GARDNER

Engine Forum

Spring 2012

www.gardnerengineforum.co.uk

No. 21

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Gardner Engine Forum Philosophy

"The aims of the Forum are to promote and foster interest in all Gardner engines"

Subscription

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Forum Officers

Chairman: Mike Johnson
5 The Green, Wrenbury
Nantwich. Cheshire
CW5 8EY Tele 01270 780093

Secretary. Yvonne Crane
7 The Green Wrenbury
Nantwich, Cheshire
CW5 8EY

Treasurer: Judith Gray 29 Verity Walk
Wordsley Stourbridge West Midlands DY8 4XS
Tele 01384 827745

Membership Secretary: Joe McCool, Artasooley, Bendurb, Co Tyrone, Northern Ireland BT1 7LN
Tele 07802 572441

Editor-Webmaster:Steven Gray 29 Verity Walk, Wordsley, Stourbridge, West Midlands. DY8 4XS
Tele 01384 827745

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Cover Picture

LW Powered Locomotive
On the Cavan to Leitrim Railway
in Ireland
Photo by J Dickson

Chairman's Notes

The weather this winter has been far milder than 2011, when the canals of Britain were frozen over for about six weeks. Whilst writing these notes in late February the weather is almost spring-like, long may it continue as I have a fair amount of boat work to do when the stoppagescome off in early March. One interesting job has just today fallen on my desk, towing a 70 foot narrow boat from off the River Weaver up the Anderton Lift to a new marina at Tattenhall.

The Annual General Meeting has been arranged for Saturday 28 April 2012, 2.00 pm, at the Anson Museum (see notice elsewhere in this magazine). It will be interesting to see what developments have taken place since our last visit two years ago. If you have motions for the AGM please let the Secretary have them by 14 April 2012. Various members have contacted me regarding 2L2 and 3L2 cylinder blocks, cracked or porous; I have 2 6L2's with porous blocks. Could we debate casting some new blocks if demand exists, discuss! Your committee is considering having some sweatshirts produced with the Forum logo. Hopefully further information will be available at the AGM, where I hope to see you all.

Mike.

NOTICE TO MEMBERS OF THE GARDNER ENGINE FORUM
THE ANNUAL GENERAL MEETING OF THE

GARDNER ENGINE FORUM
WILL BE HELD AT

THE ANSON ENGINE MUSEUM
ANSON ROAD, POYNTON, CHESHIRE, SK121TD
ON SATURDAY 28 APRIL 2012 AT 2.00 PM

ITEMS FOR THE AGENDA TO BE WITH
THE SECRETARY, MRS YVONNE CRANE,
7 THE GREEN, WRENBURY, NANTWICH, CHESHIREC,58EY
BY 14 APRIL 2012

Gardner HF13

Visitors to our rallies will have seen the superbly presented HF13 ,
To celebrate its 70th birhday Cliff Noble penned the following article
which first appeared in the Stationary Engine Magazine .
It is reproduced here with the permission of the author

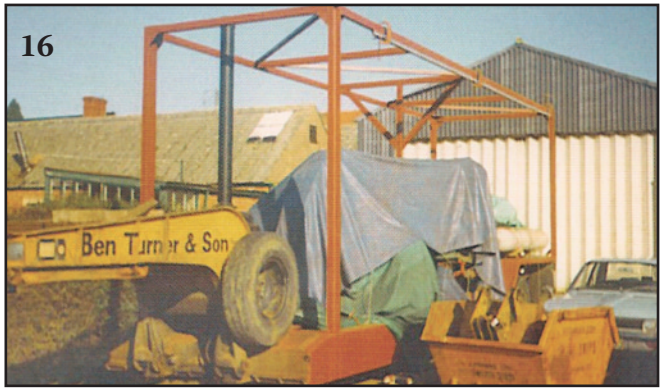
The story continues covering the work undertaken to make the unit mobile.

You might be wondering why it took so long to complete the Gardner. Our Social Club had a few members who were very interested in vintage farm machinery, and since the late 1960s we had acquired a collection of 12 tractors, ranging through the years from the Brown-Ferguson through to the Ford E27N. These had all been restored and resprayed, as had a suitable range of implements, which enabled us to give demonstrations of 'Farming through the Ages' at local shows, coupled with a Marshall threshing drum, and Dening wire tying baler, which was driven by Ivan Fear's portable engine. This collection was taken to between six to eight shows a year. Colin and I also had a collection of smaller stationary engines, with associated barn and farm equipment, which was all part of these shows. We had also acquired a number of large stationary engines, including a Ruston '0' oil engine, several stationary steam engines, a three-cylinder Petter Atomic, a Mirrlees single-cylinder air-blast engine and a National gas engine, during the period that the Gardner was restored and reassembled, having been given part of the site for our museum. You will understand our concern then, when in January 1987, the company announced that the rent review negotiations had been unsuccessful and the company would be moving, the premises having to be vacated by December that year. We had to dispose of the majority of the equipment as we had lost our storage and transport facilities, and also, although Colin was prepared to continue with the small engines if we could find suitable storage and transport, he could see no future for any of the large equipment we had collected. After considerable thought and having reflected on the efforts that had gone into the Gardner, I could not make the decision to part company with it, and with my share of the proceeds from the sale of our collection I purchased the plant trailer from the company and decided to mount the Gardner and make it portable. A lot of people were of the opinion that an engine of this size could not be mounted on a trailer as it would not be sufficiently rigid, but when you consider the reciprocating components are perfectly balanced, the only movement would therefore be fore- and-aft. The important thing would be to ensure that there was absolutely no twist in the vehicle chassis to affect the crankshaft tolerances. The trailer in question was a Tasker low-loader unit, built to carry 40 tons and had four 6in x 18in RSJs running through its entire length with a tare

weight of 12 tons, so I considered this would be sufficiently strong to avoid any twisting. Having made this decision, I went ahead, the total width of the engine across the crank was 10ft 6in, but by cutting off the end which projected from the camshaft drive case and putting the outrigger bearing as close as possible the next increased radius on the crank, I could get the width to 9ft 4 1/2 in, bringing it inside the legal limit of 9ft 6in to avoid the abnormal load restrictions.

