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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Cover Picture

Ex R.N.L.I. Lifeboat

Grace Ritchie

Chairman's Jottings

Another year, another year older and another year as chair

Having said that I cannot remain as chair for another year, I found myself pinned into a corner, so you will have to put up with my dribble one more.

For those who made the effort to attend the AGM in March,I personally thank you also those who sent their apologies.

The AGM was well attended and we have A NEW MEMBER ON THE COMMITTEE, Judith Gray who has taken on the role of treasurer. Judith is a customer service manager for a leading high street bank so can be relied upon to not abscond with the proceeds of the bank account. Steven Gray who organised last years rally at Park Head Locks Dudley has taken on the job as editor, they both work together as a great team, thank you both.

I will miss Mike and Lucy but life goes on, I am not sure that we will be seeing them again, Mike and Lucy brought a great deal of professionalism to the forum, especially when taking over the accounts without any paperwork at all.

We wish them all the best whatever they do

Bob Heath will continue as membership secretary, thank you Bob.

This leave's a vacancy for the secretary's position, new blood would be most appreciated and is essential if the forum is to continue, this not an onerous position If anyone would like more information please contact me.

I will be planning next years rally, with Milton Keynes on top of the list, any other suggestions would be considered, assistance would be gratefully accepted especially from anyone who lives in the area.

Colin Paillin

Chairman - Gardner Engine Forum

How did this happen? By Judith Gray

Despite having discussed the pros and cons of future commitments, deciding “no” stay as we are! How is it that after meeting up with friends again, sitting down to a nice lunch, chatting away putting the world to rights, even confirming to each other during the short journey from the hostelry to the Anson Engine Museum, did I find myself changing my mind and realising that “no I did not want the forum to be put to bed, when Steve and myself could take up the opportunity to step into Mike and Lucy’s shoes (big ones to step into and follow) and keep things going.

We all feel that we are too busy, been there before done that, but the bottom line is that with a small group such as our own unless people are prepared to say “yes” and help then this next year may be the last for the forum, do you really want this to happen? If anyone is thinking “what can I do” then maybe an hour every six months to jot down some thoughts, stories or anecdotes and send them to us for the magazine, or contact Colin and offer some much need assistance. Lets hope that a “no” that turned into a “yes” will encourage others amongst you to think “yes I can”. As the saying goes use it or lose it !!!!!. It would be a shame to lose what we have.

Excerpt from Technical bulletin RD 247 relating to governor modifications and tick over speeds on LW engines

Idling Speed, When an engine embodying 'K' type modifications is mounted in the chassis by means of a well designed arrangement it may with advantage be set to the low idle speed of 330 R.P.M. In other event determined by engine mounting characteristics or the use of a hydraulic coupling, the selected speed is 425 R.P.M. In order to obtain the low speed idling it is necessary to fit a new governor rack spring exerting approximately 20 ounces load. The 425 R.P.M, idle speed is provided by the previous standard spring exerting approximately 29 ounces

Governer Bar Buffer Setting Procedure.

The correct setting for the governor bar buffer when engine is hot Is as follow

Set engine at 330 R.P.M., screw in buffer one hexagon flat at a time until speed rises withdraw three hexagon flats and lock up',

Set engine at 425 R.P.M., screw in buffer one hexagon flat at a time until speed rises withdraw ten hexagon flats and lock up',

When engines are equipped with hydraulic couplings the correct setting is 425 R.P.M., with gear in neutral

Generally.

i) It is recommend that the modifications are effected only at the time of major overhaul of an engine

2) As for all engines it is highly desirable that induction arrangements be provided whereby the engine is permitted to induct the coolest possible

Please refer to Engine Instruction Book No. 56

THIS COMMUNICATION SUPERSEDES ANY PREVIOUS ISSUES ON THE SUBJECT

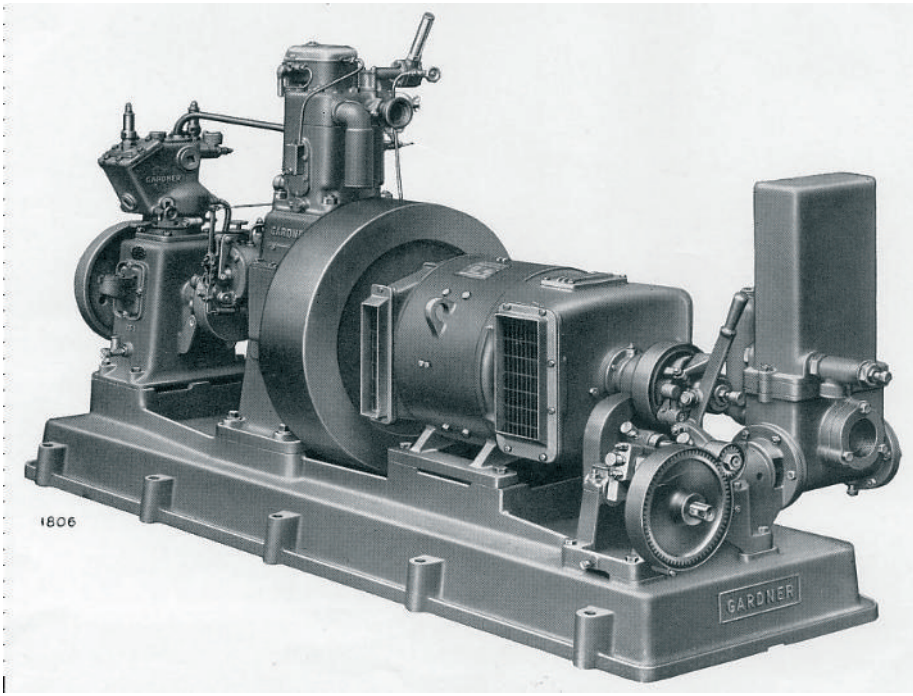
The Gardner Bug
By Jeff Ramsey - Membership No 226

Continued

After returning from the Walsall rally I was determined to try and find the missing parts from the fuel system of the 1L2. After asking around various members of the Brill Vintage Preservation Society (of which I am the Secretary) it was suggested that Bob Rose (a member of the same society) may well have the fuel filter assembly and air reservoir that I was looking for. A phone call was all it took to confirm that he did indeed have the parts, so I visited him at the weekend to purchase them. As is common among engine men, I was invited to have a look around his “collection” while I was there. Now Bob is not your normal engine collector, he belongs to a family of fairground ride owner/operators and can be seen at many local fetes and rallies providing children’s rides and entertainment sideshows, So Bob’s collection included some huge fairground machinery as well as stationary engines and very many generators. One engine in particular took my fancy – a Gardner 5LW resting under a tin sheet. It was black with old oil from top to bottom and was bolted onto huge engine bearers made from steel “I” section about 20 inches high, that looked as if they had been salvaged from an old ship! Bob’s son started the engine with a single swing of the starting handle, it sounded very good indeed. At tick over it was exactly how I remember a Routemaster bus sounded in my youth. So I arranged to buy the 5LW together with a large Broome & Wade twin cylinder sleeve valve compressor for it to drive and a genuine Smiths radiator to cool it.

