the tires, but that will be the same process I used for the Austin Seven and Citroen Traction Avant tires.
This is the wheel and the tire with appropriate logos:

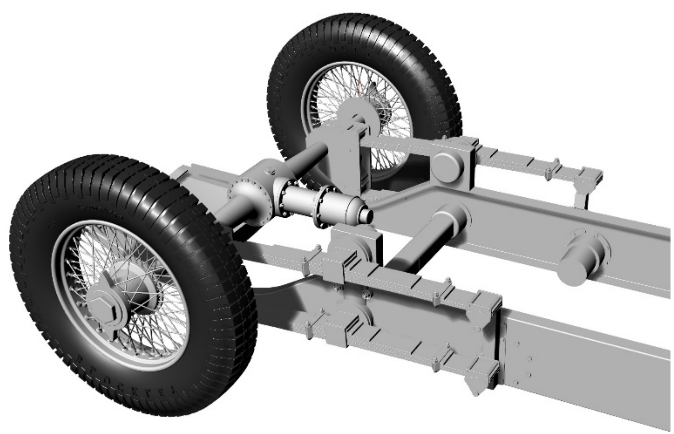
Chassis

With the engine and wheel designs completed and 3D parts only coming in slowly, there was time to begin drafting the chassis and, maybe, the front and rear suspensions.
The biggest challenge was trying to figure out the engine position and mounting. As best as I could tell, based on all available photographs, the prototype chassis rails were 10” high (31.75mm in 1:8 scale) and 2” wide (6mm). They were spaced approximately 30” apart which is much wider than the 17” spacing of the mounting rails that were built into the Napier Lion engine. Clearly some kind of sub-chassis was used to support the engine although, at this point, I didn’t know what it was. Nevertheless, based on photos, I was still able to guesstimate the engine height reasonably well. For example, the inlet to the muffler for the center bank of cylinders is above the exhaust manifold. And the position, and size, of the muffler could be calculated pretty well from profile photos of the prototype. That set one constraint. Another constraint was set because very little of the engine can be seen below the bottom of the chassis rails. Finally, the mufflers for the left and right banks lie alongside the chassis rails, but they need to be low enough that the outlet piping can pass below the lower forward spring mounting. The piping back to their exhaust manifolds created another constraint.

Rear Suspension

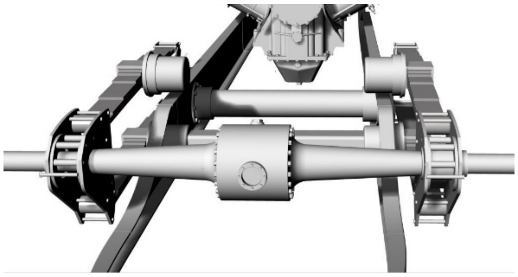
The rear suspension was another challenge. The front part was relatively straightforward based on the several photos I had. The rear part was trickier but, for now what I've drawn seems to make sense. I'm hoping a future visit to Brooklands will fill in the details.
Below , are two renderings showing the engine, exhaust system and detail of the rear suspension all mounted on the chassis rails. The positions of the wheels were known from the published dimensions of the wheelbase (10' 10") and track (5' 3"):





You can see that the chassis was underslung, which helped create a low center of gravity.
Metal straps held the mufflers to the chassis rails and supported the center exhaust muffler.
Note the stiffening plates on the outside of the mufflers.

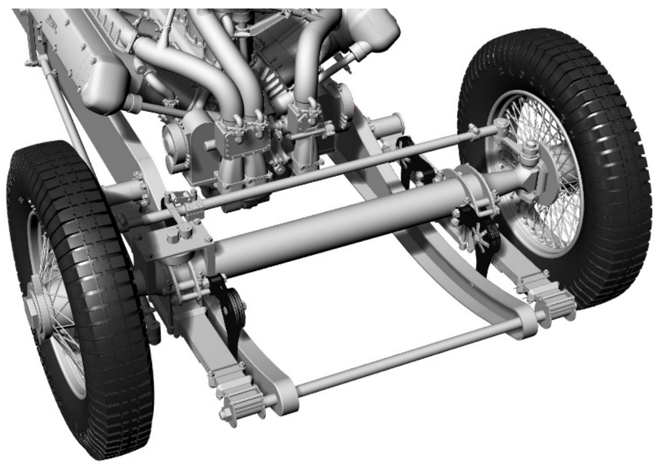
Here's a comparison of my drawings to an old photo of the chassis:



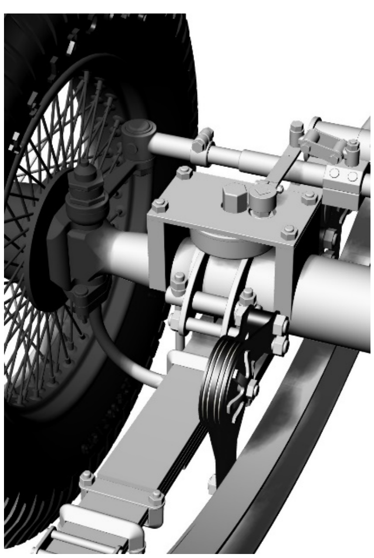
One interesting point. The photo above right shows disc brakes on the rear axle. However, the Napier-Railton was originally fitted with drum brakes, and only on the rear wheels. Since Cobb was trying to set speed records on straight or oval tracks, braking was secondary! The drum brakes are what I'll try to model. An additional driveline brake acted as a handbrake.

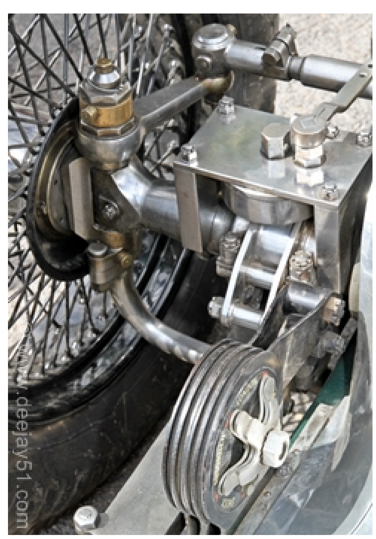
Front Suspension

The front suspension consists of a solid front axle, leaf springs and adjustable Hartford friction plate shock absorbers in front of and behind the front axle.



Because of the underslung chassis, the tie rod connecting the steering arms is located above the centerline of the front axle. Below is detail of the steering arrangement alongside the prototype:

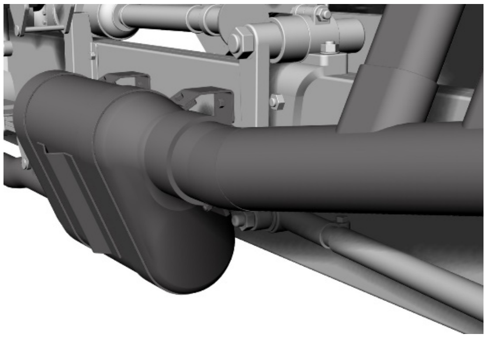


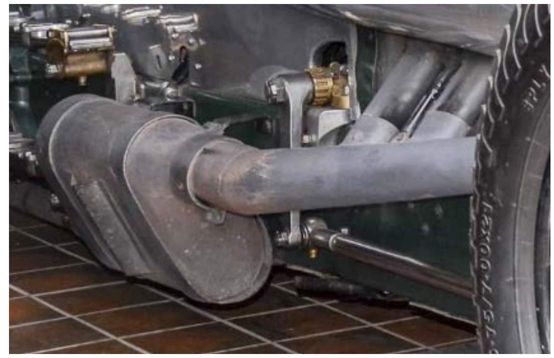


The horizontal circular drum, just above the axle appears to be part of a dampening mechanism for the steering. That would make sense since Brooklands was notorious for its very bumpy track.

Steering Components

The next step was to add the steering arm, steering box, steering column and steering wheel. Here's a picture showing some of the detail of the steering arm in comparison to the prototype:

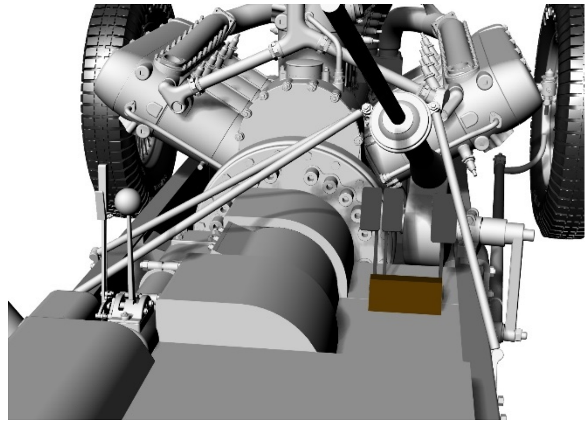




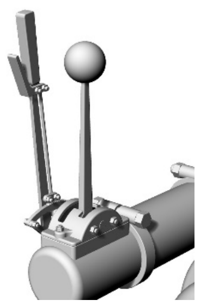
The steering wheel on the model will mirror the one on the current prototype.

At this point, one unresolved question was the angle of the steering column with respect to the longitudinal axis of the car. Based on photographs and the position of the driver, it is clear that the outer edge of the steering wheel is inboard of the rear springs. This makes sense in the context of the body fairings needed to shroud the wheel and the driver's hands.
But the steering box is mounted just inside the chassis rail. This again makes sense; first, so the steering box doesn't interfere with the clutch housing and, second, so the steering box and steering arm are closely coupled. The logical outcome is that the axis of the steering column (and steering wheel), and also the orientation of the driver, are at an approximately 7° outward angle to the centerline of the chassis. It's somewhat unusual but I'm pretty sure a check of the prototype would confirm it.

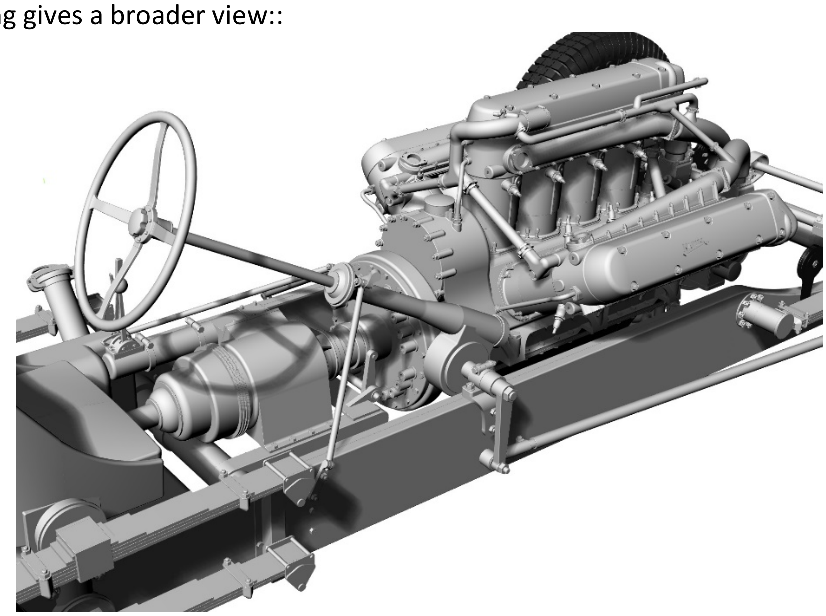
The steering column is anchored in place by three struts, which attach to the chassis. They are clearly visible in the photo on the left. Holes in the bodywork accommodate the struts.



The gearbox and adjacent components were a significant challenge. Unfortunately, I could find very few relevant photographs of the gearbox and adjacent components. So, drawing them was particular challenge. Until I can make a visit to Brooklands, I've relied on the photographs I had, a little bit of guesswork and some engineering common sense to generate the drawings! Updates may be necessary! Still, the handbrake and gear shift arrangement look reasonable:

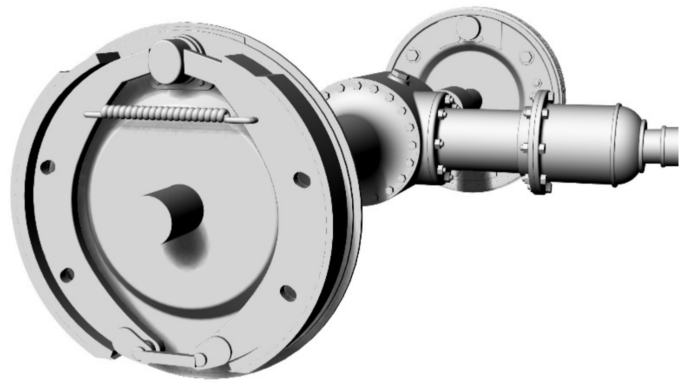


And this rendering gives a broader view::



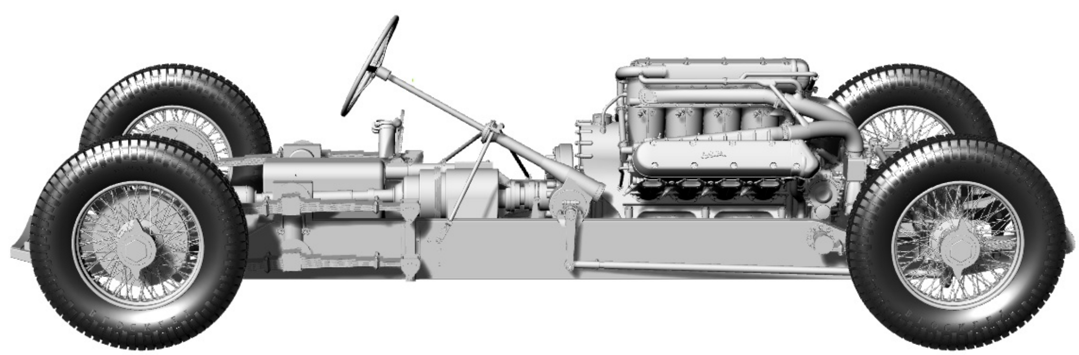
One interesting side note. The car had a 15 gall (Imp) oil tank. That's a lot of oil and needed a big tank. To get that capacity, the tank is both to the left off and also under the driver's seat.

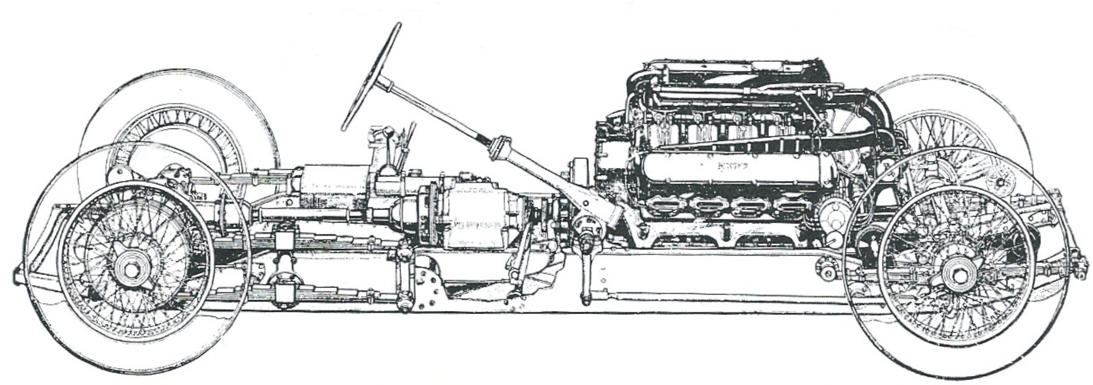
One late item I added to the drawings was the 16" drum brakes. They were only fitted on the rear wheels since braking was not a big factor on the Brooklands track. I couldn't find any pictures of the original brake arrangement, but the following is a typical arrangement:



Subsequently, after the car was retired, and converted for use in testing parachutes, the drum brakes were replaced by disc brakes. The disc brakes are the ones currently on the vehicle.

The side profile was now starting to look very similar to the side profile sketch of the prototype:



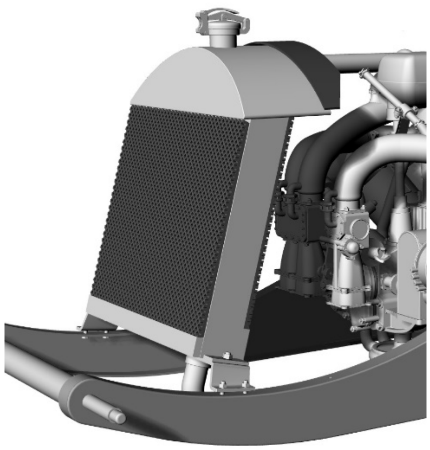


The bulk of the chassis drawings are now complete so, with engine parts now at hand, it seemed like a good time to shift gears and turn my attention to construction of the engine.
Except! A couple of nagging issues still remained. One was the radiator.

Radiator

I wanted to include the radiator in the model, but its dimensions were an issue. The bulk of the radiator was hidden by the radiator cowling and the front of the engine. What I knew was that there was a large 2" diameter pipe that flowed water from the front of the engine (i.e. nearest the cockpit) alongside the engine to the radiator. And there was a connection from the bottom of the radiator to the water pump. Obviously, the outer dimensions of the radiator were also constrained by the radiator cowling. So, if I drew the cowling, then the radiator dimensions and arrangement could be figured out!!

Here's the radiator, with and without it's cowling:

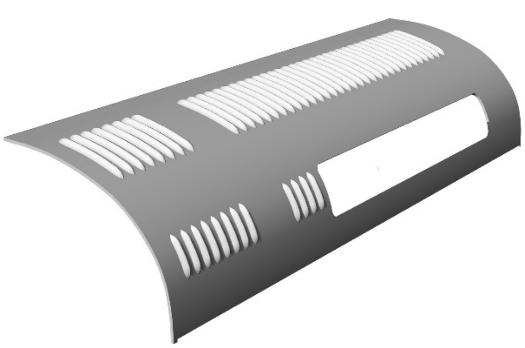


The grill is a 3D printable honeycomb of open squares and provides a realistic grill-like appearance.
The mounting bracket, bolted to the chassis frame, works. But I have no idea if it's correct or not!

The cowling drawing required a few iterations in an effort to make the proportions (and the distinctive 'cow-lick') as realistic as possible. Gurney Nutting, one of the premier coachbuilders in the 1930s, designed the body and they obviously put some flare into the design!

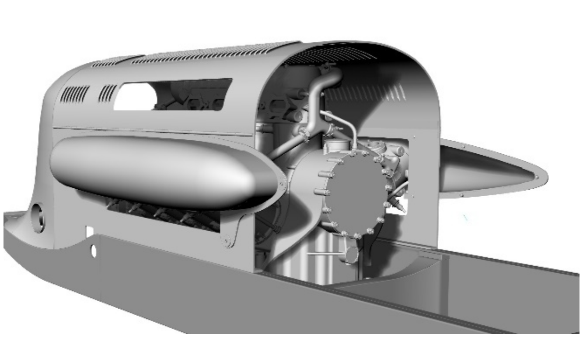
Bonnet & Side Panels

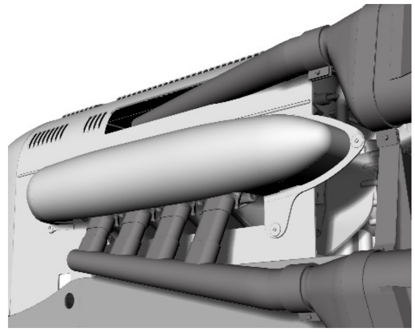
But now, with the radiator cowling complete, it made sense to try drawing the bonnet and the engine side coverings. Because I wanted a 3D printable version of the bonnet, the big challenge was going to be the louvers. Fortunately, I had figured out a way to do something similar on another model. So, after a dive into the memory bank, here's the left-hand side with its large opening for the center exhaust manifold:



The louvers are slotted all the way through.

The side panels include fairings that cover the rocker covers. Miniature piano hinges, with a removal pin (just like the prototype), will link the bonnet tops and sides:





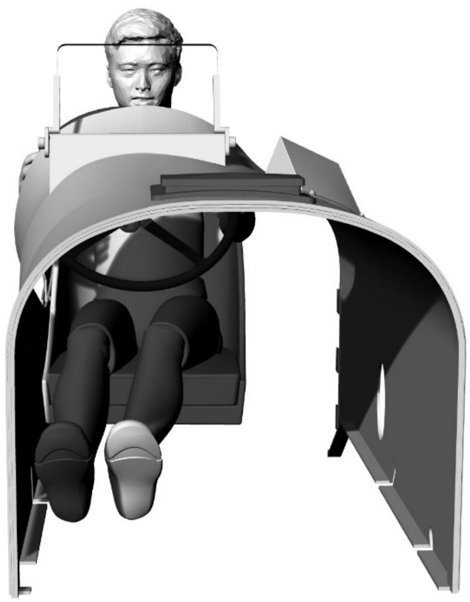
Because of the central exhaust pipe (on the left-hand side), the fairings aren't symmetrical.

On the prototype, bonnet straps held the bonnet tops in place. They will be included in the model to give it more realism. They will be fabricated rather than 3D printed, but here's a closeup of how they will look:

Rest Of The Body

Having got this far it seemed logical to go ahead and finish drawing the body.
One area of uncertainty was the body flair around the steering wheel. There was a substantial flare around the seat, no doubt to accommodate the elbows of the driver. But on the current version of the prototype, the flare around the steering wheel is much less pronounced. However, the famous picture of the Napier Railton 'leaping' at Brooklands, shows a substantial flare around the wheel. That made sense to me given the air pressures when traveling at over 150 mph. So that's what I chose to model.

Here's another drawing, from the front of the car, showing the body flare and a seated driver.

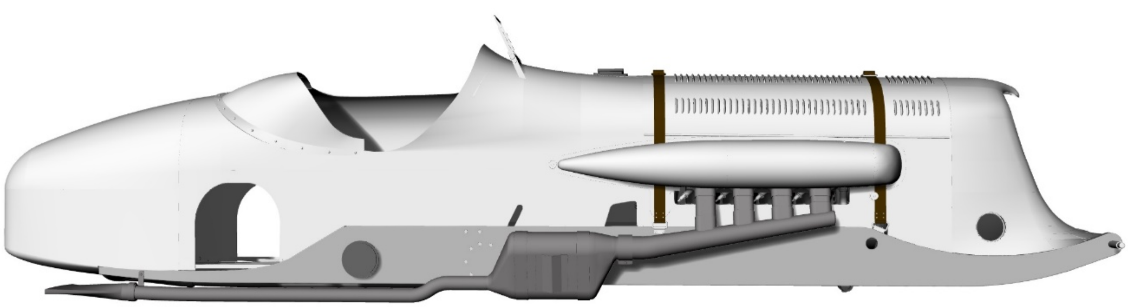


It looks right … just enough protection for open seater driving at 150+mph!

What is obvious is the skewed seating position of the driver. This was necessitated by the position of the steering column (referred to earlier) and also the offset of the pedals, which were to the right hand side of the gearbox.

