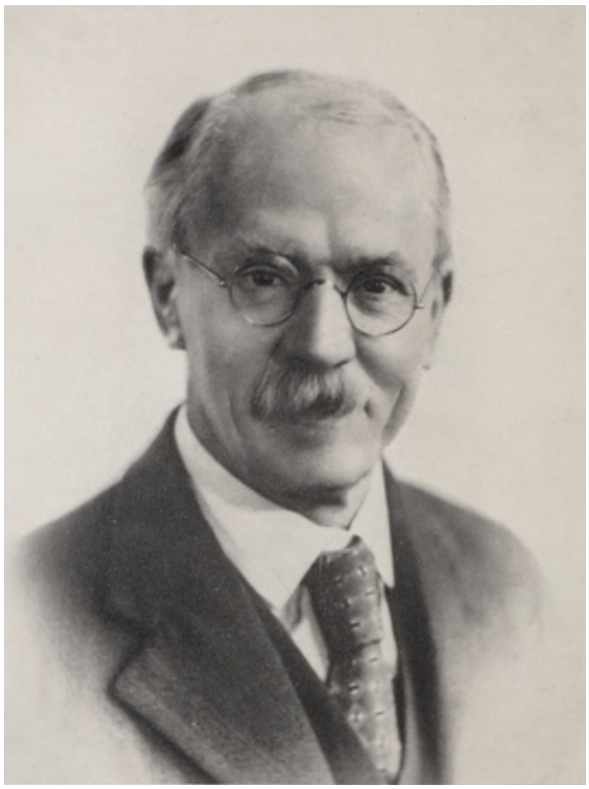
AGM Michell and the Crankless Engine

By Stephen Phillip ©

AGM Michell was undoubtedly one of Australia's greatest engineers. He is best known for his innovative thrust bearing, which revolutionised ship propulsion. His other significant invention was the crankless engine; this revolutionary engine design nearly became a commercial success.

