Leyland

SERVICE MANUAL

RAILCAR UNITS

LEYLAND MOTORS LIMITED

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for

Leyland

RAILCAR UNIT

type

R.C.U. 1

This Service Manual is arranged for quick reference, and the information needed by Service Engineers is presented by means of illustrations and brief descriptions.

Price Two Guineas

LEYLAND MOTORS LIMITED

HEAD OFFICE AND WORKS LEYLAND LANCASHIRE ENGLAND

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THE LEYLAND ORGANISATION

for Sales and Service
in Great Britain and Overseas

Head Office and Works : Leyland Motors Limited, Leyland, Lancashire, England.
Telephone : Leyland 81400.
Telegrams and Cables : Leymotors, Leyland.

Main Service Dept. : Leyland Motors Limited, Bolton Road, Chorley, Lancashire, England.
Telephone : Chorley 2231.
Telegrams : Leymotors, Chorley.
Cables : Leymotors, Leyland.

Export Sales Division : Leyland Motors Limited, Hanover House, Hanover Square, London, W.1.
Telephone : MAYfair 8561.
Cables : Leymotors, London.

DEPOTS AND AGENTS IN GREAT BRITAIN

Full sales and service facilities are available at the addresses below for all types of Leyland vehicles, unless qualified by one of the following symbols :

● Sales Office only ○ Service Depot only † Agent for Industrial Units only

ABERDEEN. John Gibson & Son, Ltd., 397-401 King Street. *Aberdeen* 20355.

BARNHAM, SUSSEX. † Penfold Metallising & Engineering, Ltd., Engineering Works. *Eastergate* 300.

BELFAST. J. A. Potter Ltd., Ravenhill Road. *Belfast* 59311 *and* 59312.

BELFAST. ● Leyland Motors Ltd., 19 Adelaide Street. *Belfast* 25418.

BIRMINGHAM. ● Leyland Motors Ltd., King Edward House, New Street, 2. *Midland* 3267. (See *also under* " *Dudley.*")

BOREHAM WOOD. ○ Leyland Motors Ltd., Elstree Way. *Elstree* 2901, 2902, 2903, 2904 *and* 2905. *After hours Elstree* 2901 *or* 2902.

BRISTOL. Leyland Motors Ltd., Bath Road, Brislington. *Bristol* 77024. *After hours Bristol* 64934.

BURY. ○ Bramwell, Preston & Co., Phoenix Street. *Bury* 523.

CARDIFF. Leyland Motors Ltd., North Road, Gabalfa. *Cardiff* 31516.

CARDIFF. ○ Arlington Motor Co., Ltd., Dumballs Road (off Penarth Road). *Cardiff* 30641.

CARLISLE. ○ County Garage Co., Ltd., Lowther Street.

CHORLEY. ○ Leyland Motors Ltd., Bolton Road. *Chorley* 2231.

DUDLEY. ○ Leyland Motors Ltd., Hall Street. *Dudley* 2535.

EDINBURGH. Joseph Wilkinson (Motors) Ltd., 2 Hope Crescent, Annandale Street. *Edinburgh Central* 4181.

GATESHEAD. Leyland Motors Ltd., Ninth Avenue, Team Valley Trading Estate, Gateshead-upon-Tyne, 11. *Low Fell* 75431. *After hours Low Fell* 75078 *and Low Fell* 75244.

GLASGOW. Leyland Motors Ltd., Salkeld Street, C.5. *Glasgow South* 2531.

GLASGOW ● Scottish Co-operative Wholesale Society Ltd., Scotland Street, Glasgow.

HULL. Albion Motors Ltd., 80-84 Cumberland Street, Wincolmlee, Hull. *Central* 31073.

LEEDS. ○ Isles Ltd., Stanningley, nr. Leeds. *Pudsey* 3001. *After hours Pudsey* 3915, 3660 *or* 3398. (Also Industrial Units.)

LEEDS. ● Leyland Motors Ltd., Clarence Road, 10. *Leeds* 31201 *and* 31202.

LEYLAND, LANCS. ● Leyland Motors Ltd., *Leyland* 81400. (See *also under* " *Chorley.*")

LINCOLN. Leyland Motors Ltd., Bracebridge Heath. *Lincoln* 20529.

LIVERPOOL. Leyland Motors Ltd., 334, Rice Lane, 9. *Aintree* 5133 *or* 5134.

LONDON. ○ Leyland Motors Ltd., Elstree Way, Boreham Wood. *Elstree* 2901, 2902, 2903, 2094 *and* 2905. *After hours Elstree* 2901 *and* 2902.

LONDON. ○ Arlington Motor Co., Ltd., 2 High Road, Ponders End. *Howard* 1266. 25-27 Vauxhall Bridge Road, S.W.1. *Victoria* 6033.

LONDON. ● Leyland Motors Ltd., Hanover House, Hanover Square, W.1. *Mayfair* 8561.

MANCHESTER. ○ W. Senior & Son, Bolton Road, Pendleton. *Peddleton* 2234. *After hours, Pendleton* 1972.

MANCHESTER. ● Leyland Motors Ltd., 25 Brazennose Street, 2. *Blackfriars* 2755.

NEWCASTLE, STAFFS. ● Newcastle-under-Lyme Motor Services Ltd., Brunswick Street. *Newcastle* (*Staffs.*) 66266.

NOTTINGHAM. Leyland Motors Ltd., Wollaton Park Gates, Derby Rd., Lenton. *Nottingham* 77274. *After hours Nottingham* 73901.

PLYMOUTH. Leyland Motors Ltd., Marsh Mills, Plympton Road. *Plympton* 2202.

PORTSMOUTH. ○ J. H. Sparshatt & Sons (Portsmouth) Ltd., London Road, Hilsea. *Portsmouth* 2421.

SHEFFIELD. ○ Albion Motors Ltd., Beulah Road, Owlerton, 6. *Sheffield* 48827 *or* 48828.

SOUTHAMPTON. ○ J. H. Sparshatt & Sons (Southampton) Ltd., The Causeway, Redbridge. *Totton* 2258.

SUDBURY, SUFFOLK. ○ Arlington Motor Co., Ltd., Cornard Road. *Sudbury* 2301.

Overseas Branches and Representatives are shown on the next page.

OVERSEAS BRANCHES AND REPRESENTATIVES

ADEN. Cory Bros. & Co. Ltd., Steamer Point, Aden.

ARGENTINE. A. G. Pruden & Co., Bouchard 680, Buenos Aires.

AUSTRALIA. Leyland Motors Ltd., 153-167 George Street, Redfern, Sydney, N.S.W. H. C. Heathorne & Co. Ltd., 53-63 Bathurst Street, Hobart, Tasmania. Leyland Motors Ltd., 76 & 84 Courteney Street (Corner of Villiers Street), North Melbourne, Victoria. D. L. Norton, 484 King St., Newcastle, N.S.W. West End Motors Ltd., 1056 Hay Street, Perth. Leyland Motors Ltd., Cr. Nudgee Road & Hedley Avenue, Hendra, Brisbane, Queensland. Flinders Motors Ltd., 62 Currie Street, Adelaide, South Australia.

BELGIAN CONGO. Mecanicongo, Nouvelle Auto-Route de Limite, Leopoldville.

BELGIUM. Leyland Belgium S.A., 64 Rue de la Loi, Bruxelles. Brossel Freres, 14 Avenue de Saio, Bruxelles.

BOLIVIA. Dr. Adalberto Markus, Casilla Correo 2247, La Paz.

BRAZIL. Goodwin Cocozza S.A., Praca Maua No. 7, 18 Andar, Rio de Janeiro. † Brass & Cia., Rua Acre 47, Salas 711/713, Rio de Janeiro. S.A.M.D.A.C.O. Rua da Consolacao 1837, Sao Paulo.

BRITISH GUIANA. Sprostons Ltd., Lot 4, Lombard Street, Georgetown.

BURMA. Blackwood Hodge (Burma) Ltd., P.O. Box 64, 26th 'B' Road, New Civil Lines, Mandalay.

CANADA. Leyland Motors (Canada) Ltd.: Factory and Head Office, Bord de l' Eau, Longueuil P, Quebec; Ontario Branch, 18 Bermondsey Road, Toronto (16). Dealers: Mackenzie Truck Sales Ltd., 965 Home Street, Vancouver 3, B.C.; Transport Equipment Co. Ltd., 1269 Albert Street, Regina, Sask. † Acadia Gas Engines Ltd., Bridgewater, Nova Scotia, and at St. Johns, Newfoundland.

CANARY ISLANDS. Estacion de Servicios Canarios Sociedad Ltda., Plaza de Cairasco 3, Las Palmas.

CEYLON. Associated Motor Ways Ltd., 185 Union Place, Colombo 2.

CHILE. Costabal y Cia. Ltda., San Ignacio 480, Santiago de Chile.

CYPRUS. Cyprus Commercial Co., Nicosia.

DENMARK. Dansk Automobil Byggeri, Silkeborg.

EAST AFRICA (KENYA, UGANDA and TANGANYIKA). Gailey & Roberts Ltd., P.O. Box 667, Nairobi, Kenya. Mr. Ian Dall, Leyland factory representative, c/o Gailey & Roberts Ltd., P.O. Box 3369, Nairobi.

EGYPT. T. W. M. Forsyth, 7 Sh. Maspero, Cairo.

EIRE. Ashenhurst, Williams & Co. Ltd., 15 Talbot Place, Store Street, Dublin.

FINLAND. Oy Suomen Autoteollisuus A.B., Fleminggatan 27, Helsingfors, Helsinki.

FRANCE (Northern). Jacques Savoye, 237 Boul. Pereire, Paris 17.

GIBRALTAR. As Spain.

GOLD COAST B.W.A. United Africa Co. Ltd., P.O. Box 775, Accra.

GREECE. Const. J. Tambacopoulos, 4 Syngros Avenue, Athens.

HONDURAS. Casa Comercial Mathews S.A., Apartado 39, Tegucigalpa, D.C. Honduras, Central America.

HONG-KONG. The Hong Kong Garage Ltd., Stubbs Road, Hong-Kong.

ICELAND. Samband Isl., Samvinnufelaga, Reykjavik.

INDIA. Ashok Leyland Ltd., 38 Mount Road, Madras 6 (*Distributors for the Indian Union*). Automotive Manufacturers Ltd., 108 Bazaar Ward, Kurla, Bombay, and 8571 Kingsway, Secunderabad, Deccan. James Finlay & Co. Ltd., 2 Netaji Subhas Road, Calcutta. V.S.T. Motors Ltd., 150 Mount Road, Madras 2. Mr. F. Crook, Leyland factory representative, Seervai Estate Kholiwhada, Juhu, Bombay, 23.

INDONESIA. Java Motors Import Corporation N.V., Djalan Kunir 9, Djakarta-Kota.

IRAQ. I. J. Saad & Fils, Rashid Street, Baghdad.

ISRAEL. Consolidated Near East Co. Ltd., 45 Haazmauth Road, Haifa.

JAMAICA. L. S. Panton, 31½ Hanover Street, Kingston, B.W.I.

KUWAIT. Bader Al Mulla & Bros., Kuwait, Persian Gulf.

LEBANON. I. J. Saad & Fils, Souk-el-Jamil, Beirut, Lebanon.

MALAYA. Champion Motors Ltd., P.O. Box 622, Singapore. (Branch office in Kuala Lumpur, Selangor.)

MALTA. Michael Attard Ltd., 5.6.7. Marsa Cross Road, Marsa.

MEXICO. Industrias e Inversiones Alba S.A., Edificio Mallorca, Ramon Guzman 132-211, Mexico 4, D.F.

NETHERLANDS. Leyland Holland N.V., Meeuwenlaan 90, Amsterdam, N. † C. V. Timmermans & Co., Bloemendaal, Midden Duin & Daalseweg 24, Amsterdam, W.

NEW ZEALAND. Leyland Motors Ltd., 222-228 Wakefield Street, Wellington, C.1. Leyland Motors Ltd., Box 2334, Auckland. A. & G. Price Ltd., P.O. Box 654, Auckland. Leyland Motors Ltd., P.O. Box 1451, Christchurch. Leyland Motors Ltd., P.O. Box 302, Palmerston North, Reilly's Central Parking Station Ltd., P.O. Box 770, Dunedin. H. E. Melhop Ltd., P.O. Box 321, Invercargill.

NIGERIA AND CAMEROONS. British West Africa (Engineering) Ltd., 22 Commercial Avenue, Yaba, Lagos, Nigeria.

NORWAY. A. S. Autoindustri, Kristian Augustsgate 23, Oslo.

NYASALAND. Halls Garage Ltd., P.O. Box 69, Blantyre.

PAKISTAN. James Finlay & Co. Ltd., Finlay House, McLeod Road, Karachi. James Finlay & Co. Ltd., Double Moorings, Chittagong, East Pakistan.

PARAGUAY. The East Asiatic Co. Ltd., Chile, 368, Asuncion, Paraguay, S. America.

PERSIA. Shishmanian Vatan, Ave. Ferdowsi-Koutche, Shahrdari No. 61, Teheran.

POLAND. Poliglob S.A., Pl. Konslytucji I, Warsaw.

PORTUGAL. Francisco Garcia & Cia. Ltda., Avenida Casal Ribeiro 28, Lisbon.

PORTUGUESE EAST AFRICA. Entreposto Comercial de Mocambique, P.O. Box 1153, Laurenco Marques and Edeficio Dias da Cunha, Rua do Aruangua, Beira.

PORTUGUESE WEST AFRICA. Comercio de Automoveis Ltda., Travessa da Asia, Luanda.

RHODESIA. Leyland Albion (Africa) Ltd., P.O. Box 2422, Salisbury; 6326 Mafeking Road, Bulawayo; P.O. Box 328, N'Dola; Connaught Road, Lusaka.

SIERRA LEONE. W. Bartholomew & Co. Ltd., Freetown.

SOUTH AFRICA. Leyland Albion (Africa) Ltd.; Head Office, P.O. Box 6226, Johannesburg; P.O. Box 6622, Johannesburg (Selby Depot); P.O. Box 1885, Cape Town; P.O. Box 2396, Durban; P.O. Box 1014, Bloemfontein; Concesionaires: R. L. Weir & Co. (P.E.) (Pty.) Ltd., P.O. Box 148, Port Elizabeth; Armsrtong Hand (Pty.) Ltd., P.O. Box 720, East London; Northern Diesel Services (Pty.) P.O. Box 292, Kimberley; Northern Transvaal Diesel Services, P.O. Box 346, Pietersburg, Tvl.: Sam Cohen Ltd., P.O. Box 215, Windhoek S. W.A.; De Jongh's Engineering & Motor Co. (Pty.) Ltd., P.O. Box 73, Pretoria North.

SPAIN. Leyland-Iberica S.A., Tomas Breton 10, Madrid.

SPANISH MOROCCO. As Spain.

SWEDEN. Forenade Bil, Ab I Malmo, Ostra Tullgatan 6, Malmo.

SWITZERLAND. Charles Keller, Theatrestrasse 10, Zurich, 1.

SYRIA. Automotive & Engineering Co. S.A., Fardous Street, Damascus.

TANGIER. As Spain.

TRANSJORDAN. As Lebanon.

TRINIDAD. Trinidad Agencies Ltd., 40 South Quay, Port-of-Spain.

TURKEY. Cifkurt Ticaret Ve Sanayi T.A.S. Halaskargazi Caddesi No. 368/2, Sisli Camii Karsisi, Istanbul.

URUGUAY. Corausa Corporacion Automotriz S.A., Dante 2258, Montevideo.

VENEZUELA. Distribuidora Venezuela S.A., Edificio Pini, Local 3, Avenida Victoria, Las Acacias, Caracas, and Casa Parejo, Calle 64, No. 4-93, Maracaibo-Estado Zulia.

YUGOSLAVIA. Generalexport P.O. Box 223, Vasina ul, 16-18 Belgrade. (Agent for vehicles only.) Trg. Republike 5/V, Belgrade Trg. Republike 8/11, Zagreb.

To keep this list up to date, please refer to your current issue of the " Leyland Journal."

Conditions of Business and Guarantee

The following Conditions of Business and Guarantee apply to all orders accepted by LEYLAND MOTORS LIMITED (hereinafter called "the Company") for Motor Vehicles and chassis therefor, or for engines, components, or spare parts, or repairs, or other work of any description.

CONDITIONS OF BUSINESS

1. PRICE ALTERATION.—If, and whenever, after the date of the order or tender, and before completion of manufacture of the goods for the customer the Company's prices for chassis, engines or components, and/or for bodies of the type specified are changed, or the rate of wages are altered by national agreement, or the prices of the vendors to the Company for material, parts, accessories, components or other articles are increased or decreased, the Company may give notice of such variation to the customer, and the purchase price above specified and agreed shall, in that event, be correspondingly increased or decreased. If the specification of the goods does not vary from the Company's standard specification the Company will accept notice of dissent from the customer within fourteen days, the Company having the option either to complete the contract without increasing the purchase price, or to cancel the contract and return the deposit to the customer. No cancellations shall give cause for any claim for loss or damage. If the specification calls for variation from the Company's standard types, the customer is under obligation to complete the contract at the increased price.

2. ORDERS.—No order shall be binding until accepted in writing by the Company.

3. DELIVERY.—Delivery shall be at the Company's Works at Leyland, unless otherwise agreed. Customers will be notified when goods are ready for delivery and the goods shall be deemed to be accepted and delivery shall be taken within seven days thereafter.

4. DELIVERY DATES.—The Company undertakes to make every endeavour to deliver each order within the period quoted, reckoned from the date of receipt by the Company of all instructions and information necessary for the execution of the work, but is unable to guarantee that circumstances not in the control of the Company may not interfere. No liability shall attach to the Company for delay in delivery, howsoever arising, or for any contingent or consequential loss or damage arising from such delay.

5. PACKING.—All packing is charged extra.

6. PAYMENT.—Unless otherwise agreed, payment must be made at the Company's Works at Leyland, in full in sterling before delivery.
   (a) Where payment has been arranged by means of a Letter of Credit, the customer will establish a "Confirmed Irrevocable Letter of Credit" payable in sterling in London, by drafts at sight for 100% of the invoice value, all Bank and other charges being payable by the customer.
   (b) Where payment is to be secured by Bills of Exchange, such Bills, unless otherwise agreed in writing, will be subject to an interest charge at the rate of 1% over Bank rate, and all charges for negotiation in London and/or abroad are payable by the customer.
   (c) Where shipments are despatched "cash against documents (foreign Port)" all Bank and other charges abroad are payable by the customer.

The Company reserves the right to call for a deposit with the order. The property in the goods will not pass until payment in full has been made.

7. IMPROVEMENTS AND ALTERATIONS.—The Company, whose policy is one of continuous improvement, reserves the right to make, without notice, any changes in material, dimensions and designs, which, having regard to all the circumstances, it thinks reasonable or desirable, without affecting the validity of the contract.

8. ILLUSTRATIONS AND DESCRIPTIONS.—Illustrations, photographs and descriptions are intended as a general guide only, and must not be taken as binding in detail.

9. INSPECTION AND TESTS.—Reasonable inspection and tests will be allowed during convenient working hours at the Company's Works before acceptance, if asked for on or before the placing of an order. No claim made after delivery regarding the quality of the goods delivered will be entertained, except under any guarantee applicable to the goods.

10. CANCELLATION OR SUSPENSION OF CONTRACT.—Should the Company be delayed in or prevented from making delivery owing to strikes, lockouts, trade disputes, difficulty in obtaining workmen or material, breakdown of machinery, accident, fire, force majeure, war, civil riot, requisitioning by Government, or any other circumstances outside the Company's control, the Company shall be at liberty to cancel or suspend the contract without incurring liability for any loss or damage resulting to the customer.

11. EXCLUSION OF LIABILITY.—Vehicles ordered by customers are driven or towed by the Company's employees at the sole and entire risk and responsibility of the customer. All goods in the hands of the Company for delivery or repair or otherwise are held by the Company at the customer's risk as regards loss or damage, howsoever arising.

12. REPAIRS.—If goods received by the Company for repair or for other work are not removed whether because of non-payment of the Company's charges or otherwise within twenty-one days of the date of rendering the Company's account, the Company may thenceforth charge for storage, and, without further notice to the customer, may at any time thereafter sell the goods and retain all amounts due from the customer to the Company out of the proceeds, the balance of which shall be paid to the customer.

13. ERRORS.—Claims regarding errors in despatch or invoicing must be made within fourteen days after delivery of the goods to the customer. The Company refuses to recognise any claim not made within that period.

14. EXHIBITIONS AND COMPETITIONS.—The Company's products are sold upon the express condition that they are not without the previous written consent of the Company to be exhibited at any exhibition or used in any competition, competitive trial or collective demonstration. On any and every breach of this condition, whether by the customer or by a subsequent owner, the customer shall pay to the Company the sum of £250 (or other such sum as the Company may be ordered to pay by the Society of Motor Manufacturers and Traders), as agreed and liquidated damages. Every purchaser of the said products from the Company for resale shall obtain a like undertaking from his customer.

15. DEFAULT OF CUSTOMER.—If the customer becomes bankrupt or insolvent or compounds or makes any arrangement with his creditors, or being a Company goes into liquidation or has a receiver appointed of its assets, the Company may give notice cancelling the contract and without further notice to the customer may resell the goods, and any loss and expenses sustained on the resale shall be paid to the Company by the customer.

16. PREVENTION OF CORRUPT PRACTICES.—The Company in no circumstances commits or permits, in relation to its contracts, any act constituting or savouring of bribery or corruption, as laid down in the Prevention of Corruption Acts, 1889 to 1916, and Section 123 of the Local Government Act, 1933.

17. WAGES AND HOURS OF LABOUR.—The Company at all times observes the provisions normally found in contracts with Government Departments, Municipal Corporations or Public Bodies in regard to payment of standard rates of wages, observance of recognised hours and conditions of labour, and freedom of employees to belong to Trade Societies. Evidence of compliance with the conditions will be produced to such Authorities contracting with the Company, whenever required.

18. ARBITRATION AND INTERPRETATION.—Any dispute or difference as to the meaning or effect of these conditions or of the Company's guarantee, or as to the rights, or liabilities of either party under the contract, shall be and is hereby referred to the final decision of a single arbitrator in England to be nominated by the parties, or in default thereof by the President of the Society of Motor Manufacturers and Traders Limited. These conditions and the Company's guarantee and any arbitration hereunder shall be interpreted and governed in all respects according to the Law of England. Except where expressly stated to the contrary by the Company the trade terms incorporated in the contract shall bear the meaning set out in "Incoterms 1953" as published by the International Chamber of Commerce.

19. NOTICES.—Any notice (which expression shall include any advice note, invoice or other document) may be served on the customer (or, if more than one, on any of them on behalf of all) either personally or by leaving it at, or sending it by post or telegram to, his last known residence or place of business. Such notice shall be deemed to have been served in the case of a letter sent by post, in due course of post, and in the case of a telegram at the expiration of the time normally taken for transmission.

20. The Company will be responsible for obtaining any necessary export licence or permit that may be required for goods ordered by an overseas customer, but if the same cannot be obtained within twenty-eight days of the goods being notified as ready for delivery or if the same is cancelled before delivery has taken place the terms of Condition 10 hereof shall be deemed to apply.

21. The customer, if an overseas customer, shall be responsible for obtaining any necessary licence or permit for the import of goods to the overseas country, and shall be responsible for acquiring the necessary sterling to enable payment to be made to the Company. In the event that the customer shall fail to comply with this condition within twenty-eight days of being notified that the goods are ready for delivery the Company may declare the contract cancelled and resell the goods and any loss sustained by the resale shall be paid to the Company by the customer. The Company will not be liable for any loss or damage resulting to the customer.

22. SCOPE OF CONDITIONS.—The acceptance of any order by the Company shall incorporate these conditions into the contract and they shall supersede and exclude all general terms and conditions of contract imposed, or sought to be imposed, by the customer at any time in relation to the order, in so far as such terms and conditions are inconsistent therewith or additional thereto.

