Engine Forum

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Gardner Engine Forum Philosophy

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

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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

6LXB powered Erf
Owned by new member
P Comber

Chairman's Notes

It has been a long, hard winter on the boats, thankfully now gone, and summer is here with a bit of warmth about it, although as I write this it is pouring down!

Yvonne and I have just had the busiest winter on record, moving boats all over the North West and beyond. We had three boats frozen in at one stage, real fun it was! Arrangements are starting to get underway for the 2011 Rally at Bugsworth. I hope to visit there shortly, to liaise with their Chairman about who does what etc.

I have also recently visited Henley-on- Thames for the Thames Traditional Boat Rally, as we have been invited to attend there in 2013. It is only a possibility at this stage, the Committee is considering.
Please see article elsewhere in journal. (page 23)

The project to restore a 6L2 seems to be struggling! Out of four cylinder blocks all are porous, so maybe that idea is doomed, however, by the time you read this I may have acquired something else to play with.

Watch this space!!

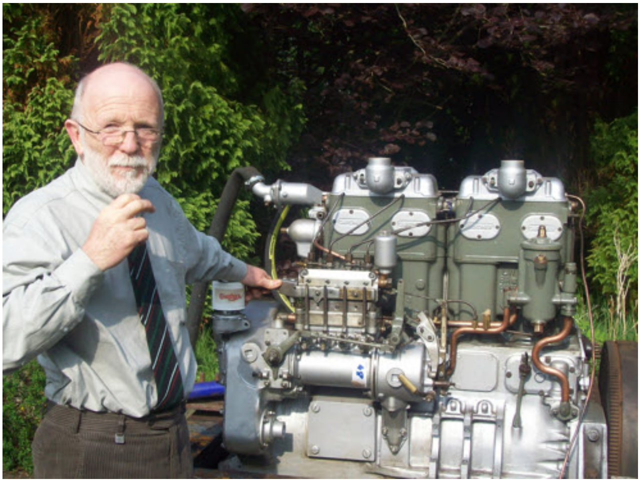
Mike

Membership Secretary

As the new membership secretary, I would just like to say hello to all members:

Firstly thanks a lot to Bob Heath and Steve Gray who have given me so much help since I took on the role. I know I must be trying their patience with all my questions.

My intention is to use a computer as much as I can to automate the renewal reminder process and to produce acknowledgements.
For this reason it is important that I have email addresses for as many people as possible. If you suspect yours is missing from our database, perhaps you could let me know. Best email address for me is tangent.gardner@gmail.com. If you have internet access but no email address, give me a call and I will help you set one up. It is quite painless and free.



Email will help reduce costs for everyone and is a super means of communication, but if you prefer not to use email, this is not a problem, I will continue to use conventional methods.

My background: I am an engineer with a love for old barges. Our 50ton (61' X 13' X 3'6") Snark is powered by a marinised 5LW and does the job remarkably well. My sons and I have a small business restoring engines and we are very passionate about all things Gardner.

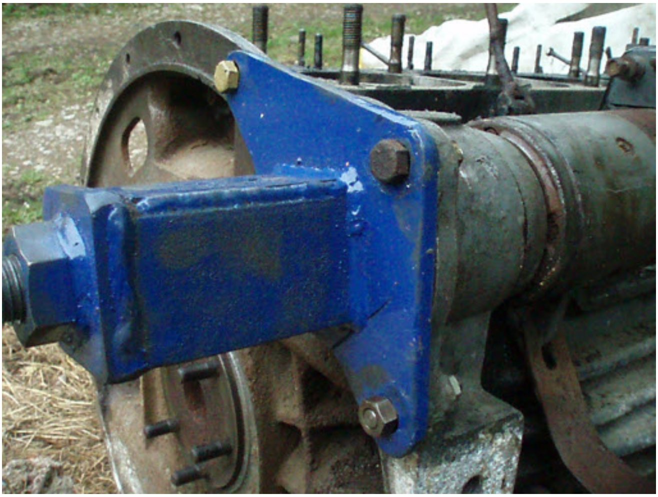
I am really honoured to be appointed membership secretary and I will do the job to the very best of my abilities.