The 5LW started its life powering an ERF lorry, When the lorry had come to end of it’s life, the engine went on to run a generator that powered woodworking machinery in a local factory. Bob and a friend bid for the engine at a dispersal sale, they then split the purchase, Bob having the engine and his friend having the generator. Bob never put the engine to use, but just kept it ready for use, so that he could start it now and again for pure pleasure. As luck would have it, my employer was scrapping four 9 foot lengths of six inch square, rolled hollow steel tubing, so I snapped them up to make a suitable chassis for this large engine and compressor combination, when I get around to the restoration.

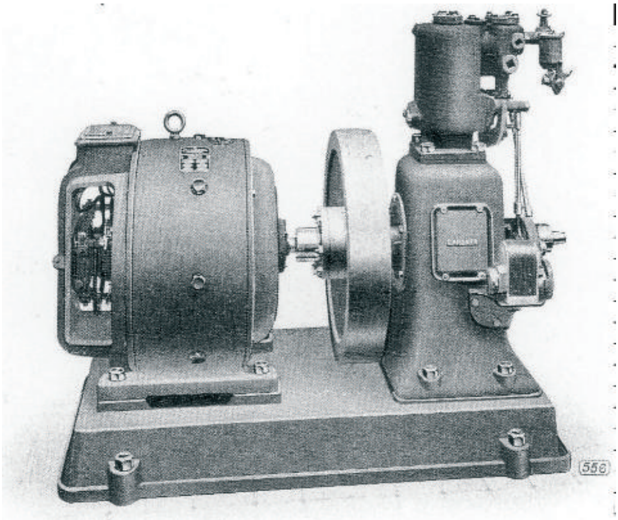
In early summer 2003, a fellow stationary engine collector, Stan Mills, told me of a friend who had a Gardner engine for sale and was I interested? Of course I was, so after getting the contact details from Stan, I phoned Stan’s friend, Dave Povey to pursue the purchase, only to find out that he had already sold the engine, but did have a Gardner water pump for sale, not yet sold. When I said that I did not know Gardner’s made water pumps, he replied that he did not either, until he bought this one from a chap in Manchester. I called round to view the water pump on the way home from work, as it was only about 30 miles out of my normal route home. It was a very unusual pump, unbolted into two more manageable lumps for transport. He had done nothing to it since he had bought it. The asking price was reasonable, so I purchased it. Before loading the pump into the back of my Landrover, Dave asked if I wanted to see the Gardner engine, as the purchaser had not yet called to collect it. I agreed to have a look. It was a very small but delightful generator set powered by a vertical single cylinder engine.



Gardner marine auxiliary set showing the general service water pump (right hand end)

Now Stan, Dave and I all belong to the Chiltern Traction Engine Club, Stan and I collect stationary engines and Dave collects vintage lorries, so we see each other occasionally at club meetings. At one such meeting, Dave tapped me on the shoulder and asked if I was still interested in the Gardner engine, as the original purchaser had changed his mind about the purchase, it was mine if I wanted it. YES, I gave him all the cash I had in my wallet as a deposit, agreeing to call round the following day with the balance and pick up the engine. After doing some research it turned out that it is a Gardner 0V country house lighting set.

It was only a matter of one week before the next Gardner rally at Nottingham, so I decided to take the water pump and the lighting set with me to add to the interest of the rally



Gardner 2V lighting set (larger brother of the 0V lighting set)

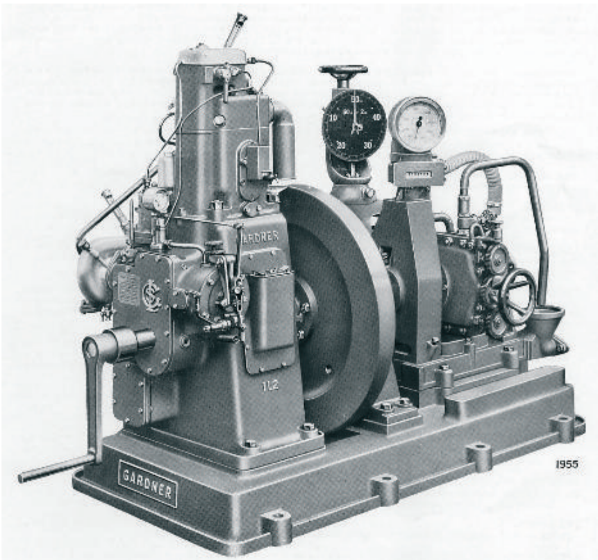
The 2003 Gardner Rally on the embankment of the river Trent in Nottingham was very nice indeed. One felt very privileged to be camping out in a riverside park in the middle of a city. Dion Houghton, who runs the Gardner Vintage Engine Register, was in attendance at the rally, so it was an ideal opportunity to ask him to verify that the water pump was of Gardner manufacture, as the only identifying feature was the Gardner brass nameplate (which could have been attached fraudulently to anything). Dion said that he was fairly sure that it was genuine Gardner, but it was the only one he had ever seen. He was going home this evening and returning to the rally in the morning, if he could find some documentation to prove the pump's lineage, he would bring it with him tomorrow. On Sunday Dion came over to see me, armed with a Gardner sales brochure showing the water pump as part of a marine auxiliary set, consisting of a 1L2 engine, generator, air compressor and water pump, all mounted on a cast iron base.

Dion also said that he would later send me a copy of the brochure, also, could I send him any details of the 0V lighting set, so that he could add it to the records.

Virtually all Gardner engines I have seen are painted grey, but the shade of grey seems to vary enormously. I took the opportunity of asking Dion what shade of grey a Gardner engine should be, His reply was “ a grey so dark that it might be mistaken for black”.

As the 0V engine has no cooling system, I only ran it for a few short runs at the rally. It starts easily but does not run very smoothly, unless you press down lightly on the air admittance valve stem, I think the spring on this valve is too strong, so I will have to experiment with some weaker ones when I get around to restoring the lighting set.

When attending rallies, I normally have heavy engines in the trailer, pulled behind my Landrover, so camping overnight for a weekend rally is the norm. The 2005 Manchester Gardner Rally turned out to be a real challenge to my boy scout training, as there was not a single bit of turf to be had on which to pitch the tent. After a bit of experimentation I found that by adjusting the frame of the tent, it could be persuaded to fit inside the trailer, just as well it is a large trailer! Once again the site of the rally was in the middle of a city surrounded by railways, canals, roads and large buildings – very interesting. One of the static exhibits was a1L2 laboratory engine on the back of a lorry, still on the bed casting, coupled to a Heenan & Froud dynamometer, so I could now see how my laboratory engine would once have looked



Gardner 1L2 Laboratory engine and dynamometer

Restoration of the Gardner water pump was now at the top of my workshop list, so I got stuck into the task. Most of the fixings came apart reasonably easily, but a few proved to be impossible. The pressure release valve is a large brass casting that is fairly fragile and would not unscrew from the air chamber above the pump, no matter how much force I put into it. Fortunately there was a fair length of thread showing outside of the air chamber casting, so I was able to carefully saw off the safety valve, split and remove the brass stub from the air chamber, clean out the thread and refit the safety valve using the excess thread length.
All the exterior surfaces were cleaned down to the bare metal with a needle gun. Under the rather crudely applied top coat of paint I found a very dark grey finish that might be mistaken for black, with a lighter undercoat beneath it. So that backs up the opinion of Dion.