The next step was to draw the tail. That was relatively straightforward except for a couple of issues. First, I wanted to make sure that the tail would accommodate a fuel tank that had the requisite 65 gall (Imp) capacity. It wasn't really necessary to figure it out. After all, who's going to see the tank and who's going to calculate the capacity? But 65 gall. is a lot of fuel so it was a fun distraction to see what was required. As you can imagine, the tank fills most of the tail. A full tank of fuel also weighs close to 500lb, and almost all of it is behind the back axle. That must have made for some interesting vehicle dynamics at speed! The second issue was the fairing behind the seat. It's a complicated shape and has a flange that was riveted to the tail. Since I was also wrestling with the exact location and size of the seat, it took a couple of iterations to get it to look right.

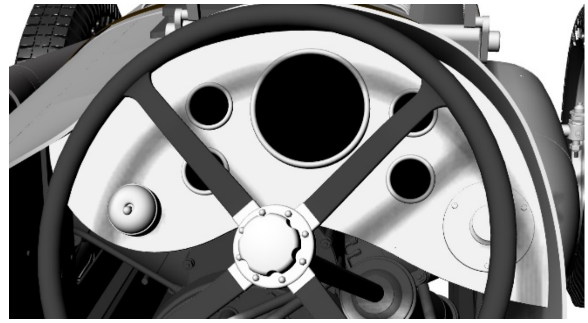
In any event, here's a side profile of the finished body panels. They can all be 3D printed.



The cutouts you see are, from left to right, for the rear axle assembly, one of the steering column braces, the steering arm and, on the far right, the front axle.

Dashboard

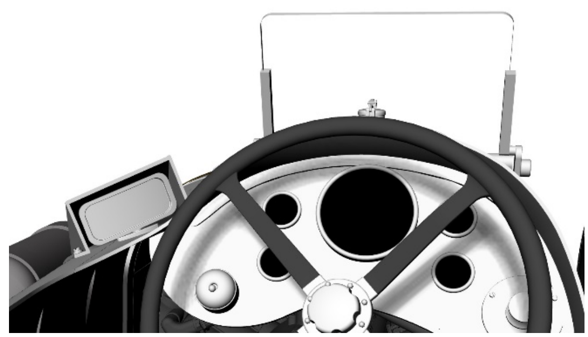
One of the last elements to add to the body, was the dashboard. Here's a comparison:



The decals aren't made yet, but there's enough detail in various photographs to create very close approximations.
The instruments have also been designed to be backlit by LEDs. But building that into the model will be an step too far.

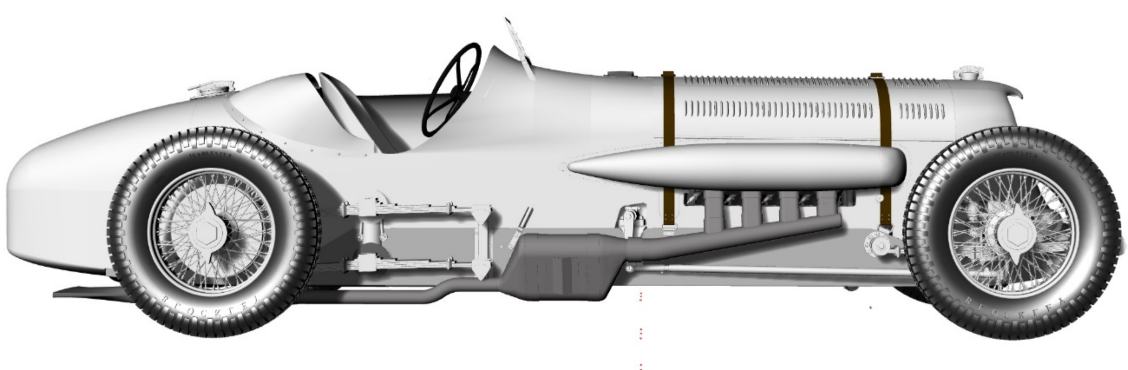
Windshield & Rearview Mirror

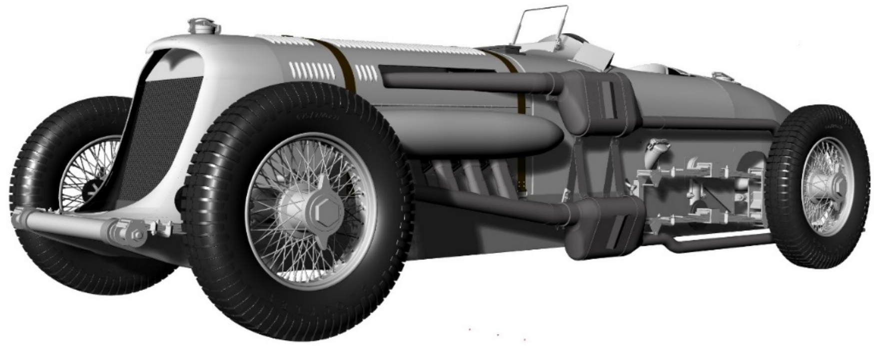
As will be obvious from the above, there was a small windshield in front of the driver and a small, shrouded rearview mirror. Both will be fabricated, but they will be included in the drawings for completeness' sake.

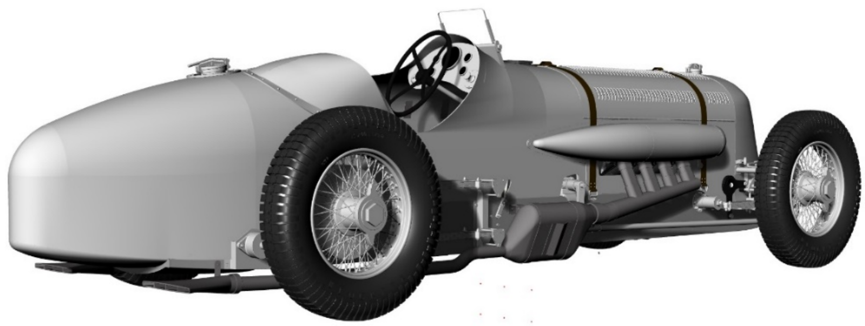


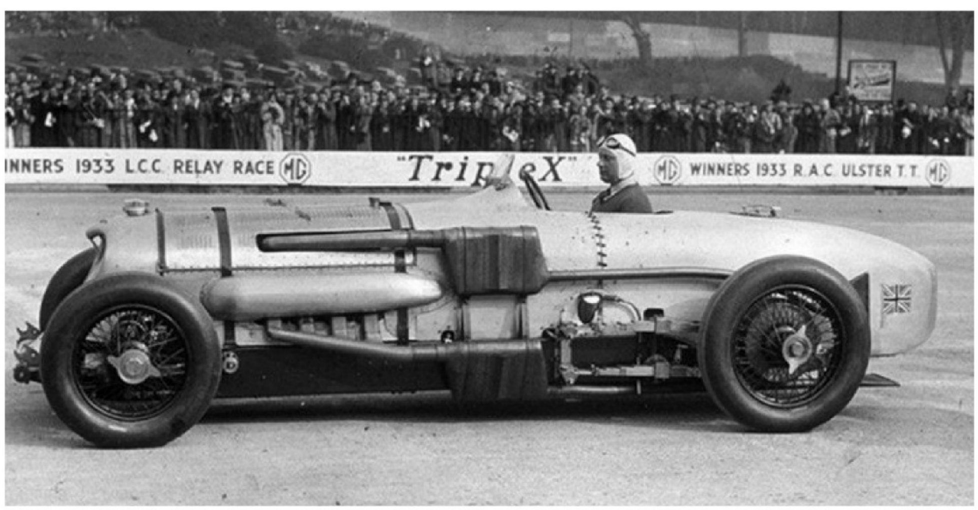
Full Drawings

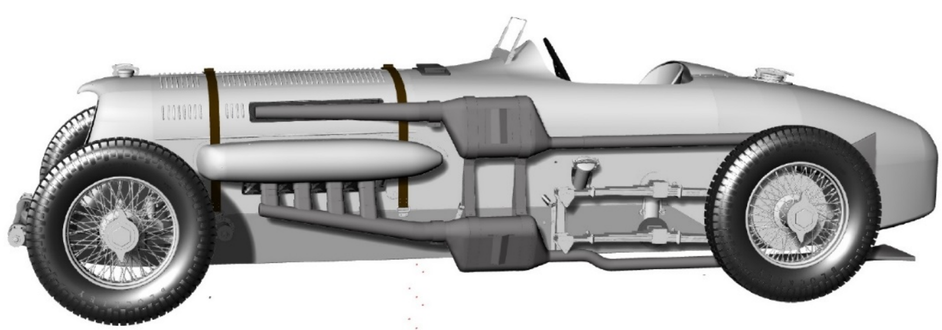
The drawings are now almost 100% complete.











The body parts are now on order, so it really is time to start construction!!

Construction

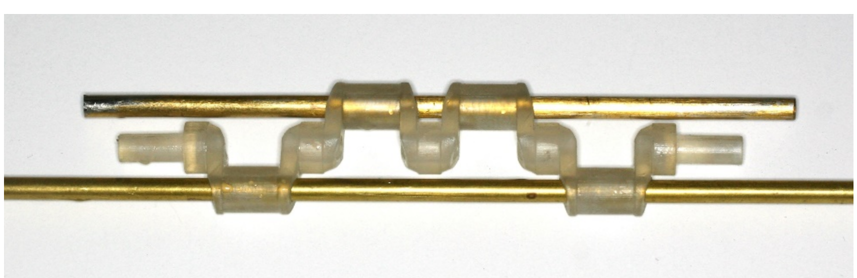
There were a couple of options as to how to start construction. The chassis was going to be fabricated from brass, and would be one of the more difficult elements in constructing the car. That was challenge number one. Challenge number two was the engine and, in particular, building the crankcase with working crankshaft and pistons. Fitting the main bearings would be the key. So, that's where I decided to start.

Main Bearings

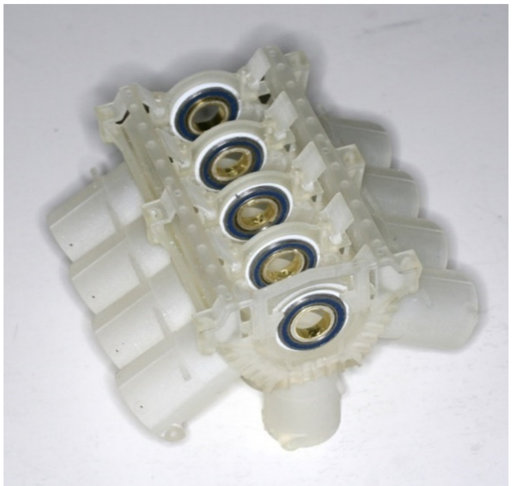
The Napier Lion main bearings were designed to slide into place over the crankshaft as explained on pp 16 and 17 of this note. The bearings were then shimmed into place with semi-circular sleeves, The diameter of the bearing lands are 9mm and the inside diameter of the bearings 12mm. So, the sleeves were made from a sandwich of a 15/32" (11.9mm) OD brass tube, a 7/16" (11.1mm) OD styrene tube and a 10mm OD (9.1mm ID) brass tube. The inside diameter of the styrene tube was reamed out from 3/8" (9.5mm) to accommodate the 10mm brass tube. It was then simple enough to cut the tubes in half to create the half sleeves.

The left-hand photo shows a main bearing and the sleeve sandwich. The right-hand photo shows the crankshaft with one of the center bearings and its half-sleeves in place, and also shows one of the end bearings. The end bearing was just a simple push fit over the end of the crankshaft.

Incidentally, the crankshaft was slightly warped after 3D printing. Fortunately, I had designed the big end cranks with 4mm wide open centers. So, two 5/32" brass rods slid through the centers held the crankshaft square while a few minutes in boiling water relieved the stresses in the part and straightened it out.



The next step was adding a 1mm thick, 4mm wide styrene band on the outside of each bearing so they would fit snugly into the 20mm diameter bearing supports.
Below, left, is a photo of the crankcase with the bearings in place between the upper and lower bearing supports. The lower supports are designed to be screwed or glued into place once the crankshaft and connecting rods are assembled. On the right, is the same setup but now with the crankshaft installed. As hoped for, the crankshaft turned freely and smoothly.



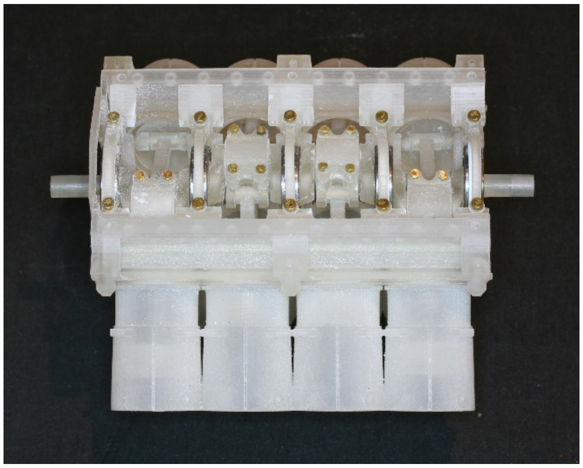
Connecting Rods & Pistons

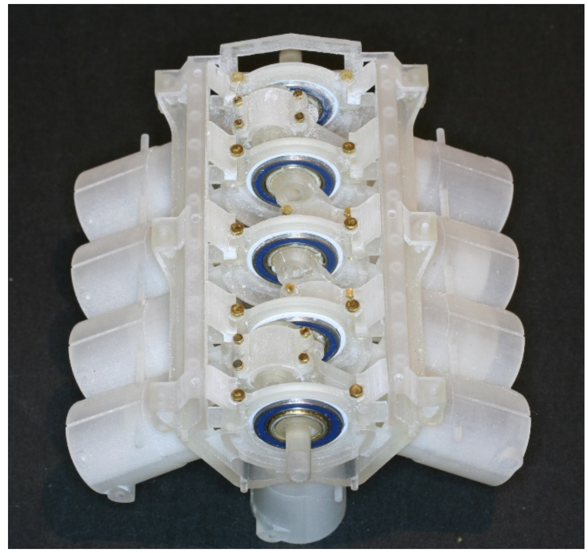
The last major sequence was adding the connecting rods and pistons and testing to see if the complete setup would work easily.

This photo shows one of the piston and connecting rod arrangements.
There are two1/16” pins hold the pistons to the connecting rods and 5/64” pins hold the connecting rods to the big end.

And this shows the arrangement installed in the crankcase. At this point everything is just a push fit, but even so, the arrangement operates smoothly.

Below is the fully completed arrangement.





There are three things to note.
First, the sequence of assembly. With the crankcase upside down, the big ends and connecting rods were inserted from inside the crankcase. The crankshaft was then installed on the upper bearing supports and the big ends and end caps bolted up to it. Installing the lower bearing supports completed the bottom end installation. The crankcase was then inverted and the pistons assembled to the connecting rods. Then the cylinders were installed over the pistons and slotted into the crankcase.
Second, as you may have surmised, the big ends had been drilled and tapped out for 00-90 bolts so that the end caps could be bolted in place.
Third, the lower bearing supports were modified so they could also be bolted in place, this time with 1-72 bolts. Originally, because of wall thickness constraints with 3D printing, I had provided pegs on the lower supports that mated with holes in the upper supports. Although I could have then just glued the lower supports in place, using bolts let me assemble and disassemble the lower end of the engine several times, not just for various tests of the assembly, but also for painting. This arrangement also replicated that of the prototype.

In any event, with everything pinned and bolted in place, a final test proved that the crankshaft and pistons continued to move smoothly. Yeah!

Chassis

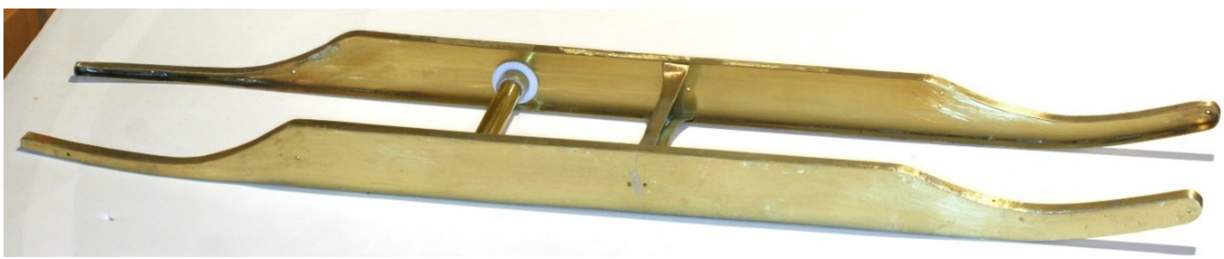
With the core of the engine sorted, I felt it was a good time to switch focus and get a start on fabricating the chassis. It was the biggest remaining challenge and an important one. Whereas much of the engine and body could be 3D printed that was not the case for the chassis and its core components. The two chassis rails would be big; 556mm long and, in the center, 31.5 mm tall. Of course, they would carry the whole weight of the car so they needed to be strong. It therefore made sense to fabricate the chassis rails and cross-members in brass.

The plan was to cut the sides from .032” thick sheet and solder .032 in x 1/4 in strip around the edges to create the flanges. That should provide adequate strength. Nevertheless, the fabrication was going to be somewhat daunting for my limited soldering skills! To keep everything straight, I opted to make 1/4" thick wooden bucks to the same size as the inside dimensions of the chassis rails. Each chassis side was then fastened to its buck and the 1/4 in wide flange strips wrapped around it and fastened in place. With this arrangement I could use a propane torch to get the necessary heat into the assembly and then use industrial solder to join the pieces together without any concern about pieces moving out of alignment.

Below is a picture of the two rails, back-to-back, after excess solder had been removed and the surfaces cleaned up.

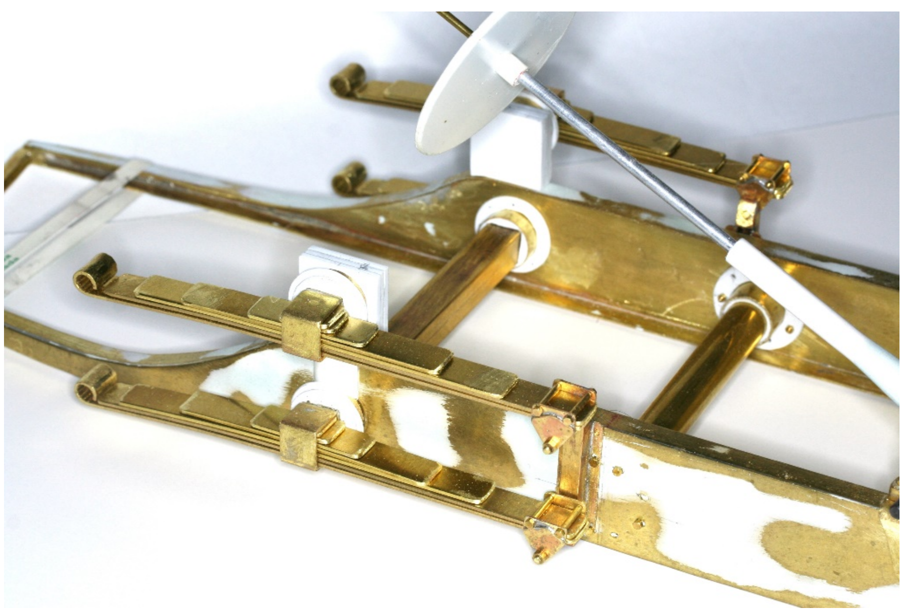
As you can see the rear of each rail flares inward. To accommodate that, the rear quarter of the buck was made detachable so separate flared pieces could be used with the core of the buck.

Below is a picture of the beginning of the chassis construction with the rails separated by the two center cross-members. Assembly of the chassis is being done with bolts and pegs so that the finished chassis can be easily disassembled for painting.



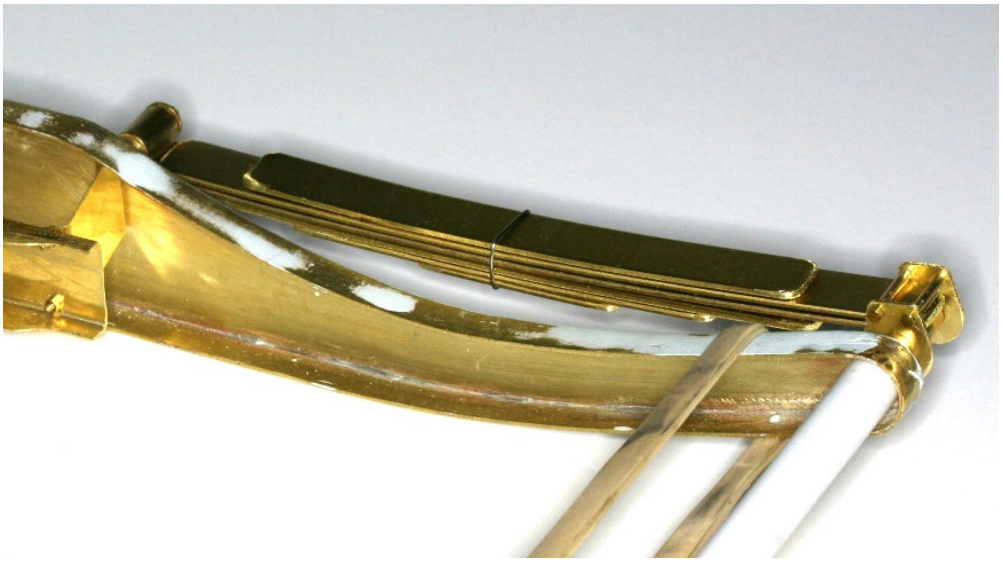
Once the core was in place, other cross members could be added and construction of the leaf spring assemblies begun. Assembly is being done with bolts and pegs. That way the finished chassis can be easily disassembled for painting.

