

**Life as an Apprentice in a Suction-Gas Fuelled Power House, at Roma
(Queensland, Australia) c. 1950.**

J.W. Watson

1. The Vision

Looking back more than half a century, I can see the skinny 13 year old boy who was myself, stopping as usual on his way home from school He is standing astride his Malvern Star bicycle gazing through the big open green doors of the old Roma Power House in Mayne Street, Roma.

He is enthralled as always by the sight of the steadily spinning shiny flywheels taller than himself, he mentally notes which engines are running, watches the open commutators occasionally softly sparking under their rows and columns of carbon brushes, sees the salient pole alternators with their smooth slip-rings. He sees the brass and nickel and glass and shiny black zalamite of the exposed switchboards with their overhead copper bus-bars softly gleaming through the light misty haze. He hears and feels the rhythmic throbbing of the engines and the occasional discordant CLANG as someone inside drops something or steps on an ill-fitting steel chequer plate covering a floor duct. A magical place! He will work there one day!



**Photo 1. Roma Power House
(Author's new 1949 Velocette Motorcycle visible)**

5. The Machines

In the 1950's, the plant at the Roma Power House (since demolished) at Mayne Street consisted of four suction-gas engines of some 150 to 200 HP each, and three Commonwealth 200 HP wood-burning down-draught suction-gas producer sets, about which there will be more later. I regret now that I have no record of the model or serial numbers of all of the engines, although I do have some crumpled Kodak 6/20 Box Brownie photographs.

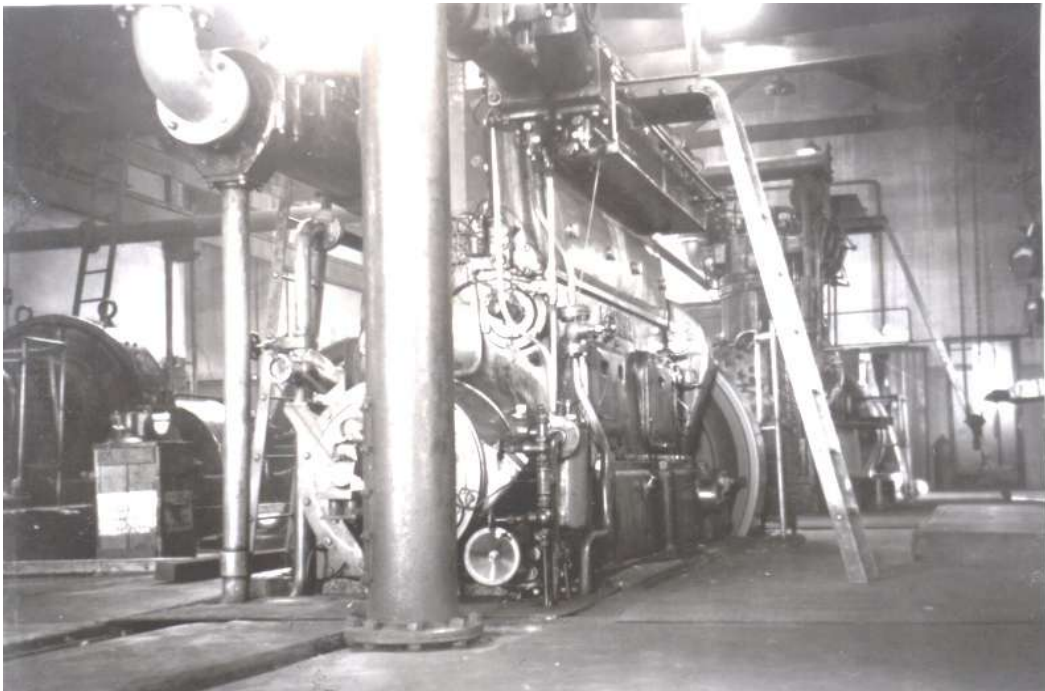


Photo 6. No.1 National Engine
The large vertical pipe in the foreground is the gas inlet



**Photo 7. No.1 National Engine
Dual ignition system visible
Note a vague picture of Crossley No. 3 rear left**

No.1 engine was a vertical four-cylinder National Gas engine Model FA2 (The “2” meaning two valves per cylinder) driving a “Lancashire” 240 volt DC generator at 428 rpm. She had a steel ladder on each side to gain access to the upper level. A quiet, clean and reliable engine, she was subject to violent pre-ignition when she didn’t like the quality of the gas she was fed. She had dual ignition; a small open 4-bladed knife switch could select either the Scintilla magneto or the car-type battery/coil ignition system. The drivers somehow learnt that she liked to have the knife switch blades slightly open; the resulting 1/8” gap seemed to intensify the spark at the plugs. She had an external “Streamline” oil filter. Her exhaust note had a distinctive “ringing” tone, especially after her valves were freshly ground. After the town was fully converted to AC, she was re-equipped with an alternator and her speed re-adjusted to 375 rpm, (50 Hertz) but she was never the engine she had been at her design speed of 428.