Joe McCool, Artasooley, Benburb, Dungannon, N. Ireland. BT71 7LN,

Tel: 07802572441

Starter Motor Extractor

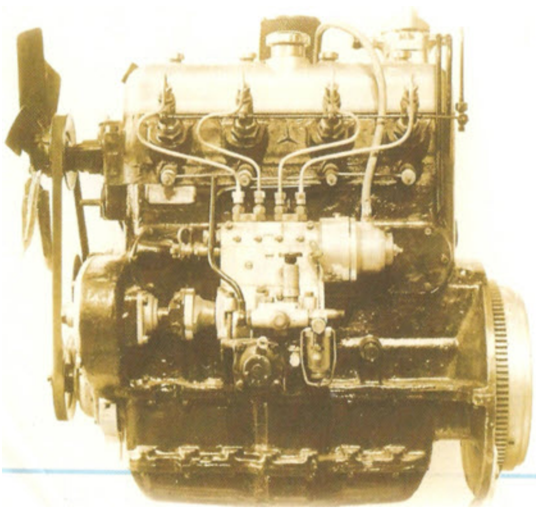
When dismantling core engines, I find that starters siezed in the end plate are often a challenge. Despite copius volumes of penentraing oil, despite heat,
despite treats with a sledge hammer, they refuse to budge. Starters are now valuable items and the risk of damaging them must be minimised. For this reason we fabricated the starter jack shown in the figures below. It works well. More details if required from Joe McCool: tangent.gardner@gmail.com



The Common Touch

Although diesel engines have been used in passenger vehicles since the 1930s, it took the advent of electronic engine management in the 1980s to allow them to compete in earnest with spark ignition (SI) engines for passenger car sales. The thermal efficiency advantages of the compression-Ignition (CI) engine have never been in doubt, but for passenger car applications there had always been issues with the CI engine's perceived lack of refinement, particularly during cold starts and at idle, The stigma of association with commercial vehicles and taxis turned buyers away, particularly in premium sectors. The rapid growth of diesels in passenger cars since then they now account for more than half of European car sales - is largely due to developments in injection technology, Engine power, fuel consumption, emissions performance and refinement have all made immense strides in a short time,

Power Unit for the Mercedes-Benz 260D. The worlds first mass produced diesel used in cars. It used a Bosch inline pump



Compression ignition combustion demands high compression ratios, as the charge air temperature must be raised sufficiently high to ignite fuel The high compression ratio naturally leads to high thermal efficiency CI en-

gines burn a heterogenous mixture which always has excess air, and the power output of the engine is controlled by the quantity of fuel injected, By contrast conventional SI engines burn a homogeneous mixture and as a result are tied to a relative small range of combustible air/fuel ratios, which means engine power must be regulated by adding a throttle valve to the intake, to control the amount of combustible air/fuel mixture reaching the cylinders. The use of a throttle inevitably leads to high pumping losses. CI engines consequently have a considerable efficiency advantage, particularly at part loads where road vehicle engines operate most of the time,
Early diesel engines used inline piston-type injection pumps, which remain in use today only on large commercial vehicle engines

A significant advance came when Bosch developed the compact VM'distributor type' injection pump in the 1960s, but the real breakthrough for passenger car diesels came with the introduction of electronically controlled injection pumps in 1986, Sensors delivered information on accelerator pedal position, engine speed, Intake air pressure and the temperatures of the intake air, coolant and fuel to an ECU which contained a series of predetermined control maps. Both fuel quantity and in injection timing were under electronic control, providing more precise control of fuel delivery, Engine power improved while fuel consumption and emissions fell. Electronically controlled diesels also benefited from slower, smoother idle - an area where direct-injection diesels in particular struggle to meet customer expectation.