Here, the rear of the chassis is under construction:

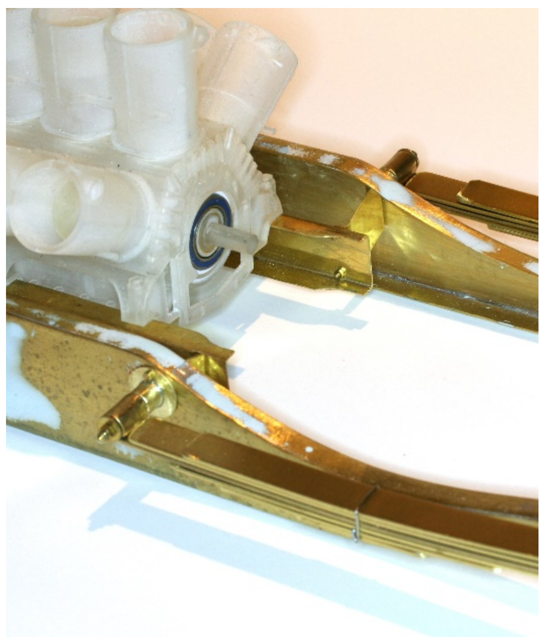


A few notes on the construction:

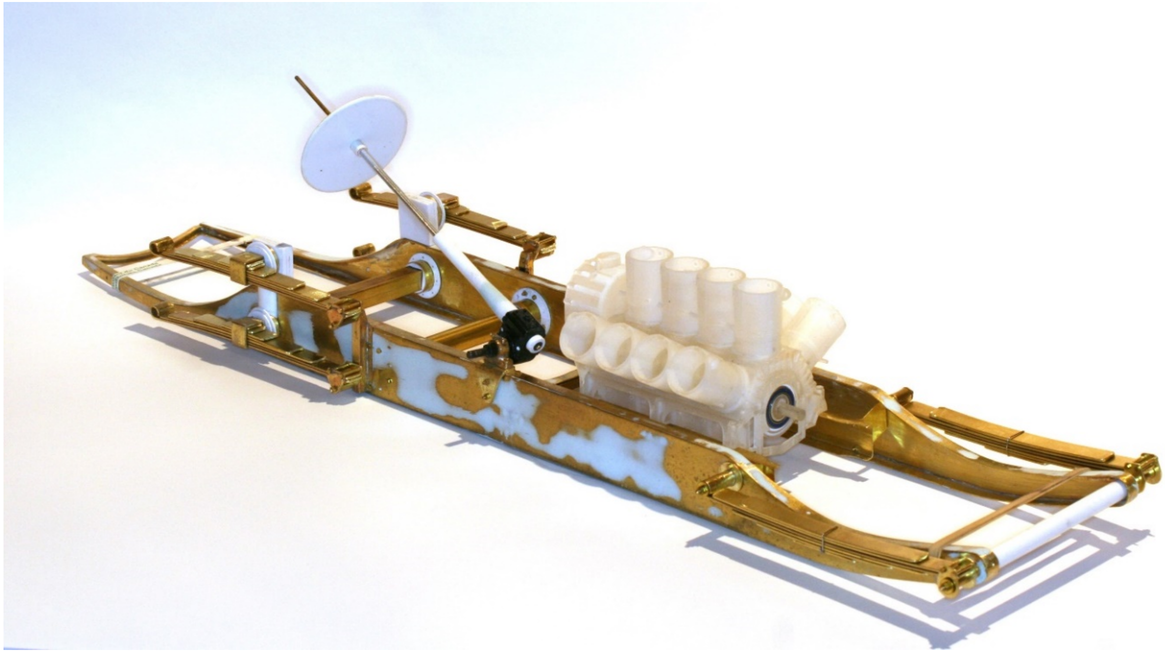
- The shading on the chassis rails is a first coat of primer that has been sanded.
- The square crossmember in the middle of the photo was fabricated from two 3/8 in x 3/16 in channels soldered together.
- The rear leaf springs are anchored in the middle. A bolt passing through the center pivot and each leaf will hold everything together. The front anchors, held in place by posts, will allow some movement as the springs flex.
- Finding 3/8 in wide, 1mm thick brass strip for the leaf springs proved to be difficult. Such strip was not available from hobby stores. But, eventually, I was able to find brass strips, used to make bracelets, which were of the appropriate size.
- The front springs are straightforward, hinged at the rear and anchored to pivots at the front:



1. The engine rests on a sub frame. The frame is cantilevered off the chassis at the front and is mounted to the center cross-member at the rear.

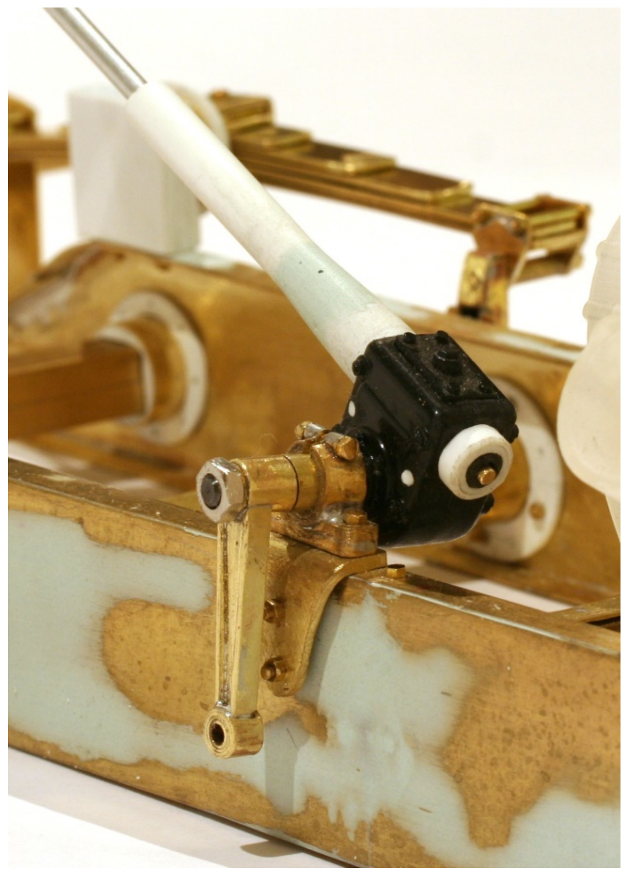


This photo shows the chassis construction so far:

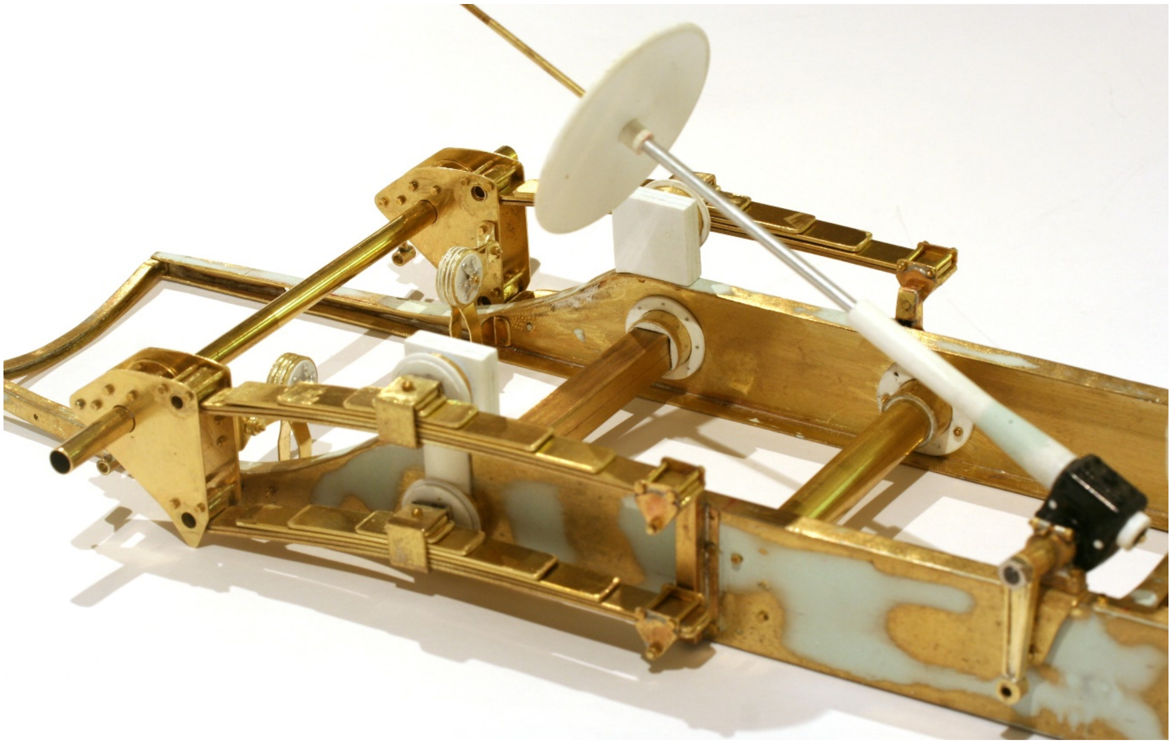


The core of the steering box and steering column are from a Pocher Rolls-Royce Sedanca kit. It was a convenient alternative to a 3D printed version. At this point the center column is too long and a styrene proxy is being used for the steering wheel. But they are sufficient to prove the steering arrangement works.

As you can see, the box is held in place by a very solid bracket. The bracket is bolted to the chassis both at the top and at the side.



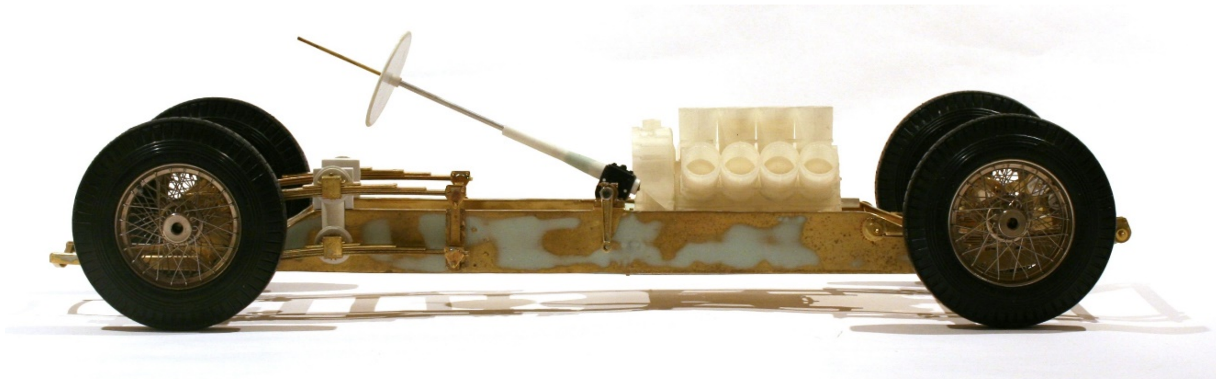
Adding the rear axle carriers and Hartford friction shock absorbers virtually completed the rear of the chassis:

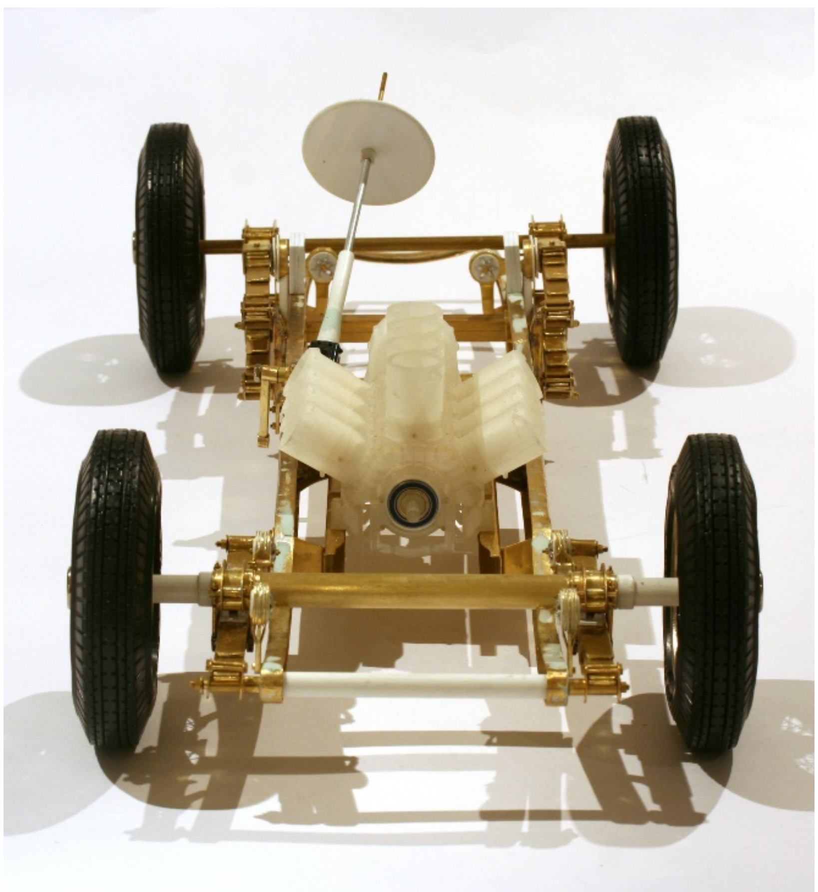


The front axle is bolted to the front springs on each side with a carrier assembly. Four Hartford friction shock absorbers control movement of the axle. That pretty much completes the front of the chassis.

NB: the base of the carrier assembly in this photo is a temporary fabrication. A more accurate 3D printed version will eventually be fitted.

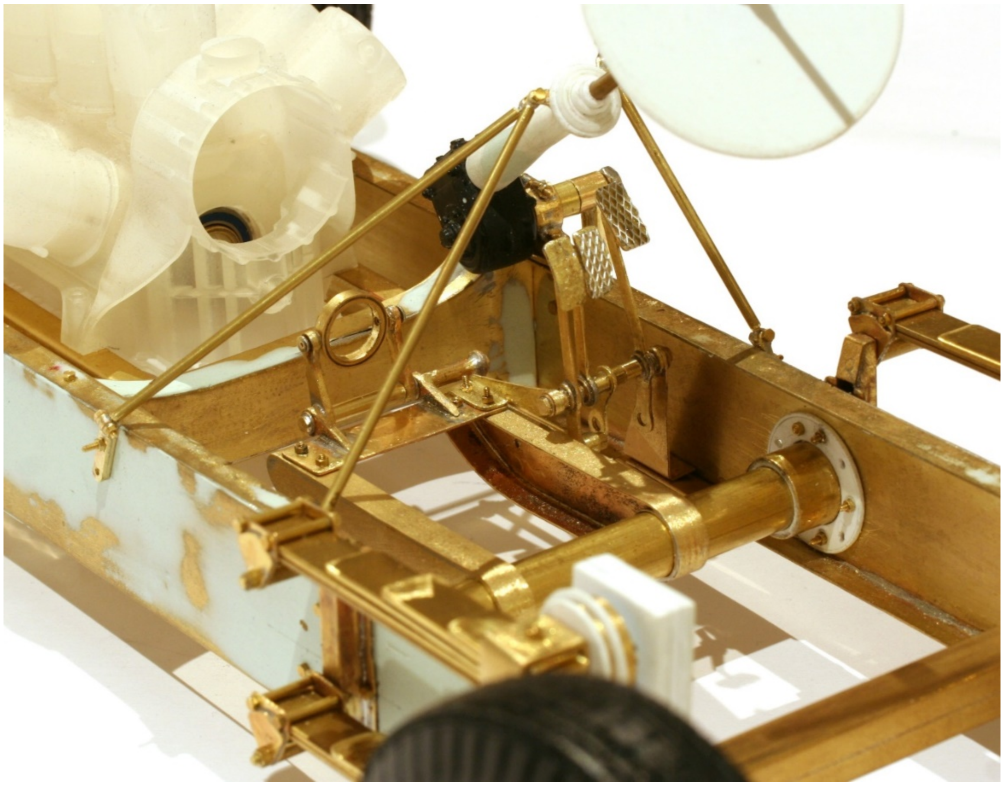
As it turned out, the wheels of the 1:8 scale Pocher Rolls-Royce Phantom II Sedanca were almost the same diameter as the ones that will be used on the Napier-Railton. That created the opportunity to dress up the chassis! However, the Napier-Railton wheels will still need to be constructed because the prototype wheels used a lot more spokes; a direct result of the speeds the race car was designed for. Nevertheless, this photo shows the low center of gravity and low profile advantages of the underslung chassis:



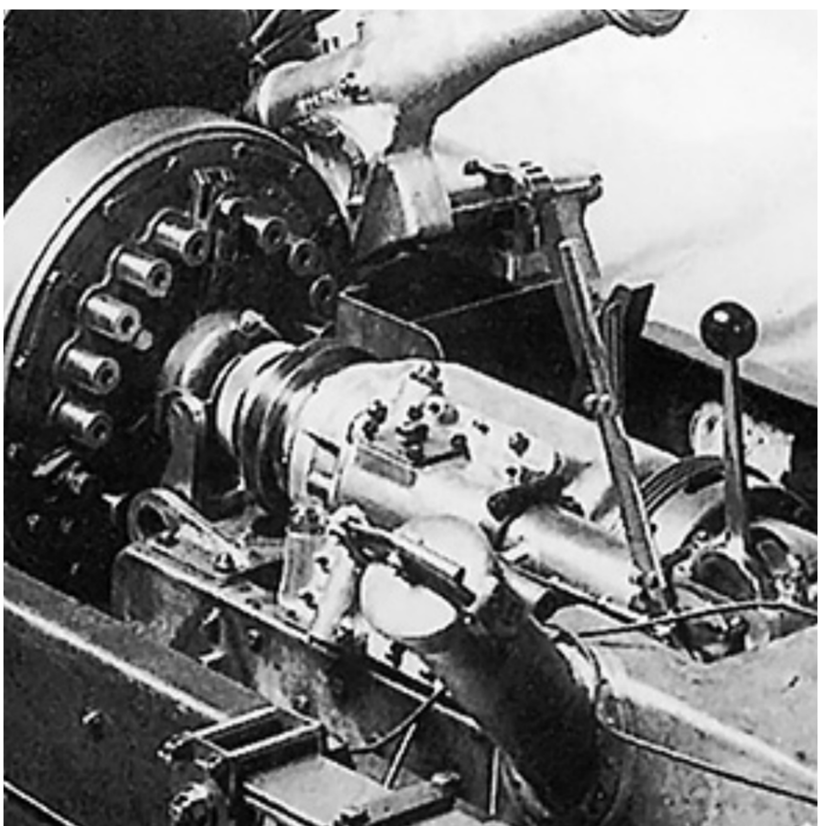


Although the majority of the chassis construction was now complete, there were still a few more components to be fabricated. Most important were the gearbox support frame, the pedals arrangement and the steering column support braces.

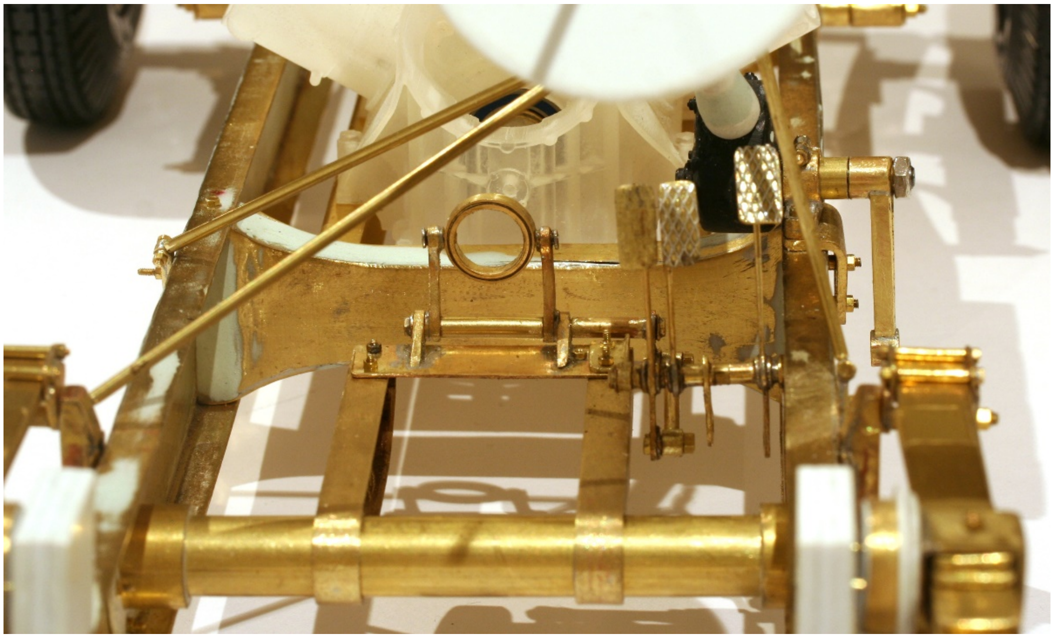
The picture shows all three of those items



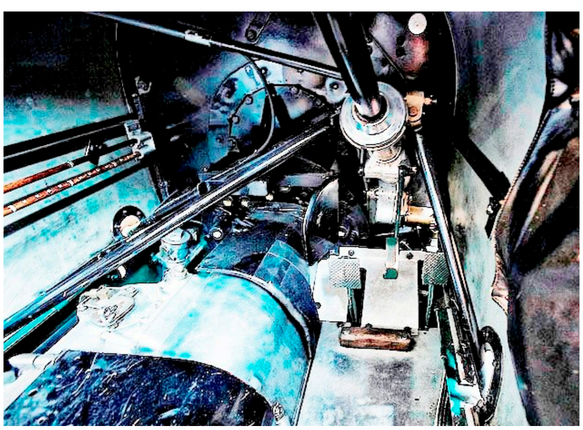
By comparison, this is a photo of the prototype, but without the steering column braces:

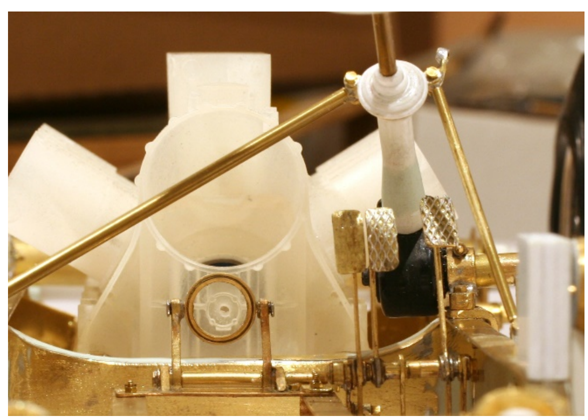


The gearbox rests on a subframe cantilevered off one of the center cross-members. Across the front of the subframe is the clutch release ring which, in turn, is linked to the pedal assembly situated on the right hand side of the subframe. A bracket, on the far right of the pedal arrangement, anchors it to the chassis rail.

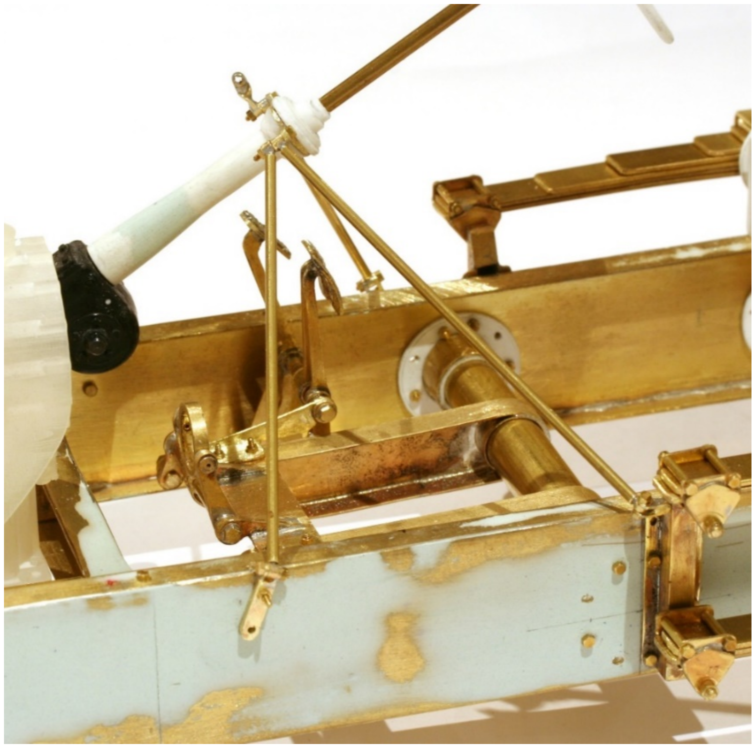


Unfortunately, the exact details of the pedals arrangement, and any front support for the subframe (if any), wasn't clear from the photographs I had. Nevertheless, the arrangement shown here works and the pedal positions seem consistent with the photograph below.
The upper left-hand brace in the prototype photo anchors the left-hand side body panel to the steering column. I've included a bracket for that brace (which will be added later), but I don't like the bracket and it needs to be reworked.





