GARDNER

Engine Forum

Autumn 2013

No. 24

www.gardnerengineforum.co.uk

GARDNER 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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Note 1: Please note that all information in this publication is given in good faith and is not necessarily checked for accuracy and hence the Gardner Engine Forum cannot accept responsibility for any errors.

Note 3: The Gardner Engine Forum does not specifically endorse advertisements placed in this publication and it does not accept responsibility for the products advertised.

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Cover Picture

Ex Midlands Gardner agent
S. Satterthwaite
Foden Truck

Photo by C Paillin

Chairman's Notes

At 6.00 pm on the 2nd June 2013, with the field at the Cotton Arms clear of exhibits and litter, all the trucks and cars on their way home and some of the boats already moving off on the canal, another Gardner Gathering was over, the sigh of relief from yours truly was audible in Nantwich. I had stood in the same field on the previous Wednesday with water over the top of my shoes and had considered cancelling the road vehicle side of the event, however, the sun came, the field dried up and the Gathering went ahead with the best weather for some years.

Many thanks to all those who assisted in organising this do and helping on the stand etc.

The AGM passed off with little to report. A committee meeting later agreed to the holding of the next Gathering at Bugsworth Basin in June, 2015. Let's hope for better weather than last time!

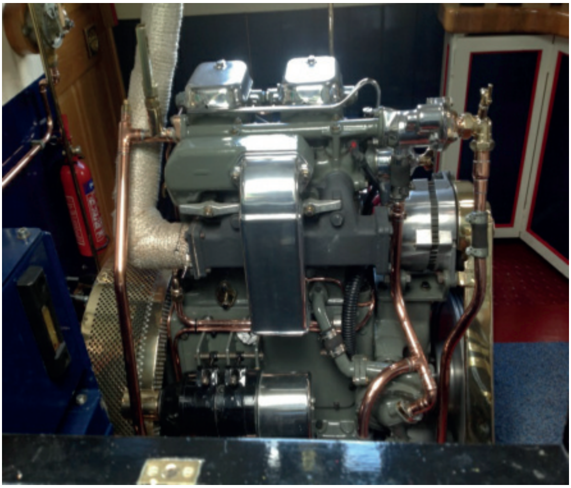
See you up the cut or road.

Mike

Saturday Exhibit at the Wrenbury Rally **Photo by C Paillin**

Gardner Engine Gathering: 1st – 2nd June 2013

The 2013 gathering was a great success but it was looking under threat early in the week; the rain poured down at the start of the week and the field was a great worry to Mike, we might get the vehicles on to the field but could we get them off again? The towpath was a sodden, muddy mess and we felt a bit gloomy about prospects. And then the sun came out on Thursday and, with a steady breeze, the field dried really fast. On Saturday morning as the trucks arrived the grass was dry, the ground was firm and the sun shone for the rest of the weekend. Thanks to the weather we had plenty of visitors, the exhibits were well turned out and we did brisk business at the Forum Stall.



There was a great turnout of boats, twenty three stretching from the electric bridge down beyond the lift bridge. There was a good variety of engines on show along the towpath; 2L2, 3L2, 4L2, 2LW, 3LW, 4LW, 4LK, with very interesting technical variations – no two alike

On the event field we had twelve lorries, five cars and six stationary engine displays. There were two lovely 1L2s running and a bevy of L2s and LWs throbbing away. An early hot-tube gas engine was running smoothly but needed a beady eye on the flame due to the wind! A

special mention of the beautiful 3J5 marine engine, one of a pair originally powering motor yacht "Cordelia". It was of great interest to visitors; thanks to Harold Lomas for showing and explaining the mechanics to visitors and thanks to Pochin's PLC for their continuing sponsorship. Unfortunately, due to ill health, Cliff Noble was unable to bring the magnificent 13HF big single which was a great pity. One impressive Jaguar and two remarkable Rolls-Royces were displayed - I'm pretty sure Sir Henry Royce never envisaged a four cylinder diesel in his cars but ingenuity and a shoe-horn made or very interesting alternatives!