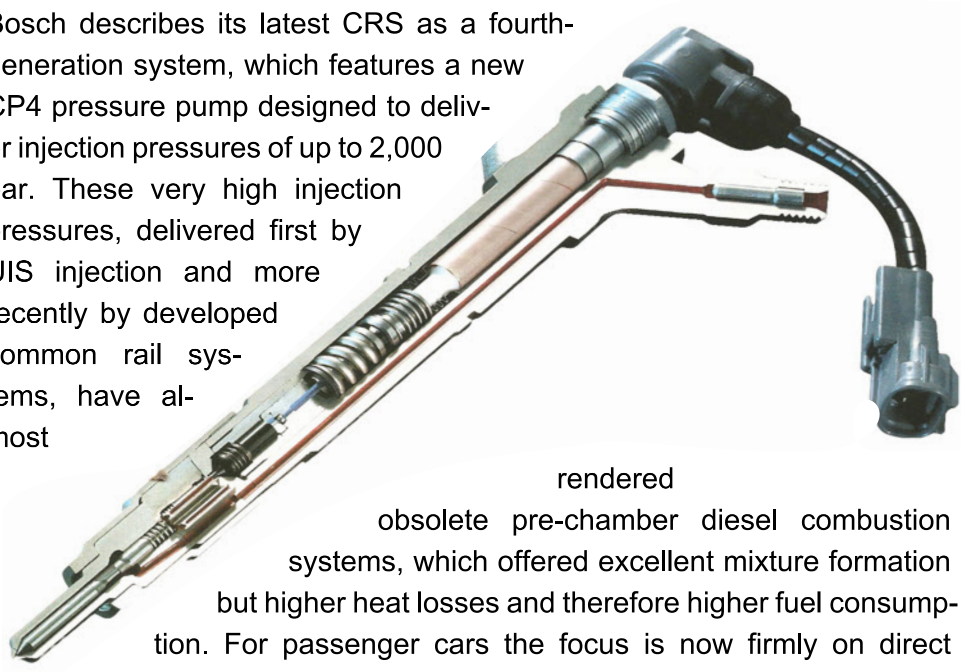
The introduction of the Bosch Unit Injector System (UIS) brought further Improvements, UIS integrated a small high-pressure pump into the injector for each cylinder, normally operated by a rocker arm from an overhead camshaft Injection timing and quantity were controlled by a solenoid valve commanded by the engine control ECU. While the idea of providing a dedicated injection pump for each individual cylinder was nothing new - it was standard practice on large industrial diesel engines In the early 20th century - the integration of a Small pump into the injector in UIS brought significant benefits. Because the unit was compact and hydraulically efficient, peak injection pressures of up to 2,200 bar could be generated.

Supplementary electronically controlled pilot injection in the low speed low load range could also be implemented, to improve cold-start performance and reduce combustion noise.

In all of these Systems, the maximum 'Injection pressure was directly related to the engine speed and the quantity of fuel injected, which is less than ideal. High injection pressures are desirable because they improve fuel and air mixing throughout the engine speed range, leading to more complete combustion and the reduction of particulate emissions - but with the side-effect of an increase in NOx emissions requiring aftertreatment. Decoupling Injection pressure from engine speed required a fundamental change in injection system design, separating the pressure generation and injection timing functions of the existing injection pump or unit injector into two individual stages.

This was achieved by the accumulator or 'common rail' diesel injection system, originally developed by Fiat and Magneti Marelli. The rail which gave the system its name carried high-pressure fuel, delivered by a single pressure pump, to all the injectors. Injection timing and metering of the fuel quantity were determined by the ECU and controlled by solenoid-operated injectors, as in UIS injection. The first-generation common rail system (CRS), introduced on the Alfa Romeo 156 JTD and Mercedes C220 CDI in 1997,'used a simple pressure regulating circuit to control fuel pressure in the supply rail. In later systems this was augmented by a pump control system which matched pump delivery to the amount of fuel injected, reducing the recirculation of excess fuel through the hot engine bay and as a result reducing fuel temperatures.