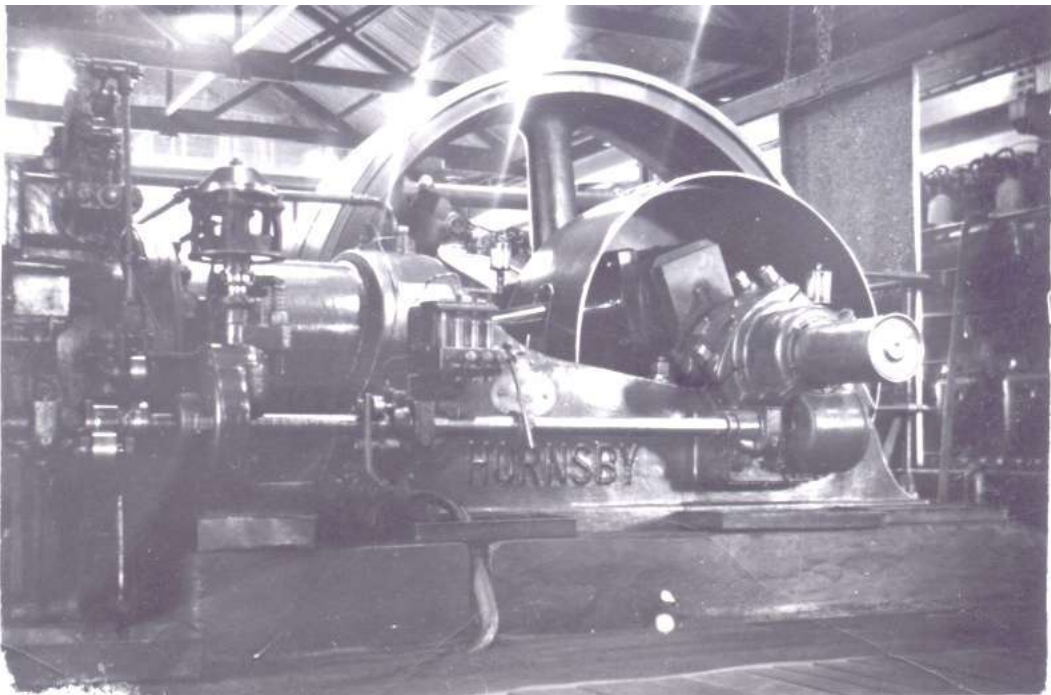
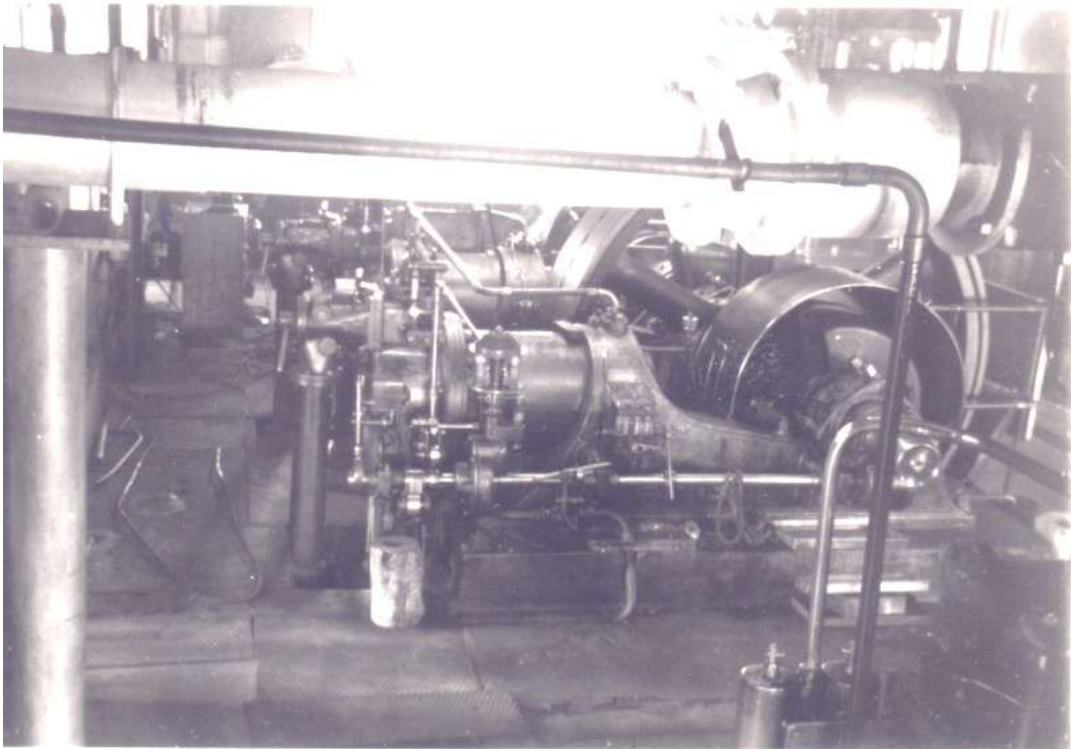


Photo 8. Two Views of No. 2 Hornsby Engine

No.2 engine was a majestic twin cylinder horizontal open-crank side-shaft Hornsby driving a handsome open 240 volt DC generator at 220 rpm, and was notable for an enormous flywheel between the cylinders. Each cylinder was in fact, practically a separate engine in its own right, sharing only the governor and the mechanical lubricator, thus being called a “Coupled Engine”.