I found the bore of the pump and the piston were very worn. I also found a gritty deposit in many places inside the pump, that must have caused the wear. I set about re-boring the pump on my lathe, using the method of bolting the pump housing to the saddle and fixing the boring bar between centres. Although I initially found the bronze material of the pump bore to be very abrasive, a change from HSS to carbide tipped tool, soon had a nice smooth round bore. I then made a new piston to suit the new bore diameter.

The crankshaft of the pump was only slightly worn but the big end bearings and the main bearing were more worn. I made a lapping tool to clean-up the journal surfaces of the crankshaft. I made new big end bearing shells from leaded bronze and a new pair of fitted bolts to hold the big end cap in place. The main bearing surface of the pump is the cast iron of the bed casting and a pair of cast iron caps, so I skimmed some metal off of the mating surface of both caps, then using engineers blue and lots of patience, I scraped surplus material from the bearing surfaces of both the bed and the caps, until the caps once again clamped against the bed and the crankshaft was a nice running fit with about a thou and a half of clearance.

When I purchased the pump, lubrication of the various pump bearing surfaces was accomplished by oil bath wick oilers and a motley collection of screw cap greasers, all to differing designs that were probably not original equipment. If neglected or allowed to collect water, open oil bath lubricators are a sure source of bearing troubles, and as this pump is going to be exhibited in the open, I thought I would make enclosed oil bath lubricators for the pump. One of the oilers fitted to the pump was a particularly nice brass one with a spring loaded cover, so I have made seven slightly larger copies of this oiler to fit to the various lubrication ports around the pump, they all make a nice matched set.

The upper casting of the pump is different to the one shown in the illustration above, it has four mounting pads with a half inch Whitworth tapped hole in the centre of each pad. I do not know what these originally did, but I have used them to mount

a fuel tank for the engine. I will pump the fuel from here to the 1L2 filter block with a home made fuel pump to be driven from the water pump crankshaft.

The illustrated parts list that was supplied with the 1L2 engine shows a heat exchanger, that mounts onto the engine inspection plate next to the cooling water pump, I have made a similar one and will feed cold water through it from the general service water pump.

The 2007 Dudley Rally was at a superb site with lots of room for all of the entries. I constructed a wanted poster for some Gardner parts that I need and attached it to the safety fence in front of my 1L2 engine, in the hope that a passing Gardner enthusiast might just have the parts I was looking for. I had a few promising contacts given to me over the weekend together with some comments like " you will never find one of those". All but one of the contacts turned out to be unable to help, but following the one good lead to Derbyshire, Rob Knowles came up trumps with three gems

A bed casting for the 1L2, that usually has a generator bolted to it for the engine to drive, but in my case I want to mount the general service water pump on it for the engine to drive. A rocker box cover for the 1L2, my present one has been welded back together from a collection of broken pieces. A 22 inch diameter flywheel for my Gardner 0V engine, that has a single small flywheel (from a pair), instead of the single large flywheel that is specified for a generator set. The documentation that I have states that the flywheel should be 22 inch diameter by 2.5 inch face width. This does seem very large for such a small engine, but it will fit into the cut out in the bed plate that is intended to provide clearance for the flywheel. The flywheel that Rob has supplied has come from an LW series engine and will therefore require modification on a very large lathe before I can install it on the 0V engine.

We are now up to date on my Gardner story. I have cleaned and primed the 1L2 bed casting and am currently building a sub-chassis to go underneath it. This sub-chassis will allow me to fit removable wheels on stub axles, so that the exhibit will sit directly on the ground for display purposes, but be easy to move onto and off of the trailer for transportation. The next steps will be to get the chassis and bed casting mobile (sitting on the wheels), then start to assemble the 1L2 and pump onto the bed casting. This will involve a new coat of paint for all of the iron, a lot of polishing for the aluminium and a lot of plumbing for the fuel, pump water and cooling water.

THE STARTING MOTOR

Automobile starting motors are usually of the Series-wound type, in which the field-coil windings are in series with the armature winding. This arrangement gives the maximum starting torque, for there is very little resistance at zero or very low speeds. The starting motor is connected direct to the battery, a switch being interposed The usual wiring diagram of the automobile starting motor is an entirely
separate circuit, and there are no connections with the switchboard, lighting, or dynamo circuits. The starting switch may, of course, be on the switchboard, but its wires are separate from the other circuits.
Fig. 272A shows the wiring diagram of a single-pole starting motor circuit. In this case the positive terminal of the battery is earthed and the negative connected through the starting switch to the one pole of the motor; the other pole is earth the frame

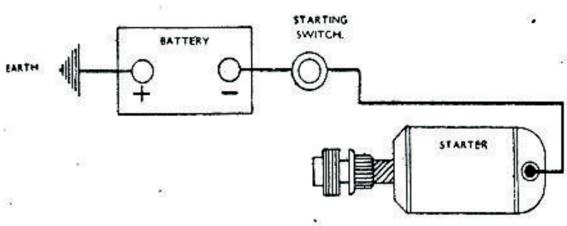


Fig. 272A.—Starting-motor Wiring Method.

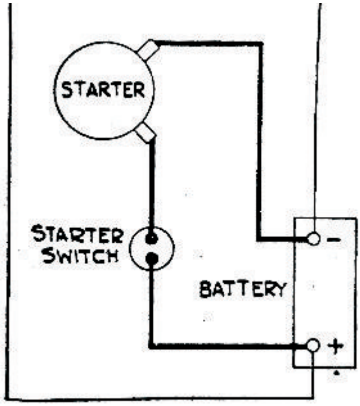


Fig. 272B.—Starting-motor Circuit (Double Pole).

Fig. 272B illustrates the wiring diagram of a starting motor of the Two wire or "pole"
system. In this case both positive and negative terminals and leads are insulated from the frame.
The fine lines from the positive and negative battery terminals indicate the leads to the switch board for the dynamo and lighting circuits

The type shown in Fig. 273 is known as the "Inboard," and is one in which the pinion moves inwards towards the motor to engage the flywheel teeth; in the case of the "Outward" type, it moves outwards (Fig. 274). A bearing is arranged at the end of the shaft, in this case to prevent the shaft bending.
The exact method of operation of the gear is easy to follow. If the shaft were standing still and the pinion were rotated it would travel along the sleeve and would engage with the flywheel.

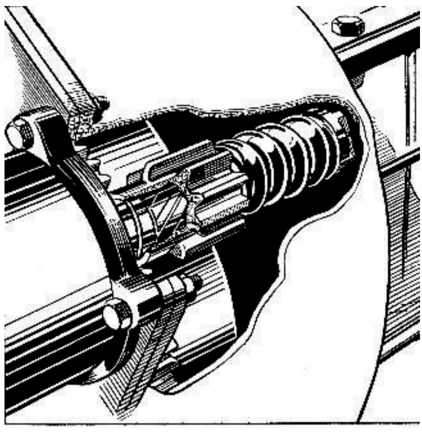


Fig. 273.—Inboard-type Starting Motor.