Guarantee

The Company uses its best endeavours to secure excellence of materials and workmanship and gives the following guarantee in regard to ts products and repairs, namely:—

1. In the event of any defect being discovered within the period mentioned in Clause 2 hereunder in any goods supplied (whether originally or by way of replacement) or repaired by the Company, then provided that the alleged defective part is returned to the Company's Works at Chorley, carriage paid and properly labelled for identification, within seven days after discovery of the alleged defect, the Company will examine such part carefully and, if satisfied that the defect is due to faulty material or bad workmanship, will (save as mentioned in Clause 8 hereunder) repair the defective part, or supply a new one in place thereof, free of charge at Works. Any claim under this Clause must be made in writing on or before the despatch of the alleged defective part and must contain full particulars of the alleged defect together with the number of the chassis from which such part has been removed.

2. The period of guarantee is:—

   (a) For chassis and bodies, twelve months for home orders and six months for overseas orders from the date on which the vehicle is first registered or put into commercial use.

   (b) For parts supplied by way of replacement or repair, either under this guarantee or voluntarily at special rates or free of charge, the unexpired portion of the period applicable to the chassis or body concerned.

   (c) For parts supplied by way of replacement or repaired at normal rates of charge, twelve months for home orders and six months for overseas orders from the date of delivery of the new or repaired part.

   (d) For engines and marine and industrial units, twelve months for home orders and six months for overseas orders following the date of delivery ex Works, or 2,000 working hours, whichever is the less, on condition that

      (i) An adequate supply of filtered air is provided under all conditions of operation, and

      (ii) Approval of the Company is obtained of the installation of marine or industrial unit which forms the subject of this quotation/contract.

3. If the Company makes any alteration in or addition to any goods, the foregoing guarantee shall (subject as mentioned in Clause 8) extend to such alteration or addition, the period of guarantee being the period, or unexpired portion thereof, applicable under Clause 2 to the goods concerned.

4. Parts received from the customer and not repaired may be scrapped by the Company, unless the customer, within fourteen days of despatch of notification of the Company's decision in regard to the claim, asks for their return.

5. Charges for dismantling and reassembly, whether by the Company or by a third party, and for carriage, shall be borne by the customer.

6. The Company accepts no liability for any loss or damage, direct or consequential, or for any accident, or the effects of an accident, resulting from defective material, faulty workmanship or otherwise.

7. The benefit of this guarantee extends to the first registered owner only, or (in the absence of registration) to the first commercial user of the vehicle and cannot be transferred without the written consent of the Company.

8. The benefits of this guarantee do not apply to:—

   (a) Bodies, coachwork and proprietary articles (such as tyres, electric lighting sets, engines, gearboxes, axles and other major and minor components) not manufactured by the Company, and spare or replacement parts therefor, but the Company will pass on to the customer the benefit of any guarantee given by the manufacturer in regard thereto.

   (b) Defects due to wear and tear, racing, accident, improper adjustment, misuse (including the use of dirty or unsuitable oil), dirt or neglect.

   (c) Vehicles or goods which have been (i) altered or added to without the written consent of the Company, or (ii) loaded beyond the gross laden weight specified by the Company, or (iii) fitted with a body of a type or weight for which the chassis is not designed, or (iv) subjected to alteration, obliteration, removal or concealment of the Company's identification numbers or marks, or (v) let out on hire (excluding hire purchase), or (vi) used for military purposes.

   (d) Parts repaired by third parties, or by the customer.

   (e) Parts damaged by reason of defects in other parts.

   (f) Governed engines, or vehicles fitted therewith, which have had the setting of the governor altered otherwise than by the Company.

   (g) Goods supplied by the Company as second-hand.

   (h) Replacements or repairs to items (a), (c), (f) and (g) above.

   (i) Defects due to faulty workmanship by a third party, or by the customer, during fitting or assembly in connection with replacements, repairs, alterations or additions.

9. The Company gives no guarantee as to performance, unless by separate agreement in writing.

10. This guarantee is in lieu of and excludes all conditions, warranties, and liabilities expressed or implied, whether under common law, statute or otherwise, in relation to all goods and repairs, whether covered by the guarantee or not.

CONTROLS.

CONTROLS.

The controls are electro-pneumatically operated and consist of electric switches which operate the various magnet valves etc., throughout the train, the electrical system being 24-volts. The switches are conveniently grouped on a control table in each powered-coach and operate the following controls:

ENGINE SPEED CONTROL
DIRECTION CONTROL
BATTERY SELECTOR
CLUTCH CONTROL

ENGINE SPEED CONTROL.

The engine speed control is operated by the drivers left hand and incorporated in this unit is the "dead man's device".

Should the driver unconciously release the handle or should he collapse while the train is in motion, all the engines are returned to idling speed, the clutches are automatically returned to neutral, and after a five seconds delay the brakes are automatically applied.

The returning of the clutches to neutral prevents the engines from stalling and also helps the driver to regain control should he have released the control lever inadvertently.

The speed of the engine is controlled by the degree of opening of the butterfly valve in the inlet manifold. This valve, in turn, is controlled by an air-operated throttle motor having four air cylinders designed to hold the valve in position and to give the engine four definite speed positions, in addition to the idling position. The engine speeds are 800, 1200, 1600 and 2,000 r.p.m. Two stops on the inlet manifold determine the idling and maximum speeds of the engine, which are 400 r.p.m. and 2,000 r.p.m. respectively.

The throttle motor consists of four air cylinders attached to a box-section aluminium casting, each cylinder having a combined piston and rod with a synthetic rubber piston washer. A spindle carried in oilite bushes passes through the length of the casing and has an operating lever at one end and a clamping boss at the other.

Four ball-ended levers are loosely mounted on the spindle to-gether with four bosses, which are keyed to the spindle. The connecting faces of the ball-ended levers and bosses are so constructed that any movement of the levers carried out by the action of the piston rod, rotates the spindle.

The degree of movement of the spindle and levers is limited by four stop-screws, set at varying lengths in the bottom of the casing. The limited movement of the side operating lever also limits the movement of the butterfly valve in the inlet manifold via the control rod, to give the engine speeds quoted.

A spring returns the side operating lever to idling position when pressure is released.

To adjust the Throttle Motor.

1. Unscrew the nut on the operating lever so that it is loose on the spindle.

2. Rotate the spindle towards its normal position until the pistons are solid at the top of their stroke.

3. With the spindle in this position clamp the levers tight on the spindle in the best position to cope with the required angular movement.

4. With the lever in this position, and the butterfly valve lever hard against the idling stop, fit the control rod.

5. Apply air to the first-speed piston and adjust the stop screw in the throttle motor until the pointed butterfly valve lever coincides with the first speed mark (800 r.p.m.) on the quadrant, and tighten the lock-nut of the stop screw.

   Adjust similarly for the 2nd (1,200 r.p.m.), 3rd (1,600 r.p.m.), and 4th (2,000 r.p.m.) speed positions.

On no account must the idling and full speed stops on the inlet manifold be tampered with, as these are carefully set when the engine is under test at the factory.

DIRECTION CONTROL.

The direction control lever has three positions, - Handle off, Forward, and Reverse. It controls the electro-pneumatic valves through which air is supplied to the cylinder mounted in the final-drive housing.

Two contact switches adjacent to the air cylinder, cut off the electric current to the electro-pneumatic valves when the spur pinion in the final drive is fully engaged with the internally-cut teeth of either of the crown wheels. These switches also give the driver clear indication by indicator lights when the sliding spur pinion has engaged for the desired direction.

In the event of the sliding spur pinion creeping out of gear, air is automatically re-applied to restore it to its correct position.

The reversing mechanism has been designed so that should a fault occur in the controls, it can be manually set in the neutral position.

BATTERY SELECTOR.

The battery selector has three positions - No. 1 Battery, Off, and No. 2 Battery.

When any selector is put into either No. 1 or No. 2 battery position, all the other battery selectors are automatically locked in the off position.

CLUTCH CONTROL.

The clutch control lever is operated by the drivers right hand and has four positions - Handle off, Neutral, Converter Drive, and Direct Drive.

The clutch is controlled by a double-acting air cylinder (Fig. 1) mounted on the torque converter, consisting of two chambers or cylinders, bolted together, with a piston in each chamber.

The piston in the first chamber is in two parts, each part being machined in the centre to form a spherical housing for the ball-end of the operating rod. The two parts are bolted together and two retaining rings hold the piston rings in position.

A rod with one half of the piston, passes through seals into the second chamber. The piston in the second chamber is free to slide on this rod. The end cover of the second chamber contains an air inlet and spring-loaded plunger, the latter engaging in a groove in the piston rod to give a positive neutral position of the clutch.

When the driver moves the control lever to converter drive, air is admitted to the first chamber, via electro-pneumatic valves, and pushes the piston and rod to-wards the second chamber, at the same time pulling the clutch operating rod. This action also causes the free piston to be pushed against the end cover of the second chamber. When direct drive is engaged, the action is reversed except that the free piston remains against the cover of the second chamber.

When engaging neutral position from direct drive, the control lever has first to be moved to the converter drive position and then to the neutral position. Air is then admitted to the second chamber and pushes the free piston and rod until the spring-loaded plunger engages in the groove in the rod.

The seals and piston rings should be examined periodically for signs of wear etc.

On re-assembly after overhaul the cylinders should be smeared with grease.

A drum switch described as the Rotary Contactor is provided to cut off the current from the magnet valves and so place both sides of the piston in communication with atmosphere when either of the three positions is attained.

Rotary Contactor.

This unit is mounted in the torque converter clutch housing, and comprises a cam-operated switch with the cam mechanically linked to the clutch control arm.

The switch which is housed in an aluminium casing, consists of a central cam spindle which operates on spring-loaded arms carrying contact points, and contacting with fixed points in such a manner as to "make" and "break" circuits originally closed or preselected at the driver's control panel, in accordance with the movement of the clutch lever.

These circuits control the two magnet valves for the clutch cylinder, the starter motor and the engine safety devices.

In the body of the rotary contactor are four banks of contacts, the top bank for the starter motor circuit, the second bank for the engine safety devices, the third bank for direct-drive operation and the fourth bank for converter-drive operation.

A cast aluminium cover supports the rotary contactor, and houses a double set of contacts for finding the neutral position of the clutch, and a multi-pin plug.

The converter and direct drive contacts are so arranged that they break the feeds to the magnet valves in either converter or direct drive positions, thereby relieving the clutch ball race of load and preventing waste of air and electricity.

The engine safety contacts interrupt the circuits to the oil-pressure switch and water-level switch when the contactor is in the neutral position.

The starter motor contacts complete the curcuit for the starter motor relay when the rotary contactor is in the neutral position only. No circuit is obtainable through the rotary contactor when in the converter or direct drive positions.

The double set of contacts housed in the cover are provided with adjustment which permits the points to "make" earlier or later as required. The contacts are used for finding the neutral position of the clutch lever, and permit a very fine adjustment to be made, thus preventing unnecessary hunting of the clutch.

A pointer is fixed to the end of the cam spindle, and the base of the neutral contacts has a raised portion with a line scribed on it. When the end of the pointer coincides with the scribed line, the "electrical centre" of the rotary contactor is found.

When neutral is selected on the drivers control switch, contact 2 on the rotary contactor is in circuit, which is shown on the diagram as a sliding bar for the sake of clarity.

If the bar is moved to the left by some outside influence it would bring contact point 1 into circuit, energising the converter drive valve and admitting air to left hand side of the piston with the effect of restoring the bar to its original postion.

A similar action would take place in conjunction with contact point 3, if an external force should tend to cause movement to the right from the central setting.

Consider the bar in the position shown (neutral). If converter drive is selected on the drivers control switch the circuit would be completed through C and 5 to the converter valve, causing the piston to move to the right hand or converter end. Some time before completing the travel the point 5 would lose contact with its contact arm, de-energising the magnet valve and leaving the piston with atmospheric conditions on both sides. Under these conditions the toggle action of the springs is sufficiently powerful to complete the motion.

A spring detent holds the piston in the neutral position without need of pneumatic effort. When in direct or converter drive the clutch is held in engagement by the toggle action springs which follow up wear without requiring adjustment of the contactor.

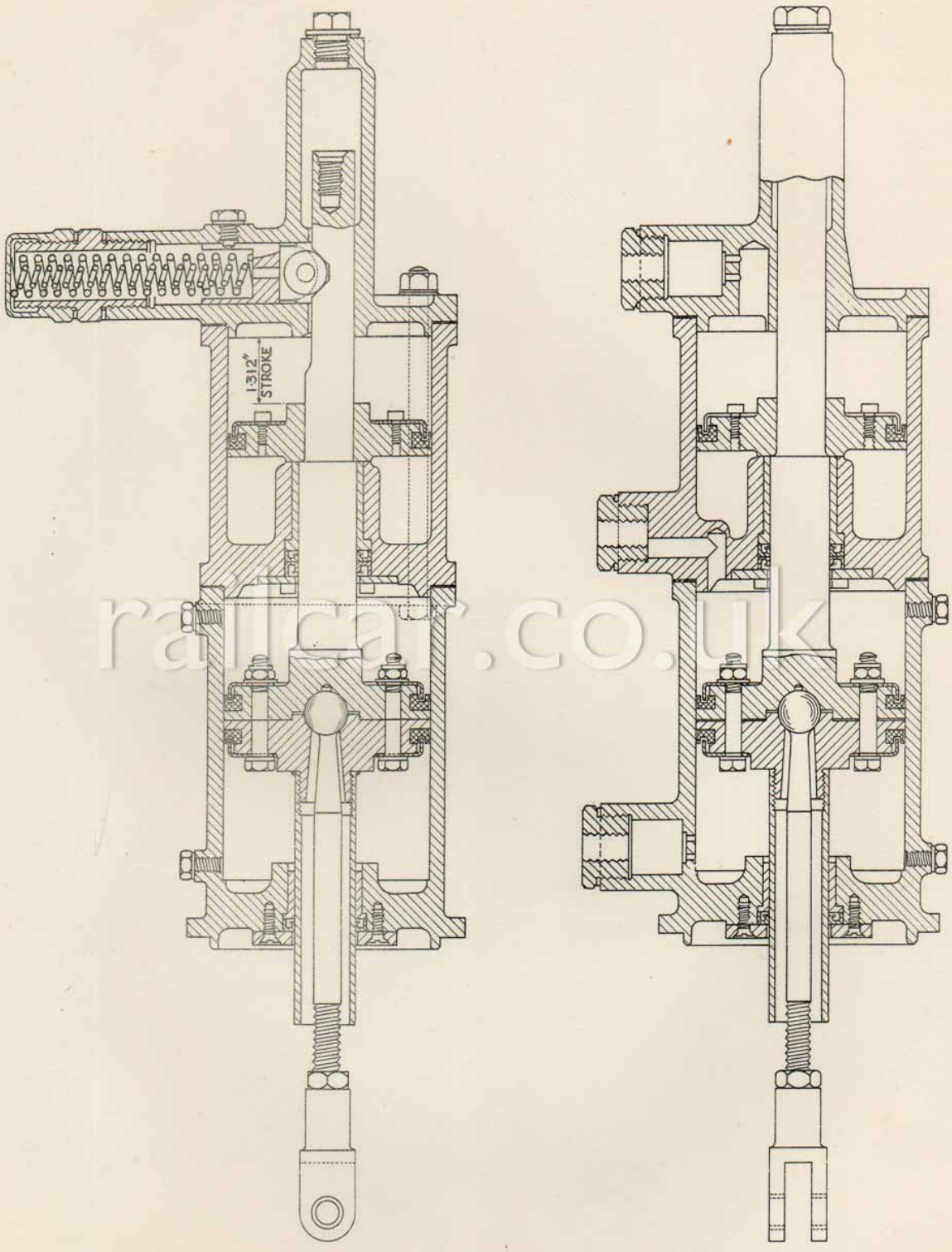


FIG.1. SECTION THROUGH DOUBLE-ACTING AIR CYLINDER.

LUBRICATION

LUBRICATORS

General lubrication is through Tecalemit hexagon lubricators with an oil- or grease-gun, as the case may be. The lubricators on rotating or moving parts should be inspected periodically to ensure that they are screwed home tight.

Certain points, where only a limited supply of grease is required, are fitted with screw-down grease cups or relief valves. The cups have click springs to enable an accurate half or full turn to be given.

SPECIFICATIONS FOR LUBRICANTS OTHER THAN S.A.E. STANDARDS

L. M. Ltd. Spec. A. Oil

i.	Specific gravity	Not more than 0.925.
ii.	Viscosity (Redwood 1)	Not more than 1,100 seconds at 140° F., and not less than 155 seconds at 200° F.
iii.	Cold test (pour point I.P.T. method I.P. 15/42)	Must not exceed 35° F.
iv.	Mineral oil	Not less than 80 per cent.
v.	Ash	Not more than 0.05 per cent.
vi.	Colour	When viewed by reflected light, green, greenish-brown or amber.

L. M. Ltd. Spec. C. Lime-Soda Soap Grease.

The grease shall be a smooth, well-milled product, composed of high-grade soap and refined filtered mineral oil. It shall be free from fillers or any kind of corrosive matter or any gritty substance.

i.	Worked penetration (I.P. 50/42)	Between 280 and 320.
ii.	Drop point (I.P. 31/45)	Not less than 280° F.
iii.	Viscosity of mineral oil used in grease (Redwood 1)	Not less than 160 seconds at 200° F., not more than 200 seconds at 200° F.
iv.	Soap	Sodium soap shall constitute approx. three-quarters of the total soap content.
v.	Ash	Not more than 3 per cent.
vi.	Free fatty acids	Not more than 0.2 per cent. expressed as oleic acid.

vii. Water	Not more than 0.2 per cent.
viii. Corrosion	Polished copper or steel plate shall show no discoloration after remaining submerged in the grease for 48 hours at room temperature.

RECOMMENDED LUBRICANTS

ENGINE OILS

S.A.E. 20W Engine Oil	0° to 30° F.
S.A.E. 30 Engine Oil	30° to 90° F.
S.A.E. 40 Engine Oil	Above 90° F.

DETERGENT OILS

The use of detergent oils is desirable in engines operating under arduous conditions, particularly when the sulphur content of the fuel exceeds 0.5 per cent. Such detergent oils should comply with any of the following specifications.

British Defence Specification	DEF/2101.
U.S. Defence Specification	MIL-0-2104.
U.S. Defence Specification	2-104B. Supplement 1.

FINAL DRIVE

S.A.E. 30 Oil

ELECTRICAL EQUIPMENT OILS AND GREASES

DYNAMO (C.A.V.)

Shell Nerita 3 Grease	Bearings.

STARTER MOTOR (C.A.V.)

1.	**Shell Nerita 3 Grease**	Pinion, commutator end bearing and clutch.
2.	**S.A.E. 20 Oil**	Driving-end bearing.

GENERAL LUBRICATION

1. **L. M. Ltd. Spec. A. Oil**
2. **S.A.E. 140 Oil**
3. **L. M. Ltd. Spec. C. Lime-Soda Soap Grease**

TORQUE CONVERTER.

40% Monsanto Aroclor and 60% Shell Tellus 15.

LUBRICATION OF RAILCAR UNIT - RCU. 1

Component	Location of point	No. of Points	Attention	Winter 0°F. to 30°F.	Normal 30°F. to 90°F.	Tropical Above 90°F.
DAILY						
Engine Sump	Oil filler and dipstick	1	Check dipstick. Top up as required	S.A.E. 20W	S.A.E. 30	S.A.E. 40
Torque Converter	On sides of car close to unit	1	Check fluid level. Top up as required	40% Arocolor and 60% Shell Tellus 15		
EVERY 2,500 MILES						
Torque Converter Free-wheel Unit	Dipstick in filler plug	1	Check dipstick. Top up as required	S.A.E. 30 Oil		
Final Drive	Oil filler and dipstick	1	Check dipstick. Top up as required			
Water Pump Drive Bearings	Greaser attached to engine oil filler and piped up to pump (limited supply)	1	Grease gun (one shot only)	Leyland Spec. C grease		
Driving Belt Tensioner Bearings	Grease cup on tensioner bracket	1	Two full turns. Refill when empty			
C.A.V. Fuel Pump and Governor	Dipsticks on pump and governor	2	Check dipsticks. Top up as required	As for engine		
Clutch Withdrawal Bearing	Greaser - on side of Torque Converter	1	Grease gun	Leyland Spec. A oil or S.A.E.140 oil		
Torque Converter Pump Wheel Bearings	Greaser - on side of Torque Converter	1	Grease gun	Leyland Spec. C grease		
Dynamo and Fan Main Drive Bearings	Plug	1	Replenish only in case of leakage			
Fan Drive Bearings	Greaser at side of housing	1	Grease gun			
Fan Bearings	Greaser at bottom of fan cowl	1	Grease gun			
All Control Rod Joints, Etc.	———	—	Oil can	S.A.E. 30		
EVERY 5,000 MILES						
Engine Sump	Engine oil filler	1	Drain sump through drain plug, and re-fill to top level mark on dipstick with fresh oil. Renew filter cloth	S.A.E. 20 W. oil	S.A.E.30 oil	S.A.E.40 oil
Air Filter	Adjacent to engine	1	Inspect level. Top up to level mark in bowl if required. In very dusty conditions, drain, clean and refill	As for engine		
Final Drive	Final drive oil filler	1	Drain box through drain plug and refill to top level mark on dipstick with fresh oil	S.A.E.30		
Main Auxiliary Drive Shaft	Couplings	3	Grease gun	Leyland Spec.A oil or S.A.E.140 oil		
OVERHAUL						
Water Pump Drive Bearings	Clean and repack bearings with grease			Leyland Spec. C grease		
Driving Belt Tensioner Bearings	Clean and repack bearings with grease					
C.A.V. Fuel Pump and Governor	Drain and refill with fresh oil			As for engine		
Clutch Withdrawal Bearing	Clean and repack bearing with grease			Leyland Spec. C. grease		
T.C. Pump Wheel Bearings	Clean and repack bearings with grease					
Dynamo and Fan Main Drive Bearings	Clean and repack bearings with grease					
Fan Drive Bearings	Clean and repack bearings with grease					
Fan Bearings	Clean and repack bearings with grease					
Torque Converter	Drain and refill with fresh fluid			40% Arocolor and 60% Shell Tellus 15		
C.A.V. Dynamo Bearings	Clean and repack with grease			High-melting-point-grease Shell Nerita 3 preferred		
C.A.V. Starter Motor	Clean and repack pinion and commutator-end bearing with grease Reassemble clutch and smear all parts lightly with grease Lubricate driving-end bearing with oil (12 c.c.)			Shell Nerita 3 Shell Nerita 3 S.A.E. 20 oil		
Clutch Spigot Bearing in Flywheel	Clean and repack bearing with grease			High-melting-point-grease		
Clutch Double-Acting Air Cylinder	Lightly smear inside cylinder and ball joint with grease			Leyland Spec. C grease		

MAINTENANCE.

LOCATION AND CORRECTION OF FAULTS.

ENGINE.

1. Engine failing to start when turned by the starter motor - may be due to:

   (a) No fuel in tanks.

   (b) Operation of fuel-feed pump on side of main fuel pump being faulty.

   (c) Air in fuel system between fuel pump and injectors. Release the delivery pipe nuts at the injectors and turn the engine until fuel flows free from air bubbles.

   (d) The stop solenoid being energised or sticking.

   (e) Incorrect fuel pump timing. This may only occur after overhaul when the fuel pump may have been replaced on the engine 180° out.

2. Engine starts but runs unevenly - may be due to :

   (a) Fuel in tanks getting low.

   (b) Air in fuel pipes. Vent the system.