A further refinement was the introduction of piezo injectors, which were significantly faster in operation than existing solenoid injectors. As a result, the piezo Injectors could deliver multiple injection events during each combustion cycle with much greater precision, allowing the use of pilot injection (to reduce noise and NOx) and post-injections (to minimise soot by extending burning Into the exhaust stroke). The piezo injectors were also smaller, potentially reducing the overall height of the powertrain and allowing easier positioning of the injector in a modern four-valve combustion chamber.



Bosch describes its latest CRS as a fourth-generation system, which features a new CP4 pressure pump designed to deliver injection pressures of up to 2,000 bar. These very high injection pressures, delivered first by UIS injection and more recently by developed common rail systems, have almost rendered obsolete pre-chamber diesel combustion systems, which offered excellent mixture formation but higher heat losses and therefore higher fuel consumption. For passenger cars the focus is now firmly on direct injection systems, using multiple injection and exhaust gas recirculation to reduce the harsh combustion noise often associated with direct injection which initially limited it to commercial vehicles.

Today the best direct injection CI engines can largely meet SI standards of refinement, and as a result sales in Europe have grown enormously. When common rail technology was first brought to market in 1997, 22% of cars sold in Europe were diesels. Now diesels account for half of all European passenger car sales, with the highest share of sales in Belgium (74%), France (71 %) and Spain (68%). Bosch's production of common rail diesel injection systems exceeded eight million units in 2007.

Although CRS is now firmly established in Europe there is massive potential for expansion elsewhere, With the US remaining the biggest potential growth market in the medium term. While vehicle fuel prices in North

America are still considerably less than those in Europe, they have more than doubled since 1990 and the rise has stimulated market interest in more economical vehicles. Diesels offer high torque, mimicking in that respect the large-displacement gasoline engines American consumers have traditionally chosen, but offer much better fuel economy. Currently diesel-engined cars and light commercials make up around 5% of US vehicle sales (around 800,000 units annually) but Bosch expects diesel's market share to triple to 15% by 2015, supported by a fact-based marketing campaign which aims to bring the benefits of diesel to the notice of American consumers.

Common rail engines will also drive diesel growth in the emerging Asian markets. Bosch predicts annual sales of around 1.3 million units in China and around the same number in India by 2010, with sales continuing to increase as both markets develop. Suppliers of diesel injection equipment are already setting up production facilities in these areas. Bosch has established plants at Nashik and Bangalore, manufacturing injector components and high-pressure pumps respectively, while Denso expects to begin production of CRS equipment in China in 2009. With these markets in mind Bosch is developing low-cost common rail systems with injection pressures in the 1,100-1,450 bar range for 'low price vehicles', costing below €7,OOO. It expects such vehicles to make up 13% of the world passenger car market by 2010, a volume of around 10 million vehicles a year.

While low-cost CRS is the focus of development for emerging Asian markets, the more mature European and North American markets present different challenges imposed by tightening emissions legislation, and in particular the significant reductions in allowable emissions of nitrogen oxides (NOx). NOx is produced during combustion when airborne nitrogen reacts with oxygen, which occurs readily when very high temperatures are generated during combustion. Euro 5 due to come into force in 2009 reduces the NOx limit from 250mg per kilometre to 180mg/km, and the 2014 Euro 6 standard will reduce that still further to just 80mglkm.