The most important ingredient of a successful gathering is the people; there was lively socialising and great music in The Cotton Arms provided by our members; Jimmy, Bruce, Mal, Alan and Ann. Joe and Julie Kelly who run the Cotton Arms provided a convivial atmosphere and managed the increased kitchen demand very well indeed. The food was lovely, the beer was plentiful, the sun shone – what

more could we want? Richard and Mim Alderman on NB Magic said of the evening do on the Saturday "we don't have anything like this down south!"
On Sunday morning St. Margaret’s bells rang out over Wrenbury, apparently two of our members joined the campanologists while one lady disappeared up the tower with a notorious local character !…

A truly successful rally and very well supported. Thanks must be extended to Mike and Yvonne for their organisation (which takes a lot more than may be apparent). We should also thank Mornflake

for their kind contribution of porridge-oats to the “goody bag” and to Canal & River Trust for facilitating the reserved moorings in Wrenbury. I’m looking forward to the next gathering!
Hyphen

Photographs by author

Salt Water Destruction

The following article applies not only to Gardner engines but to all makes of marine engines having cast iron parts which used raw sea water cooling systems and have been exposed to a salty atmosphere. Unfortunately any old engine which may have been saved in dry conditions for some future project such as installing in a suitable boat, will without doubt seriously suffer the ravages of salt damage corroding iron parts to total destruction. It is a well-known fact that salt loves eating away at ferrous metals with disastrous results. In a way it is like the effects of a hard frost that freezes water which then expands with enormous force to destruct areas where water has been trapped. Where salt water has been in direct contact with cast iron, the salts have penetrated into the pours of carbon within the iron. When dried out there is a chemical reaction whereby the crystals expand with tremendous force so much that in serious cases the iron literally crumbles to pieces! Tragically this means finding and obtaining replacement parts which is likely to be very difficult and probably extremely expensive.

So what is the answer? The damage is already done and is forever on going, there are a few ways of retarding this ageing process of destruction, however it is a difficult one to deal with.

Assuming that the engine is only occasionally run and spends long periods as a “show exhibit” one can take preventative steps to slow down the damaging process, but you won’t necessarily stop it. By thoroughly steam cleaning for a long period at the highest temperature it is possible to neutralise the salts within. Blast stem cleaning is also an effective way on external iron parts that have been exposed to a salty atmosphere.

When the exposed parts are thoroughly dry, the surface should be prime painted with a suitable iron etching primer, remember that two thin coats are better than one thick one. Then build up with a good undercoat followed by final gloss finish.

Concerning the inside of the cooling system, a good prolonged high pressure steam cleaning is suggested., the internal parts can then be dried by using a “hot air” paint stripper to blow hot air through the passage ways. It is strongly recommended that a low pressure air test is carried out to ensure that there are no apparent leaks. A pressure test can be achieved by blowing down a suitable plastic tube and the use of soapy water as an indicator, all outlets having been blanked off. The pressure test must prove to be totally satisfactory before moving on to the next stage.

This article is not intended to explain ways of repairing fractured castings, however let's just say that "chemical engineering" works wonders. Two pack epoxy metals can render very satisfactory results quickly and cheaply.

If the cooling system is of the closed circuit variety the after a thorough cleaning it can either be filled with neat anti-freeze / corrosion inhibiter or alternately a suitable oil, care of course would need to be taken if the latter route is used to ensure that the system is not topped up with water , the two don't mix! Regardless of the coolant that is used the system should be filled from the lowest point to ensure that all the air is expelled.

This iu sone way of attacking the the salt water corrosion of cast iron but is not necessarily going to be 100% satisfactory. No doubt the editor would appreciate alternative suggestions to publish in the forum magazine

P.J.Freakley

Sunday Exhibits at the Wrenbury Rally

Photo by S Gray

Sydney Heritage Fleet

Gardner 8L3B Engine

Electrical Systems

Andy Hewat V1.2 October 2011

Gardner 8L3B Engine Electrical Systems

1. Description

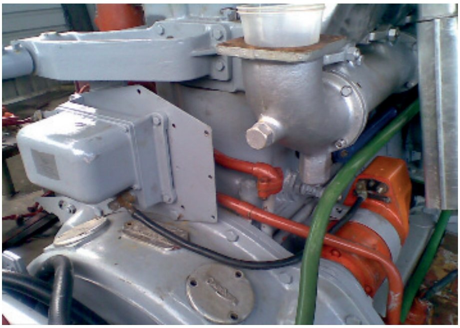
The Gardner 8L3B uses a 24V electrical system which consists of two CAV U624B Axial Starter Motors and external Solenoid Box and a CAV AC7B Alternator with associated Regulator, Surge and RFI Filter Box. Local controls for the starter are located above the gearbox and next to the Starter Solenoid Box on the engine. Remote starter controls are possible.