An exactly similar proceeding takes place when the pinion is at rest and the spindle is put in motion by operating the starter switch. When this is done, the pinion is drawn along the sleeve and engages with the gear ring on the flywheel; as soon as it is fully meshed it rotates the engine. When the engine fires it over-runs the motor and automatically thrusts the pinion out of engagement.

Starting Motor Characteristics and Data

Two principal types of starting motor are employed for motor vehicles,namely the four-pole four-brush series one having two field windings, as shown in Fig. 275, and the four-pole four-brush series with four field windings (Fig. 276). The former type is used for small cars and the latter for cars and commercial vehicles.

Refering to fig 275 as the starting current is much lower than for the larger starting motors, a switch someimes of the pedal operated type can be used in the supply line from the battery to starter. In the instance of larger motors, Where heavy currents flow through the main starting circuit, a solenoid switch is fitted on the motor casing, as shown in Fig.276. This is energised by current from the ordinary supply,so that only a low value of current is required and a simple dashboard press button switch can be used for starting purposes.

The effort or torque required to rotate the engine is much greater with the engine initially at rest; it is known as the breakaway torque. Once started, a much lower torque is required; usually about twice as much torque is needed for starting than for turning at the usual low cranking speed (60 to 90 r.p.m.).

The starting motor must be capable of providing the breakaway torque, and in this connection the starting-motor torque is known as the locked torque The torque needed to rotate the engine after starting from rest is known as the driving torque. From tests made to determine the effort required to start various types

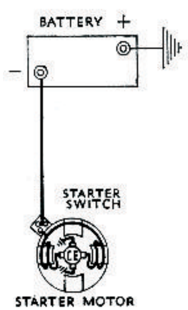


Fig. 275.—Starting Motor with Two Field Windings.

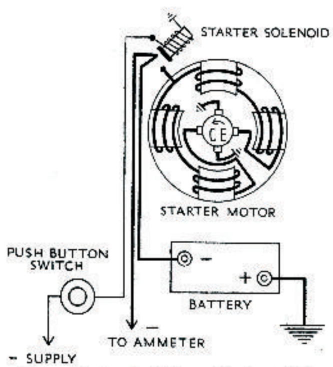


Fig. 276.—Starting Motor with Four Field Windings.

continued on page 14

Grace Ritchie

Ex RNLI Clyde class 70ft lifeboat. Owned by Iain Crosbie

This boat was built at Yarrow's of Scotstoun in 1965 as the second in a class of three 70ft steel lifeboats. Originally named "Grace Paterson Ritchie" after the lady from Skelmorlie who bequeathed the £65,000 required for its construction, the boat was launched in 1966, and was named at Wemyss Bay Pier on 6th September 1967.

This class of boat was the largest ever built for the RNLI, and the only class ever designed to be permanently manned, and has accommodation for the crew, and a galley. The boat has a double hull construction, the space between the inner and outer hulls being filled with expanded foam buoyancy. In addition there are double bottom tanks some of which are used for fuel, water and ballast. The hull is divided athwartships by seven watertight bulkheads, and there are two engine rooms, separated by a longitudinal watertight bulkhead. Each engine room houses a Gardner 8L3B diesel engine of 230 bhp, and a 30kva 230v generator.

Following extensive trials and demonstrations around the British Isles and in Scandinavia the boat was stationed temporarily at Kirkwall. In 1969 both 70-002 and the Longhope lifeboat were called out to aid the cargo ship "Irene", in trouble in a storm off the Orkney Islands. Sadly the Longhope boat was overwhelmed by the exceptionally high seas and all the crew were lost: at this time lifeboats including 70-002, were not self-righting. The loss of the Longhope boat led to the permanent establishment of 70-002 in Orkney, becoming based at Kirkwall in 1971

When these boats were withdrawn from service by the RNLI in 1988, Grace Paterson Ritchie was sold to the Icelandic Lifesaving Association and left Kirkwall for Iceland on 22nd March 1989 to become the Reykjavik lifeboat "Henry A Halfdansson" where it remained in service until 2002, when it was sold into private hands, and returned to the Clyde.

The boat is 70' in length, 17' beam, draws 7'6" and displaces 78 tons. The vessel carries 1140 gallons of fuel and has a maximum speed of 11.75 knots. At the cruising speed of 9.5 knots it has a range of 1000 miles and an endurance of 4 1/2 days.

Thanks to Iain for the use of this article and the photo’s. (Ed)l

of petrol and high speed oil engines from the cold under various temperature and oil viscosity conditions, the corresponding starting torques have been estimated, and the electrical manufacturers have provided a range of starting motors to cover all existing engines.
The usual range of starting or locked torques is from about 30 to 100Ib.-ft. for motor-cars and commercial vehicles.

It may here be mentioned that the series-wound motor has the desirable property of giving its greatest torque when starting from rest, the torque thereafter diminishing with increased engine speed. A typical starting motor operating from a 12-volt battery would develop a maximum of 1-3 b.h.p. at about 1,500 r.p.m. and have a starting (locked) torque of 73 to 77 Ib.-ft.,falling to about 50 Ib.-ft.at 500 r.p.m. The starting current would be about 450 amperes, falling to about 300 amperes at 500 r.p.m.

It should be noted that the speeds given are the actual motor armature ones. Since the motor is geared down to the engine flywheel starter ring usually in the ratio of 1 : 10 the engine speeds corresponding to 500 r.p.m. will be 50 r.p.m. In the case of Diesel-engine starting motors, these require to be more powerful than for petrol engines of the same output. The cranking speed to start the average commercial-vehicle Diesel engine are appreciably higher than for the petrol engine; the usual starting speeds are from 90 to 180 r.p.m.

Starter motors of 4 to 6 b.h.p. are fitted to such engines, and in these the starting currents range from about 600 to 1 ,000 amperes, falling to about 500 to 600 amperes when the motor is exerting its driving torque at 100 to 150 r.p.m. (engine speed).

The Lock Torque Test

The lock or stall torque is the torque required to start the engine from rest. Most starter motor manufacturers give information on the values of the lock torques of their motors, so that the latter can be checked after overhaul or should any loss of power occur in service.
The method of making the lock torque test is illustrated in Fig. 284 in the case of the Simms axial starter fitted to certain Leyland heavy vehicle engines. The starter motor is mounted with its casing fixed securely to a suitable bracket, and is wired up to the battery, solenoid, and push switches as indicated in Fig. 284. An am-

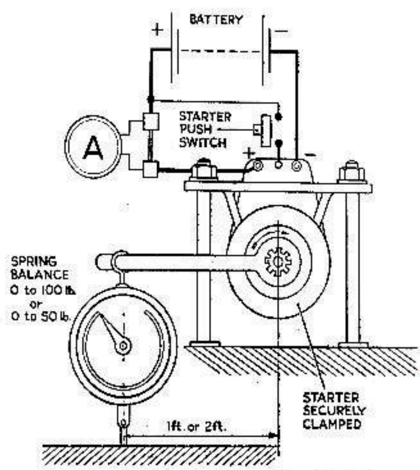


Fig. 284.—Making a Lock Torque Test (Leyland).

meter reading up to 1,500 amperes is connected in shunt as shown. A flat plate should be fitted over the plunger cover screws so that the pinion is held in the engaged position.