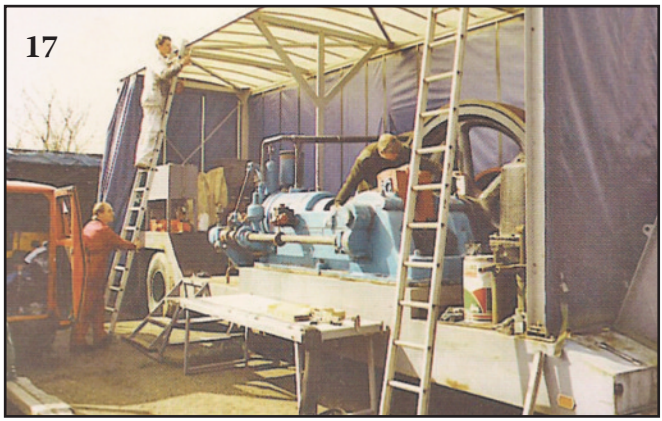
Given a dry weekend we took the floor out of the plant trailer, cut out two cross members to allow the flywheel to go through, made up a temporary frame from some 12in x 6in channel, tack weld hem to the chassis, lifted the crank out of the engine, out the bed on the trailer, put the crank back, checking and temporarily shimming the outrigger bearing on a block to protect the crankshaft line-up, packed all the associated pieces, radiator, air tank fuel tank etc, on the trailer and sheeted it down to protect it from the weather and left the concrete base for the future site developers!

As you can imagine this was heartbreaking work, but I was never again going to rely on anybody else for a site for the engine, and making it mobile had meant I could attend rallies, which would enable many more people to see and enjoy the 13HF.



Work on converting the trailer into a curtain sider had begun

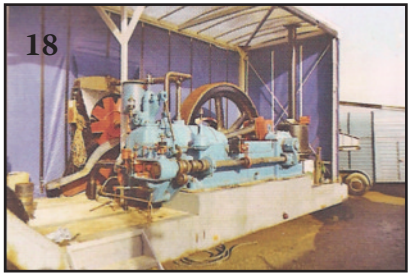
Photo 16 shows the engine in this condition, with the commencement of convening the trailer into a curtain sider, and when the structure work was done was done I then had to reassemble the engine to its properly made mounting bed, re-shim the outrigger bearing to the correct crankshaft settings. This was done having first levelled the trailer chassis perfectly in both plans clear of the ground;



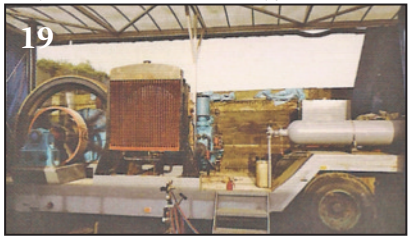
Work in progress

this would ensure that when set up level on a rally site the crankshaft would be correct.

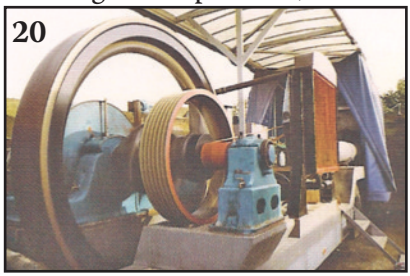
In **Photo 17** we see this work in progress, which commenced in 1988, progress was exceedingly slow to start with as I was working single-handed until my friend John Charman offered to come and give me a hand on Sunday mornings, which speeded the job up considerably and we made reasonable progress over the next two years. **Photo 18 and 19** show the progress that was being made, and by 1992 the engine was once again running, **Photo 20** but having been started by the rope around the pulley system, which allowed us to run the engine and prove the point that with the trailer perfectly level it would perform satisfactorily with a small amount of fore and-aft movement on its wooden packing blocks. The next operation was to complete the air-starting system, and having assembled the plumbing we found that the air-start valve was leaking under pressure, to the extent that the system was unusable. On investigation the seat in the head needed re-cutting. This seat is recessed in the head approximately 4in and with the valve housing removed we had to make a special adaptor to take its place, which would support a cutter to trim the seat. This took considerable time and expense as the 60° cutter had to be modified in length and the housing machined to support it correctly before the operation could commence. However, having completed this and lapping in the valve, it was successful and for the first time since we acquired the engine we were able to start it on compressed air, which was essential if we were to rally this unit. We then set about cleaning



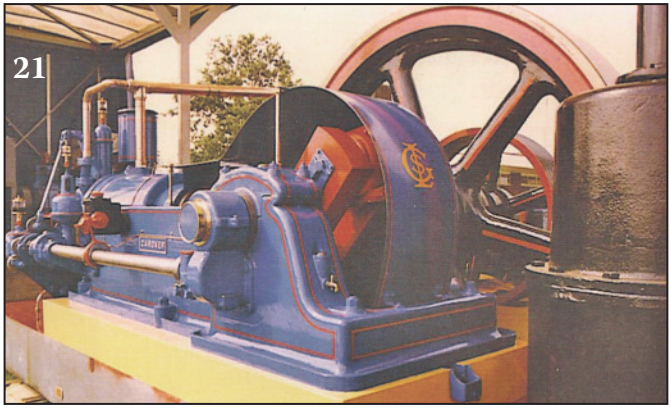
By 1992 we had the unit ready for a test run