   (c) If unsuccessful check that:

   1. No pipes are leaking, especially those on the suction side of the pump, where a small air leak may pass undetected.

   2. The vent pipe is not blocked.

   3. The primary and main fuel filters are clean and that the primary filter bowl is perfectly tight.

3. Loss of engine power - may be due to :

   (a) Faulty injection. This may be accompanied by one or more of the following:

   1. Heavy blue-white smoke in the exhaust when the engine is hot and pulling on load.

   2. Misfiring.

3. Pronounced knocking in the affected cylinder.

4. To locate the cylinder that is misfiring, loosen the upper delivery pipe nut for each cylinder in turn and so stop delivery of fuel to that cylinder. If the cylinder has been misfiring, the uneveness will be accentuated, if not firing, there will be no difference in the running.

(b) Bad compression. Check for compression by listening for blow by. Bad compression may be caused by a scored cylinder, cracked piston, stuck piston rings or badly seating valves.

(c) Dirty air cleaners.

4. Engine races when in direct or converter drive - may be due to :

(a) Clutch slipping.

(b) Wheels slipping.

(c) Loss of converter fluid caused by faulty injector, failure of pipes or damaged seals.

(d) Worn clutch linings and air cylinder piston at end of stroke.

5. Engine stopping - may be due to :

(a) Stoppage of fuel supply.

(b) Converter remaining in direct-drive when car stops.

6. Engine returning to idling speed - may be due to :

(a) Failure of air supply to throttle motor.

(b) Failure of current to throttle magnet valves.

(c) Operation of dead man's handle (All engines)

7. Engine starter motor engages but fails to turn the engine - may be due to:

(a) Flat battery.

(b) Converter in direct-drive.

8. Engine starter motor engages but turns engine slowly - may be due to:

   (a) Battery run down.

9. Engine starter motor failing to engage - may be due to :

   (a) Isolating switch tripped.

   (b) Local battery isolating switch not in circuit.

   (c) Battery connections broken, loose or corroded.

   (d) Failure of relay in starter motor.

   (e) Failure of relay in starting circuit.

CONVERTER CONTROL.

1. Control fails to engage converter or direct-drive - may be due to:

   (a) Incorrect setting after overhaul.

   (b) Faulty air connection to magnet valve or air cylinder.

   (c) Faulty points, loose or broken wires and connections in control system.

2. Control fails to engage neutral. In addition to (1), may be due to:

   (a) Faulty adjustment of rotary contactor.

   (b) Air pressure too low or too high.

   (c) Wrongly-adjusted clutch air-cylinder piston-rod.

3. Converter overheating - may be due to :

   (a) Lack of converter fluid.

   (b) Seal failure (rare).

   (c) Faulty injector.

   (d) Dirt on cooler or water radiator tubes.

   (e) Clogged filter.

TORQUE CONVERTER CLUTCH LEVER SETTING.

This setting should always be checked after a complete overhaul, or when a service converter is being fitted, or in case the initial setting has been disturbed for any reason. Do not attempt to adjust the rotary contactor until the clutch lever has been set correctly.

The 'mechanical centre' or 'neutral' position of the clutch lever can be found with a special tool, consisting of a flange, carrying a special loose-fitting bush which has an end play of $\frac{1}{4}$". An operating screw, having a jaw-end fixed to the end is fitted in the bush.

Fasten the tool to the double-acting air-cylinder facing onthe clutch housing and connect the jaw-end to the boss at the end of the clutch arm. Now turn the bush to bring the clutch lever towards the neutral position; on nearing this position the bush will turn easily, but take care to turn it slowly. When the clutch lever has moved a short distance over the neutral position it should 'flirt'. Immediately this happens cease turning the bush and make a pencil mark on the flat of the operating screw in line with the end of the bush.

The bush should now be turned in the reverse direction until the lever flirts, as before, and again mark the position of the end of the bush. Repeat this procedure a few times to check the markings. Put a mark on the operating screw mid-way between the two marks and turn the bush until the end face coincides with the half-way mark. Retaining this setting remove the tool and with the bush pulled hard against the inside face of the flange measure the distance from the centre of the pin hole in the jaw-end to the face of the flange, and make careful note of this measurement. This dimension will give a clutch lever position $\frac{1}{8}$" over the neutral position towards converter drive, thus giving the clutch mechanism a bias towards converter drive.

This is the condition of the clutch actually required for setting the neutral contacts of the rotary contactor.

With the detent plunger engaged in the notch on the clutch air-cylinder tail-rod, adjust the length of the piston-rod to the measurement taken from the tool. Fit the air-cylinder to the clutch housing and connect the jaw end to the clutch lever.

GENERAL NOTES ON OVERHAULING.

CLEANING.

1. All assemblies dismantled for overhaul should be thoroughly degreased and cleaned before any inspection for wear or damage is carried out. Small but dangerous cracks may pass undetected unless cleaning is carried out.

2. When rebuilding assemblies after overhaul, observe scrupulous cleanliness throughout the operation. Dirt or swarf left between fitting faces causes oil leaks.

3. All oilways, pipes, etc., s hould be thoroughly flushed clear of sludge and old oil.

BALL AND ROLLER BEARINGS.

1. Examine for excessive play between the balls or rollers and the races.

2. Examine for broken cages and cracked balls or rollers.

3. Examine for any signs of blueing due to overheating.

4. Use a press whenever possible for inserting bearings which are an interference-fit in housings. If no press is available, hammer in with a block of wood laid across the bearing. Always make certain that the bearing enters the housing squarely.

TAPER-ROLLER BEARINGS.

The bearing assembly consists of two parts, the outer race or cup and the roller assembly, i.e., rollers secured in a cage on the cone or inner race.

1. Outer Races.

i. The cups must be an interference-fit in their housings. If not, the housings, should be replaced.

Knurling, application of solder, or the use of liners, other than press-in-steel, must not be resorted to.

ii. The cups must not be tilted when being pushed in.

iii. The cups must be pressed right home against the abutment shoulder, preferably under a press, or by a bolt and nut arrangement. It should not be possible to enter a .002 in. (.0508 mm.) thickness gauge between the cup and the abutment shoulder.

iv. Grease the seating for the cup, which should be assembled clean and smeared with lubricant after installation.

2. Roller Assemblies.

i. Cones on stationary shafts must be a "creep" fit on the shaft, the ideal being .0005 in. (.0127 mm) loose. The seatings for the inner races must always be smeared with grease before the bearings are fitted. Bearings should be adjusted by screwing up the adjoining nut fairly tightly, revolving the rollers, then slacken back the nut to give the correct end-play. Always make a check after the assembly has been locked up.

ii. Cones on revolving shafts should be press-fit, but in some cases where bearing adjustment is made by moving one of the cones, it is not practicable to be more than a light push-fit. If the cones are loose enough to turn on the rotating shaft, overheating and rapid wear of the seating will occur.

OIL SEALS.

1. Use of Part-worn Oil Seals.

As a general rule, once a part-worn oil seal has been removed from its location, it is advisable to renew it.

Warning: Never allow a seal to pass through a degreasing plant (trichlorethylene). Do not clean with petrol or paraffin. Use light lubricating oil.

2. Examination of Seals before Refitting.

In determining whether a seal is suitable for further use :

i. Discard the seal if charred, cut, hard, or the wiping edge has become folded back.

ii. Discard the seal if loose in the shell.

iii. Discard any seal with a broken or damaged spring.

iv. Discard seals in which the shell or metal components are distorted or damaged.

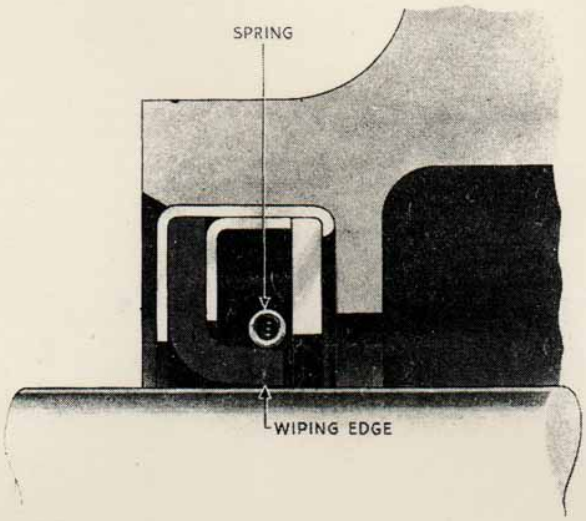


FIG.1. SECTION THROUGH OIL SEAL IN POSITION.

v. Finally, on shafts or sleeves which are scored sufficiently to necessitate a reduction in diameter of .03125 in. (.7937 mm.) to clean up, fit a new part and seal.

3. To Fit a Seal.

i. Assemble the wiping edge or lip of the sealing member towards the bearing in which the lubricant is to be retained, as shown in Fig. 1.

ii. Fit the seal into the housing with a tool or ram, approximately .015 in. (.0381 mm.) less in diameter than the outer diameter of the seal by exerting a firm or uniform pressure squarely on it. Avoid entry of the seal into the recess in a tilted position and under no circumstances fit with a drift and hammer, as the irregular impact will loosen the rolled edge and release the pressure of the inner member on the sealing element and cause seepage round the sealing lip.

GEARS.

1. Gear teeth should be examined for signs of cracks or pitting. A burnished finish indicating wear is not in any way detrimental. Discard any gear which is chipped right through the case-hardening.

2. Examine the bores of gears which rotate on shafts for wear or scoring. Check for excessive diametral clearance in excess of that permitted for that particular gear.

3. Examine the teeth of all gear-type engagement dogs for tapered wear. This can be one of the causes of gears slipping out of engagement.

4. It is not sufficient to replace worn or damaged gears without first ascertaining the cause. Gears do not fail or wear badly at low mileages on their own account ; badly adjusted or worn bearings, lack of, or unsuitable lubricant, and bad fitting are usually the causes on close investigation.

COVERS AND HOUSINGS.

1. Whenever tapped holes are provided for jacking screws, use them.

2. When fitting spigoted housings or covers, check that the spigot is not burred or damaged in any way. Check that there is a good chamfer on the main component for entering the spigot.

3. Always enter a spigoted component evenly. Damage will be caused if it is entered in a tilted position.

4. Always see that the fitting faces are wiped perfectly clean.

GASKETS AND JOINTS.

1. Fit new gaskets and joints throughout when rebuilding, unless existing gaskets and joints are obviously in good condition.

2. Where an oil-tight joint is required, paint the joint and fitting face with jointing compound.

SHIMS.

1. When stripping, note the number and position of shims removed and place in a clean place for subsequent use.

2. Discard any torn or crumpled shims and substitute new ones of the same thickness.

3. Wipe all shims clean before reassembly and smear lightly with oil.

4. Where an oil-tight joint is required at a shimmed face, smear the shims lightly with jointing compound before final assembly.

BUSHES.

1. Never re-insert extracted bushes.

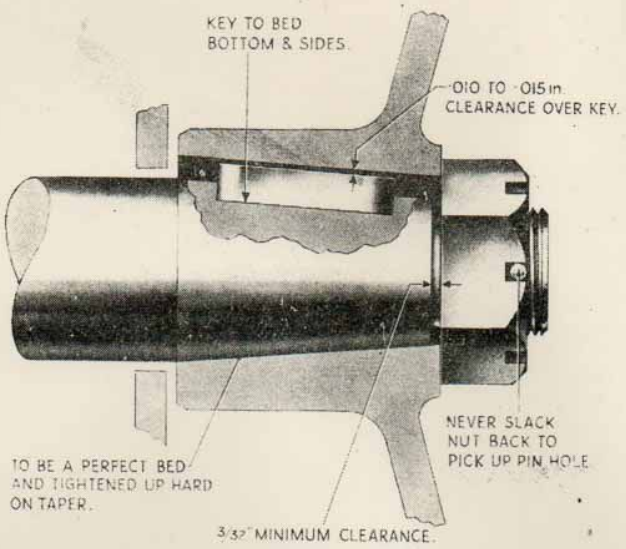


FIG.2. TAPERS, KEYWAYS AND NUTS.

2. Always ream out new bushes after pressing in.

3. New bushes should be inserted by a press where possible. Failing that, use a block of wood or a hide hammer.

4. Make certain that the bush does not enter its housing in a tilted position.

KEYWAYS.

1. When fitting a key, check that it bottoms into the keyway.

2. Check that the top of the key is not bedding in the bottom of the component fitted to the shaft, as shown in Fig. 2.

SCREW THREADS.

1. Always protect against burring threads in exposed positions.

2. Large-diameter threads on shafts, etc., should be wrapped with a rag or tape for protection against damage or dirt. A small amount of dirt will bind or jam the nut, especially where Simmonds nuts are used.

3. Clean all split-pin holes and threads before final assembly on any unit.

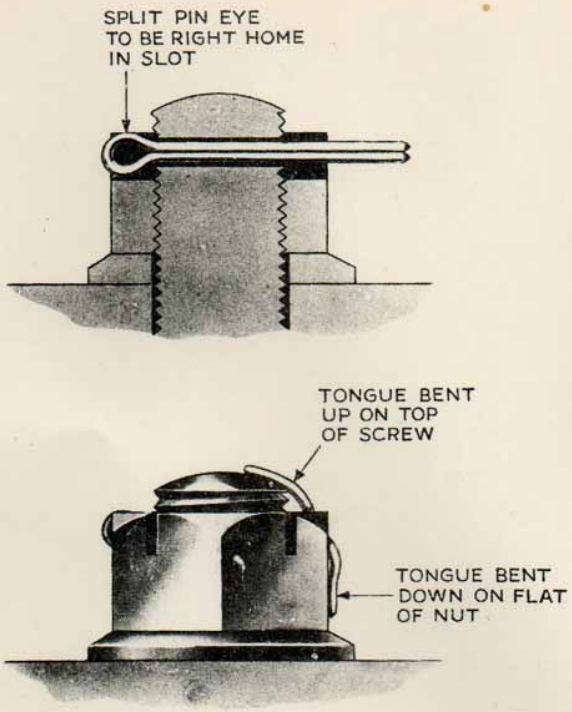


FIG. 3. FITTING SPLIT-PINS.

4. Discard any bolts or studs on which the condition of the threads is bad (e.g., threads stripped or deformed.)

NUTS.

1. When tightening up a slotted or castellated nut, never slack it back to insert the split-pin or locking wire. File the base of the nut until the pin or wire can be inserted.

2. Simmonds nuts can be removed and replaced as many times as desired. This type of nut is renewed only when it is obvious that the fibre insert is no longer locking the nut.

SPLIT-PINS.

1. Never refit an old split-pin after removal, always fit a new one.

2. Always fit split-pins where split-pins were originally used. Do not substitute spring washers ; there is always a good reason for the use of a split-pin.

3. All split-pins should be fitted as shown in Fig. 3, unless otherwise stated.

PIPES, NIPPLES AND UNIONS.

1. Examine all pipes carefully for cracking, chafing or fatiguing, especially at bends or clips.

2. In addition to being examined as above, pipes should be examined for cracked union nuts, dirt under the cones and seatings of the nipples.

3. Before connecting up a pipe, whether old or new, it is advisable to blow it through with compressed air.

4. Never strain or pull a pipe when connecting it up, find out why it will not meet the other component.

RUBBER HOSE CONNECTIONS.

Examine all hose connections for :

1. Hardening due to heat.

2. Softening due to oil.

3. General perishing.

ENGINE.

ENGINE DATA

General

Marks...	E.O.600/229
Known as	Leyland 0600 horizontal Diesel engine (9.8 litres).
Type	Six-cylinder, compression-ignition, direct-injection, overhead-valve, horizontal, water-cooled.
Bore	4.8 in.(122 mm.).
Stroke..	5.5 in.(139.7 mm.).
Cubic capacity..	597 cubic inches (9,785 c.c.).
Compression ratio...	15.75 to 1.
Firing order	1,5,3,6,2,4.
Maximum b.h.p...	140 at 2,000 r.p.m. (142 metric b.h.p.).
Installation	Engine mounted at 3° from horizontal.

Lubrication

Type	Wet sump, gear-type pump.
Pump data...	Interference of pump gear on shaft, .0003 in. to .0013 in. Initial diametral clearance between idler-gear and spindle, .0012 in. to .0022 in. Backlash between gears, .022 in. to .026 in.

Sump capacity...	4 galls.(18.4 litres).
Oil pressure	60 lb./sq.in.(4.2 kg./ sq.cm.) at 1,000 r.p.m. or higher speeds, with warm engine. Not below 10 lb./sq.in. (.70 kg./sq.cm.) with engine idling.
Pump delivery...	6 galls, per min. at 1,000 r.p.m.
Filter..	Leyland, full-flow, cloth-type element.

Cylinder Heads

Type	Detachable, 2 per engine, each covering 3 cylinders.
Material	Cast iron.
Valve guide interference in head ...	.001 in.to .002 in.

Engine Block

Type	Cylinders and crankcase in one-piece casting.
Material	Cast iron.
Liners..	Pre-finished, dry, cast iron, press-fit, shoulder located.
Initial bore of liner after fitting to engine block	4.8 in.* .0015 in. - .0005 in.
Reline when wear of liner bore exceeds	.020 in.

Piston and Rings

Piston make	Specialloid.
Piston type...	Toroidal cavity.

Piston material...	Aluminium alloy.
Initial piston clearance..	Bottom of skirt at 90° to gudgeon pin .006 in.to .009 in.
Piston make (alternative).	Wellworthy.
Piston type...	Toroidal cavity.
Piston material...	Aluminium alloy.
Initial piston clearance..	Bottom of skirt at 90° to gudgeon pin .007 in. to 010 in.

Compression Rings

Number of rings...	Three (1st,2nd and 3rd grooves).
Type of ring..	.125 in. wide, 3° tapered sides, hardened and tempered, 90° gap.
Initial gap...	.020 in. to .027 in.

Scraper Rings

Number of rings...	Two (4th and 5th grooves).
Type of ring..	.250 in. wide, straight sides, slotted, 90° gap.
Initial gap...	020 in. to .027 in.
Initial side clearance,top ring... ...	.004 in. to .006 in.
bottom ring ...	.003 in. to .005 in.
Renew when side clearance exceeds. ...	.015 in.

Connecting Rods and Gudgeon Pins

Gudgeon pin...	1.625 in.dia.hollow, full floating.

Pin retained by...	Two circlips in piston.
Connecting rod type...	I-section.
Small-end bearing.	Phosphor-bronze bush.
Initial diametral clearance of pin in small end bush (cold)..	.00045 in. to .001 in.
Renew small-end bush when diametral clearance exceeds...	.0025 in.
Interference of small-end bush in connecting rod.	.00225 in. to .00425 in.
Big-end bearing type..	Prefinished strip bearing.
Big-end bearing material..	Lead-bronze, steel shell,bearing surface indium-coated.
Big-end initial diametral clearance.	.0018 in. to .0037 in.
Renew when diametral clearance exceeds...	.008 in.
Undersize big-end bearings available.	Prefinished in five steps of .010 in.each.

Do not grind sides of crankpins.

Crankshaft and Main Bearings

Number of main bearings...	Seven.
Main bearing type...	Prefinished strip bearings.
Type of bearing...	Lead-bronze, steel shell, bearing surface indium coated.

TABLE OF CRANKSHAFT DIMENSIONS

Type	Part Number	Crankpin Diameter	Crankpin Width	Journal Diameter	Journal Width			
					Front	Centre	Rear	Others
Standard Service	Part Number as stamped on front web.	3.0005 in. 2.9998 in.	2.203 in. 2.200 in.	3.5005 in. 3.4998 in.	2.000 in.	2.702 in. 2.700 in.	2.705 in. 2.695 in.	1.710 in. 1.700 in.
1st Service	Part Number S.1.	2.9905 in. 2.9898 in.	2.203 in. 2.200 in.	3.4905 in. 3.4898 in.	2.000 in.	2.702 in. 2.700 in.	2.705 in. 2.695 in.	1.710 in. 1.700 in.
2nd Service	Part Number S.2.	2.9805 in. 2.9798 in.	2.203 in. 2.200 in.	3.4805 in. 3.4798 in.	2.000 in.	2.702 in. 2.700 in.	2.705 in. 2.695 in.	1.710 in. 1.700 in.
3rd Service	Part Number S.3.	2.9705 in. 2.9698 in.	2.203 in. 2.200 in.	3.4705 in. 3.4698 in.	2.000 in.	2.702 in. 2.700 in.	2.705 in. 2.695 in.	1.710 in. 1.700 in.
4th Service	Part Number S.4.	2.9605 in. 2.9598 in.	2.203 in. 2.200 in.	3.4605 in. 3.4598 in.	2.000 in.	2.702 in. 2.700 in.	2.705 in. 2.695 in.	1.710 in. 1.700 in.
5th Service	Part Number S.5.	2.9505 in. 2.9498 in.	2.203 in. 2.200 in.	3.4505 in. 3.4498 in.	2.000 in.	2.702.in 2.700 in.	2.705 in. 2.695 in.	1.710 in. 1.700 in.

Note 1. - When re-grinding crankpin and journals the sides must not be ground unless they have been damaged. If the location faces of the centre main bearing have been damaged, the width should be increased to 2.710 in./2.712 in., otherwise the dimension should remain unchanged.

Note 2. - The crankshaft should be re-nitrided at service sizes S.2 and S.4.

Crankshaft type...	Forging, incorporating balance weights.
Crankshaft material...	Alloy-steel, nitrided.
Thrust taken on...	Thrust washers at centre journal.
Central journal initial end clearance.	.004 in. to .010 in.
Renew thrust washer when end clearance exceeds.	.014 in.
Oversize thrust washers available.	One set .010 in. thick (.005 in. each washer).
Regrind journals and crankpins.	When .003 in. oval.
Undersize main bearings available.	Five, in steps of .010 in. each.
Main bearing initial diametral clearance...	.0020 in. to .0042 in.
Renew when diametral clearance exceeds...	.009 in.
Maximum run-out on shaft..	.003 in.(total clock reading, .006 in.).
Maximum run-out between two adjacent bearings.	.003 in.(total clock reading).
Crankshaft damper.	Rubber-bonded vibration damper at front of crankshaft.

Camshaft

Number...	One

Camshaft type	Forged with integral cams.
Camshaft material	Steel.
Type of drive	Single-helical gear.
Number of bearings...	Seven.
Material.	Front and rear-leaded gunmetal; intermediate-carobronze.
Thrust taken on..	Front bearing only.
Interference fit of all bearings in engine block.	.0005 in. to .0025 in.
Journal diameters	2.396 in. to 2.397 in.
Initial diametral clearance in all bearings..	.004 in. to .0055 in.
Renew bearings when clearance exceeds..	.010 in.
Backlash between oil pump drive gears..	.004 in. to .008 in.
Initial dimension from nose to back of cam...	1.995 in. to 2.005 in.
Renew camshaft when this dimension is.	1.983 in.

Timing Gears

Type.	Single-helical gears.
Gear Material	Hardened and ground steel.
Permissible backlash between each pair of gears...	.002 in. to .004 in.
Idler gears, initial diametral clearance between bush and gear... ...	.001 in. to .00325 in.

Diametral clearance between bush and idler spindle ... ... .001 in. to .00325 in.

End float between thrust washers and idler gear ... ... .004 in. to .0095 in.

Renew thrust washers when end clearance exceeds. ... ... .012 in.

Interference fit of timing gear on crankshaft ... ... .00075 in. to .00225 in.

Valves

Type.. ... ... Overhead poppet, stellite-faced, hard-chrome plated stems.

Valve material ... ... Stellite faced hard chrome-plated stems.

Number per cylinder... ... ... One inlet, one exhaust.

Stem diameter. ... ... .4375 in.

Stem clearance in guide:

Inlet.. ... ... .0025 in. to .00375 in.

Exhaust ... ... .004 in. to .00525 in.

Valve head diameter:

Inlet.. ... ... 2.10 in.

Exhaust ... ... 1.80 in.

Angle of valve seat... ... ... 30°.

Angle of valve face... ... ... 29½°.

Valve lift ... ... 0.5 in.