Arrange a steel arm to engage the pinion teeth at one end, and a spring balance at 1ft. or 2 ft.as the case may be, from the centre of the pinion. The spring balance-must read up to 50 Ib. for the 2-ft. arm or 100 Ib. If used with the 1 ft. arm. When the push is operated, the current should rise rapidly to a peak figure which, together with the corresponding spring balance reading, should be noted. With a 24-volt 180 ampere-hour battery, the readings should be 90 Ib.-ft. and 1,200 amperes.

Commercial Vehicle Starting Motors

Two different types of electric starting motors, subsequently referred to as "starters," are employed for commercial vehicles, namely, the Non-axial Starter and the Axial Starter (Figs. 291 and 292).Usually, these are similar in regard to certain electrical details e.g. the armatures and brush gear, etc., so that the general information on their maintenance is applicable for such items The two types of starter, commencing with the axial type, are described in the following pages.

The commercial vehicle starters, except for light delivery-van chassis, generally employ special solenoid starting switches, particulars are given later

Axial Starting Motor

The axial type of starting motor,of which the C.A V is a good example, is fitted to different makes of commercial vehicle. It is so called since the armature with its shaft is capable of axial movement in its bearings. When extended its shaft engages the pinion with the teeth on the flywheel rim.

It is held in a disengaged position by means of a spring fitted inside the shaft at the commutator end the armature being thus kept out of complete register with the pole shoes!

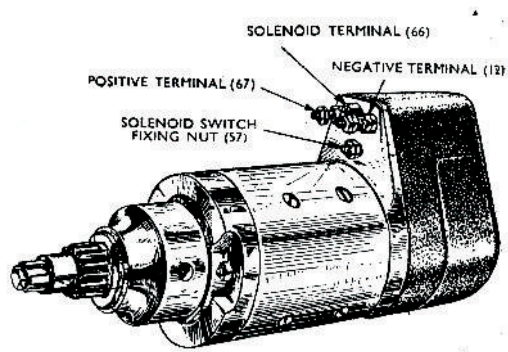


Fig. 292.—The Simms Axial Starting Motor.

The field winding of this machine is divided into the main series winding and the auxiliary series winding and a shunt winding. When the starter switch is operated a small current passes through the shunt and auxiliary field windings causing the armature to commence to rotate slowly. Simultaneously, the magnetic field set up pills the armature forward and brings the pinion into mesh with the engine flywheel teeth. This movement also causes the triping disc to operate the tripping lever attached to the contacts of the solenoid switch which completes the main circuit. The full current from the battery then flows through the armature and series winding, the motor then entering its full torque. When the engine starts the motor current is reduced, the magnetic field diminished, and the tension of the spring overcomes the magnetic force, thus disengaging the pinion. Even if the starter switch is kept engaged the starter will not again couple up with the flywheel rim teeth, but will continue to run free.

This is not the case, however, with motors fitted with " holding-on "windings in which the pinion is held in mesh with the flywheel teeth until the starter button is released. On some machines this arrangement is carried a step further, the pinion being held in mesh until either the cut out points close or the starter button is released, disengagement being effected by whichever operation occurs first. "Holding-on" windings on certain types of axial starters have the effect of reducing the number of engagements necessary to start the engine.

Another special feature of the axial starter is a unique overload device which prevents damage occurring during an engine backfire. This consists of a single screw and spring-loaded clutch arrangement which has a slipping torque about three times the lock torque of the starter, but is below the shearing strength of the starter pinion teeth so that instead of breaking the pinion teeth the clutch slips under excessive load. A modified design,known as the " two-step " clutch, is fitted to certain motors; this not only prevents damage through backfires but also prevents any load being taken by the pinion until it is in engagement with the flywheel teeth. The phosphor bronze pinion is designed to withstand all normal working conditions, but should any wear occur it takes place on the pinion and not the flywheel teeth, thus reducing maintenance costs.

Avoiding Excessive Pinion Wear. In this connection it is important to note that following a failure of the engine to start, after "firing" to allow both the engine and starter to come to rest. Otherwise the teeth on the phosphor bronze pinion will be milled away quickly, causing complete failure of the starter and the expense of fitting a new pinion.

The C.A.V. Axial Starter Motor

It is now proposed to describe in more detail the starter fitted to heavy oil-engine vehicles, e.g. the Leyland " Comet "and A.E.C."Mammoth Major."The starter, which is shown in dismantled form in Fig. 293, is the C,A.V,Type BS5224K, operated from a 24-volt battery. It has a reduction ratio to engine flywheel ring of 13.25:1.It employs a clutch "overload" device (Fig. 294) to prevent any damage occurring due to an engine backfire.

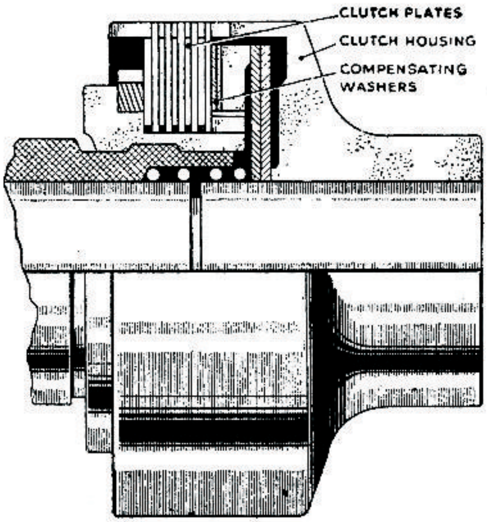


Fig. 294.—The Leyland C.A.V. Starter Clutch Overload Device.