The engine running viewed from the radiator side



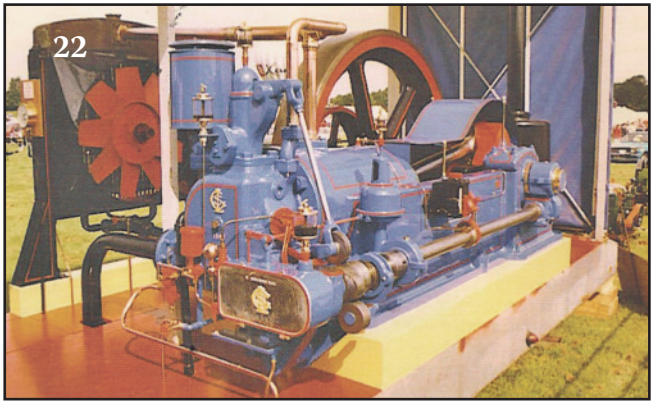
The test run showed that everything was in order



In 1994 after cleaning and painting,the unit made its rally debut

and painting, which had suffered considerably during its tarpaulin-covered days.

In **Photos 21 and 22**, we see the completed engine at its first rally in 1994, which was at Bromley where another good friend Julian, brought the Champagne to celebrate our success. **Photo 23** shows the unit packed up and ready to move off with a gross trailer weight of 28 tons!



I was very pleased with the response the Gardner received, It made all the hard work worthwhile

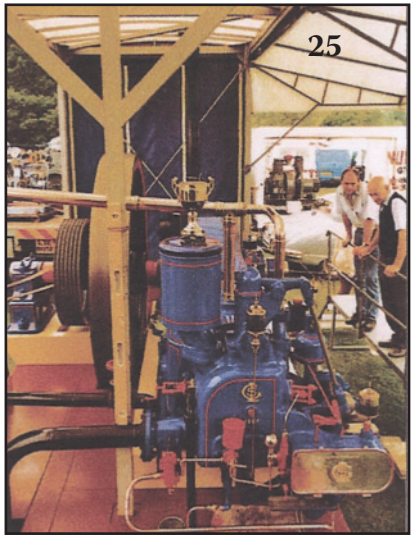
The unit with trailer weight of 28 tons,about to hit the road

So, another 10 years on and we now had a Gardner 13HF back in running order, in exhibition condition, totally mobile and independent. Needless to say, we were extremely pleased with this achievement and John was made a legal partner in the engine as a reward for all his hard work and support

We attended a few local shows in 1994 to iron out the bugs in the system and soon found that jacking the trailer up with hydraulic jacks, although satisfactory on hard standing, was no joke on wet uneven sites as we had to have large 1/2 inch

The unit as exhibited at the 1995 Gardner rally

thick metal plates under the jacks to prevent sinking, but the principle of getting the trailer perfectly level to protect the true running of the crankshaft worked well. We decided that a walkway was necessary as with trailer-mounted engines the public need to be at engine-room floor level to be able to look into the engine and appreciate its operation. The walkway was made up of three metal trestles with locking pins and fixed rails, and again this worked well on a level site, but on uneven ground was difficult as it had to be level and in a safe condition for anything up to 20 people to be on the platform at anyone time. At the end of the shows, all of the outside equipment had to be loaded into the neck of the trailer, and the trestles and steps, all made out of steel, were quite heavy! We also added a canopy as in wet weather the water dripping from the edge of the roof fell straight onto the camshaft and filled the bearing boxes up with water. This was a bonus for the spectators as it also covered the walkway and kept them dry in adverse conditions.



The engine at the 1000 Engine Rally
It won the cup

Our first show in 1995 was the Gardner Rally held in the Riverside Park at Nottingham. **Photo 24** shows the set-up at that show, with the walkway. This was a very interesting rally, with all types of Gardner engines present. The Managing Director of Gardners came along and asked if he could have a photograph of Japanese Trade delegates taken alongside the l3HF; he said "I never knew the company made engines like these". From there, via sponsored transport, we attended the Tatton Park 1000 Engine Rally; the year of Gardner Engines, and came away with the cup **Photo 25** Unfortunately, running a rig like this is not only about maintaining the engine; the trailer falling into 'special type . (as it cannot be used for commercial purposes) is exempt from MOT, but obviously it is our responsibility to maintain it in a safe condition, and to this end **Photo 26** shows the reconditioning of the brakes on the trailer in 1996, and the work involved stripping and rebuilding them. As mention in my previous Tangye article, transport by this time was becoming extremely difficult, and so a decision was made to purchase our own unit. Naturally this had to have a Gardner engine, and in 1998 we purchased an ex-Fountains transport ERF C32 unit fitted with a Gardner 6LXCT Turbo engine serial No 233309 of 1983. The engine was

Reconditioning the brakes

reconditioned with genuine Gardner service-exchange blocks, cylinder-heads and injectors, with new pistons and big-end shells, and despite the 430,000 kms on the clock the bottom end was perfect, with no ovality whatsoever on the big-ends and no lift on the crankshaft, the quality of Gardner Engines was without question.