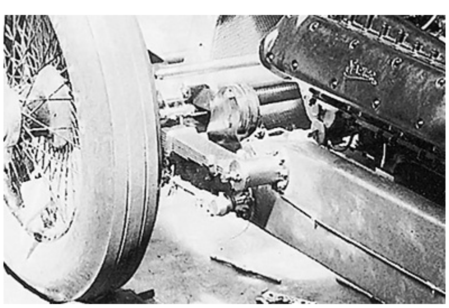
Here's more detail of the bracing arrangement:



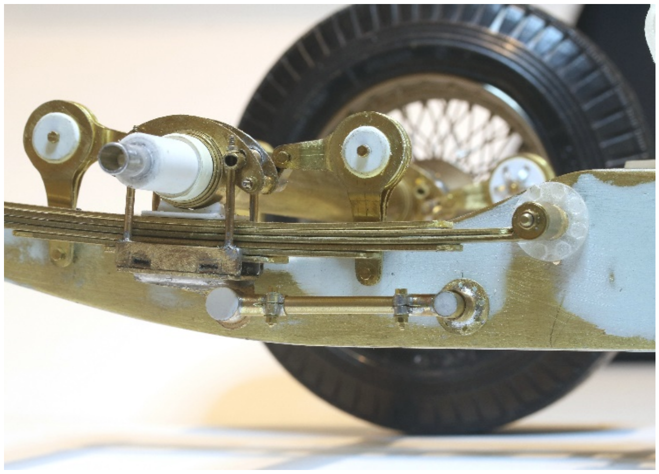
The anchors for the braces were made from 3/32" brass tube soldered onto the ends of a 1.2mm thick brass strip (two .025" strips soldered together). The ends of the anchors were then slotted for the ends of the braces. The braces themselves are 2mm in diameter and consist of a 1/16" thin wall brass tube oversleeved with a 5/64" (2mm) thin wall tube. The hardware are 00-90 nuts and bolts.

As in any modeling project, where you have incomplete information, there are always questions as to what certain parts are for and how they worked. This was especially true of the Napier-Railton where a visit to the prototype was impossible because of COVID.

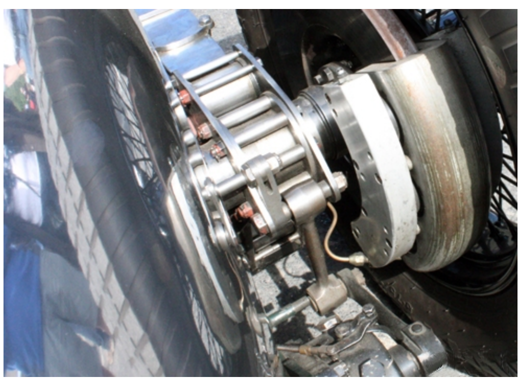
Here's a good example.
The photos below show a hub, mounted on the side of the chassis with a rod extending forward and behind the front wheel. What is it for? It's obviously not part of the springs, they have their own hub, nor is it part of the steering arms which are above the centerline of the wheels.

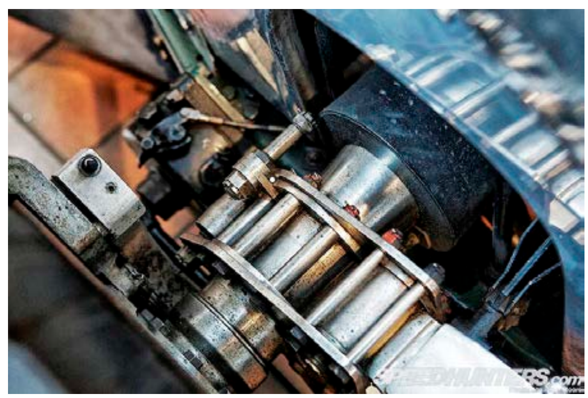


The Brooklands Museum kindly provided the answer. It's a radius arm. It's anchored to the bottom of the front axle and designed to keep the front axle in position relative to the chassis. Even though it's often missed in renderings of the car, it's an essential part of the vehicle. Once its function was understood, it was relatively straightforward to figure out how to add it to the model.



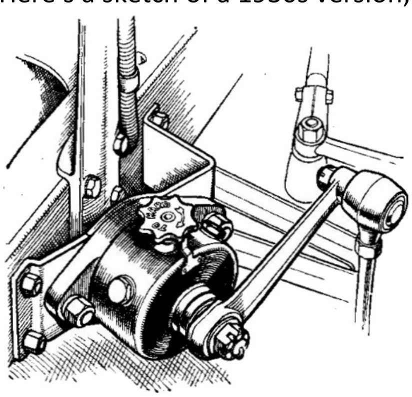
Here's another one.
The first picture shows the end of the rear axle and the disc brake, Below the disc brake assembly is a linkage which connects to a device mounted on the chassis. The device is visible in the second photo although it is typically hidden in most photos of the car. What is it?



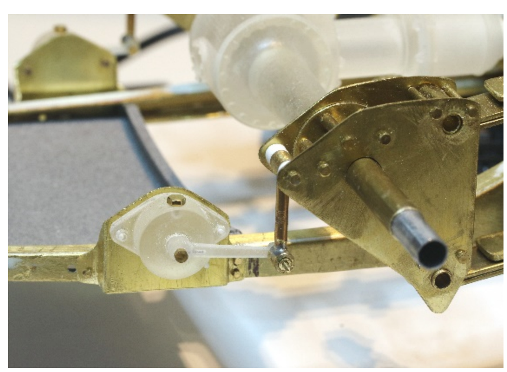


The answer is a Luvax lever arm hydraulic shock absorber. The external arm moved vanes inside the body that forced hydraulic oil through an orifice and so dampened any movement.
Once again adding them to the model wasn't too complicated once the function was understood.

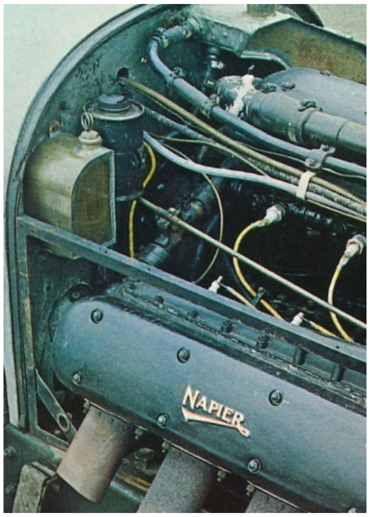
Here's a sketch of a 1930s version;



And here's a picture of the model damper:

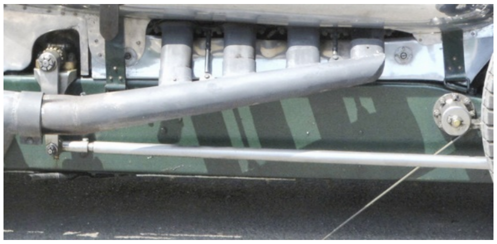


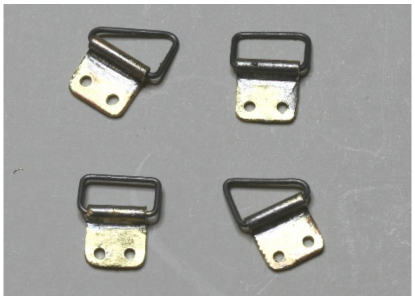
Lastly the photo opposite, which is from the 1970s, shows a small brass tank mounted on the firewall. What was it for? I had no idea.



Once again the Brooklands Museum helped out. They explained that the “reservoir was (is) for the Ki-Gass starting system – it holds about half a litre of petrol, which is pumped into the inlet manifolds of the engine by the small hand-pump on the lower right-hand side of the dashboard. This is done just before starting to ensure that there is fuel available that can be immediately drawn into the cylinders and to provide a rich air/fuel mixture to help the engine to start.
Pretty neat. Here's my model version:

One last detail was the fabrication of the anchors and buckles for the bonnet straps. The rear anchors were straightforward, but the front anchors attach to a sloped part of the chassis behind the rear anchor point of the front springs. The anchors for the straps will be attached to the chassis rails with 1mm bolts.





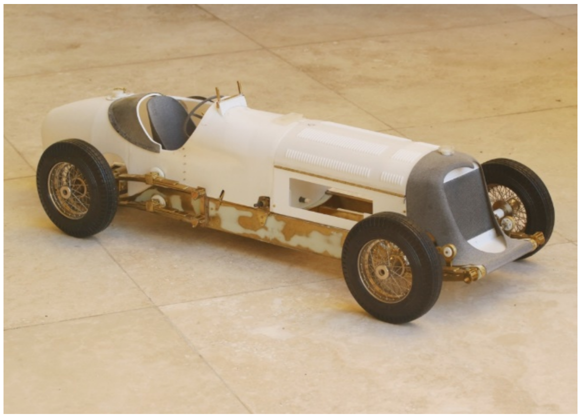
That pretty much completed the chassis construction.

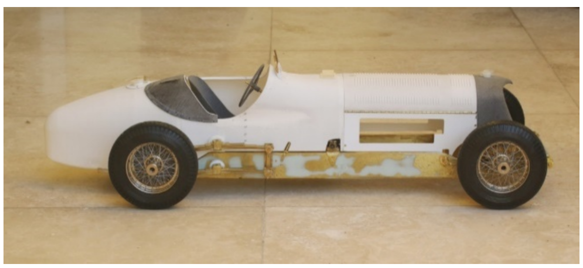
Body

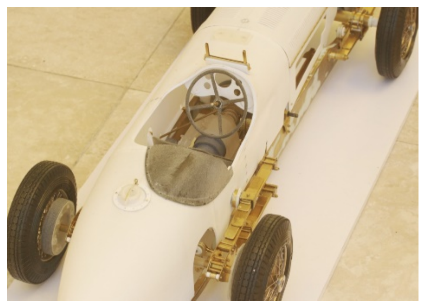
It was now time to turn attention to the body.

Most of the body panels were 3D printed in nylon. The typical wall thickness was 1mm. Although nylon has a slightly pebbled surface and needs quite a bit of finishing work to get a smooth surface, the panels are strong, flexible and resistant to cracking so thin walls aren't a problem.

These are pictures of a test fit of the body panels.







The tail, center body, and the louvered bonnet panels are all separate 3D printed pieces. The flat bonnet sides were cut from 1mm styrene sheet. The beige colored body panels were printed with selective laser sintered nylon. The radiator cowl, and seat fairing on the tail, were also 3D printed in nylon, but using a multi-jet fusion process. It was the first time I had used that particular material. They have a slightly less grainy finish and seem easier to clean up. The overall quality of all of the panels was excellent, but some light body filling will be needed to get the final body profile. Once that is done painting can start.

You may also note that the side covers for the engine rocker covers are missing, but they are a simple installation. They were also 3D printed with selective laser sintered nylon.

One element of the body that still needed to be created was the correct split between the tail and the center part of the body. On the prototype the two were joined by a series of small external plates. If you look very carefully at the profile photo of the model above, you can just see the penciled in position of the plates underneath the steering wheel. 'L' shaped strips on the inside of the body provided reinforcement for the edges of the body panels and acted as anchors for the plate screws.

This photo shows the right hand side connecting plates:

The reinforcing strips are on the far left of this photo of the prototype:

Here are the reinforcing strips being installed on the model:

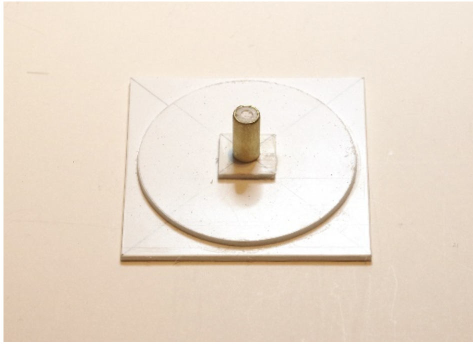
All these details help make a model.

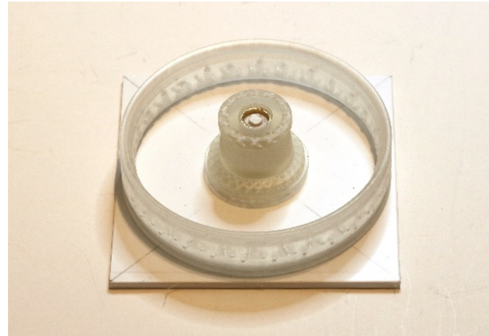
Here are more. These pictures are of toggle fillers for the fuel tank (the larger one), the oil tank and the radiator. They are designed to work just like those on the prototype. Most of the parts were 3D printed in acrylic.

Wheels & Tires

During construction a set of Rolls-Royce Phantom II wheels from a Pocher kit were used to support the chassis and are visible in some of the photos. However, the Rolls-Royce wheels are slightly smaller than the Napier-Railton wheels and had significantly fewer spokes so new tires and new wire wheels had to be made. The firsts step was to make new tires using the method outlined on my website at https://www.jrhscalemodels.com/tire-molding.
The tire master was 3D printed in acrylic and married to a fill spout and flange which would allow for easy filling of the mold. The mold itself was then made with Smooth-On's Mold Star Slow 15 silicone. From the mold, a test tire was cast with Smooth-On's Reoflex 50 urethane rubber:

Meanwhile, the wire wheels were being constructed. The hubs and rims were 3D printed in acrylic. The fine detail made possible by using acrylic allowed properly aligned holes for the 0.020" spokes to be included in the printing. This avoided the need to set up a drilling jig with all the challenges that would entail. Apart from cleaning out the spoke holes with a #75 (0.021") drill, all that was required to assemble the wheels was a simple jig to hold the rim and hub in place as shown below;





The circular flange holding the rim in place is 2mm thick and the square flange on which the hub rests is also 2mm thick. This gives the required offset of 4mm.

The first step was to install the spoke tighteners. Rather than cut 1mm thin wall tube into 336 4mm long pieces, I was able to find some long, 1mm diameter, cylindrical copper beads which would simulate the tighteners. Here they are installed in the rim:

After that it was a straightforward job to lace in the spokes starting with the rear spokes. The end result of this first tire casting and wire wheel construction is shown below. At this point I was still waiting for tire colorant to arrive, so the tire is just the natural urethane rubber color.

But I wasn't entirely happy.

Firstly, the diameter of the spoke tighteners (1mm) was really too big. Their diameter made them more prominent than they would be on the prototype. Although painting would likely mask the issue, it still wouldn't look right. Fortunately, I was able to find some brass tube that was 0.8mm OD and 0.6mm ID from Albion Alloys, Ltd in the UK. So, my plan was to use that tube instead of the beads. Cutting out 336 pieces of tube (84 x 4) would be tedious, but that was all.

Secondly, the wall thickness of the tire turned out to be too thin. The sidewall was very realistic in profile, but had too much flex. Although it was possible to use a heavier rubber (Reoflex 60), it was simpler to slice off some of the silicone in the mold that formed the inner bulge of the sidewall and thus thicken it up. The revised mold surface wouldn't be pretty, but it would form the inside of the tire and therefore not be visible. The other advantage of the change was that it would make the molded tire easier to separate from the mold without tearing. You can see the revised profile opposite:

Lastly, I needed to be more careful about keeping air out of the casting. I don't have a vacuum de-gassing chamber, so more care with mixing, and more time letting the rubber outgas naturally, was required. But one simple change helped enormously. For each tire, and before pouring rubber into the mold, I painted liquid rubber around the tire edges and over embossed features on both halves of the mold. This seemed to significantly reduce any air bubbles on the surface. And that's why a test mold really helps.

Here's a picture of the revised tire and wheel. The rubber has been colored, the smaller diameter spoke tighteners used, and the wheel painted with Tamiya surface primer. Eventually, the spokes will be painted with Tamiya Gloss Black (TS-14).

Painting

Virtually all the fabrication work was now complete. It was time to start priming, painting and assembling. There isn't much magic to the process but it was important to make sure the various paints were compatible with one another. Paint formulations have changed a lot in the past ten years and not too long ago I had problems with crazing on my Traction Avant model. Also, the body of the prototype is polished aluminum and I wanted to replicate that, if possible. There are some "chrome" paints that aren't very effective as chrome, but they might be ideal as polished aluminum.
So, a paint test was in order.

For the nylon body parts I planned to use two coats of Rustoleum Filler Primer, wet sanding each coat aggressively with 400 Grit to get a smooth finish. Then coating with Rustoleum Primer Sealer and wet sanding with 800 Grit to set the foundation for the finish coats. For smaller parts, especially those that were acrylic, I planned to use Tamiya primer surfacer. Those were the two primer alternatives. For top coats, I tested two Tamiya lacquer paints, three "chrome" paints, one silver paint and one aluminum paint. I also re-tested the Aluminum and Stainless Steel Model Master Metalizer paints that I had. Unfortunately, the Metalizer lacquers are no longer being manufactured, but I had managed to accumulate several spray cans before production ceased.
It would be a slow test as I planned to let each new coat dry for a minimum of 24 hrs and, preferably, 48 hrs.

Here are the results:

First off, as you can see below, Tamiya's Gloss Black (TS-14) over Tamiya Primer (top) provided a slightly glossier base than Tamiya Gloss Black over Rustoleum Primer Sealer (bottom).

Second, here's an array of eight different silver or chrome paints. Six are over a Tamiya Primer / Tamiya Gloss Black (TS-14) base. Four are over a Rustoleum Primer Sealer / Tamiya Gloss Black base:

My takeaways;

- For chrome, Alcald II (for Lexan) worked out best.
  Although the paint is made for Lexan, it worked perfectly well over Tamiya's lacquer.
- Close second for chrome were Rustoleum's Metallic Finish and Krylon's Premium Metallic Original Chrome.
  In the past, I've struggled to get a good even coat with Rustoleum's Metallic Finish. The paint was prone to run and took a long time to dry (several days). During that time it was very vulnerable to finger marking. I had no experience with Krylon's Chrome so, for comparison purposes, a broader test was in order.
- For silver, the glossiest finish was with Tamiya's Metallic Silver (TS-83). It certainly looked good, but it is expensive; almost three times the price of regular Tamiya paints. Tamiya's Silver Leaf (TS-30) was almost as good, and certainly better value.
- Krylon's Short Cuts Chrome was a disappointment. Others have commented favorably on it, but in this test, the paint was neither 'chrome' nor even a good silver.
- Tamiya's Mica Silver was a relatively dull gray, but that was over a Rustoleum / Tamiya Gloss Black base. I need to try it over a Tamiya Primer / Tamiya Gloss Black base.
- Lastly I tried Model Master's Metallizer Aluminum Plate over both the Tamiya and Rustoleum bases. I've used the Metallizer paints in the past with very good results and, with a gloss top coat, they provide realistic metal finishes. But Rustoleum had decided to stop making Model Master paints so did I want to use up what I had left of the Metalizer paints on the Napier-Railton body?

In the end, I decided that if I was going to pain the body panels I would use Rustoleum's Metallic Finish even though I wasn't completely happy with it.
Then a diversion intervened.

A Second Napier-Railton Model

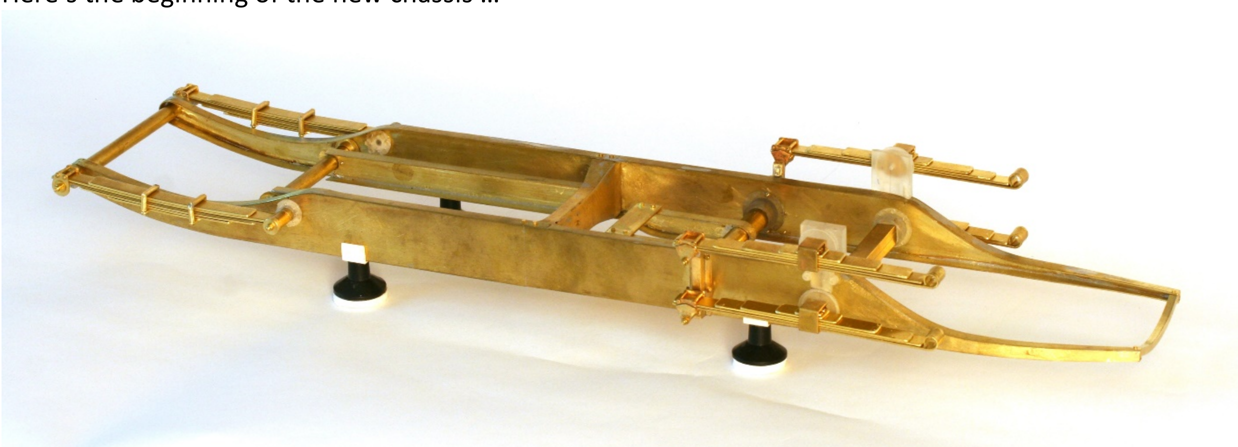
At this point I was asked if I would build a second model of the Napier-Railton, this time for a client. Although I had resisted such requests in the past, simply because the time involved didn't justify it, I was far enough along with the first model that a second model looked like it would be straightforward. It also turned out to be fortuitous.

The first model was set aside and work was shifted to the new model. Coincidentally I was generously given access to a large number of detailed photos of the Napier-Railton taken by a fellow modeler. These proved to be invaluable since, because of COVID, I couldn't travel to the UK to take my own photos. The photos resolved several questions I had about features of the car and, more importantly, showed that some of the details of my chassis construction were incorrect. These primarily impacted the front axle and its radius arms, the pedal arrangement, and the engine support subframe. These corrections would be incorporated into both models.

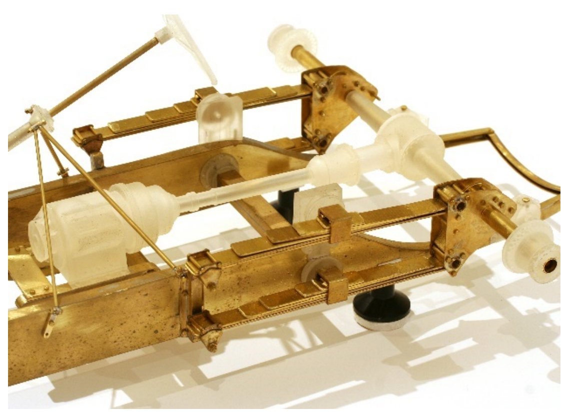
As with the first model, I planned to fabricate the model completely, making sure everything fit and looked right, and then disassemble it for painting.

Chassis #2

Here's the beginning of the new chassis …



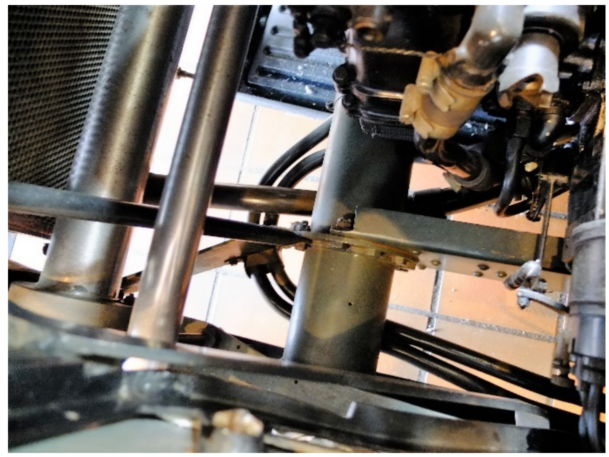
And with more parts added ….