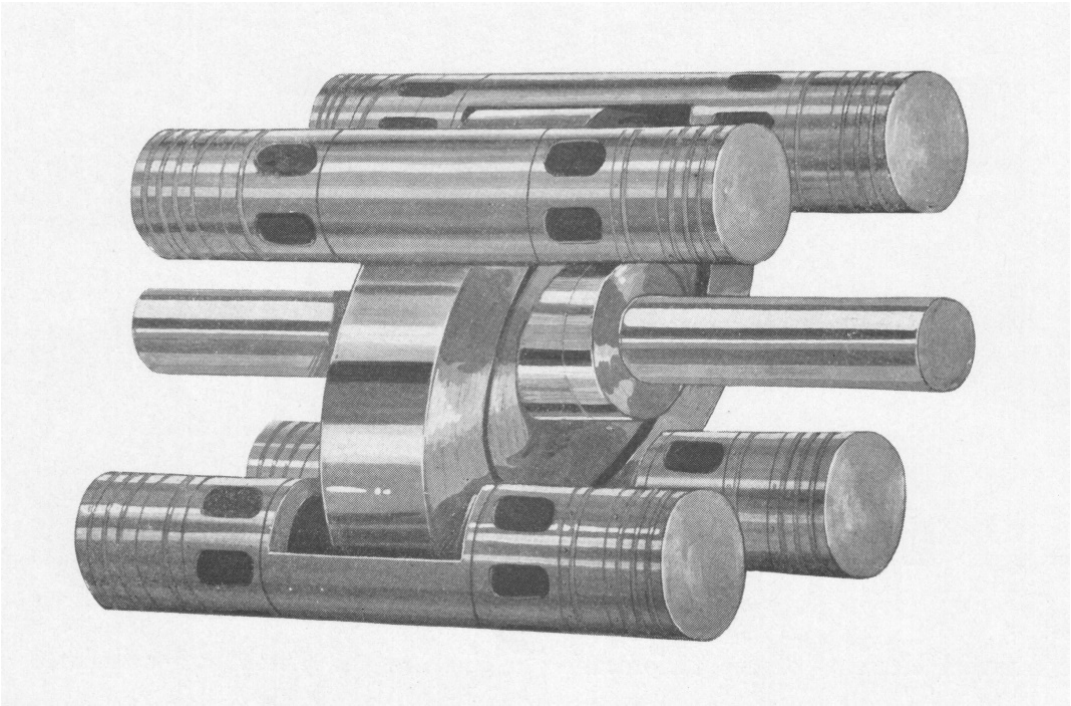


AGM (George) Michell

TL (Louis) Sherman

Michell had concluded that existing internal combustion engine designs were mechanically inefficient. In particular he disliked the crankshaft, that part of the engine which converts the reciprocating motion of the pistons into rotation of the drive shaft.

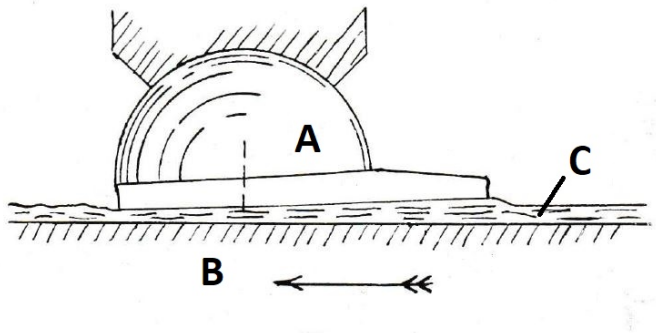
To Michell, the connecting rods and crankshaft were clumsy and inelegant, and he set about developing an entirely new mechanism. He began by arranging the pistons around and parallel to the drive shaft. He then attached a thick disc, referred to as the slant, to the drive shaft at an angle (usually 22.5 degrees). The slant also acted as a flywheel and therefore a separate flywheel was not required.



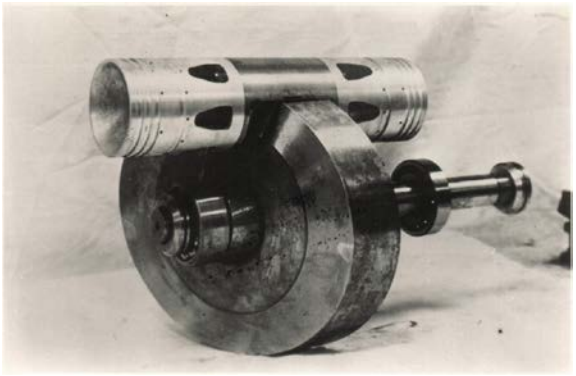
The crankless mechanism consisting of shaft, slant, and pistons

An important challenge was how to transfer the thrust from the pistons to the slant. To achieve this Michell used slipper pads, which employ the same technique used in his famous tilting pad thrust bearing.

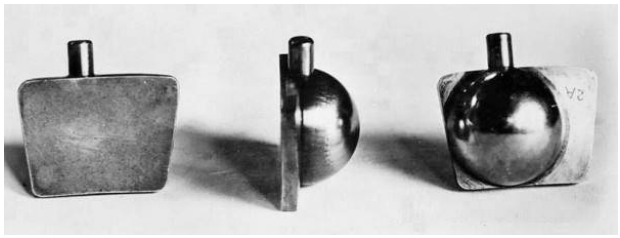
A tapered wedge of oil is established between the front face of the slipper pad and the slant, which eliminates metal to metal contact. On the rear face of each slipper pad is a spherical half ball, which fits into a socket on the end of the piston. His new invention did not have a crankshaft, so Michell called it the crankless mechanism.



A = slipper pad
B = slant
C= tapered wedge of lubricating oil between slipper pad and slant



Shaft, slant, and pair of pistons



Slipper Pads

Others had previously made engines of a similar arrangement, ie. with the cylinders parallel to the shaft (sometimes referred to as barrel engines). However, Michell made two significant contributions so that his invention was unique : (1) he used highly efficient slipper pad technology as the interface between the pistons and the slant (2) he conducted a detailed mathematical analysis on the mechanism to achieve dynamic balance.