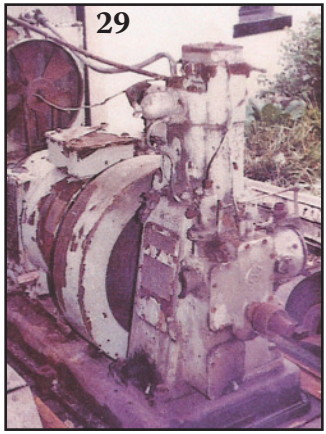
The unit on its return from the spray shop

Having completed our overhaul, a colleague of mine agreed to paint the unit, but on the way to the spray-shop we experienced out first problem when a serious leak developed on the fuel tank due to corrosion from the packing strips of the tank band straps and this had to be repaired before the painting could be completed. **Photo 27** shows the unit on its return from the spray-shop. When we reconditioned the engine, Peter May of Mays Motors, our friendly Transport Contractors, had run a Fleet of Atkinsons with Gardner 180's advised that when overhauling Gardner engines always change the radiator core. We looked very carefully, but could see no reason to do this as it was not leaking. However, in 2000, on our first outing with our re-conned unit we had only done a few miles before the revs began to drop and Tony was forced to pull onto the motorway hard shoulder. A partial seizure has been caused by overheating! Mays Motors overcame the problem with another unit, and after ours had cooled down it was returned to the depot and the heads removed. Fortunately no damage has been done, so we removed the radiator and made an adaption nozzle for our pressure washer to test the tubes in the dismantled core. Only 11 of the many tubes were free-flowing, the rest were either restricted or totally blocked due to internal corrosion. Another lesson learnt the hard way; there is no substitute for experience! A new core was obtained and fitted and following re assembly, no further overheating has been experienced.

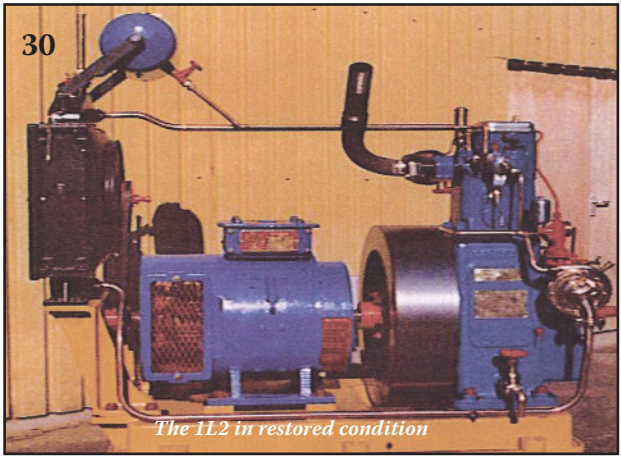
The unit is a 36 GTW configuration weighing 5.6 tons with 28 tons of trailer behind it. It works hard, and although Tony can overtake units with limiters on the flat, they all seem to pass us when going up hill, but its performance is perfectly satisfactory and its servicing and maintenance costs are negligible, due to the Gardner reputation of quality engineering. Following Tony's dedication to driving and working on the lorry and trailers, he was made a legal partner at this point in return for all his support and assistance. In 2003, we were approached by the "Commercial Motor" to request the use of our unit in an article testing 1980s trucks on the test track at Chobham **Photo 28.** A short quote from the test results

"The ERF's performance on the flat, top speed somewhat in excess of the current motorway limit was achieved with relative ease. Thankfully the brakes are strong and progressive and, having been recently overhauled, the steering was impressively tight and accurate; well up to modem, new truck standards, just heavier. "

In 1995 the Stationary Engine magazine was advertising a Gardner IL2 generator set, and having become addicted to Gardner quality engineering, a phone call secured the engine, which was located in Manchester, and the following weekend a trip to my eldest son in Southport engineered its

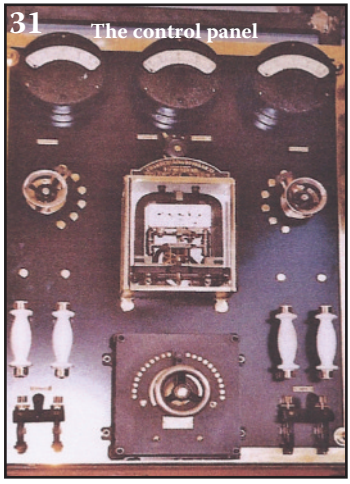


The 1L2 gardner with dynamo was added in 1995



The 1L2 in restored condition

collection.**Photo 29** shows it loaded for the return journey. The engine was one of 12 Marine Auxiliary Units shipped to Gardner Diesel Engines, Vancouver, in 1935 for the Canadian Pacific Coast Steamship Company serial No 33022. This is quite an early engine with a round section con-rod and a cold start device involving a spirit tray under a hole in the inlet manifold. The unit was completely overhauled, including the dynamo, and following the overhaul and rebuild fired on its second compression stroke after dropping the decompression lever, and has never failed since. **Photo 30** We set about modifying the trailer to accommodate this unit by moving the fuel tank and mounting the IL2 over the rear axles; following later by the control panel **Photo 31** which was reconditioned and assembled by Tony Harcombe. Unfortunately, this has not been wired in yet, but will be completed, and makes a very interesting addition to the exhibit. This was done in time for the 6th Gardner Rally in 2005 at Manchester, along with the new' fold-up' walkway with electric winch, which made life a lot easier at the end of a show. (To be continued)



GARDNER 13 HF – NO: 51758

BUILT: February 8th 1941 to Order No: 8082

SUPPLIED: March 3rd 1941 to Sir Robert McAlpine & Sons Hayes Works c/w OVC. Compressor No: 46851, where it supplied compressed air to their extensive construction machinery plant repair workshop.