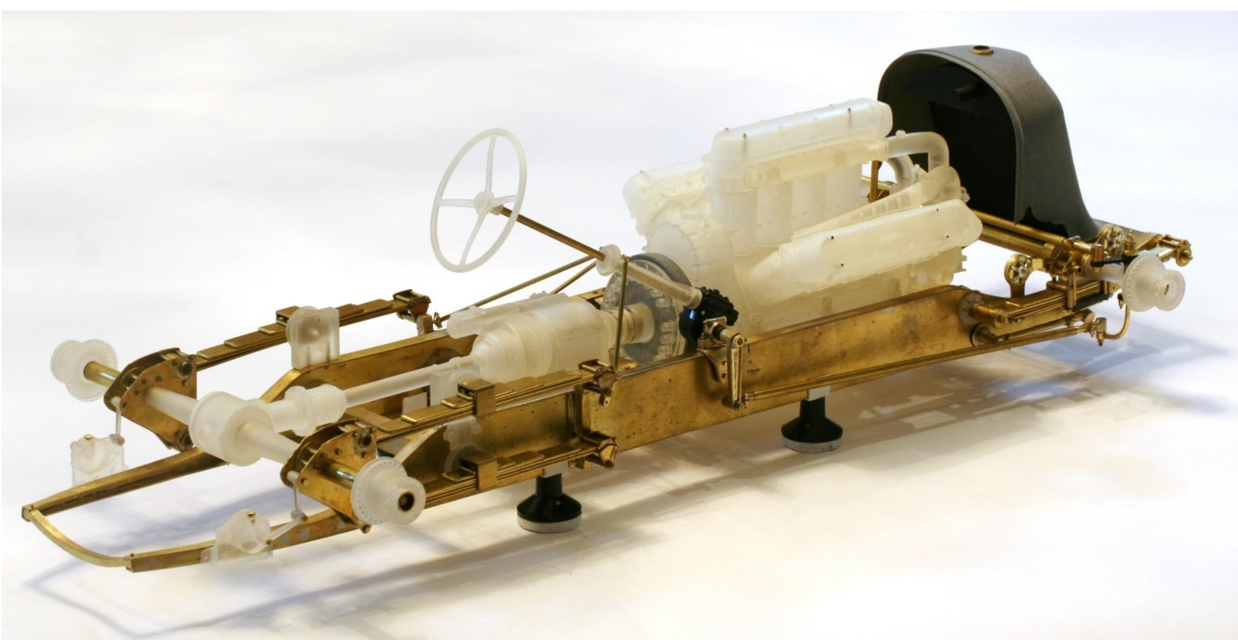
This photo shows more detail of
the front axle components ….

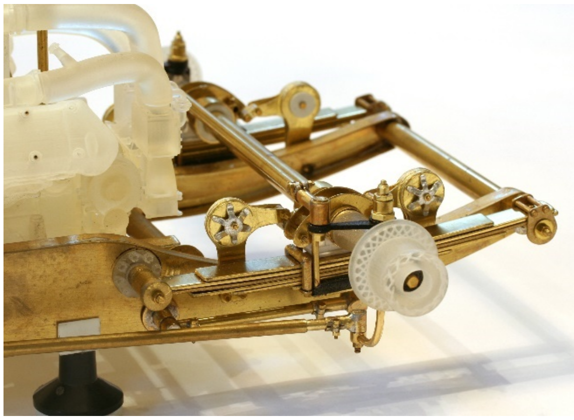
which mirror the prototype ,,,

In the center of the photo is the front end of
the engine support sub-frame



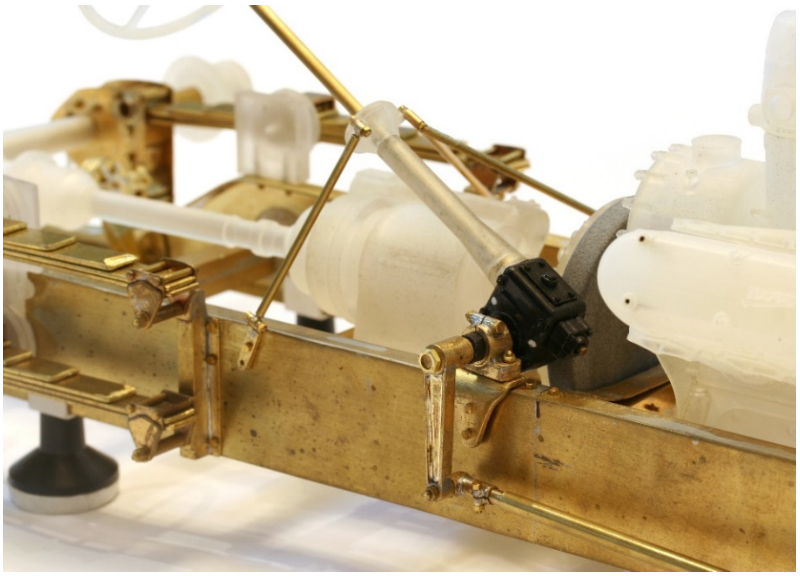
Here's the right-hand side with a test installation of the engine, drivetrain and radiator.





The Hartford shock absorbers have been test installed (although they are in backwards; an error that will be fixed later).
The steering arms have also been test installed. Assembly is designed so that final adjustments can be made after painting.

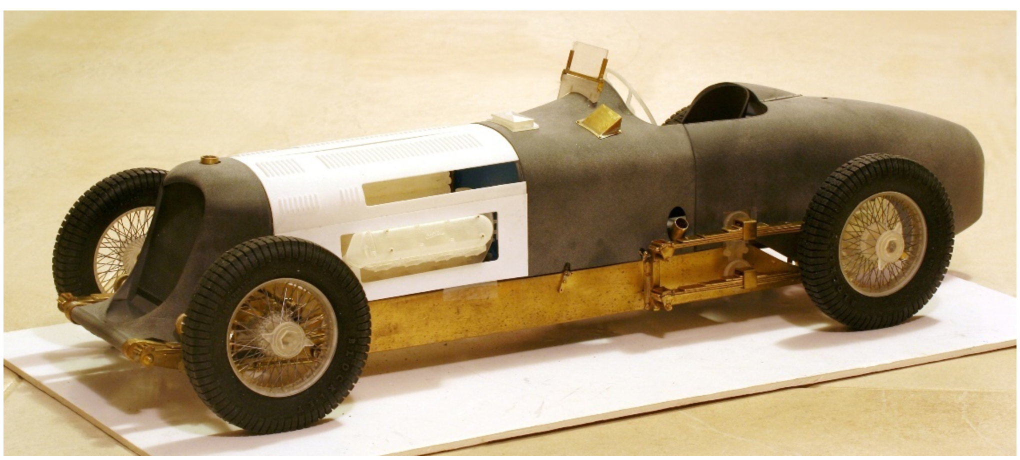
More detail of the steering arms as well as the steering column supports …



The core of the working steering box is from a 1:8 scale Rolls-Royce Phantom II kit.

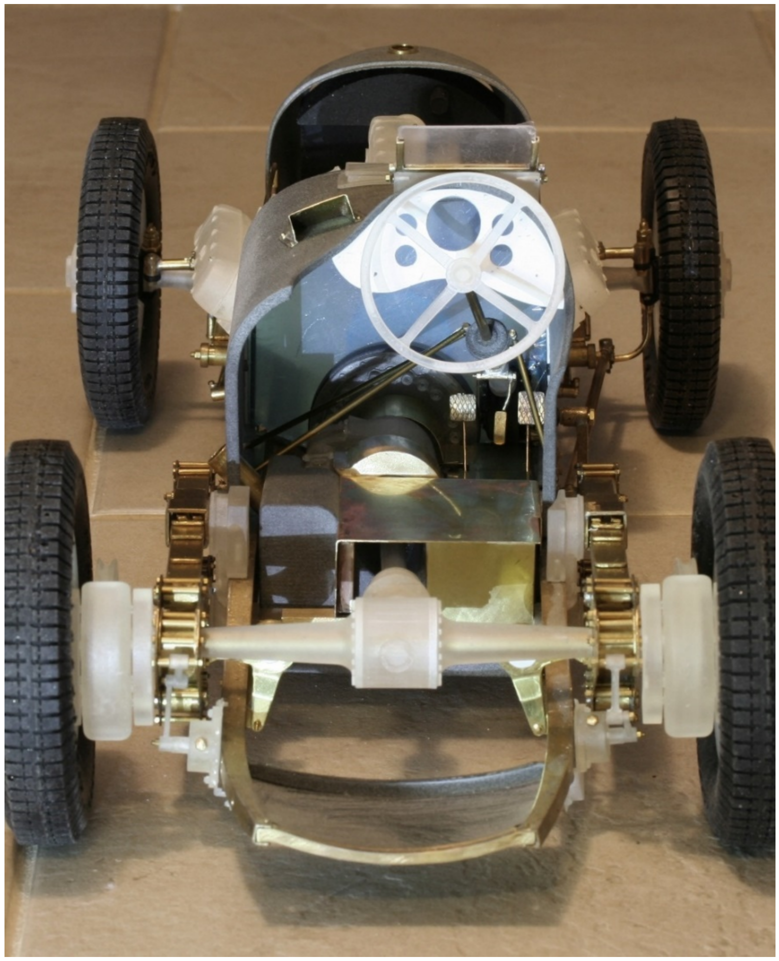
Body Fitting

With the chassis largely completed it was time to test fit the body panels.



As with the first model, and with the exception of the bonnet side panels (cut from styrene sheet), all the panels were 3D printed in nylon. The wheels were also built in identical fashion to the first model.

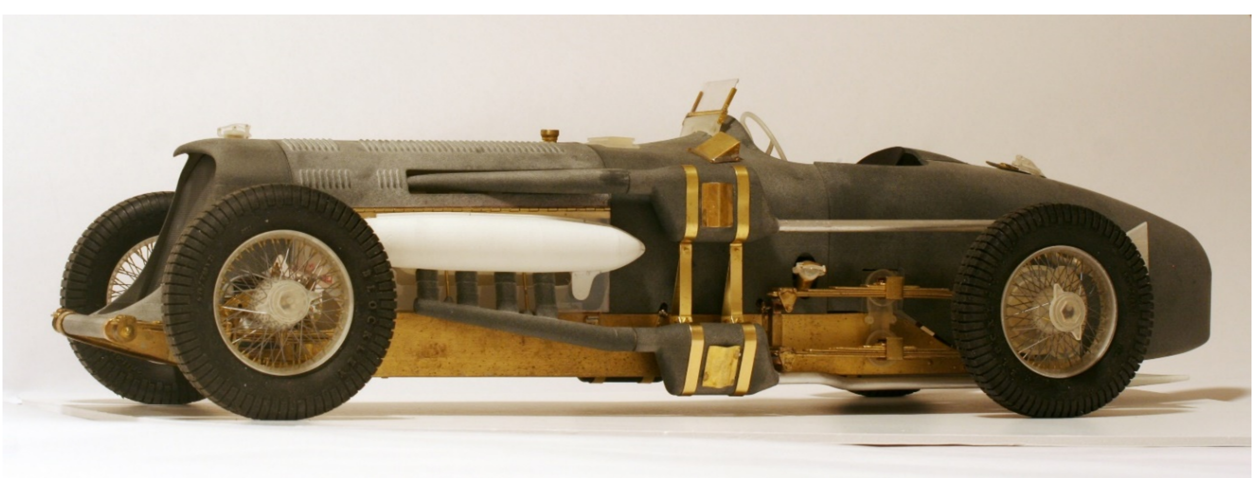
Some more details are shown here; the pedals, floorboards and rear disc brakes.

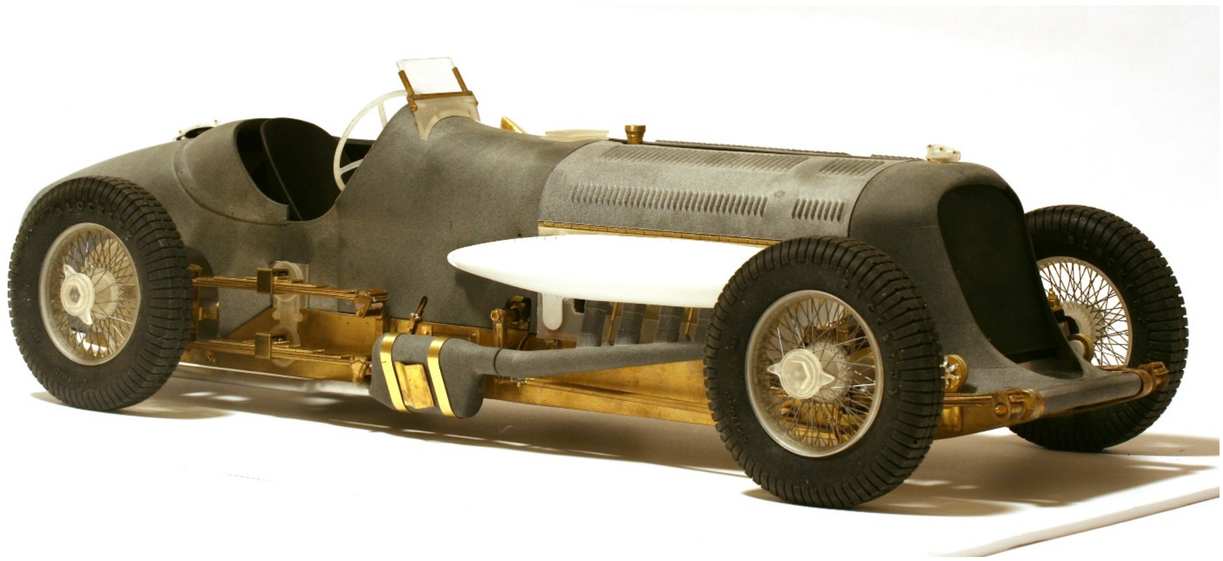


The brake pedal is mounted off the steering column. In racing form, the Napier-Railton had rear drum brakes (no front brakes). Later, when the car was converted for parachute testing, the drum brakes were replaced with disc brakes which are still fitted to the prototype.

Exhaust System

The last major step was fabricating and fitting the exhaust system. The exhaust system was a requirement to race at Brooklands since the track was in suburban London. The mufflers, exhaust manifolds, and fantails were 3D printed. The exhaust pipes are aluminum rod.

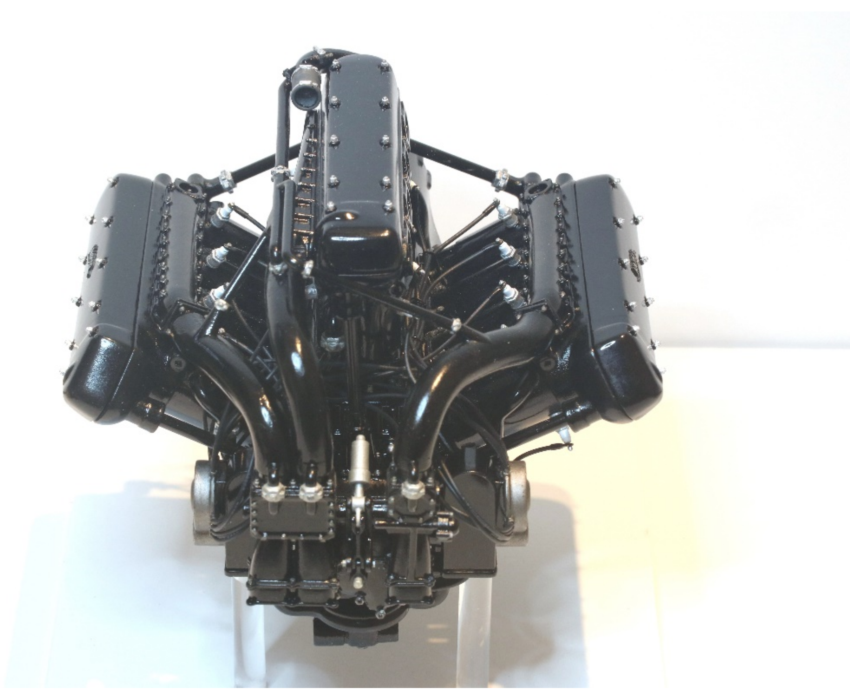


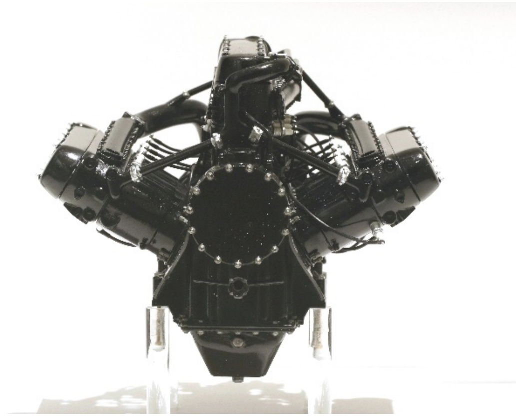


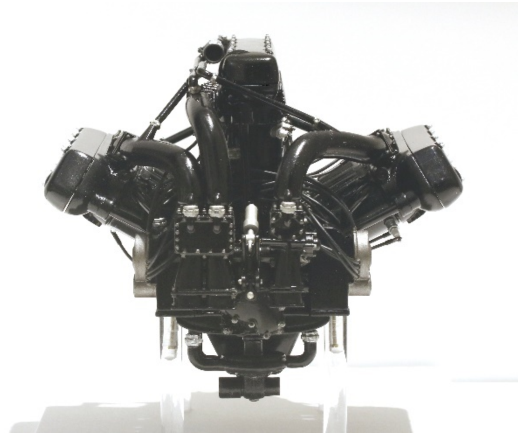
With construction virtually complete, my focus could now shift to painting.

Painted Engine

Painting started with the engine.
Virtually all the engine parts had been 3D printed in acrylic, which provides a high level of detail. The parts were lightly sanded or scraped to remove any excess acrylic powder and, where possible, remove any stepping.
Tamiya Fine Primer was sprayed on for a base coat and, for most of the parts, the finish coat was Tamiya Gloss Black. All the coats were applied from rattle cans. For most parts, each nut and each bolt was hand painted using Tamiya Metallic Gray. This was sufficient to draw the eye without overly jazzing-up the model. Other hardware was highlighted in silver.
The magneto faces which, on the prototype, were made from Bakelite (an early thermoplastic), were painted in a mixture of metallic gray acrylic, black lacquer and white acrylic. The mixed nature of the paints helps mimic the shading that was typical of Bakelite.

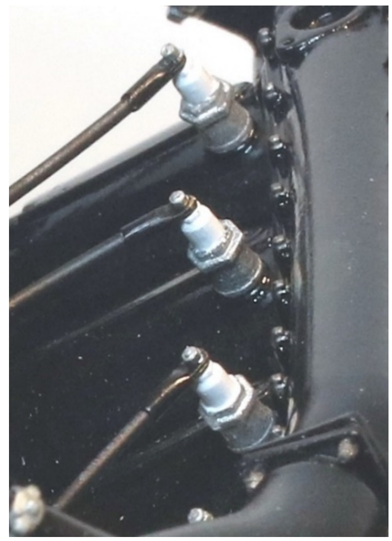


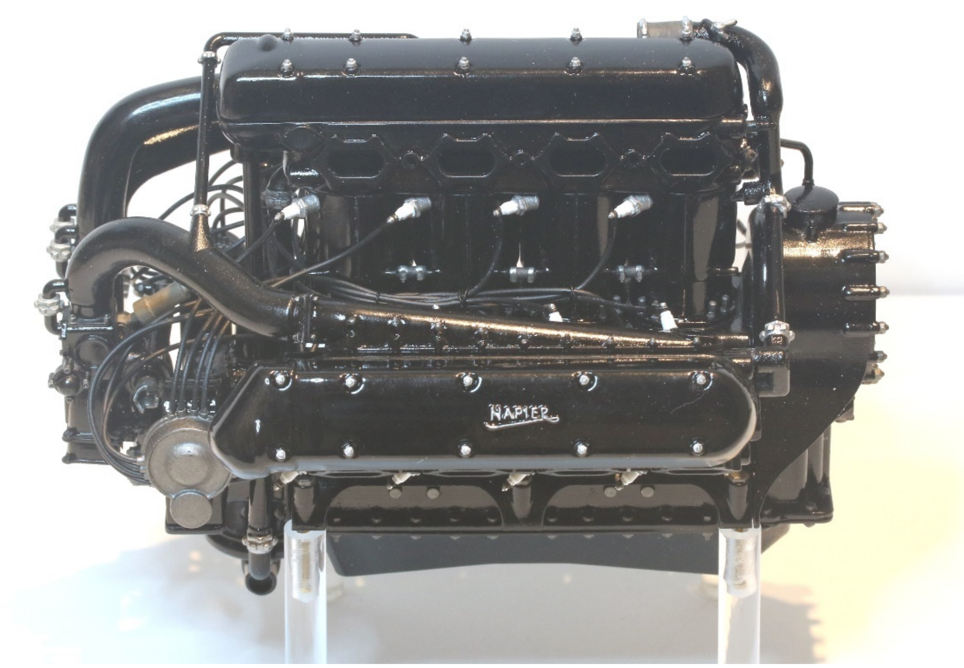




Each of the twelve cylinders had two spark plugs. One was fed from the magneto on the right side and the other from the magneto on the left side.

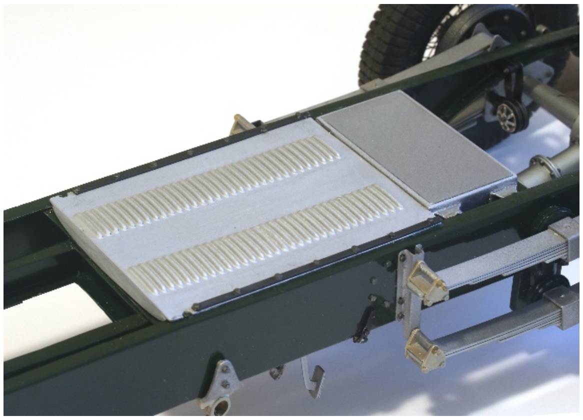
For the model, the spark plugs were 3D printed in acrylic and then drilled through the center to take 0.020” piano wire. At one end, the piano wire anchored the spark plug to the cylinder and, at the other end, provided a post for the ignition wire spades.
The spades are made from 1.5 mm diameter (1/16”also works) thin wall brass tube. The tube is flattened at one end and is then drilled out for the spark plug post. The other end takes the 1mm diameter ignition wire. A 0.8mm nut secures the spade on the post.
The spark plugs are wired to the magnetos in the exact same order as the prototype. This, of course, reflects the firing order of the engine.