The Michell crankless mechanism is the most efficient mechanism for converting reciprocating motion to rotary motion. The pistons undergo true sinusoidal motion, and the mechanism is in perfect dynamic balance at all speeds. This means that it operates without vibration. Michell obtained British, American, and Australian patents for his crankless engine.

Michell founded the company Crankless Engines Australia in August 1920, and shortly afterwards setup a workshop at 129 Greeves St in the Melbourne suburb of Fitzroy.

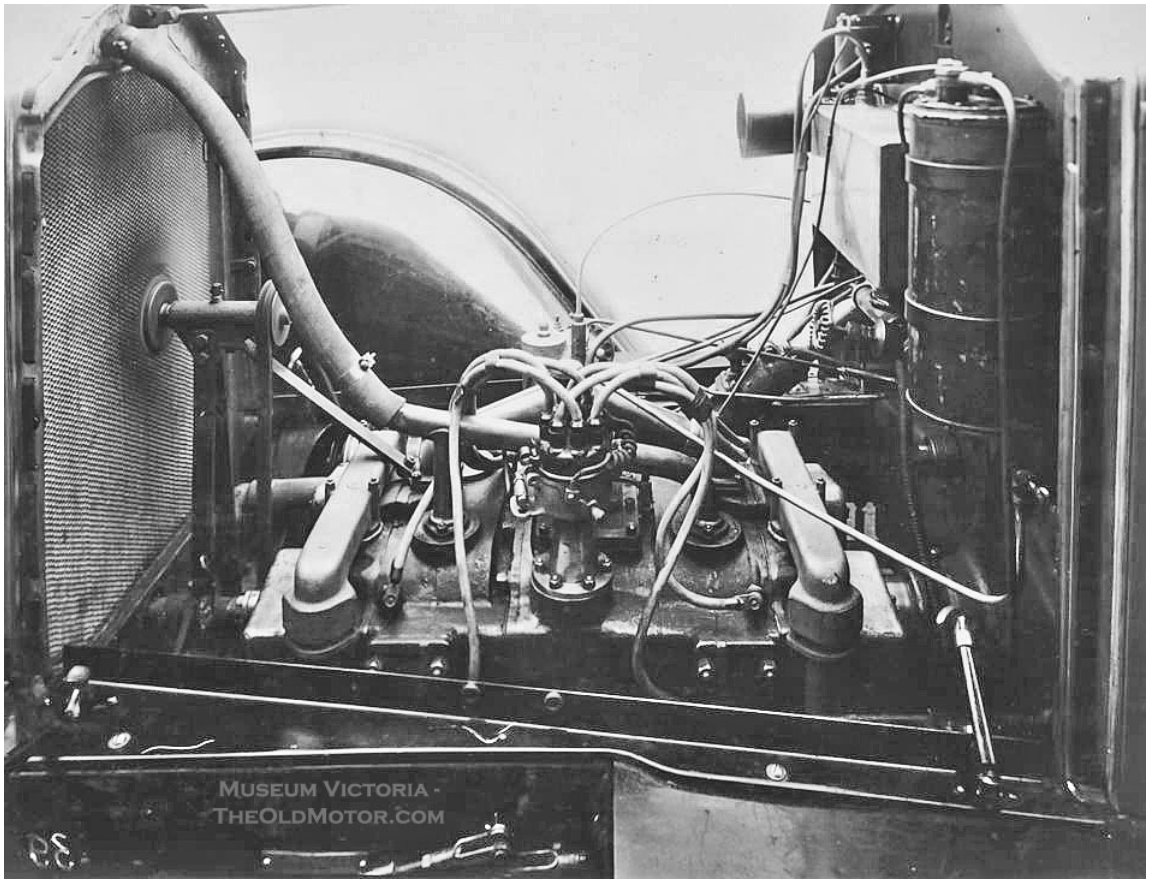
Louis Sherman was employed as Chief Engineer and was in charge of the design office. He was considered to be an outstanding and gifted engine designer, and was responsible for taking Michell's preliminary engine concepts and turning them into proper engine designs. Over the next eight years, the workshop manufactured more than 50 prototype crankless engines.