H.P: Max. 98 at 240 r.p.m. normal running 74/84 at 210 r.p.m.

BORE: 14 ½" **ENGINE WEIGHT:** 12 ½ tons.

STROKE: 24" **TRAILER & FRAME:** 14 ½ tons.

FLYWHEEL: 90" x 12" **FUEL:** Diesel or Heavy Oil

PRESERVATION: Acquired in 1971 through the good offices of Sir Bill McAlpine, at the close of the Hayes Workshops, and set up on concrete base at Sendmarsh Works, Ripley, Surrey in 1982/3. These works closed in 1987 and the engine was dismantled again. A decision was then made to mount the 13 HF on a trailer to avoid any further site problems!

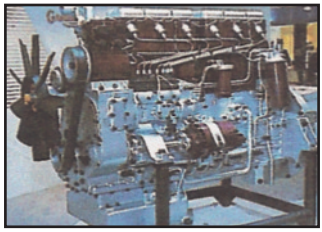
A suitable trailer was purchased and converted to "Curtain Sider" for total weather protection and reassembly commenced again. Many problems were experienced with a project of this size not only with the engine, but also with the trailer.

Owned by:-

C.E. Noble – Ripley, Surrey Tel: 01483 224710
J Charman – Wormley, Surrey
A.C. Bowman – Woking, Surrey

Gardner: a tale of technology

For most of this century Gardner was at the fore front of diesel engine



manufacturing. Now its up for sale,having failed to adapt to the hi-tech,high power demands of the nineties

Last week *Commercial Motor* revealed that Perkins is to sell Gardner, the 124-year-old Manchester engine manufacturer it bought from Hawker Siddeley in 1986. Like many British firms, Gardner's mistake was not adapting to a changing market. As computer technology became all-important in diesel engine development, and customers demanded ever more performance, Gardner was still relying on traditional hand assembly skills and one-off matching of component tolerances. For Gardner to have kept up with the pack in the relentless drive for more horsepower would have required a far greater R&D budget than the dwindling output of engines from Patricroft could support. By the 1970s a sad spiral of decline was in train. When Gardner engines led the field in durability they relied on components being lightly stressed. When governed speed was lifted above 1,700rpm on the first 6LXB, engine life expectation and fuel economy started to suffer. Turbocharging helped keep fuel consumption competitive, but the major upgrading in specification needed to retain the marque's traditional high mileage reliability was repeatedly postponed for lack of funds.

Soon after its 1977 takeover engines of Gardner,from its Shrewsbury Hawker Siddeley finally sanctioned a major redesign. Bore and stroke increase to raise swept volume double-from 10.45 to 12.7 litres in the 6LXDT engine. And a wholly new design, the 6LYT, took the company into the 260kW (350hp) class. Both new engines proved to troublesome, the 6LYT option especially so, which tarnished Gardner's reputation among the many loyal users, most of them similarly devoted to ERF, Foden the or Seddon Atkinson chassis.

In the less stressful environment of bus operation the 12.7 litre model - renamed the LG1200 in its 1990 version proved

Gardner: a history

1868 L Gardner & Sons founded.
1925 Two-stroke diesels on trial
1929 Direct-injection (four-stroke) diesel pioneered.
1930 First automotive application, 412 diesel, in lancia bus.
1931 First engines designed for rood vehicles - the 4l LW and 6LW - with unique weight-saving alumini crankcases.
1958 cylinder bore enlarged to make best-selling 10.45-litre 6LX.
1966 Power raised from 112 to 134kW (150 to 180hp) in faster-revving 6LXB.
1970 Eight-cylinder in-line 17,9kW (:,240hp) BlXB.
1977 Gardner acquired by Hawker Siddeley Group.
1980 12.7 -litre 6LXDT and 15;5.;;litre 6l YT introduced.
1986 Perkins buys Gardner.
1990 Improved 12.7 -litre lG 1200 launched.

more dependable and customer demand was maintained. But for the past few years profits at Patricroft have come from engine reconditioning rather than the paper thin margins of new engine building

Like many British firms, Gardner's mistake was not adapting to a changing market in the 1980's

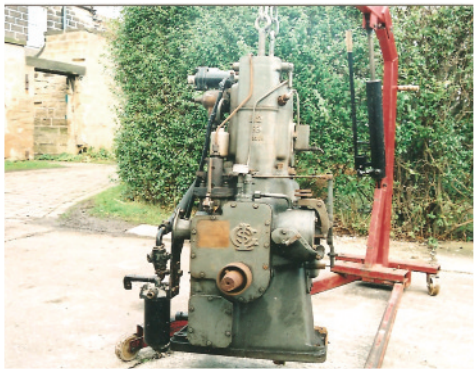
At first reconditioning was sub-contracted to Bus Engineering at Chiswick, west London, but when its profitability became apparent it was moved into Gardner's by then underused main factory at Eccles, Manchester. It is clear that engine reconditioning as a prime revenue earning activity is not seen to fit into Perkins' corporate strategy. Gardner is selling about 250 new engines a year; nearly all to bus operators. Perkins would obviously like those customers to switch to 12-litre Eagle from its Shrewsbury division. But the buses those Gardners are powering are Dennis Dominators and Dragons, and Volvo Olympian double deckers and to date Eagles do not fit these models Volvo will Undoubtedly try to exploit this situation by seeking to convert Olympian customers to Volvo power with its 9.6-litre TD102/3 diesel. The only other is Cummins' ubiquitous L10 engine which, like Volvo, is smaller than either of the Perkins group contenders. Should Gardner become purely an engine reconditioner, as seems possible under new ownership the-main beneficiary would be Cummins, whose 10- litre bus engine weighs about the same as the 6LXDT. It is a good deal lighter than either the Eagle or the Volvo. Not so long ago Gardner's advertising featured a quote from the *Financial Times* which described it's diesel as "legendary"!