It should be noted that the starter motors used in this configuration are not those generally found and are very specific to the Gardner 8L3B installation (and perhaps a few others). This configuration will **NOT** function correctly if used with any other model of CAV starter motor. For this configuration to work correctly the starter motors must have the S1 and S2 auxiliary terminals. **Replacement of a starter motor with any other model or the external Solenoid Box with any other model will result in incorrect operation and potentially the starter motor remaining permanently engaged or even trying to start the engine. This situation will ruin the starter motors in a matter of minutes!**

The Gardner system can be considered are two independent systems, Starter Circuit and Alternator Circuit. Figures 1 - 4 shows the wiring for the starter motors and control box and the internal operation of the starter motors. Figures 5 & 6 show the connection of the alternator and RFI suppression box.

2. Operation of the Twin CAV Axial Starter Motor System

2.1. Description



This system comprises 2 off CAV U624B Axial starter motors and a BBNFA Starter Box and control panel. The purpose of the starter box is to ensure that the two starter motors are fully engaged with the engine flywheel ring gear before the full power is applied to the two motors to crank the engine. The CAV U624B Axial

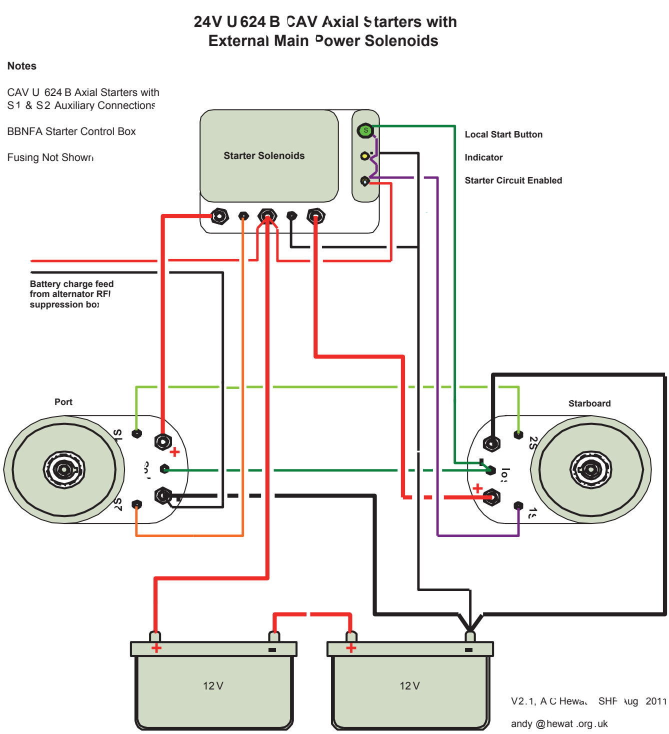
Starter Motor has Sol, S1, S2 "+" and "-" connection terminals and an internal sequencing solenoid type BBNG10.

The starter motor has three sets of windings, the main crank windings and two low power auxiliary windings for rotor axial movement and slow speed rotation (relatively). These two additional low power windings are called "Pull-in" and "Auxiliary". A general view of the Starter Box and one Starter Motor is shown in Photo 1.