Number of valve springs... ... ... Two per valve, concentric.

Maximum spring pressure (valve open)... ... ... 134 lb.(61.1 kg.).

Free length of spring :	
Inner	2.130 in.
Outer	2.50 in.
Renew springs when.	Inner spring will compress to 1.25 in. under a load less than 35 lb. (15.94 kg.). Outer spring will compress to 1.5 in. under a load less than 74 lb.(33.74 kg.).
Initial diametral clearance of rocker shaft in rocker.. ...	.0005 in. to .00175 in.
Renew rocker shaft bushes when diametral clearance exceeds ...	.003 in.
Initial diametral clearance of tappet in engine block.. ...	.00175 in. to .00375 in.
Renew tappet when diametral clearance in engine block exceeds	.004 in.
Tappet clearance :	
Inlet	.020 in., engine cold.
Exhaust..	.020 in., engine cold.

Valve Timing

Inlet opens	10° before T.D.C.= 1.72 in. on flywheel rim. (43 mm.).
Inlet closes...	50°after B.D.C.= 8.61 in. on flywheel rim. (219 mm.).
Exhaust opens..	46°before B.D.C.= 7.92 in. on flywheel rim. (201 mm.).
Exhaust closes.	14°after T.D.C.= 2.41 in. on flywheel rim. (61 mm.).

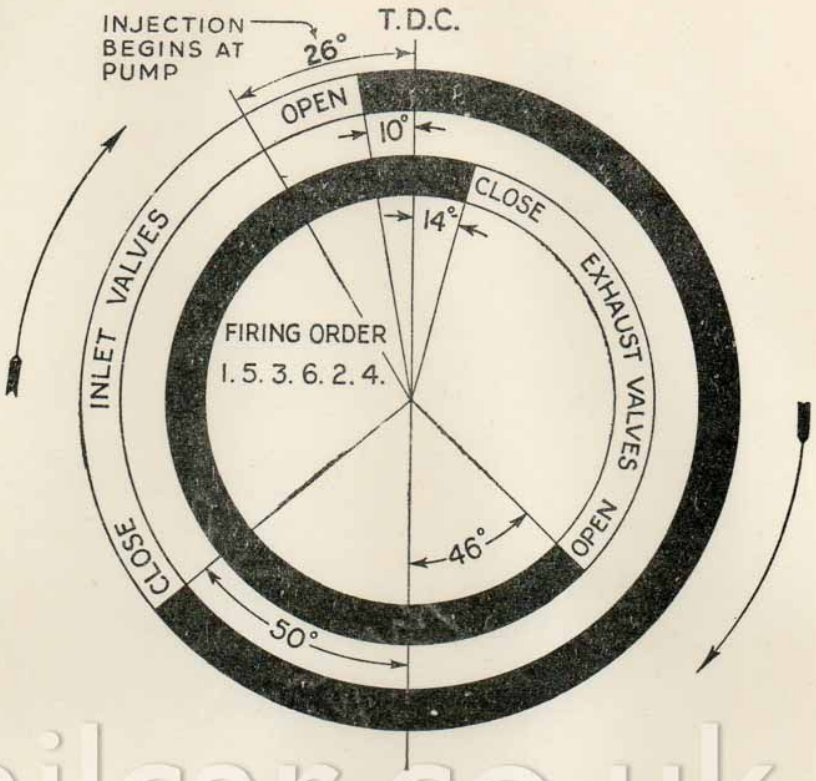


FIG. 1. VALVE TIMING DIAGRAM.

(Looking at front of Engine)

Fuel System

Control...	Electric solenoid on fuel pump governor.
Main fuel filter..	C.A.V. type B.F.A.

Injection Pump

Make..	C.A.V.
Type..	BPE6B75V320/S6063.
Number of deliveries..	Six.
Plunger diameter..	7.5 mm.
Cam lift..	7.5 mm.
Helix.	Right hand.

Drive.	Flexible, adjustable coupling, clockwise rotation, half engine speed.
Timing	Timing begins at the injection pump, 26° before T.D.C.

Governor

Make..	Leyland-C.A.V.
Type..	BEP/LB1000DS23CW.
Cutting-in Speed..	2,000 r.p.m. engine speed.
Runaway speed.	2,150 r.p.m. engine speed.
Idling speed..	400 r.p.m. engine speed.

Fuel Feed Pump

Make..	C.A.V.
Type..	DFP1/1.
Pressure maintained...	4 to 5 lb.per sq.in.(.28 to .35 kg./sq.cm.).
Operation...	Operated by arm in contact with eccentric on injection pump camshaft.

Injectors

Make	Leyland.
Type	N.35/1.
Discharge pressure..	140 to 145 atmospheres, 2,057 to 2,130 lb./sq.in.(144.6 to 149.7 kg./sq.cm.).
Sustained pressure..	130 atmospheres 1,911 lb./sq.in. (134 kg./sq.cm.).
Discharge pressure adjusting washer	Available in ten steps of .010 in.each.

Needle valve lift... ... ... .016 in. to .018 in.

Needle valve adjusting washer.. ... ... Available in the following thicknesses:
.0965 in.
.0985 in.
.1005 in.
.1020 in.
.1040 in.
.1060 in.

Angle of sprays. ... ... 140°

Valve spring free length ... 1.5625 in.

Valve spring length under load of 50 to 52 lb... 1.355 in.

Air Intake

Air precleaner.. ... ... A.C. Sphinx.

Type ... ... Centrifugal.

Air cleaner. ... ... Air Maze.

Type ... ... Two-stage oil-bath.

Venturi... ... ... Incorporated in inlet manifold.

Bore of venturi... ... ... 61 mm.

Compressor

Make.. ... ... Westinghouse

Type.. ... ... E.15

Drive. ... ... Gear type dog coupling, driven from timing gear train at half crankshaft speed, clockwise rotation.

Backlash with driving dog in mesh with mating gear.. ... .001 in. to .005 in.

Cooling System

Controlled by thermostat.. ...	Opening at 185°F.(85°C.). approx.
Water pump	Belt-driven from crankshaft at 1.5 x engine speed.
Interference fit of driving shaft on impeller. ...	.0005 in. to .0018 in.
Interference fit of driving shaft on pulley bore..	.001 in. to .002 in.
Fan drive.	From crankshaft by propeller shaft and V-belts. Clockwise rotation at 1.4 x engine speed.
Interference fit of driving shaft on pulley flange bore	.001 in. to .002 in.
Interference fit of fan driving shaft on pulley bore	.001 in. to .002 in.

Propeller Shaft(fan drive):

Make..	Layrub.
Length face to face...	29.2 in.

CYLINDER HEADS AND MANIFOLDS

Cylinder Heads

The two cylinder heads are interchangeable, each head covering three cylinders. The stellite-faced valve seats are shrunk into the heads.

To Remove and Replace Cylinder Heads

1. Disconnect the inlet, exhaust and water manifolds and remove them from the heads.

2. Remove valve covers and uncouple and remove the fuel pipes between the support bracket and the injectors.

3. Take off the nuts securing the rocker shaft brackets. Lift off the rocker assembly and withdraw the push rods.

4. Remove all cylinder head nuts and raise the heads by unscrewing the special lifting nuts (see Fig.3). Two lifting nuts are provided for each of the heads, to prevent damage to the gaskets when lifting. Both nuts should be screwed evenly as far as they will go, then lift the heads off the studs. If the heads are tight on the studs, a further lift can be obtained by screwing long 1/2 in. B.S.F. bolts into the lifting nuts.

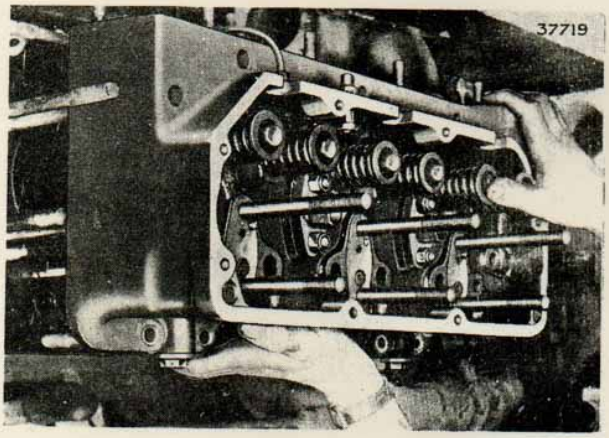


FIG. 2. REMOVING THE CYLINDER HEADS.

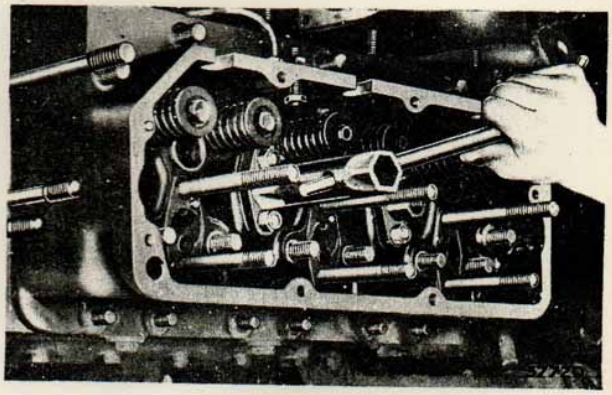


FIG. 3. TIGHTENING LIFTING NUTS.

5. Before replacing the cylinder heads, wash out all water spaces. Clean all rust and carbon from the studs and engine block face. If this is left on, the heads may scrape some down and prevent a good bed being obtained when the nuts are tightened.

6. New gaskets should be fitted if the old ones are not in good condition. Gaskets must always be fitted so that the turnover reinforcement surrounding the cylinder bores is facing outwards. Do not use jointing compound on the gaskets.

7. Place each head on to the lifting-nut studs and screw down the nuts evenly a little at a time, keeping the heads parallel with the engine block.

8. To ensure freedom from distortion and gasket leaks, the cylinder head nuts must be tightened down evenly in a definite order, starting at the centre and working outwards, as shown in Fig.5. First tighten down with a short spanner, then with a torsion spanner set at 150 to 160 lb./ft.(20.5 kg./m. to 22 kg./m.), see Fig.4. A torsion spanner set at 80 to 85 lb./ft.(11 to 11.7 kg./m.) should also be used for the 7/16 in. dia., B.S.F. nuts along the right-hand of the cylinder-heads.

9. Replace push rods and fit rocker gear. Set inlet and exhaust valve clearances to .020 in. cold. Replace fuel pipes and manifolds.

10. Do not over-tighten the exhaust manifold nuts or the flanges may be fractured.

11. Check tappet clearances after the engine has had a short run.

Valves and Rocker Gear

The rocker levers (Fig.7) are bushed and carried on hollow shafts. Each shaft is held in position by three support brackets which also carry the decompressor shaft. The number one bracket on each head carries a spring-loaded plunger which comes into contact with a flat, milled on the decompressor shaft, and holds it in the off position.

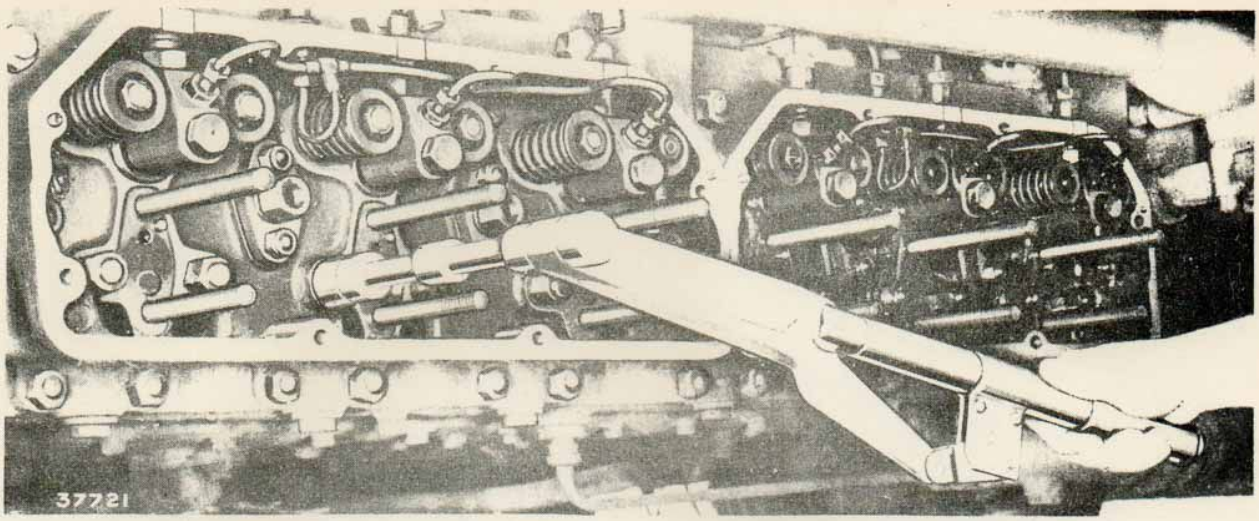


FIG. 4. TIGHTENING HEAD NUTS WITH TORSION SPANNER.

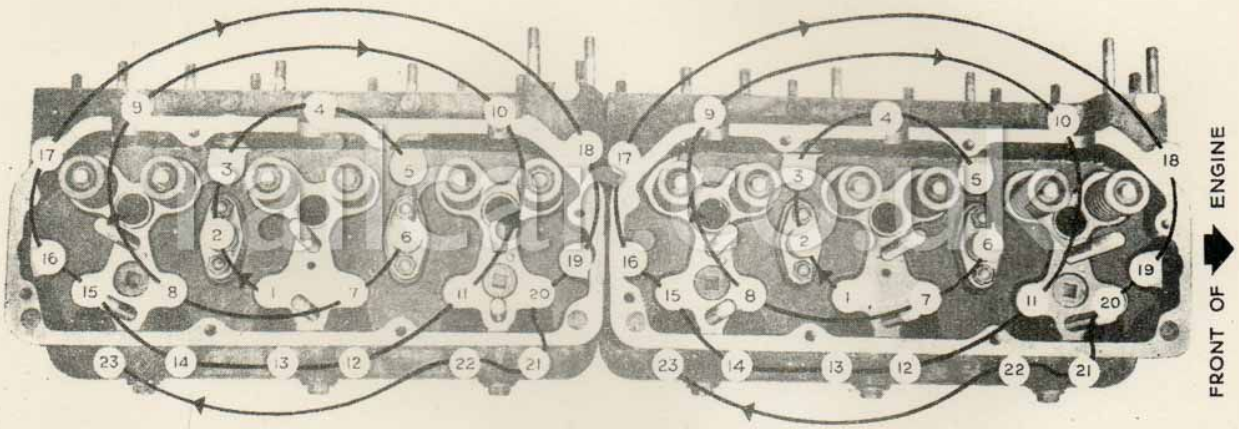


FIG. 5. CORRECT SEQUENCE OF TIGHTENING HEAD NUTS.

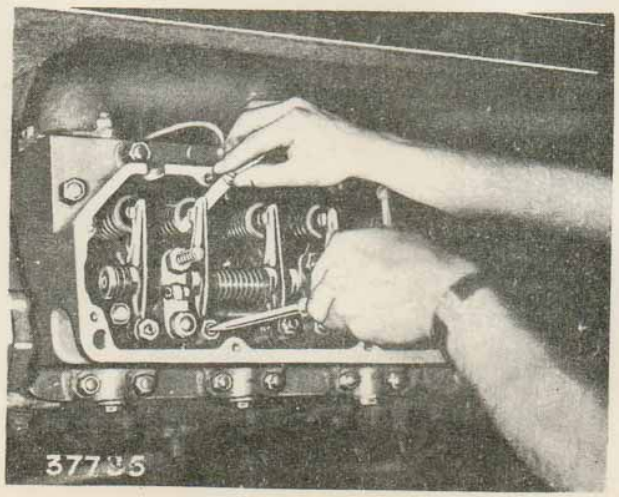


FIG. 6. ADJUSTING THE TAPPETS.

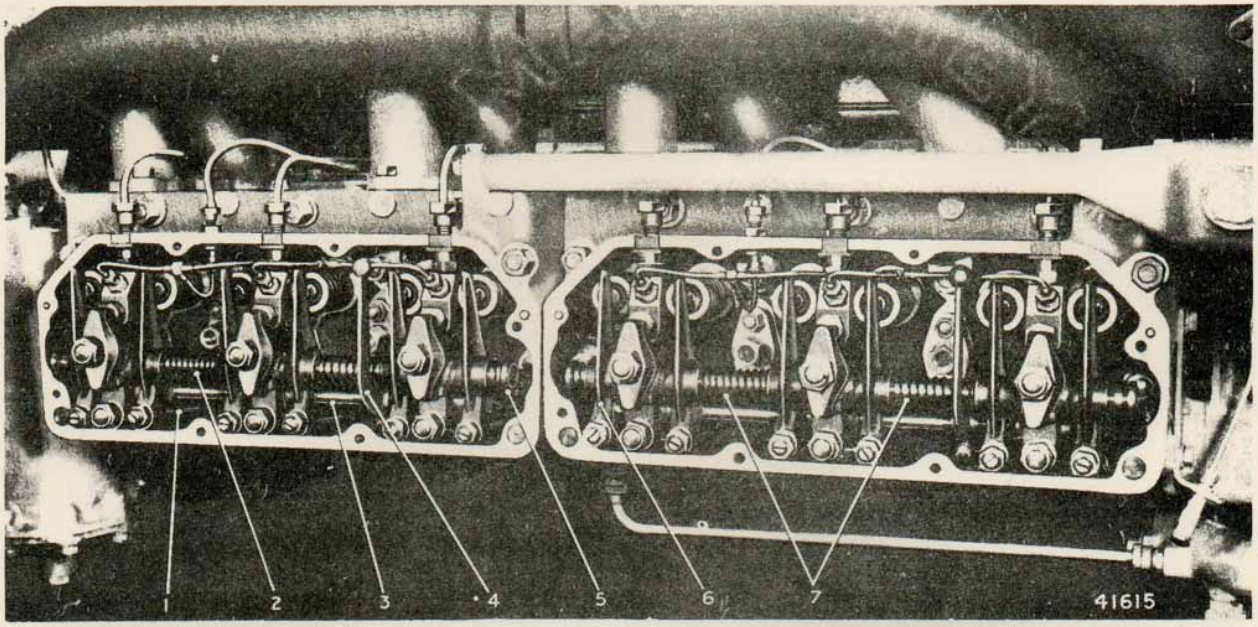


FIG. 7. CYLINDER HEADS IN POSITION SHOWING VALVE GEAR.

1. Push rod.
2. Rocker shaft.
3. Decompressor shaft.
4. Decompressor lever.
5. Retainer and clip.
6. Rocker lever.
7. Rocker shaft spring.

Lubrication is effected by an intermittent feed from the second and fifth camshaft bearings, via oilways drilled in the engine block and heads, and through the centre rocker-shaft support brackets, thus along the rocker-shafts to the rocker levers, a drilled passage in each rocker carries a supply of oil to the top of rocker lever.

The correct tappet clearance is .020 in.(cold) for both inlet and exhaust valves. When checking the clearances make sure the tappets are on the backs of the cams. Turn the engine until the valve is fully open, then turn through one complete revolution to bring the tappet on the back of the cam.

Both valves are stellite-faced and have hard-chrome-plated stems. The valves can be distinguished by the difference in size across their heads, the exhaust being 1.80 in.dia., and the inlet 2.10 in.dia.(Fig.10).

When removing the valves and springs for inspection and

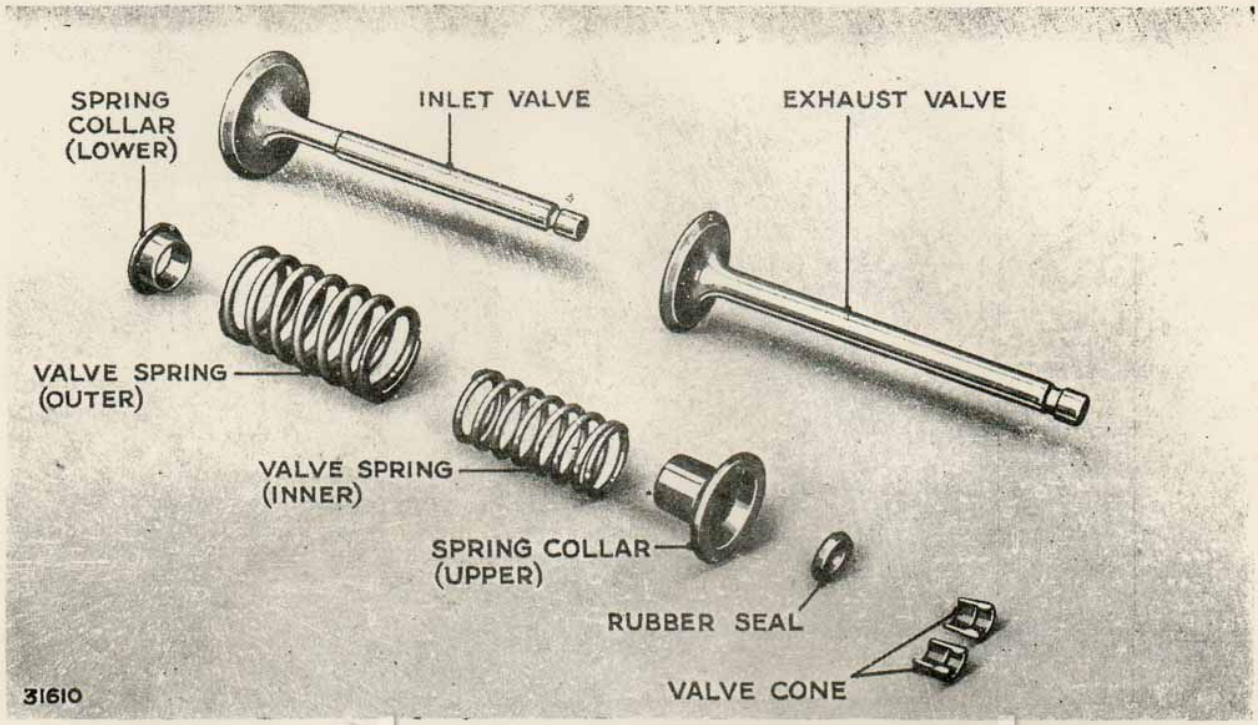


FIG. 8. VALVES AND SPRINGS.

refacing, it is important that subsequently they are replaced in their original position.
The valves and cylinder heads are numbered as shown in Fig.12 to facilitate re-assembly.

To Remove and Replace Valves

1. Remove the cylinder head and place it face down - wards on the bench.

2. Extract the split cone (Fig.9) and remove the valve collar together with the rubber sealing ring and valve springs (Fig.8).

3. The rubber sealing rings should be inspected and renewed if perished.

4. Check valve springs for length, see Data.

Decarbonising, Valve Guide Renewal and Valve Grinding

Decarbonising

Remove the heads and valves as previously described.