Nearly all new Gardner engines go to power PVCs.

How times have changed.

Originally published in Commercial Motor 27 August-2 September 1992
Thanks to member P Comber for supplying a copy of the original article

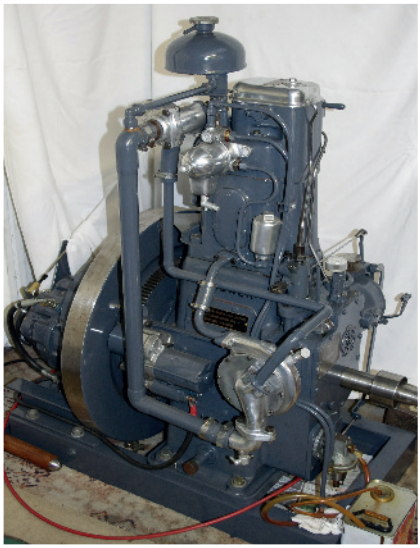
The Light of Day Again



Yet another Gardner engine comes to light having been in hibernation at the back of a storage container for a number of years. It's a laboratory engine model 1L2 rated at 16hp when running at 1600 rpm. This engine numbered 164527 was advertised in the spring 2010 newsletter, its owner had big ideas of marinising it and installing it in a small narrowboat, this never came to fruition and was eventually sold on,its fate unknown. Prior to this it had been in safe keeping and its true history then becomes very vague. One thing for certain it hadn't been running for very many years .When I set my eyes and hands on it, the engine turned over nice and freely but then what does one expect with no compression, Basically it was almost "all there" though in a very dirty and rusty condition as you would expect. So really all that appeared to be required was a little T.LC

Partial dismantling proved that its guts were in excellent condition except for the injector pump and injector sprayer. This was all stuck solid due to the fuel going nasty. How many years does it take being undisturbed for diesel to get in this solidified condition?. One might wonder. could it have been some kind of experimental fuel, I don't know it certainly smelt horrible.

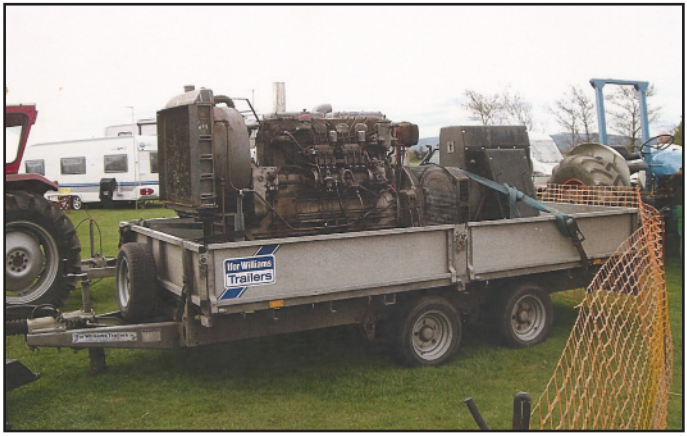
Anyway all the fuel system has been stripped down for carefull examination and through cleaning. This is one of the benefits of Gardner injection, it is relatively easy to diagnose troubles and undertake their rectification. Having completed and tested the sprayer (beautiful) the engine is now in perfect running order. It is painted in a deep charcoal grey colour, wether this shade is correct or not is open to discussion



My intention is to fit an original Gardner base plate with pedestal bearing block so as to drive a dynamometer. It can then be presented as a true working exhibit. Considering that the engine was built in 1968 one wonders if its ever done a full days WORK, I very much doubt it!

P J Freakley

Gardner Powered Equipment



6 LX powered Genset

4 LW ? Powered Fordson Major Tractor. Is this the only agricultural tractor with a Gardner power plant?

Genset and Tractor seen at the Balado Steam and Vintage Rally Near the to Kinross

4 LW powered Locomotive

At Drumod on the Cavan to Leitrim Railway in Ireland.

Photographs courtesy of John Dickson

Continued from Newsletter 20

GENERAL DESCRIPTION (*continued*)

Connecting Rods (*continued*)

that there is nothing to determine the position of the rod relative to the centre of the gudgeon pin. This is quite true when the engine is at rest; but a little reflection will suffice to show that, as soon as the engine begins to turn, the rod automatically adjusts itself so that the line of rolling contact is always in the same place for any one assigned angular position of the rod. In other language, as soon as the engine begins to turn, the rod automatically locates itself so that the key rolls to and fro through an equal distance on either side of the centre line of the rod.

It will be understood that the relatively small arc of roll permits our fixing the gudgeon pin in four different angular positions in the piston, a quarter of a turn apart, thus providing three fresh arcs of rolling contact. This is done partly because it is so easy to do and partly because of the additional security that it affords in the remote event of a gudgeon pin developing a defect in its surface.

To repeat ourselves, we have proved these new bearings so exhaustively and severely that we can confidently assert their supreme superiority to rubbing bearings.

Flywheels.—These are machined all over. The mass and energy are of proportion sufficiently generous to smooth out the peaks of the torque diagrams and so reduce to a minimum the stresses on the clutch and propeller shaft. In Stationary Engines and Electric Generating Sets the energy of the wheel suffices to give any desired coefficient of cyclic variation.

Vertical Counter Shaft.—This is driven through helical gears by the crank shaft and serves to drive the cam shaft and the pump for the main lubrication system. It also carries the governor and the reversing gear of the engine.