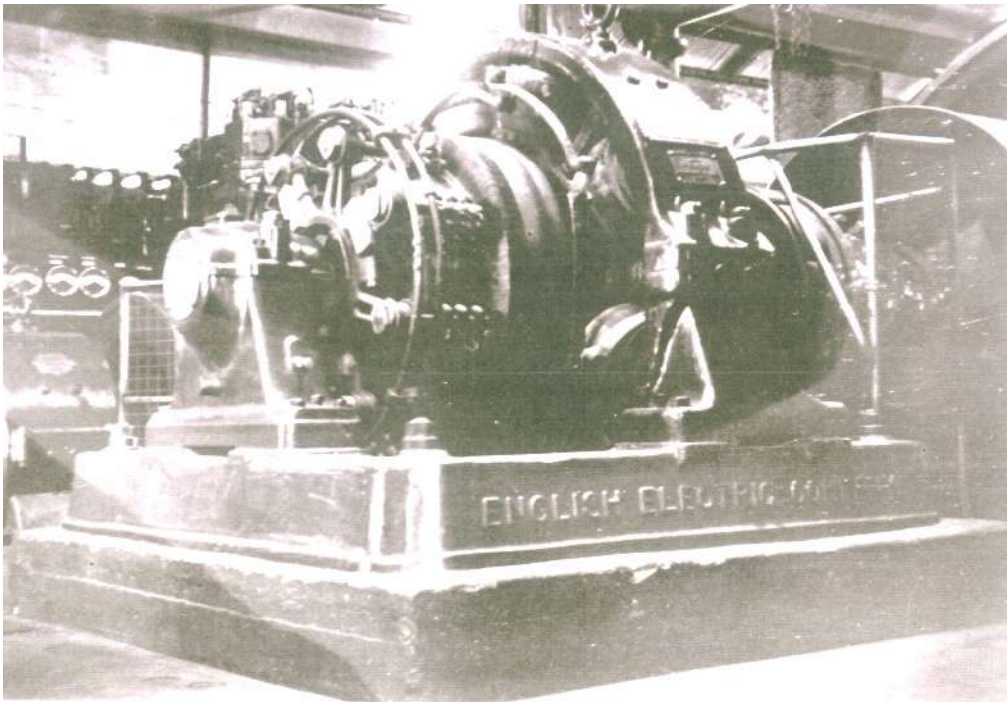


Photo 9. No.2 Engine's DC Generator

She and her “English Electric Dynamo” were beautifully painted dark green with rich gold transfers and ornate lining. She had low-tension trip-magnetos with a moving electrode on the ignitors.

I remember her as a reliable and favourite engine which once ran for 10 months continuously during a period of difficulty with other plant, No.2 was particularly prone to “reversing” if she lost power, more about which will be mentioned later. Her powerful steady “chuff chuff” exhaust note could be heard over a wide area, and those standing nearby could feel the concussion in their chest cavities. Loved by some of us, feared by others, but respected by all. Sadly, she was later to be blown up with dynamite and sold for scrap.

No. 3 engine (of which I have no clear picture) was a Crossley twin cylinder open crank engine driving a 240 volt DC generator, generally similar to No. 2, but on a smaller scale. Considered by the drivers to be a bit of a prima donna, pretty in appearance but with a nervous disposition and demanding attention to get the best out of her. She broke a crankshaft, perhaps due to a generator “reversal”, and was out of commission for a long time. She was eventually repaired, but was too small to be of much use. Her DC generator was later removed and mounted alongside the No.5 engine, belt-driven from it in addition to its own shaft-coupled AC alternator. No. 3 was later demolished to make way for a larger engine.