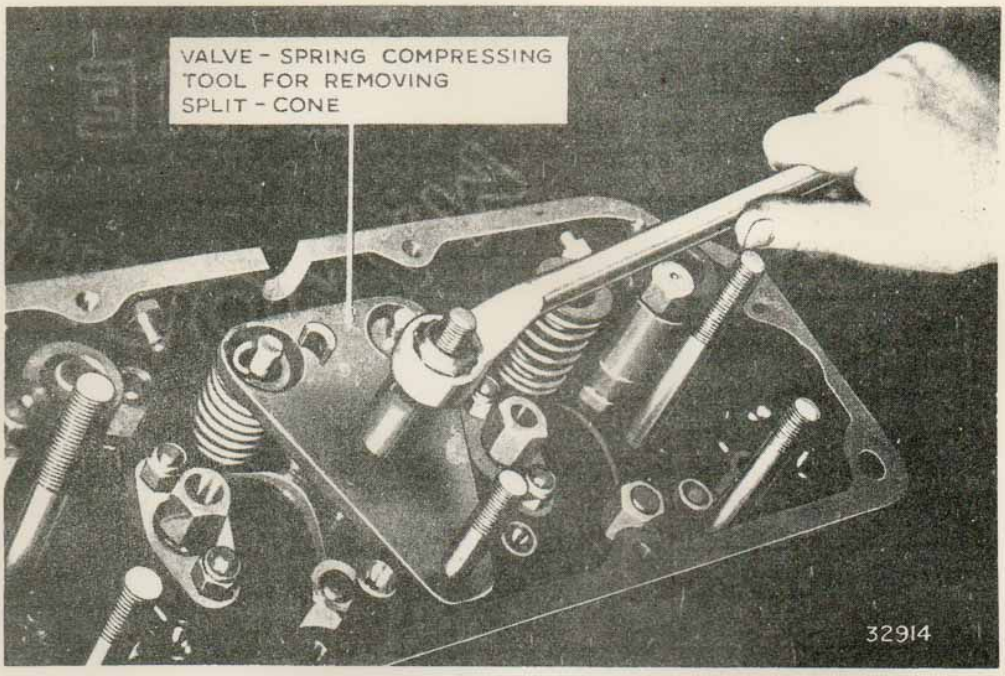


FIG. 9. VALVE SPRING COMPRESSING TOOL.

Carefully scrape off the carbon deposit on the heads and pistons, but on no account must any form of abrasive be used. Do not disturb the ring of carbon at the top of the bore, as it will help to restrict the passage of oil into the combustion chamber if the bores are worn.

Renewal of Valve Guides

1. Check the valve guides for stem clearances. If this is excessive, .010 in. or over, renew the guide. If the stem is worn, renew the valve. Always check the fit of a valve in the new guides. They must have .0025 in. to .00375 in. clearance for the inlet valves and .004 in. to .00525 in. clearance for the exhaust.

2. The valve guides are an interference fit in the heads and must be pressed in and out when replacements are necessary. See Fig.10 for position of valve guide in head.

3. After fitting a new valve guide, always regrind the valve seat so that it is concentric with the guide.

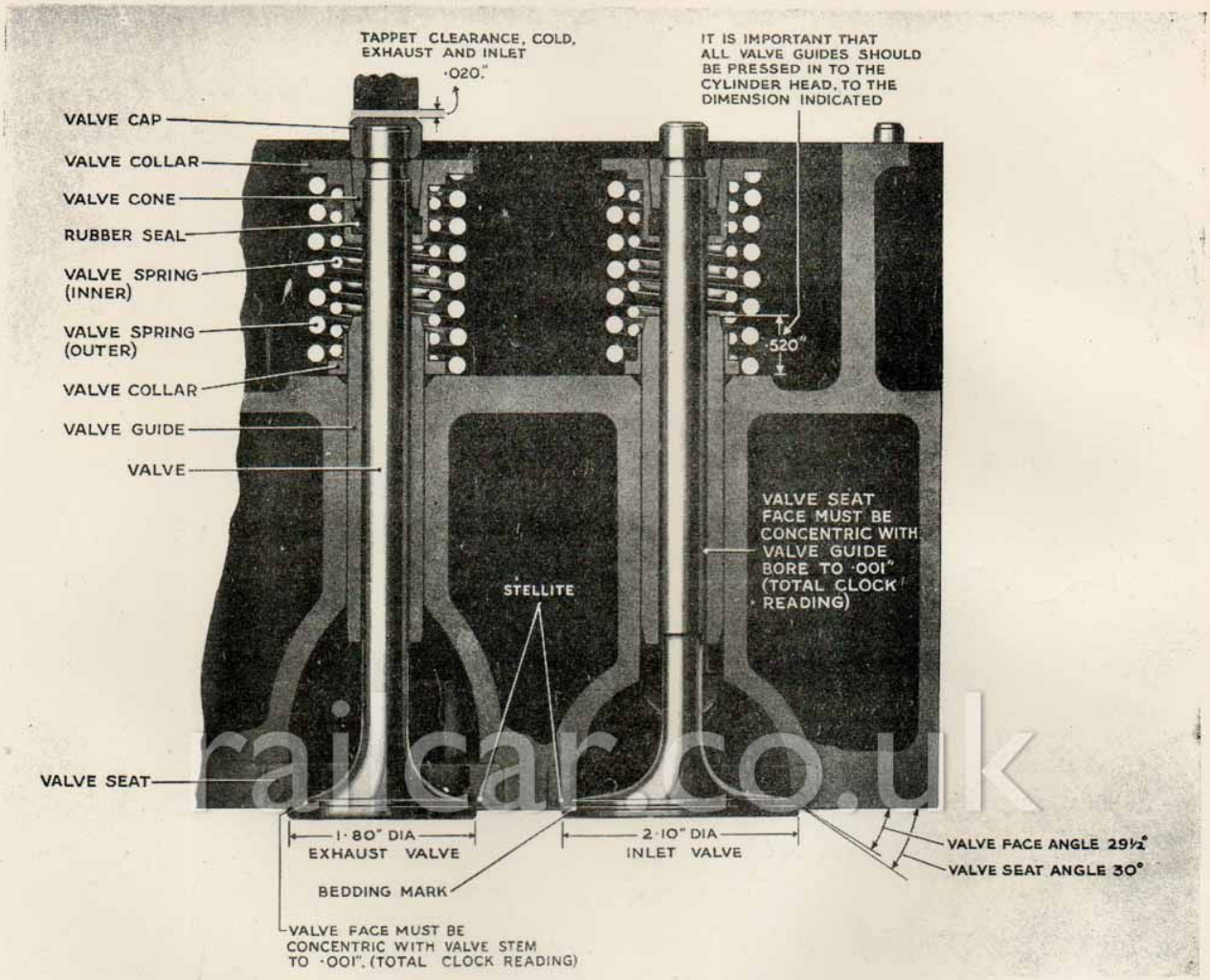


FIG. 10. VALVES AND SPRINGS IN POSITION.

Valve Grinding

1. Examine the valve facings and seats. If the valve seats are at all pitted and require grinding, a special carborundum tool must be used. This must have a working face of 30° (the accuracy of this angle is important), and must be accurately positioned by a spindle located in the valve guide. The stone must be rotated at high speed. The face of the seat should be concentric with the valve guide bore to within .001 in. (total clock reading).

2. If the valves require refacing, this should be done in a valve-facing machine with the stone

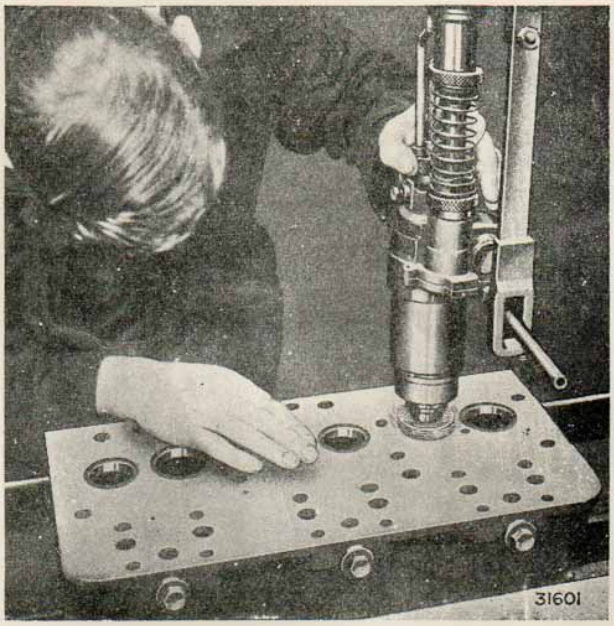


FIG. 11 GRINDING VALVE SEATS.

set at an angle of 29½°. The valve facing must be concentric with the valve stem to within .001 in. (total clock reading).

3. On no account must badly pitted valves and seats be lapped together, as this will cause excessively wide seats.

4. When the valves and seats have been re-cut, or when the valves and seats are in good condition, they should be lightly lapped together to give a perfect seating. The seating mark should be a thin line towards the top of the seat (Fig.10).

5. To lap in the valves, put a thin layer of fine grade carborundum paste on the valve seat and rotate the valve to and fro on the seat, occasionally lifting the valve off the seat. Do not rotate the valve through a complete revolution before lifting as this will groove the seat. All traces of grinding compound must be removed before assembly.

Valve Timing

The valve timing is shown in Fig.1 under Data.

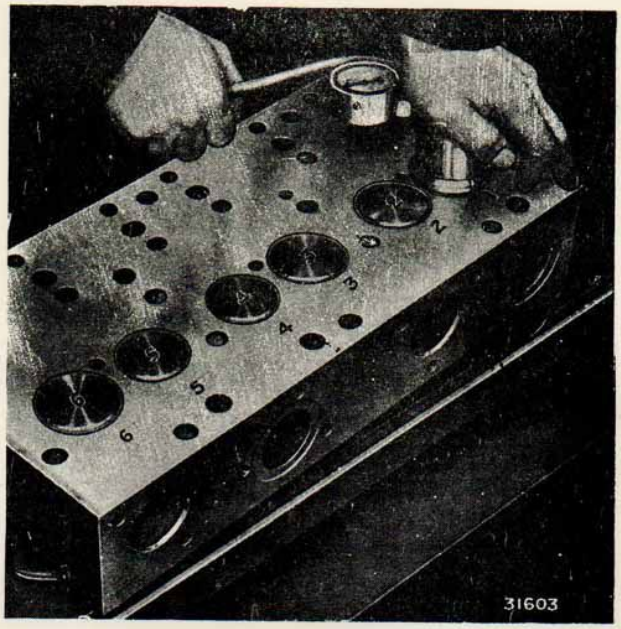


FIG.12. TEST GAS-TIGHTNESS OF VALVE ON ITS SEAT.

To Check Valve Timing

1. To check the valve timing, set the tappet clearances of No.1 cylinder to .020 in.(cold).

2. Turn the engine until the timing plunger engages in the flywheel, and No.1 piston is on T.D.C. of the firing stroke, i.e. the fuel pump has just delivered. At this point the inlet and exhaust valves are closed. Mark the flywheel 10° before T.D.C., 1.72 in.(44 mm.) on flywheel rim.

3. Now turn the engine until the inlet valve of No.1 cylinder just opens. To check when the inlet valve is just opening hold the valve collar between thumb and forefinger and attempt to turn. When the valve lifts off its seat, the collar will turn. If the timing is correct, the piston should be 1.72 in. (44 mm.), before T.D.C. measured on the flywheel rim (Fig.13).

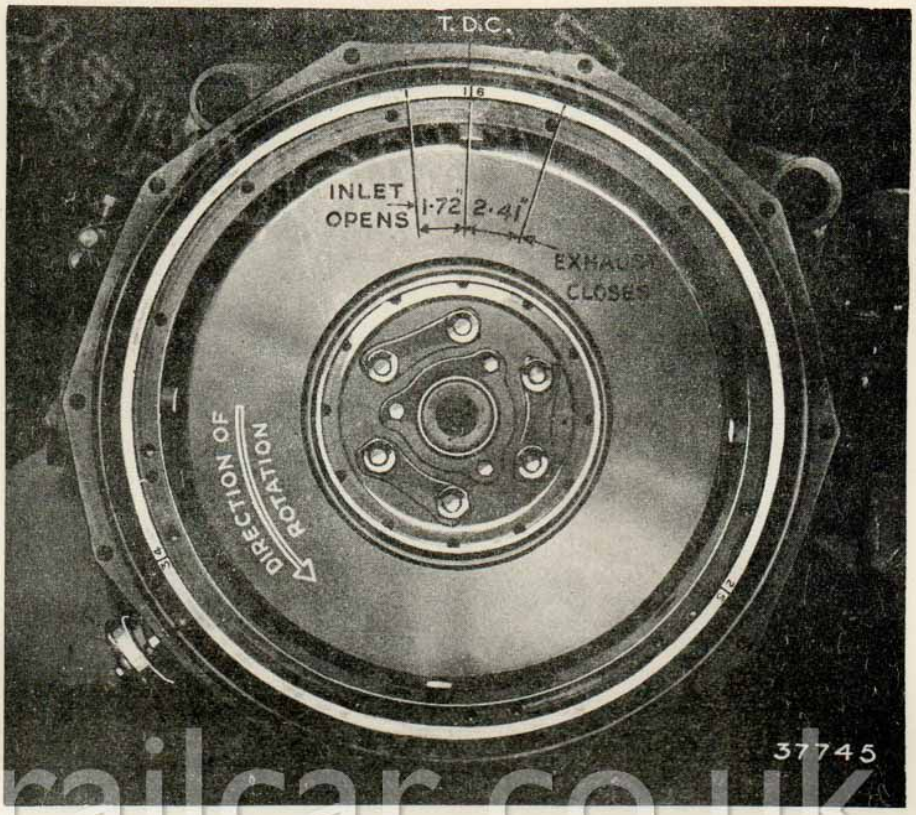


FIG. 13. VALVE TIMING.

Timing Plunger

This is fitted to facilitate finding T.D.C. for Nos.1 and 6 pistons and also the fuel pump injection positions which is 26° before T.D.C. of No.1 piston (both valves closed). The plunger at lower left-hand side of flywheel housing. (Fig.13), has three positions: T.D.C., INJ. and OFF. To operate the plunger, lift and turn until the required position is shown, then turn the engine slowly until the plunger is felt to drop into the appropriate hole in the flywheel. Never use the starter to turn the engine when using the plunger. A hole in the coupling connecting the fan drive propeller shaft to the crankshaft, suitable for a tommy bar, is provided for this purpose.

Set the plunger in the off position when engine has been correctly timed.

FUEL SYSTEM

Description

The fuel is drawn from the fuel tank by a diaphragm-type feed pump, secured to the side of, and driven by the injection pump. There are three filters through which the fuel must pass before entering the injection pump, one in the fuel tank, an on-off tap and filter in the fuel pipe line, and a main sack and pack type filter between the feed pump and the injection pump. The injection pump delivers fuel under high pressure through a separate pipe line to each injector, each pipe line consists of two pipes joined at the support bracket on the engine block.

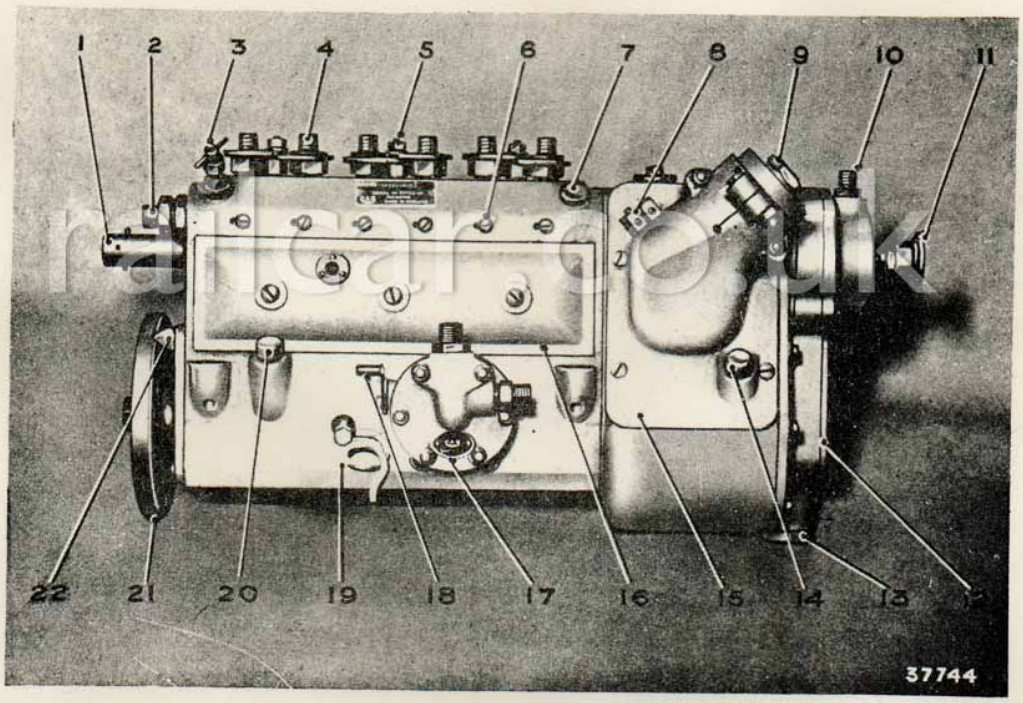


FIG. 14 THE FUEL INJECTION PUMP.

1. Control rod stop
2. Fuel inlet
3. Vent cock.
4. Delivery valve holder
5. Nut for locking plate
6. Barrel locking screw
7. Hexagon plug
8. Solenoid terminals
9. Solenoid.
10. Vacuum pipe adaptor
11. Damper valve unit
12. End plate
13. Base plug
14. Governor dipstick
15. Inspection cover and solenoid housing.
16. Inspection cover
17. Fuel feed pump
18. Priming handle
19. Drain
20. Filler and dipstick
21. Flywheel
22. Timing pointer

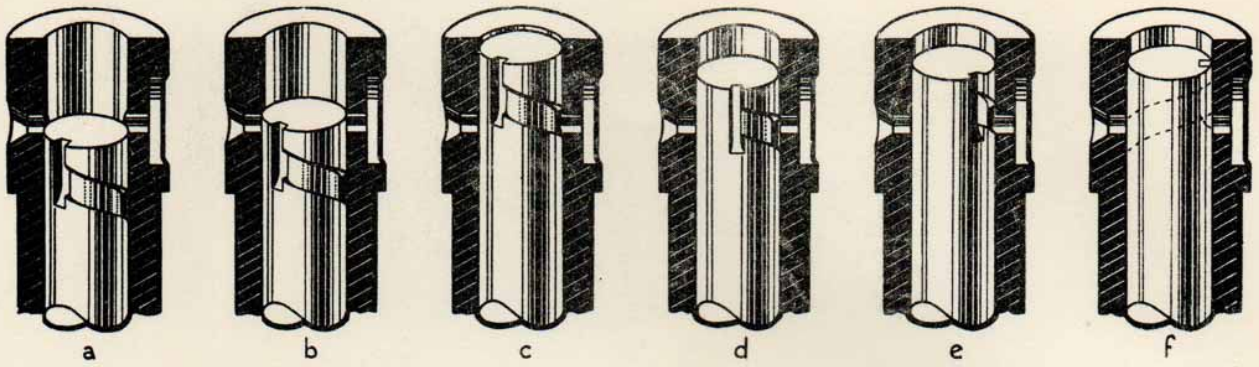


FIG. 16. PRINCIPLE OF FUEL METERING.

a. Fuel enters barrel
b. Delivery commences
c. Full load
d. Half load
e. Idling
f. No delivery

Fuel Injection Pump

The fuel injection pump is of the constant-stroke, cam-actuated, lapped-plunger type. The pump consists of a body with camshaft compartment at the bottom whilst in the middle and upper portions of the pump housing are located the plunger and barrel assemblies, metering control sleeves with regulating toothed quadrants, plunger springs and control rod. The upper portions of the housing also contain the fuel suction chamber, delivery valve assemblies and delivery valve holders for connection to the injection feed pipes.

Lubrication

The fuel pump should always have an initial filling of engine oil, to the top marking on the dipstick. From then on, the normal leakage of fuel oil passed the pump elements will usually keep the injection pump sump topped up. It is advisable however tc check the injection pump dipstick at the same time as the governor dipstick.

Maintenance

The presence of any air bubbles in the system will cause irregular injection. To eliminate these air bubbles, the system must be bled by opening the vent cocks at the top of the main filter and on the injection pump.

Overhaul

To Remove the Injection Pump:

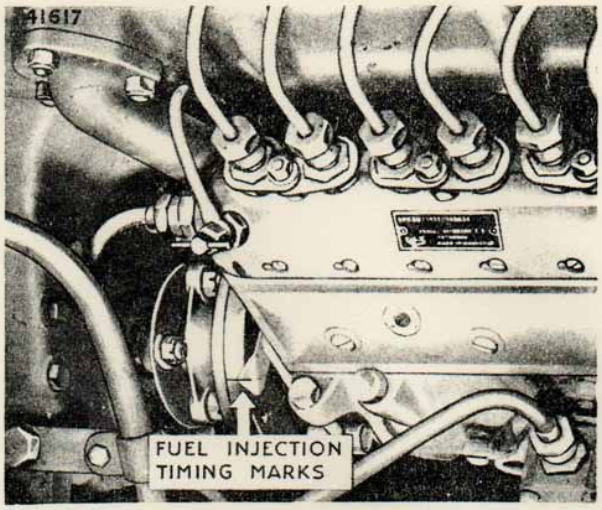


FIG. 16. INJECTION PUMPTIMING MARKS.

Immediately pipes are disconnected from the fuel pump, the ends of the pipes and unions on the pump must be covered with clean rag or caps. No dirt must be allowed to fall into the injection pump.

1. Uncouple the pipe from the governor to the venturi.

2. Disconnect wires to solenoid stop control.

3. Uncouple the pipe from main filter to pump and the suction and delivery pipes to the fuel feed pump.

4. Disconnect the delivery pipes to the injectors.

5. Set the engine to No.1 pump injecting and remove the setscrews connecting the flexible coupling to the pump flywheel. The flywheel must not be removed from the injection pump camshaft.

6. Disconnect the fixing straps and remove the pump.

To Replace the Injection Pump:

1. Set the engine to the INJ. mark of the timing plunger, so that No.1 cylinder is on compression stroke.

2. Turn the pump camshaft until the mark on the flywheel is in line with the pointer on the pump body (Fig.16), insert setscrews connecting flexible coupling to flywheel and tighten securely.

3. In the event of a replacement pump having to be fitted, set the engine to the INJ. mark as in paragraph 1.

4. Couple up the main feed pipes, but only the delivery pipe to No.1 injector.

5. Prime the pump by opening vent-cock and also prime through to No.1 injector.

6. Now turn the pump flywheel clockwise, until resistance becomes solid. At this point No.1 injector starts injecting fuel.

7. Insert setscrews and connect flexible coupling to pump flywheel.

8. Mark flywheel opposite timing pointer on pump body to facilitate replacemant of pump should subsequent removal become necessary.

To Dismantle Injection Pump:

In the event of the injection pump being faulty in service, it should normally be removed complete and replaced by a spare pump, the faulty unit being dispatched to the nearest Leyland Service Depot. As a replacement pump may not always be available, details whereby emergency repairs can be carried out are given in the following paragraphs.

Warning : Strict cleanliness must be observed when preparing to dismantle fuel injection pumps, care being taken that all filings, dust, dirt and grit, etc., have been removed from the bench on which work is to be done. The bench should then be covered with clean grease-proof paper and a number of clean containers provided for the various parts removed. It is also an advantage to have a supply of clean, fresh fuel oil for washing these parts.

The various parts of one pumping element should never be interchanged with another, particularly the barrel, pump plunger, delivery valve and seating. To keep the six elements isolated they should be placed in separate containers.

The surfaces of these parts must never at any time be touched with a file, scraper, or other hard tool or any abrasive compound.