Methods of meeting these standards using a combination of improvements to the diesel combustion process have already proved successful in commercial vehicle diesel engines. These include the use of higher charge air pressures through more aggressive useturbocharging, higher rates of cooled exhaust gas recirculation (EGR) and higher injection pressures at part load, and using high-speed injectors to deliver up to eight separate injections in each combustion cycle. Promising recent research in this area by Delphi has seen test engines deliver low NOx and soot emissions without a fuel consumption penalty by significantly advancing the injection timing at part load, producing a prolonged pre-mixing phase, then increasing swirl and injection pressure to reduce soot formation.

This is a form of pre-mixed charge compression ignition (PCCI) which is a halfway house between existing diesels and the potentially even more effective homogeneous charge compression ignition (HCCI), which is being developed by several OEMs and their suppliers. In HCCI a combustible mixture is compressed to the point where it self-ignites, in-cylinder conditions being controlled by varying the rate of EGR, the valve timing and, in one design, the compression ratio to control the timing of ignition. Although the system can keep NOx levels low, it can produce unacceptable levels of HC and CO, and costs are high. The technology is still in its early stages of development, and it is too soon to say whether it will definitely achieve all that is hoped of it.

While research continues into more advanced combustion techniques, careful development of diesel injection can meet the requirements of the Euro 6 test, but the tighter US standard seems certain to require the use of after treatment in the form of urea injection and a selective catalytic reduction converter, which assists the conversion of Ox and urea into nitrogen and steam. Though this system works well it remains to be seen whether consumers will ensure the liquid urea system is refilled during scheduled maintenance or will instead take the cheaper option of allowing it to remain empty and inactive. The latter seems likely unless drivers are required by law to maintain their vehicles correctly. Changes to the emissions tests which are part of mandatory annual vehicle inspections might be necessary to ensure these systems continue to provide the emissions performance they are capable of when new.

The future for diesel in the short to medium term seems likely to develop in two different directions. In more sophisticated markets such as Europe and the US the emphasis remains on maintaining power and refinement, while reducing fuel consumption and raising emissions performance. This will lead to ever higher injection pressures, more complex multiple-event injection strategies and innovative combustion modes such as PCCI and HCCI to further reduce combustion noise and combat NOx and particulate soot emissions. In developing markets such as China and India the challenge will be to retain the fuel consumption and emissions benefits of sophisticated diesel injection while using lower injection pressures and reducing the unit cost of the system so it can be applied to the very low-cost vehicles which will make up the bulk of sales in these markets. In both cases, developments of CRS injection seem certain to play a major role.

www.EuropeanAutomotiveDesign.com

August 2008 Author Andrew Noakes

Welcome to New Members

Mr B Ledger of Basinsgtoke
Mr E Byrne of Bromsgrove 4L2
Mr I M Thompson of Kingswinford 3LW with 2UC Gearbox
Mr P Comber of Ukfield 6&8LXB
Mr A Goldthorpe of Penistone
Mr E Hales of Llanelli
Mr H Scarrott of Totton 4LW
Mr D Sheen of Stanley 4LW
Mr J Mann Maldon of Maldon
Mr J A Fielding of Accrington
Mr P Mathews of Warksworth New Zealand

Not Just LXB
A few more Metro bus Engine Choices

“West Midlands Metrobuses were powered by Gardner 6LXB engines”. “Wrong” say the knowledgeable, there were 22 Rolls Royce Eagles and a couple of Cummins L10s” Very true, but what of those with Gardner 6LXC engines the one 8LXCT and the unheard of 6LXBG?

To start at the beginning~ the two Rolls-Royce prototypes were not originally intended to be testing alternative engines but alternative transmissions. Although widely used in Germany, the Voith D851 was comparatively new to the UK and MCW were keen to explore alternatives. GKN were hoping to market the SRM transmission through their driveline division in based in Aldridge: the SRM had a chequered, history having originated years earlier in Sweden’ then manufactured in Italy and been marketed by Hawker Siddley in Coventry at one stage. Hence 7006/7 were initially specified with Gardner engines and SRM gearboxes when GKN pulled out, the first reaction of WMPTE (West Midland Transport Executive) was to cancel them, but with murmurings of the long term security of Gardner supply (and after quiet discussions with MCW Development), I persuaded the Director responsible to retain the order, but with the Rolls-Royce Eagle/Voith combination. Thus 7006 and 7007 emerged and paved the way for the other 20 when the predicted engine delivery problems loomed.