2.2. Starter Motor, Type U624B

The main features of this type starter motor are its size and robust construction. For the engagement of the pinion to the fly-wheel ring gear, the complete armature assembly slides axially through the motor casing. The schematic diagram of the starter motor and associated control box and controls is shown in Figure 1. A simplified construction of the starter motor is illustrated in Figure 2. In the figure, the motor is shown in the rest position. The armature is held by a spring (not shown) so that it is offset to the field poles. When the field is energized, the armature is pulled to

Figure 1 - GARDNER 8L3B STARTER CIRCU



the left and the pinion is slid into engagement with the ring gear. The figure illustrates the electrical circuit of the starter motor, which uses three field windings. The main winding as usual is of thick-section and low-resistance winding, and is connected in series to the armature. The two other windings are wound with thinner wire so that they have a relatively high resistance, the Auxiliary winding is also connected in series with the armature but in parallel with the main winding. The Pull-in winding is also a high-resistance winding but is connected in parallel with the armature as well as with the other two windings. A two-stage solenoid switch, mounted in the starter operates the external Solenoid Box.

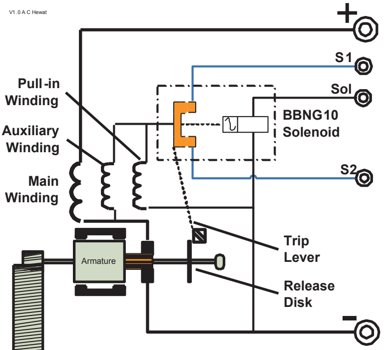


Fig 4 - CAV U 624B Axial Starter Motor

When the external starter button is operated, power is applied to the 'Sol' contact and operates the internal Solenoid closing the first pair of contacts but the second pair is held open by a pawl that engages in a slot in the trip lever. Once the pinion is near fully engaged with the ring gear, the pawl allows the second pair of contacts to close. Figures 2 to 4 illustrates the operation of the motor. Fig. 3 shows the first pair of contacts closed (the internal solenoid operated), which energizes the auxiliary and pull-in windings and armature. The armature rotates slowly and moves axially so that it is central to the field poles. Simultaneously, the pinion is slowly slid into mesh with the ring gear. When the pinion is on the verge of its full engagement, the release disc on the armature strikes the pawl so that the trip lever closes the second pair of contacts as shown in Fig. 4. This via S2 operates the external solenoids in BBNFA sequencing box providing power to the '+' terminal of the motor and current through the main windings, causing the motor to develop its full torque.

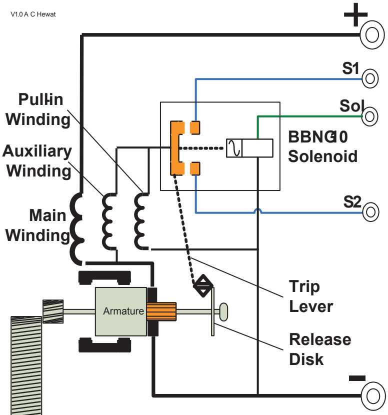


Fig2 - CAV U624B Axial Starter Motor

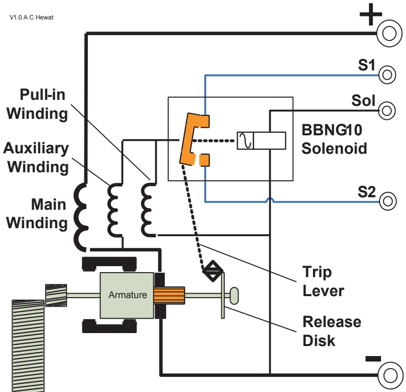


Fig 3 - CAV U624B Axial Starter Motor

As cranking speed rises, the current through the main and auxiliary windings decreases due to back emf generated by the rotating armature, especially when engine fires spasmodically but does not actually start. Now the magnetic strength in the main and auxiliary winding is insufficient to oppose the armature return spring and hold the pinion in full engagement. However, this is prevented by the pull-in winding as the current in this winding is not affected by the back-emf. Once the pinion has de-meshed and the armature has returned back, the momentum of the rotating mass tends to keep the armature rotating. This is however resisted by the 'generator effect' developed due to the interaction of the holding winding and the armature. This electrical reaction quickly brings the armature to rest. The pinion joins to the armature shaft through a small multi-plate clutch, which serves two functions.

(i) It slips when the torque applied to it exceeds a predetermined limiting value, so that the starter is safeguarded from damage if the engine backfires.

(ii) It disengages when the engine starts and tends to drive the pinion faster than the armature, so that the armature is prevented from damage by excessive speed.