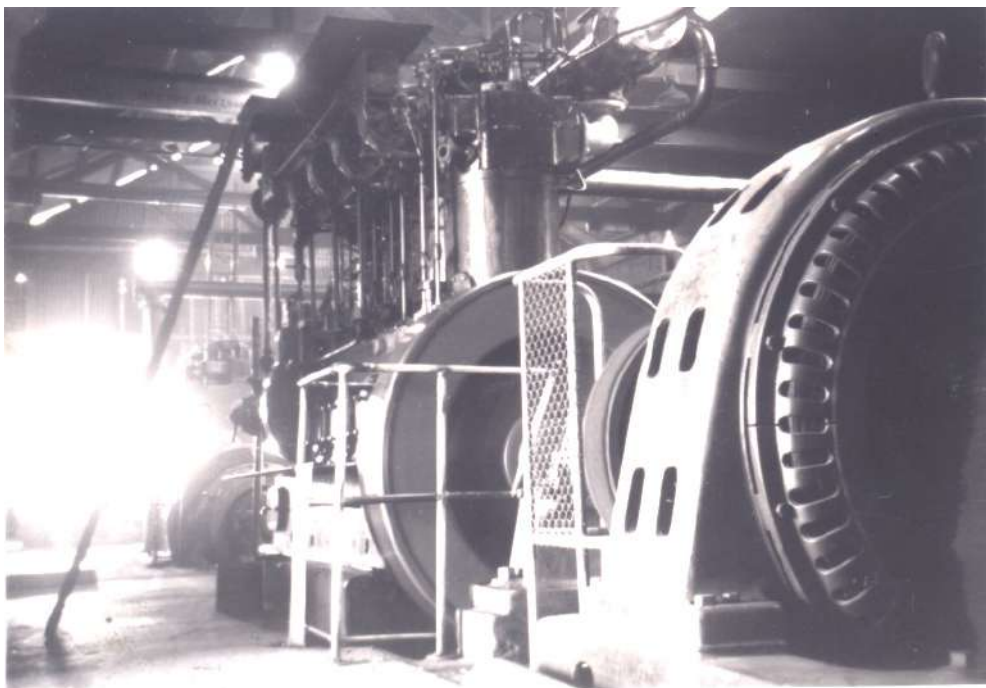
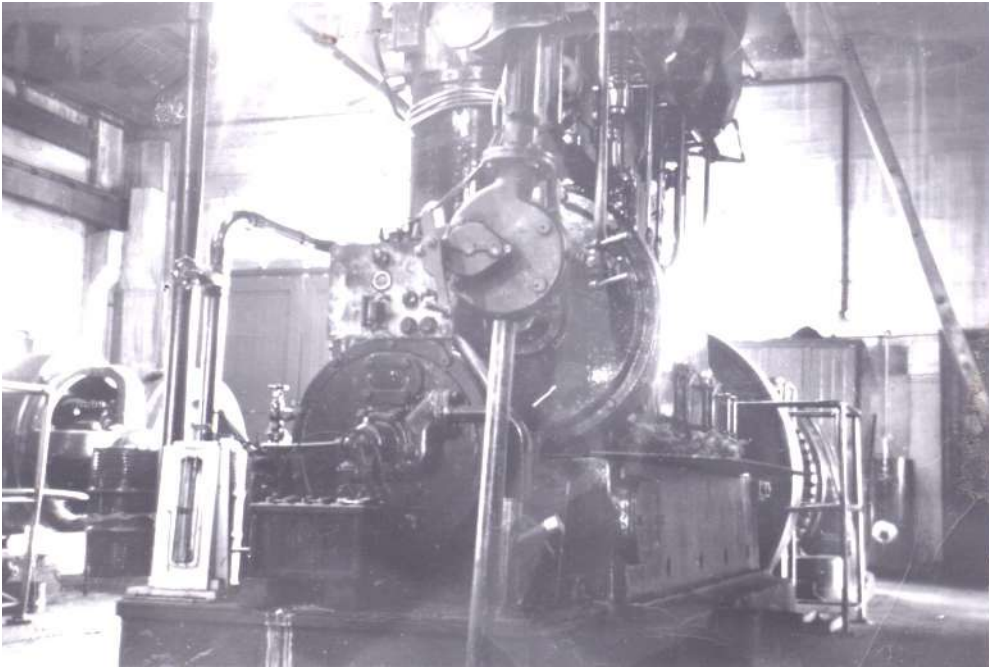


Photo 10. Two Views of No. 4 National Engine

No. 4 engine was a large four cylinder vertical National engine Model 13 x 14, (denoting bore x stroke), driving a 3-phase 240/415 volt AC alternator at 375 rpm. I understood that it was purchased second-hand from a butter factory in Armadale (NSW).

It was a temperamental engine unpopular with the drivers. He (never “she” for some reason) had twin high-tension BTH magnetos and two spark plugs the size of beer bottles per cylinder. A steel ladder gave access to two chequer-plate decks mid-way and at the top of the engine. None shed any tears when he was eventually demolished.

There was some suggestion later that the intake manifold had been incorrectly assembled upside-down when the engine was installed at Roma, resulting in a larger passage for the gas than for the air, but I cannot vouch for this.