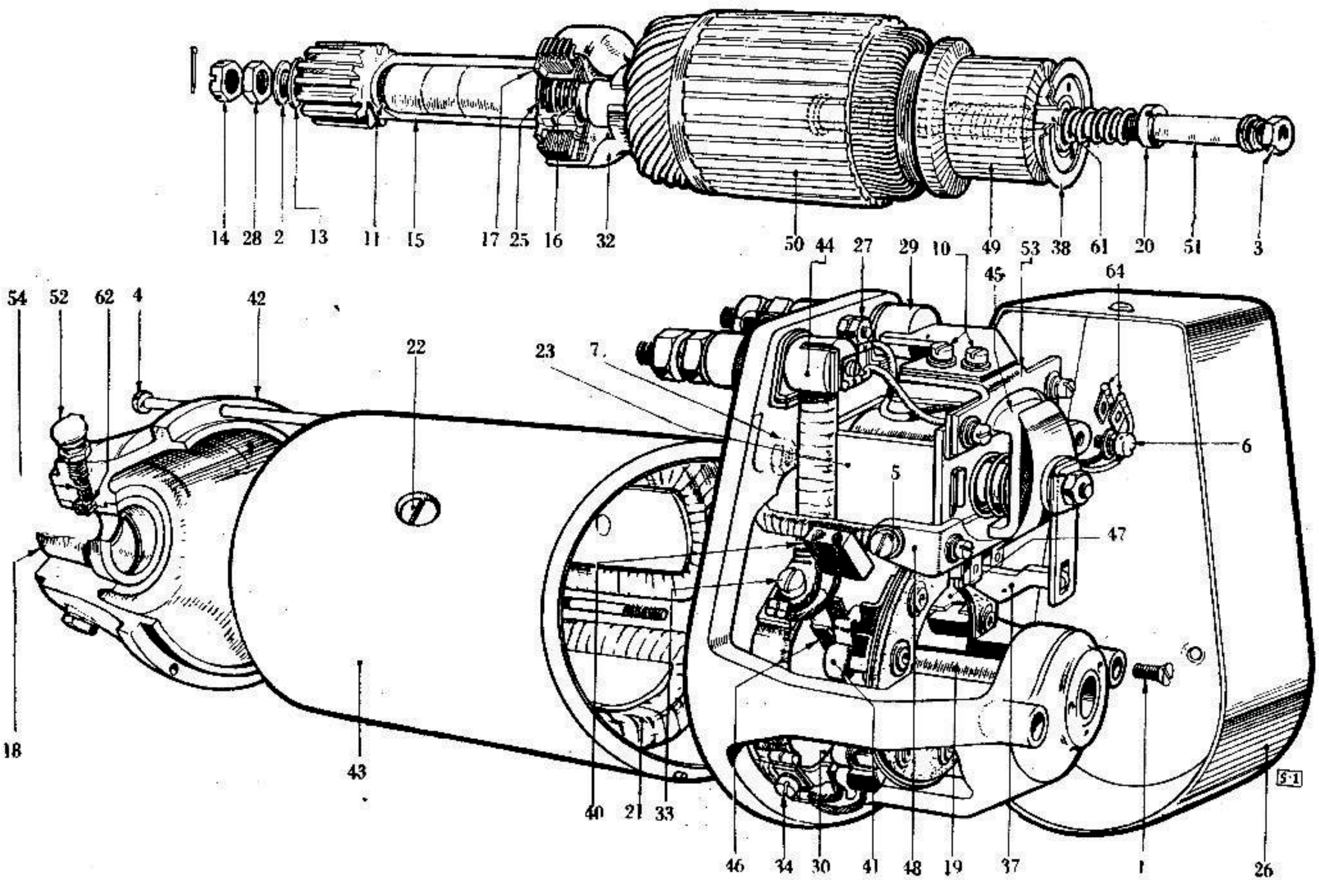


Fig. 293.—The C.A.V. Axial Starter, as fitted to Leyland Vehicle.

Major components: 4, Through Bolts. 7, Switch Fixing nut. 10, Positive Terminal Screws. 15, Pinion. 16, Clutch. 21, Field Coils. 22, Pole-fixing Screw. 23, Solenoid Cover. 26, Casing. 29, Positive Connector. 30, Brush Spring. 32, Clutch Housing. 34, Brush Guide Screw. 37, Trigger. 38, Trip Plate. 40, Brush. 43, Outer Casing. 44, Negative Terminal. 45, Moving Switch Contact. 47, Positive Brush Holder. 48, Second Contacts. 49, Commutator. 50, Armature Outer Casing. 52, Lubricator. 53, First Contact. 54, Spring. 62, Felt Pad in Lubricator.

Note.—Other numbers refer to spare parts numbers.

This is a simple screw and spring-loaded clutch which has a slipping torque about three times the lock torque of the starter, but it is below the shearing strength of the pinion teeth, so that the clutch will slip instead of the pinion teeth shearing under excessive loads,

A special; starter switch of the solenoid type shown in exploded view in Fig 295 is used in conjunction with this starter motor,

The field winding is divided into (a) two main field coils, (b) two auxiliary coils, each made up of an auxiliary shunt Coil, and (c) an auxiliary Overload Device series coil.

When the starter button is operated the magnetic field set up in the switch windings draws in a plunger until the trigger catch plate (38) (Fig.293) rests on the step in the trigger (37). This movement closes the moving contact (45 long arm) on to fixed contact (53); this completes the auxiliary and shunt-field coil circuits giving the starter armature its axial movement, and gently but positively engages the pinion with the teeth on the flywheel ring.

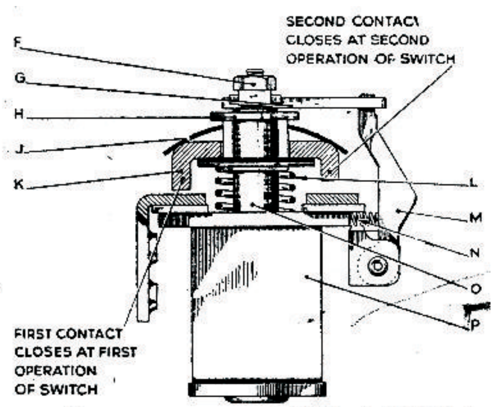


Fig. 295.—The C.A.V. Starter Switch (Leyland Vehicles). F, Plunger Nut. G, Trigger Catch Plate. H, Adjusting Washers. J, Leaf Spring. K, Moving Contacts. L, Main Return Spring. M, Trigger. N, Trigger Spring. O, Plunger. P, Solenoid.

This travel of the armature trips trigger (37) permitting the plunger to be drawn farther in, closing contact (45 short arm) on to second contact (48) Thus the circuit through the Starter main series coils is completed and the starter deveolps its maximum power

Testing the C .A .V. Axial Starter Motor.

Before testing the starter in position on the vehicle, see that the battery is fully charged and that all cable connections on the battery, starting motor, and the switches are secure.

(1) Push the starter switch button. If the motor does not start connect up a voltmeter 0 to 30 volts between SOL and negative terminals on the starting motor. Then push the starter button again. If the voltmeter gives no reading, examine for a fault in the cable between the starter button and motor or in the windings of the solenoid switch.

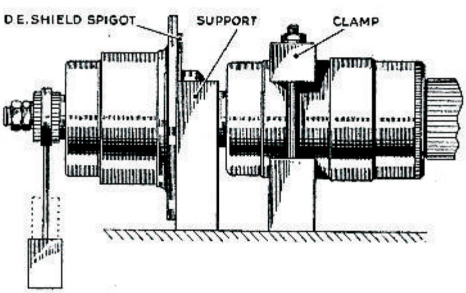


Fig. 296.—Testing Leyland C.A.V. Starter. The Torque Lever and Clutch Clamp are shown in this illustration.

(2) Push the starter button, and if the solenoid clicks this will indicate that the solenoid is working on the first contacts (53) (Fig 209) only, but that full current is not being supplied to the motor.