2.3. Gardner 8L3B Starter Sequence of Operation

Refer to Figure 1. To operate the starting system the Enable Switch on the control panel needs to be in the up position. The indicator light will now illuminate. The operation of this switch also provides power to the starter button circuit and a positive supply to the S1 terminal of the starboard starter motor. As the starter button has not been pressed, a positive supply to the S1 terminal of these starters does not yet do anything.

Upon operation of the Starter Button a positive supply is connected to the Sol terminals of both the starter motors, this energizes the internal solenoids of both starter motors and provides an electrical path between the S1 terminal and the solenoid armature and the Auxiliary and Pull-in windings in the starter motors.

As the starboard starter motor has a positive supply on the S1 terminal the starter motor armature will start to rotate and move towards the flywheel ring-gear. Upon engagement in the ring gear the mechanical interlock on the solenoid is released by the forward axial movement of the rotor. This permits the solenoid to provide an electrical path between the S1 terminal and the S2 terminal. Power is still applied to the Auxiliary and Pull-in windings but the motor is now stalled, the low power windings not generating enough torque to crank the engine.

The S2 terminal of the starboard starter motor is connected to the S1 terminal of the port starter motor. The Starter Button is still pressed and thus a positive supply is available to the Sol connections of both starter motors and as the internal solenoids are operated the solenoid armature is connected to the S1 terminal. A positive supply appearing on S2 of the starboard starter motor provides power to the port starter motors Auxiliary and Pull-in windings via the S1 terminal and solenoid armature. The starter motor engages in the ring gear and releases the solenoid to stage two providing a connection between S1 and S2 and thus a positive supply now appears at S2. Both starter motors are fully meshed with the ring gear and a positive supply on S2 of the port starter motor energizes the two solenoids in the BBNFA control box providing a positive supply to the positive terminals of the two starter motors and thus their main windings, applying full power to both starter motors to crank the engine.

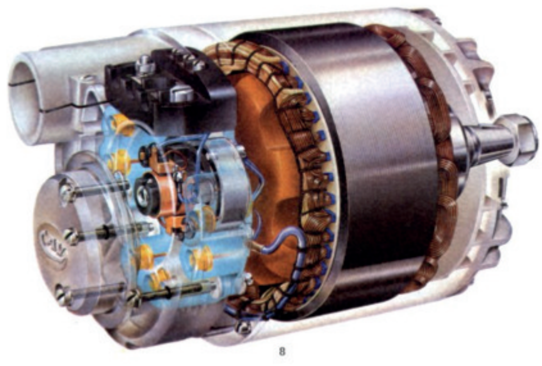
Alternator and Charging Circuit

2.4. Description

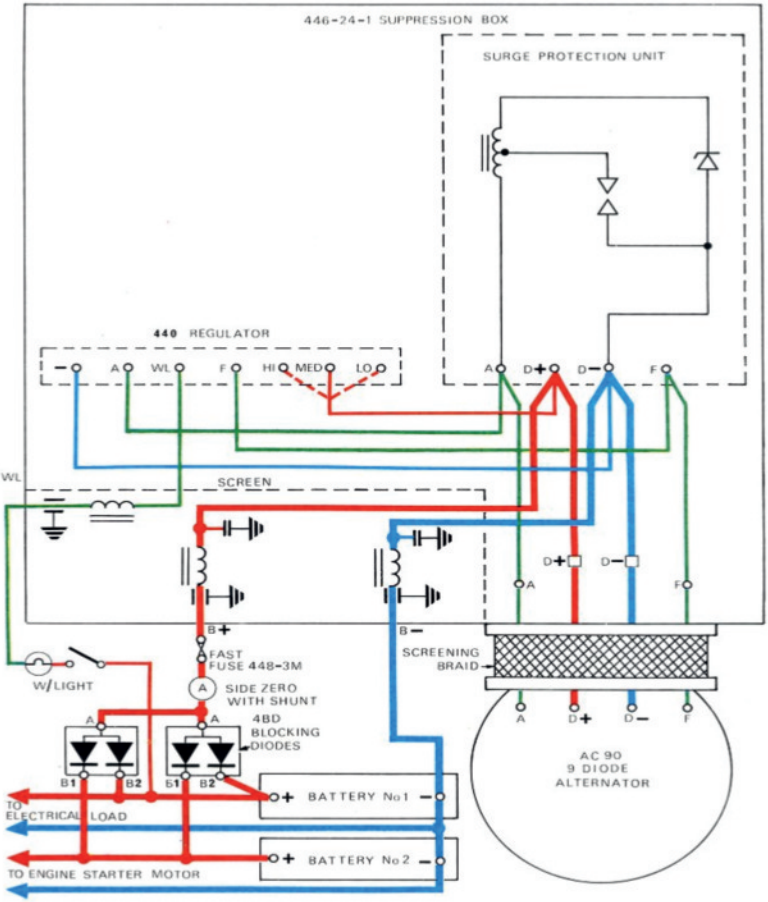
This system comprises of CAV AC7B24-209C2M alternator and a 446-24-1 RFI Filter and Surge Suppression box. The purpose of the Filter and Surge Suppression is to house the regulator and provide RFI screening and filtering on the alternator supply. This is a typical marine installation where HF radios are used and thus electrical interference suppression is a requirement.