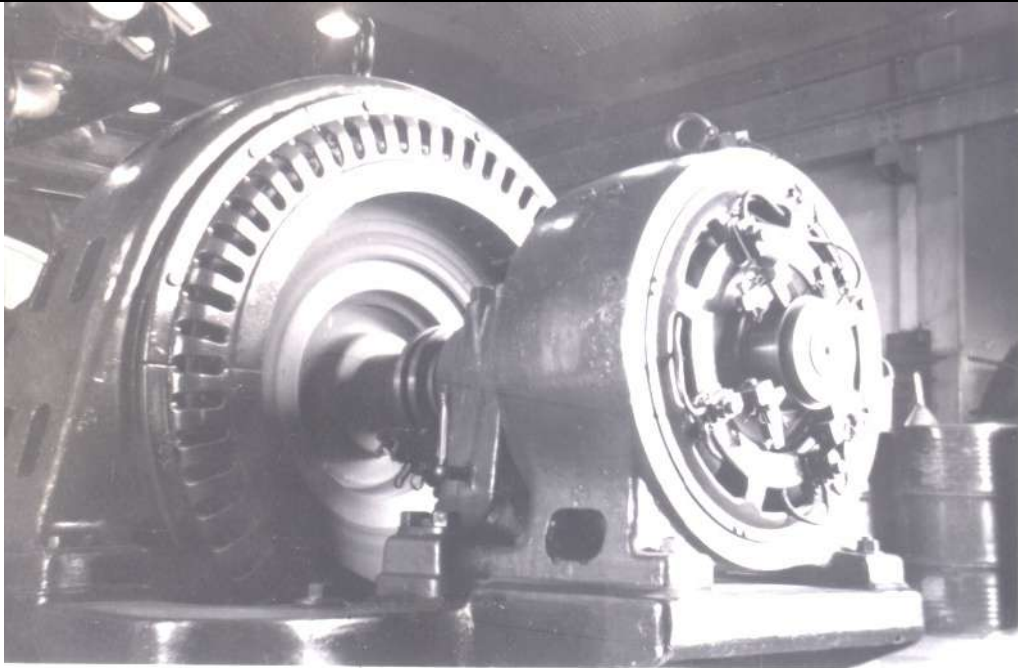


Photo 11. No. 4's Alternator

Then there was the “M.A.” (motor/alternator), a 240 volt DC motor/generator set of about 100 HP, driving a similarly sized 3-phase 240/415 volt “Weymouth” AC alternator/synchronous motor via a set of ten “A” code vee-belts. The MA set was installed originally to provide the first AC supply in Roma, for the new hospital when it was built in about 1946. With the steady growth of the AC load, the next engine (No. 4) was later installed. The MA could provide either AC or CD as required from the alternate supply, whichever side had spare capacity at the time.

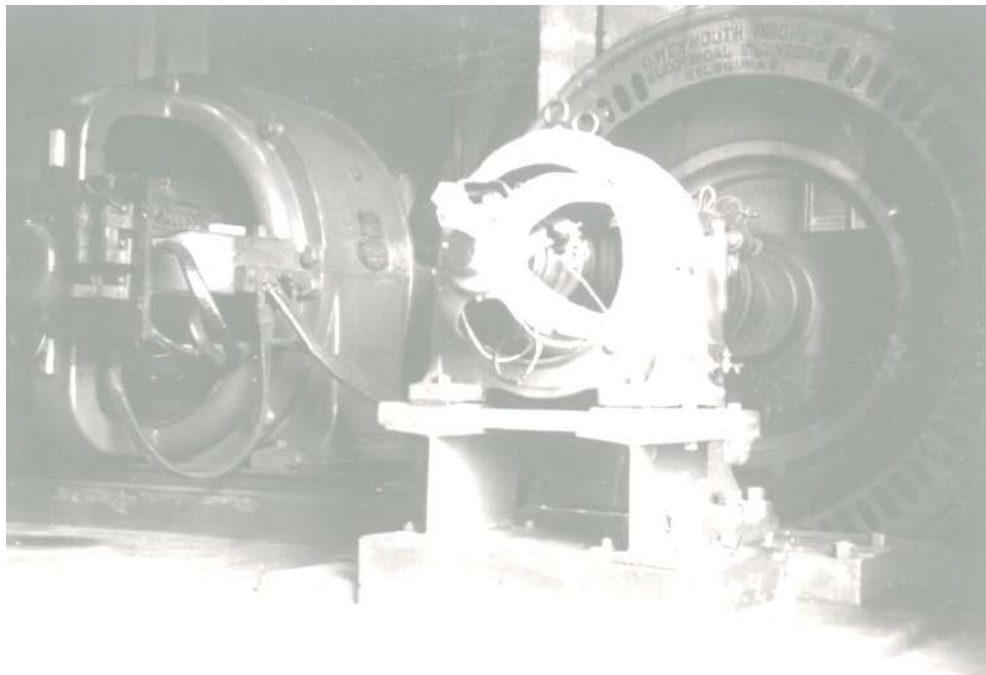


Photo 12. Motor Alternator (“MA”) Set

6. Ancillary Plant

There was quite a lot of ancillary plant for the engine cooling systems and producer scrubber water circulation, fuel supply, lubrication oil reclamation, compressed air starting systems and so on. We had our own sub-artesian water bore pumped up by compressed air.

7. The Gas Producers

Three down-draught suction-gas producers, or gas generators, fed the four engines through a common header pipe. Fuel for the producers was sawn “Ironbark” hardwood (*Eucalyptus paniculata drepanophylla*) blocks. To supply the wood fuel, a small sawmill was operated on-site by contractors. The sawn blocks were loaded onto steel skips (wagons) running on 24 inch gauge rail tracks. Each skip was loaded to 15cwt. (3/4 ton or 1,680 lbs.) Each block would have been about 18 inches in diameter and 18 inches long, and each weighed some 80 lb. when dry. There would have been on average about 20 blocks per skip.

The skips were hand pushed to the back of the powerhouse (over a weighbridge) by contractors each weekday and left adjacent to the turntable for the use of the night shift engine drivers. Firing was done by the power house labourer during the day shifts on weekdays, and by the engine driver and/or an apprentice on night shifts and weekends. Apprentices worked with the drivers on day and afternoon shifts six days per week.