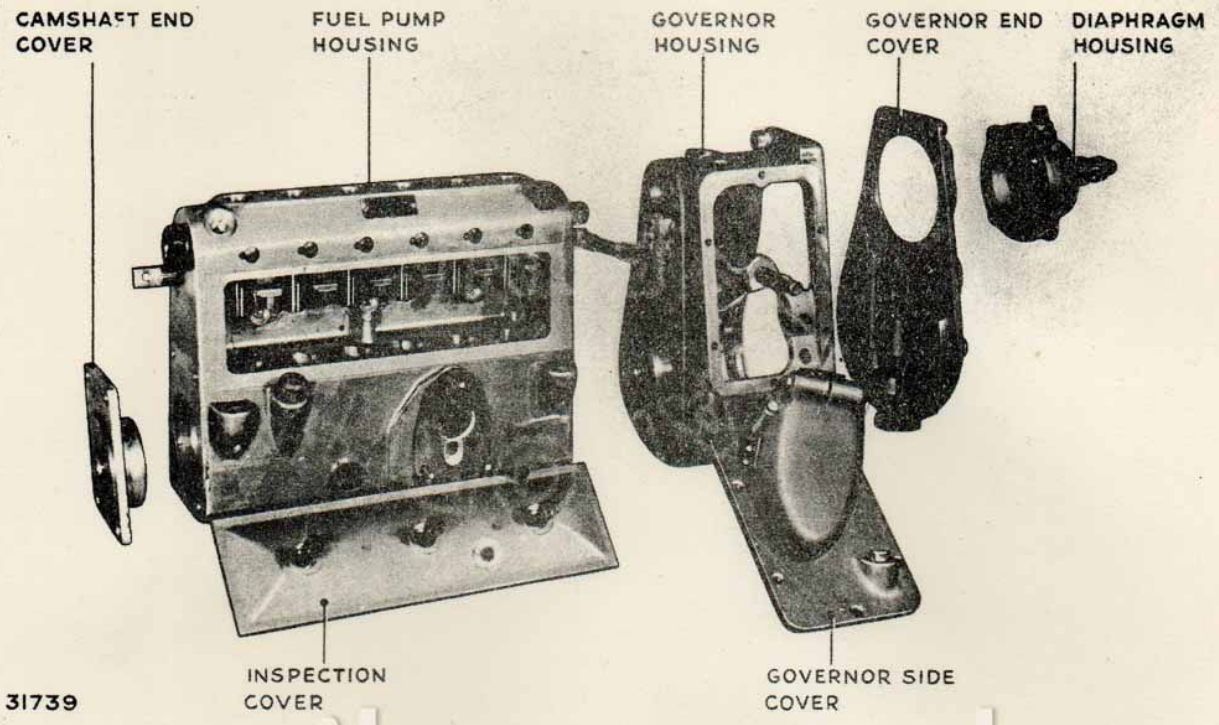


FIG. 18. INJECTION PUMP GOVERNOR HOUSING AND COVER.

Procedure is as follows, the components being removed in the sequence given:-

1. Remove the fuel feed pump by unscrewing fixing screws.
2. Remove the inspection cover-plate and dipstick.
3. Remove the governor (see To Remove Governor.)
4. Rotate the camshaft to bring each tappet assembly to its top dead centre position and insert the tappet holder under the head of the tappet adjusting screw (Fig.19).
5. Unscrew the base closing plugs (Fig.20).
6. Remove the injection pump flywheel using the withdrawal and holding tool (Fig.23). The removal of the flywheel from the tapered end of the camshaft must never be done by the use of a hammer or drift.

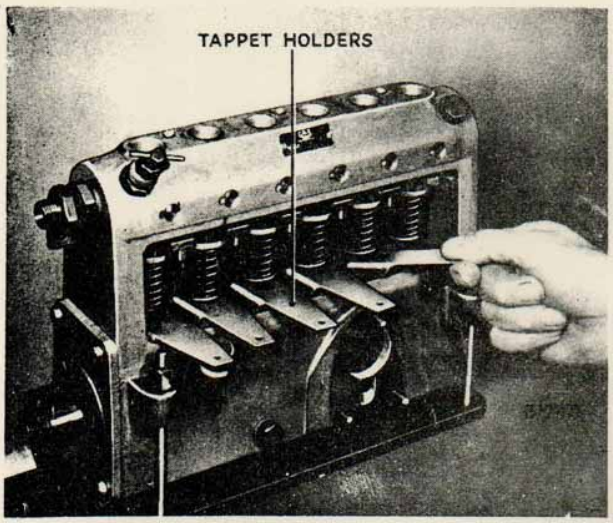


FIG. 19. FITTING TAPPET HOLDERS.

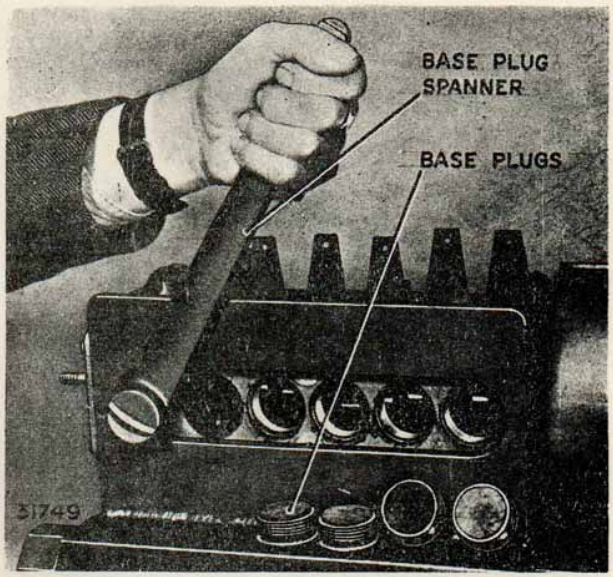


FIG. 20. REMOVING BASE CLOSING PLUGS.

7. Remove the bearing end plate and withdraw the camshaft (Fig.22). The camshaft has a chisel mark at the driving end to ensure that it is replaced correctly.

8. Push up the tappet assembly until it is possible to withdraw the tappet holder, after which the tappet assembly, lower spring plate, plunger spring, upper spring plate and plunger can be withdrawn through the base (Fig.24).

9. Unscrew delivery valve holder, withdraw spring, spring peg, and delivery valve. The valve seating and its joint can now be removed by the extractor tool (Fig25).

10. To remove the pump barrel, unscrew the locking screw situated above the inspection cover-plate and push the barrel from below with a fibre or soft brass drift (Fig.32).

To Renew the Control Rod Bushes:

1. If the control rod bushes are worn and need renewing a special extractor tool C.A.V. No. ET.431 is required for removing the bushes.(Fig. 28)

2. To remove the locking ring holding the rear control rod bush in position in the pump housing, use C.A.V. Tool.No.ET.031. (Fig.26).

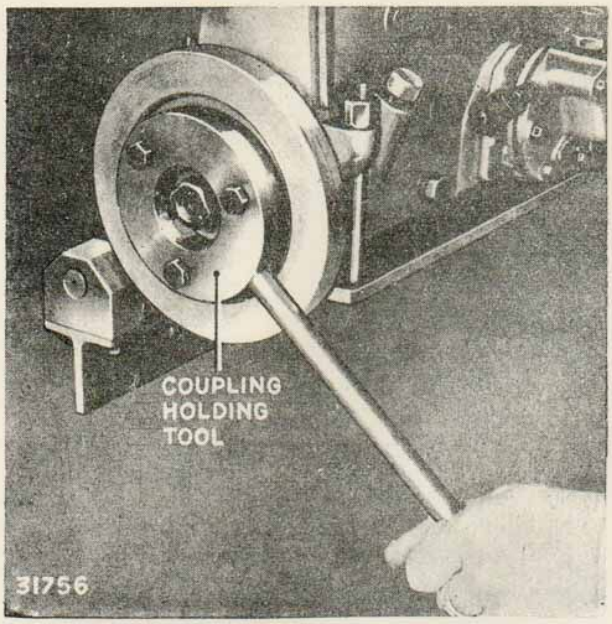


FIG. 21. HOLDING INJECTION PUMP FLYWHEEL.

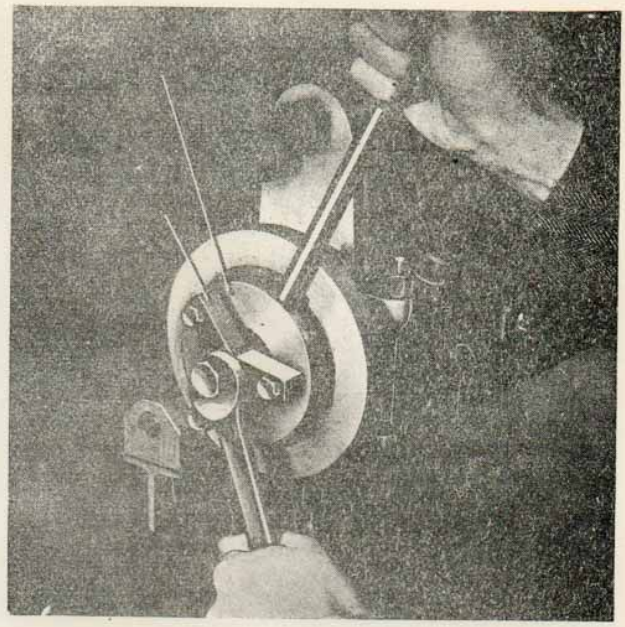


FIG. 23. REMOVING INJECTION PUMP FLYWHEEL.

3. New bushes will have to be line reamed and fitting with C.A.V.Tool No.ET.109 ET.110. (Fig.29).

4. To remove the camshaft bearing outer race from the end cover and governor housing, use extractor tool C.A.V.No ET.026B. (Fig.30).

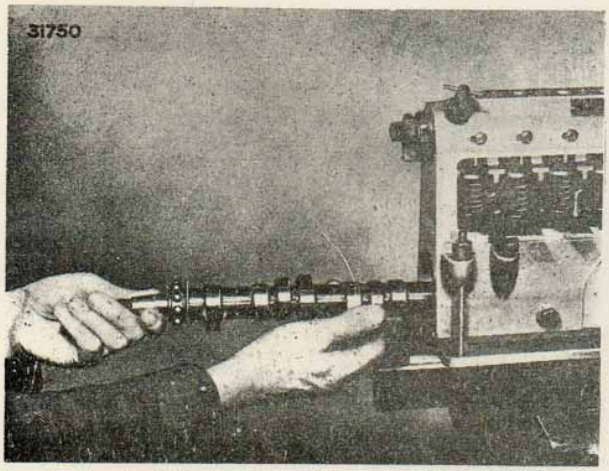


FIG. 22. REMOVING CAMSHAFT

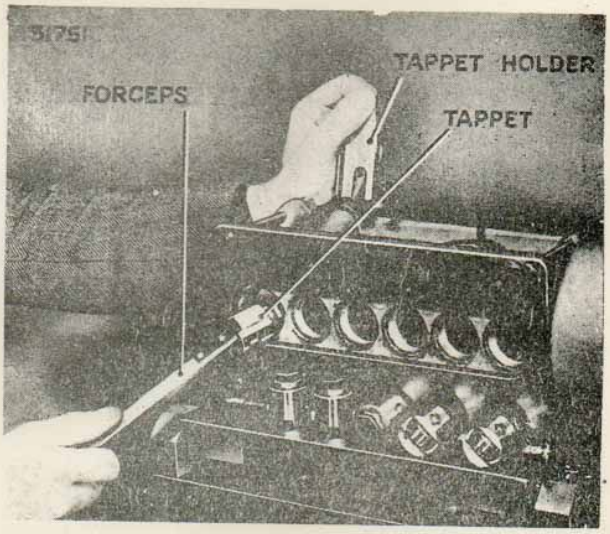


FIG. 24. REMOVING TAPPET ASSEMBLY.

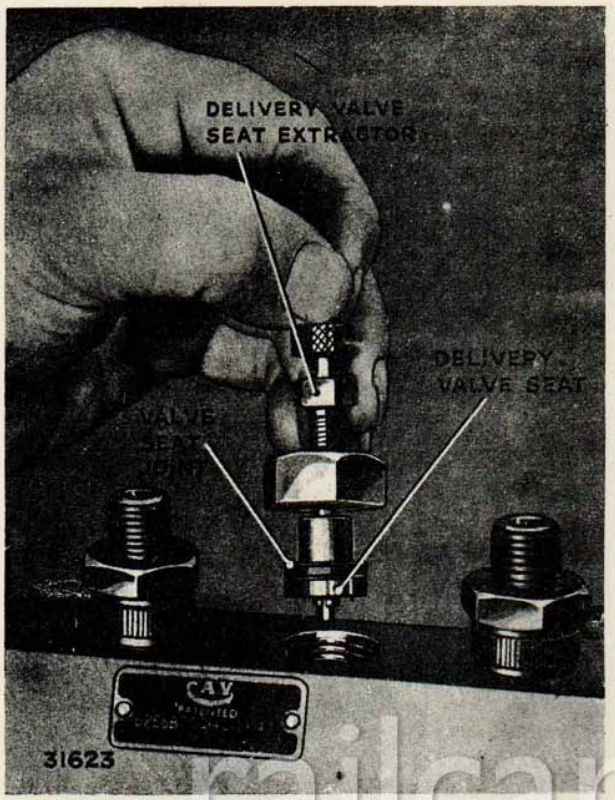


FIG. 25. REMOVING DELIVERY VALVE SEATING.

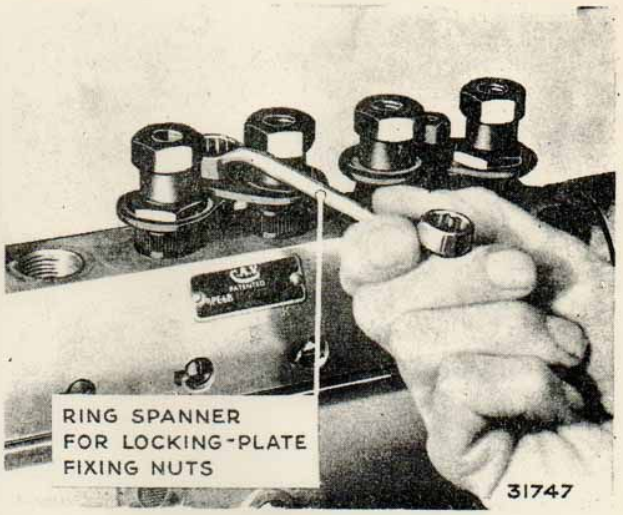


FIG. 27. REMOVING DELIVERY VALVE LOCKING PLATES.

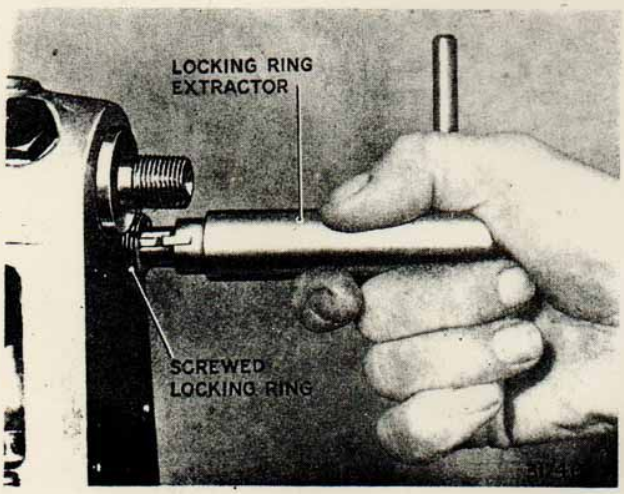


FIG. 26. REMOVING LOCKING RING.

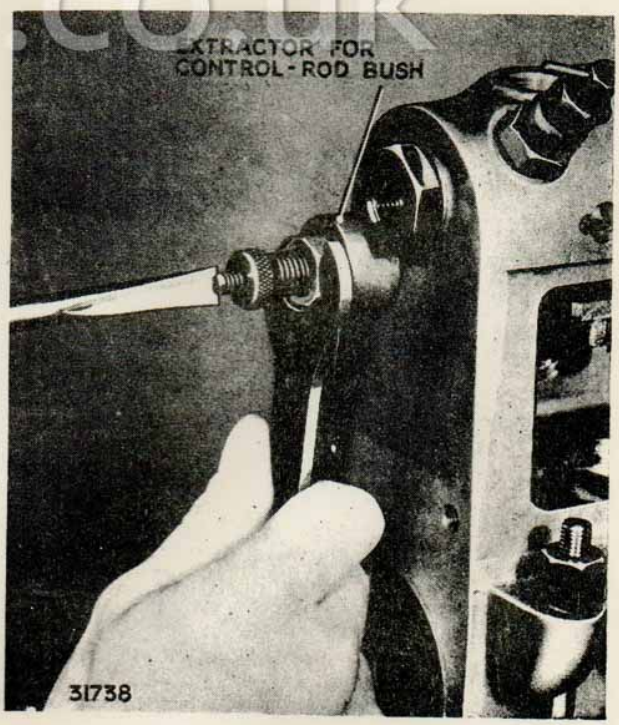


FIG. 28. REMOVING CONTROL ROD BUSHES.

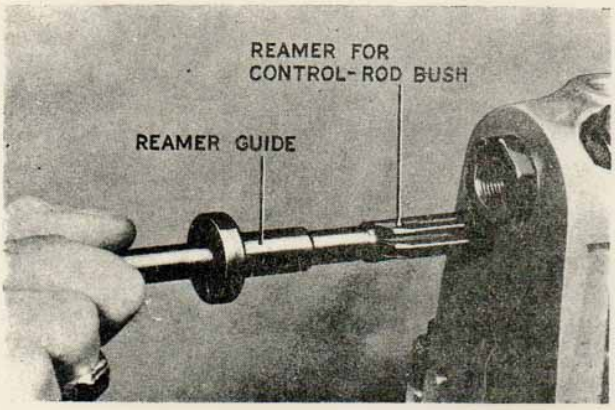


FIG. 29. REAMING CONTROL ROD BUSHES.

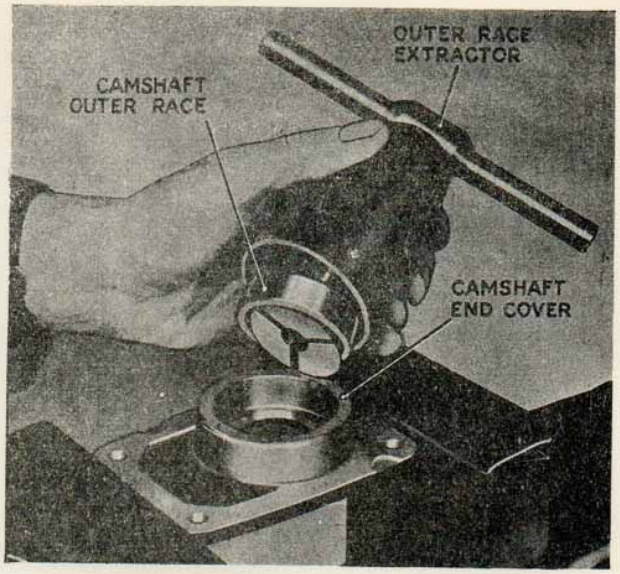


FIG. 30. REMOVING CAMSHAFT BEARING OUTER RACE.

To Re-assemble Injection Pump:

Care must be taken that all joints and other parts are entirely clean. The cleaning operation should be :

i. Rinse in clean fuel oil.

ii. Bring together without the use of cotton waste, rags, or wipers of any kind.

1. Fit the plunger barrel carefully, observing that the slot in it is opposite the hole for the locking screw (Fig. 32). Carefully screw in the locking screw, with new joint, until it locates with the slotted recess in the barrel, when it can be tightened. If correctly engaged, it will prevent rotating movement of the barrel whilst permitting a limited vertical movement.

2. Fit the delivery valve seatings with new joints and insert the valves.

3. Replace the delivery valve springs and pegs. Screw on valve holders and fit locking plates.

4. Assemble control rod in the pump casing and set it in the middle position. The dot at each end of the

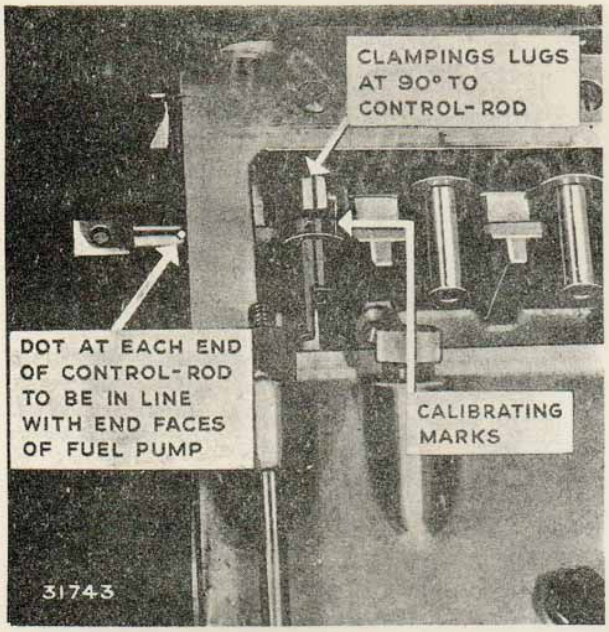


FIG. 31. SETTING OF REGULATING QUADRANTS.

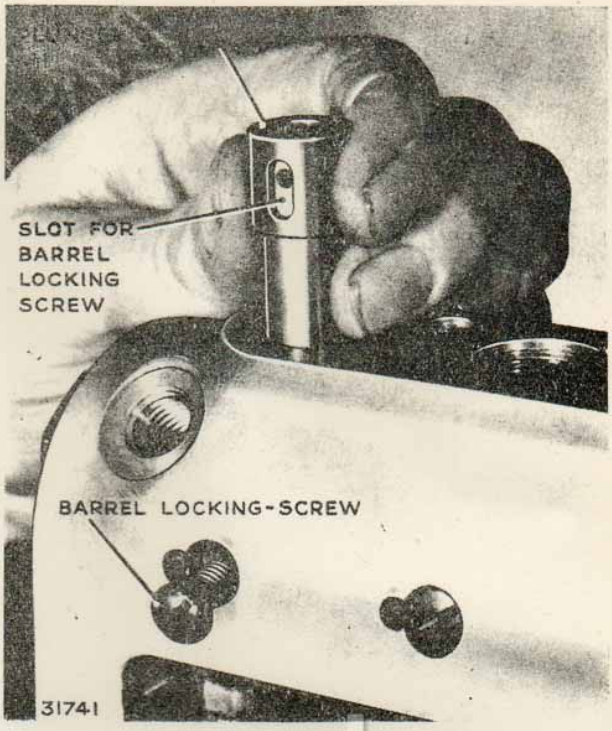


FIG. 32. REPLACING PLUNGER BARREL.

control rod should be set so that it is in line with the outer face of the pump body (Fig.31).

5. Assemble regulating quadrants and sleeves, together with the upper spring plates on the plunger barrels. Calibration marks on quadrants and sleeves must coincide.

6. With the control rod in the central position, quadrants should be meshed so that their clamping lugs are at 90° to the control rod and in line with the barrel locking screws (Fig.31).

7. Slide the plunger springs into location with top spring plates.

8. Fit lower spring plates on to the plungers and insert the plungers into the barrels through the base plug holes, using C.A.V.Tool No.ET.569 (Fig.33).

9. It is essential that the chisel marks on the plunger lugs coincide with the chisel marks at the base of the regulating sleeve guide slots.

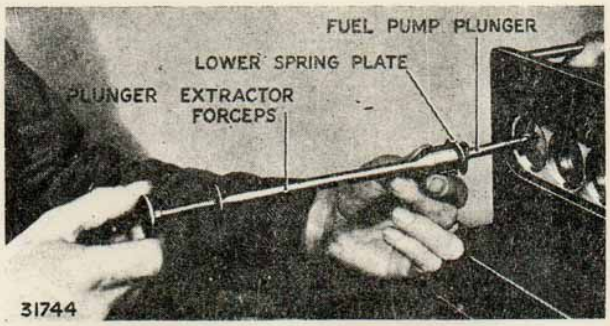


FIG. 33. REMOVING OR REPLACING PLUNGER.

10. Insert tappet assemblies and press against each spring until the tappet holders can be inserted under the heads of the tappet adjusting screws.

11. Fit the camshaft and its bearings in the pump housing, taking care that the mark on the shaft is fitted to the correct end of the pump body. Check the end-play, and if the movement measured does not lie between .1 mm. to .2 mm., remove one bearing end-plate and insert shims as required between oil thrower and bearing.

12. Refit the base closing plugs and securely tighten. Rotate camshaft and remove tappet holders in correct sequence, but only when their corresponding cams reach top dead centre.