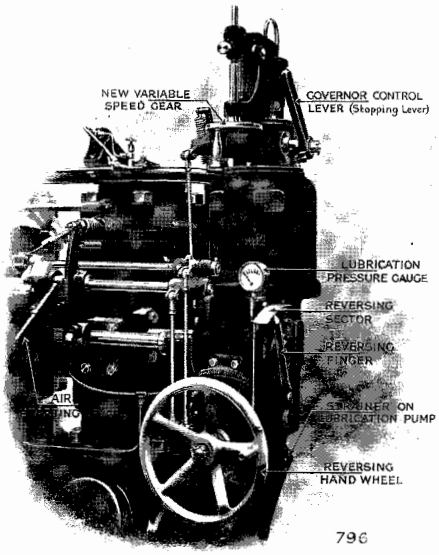
Cam Shaft.—This is driven through helical gears by the vertical shaft. The gear on the vertical shaft is provided with a sliding motion along the shaft for reversing the engine and for varying the time of ignition if required. The fuel injection cams are of steel, hardened and ground to shape.

Governor.—A centrifugal governor is mounted on the vertical shaft and is entirely enclosed. It is of great power and responds to the fine regulation called for in the driving of Electric Generators. The whole of the working parts of the governor are enclosed and are lubricated from the main circulation system, described on page 15.

GENERAL DESCRIPTION (*continued*)

Variability of Speed.—For Electric Generation and Industrial Purposes the speed can be varied within certain limits by the usual external means, while the engine is running.

Governor : Variable Speed Gear for Marine Engines.—All The Gardner T type Marine Engines are now fitted with this new gear by means of which the engines are under complete control of the governor throughout the range, from full speed down to $\frac{1}{10}$ (or less) of full speed when driving the propeller. The engine can be set to run at any speed within this range by turning the handle or hand wheel shown in the accompanying illustration.



In addition to this variable speed gear, each engine is provided with our usual hand control lever which enables the speed to be instantaneously changed while manœuvring.

It may here be mentioned that the new, variable speed gear has been so designed as to be applicable to all existing T type Marine Engines.

It is to be observed that the governor is not of the usual type which merely controls the engine when running at the normal maximum speed : it controls the engine when running at any and every speed within the above-mentioned range.

The outstanding feature of our governor is that, in the case of a twin screw ship, it enables the engineer to speed the engines equally at all speeds within the range and so distribute the power equally between the two engines. In other words, after setting both engines to run at the speed desired, they may be left to take care of themselves so far as speed is concerned—a very desirable thing in heavy seas, whether in a twin screw ship or a single screw.

GENERAL DESCRIPTION (*continued*)

Auxiliary Crank Case.—This structure, situated at the forward end of the engine, carries the Air Compressor, the Circulation Pump, and, in the case of Marine Engines, the Bilge Pump, all three of which are operated by the one crank. The lubrication of all the parts in this crank case is derived from the circulation pressure system.

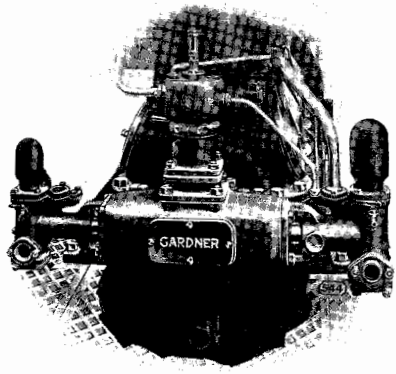
Compressed Air Starting.—All engines, whether Marine or Stationary, reversible or non-reversible, are started by Compressed Air. The machinery necessary for its generation, storage and distribution is supplied with each engine, and includes :

AIR COMPRESSOR built in with the engine and driven direct by the main crankshaft : it is water-jacketed and cooled by derivation from the main cooling system of the engine, and is provided with safety valve and unloading valve.

AIR RESERVOIRS, one or more, according to the size of the engine, each reservoir being supplied with stop valve, pressure gauge, safety valve, and scavenging valve.

AIR STARTING VALVES one to each cylinder, timed and operated automatically by the cam shaft. Each valve is connected to the main distribution air pipe fixed on the engine.

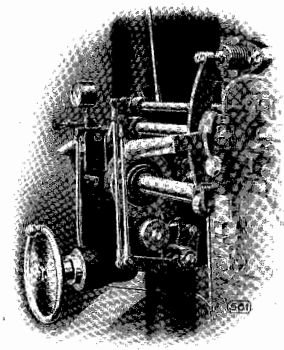
Circulation and Bilge Pumps (the latter for Marine Engines only). These are of the plunger type and are built in the auxiliary crank case. They are driven by a crank on the main crankshaft ; the motion work is lubricated by oil derived from the circulation system. Air chambers are fixed on both delivery and suction sides. The rams are of gun-metal, and the pump bore has a gun-metal liner. The air chambers and the special valves used eliminate every vestige of " water hammer."



GENERAL DESCRIPTION (*continued*)

Reversing and Starting Mechanism for Marine Engines.—This is somewhat analagous in its effect to that of a steam engine. The complete operation of reversing is performed by four turns of a handwheel, during which the following operations take place **automatically.**

The angular position of the cam shaft is changed from "ahead" to "astern," or vice versa. The first turn or so of the handwheel puts out of action the fuel injection pumps and the engine begins to stop. Towards the end of the third turn, the fuel pumps are brought into action again simultaneously with the compressed air starting valves, which latter give a puff of compressed air to the cylinders, causing the engine to start in the other direction. At the end of the fourth and last turn the air valves are put out of action and the engine now runs under full conditions in the desired direction.