Crankless Engines workshop in Greeves St, Fitzroy

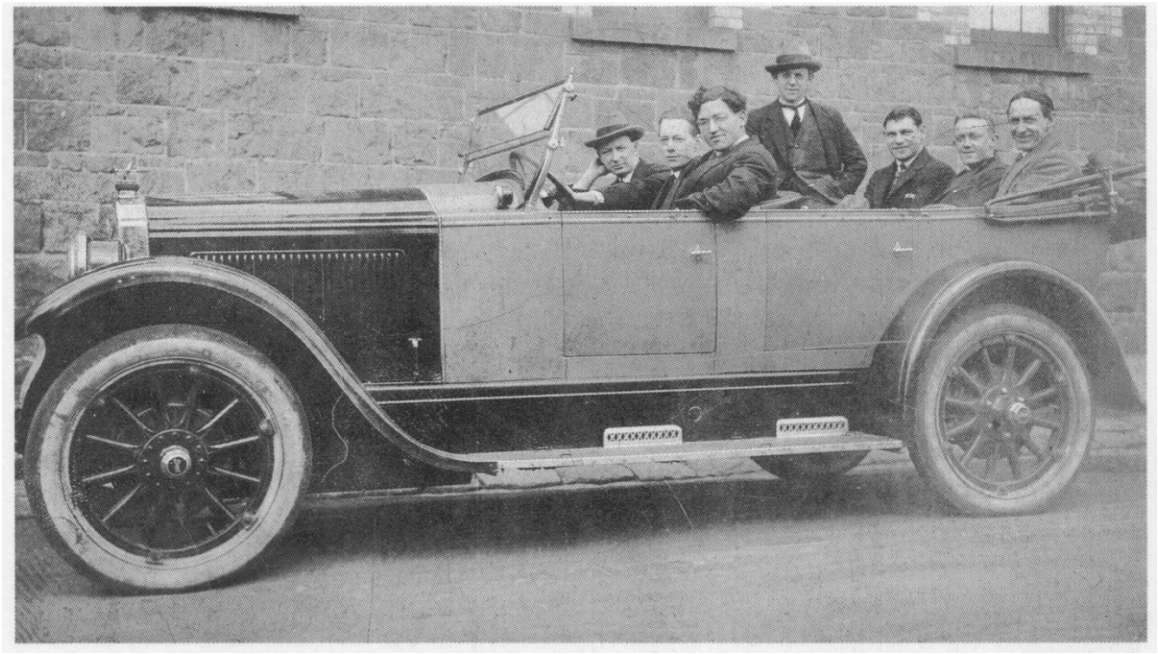
In 1923 Michell developed his first crankless car engine. It was an 8-cylinder petrol engine, with pistons of 3.31” (84mm) bore and 3.5” (89mm) stroke. It had overall dimensions of 20” (508 mm) height, 15” (380 mm) width and 28” (710 mm) length. With a total displacement of 4 litres, the engine produced 35 hp at 2,000 rpm and 64 hp at 3,000 rpm.

Pairs of cylinders were arranged back to back, and joined together with a steel yoke. The yoke carried the two spherical bronze cups into which the slipper pads were mounted and engaged with opposite sides of the slant.

Michell decided to test the engine in a car, and purchased a Buick for this purpose. The original Buick engine was quite readily removed, however several serious problems had to be overcome to fit the new crankless engine. Many of the controls had to be rearranged and a universal joint was added between the engine and the driveshaft.