2.5. Alternator

The CAV AC7B alternator uses an external regulator contained in the RFI box with the surge filter and radio interference suppression components. The alternator is driven by two belts and can produce approximately 60A output. The unit **MUST HAVE** a 1697D520 CAV 440D-24 regulator for correct operation (now replaced by a VRG3691).



The AC7B series alternator is a three phase unit with 6 rectifier diodes contained within the case. There is **NO** internal regulator and the unit must not be operated without the external regulator connected. The regulator and filter box assembly does not permit remote monitoring of the charge voltage. To compensate for this there are three connections on the regulator labelled HI – MED – LO so as to provide a fixed level of compensation for the external connecting cables. Figure 5 shows the connections for the alternator and associated items configured for dual batteries and the necessary blocking diodes.



Note: Should any 440D regulator other than the 440D 24–11 version, be used for this application, terminals 'A' and 'D+' of the surge protection unit MUST be linked.

Fig 24 Twin blocking diode applications

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Figure 5 – Alternator Connections & RFI Suppression Box

2.6. RFI Suppression Box

The CAV Suppression Box contains the alternator's regulator and RFI suppression components and is connected to the alternator via a screened multicore cable. The cable screening braid must not be used for a negative return conductor

2.7. Surge Protection Unit

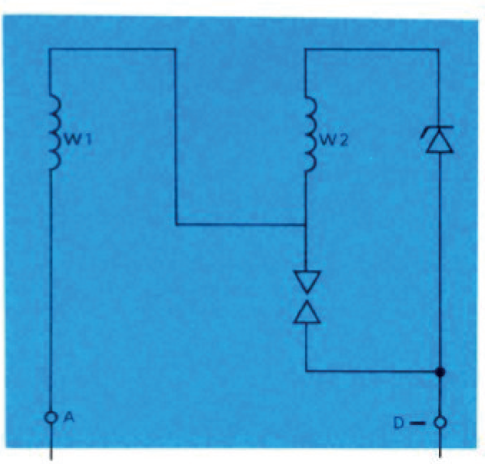


Figure 6 – Surge Protection Unit

Under normal conditions the zener diode is non-conducting and the unit is inoperative. When voltage surge conditions occur, the zener diode conducts within approximately 5ms and current flows through both relay windings, causing the relay contacts to close. These contacts are connected across the 'A' and 'D-' terminals and are in series with winding W1 of the Relay. The current through W1 is sufficient to hold the relay in the closed position, and in this position the alternator and field are short circuited causing rapid collapse of the alternator output. Closing the contacts also short circuits the zener diode and winding W2. The relay contacts remain closed until the alternator output falls to a value slightly higher than that obtainable from the residual magnetism of the rotor This ensures that the relay contacts are always open – thus restoring the charging circuit to the normal operating condition.