The above operation, from beginning to end, takes only three or four seconds.

All engines, whether Marine or Stationary, are started by compressed air, but it is only in engines of three or more cylinders that starting will take place from any position of the cranks. For engines of two cylinders the flywheel has to be "barred round," consequently in practice, the reversing mechanism on the engine is not relied upon; in its stead, the propeller drive is effected through a Gardner Transmission Reversing Gear.

Variable Ignition.—The reversing mechanism is used also to vary the time of fuel injection, and therefore, of ignition where fuel oils of varying qualities are used.

Stationary Engines, not being required to reverse, are fitted with a modification of the reversing mechanism for varying the time of fuel injection as above, but all engines are furnished with air compressors and compressed air starting gear.

Lubrication.—This is effected by two separate and distinct systems:

1. A Circulation Pressure System.
2. A Multi-Point Lubricator which delivers accurately measured charges of oil, under pressure, to various points about the engine.

GENERAL DESCRIPTION (*continued*)

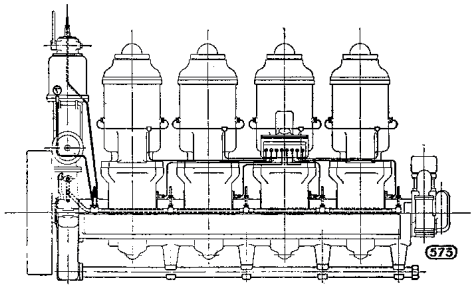
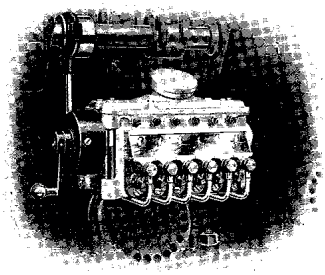


Illustration showing Lubrication Pipe System.

1. THE CIRCULATION PRESSURE SYSTEM lubricates the crank shaft bearings and all other important parts external to the crank case and cylinder. The lubrication ram-pump, situated on the case of vertical counter shaft, delivers a continuous and copious supply of oil under pressure to a service pipe, which distributes it to each element to be lubricated, in such manner that a continuous flow of oil passes through each main bearing, or other element, from whence it passes back to the sump underneath the pump.

The pulsations of the pump are damped by an air chamber fixed on the suction side of the pump and an anti-pulsator valve on the delivery side. This valve serves also to control at will the pressure in the system.

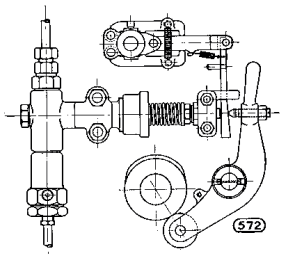


2. A GARDNER PATENT MULTI-POINT LUBRICATOR delivers accurately-measured charges of oil to each cylinder for oiling the piston, and to each crank case for feeding the centrifugal oiler, which lubricates the crank pin and the gudgeon pin (*see under "Connecting Rod"*); the surplus oil collects in the bottom of the crankcase, from whence it is expelled periodically and filtered for use again.

This Patent Lubricator is fully described in the accompanying Lubricator Booklet.

GENERAL DESCRIPTION (*continued*)

Fuel Injection Pumps.—Each cylinder is served by a separate pump which accurately measures the charge of fuel corresponding to the load on the engine and forces it, under high pressure, to the fuel injection sprayer. The amount of charge delivered depends upon the position of a hard steel wedge interposed between the pump ram and the rocking lever, which position is controlled by the governor. The wedges are "flexibly" connected to the drop links from the governor, in such manner that the latter has always perfect freedom of action, notwithstanding that each wedge in succession is momentarily immovable while operating its pump.



The pump valves are of steel balls, carried in units separate and detachable from the pumps. The delivery valves are in duplicate, one covering the other.

Fuel Injection Sprayer.—The Gardner Patent Rotable Sprayer forms an exceedingly important feature of the engine, in that it solves the well-known difficulty of running under varying conditions as regards load, kind of fuel, etc. Its function is to direct the geometric axis of the spray-form on to different parts of the surface of the Hot Dome, which is effected at will, either while the engine is running or at rest, and with the same facility as turning the lever of a cock. The result is that the engine, after having once been heated internally by a short run under load, will run light for sufficiently long periods ready to take up full load at any moment.

It is not, however, to be understood that the sprayer is to be continually adjusted as the load varies. In practice three positions suffice: 1, no load; 2, full load and 3 an intermediate position for manœuvring or for mixed loads. (*Illustrated on page* 9).

To Be Continued

For Sale

1974 ERF 8 wheel livestock lorry. (As seen on cover of newsletter 18)
9 speed fuller gearbox, caravan accommodation in lift off body.
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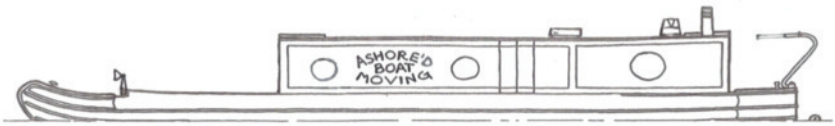
Several Gardner 4/5/6 LW type engines ,several 4LK engines, Tons of LW, L2 and LK parts new and used Retiring after 35 Years

4L2 engine built in 1930 amongst the first 12 ever built,complete ,dry stored for over 20 years Very rare. £2500

1L2 Built in 1966 the last but 3 to be built,Ex Isle of White ferry,"The Plymouth Queen"Immaculate condition £5000
Tony Redshaw 01788899123



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