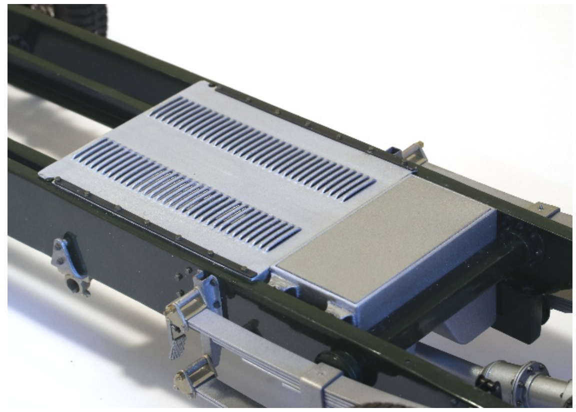




Painted Chassis

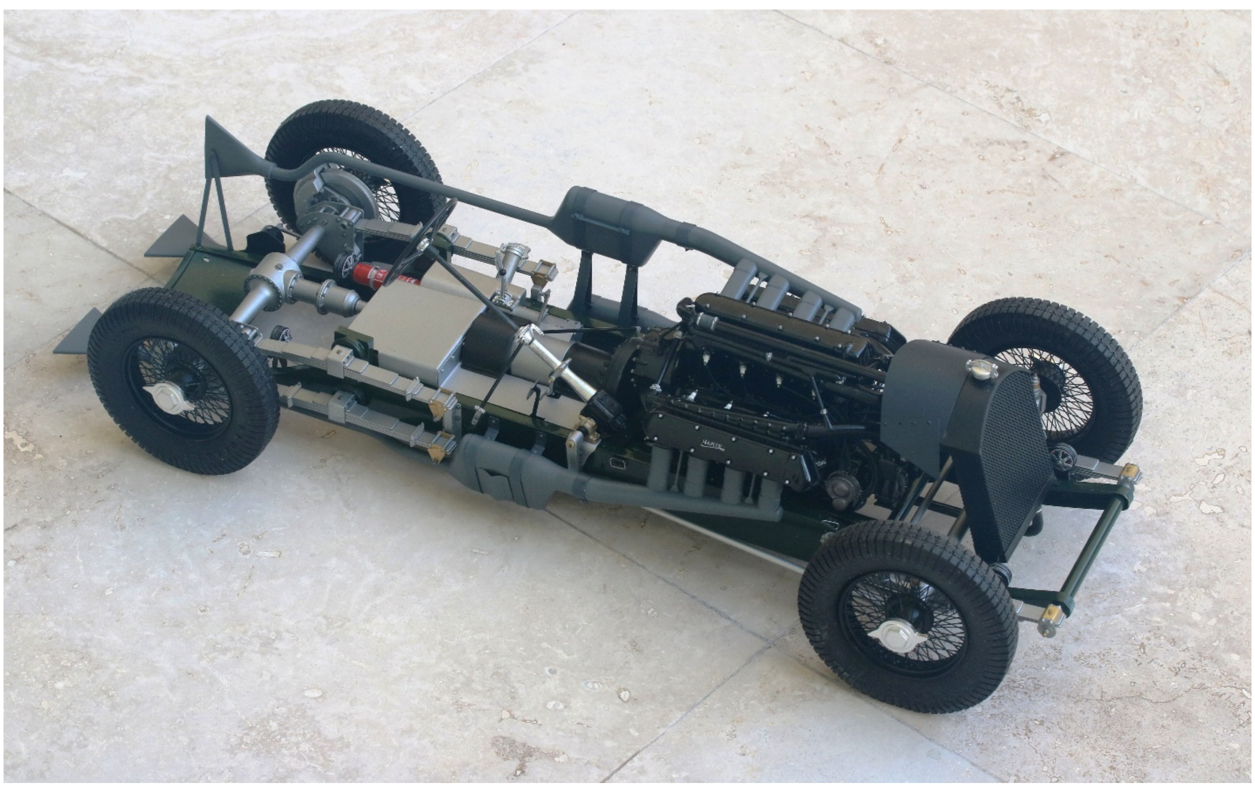
In photos of the prototype cockpit, there did not appear to be any floorboards on the lefthand side of the gearbox. So, what would prevent the air flowing under the car (which was often traveling at over 150 mph) from rushing up into the cockpit? The answer was a louvered undertray placed between the center crossmember and the oil tank. This covered the area between the firewall and the rear of the driver's seat, effectively diverting the underflow away from the driver. Here are a couple of 'under construction' photos of the chassis undertray …

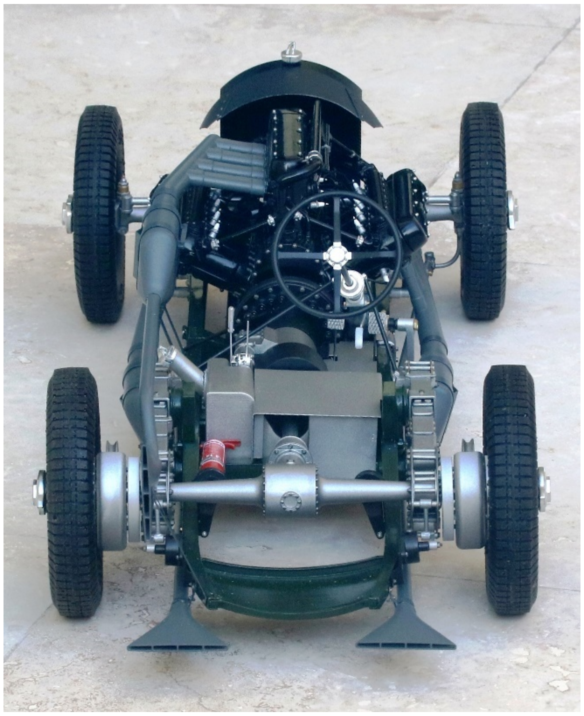


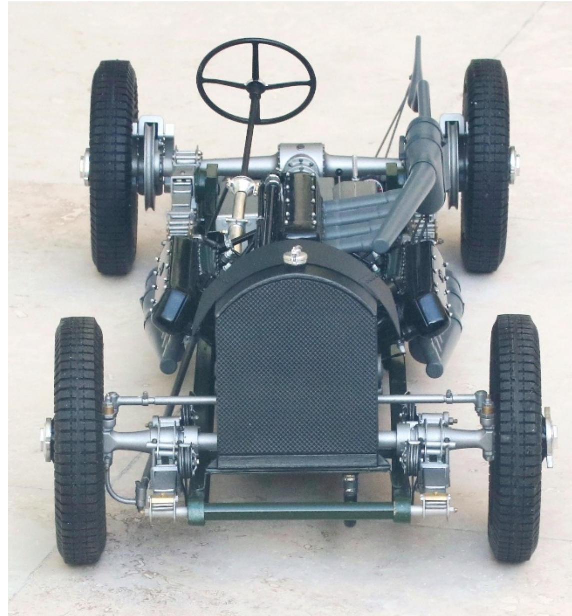


On the model, the undertray will likely not be visible, but it's an important part of the car so I wanted to include it. The undertray is made from a couple of spare bonnet tops, softened in boiling water so they could be flattened, and then cut down to the needed length.

Now for pictures of the finished, painted chassis ….







The eagle-eyed might notice that the steering dampener (mounted on the right end of the front axle) is not yet installed!

The following photos highlight some of the chassis details …

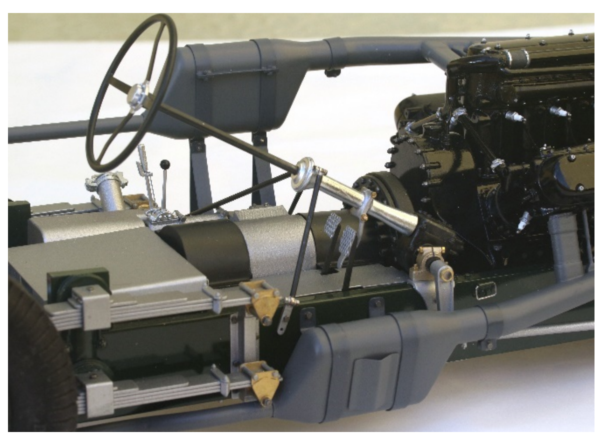
The Hartford shocks are now correctly installed.

Three braces anchor the steering column.

The column is at an angle to the chassis centerline in order to accommodate the pedals mounted on the right-hand side of the gearbox.

The rectangular ring in the lower right of the photo is the anchor for the rear bonnet strap.

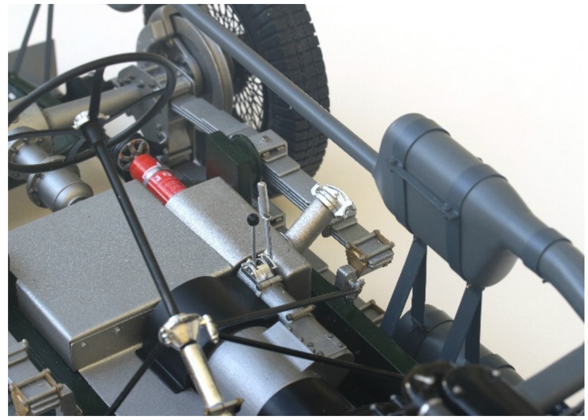
Immediately below the steering wheel is the floorboard over the oil tank. The seat sits on this floorboard.



Note the handbrake lever and gearshift. The car had only three forward gears.

In the center of the photo is the oil tank and filler. The 'lock-over' cap works just like the prototype.

The fire extinguisher is a modern addition to the prototype.



Rear axle and disc brake detail.

The rear axle had both Hartford friction dampers (half hidden behind the differential) and also Luvax hydraulic dampers (bottom center).

At this point, the chassis was virtually complete and the next steps was going to be adding the body panels.

Body Panels

As noted earlier, I had experimented with several paints in an attempt to replicate the polished aluminum finish of the current prototype. Rustoleum Metallic paint (from a rattle can) gave the best results, but there were two issues. First, it was difficult to apply the paint evenly without getting runs or having areas of orange peel. Second, and more importantly, the painted surfaces take a long time to dry and even then they were very susceptible to finger marks. And once marked, the surfaces were almost impossible to clean up.

Vacuum plating was another alternative with definite advantages in terms of consistency and robustness of finish. Through the client for my second model, I was offered a source in Asia and so decided to take that option. However, COVID, restricted travel, and supply chain issues all got in the way and an extended delay in getting the panels seemed almost certain. Nevertheless, the prospect of getting high quality panels justified the wait. Patience is a virtue with this kind of modeling!

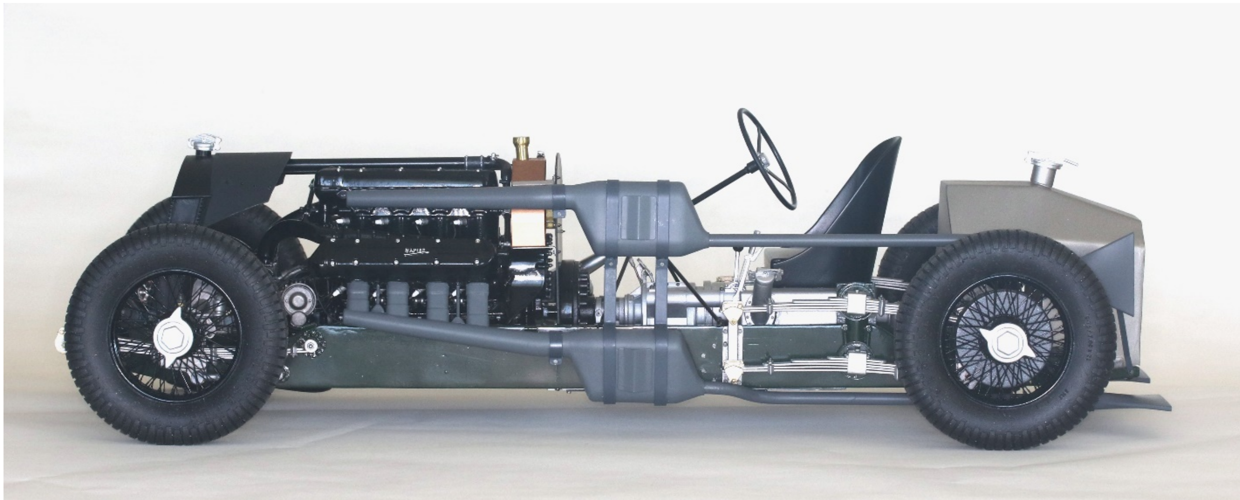
Finishing The First Model Chassis And Engine

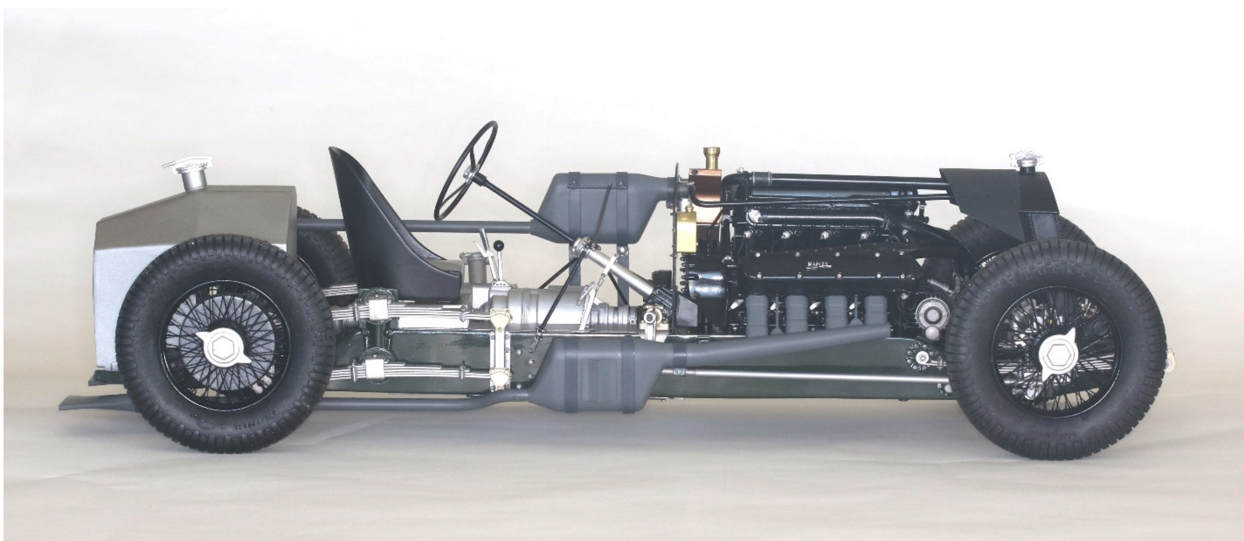
The interruption gave me the opportunity to finish the complete rolling chassis of the first model. In doing so I was able to incorporate some of the new details I had uncovered whilst working on the second model.

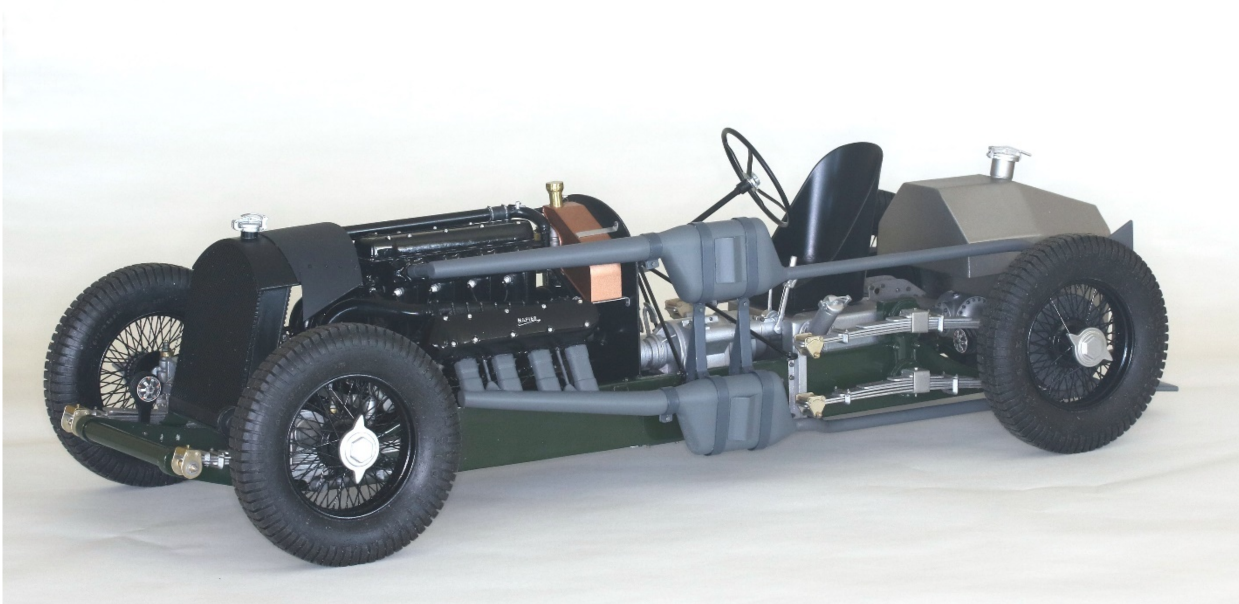
The primary difference between the two models is that this first model includes many more engine details such as crankshaft, pistons, valve gear and camshafts. It also features rear drum brakes. Drum brakes, not disc brakes, had been used throughout the Napier-Railton racing career.

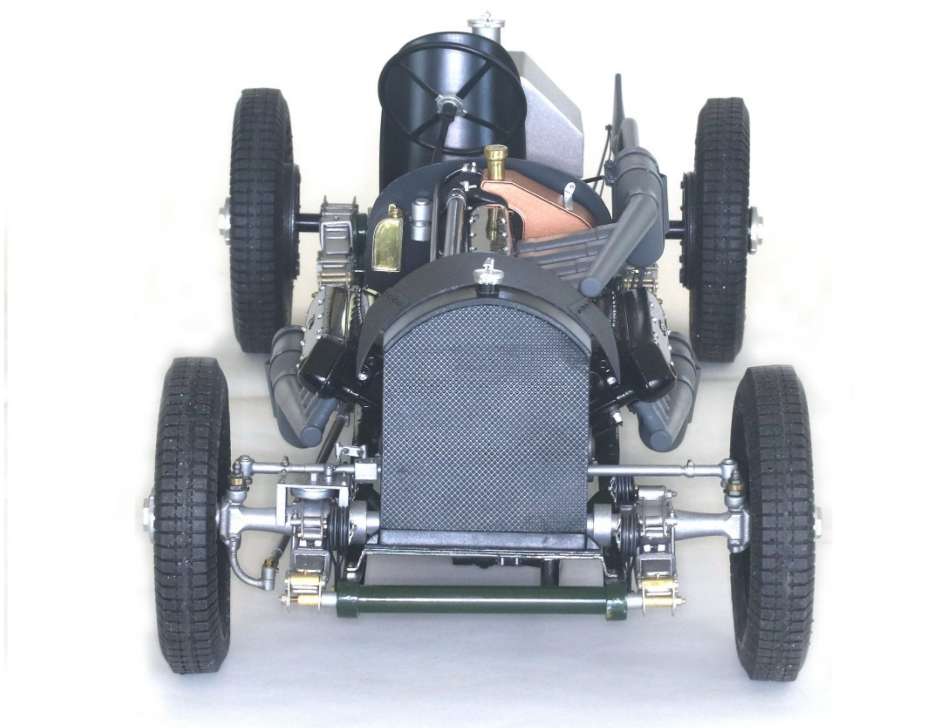
Here, then, are photos of the completed engine and rolling chassis:

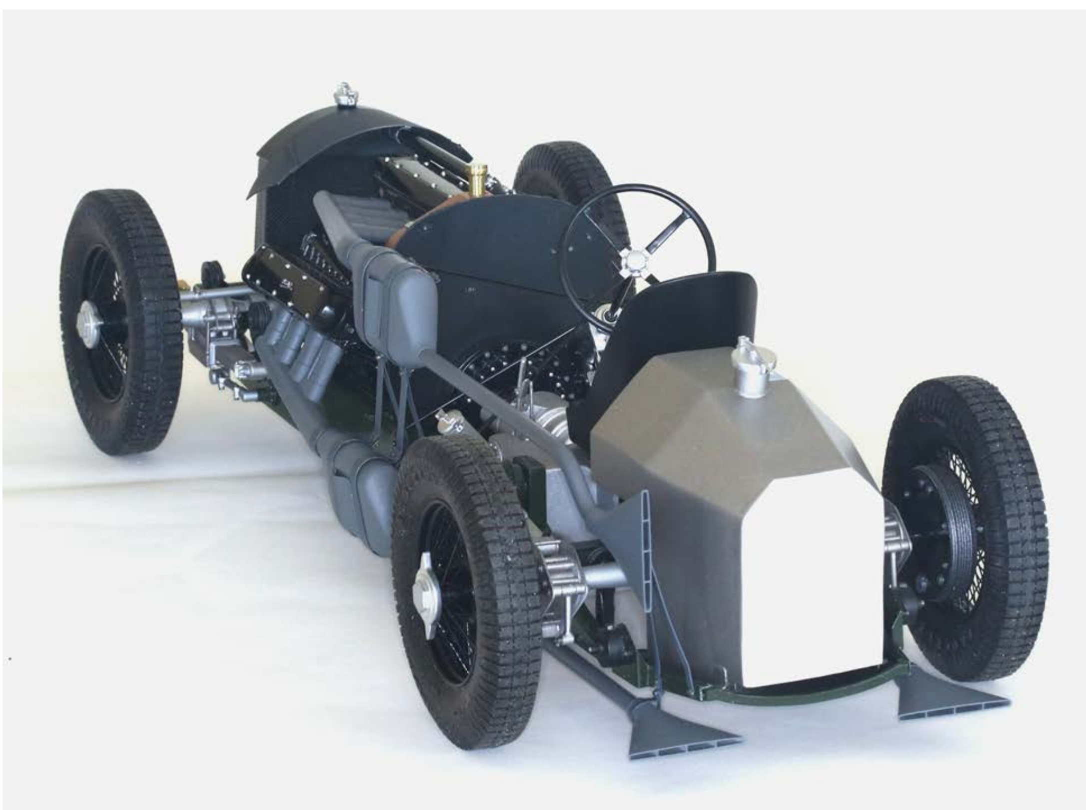
Finished Chassis



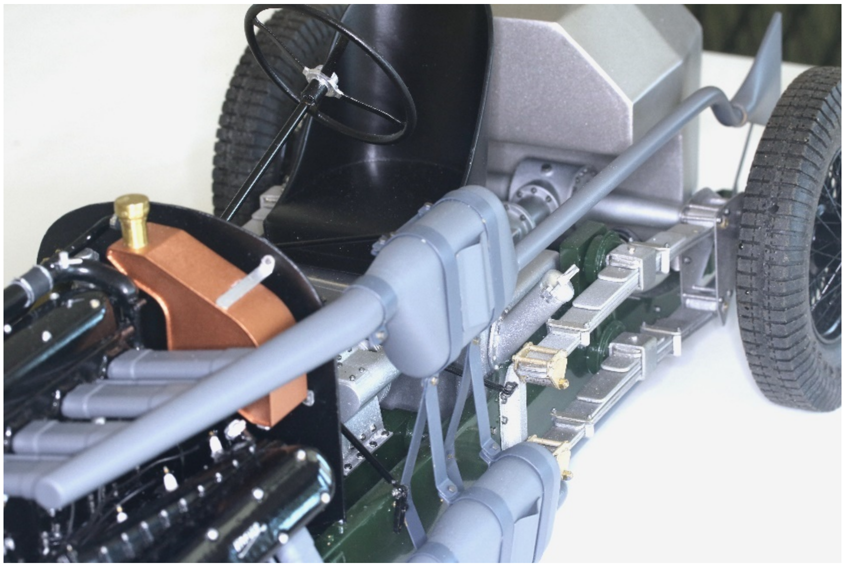


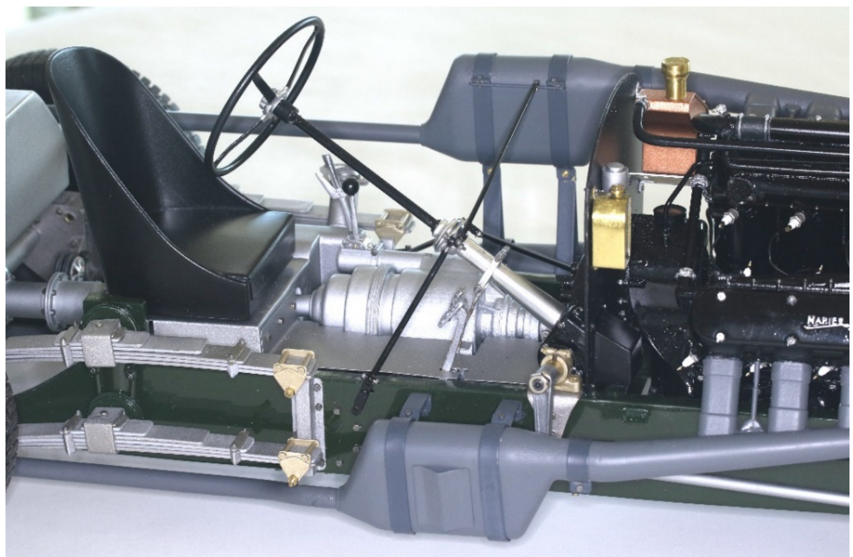


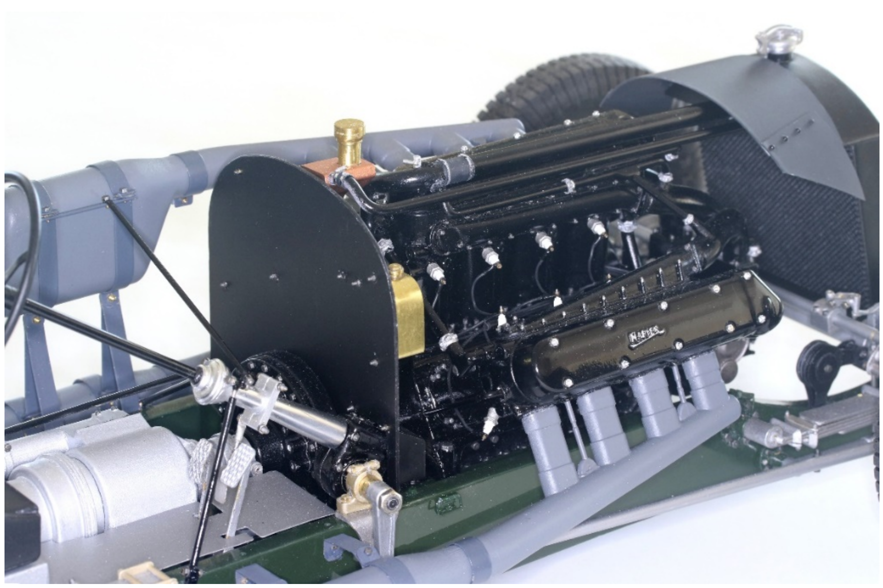


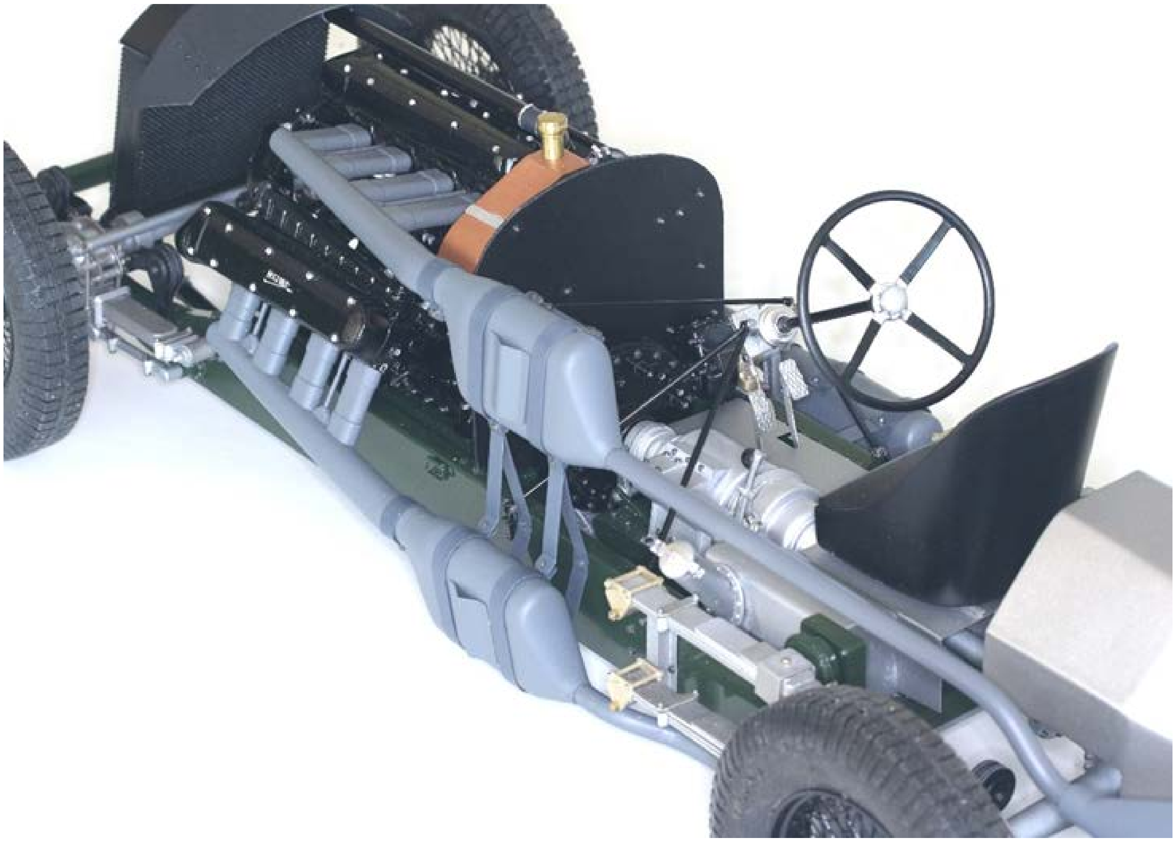


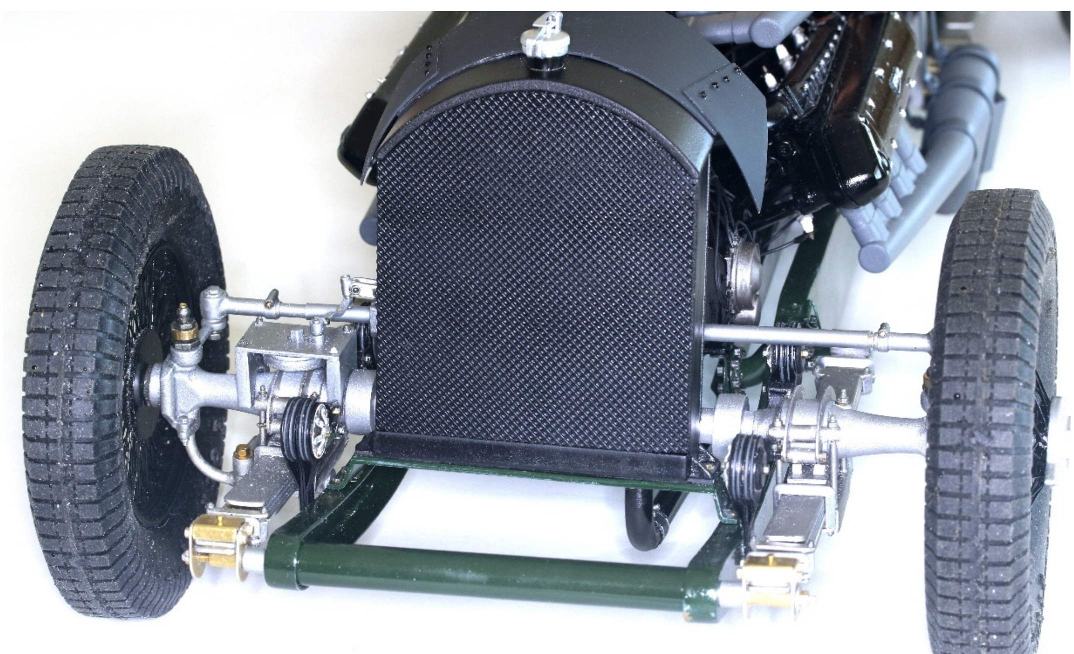
Chassis and Engine Details









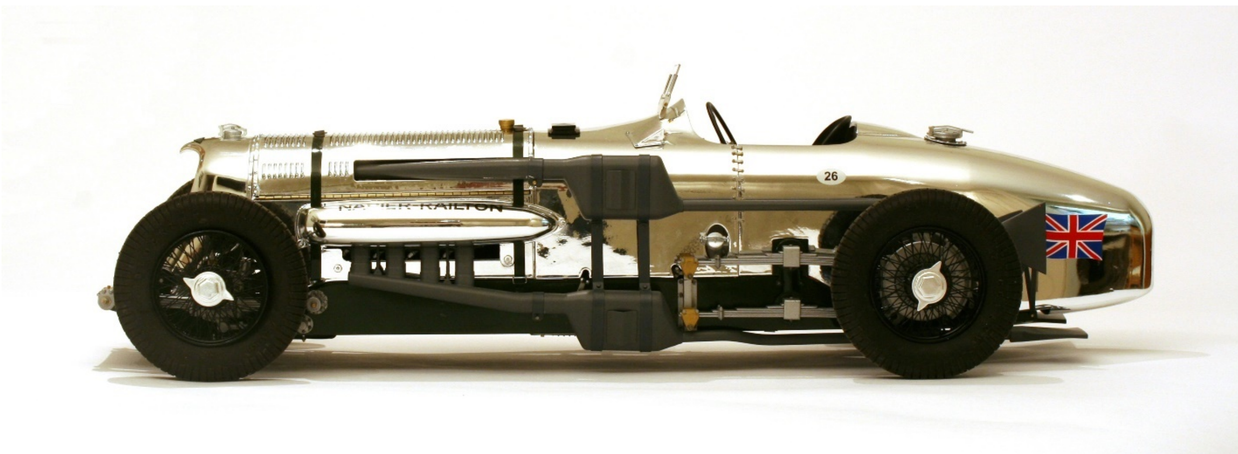


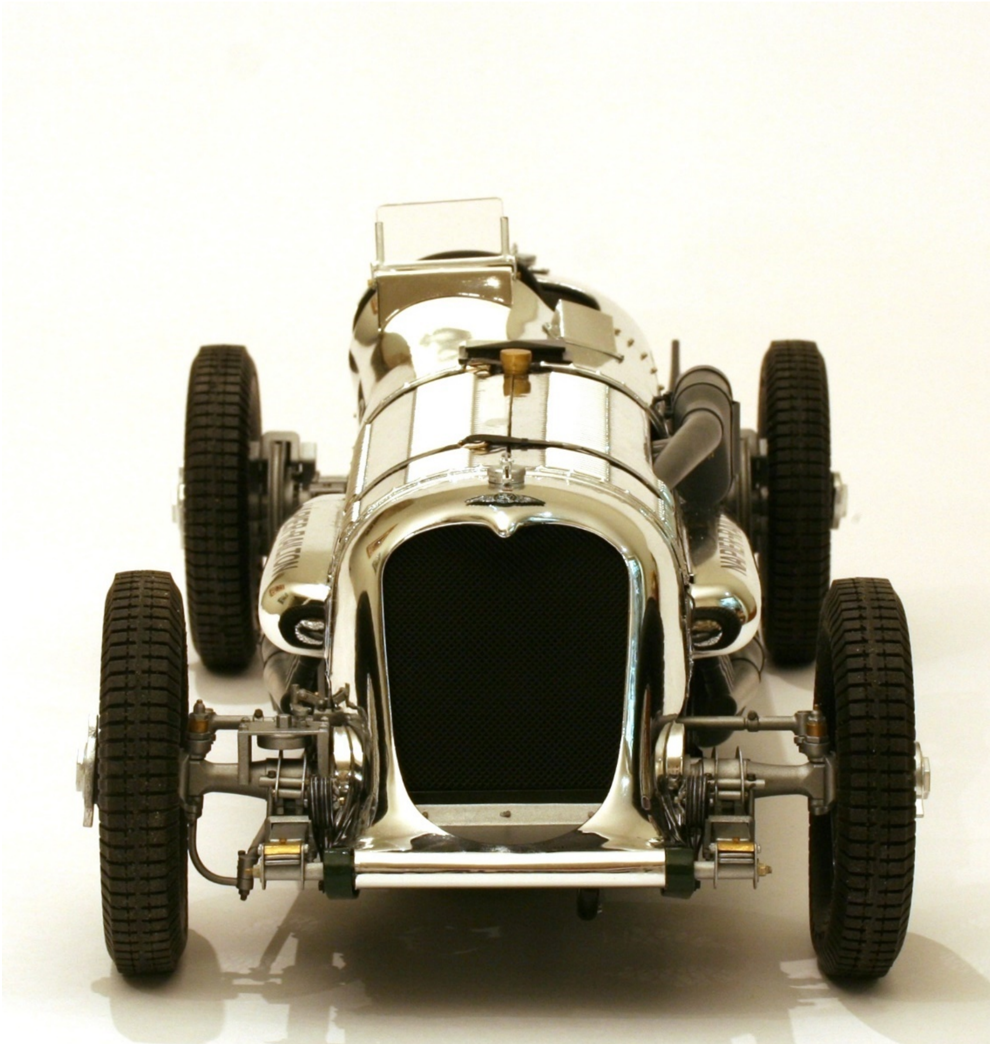
Body Panels

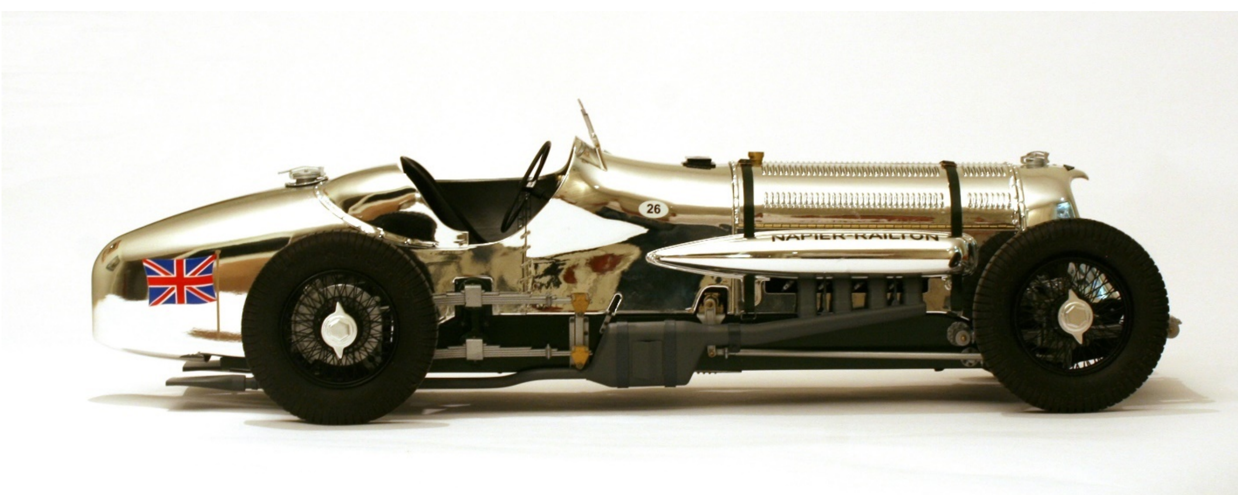
Eventually, the body panels arrived. Pleasingly, the quality of the finish was very high. Some minor adjustments were necessary to properly fit the panels and that had to be done with care as the edges of the were prone to flaking. But, that aside, fitting of the panels was straightforward. With the panels in place the complete exhaust system, which had already been painted, could be put in place. Other details, such a filler caps, the dashboard, rearview mirror, windshield etc., had also been finished and had simply to be fixed in their respective positions.

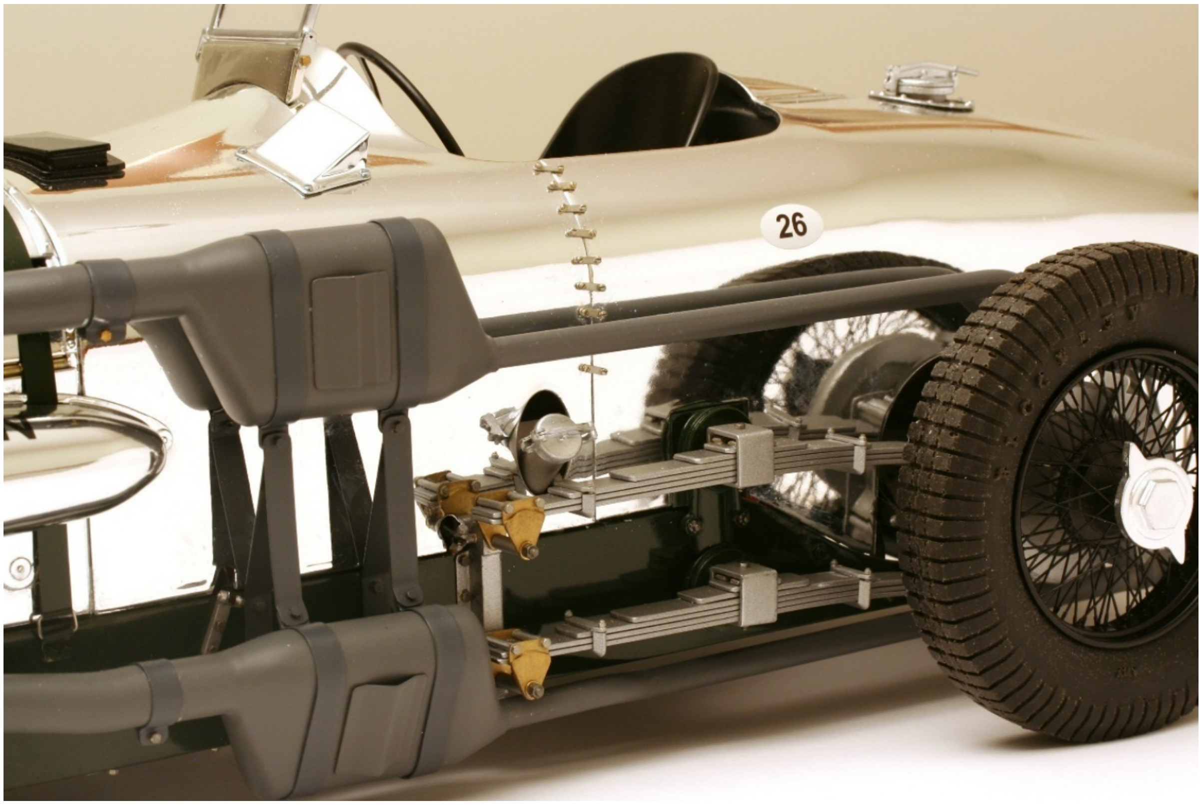
Finished Model

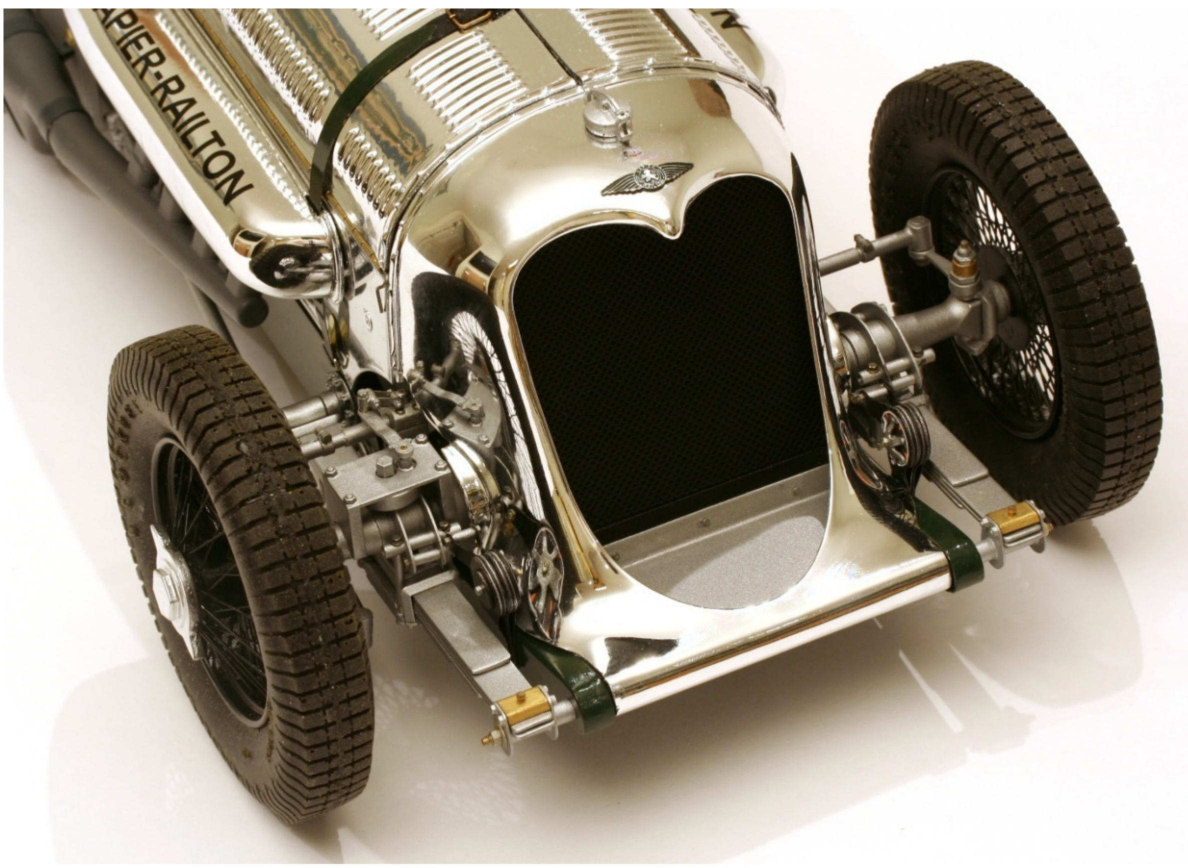
Here then are photos of the finished model.
The model is approximately 24 in long, 8 in wide and 8 in high.