2.8. Regulator

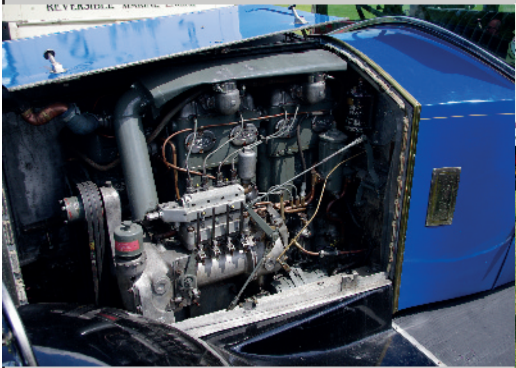
The CAV AC7B alternator uses an external regulator contained in the RFI box with the surge filter and radio interference suppression components. The regulator is a 1697D520 CAV 440D-24 for correct operation (now replaced by a VRG3691). The internal operation of this solid state regulator is beyond the scope of this document.

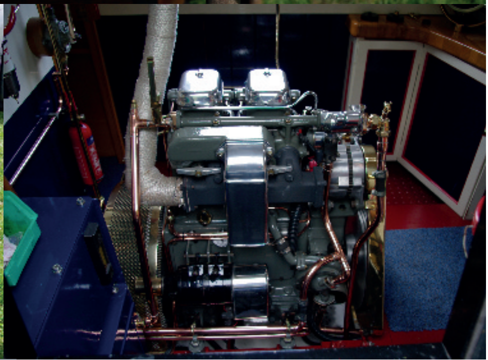
The sense input to the regulator (LO, MED, HI) should be set for the correct float voltage at the battery terminals of 27.6V, for standard lead acid batteries.

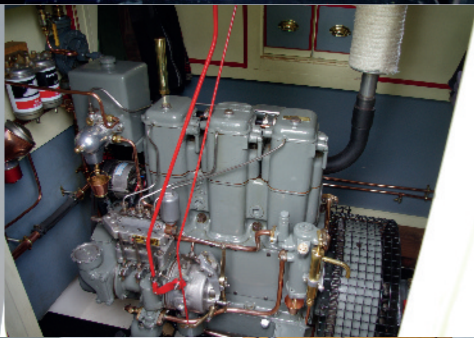
Acknowledgements

Some of the above diagrams and descriptions are copied from CAV publications and are thus taken out of their original context.