Faulty armature adjustment or a worn trigger may be the cause. If the Starter should
(3) If the starter should “crash” into engagement the trigger (37) (Fig 293) and plate (38) should be examined for wear.
(4) If the starter operates intermittently when the starter button is held down this may be due to the second contacts (48) on the solenoid switch being burnt or to wear of the motor bushes.
(5).If the bearing (18) at the driving end of the motor becomes worn this will result in slow engagement and considerable loss of power owing to the armature touching the pole pieces.
(6) Should the motor operate without cranking the engine this is due possibly to a slipping clutch or worn flywheel teeth. Another possible cause is movement of the starter in its mounting away from the flywheel

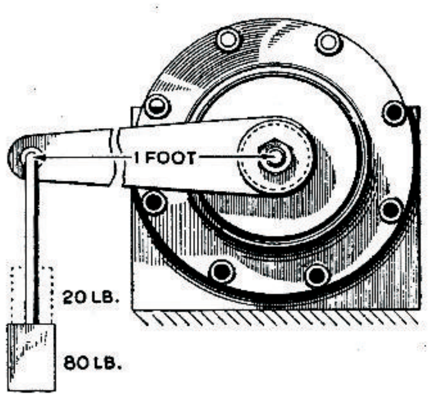


Fig. 297.—The Torque Test on Leyland C.A.V. Clutch.

Checking and Adjusting Starter Clutch

t is essential that the overload clutch on commercial-vehicle starters should be adjusted correctly after overhaul, long service, or replacement, to ensure that the slipping torque is correct.

The method of testing the clutch used by Leyland Motors, Ltd. Is illustrated in Figs 296 and 297. The clutch is clamped in a special fitting shown on the right in Fig. 296, and supported at the D.E. shield spigot

An arm 1 ft. long is fixed as shown and a weight pan arranged When newly assembled the clutch should be adjusted to slip at 100 to 115 ft lb The tests should be repeated several times using weights of 100 to 115 lb at the end of the lever If the cutch slips at less than 80 ft.-lb. a compensating washer (Fig 294) must be fitted between the clutch plates and the back ring. Washers are supplied in thicknesses of •004” and •006” and one or more must be inserted as required.

The Simms Starter Motor

This is fitted as an alternative to the C.A.V. one on certain Leyland and A.E.C. vehicles, is shown in section in Fig.298 and externally in Fig. 292. It is of the 24-volt type, with a reduction 13.25:1

The commutator end of the shaft runs in ball bearings and the driving end in phosphor bronze bushes. A ball thrust is fitted to the push rod When starting from rest (lock torque conditions) the current taken is 1,200 amperes. The lock torque is 90 lb.-ft. falling to 32 lb.-ft. at the maximum motor output which is 5.8 b.h.p. at 950 (motor) r.p.m.

The spring pressure per brush is 1lb. 13 ozs.

This series motor has four field windings connected in parallel with each other, as shown in Fig. 299, and in series with the wave wound armature. The drive is trans-

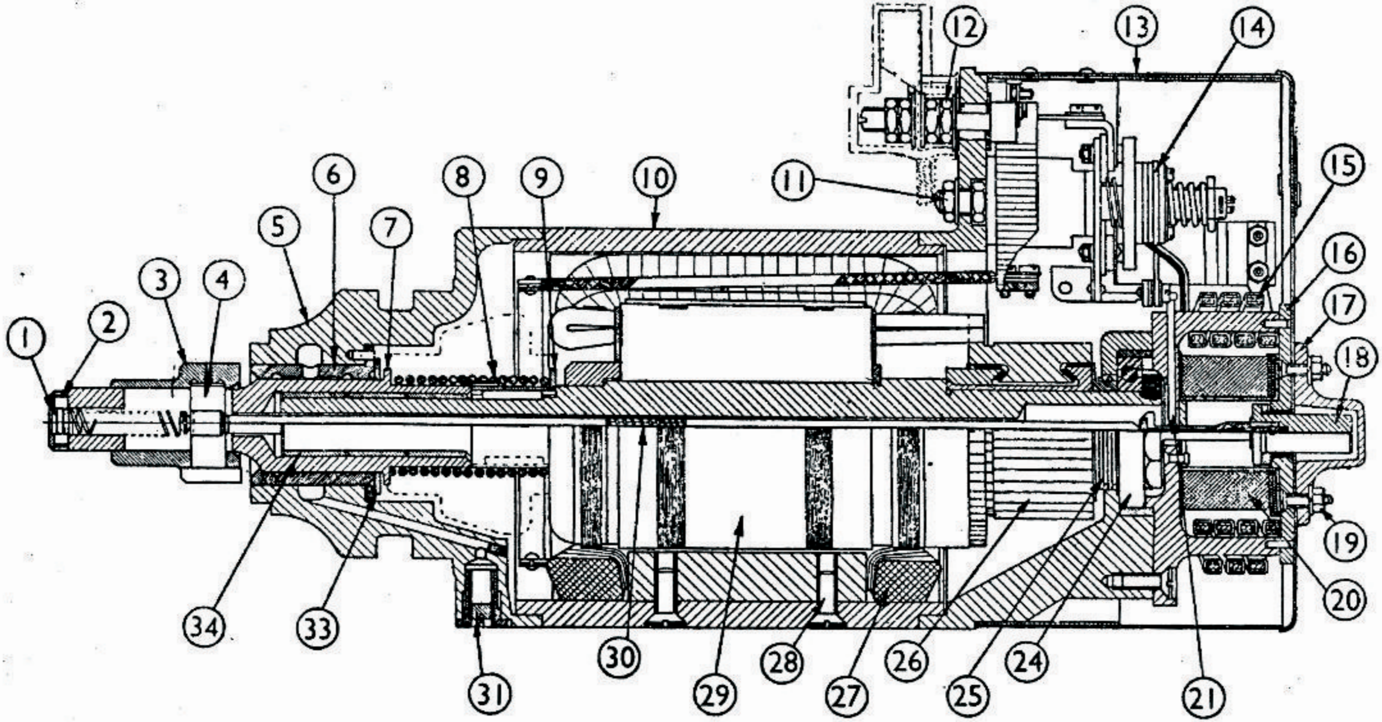


Fig. 298.—The Simms Starter Motor (A.E.C., Ltd.).

1, End Plug. 2, Cross Dumb-bell. 3, Pinion. 4, Cross-key. 5, Nose. 6, Plain Bronze Bearing. 7, Splined Shaft. 8, Clutch Spring. 9, Driving Sleeve. 10, Outer Cylindrical Casing. 11, Solenoid Switch Fixing Nut. 12, Solenoid Terminals. 13, Casing. 14, Solenoid Switch Assembly. 15, Heavy Series Coil. 16, Solenoid End Plate. 17, Plunger Cover. 18, Plunger. 19, Cover Nut. 20, Core. 21, Washer. 24, Ball Race. 25, Labyrinth Seal. 26, Commutator. 27, Field Winding. 28, Pole-securing Screw. 29, Armature. 30, Push-rod Spring. 31, Lubricator. 33, Washer. 34, Bushes.

mitted through a spring release clutch and the pinion moved axlally into engagement with the flywheel teeth bv means of a double-wound solenoid at the commutator end

The solenoid swltch also mounted at the commutator end of the starter, functions in two movements.When the starter button is pressed the first moving contact snaps down on to the fixed contact further movement being prevented by a plate which is held against the notch on the trigger. As the engagement solenoid meshes the starter pinion with the gear ring on the flywheel, it releases the trigger and the switch then closes the second contact which applies full voltage to the armature and field circuit.