26
NAPIER-RAILTON


26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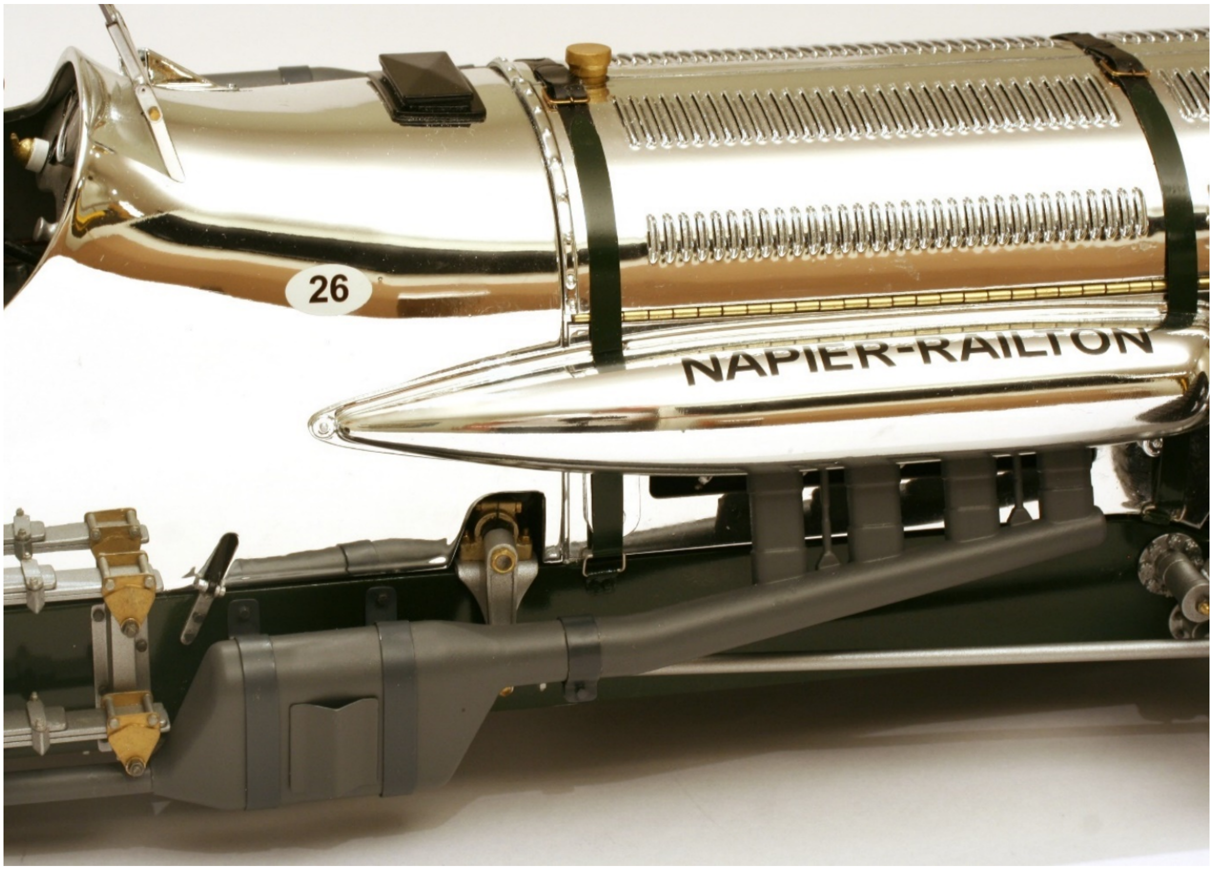
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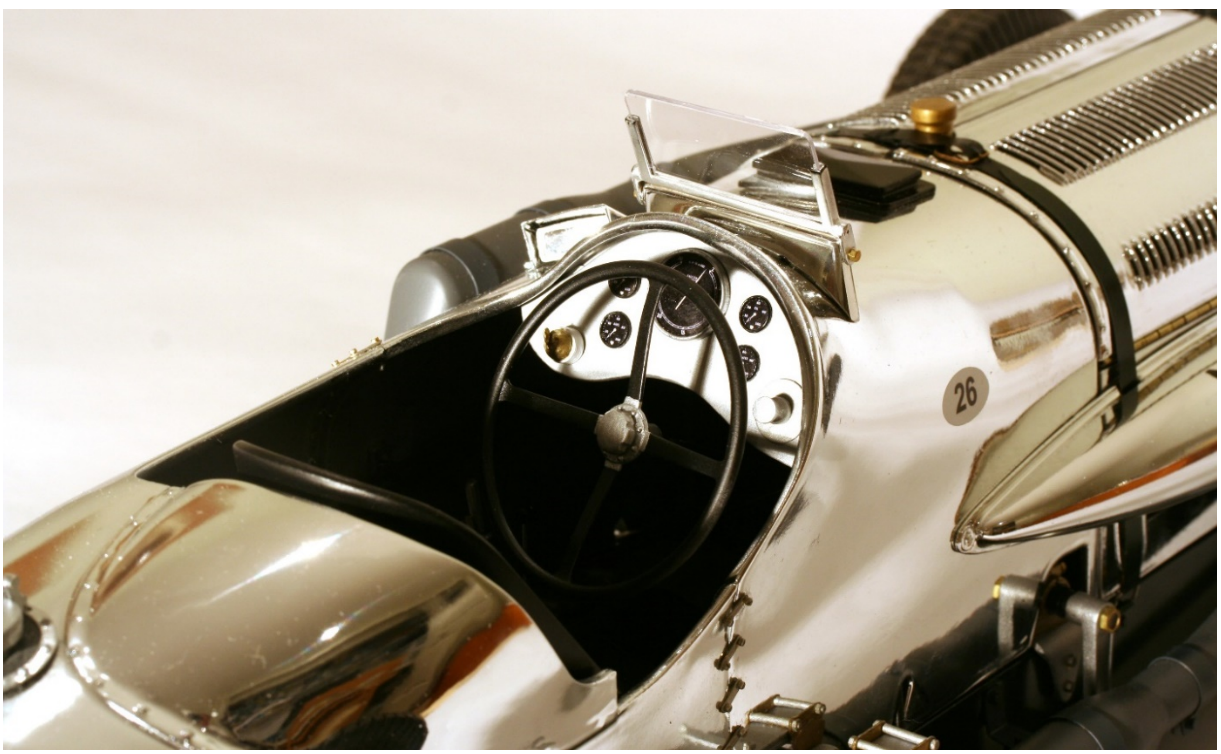
NAPIER-RAILTON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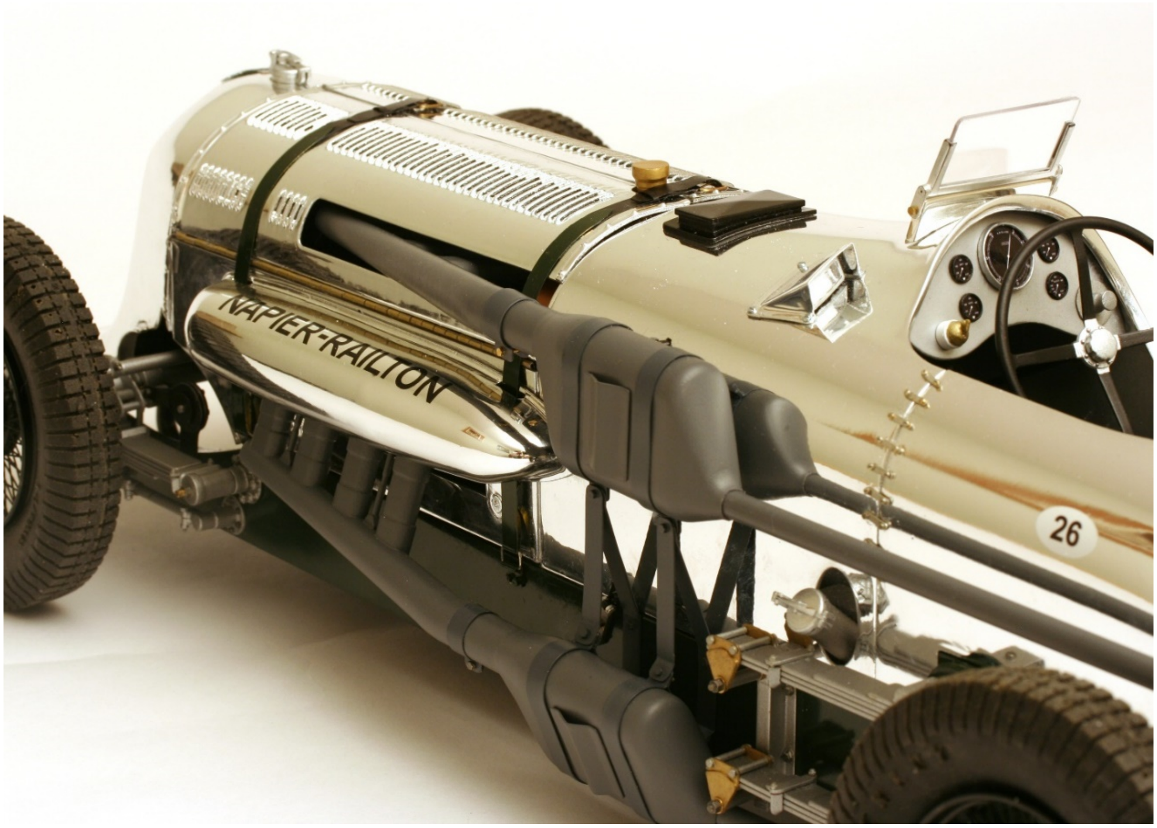
NAPIER-RAILTON
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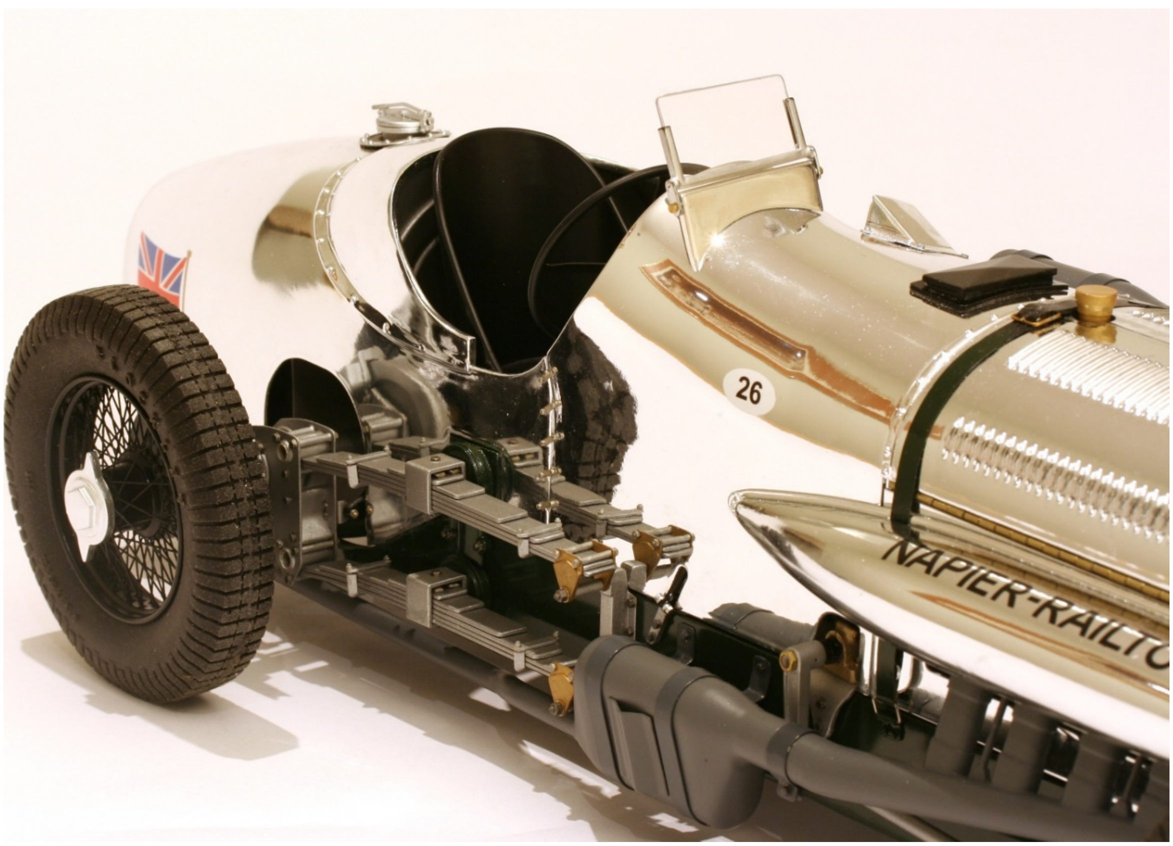
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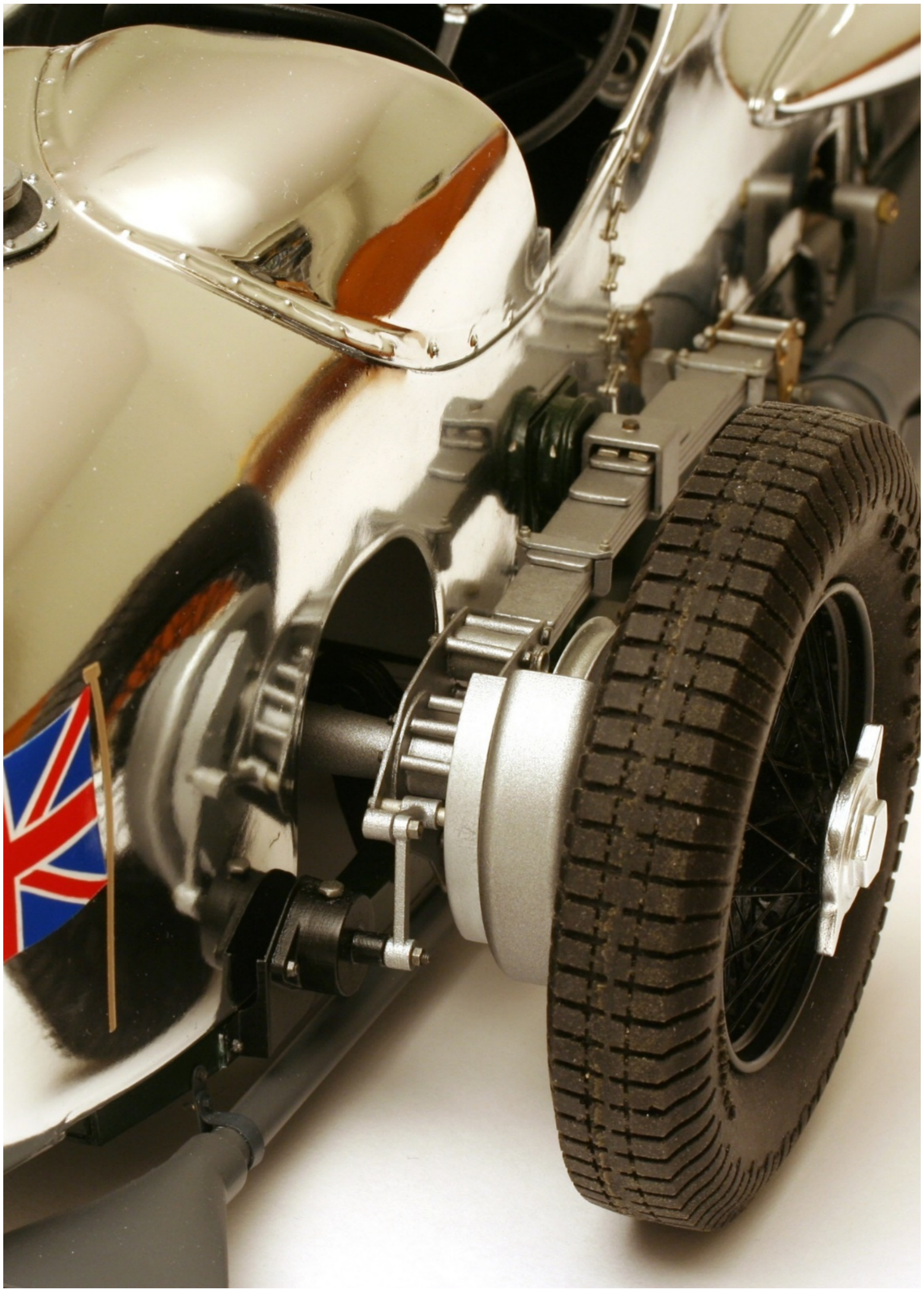
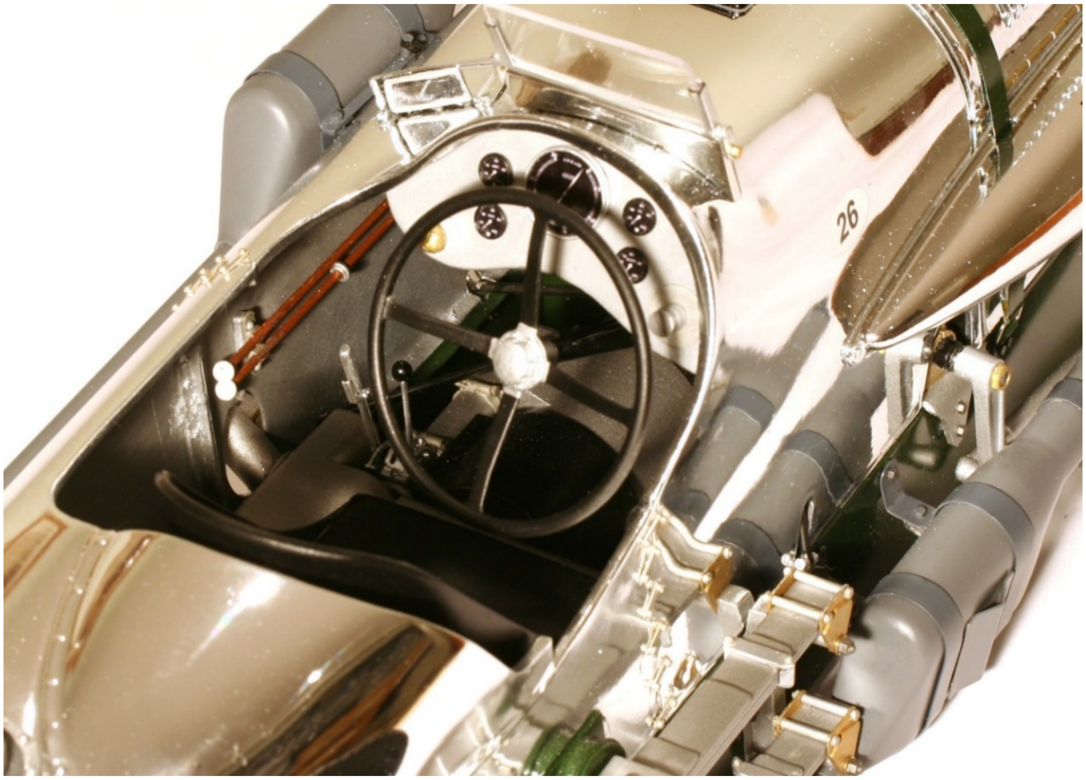
NAPIER-RAILTO

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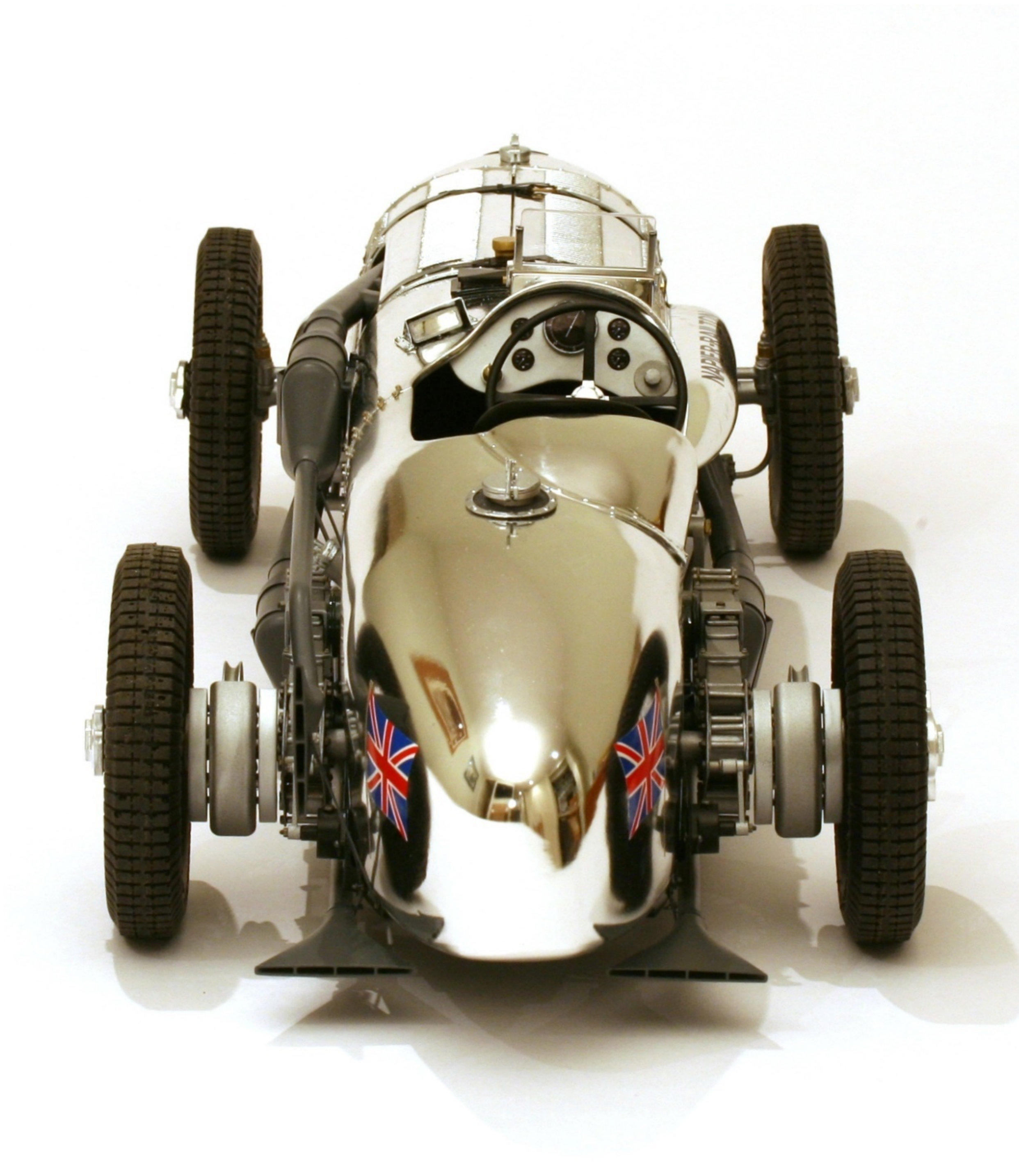

The last steps would be to add the body panels and other components to my first model. That was going to be straightforward so, to all intents and purposes, the model was complete. It’s been quite a journey, but a satisfying one. I think the final result more than justified the effort.

John Haddock
Dec 2022