8-cylinder crankless engine installed in a Buick

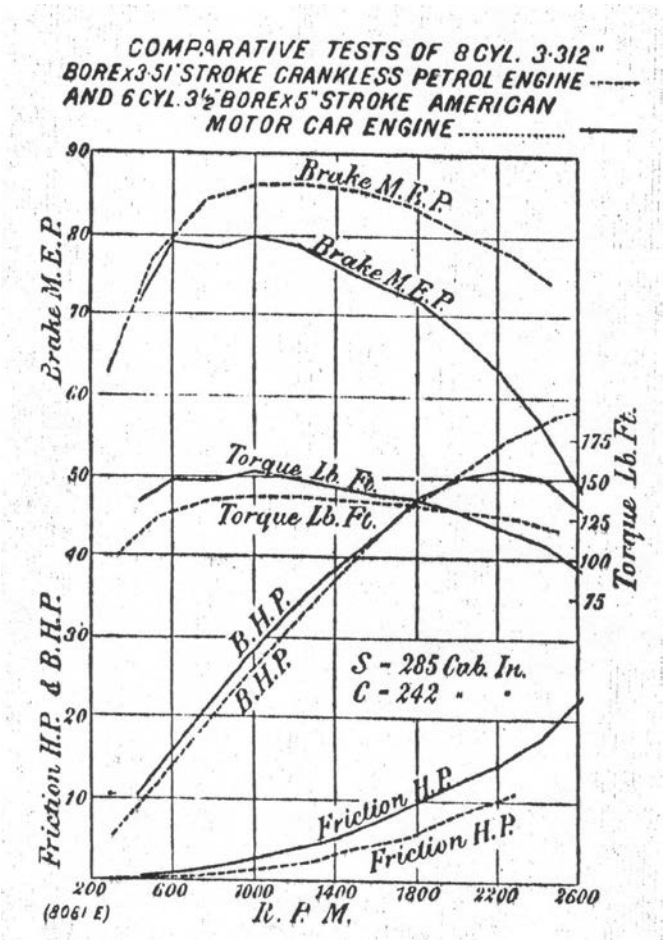


The Buick with its new engine going for a test drive

During the Easter break in April 1923 Sherman drove the Buick to Sydney, together with Vic Wilson (workshop foreman) and Norman Matthews (mechanic). The crankless engine performed extremely well, and they returned

to Melbourne without it having caused any incident. There were many long and isolated stretches of road between towns, so their journey in a car with an experimental engine was a daring adventure.

Following this successful field trial Michell shipped the car to the US, and arranged to show it to several car companies, including Ford and General Motors. The car was tested by General Motors at its research establishment at Dayton, Ohio and subsequently by Ford at its facility at Detroit, Michigan. Both companies confirmed that the crankless engine performed exceptionally well. Compared to their existing production models it was lighter, smaller, and had less moving parts. Furthermore, it was about 10% more efficient. These benefits were however not enough for them to adopt the new engine.



Performance test results comparing a crankless engine to an equivalent conventional engine :

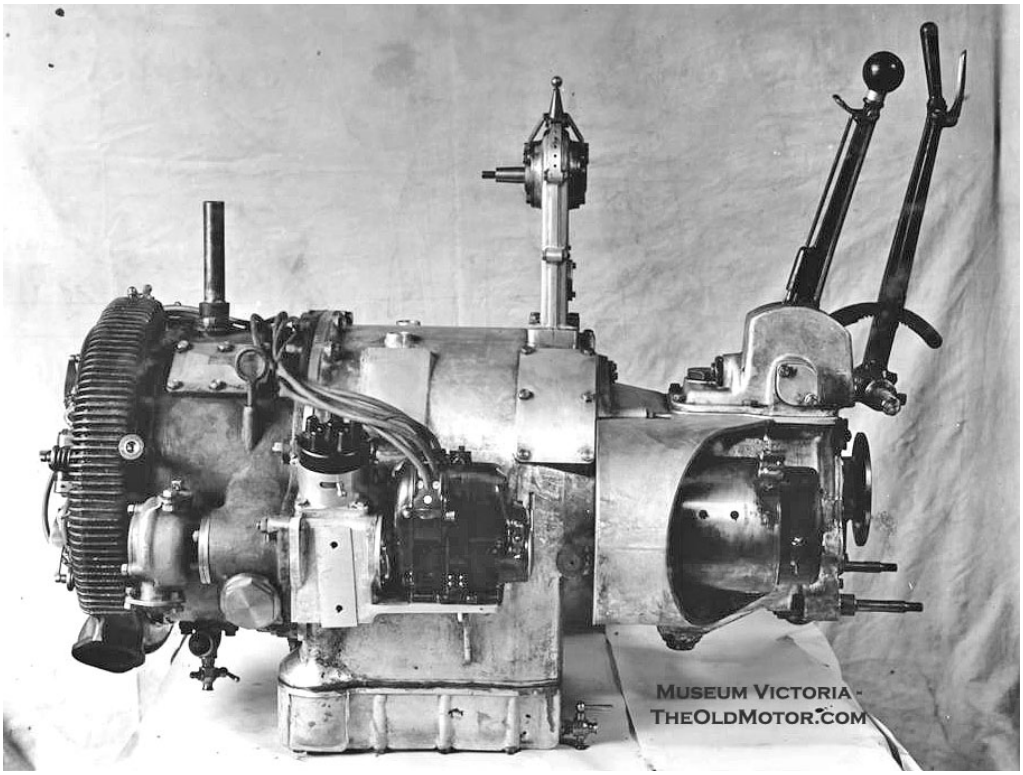
- *Brake MEP (Mean Effective Pressure)*
- *Torque*
- *BHP (Brake Horsepower)*
- *Friction*