13. Examine each tappet screw locknut and tighten if necessary. If a tappet adjusting nut is found loose, or is renewed, it is advisable to retime the complete unit, but as a temporary measure it can be adjusted and locked so that the distance between the screw head and locknut is uniform with the remaining tappet assemblies.

14. Care must be taken that plungers do not hit delivery valve seatings at peak of cam lift. If a tappet has been readjusted, test clearance between plunger top at cam T.D.C. and base of delivery valve seating by inserting a screwdriver gently below head of tappet adjusting screw and lifting plunger. The resultant movement should give a play of .3 mm. to .5 mm. On no account must a screwdriver be used in this position for any other purpose.

15 Replace the governor (see To Replace Governor Assembly.)

16. Refit fuel feed pump.

Re-calibrating the Pump (Governor attached):

Calibration should be carried out on a power-driven test rig, using gravity feed and master test injectors.

Make sure that the locknut on the full load stopscrew has been fully tightened and the clearance between the screw on the lower part of the lever and the governor thrust arm is .035 in. to .045 in.

Governor

The Leyland-C.A.V. combined vacuum and mechanical governor is housed in a casing at the rear end of the injection pump. The governor consists of a vacuum-operated element which controls the idling and intermediate speeds of the engine. A flyweight governor controls the maximum speed of the engine.

The control rod is connected to a spring-loaded leather diaphragm which separates the main governor housing from the vacuum chamber. The control rod is held at full-load position by the spring. The vacuum chamber is in communication with a venturi unit, fixed over the air intake. The damper springs hold the control rod steady at idling speeds. When the damper valve lifts, however, due to the control rod touching it, air is drawn into the suction chamber. This helps to destroy the vacuum rapidly and the engine speed tends to increase, but as soon as the control rod moves forward, due to the decrease in vacuum, the valve shuts, thus restoring the vacuum, and engine speed decreases. This limits the movement of the control rod to a very small range, thus reducing any tendency of the engine to "hunt".

The vacuum in the suction chamber is determined by the speed of the engine and the extent to which the throttle valve is opened. As the throttle valve is opened a reduction in vacuum takes place in the diaphragm block, thereby allowing the diaphragm return spring to move the diaphragm and control rod towards the full load position.

At maximum speed, the flyweight governor comes into operation and moves the forked pickup lever into contact with the end of the lower adjusting screw on the operating lever, thereby moving the control rod back towards the closed position.

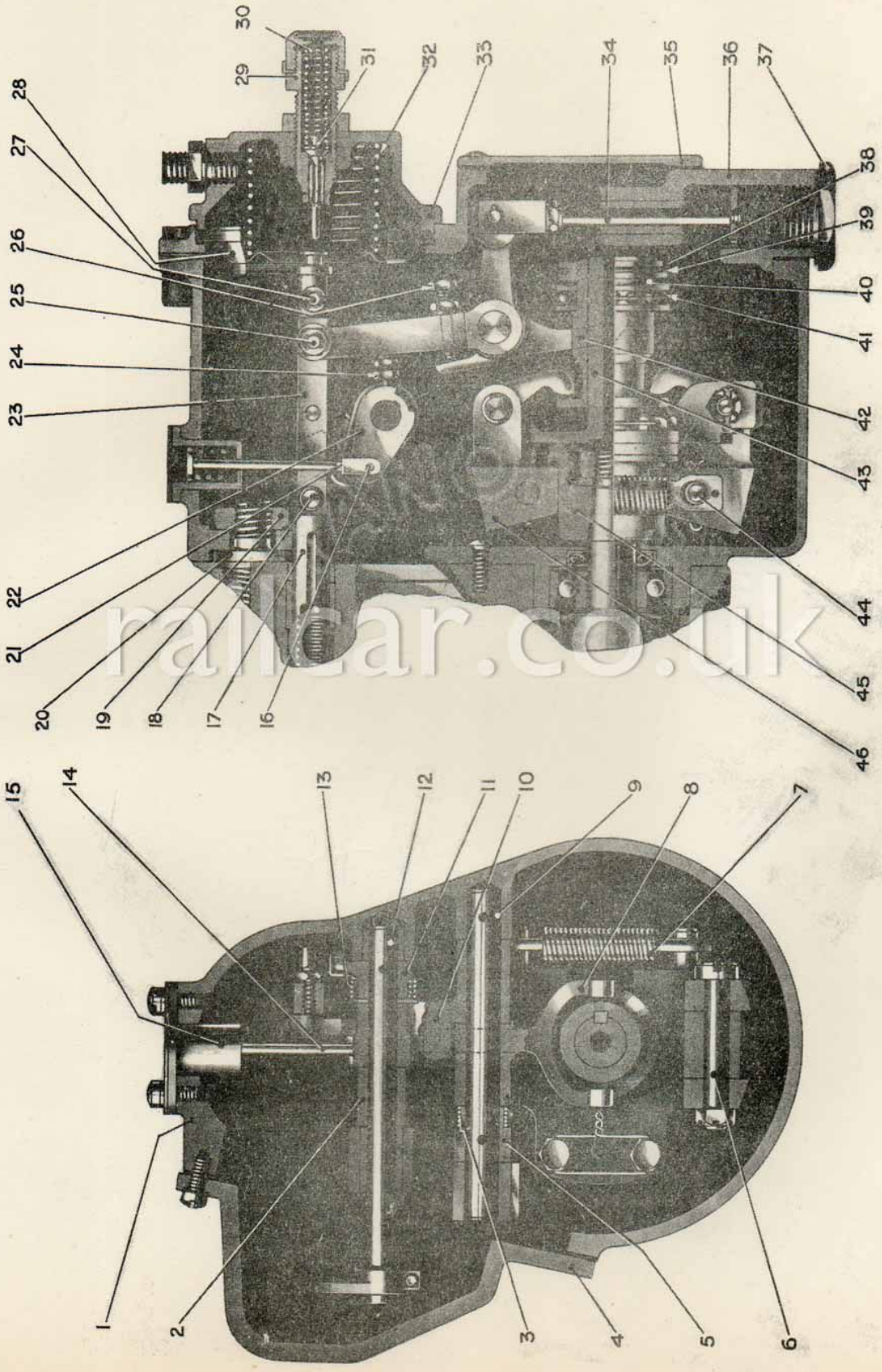


FIG. 34. SECTIONS THROUGH GOVERNOR.
(see key on page 37.)

KEY TO FIG. 34.

1. Governor casing.
2. Distance piece.
3. Torsion spring.
4. Inspection cover.
5. Torsion spring carrier.
6. Weight carrier pin.
7. Weight spring assembly.
8. Pick-up lever.
9. Governor cross-shaft.
10. Operating lever.
11. Stop lever.
12. Spindle.
13. Torsion spring.
14. Excess fuel plunger.
15. Excess fuel plunger barrel.
16. Pivot pin.
17. Control rod.
18. Pivot pin.
19. Housing nut.
20. Housing stud.
21. Excess fuel adjusting nut.
22. Fuel stop.
23. Link.
24. Setting stop.
25. Screwed pin.
26. Pick-up lever adjustment screw.
27. Screwed pivot pin.
28. Diaphragm.
29. Damper valve body.
30. Damper valve spring.
31. Damper valve.
32. Main spring.
33. Diaphragm housing.
34. Oil damper.
35. End plate.
36. End cover.
37. Base plug.
38. Sleeve nut.
39. Locking circlip.
40. Seegar circlip.
41. Thrust race.
42. Sleeve.
43. Weight carrier.
44. Pin.
45. Driving centre.
46. Flyweight.

Stop Control and Excess Fuel Device:

The stop control and excess fuel device for starting, are operated by an electric solenoid housed in the inspection cover of the governor. The solenoid is operated by means of a push-button on the control panel at the driver's right-hand side. Fig. 39 shows the general working principle, and Fig.40 shows the action of the fuel stop in detail. When the engine is running and it is required to stop, the push-button on the control panel is pressed and the solenoid is energised, thus drawing the plunger (4) into the body of the solenoid. This movement turns the spindle (5) in a clockwise direction which, through lever (11) and pin (10), moves the pump control rod to the stop position. Carried on spindle (5) is a flat spring (13), Fig.40 which, when the spindle turns, engages in a keyway in the fuel stop (6, position 2). This action locks the fuel stop (6) to the spindle (5). On switching off the

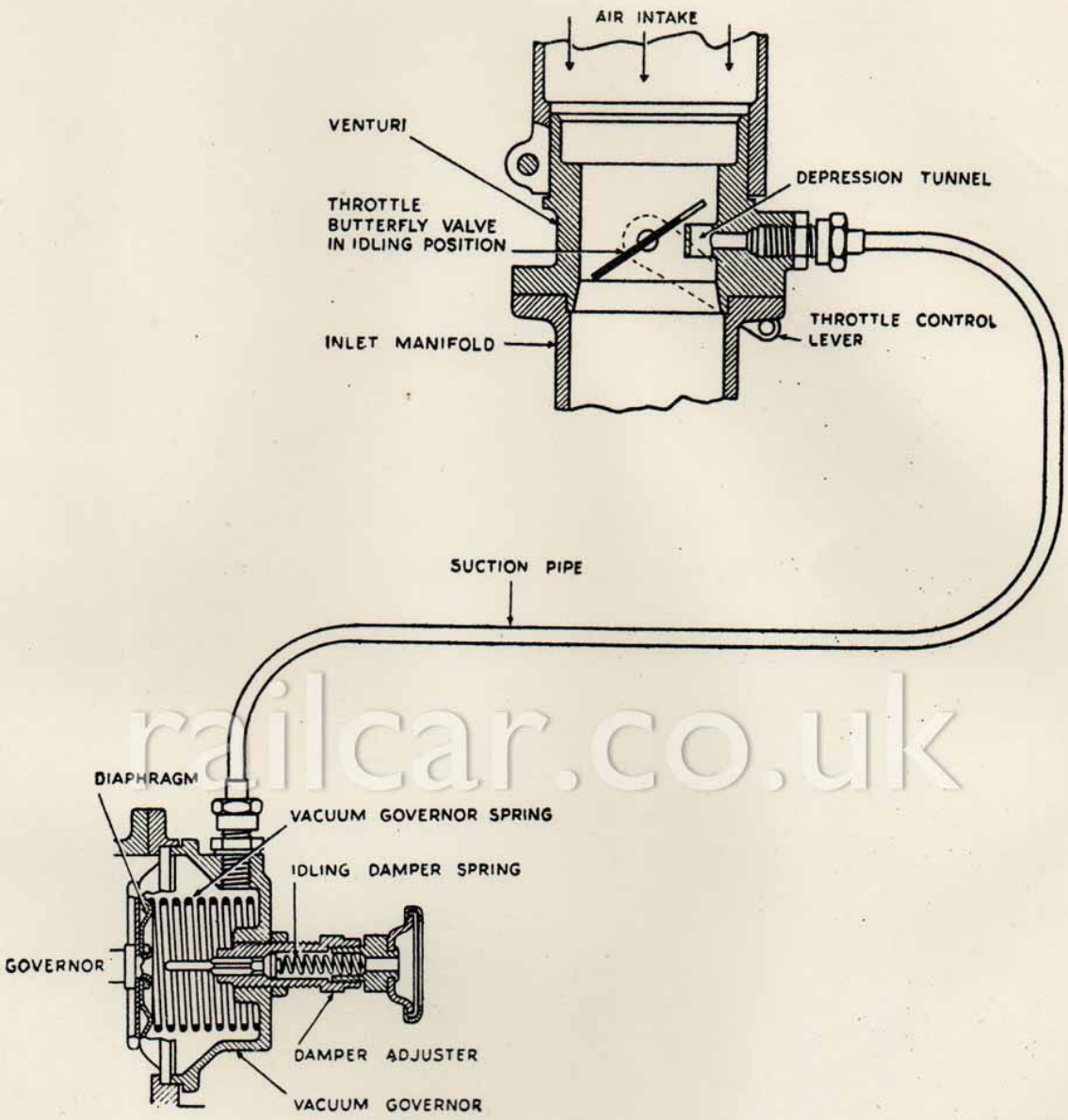


FIG. 35. DIAGRAM OF VACUUM GOVERNOR AND VENTURI CONNECTION.

solenoid, the spindle (5) rotates in an anti-clockwise direction to bring the fuel stop to the excess fuel position, where the setting stop (7) strikes the pin (14) to release the spring (13), from the keyway of the fuel stop (6, position 3). This allows the shoulder of the fuel stop to come to rest against the setting stop (7); this is the excess fuel position for normal starting. When the engine is started the setting stop (7) is withdrawn, due to the action of the governor diaphragm, from the fuel

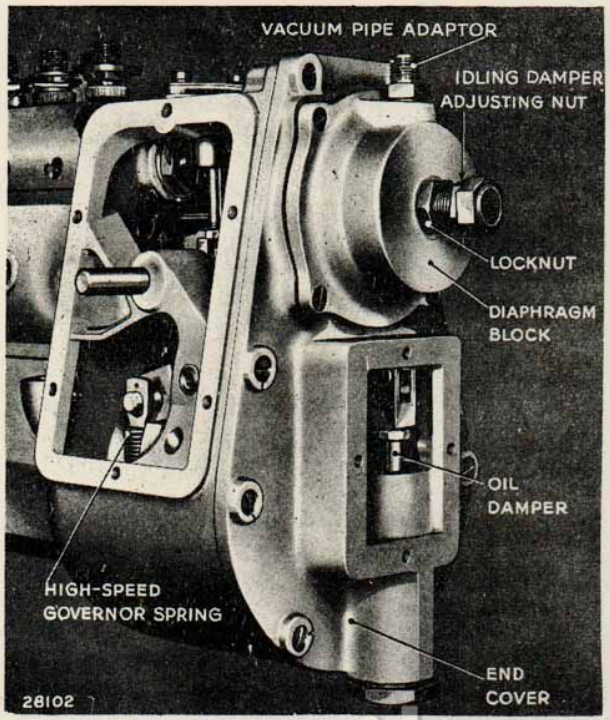


FIG. 36. GOVERNOR WITH SIDE COVERS REMOVED.

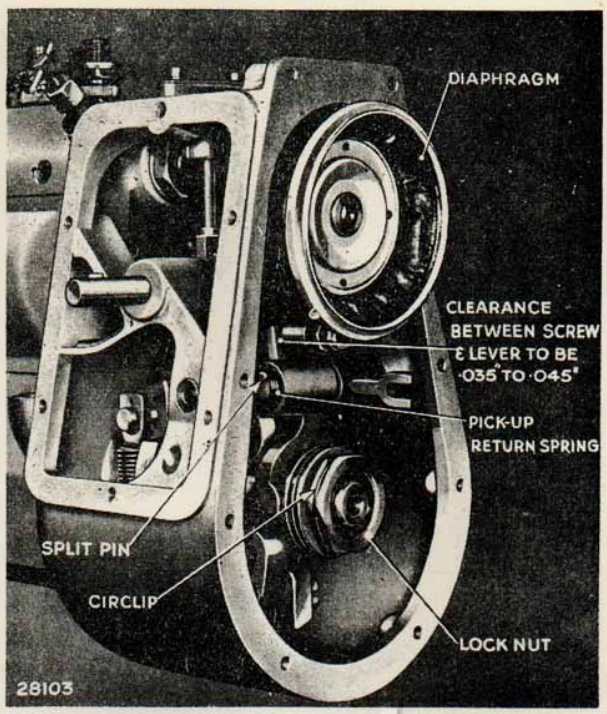


FIG. 37. GOVERNORS WITH END COVER REMOVED.

stop (6) which can now trip and return to the normal maximum fuel position (position 1) by the force exerted from spring (1, Fig.39).

Maintenance

To Test Condition of Idling Diaphragm:

1. Move the control rod to the stop position by removing the inspection cover, and operating the stop lever.

2. Plug the vacuum pipe adaptor (Fig.36), with finger and release the stop lever. The control rod should not return to the open position. If it should do so, the leakage may be due to the following causes :

   i. Porous diaphragm.

   ii. Leaking diaphragm joint.

   iii. Leaking idler damper valve.

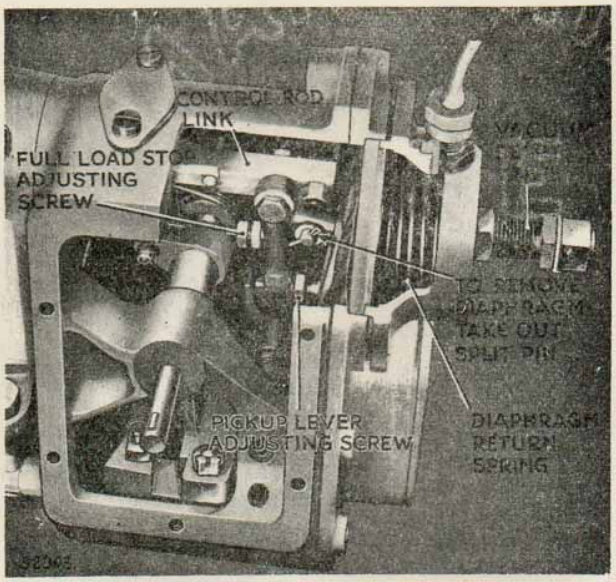


FIG. 38. GOVERNOR MECHANISM.

To Set Idling Controls:

This is done with the engine running and at its normal working temperature :

1. Screw out the idling damper (Fig.36), so that it is clear of the diaphragm when the engine is idling.

2. Adjust the idling stop on the venturi so that the butterfly valve is set to give an idling speed of 400 r.p.m. Under these condition the engine will fluctuate or "hunt" badly.

3. The idling damper must now be screwed in to eliminate this "hunting". This adjustment is so extremely critical that a fraction of a turn of the adjusting nut from the pre-determined position will cause "hunting."

To Check High-Speed Governor:

This should cut in at 2,000 r.p.m. engine speed and the runaway speed should not exceed 2,150 r.p.m. engine speed.

When checking the governor on a test rig, an allowance

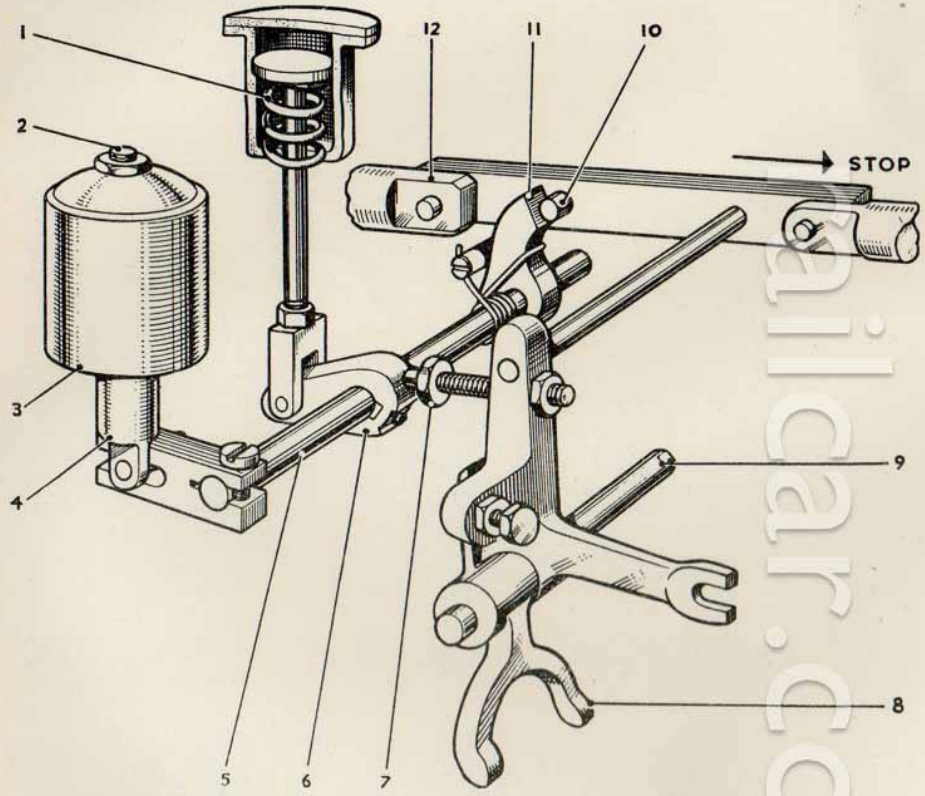
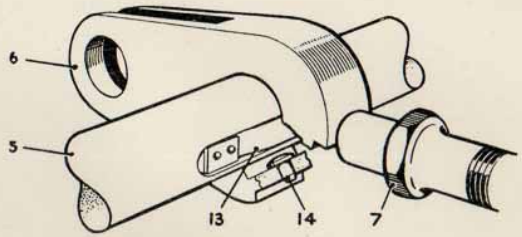
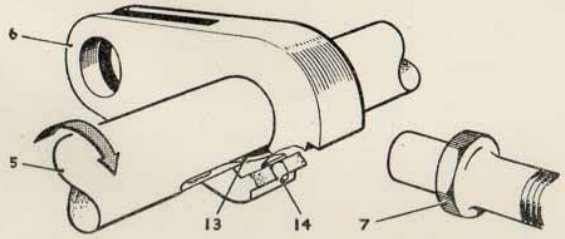


FIG. 39. OPERATION OF STOP CONTROL AND EXCESS FUEL DEVICE.

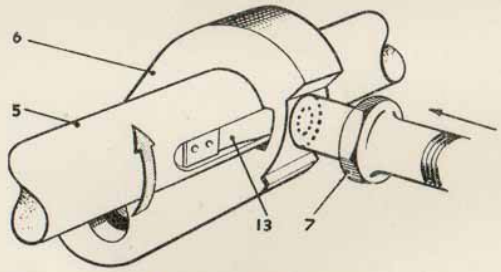
1. Spring.
2. Solenoid stop.
3. Solenoid.
4. Solenoid plunger.
5. Spindle.
6. Fuel stop.
7. Setting stop.
8. Pick-up lever.
9. Governor cross-shaft.
10. Pin.
11. Lever.
12. Control rod.
13. Flat spring.
14. Pin.



POSITION 1. NORMAL MAXIMUM FUEL POSITION.



POSITION 2. STOPPING OPERATION (SOLENOID ENERGISED)



POSITION 3. EXCESS – FUEL POSTION (SOLENOID OFF)

FIG. 40 OPERATION OF STOP CONTROL AND EXCESS FUEL DEVICE.
(see Fig. 39 for key)

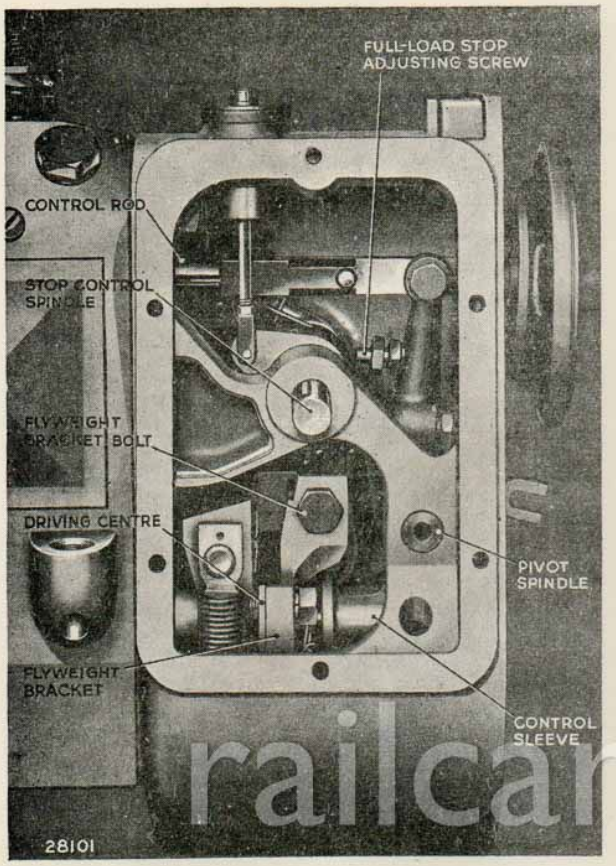


FIG. 41. FULL-LOAD STOP.