8. Producer Gas

In small generating stations where the capital cost of steam turbines is prohibitive, diesel generators are now generally used. Because power houses for small towns are, at the best, marginally profitable, the capital cost and the cost of fuel must be kept low. In those days, much of the transporting of diesel fuel was by means of 44 gallon drums, which added to the handling cost. One solution widely used in Australia in the early to mid twentieth century to avoid the cost of diesel fuel was to install gas-fuelled internal combustion engine generators.

Note: The use of the term “gas” in this article refers to Producer Gas, not to gasoline.

Suitable gases include natural gas or the manufactured gases – these could include town gas (obtained by heating coke), gas produced as a by-product of blast furnaces, water-gas (or blue gas) obtained from the action of steam on hot coke, coal gasification from the action of air and steam on pulverized coal and carburetted gas obtained from cracking or enriching oils.

Another alternative is gas generated by various types of simple gas producer adjacent to the engine. Some of these burnt coal, charcoal, wood or even combustible waste such as sawdust, wood-chips or “begasse”, the waste fibre from sugar mills. Hardwood was preferable to the softer pines or fibrous material which burnt too quickly. These gas plants are similar in principle and action to the charcoal burning producers widely fitted to motor cars, trucks and tractors during WW2 in Australia and Europe.

When firewood was readily available in the district, many power houses installed wood-burning suction-gas producers. In later years when the supply of suitable wood diminished or its use became a concern, these plants fell into disuse and were replaced by diesel generators, and more recently by gas turbines fuelled by diesel or natural gas, when this became widely available.

In the Roma power house, wood-fired suction-gas producers were used from its inception in 1916 until the 1960's.

9. Constituents of Producer Gas

Wood fired producer gas typically consists of:

Combustible gas:

CO (Carbon Monoxide)	22.0%
CH ₄ (Methane)	2.4%
H ₂ (Hydrogen)	8.0%

Inert gas:

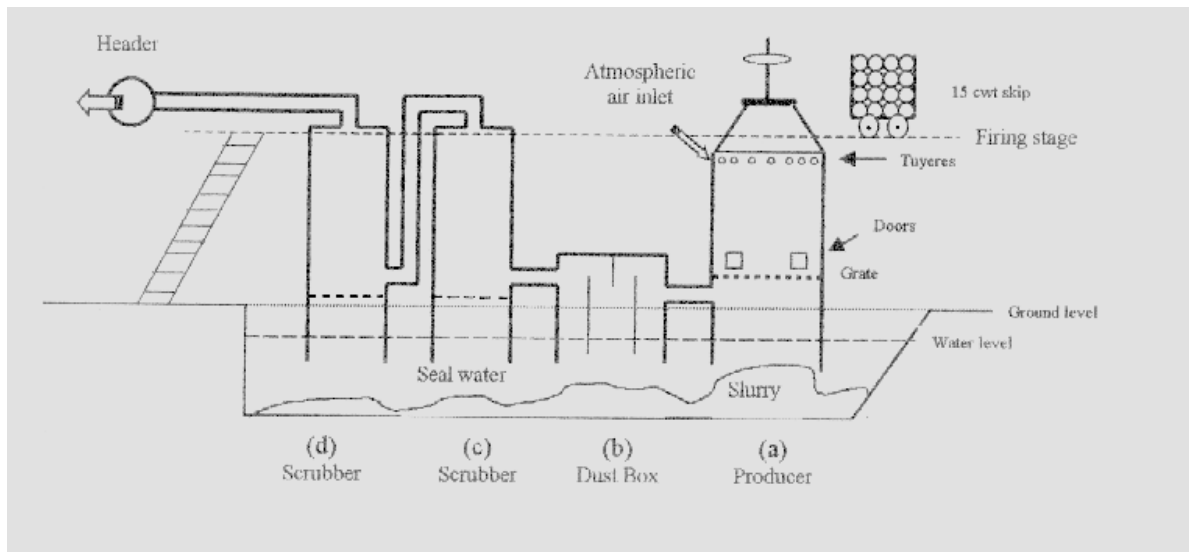
CO ₂ (Carbon Dioxide)	6.6%
N ₂ (Nitrogen)	61%

Plus small amounts of impurities - sulphur, ash, moisture, etc.

(Ref. "Standard Handbook for Mechanical Engineers"
Baumeister & Marks 1967)



Photo 13. Gas Producer Shed at Roma



Drawing 10.1 Gas Producer

10. Gas Producer Construction

Referring to Drawing 10.1, each gas producer set consisted of (a) the producer, (b) the dust box and (c) and (d), the scrubbers, all mounted above (straddling) a water “seal” pit. A firing stage was constructed above, where a set of 24 inch gauge tracks ran along the line of producers. A typical producer was a vertical steel cylinder lined with firebrick, about 6 feet in diameter and 15 feet high with a conical top of a further 3 feet high tapering in to an opening of some 30 inches in diameter.

A cast iron cover sat on top fitted with a handwheel and a swivelling bracket allowing the lid to be raised a little and swung aside for charging with firewood. The producer had a grate about 3 feet above ground level.