A Selection of vehicles from the Rally Weekend

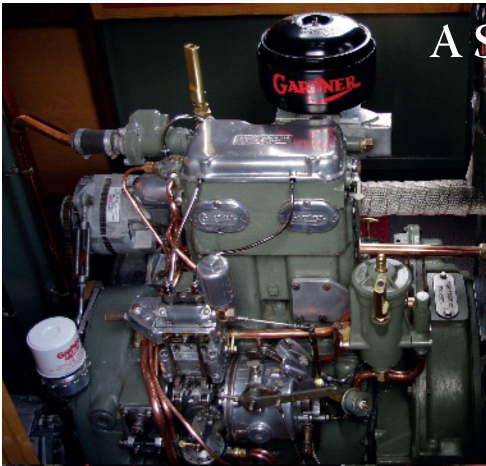


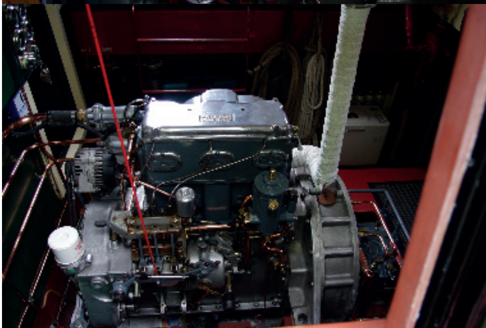




IHF and a selection of L2's

A Selection of LW's





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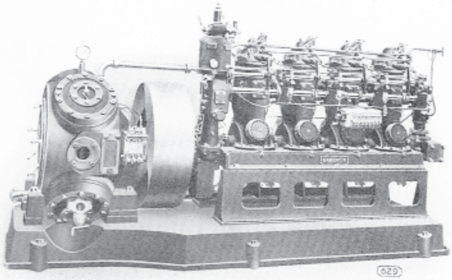
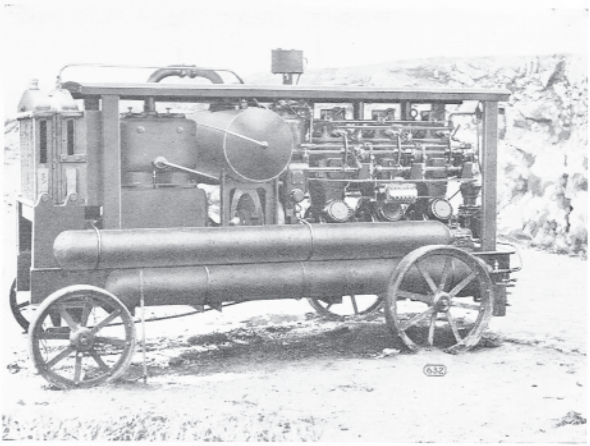
GARDNER
HEAVY OIL
ENGINES

STATIONARY ENGINES (*continued*)

Compressor Sets.—These engines are also used for direct coupling to Air Compressors. The accompanying illustration shows a typical set of a Reavell Air Compressor coupled to a T Type



Gardner Heavy Oil Engine, one of many sets that we have supplied to a Department of H.M. Government. The photograph shows a 4T4 engine of 48 BHP. This set, in particular, was subjected to an official test which included two separate non-stop runs of 100 hours each at full load.

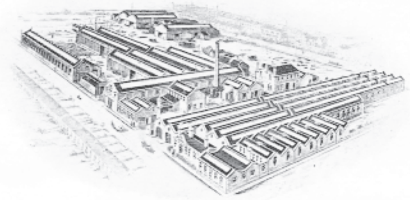


4T4 Stationary Engine, 48 BHP, coupled to an Air Compressor.

WHERE GARDNER PRODUCTIONS ARE MADE

L. Gardner & Sons Ltd.

Established 1868.



Barton Hall Engine Works, Patricroft, Manchester.

THE Barton Hall Engine Works, with their Recreation Grounds, cover about 25 acres. Though the firm is an old one, dating from 1868, its home is of the most modern description, constantly and continuously kept abreast with the enormous developments which have taken place in engineering practice during recent years. In it are lodged the

Iron Foundries,	Machine Shops,	Physical and Chemical Laboratories,
Brass Foundry,	Fitting and Erecting Shops,	Power House,
Forge,	Component Stores,	Research Bay,
Pattern Shop,	Test Bay,	Inspection Bay,
Pattern Stores,	Shipping and Packing Bay,	etc., etc., etc.

One of the features of the works is the huge Component Stores, where are kept in stock, under a " maximum and minimum " system, all the components which are required for the erection of engines. The primary object of this stores is to facilitate the administration of the works, but it will be conceded that it facilitates equally the expedition of spare parts and the delivery of engines.

Closely related to the Component Stores is the Inspection Bay, where every component is passed by a large staff of inspectors. This inspection applies to every operation and every component ; in other words, a batch of components is not allowed to go for any one operation until the preceding operation has been inspected and passed.

The power throughout the works is distributed electrically from Generator Sets driven exclusively by Gardner Oil and Gas Engines, which, apart from their primary function of power generators, furnish valuable records as regards reliability, durability, wear and tear, consumption of fuel, and cost of maintenance. And, above all, their consistently satisfactory behaviour, year in year out, stands as most eloquent testimony of their high commercial value.

GARDNER HEAVY OIL ENGINES

MATERIALS USED IN GARDNER PRODUCTIONS

LITTLE or nothing has been said on this subject in the general description herein, for the reason that the variety of materials now available is so great that a specification for each component would be wearisome to read. Suffice it to say that, for the most part, the selection of materials is entirely governed by the function that each component has to perform. For example, components made of steel, where hardness is of primary consideration, are made of steel which will harden, the components being afterwards finished and sized by grinding. On the other hand, the bolts in the big end of the connecting rod, for example, the failure of which would wreck the engine, have to withstand rapid variations of stress, and so are made of very special steel. Again, the iron used for cylinders and piston castings has to combine great hardness with strength, while that of the engine beds, flywheels, etc., is governed mainly by considerations of strength.

The various properties of all the important materials are verified by daily tests made in our Physical and Chemical Laboratories.

To Be Continued

Disclaimer please see note 3 on page 1