The disastrous strike at Gardner resulted in the next non standard engines.

A group of us were summoned to a discreet meeting in Manchester where we were to ask to see someone with a female name. I seem to recall not exactly ring twice and ask for Flossie but along those lines in a state of great security we were ushered in to find a number of senior Gardner engineers with piles of drawings and a few castings: this was Gardner in exile plans were being drawn up to have some components made outside to enable contracts, such as the WMPTE order, to be fulfilled. it appeared that a surplus of truck 6LXC engines existed that could be recalled and adapted to become, to all intents and purposes, 6LXBs. A number of engines were obtained (from ERF I think), reworked and supplied to MCW in service they would have looked and run like 6LXBs, although internally, the pistons and a few other parts were to 6LXC standard,

After the supply scare, MCW were keen to find a viable alternative; the Eagle, although well built and reliable, was heavy on fuel and, through the Metroliner and Metrorider development programmes, MCW were already familiar with Cummins. The L10 was proving successful in buses elsewhere and MCW were therefore, keen to have local service experience, which resulted in the West Midlands trials. From an operator viewpoint, however, standardisation was a valuable asset, and further Cummins Metrobuses would not have helped in this direction.

In an attempt to improve environmental conditions, new noise level legislation was introduced in which a lower level was required on buses with engines under 200bhp; there were two levels within each class, one *for* new vehicles and one for vehicles in service. A new 6LXB Metrobus would just squeeze past the test without undertrays, but was so close that every vehicle would have to be tested individually, which would be expensive and disruptive. MCW therefore sought to bring the level sufficiently below the *mark* so that type approval would apply, Hence undertrays were supplied, against the wishes of WM and other operators, who knew they would inhibit maintenance and, quite posibly, drop off, be left off and otherwise cause trouble.

One day, the receptionist at Summer Lane rang me and said there was a bus for me to lock at. Parked outside was new, undelivered, 2622, in the hands of MCW Development Engineer Les Pearson and his fitter, Colin Eccles, who wouldn't tell me; what was different, but just asked me to drive it. In reality, I couldn't notice much difference apart from it sounding unusual but on opening the back, a turbocharged 6LXCT was revealed; it was derated to give similar performance to a 6LXB, but the reduced noise from the turbo engine would probably have been sufficient to allow type approval. In the event, the higher cost of the engine coupled with lack of enthusiasm from MCW management terminated the test and 2622 was delivered soon after with a standard 6LXB.

Although I have drawings of a Metrobus Mk 111 using a 5LXCT, that development was to late (and another story) MCW closed and Gardner's faded. And I thought that no more trials would come, however in the mid-1990s, interest in gas power surfaced. Daf championed LP'G while Volvo supported CNG; both were heavy on fuel, due to the lower efficiency of the spark-ignition engine, but particulate emissions and noise were very low. At WM we looked at various conversions; including a Guide Friday VIR inspected in Acocks Green, which, though technically efficient, looked amateurish and unlikely to withstand long term operation, I was then approached by a consultant engineer working for Power Torque in Coventry, who were hoping to develop a Gardner LPG conversion, in conjunction with Gardner-Avon themselves. They wanted to borrow a bus, convert. it and then put it into service; we were less enthusiastic, but offered them a newly withdrawn Metrobus on loan, on the basis that, if successful, the engine and tanks could be transferred to an operational vehicle later. Indeed formal application was made for a grant for a trial route conversion in Coventry