Just above the grate were four steel doors arranged 90° around the circumference, to allow periodic raking of the grate to clear the ash and clinker, if any. Fine ash normally fell through the grate into the seal pit, but quite a lot hung up on the grate, especially if any clinker were present.

The bottoms of the producer below the grate, the dust-box and the scrubbers, consisted of open skirts projecting down below the water level of the “seal”. The seal provided a safety valve in case of a “blow”, or internal explosion. Ash fell through the grate into the seal and formed a slurry which had to be shovelled out regularly. This was a daily duty of the power house labourer. When the engines were working hard, the seal water would sometimes rock rhythmically due to the suction pulsations.

11. Producer Operation

Again referring to the Drawing 10.1, atmospheric air entered the producer through a series of radial holes of some 1.5 inches in diameter about half way up, usually fitted with venturi-like “tuyere” tubes or nozzles (pronounced “tweeair”).

The producer was started by lighting it from kindling on the grate and progressively adding larger pieces through the top until filled. The lids and doors were left open until the fire burnt well, often overnight. During this period dense clouds of smoke were produced, to the justifiable annoyance of neighbours downwind, as the power house was in a residential area. Once the doors were closed and the producer on line, there was no smoke or fumes emitted except when being fired (recharged with wood fuel) every two hours or so, as the interior of the producer operated slightly below atmospheric pressure, hence the name “suction gas”.

Simply stated, the contents of an operating producer is in the form of a bed of incandescent burning material sitting on the grate and extending perhaps half way up the producer, and above this right to the top lay the progressively less consumed fuel zones where physical and chemical changes occur, up to fresh wood at the top.

In operation, the engines drew atmospheric air in through the tuyeres. This then passed down through the zones to the firebed where the available oxygen was consumed, leaving “producer gas”, produced by the heat of the partially consumed fuel. There being insufficient atmospheric air (i.e., oxygen) for the complete burning of the fuel, the oxygen-starved environment resulted in unconsumed gas, (mixture of combustible and inert) which passed down through the grate.

The very hot gas then exited the producer horizontally between the grate and the water seal via an open bottomed steel dust-box, which contained baffles. The gas then passed upward through the two scrubbers in turn. These consisted of steel cylinders some 5 feet in diameter and 15 feet high, containing a variety of filtering material, typically blocks of firewood, coke or even rocks and perhaps wood-wool at the tops. Water was sprayed down through the scrubbers to cool and wash the gas. This water then drained into the seals which constantly overflowed to an underground tank from where recirculating pumps returned it to the scrubbers through cooling towers. The “clean” and cool gas now passed to the header pipe, running horizontally the length of the powerhouse, to which each engine has its gas intake pipe fitted. Annually the scrubbers were opened up and the filter material cleaned or renewed. This was a dirty and unpopular job.

There was no provision for the storage of gas – the rate of gas generation was determined by the demand of the engines at the time and it was consumed almost immediately.

12. Firing up

Every two hours, the producers had to be fired up. This operation consisted of the operator pushing by hand a full 15 cwt. loaded skip across the turn-table to the hoist platform at ground level. He then climbed the steep wooden stairs to the firing stage, started (with the face-plate starter) the 5 HP DC electric motor, winched up the skip, pulled it off the hoist onto the top turntable, and pushed the skip along the tracks running along the line of producers. The operator then opened the top of each producer in turn via a rather hot hand-wheel and swung the pivoted heavy cast-iron lid clear of the opening which was not much larger than the diameter of the larger blocks. He soon learnt to stand back and wait a few seconds for the *whoosh* while a mini fireball erupted as a gulp of atmospheric oxygen was sucked into the inferno to combine with some gas and momentarily ignite. He would then throw in half a dozen or so blocks. Heavy work for an apprentice, especially when alone! I don't know why, but we never thought of wearing gloves! (Gloves were rarely worn by manual workers in Australia, even to this day).

He would be careful not to leave the top open for more than a few minutes or the engines would begin to pre-ignite due to the rich gas resulting from an excess of air being drawn through the producer. This usually happened when blocks got stuck, and he was unable to close the lid within a few minutes. Sometimes logs hung up within the producer, and had to be released with a long steel bar. The load would drop with a *whoomp* and a shower of sparks, causing the fire to collapse and resulting in all the engines beginning to pre-ignite and backfire due to a surge of rich gas. He would have to slam the top shut if possible, (it was frequently obstructed by a block of wood which failed to drop cleanly), run down to the engine room and adjust the gas and air levers on each engine, then when they had settled down, back to finish the firing.

Engine drivers tended to be lean and agile with callused hands and permanently singed hair and whiskers!

13. Driving The Engines

The Roma plant at this time consisted of one Hornsby and one Crossley twin cylinder horizontal engine and two National vertical four cylinder engines as described.

The intake manifolds of each engine were divided internally into two sections – air and gas, each controlled by its own master control lever. Governing was attended to by control levers and rod-coupled butterfly or flap valves within each cylinder intake port. The air section of the manifold was larger than the gas section, and each section had its own interconnected but individually adjustable butterfly. Air and gas did not finally mix until they were within the combustion chamber. The intake valves had double seats.