About 50 years later this unique engine was finally returned to Australia. It is now on display in the foyer of the mechanical engineering department at Melbourne University.

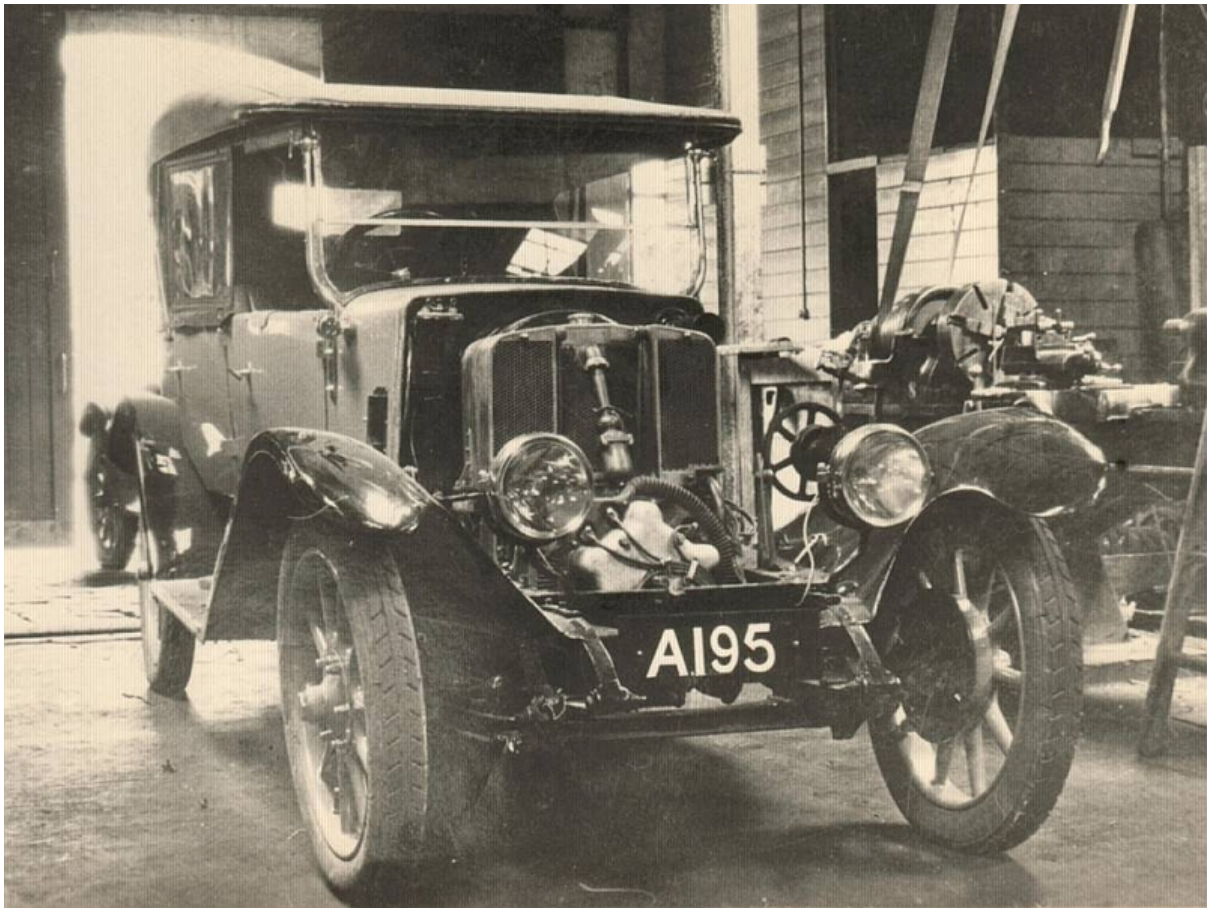
Both Ford and GM had expressed some serious concerns about the design of the crankless car engine. It was extremely difficult to access the rear-facing cylinder heads. Also, the even number of cylinders caused unbalanced flow of air/fuel into the cylinders, which resulted in the occasional mis-fire.