Ex-Park lane MkI Metrobus 2182 'was accordingly despatched to Coventry and by April 1999, it was ready to be revealed. In view of the possibility of press coverage, the rather tired bus was whisked into Wheatley Street 'for a spruce up that actually took the form of a hand repaint (and very well done to), after which I was asked to try the vehicle. The transformation was amazing; the engine was incredibly smooth and quiet with no diesel knock and the unladen performance appeared well up to standard. Gardner seemed impressed and issued a coloured brochure and press pack for the 6LXBG, as they called it, with photographs clearly showing that it was a WMT bus, though no enthusiast seems ever to have picked up on the conversion. They offered fully converted, fully remanufactured engines; in practice, with the effective end of Gardner and interest in LPG waning the project quietly disappeared, the engine was removed and 2182 sold as a non runner, marking the virtual end of Metrobus/Gardner experiments within West Midlands

Martin Fisher. (From the Aston Manor Transport Museum News Edition 52 July-September2007.) www.amrtm.org

GARDNER ENGINES

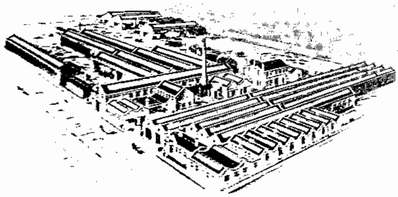
T

VERTICAL HEAVY OIL TYPE

“T” type engines were manufactured between 1913 and 1938, making this catalogue between 72 and 97 years old and apart from rusted staples and missing the back cover, it is still in remarkably good condition

Catalogue No. 510

GARDNER ENGINES



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*Marine Heavy Oil Engines.

GARDNER HEAVY OIL ENGINES

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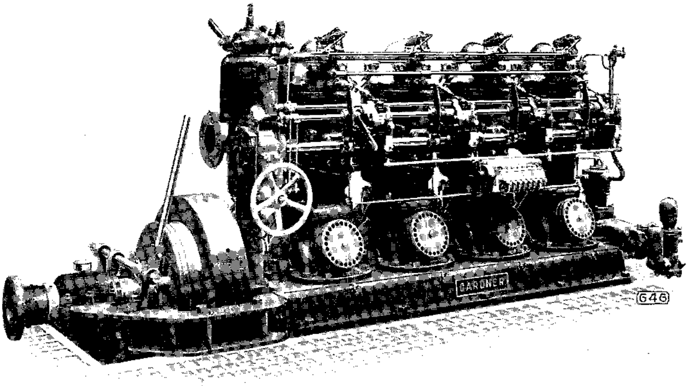


Typical 4-Cylinder Marine Engine

PRELIMINARY

THIS engine is of the type now generally known as the Semi-Diesel Engine. In effect, it is a Two-Cycle Vertical Engine designed to burn Heavy Oils. The principle on which such engines work is now so well known that a detailed description of it is hardly necessary. Condensed in a few words :

> A charge of pure air is drawn into the crank case and thence is forced into the cylinder. Practically the whole of the charge is then compressed into a combustion chamber, part of which is formed in the cylinder breech and is water-jacketed ; the other part is a small non-jacketed dome which, during work, remains at a " black hot " temperature. Just before compression is completed, a charge of fuel oil is injected in the form of a spray into the combustion chamber and is ignited by contact with the surface of the " black hot " dome in conjunction with the temperature of compression. The admission of the air charge to the cylinder and the expulsion of the products of combustion are effected by ports in the cylinder wall, which are covered and uncovered by the piston.

The present Gardner Heavy Oil Engine is the result of many years' original research, supplemented by the forty years' experience which the makers have had in the building of, and the experimenting with, an enormous variety of types and sizes of Oil Engines.

PRELIMINARY (*continued*)

This research has been attended by complete and unqualified success, which has been amply confirmed by the experience of the many users.

Among the many desirable properties possessed by the Engine, the following may be mentioned :

It runs with the smoothness of a steam engine.

Will stand up indefinitely to the maximum load for which the engine is sold.