Each engine had its individual peculiarity and its own best setting of the master air and gas control valves, and this had to be learnt by the new drivers mainly by experience. It is difficult to teach this technique - learning this magic mixture setting is the black art of producer-gas engine driving. It differs for each engine, for starting and running, even for fine or rainy days. It differs with differences in ambient temperature and humidity, the weather, the moisture content of the wood, and even, we said, with phases of the moon or the engine's mood!

Pre-ignition was common, usually due to a rich gulp of gas when firing-up or from overload. In those days (the 1950's) most power-houses were grossly overloaded from the post-war growth of housing and industry and the difficulty and delay in obtaining new plant.

Pre-ignition could manifest itself from anything from a dull bumping sound to a series of frightening explosions, and when it could not be cured by judicious adjustment of the master levers, the cause was usually incandescent carbon within the cylinder or valve cage. It is the nature of a suction gas plant that the scrubbers fail to remove a lot of the tar-like material from the gas which carries over into the manifolds, valves and cylinders, leading to deposits of soft carbon.

The remedy – first decide which cylinder was the culprit, then run for your tea-mug, fill it with water, scramble up the engine ladder, disconnect the gas butterfly by removing its clevis-pin then close it, unscrew the brass plug in the air manifold and pour in some water. Usually this quenched the glowing carbon, or perhaps the cooling effect broke it away.

It added much to the drama of the moment and to the amusement of the proceedings (from the spectator's point of view) if you managed to drop the brass plug or the clevis pin, either or both of which loved to fall onto the chequer-plate with an alarming *CLANG* to further disturb your quivering nerves, and to roll away out of sight as you were sprayed with sooty water being spat back at you. The engine of course would drop some of its load onto the others, adding to the excitement.

The fun of driving gas-producer powerhouses lay in the total inter-dependence of all of the engines. When one engine became upset by rich or lean gas, they all joined in the game one after the other or all together, since they all sucked on the same gas header. After a period of steady running the state of brightness of the fires and thus the quantity and quality of gas produced would eventually settle down to satisfy the demand.

Merely starting or stopping an engine had to be planned like a battle. Starting an engine meant a preparation period beforehand of raking the fires to dislodge any compacted ash or clinker from the grates and pricking the numerous tuyeres (inserting a long steel rod and wriggling it energetically to ensure the incoming air had a fair passage) in an effort to brighten up the fires and enrich the gas. Later we installed a fan to help brighten the fires to induce a supply of richer gas before starting a new engine and we fitted a test jet cock which we could light and so judge from its colour the richness of the gas.

When the next engine was started, you could expect a period of lean gas until the status quo was re-established. The amount of gas generated was to a large extent automatically controlled by the demand of the engines, and this took some time to equalize. The same enriching procedure was necessary before the peak load time was expected.

Conversely, when an engine was stopped a period of rich gas could be expected for a while. The problem usually was compounded when a sudden unplanned stoppage occurred, or if a load breaker tripped due to a line fault or during electrical storms, upsetting the steady-state conditions.

In rainy weather, when the wood was wet, the engines seemed to run better. This was certainly more fact than just imagination. As well as the oft discussed benefit claimed to be gained by adding a small quantity of water to the intake air, it is a fact that water or steam injected into the producer itself is an essential part of the design of other types of plant, e.g. the "water-gas" referred to in many texts. However, this was not installed in the producers in Roma, where it was generally the opinion that the wood already contained moisture which would not be present in, say, coal or charcoal, and (rightly or wrongly) that in our case this would give short time calorific advantages against long term corrosion and rust problems in all parts of the system including the engine.

19. Historical Footnote

On October 16th 1900, natural gas was discovered in Roma during the sinking of a water bore (well) on Hospital Hill. After six years of debate and bitter argument, the town was reticulated for gas, but this was abandoned when the gas pressure mysteriously fell fourteen days later. In 1908, a disastrous fire occurred at a nearby bore and burnt for three months before being extinguished.

Although there were many later sporadic natural gas and light oil discoveries in the district, the extent of the gas field was not realised or exploited until 1969 when a 300 mile long pipe line was built to supply Brisbane with Roma gas. At one stage, at least one engine at Roma was fuelled by the light crude oil direct, untreated, from a local well. Additional “gas-cum-oil” engines from the closed Dalby power house were installed in Roma, operating from Roma gas. Gas-cum-oil engines start and run on diesel and can be adjusted to run on up to 90% natural gas. They use at least 10% diesel at all times.

The original power house in Mayne Street became known as the OPH (Old Power House). This was demolished and eventually the site was levelled after the NPH (New Power House) was established on the eastern outskirts of Roma, adjacent to the site of the old original aerodrome. Here new engines and later, a 2.5 MW gas turbine were installed, operating from local natural gas. The NPH which eventually had a capacity of nearly 18 MW operated successfully for many years until it too was demolished some time after it closed at 1.15 am on 8th May, 1986, much to the disquiet of the locals. Roma then obtained its electricity supply from the huge Tarong steam power house which supplied a State grid.

Ironically, to complete the circle, a large gas-turbine stand-by power station was recently built on the now vacant Roma NPH site, fuelled by Roma Natural Gas!



Photo 19. Author with Ford Freighter Line Truck c.1951