Michell concluded that these issues would be solved with a single-ended engine configuration, which had pistons only on one side of the slant and pointing towards the front of the car.

He developed a 5-cylinder car engine, with pistons of 2.82” (71.6 mm) bore and 3.95” (99 mm) stroke. Each piston had two slipper pads, one on each side of the slant, joined together by a bridge piece and attached to the end of piston. It had a capacity of 2 litres, and bench testing confirmed that it developed 23 hp at 1,600 rpm. Michell installed this engine into an Austin 12, which was a popular car at the time.



5-cylinder crankless engine



5-cylinder crankless engine installed in an Austin 12

To provide access to the front of the engine the workshop team mounted the radiator on hinges so that it could be rotated out of the way. The engine met all performance expectations, and was shown to several car companies with the hope that one of them would implement it.

Michell devoted 12 years to seeking commercial applications for his crankless engine, including four years while living in the US. Ultimately however, he learnt a bitter lesson: an invention, no matter how brilliant and effective, has no guarantee of success.

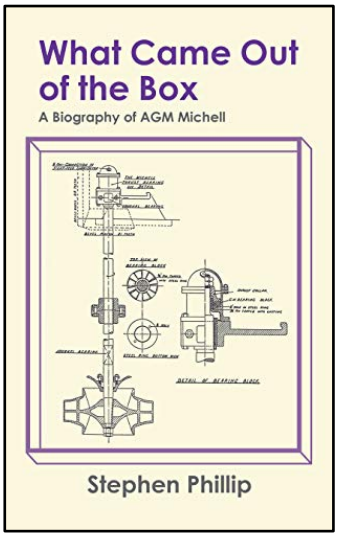
Michell closed the Melbourne office and Fitzroy workshop in 1928. It was not until 1946 that he finally conceded defeat and formally wound up the Crankless Engines company. Perhaps he clung to the hope that a business opportunity would eventually arise.

There were some small victories along the way, including National Gas Engines in England and Sterling Engines in America. Both of these companies produced modest numbers of crankless engine under license. Despite these

minor wins, ultimately Michell's remarkable engine did not enjoy the commercial success it deserved. This was due to several factors, including :

- the Great Depression was already looming by 1925 and hit hard by 1929. It devastated the world's financial system and left no money for investing, particularly on projects involving new technology and risk.
- conservative auto makers were unwilling to make the substantial investments necessary to take on the new engine. The performance gains from the crankless engine were not sufficient to justify it.
- companies were reluctant to be the first to adopt the crankless products, and wanted to see them already in use by other companies.

The Michell crankless engine very nearly caused a major revolution in the engine industry, and remains a vitally important part of Australia's engineering heritage.



This article is based on material from my book :

'What came out of the box – a biography of AGM Michell'.

It is available from Amazon Australia ($30.75 paperback) :

https://www.amazon.com.au/What-Came-out-Box-Biography/dp/0228820510/ref=tmm_pap_swatch_0?_encoding=UTF8&qid=1630967821&sr=8-1