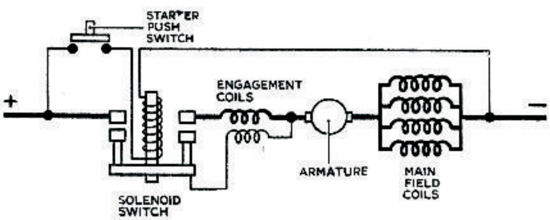


Fig. 299.—Wiring of the Simms Starter.

Lubrication of Motor. The ball-race and the thrust-race on the push rod at the commutator end of the armature shaft are packed with high melting point grease, and should receive attention at overhaul. The spring release clutch is packed with graphite grease, and should receive attention after the same period. On the driving end of the armature shaft three "Oilite" bushes are pressed on. At overhaul the "Oilite " bushes should be lightly lubricated with thin oil.

Every month the driving end nose bearing should be lubricated through the screw in the nose with light machine oil. The splined shaft,upon which the pinion slides, must be maintained clean and free from dirt and should be lightly lubricated with thin oil after overhaul

Testing The Starter Motor

The general procedure for testing and inspection of the starter and switch system is similar to that previously described for the C.A.V. motor

Performance Check of Reconditioned Simms Starter Motor

The following method applies in general to the Simms Type 6245GR23 starting motor illustrated in fig 292 and 298

Connect the starter up to the battery in the normal way, connecting a small push switch between the solenoid terminal and the positive terminal, Insert a strip of paper under the second contact of the solenoid switch and press the small push switch to energise the solenoid. The first contact should close, the armature revolving in a clockwise direction looking on the pinion end, and the pinion travel forward for a distance of approximately 1"in, where it will remain revolving as long as the push switch is depressed, Do not prolong this test. Repeat this test after removing the paper from under the second contact, when the starter will operate as previously but at a much higer speed, the pinion returning automatically to the disengaged position, revolving at high speed until the push switch is released.

Lock Torque Test. In addition to these tests the motor should be given alock torque test to ascertain the breakaway or starting torque and current as described on page 276. The lock torque should be 90 ib.-ft. and starting current 1,200 amperes.

Maintenance of Axial-type Starters

Provided that reasonable care is taken when operating this type of starting motor, it will give trouble-free performance over a long period When mounted on the engine in the case of the C.A.V. starter it should pitch clearance of .015 in. to .025 in. (Fig. 300). Further it should be possible to withdraw the commutator end cover and inject the brushes without removing the starter from the engine.

The Brush Gear.-The brushes should be inspected at regular intervals, say every 25,000 miles,and they should always be free in their guides,with their flex leads quite clear for movement. When special fibre insulation is provided for the brush flexes it should be examined for charring a cause of short circuits.

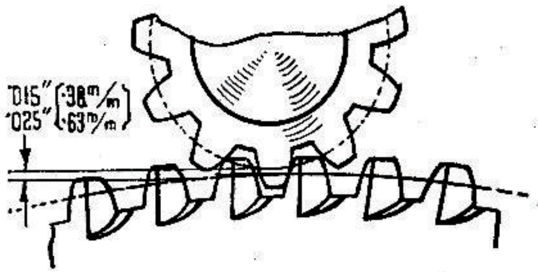


Fig. 300.—Mounting of Axial Starters (Flywheel Clearance).

The positive and negative brushes must be insulated from one another They can be tested by means of a lamp as used for testing field coils and and other insulation,The brushes need only be lifted from the commutator for this test

If a brush is removed it must be replaced in exactly the same position in the brush holder, to ensure the same bedding curvature of the brush on the commutator. On insulated return motors the brush gear is insulated from the rest of the motor.The brushes when refitted to a motor should be well bedded down.If not,wrap a strip of very fine glass- or carborundum paper firmly around the commutator and With the brush in position rotate the armature by hand in the proper working direction of rotation until the correct brush shape is obtained. The brushes on a motor should not wear down so that the trigger or spring is not giving effective pressure.

The brush-spring pressure value is very important. It should be tested by means of a spring balance hooked under the spring trigger or spring tips and its value for the various types of C.A.V. axial starter motors should be as follows:

SC, 85, ZBB, ZAB 12v.	24-32 ounces	
ZAB 24v.	36-48	„
BS5 i2v., BS5 24v .	32-40	„
BS6 i2v., BS6 24v .	18-24	„

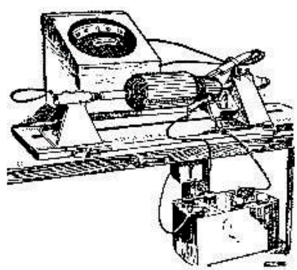


Fig. 301.—Method of Testing Armature Coils.

Armature Maintenance.

The commutator surface should be clean and free from uneven discoloration.

There should be no deposit bridging the segments across the inter-segment insulation.

The surface can be cleaned with a very fine grade of glass or carborundum paper (do not use emery cloth)

except in cases where it is in a very badly pitted condition, when it should be set up on a lathe and skimmed. A very light cut should be made and, where possible, a diamond tool be used, in order to provide the desired high-quality finish. The armature (where stated) should be undercut' I.e. the mica insulation between the commutator bars, in the C.A.V. starters' should be removed to a depth of 1/32"in. (0.8 mm.) below the surface of the copper, care being taken to remove the full width ot mica and to leave nothing to project above the copper

The respective armature coils can be tested for continuity or short circuits by mounting the armature on a block and connecting the commutator to an ordinary car battery through the medium of two brass or copper brushes mounted at an angle of 90° to each other. Contact is then made to any two adjacent commutator bars by means of hand spikes which are connected direct to a millivolt meter (see Fig.301)

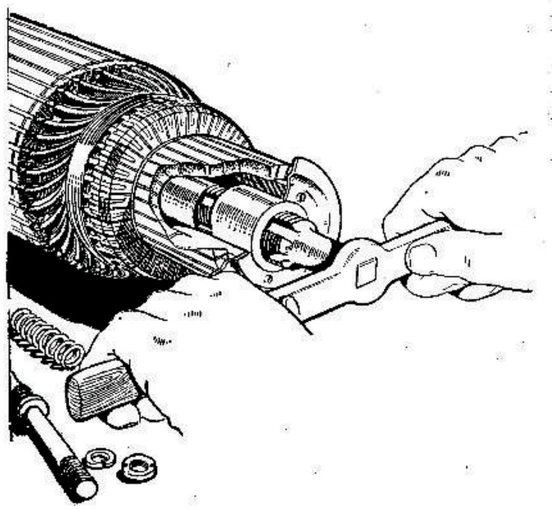


Fig. 302.—Extracting the C.A.V. Axial Starter Oil-less Bush.

A variable resistance included in the battery circuit should be capable of carrying the full output of the battery and adjusted to give 2 volts or less on the armature. The armature is then rotated until every commutator bar has been tested, the reading on the millivolt meter in each Case should read approximately the same; any big variation indicating a fault in the coil connected to one of the commutator bars under test.

A reduction in the millivolt reading will generally be found due to a short circuit, while an increased reading will indicate either an open or a faulty connection.

It should also be mentioned that the "Growler" armature tester is to be recommended for starter-motor armature testing; indeed, it may be regarded as almost a necessity for both starters and dynamos.

To be continued

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