After having once been heated internally by a short run under load, the engine will run light for sufficiently long periods, ready to take up full load at any moment.

Runs equally well at all intermediate loads.

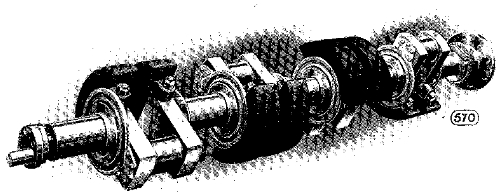
In the Marine type, of three or more cylinders, the reversals of the engine for manœuvring are performed with absolute certainty and precision, as quickly and as easily as in the steam engine.

The engine burns efficiently a variety of the heavier and cheaper grades of fuel oil, and with very low consumption per BHP per hour.

The consumption of lubricating oil is remarkably low, not exceeding that of $\frac{1}{50}$ of the fuel oil (actually it is much less than this).

It will be seen in the sequel that the T engine is a very perfect machine, in that it responds to so many desirable conditions and demands. In appearance, it is costly to build, yet the perfect administration of the works, together with very special methods of production, enable the engine to be put upon the market at an extremely low price.

Crank Shaft.—This is, of course, cut from the solid steel forging. The general dimensions are made to the latest issue of Lloyd's rules. Balance weights are fixed to each crank, sufficient for the balance of the crank and the proper proportion of the mass of the connecting rod. The diameter of the crank shaft is finished and sized by the modern process of grinding.



Cylinders.—The cylinders, as well as all other castings, are made in our own foundry from a blend of iron established by years of experience. Ample means of access are provided for examination of the water-jacket, the inlet and outlet ports.

The cylinder bores are finished and sized on Planet grinding machines.

Cylinder Breech.—This is a carefully designed, water-cooled structure in which is formed the lower part of the combustion chamber and the water-cooled duct through which passes the sprayer of the fuel injection.

Dome.—The dome is a light casting clamped on top of the cylinder breech and forms the upper part of the combustion chamber. It is maintained at a " black hot " temperature by the internal combustion, which temperature, added to that of compression suffices to ignite the incoming spray of the fuel charge. Owing to the low working temperature, the life of the dome is indefinitely long.

To be continued

Gardner Rally 2013

Some time ago the Forum was toying with the idea of holding a rally"down South", on the Thames, Kennet & Avon, or elsewhere. Suggestions were sought.

Out of the blue a letter arrived from the Thames Traditional Boat Rally, with a suggestion that the Forum's members may like to combine with their rally at Henley-on-Thames in July 2013. I accepted a kind invitation to attend the 2010 Rally held over the weekend,17/18 July, 2010, and what a rally it was! The site is bank side on the Thames, adjacent to Henley Rugby Club, about 100 acres in all, with ample parking and room for shore based exhibits etc. There is something for everyone with an interest in the past: vintage cars, motorcycles, push bikes, etc, rope splicing demonstrations, art exhibition, kids' farm and plenty of catering facilities. The toilets were excellent. All in all an excellent do, however, like every fairytale there is a down side. Mooring is "tight" and narrow boats would be expected to double or even treble up - boarding planks vital! Boats would also be expected •to "parade" up the river on at least one of the two days of the rally. As to costs, the rally is totally self supporting and a sliding scale of charges for attending the rally is operated. Going by 2010 charges a 50' boat could expect to pay in the region of £60 to attend, with a crew of two, but this could vary considerably, depending on the historic interest in the vessel. With land based exhibits there does not appear to be a "mooring" problem as there is plenty of room, even for trucks and buses, cars and stationary engines. Camping is available on site for a small charge. It would be helpful if members could let the Chairman know if they are interested in possibly attending this event in 2013. The Thames Traditional Boat Rally has intimated to him that they would be embarrassed if the Forum had more than 20 boats present. The above request is not a booking for your boat but just so that the Committee has an idea of numbers if we decide to go ahead.

Mike.

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