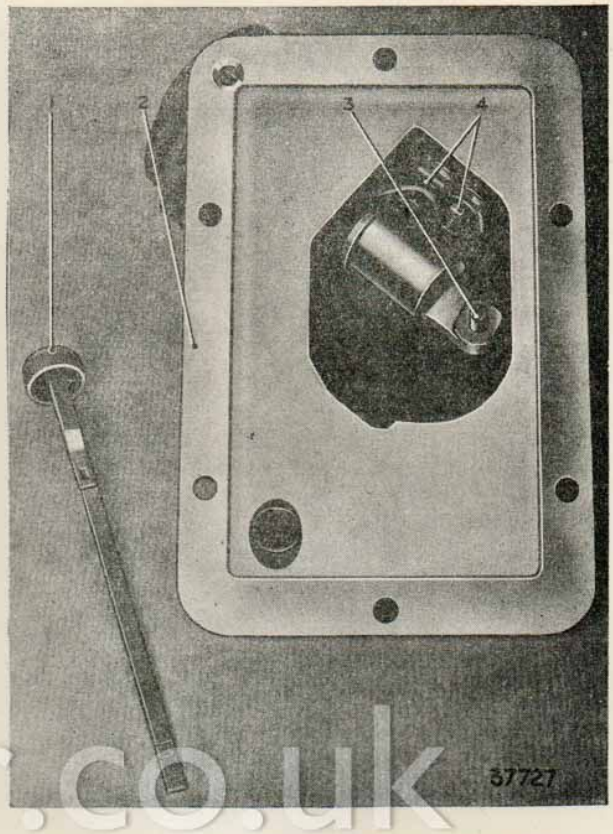


FIG. 42 INSPECTION COVER HOUSING SOLENOID.

1. Dipstick.
2. Cover.
3. Solenoid plunger.
4. Electrical contacts.

of 75 r.p.m. (pump speed) should be made for the effect of the vacuum diaphragm not being in action; therefore, the governor is set to cut in at 975 pump r.p.m.

Setting the Stop Control:

Before adjusting the setting stop (7), Fig.39. check that the fuel stop (6) is perfectly free on the shaft, when the flat spring (13) is not engaged, and adjust tension of spring (1) to get a snappy return of the fuel stop. This adjustment is made by screwing in or out the spindle. Next, with the end cover (containing the diaphragm and dashpot) removed, the solenoid is tested and should operate on 24 volts. The solenoid stop (2) is adjusted so that a slight endwise movement can be detected on the pump control rod when the solenoid is energised, thus ensuring that the force exerted by the solenoid is arrested by its stop and not imparted to the control rod mechanism.

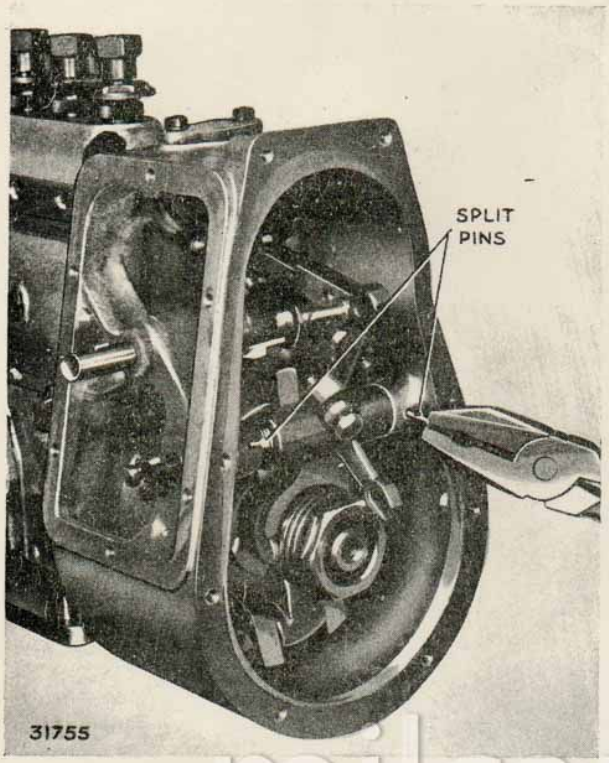


FIG. 43. REMOVING SPLIT PIN SECURING LINKAGE SPINDLE.

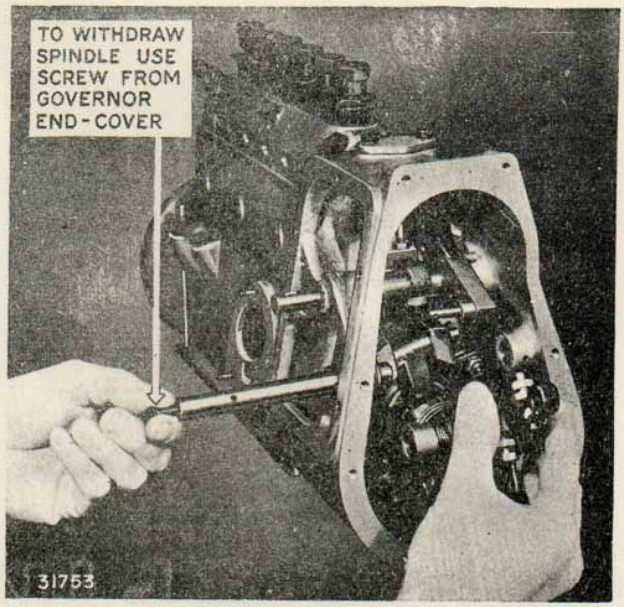


FIG. 44. REMOVING LINKAGE SPINDLE.

Overhaul

To Remove Governor Assembly:

1. Remove the diaphragm block; press against the cover while removing the setscrews, as there is a strong spring underneath.

2. Remove the dipstick, then remove the side cover and end cover. The oil damper will come away with the end cover.

3. Remove the split pin (Fig.38), securing the diaphragm to the control rod pin. Draw the rod to the full-off position and unhook the diaphragm.

4. Take out the split pins securing the pivot spindle (Fig. 43), screw a 1/4 in. B.S.F. bolt into the tapped end and withdraw the spindle (Fig.44). Remove the torsion spring and forked pickup lever (Fig.34).

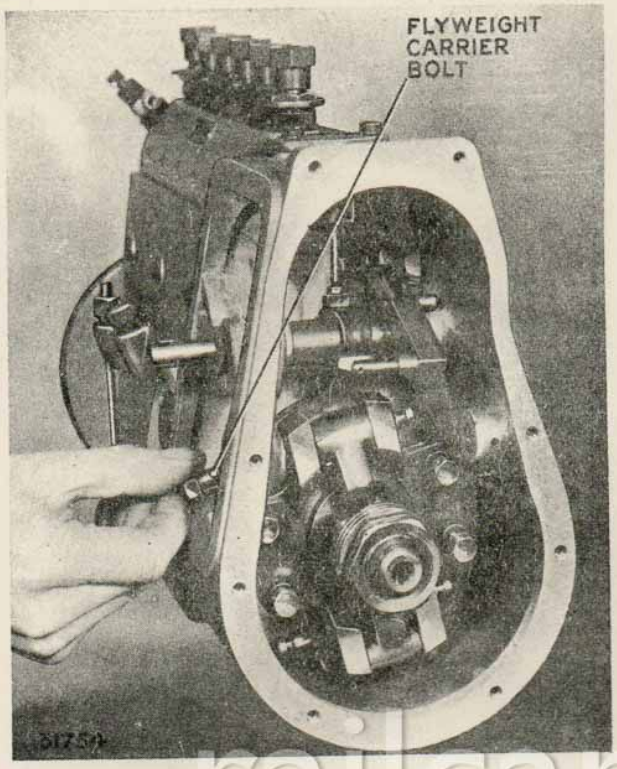


FIG. 45. REMOVING FLYWEIGHT CARRIER. BOLT (OR PIN)

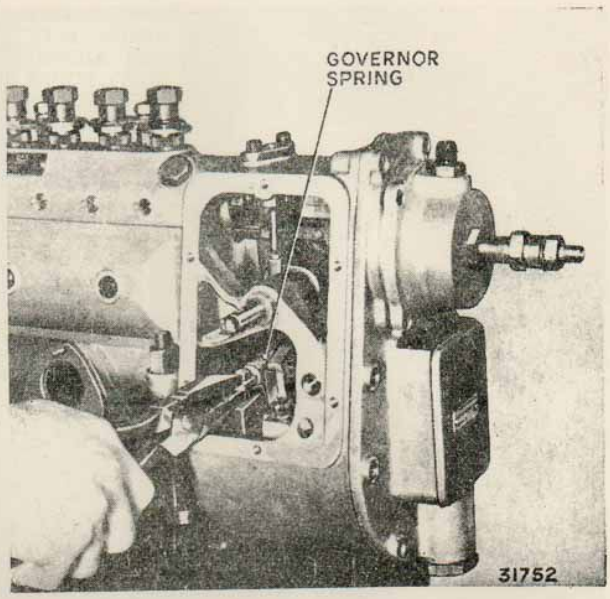


FIG. 46. RELEASING GOVERNOR SPRING.

5. Release the governor springs (Fig. 46).

6. Remove the flyweight carrier bolts, later models remove four setscrews from flyweight bracket, then remove retaining brackets and pivots, then withdraw the flyweights (Fig.45).

7. Remove the four setscrews securing bracket (Fig.45) to the driving centre and remove the bracket and sleeve.

8. Unscrew nut securing driving centre and using a special drawer (Fig.47), remove the driving centre.

9. Remove the housing nut and setscrews (Fig34) securing the governor casing to the injection pump housing, and remove the casing.

To Replace Governor Assembly:

Reverse the sequence of operations for Removing Governor.

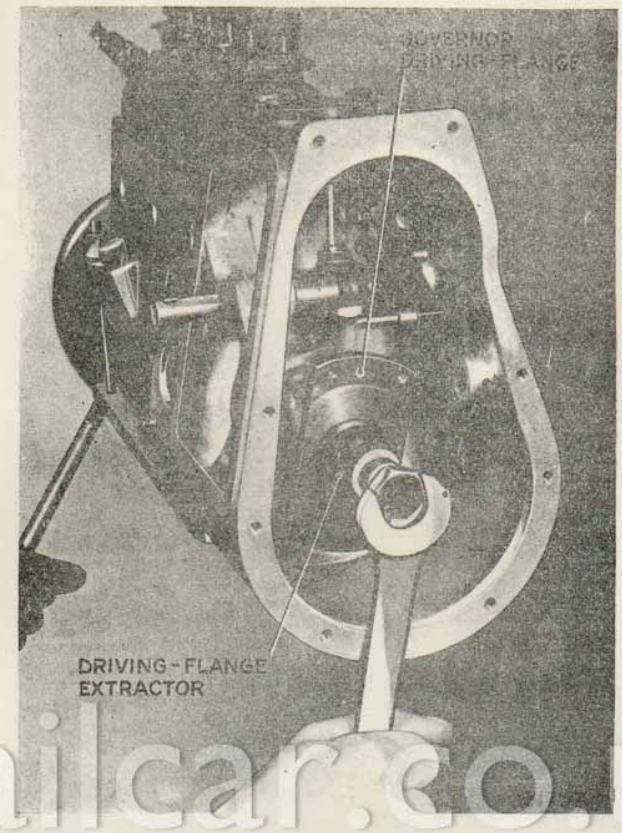


FIG. 47. REMOVING GOVERNOR DRIVING FLANGE.

Note: The flyweight bracket and driving centre are both meshed on initial assembly and they must be replaced so that the marks coincide.

Fuel Feed Pump

The feed pump (Fig.48) is of the variable-stroke diaphragm type, driven directly by an eccentric on the injection pump camshaft. The pump is of ample capacity to ensure an adequate supply of fuel at all speeds.

Operation :

As the injection pump camshaft revolves, the eccentric, pushes the rocker arm down; this pulls the diaphragm held between metal discs, inward against spring pressure thus creating a vacuum in the pump chamber.

Fuel enters the pump through the suction valve into the pump chamber. On the return stroke the return-spring pressure pushes the diaphragm outward, forcing fuel from

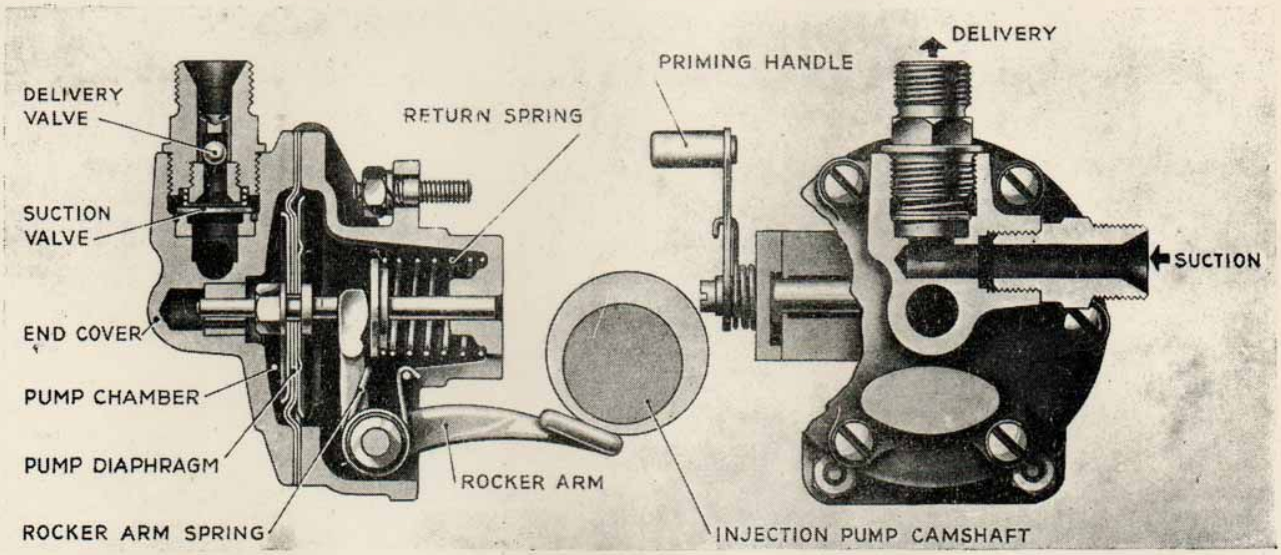


FIG. 48. THE FUEL FEED PUMP.

the chamber through the pressure valve into the main fuel filter and so to the injection pump.

When the injection pump fuel gallery is full, a pressure is created in the pump chamber. This pressure will hold the diaphragm inward against the return-spring pressure, where it will remain inoperative until the pressure in the injection pump drops.

The small spring on the rocker arm is merely to keep the arm in constant contact with the eccentric to eliminate noise.

Overhaul:

If trouble occurs in the fuel supply to the injection pump, the following checks should be made before attempting any repairs to the pump:

1. Make sure the fuel pipes are not blocked.
2. Check that the main filter is clean.
3. Examine for leaks on the suction side of the pump.
4. Examine the valve and, if defective, renew.

If the pump still fails to operate satisfactorily, dismantle and check for the following:

1. Broken diaphragm return spring.

2. Diaphragm retaining-nut loose.

3. Punctured or worn out diaphragm.

4. Leakage at diaphragm flange.

5. Broken rocker arm.

Injectors

The fuel, after filtration, is delivered at high pressure by the injection pump to the injectors where it passes via the inlet adaptor over the edgewise filter and along the drilled passage in the injector body to the needle-valve face and nozzle seat. When the required pressure is reached the needle valve is lifted off its seat by the fuel pressure, allowing the fuel to be discharged into the combustion chamber through four spray holes each approximately .010 in dia., drilled radially and equally spaced in the tip formed at the end of the nozzle barrel, as shown in the enlarged section view Fig.50 At the end of the injection period the needle-valve, under pressure from the return spring, snaps back on to the nozzle seat giving a clear cut off to the fuel, thereby ensuring a perfectly dry seat which is essential to prevent after dribble and carbon deposit forming on the nozzle tip and blocking the spray holes. Although the needle valve is a very fine fit in the injector body a small quantity of fuel leaks past the valve stem and is led away via the leak-off passage in the injector body to a branch pipe connected to the leak-off adaptor, and thence to the main leak-off gallery.

The injectors will give long periods of efficient service if correctly maintained. Special equipment is required for reconditioning the injectors and special lapping tools are obtainable. If however no equipment is at hand, injectors should be returned to Leyland Service Department and a replacement set fitted.

Diagnosis of Injector Trouble

Any inefficiency in an injector can usually be detected by one of the following symptoms:

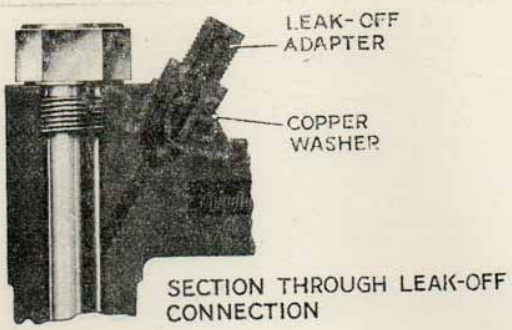
FIG. 49. PART SECTIONED VIEW OF INJECTOR UNIT.

1. Pronounced knocking on one (or more) cylinders.
2. Complete or intermittent misfiring.
3. Smoky exhaust (black).
4. Increased fuel consumption.
5. Engine overheating.

To locate a faulty injector, slacken off the injector pipe union nut two or three turns and allow the fuel to leak past the threads while the engine is running slowly. This cuts out the injector and if no change in engine performance can be detected, it is reasonable to assume that the injector is faulty and should be removed for examination.

Faulty injection may be due to any of the following:

1. External carbon on nozzles.
2. Choked nozzle spray holes.
3. Loose nozzle lock-nut.



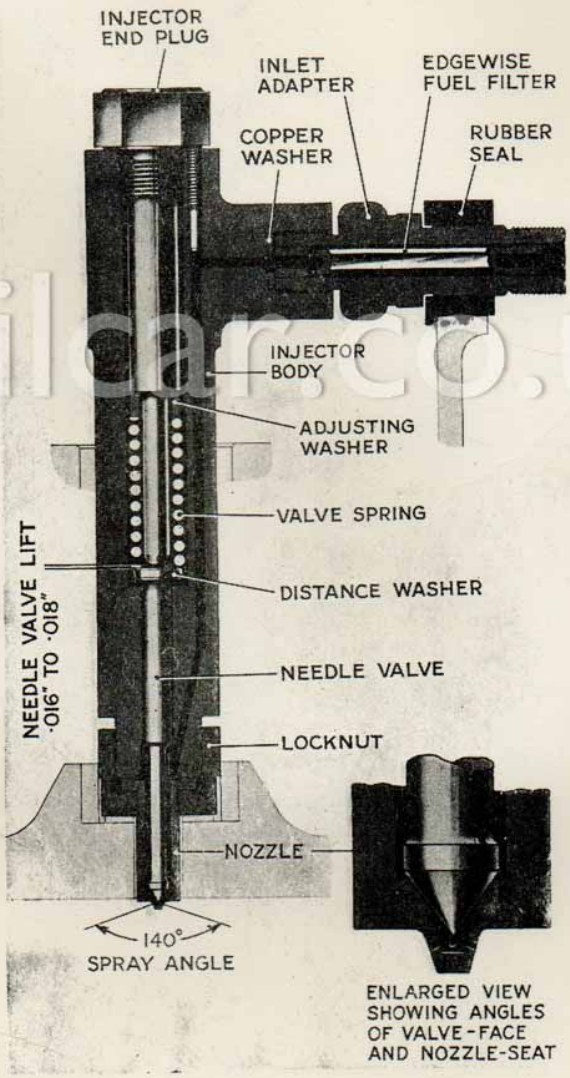


FIG. 50. THE INJECTOR UNIT.

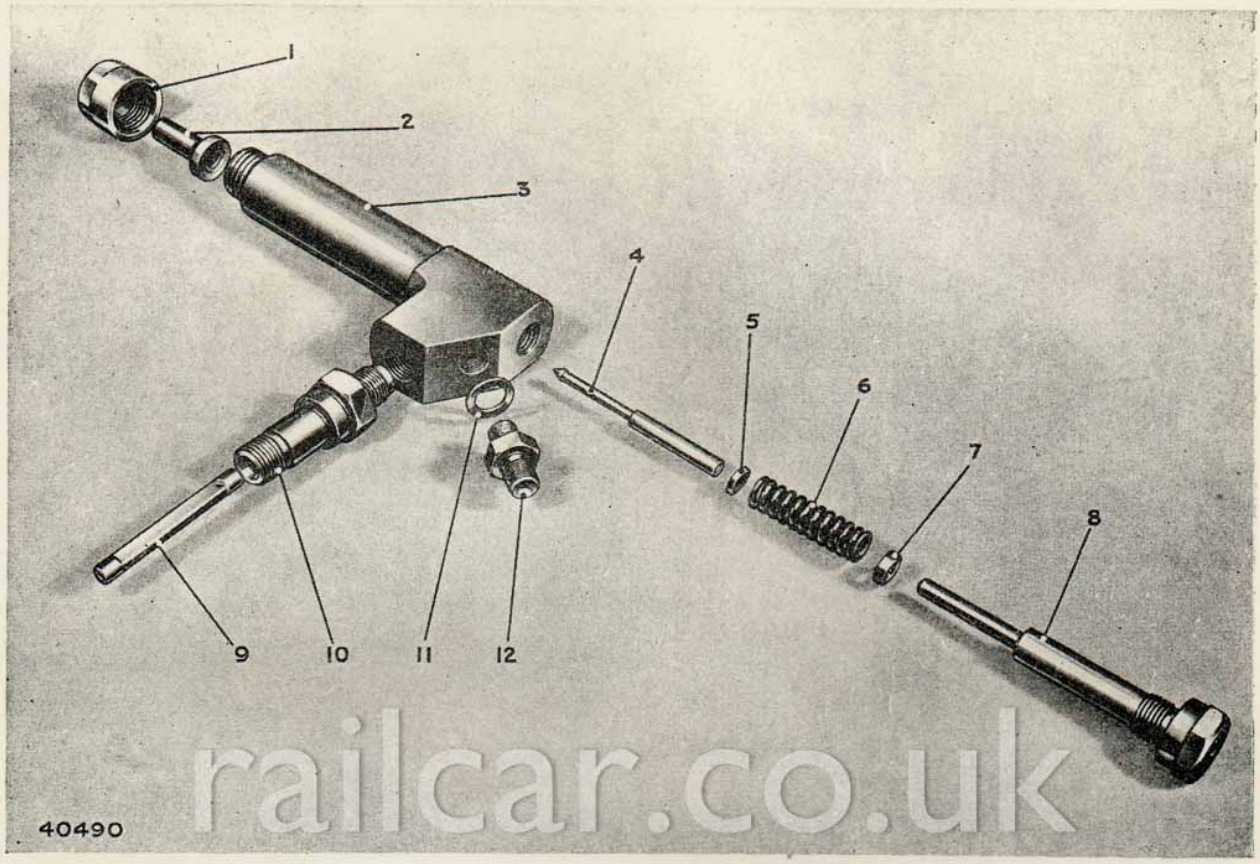


FIG. 51. EXPLODED VIEW OF INJECTOR UNIT.

1. Locknut.
2. Nozzle.
3. Injector Body.
4. Needle Valve.
5. Needle Valve Lift Distance Washer.
6. Valve Spring.
7. Discharge Pressure Adjusting Washer.
8. End Plug.
9. Edgewise Filter
10. Inlet Adaptor.
11. Copper Washer
12. Leak-off Adaptor.

4. Dirt on the joint face between nozzle and body.

5. Dirt or carbon on needle valve seat.

6. Needle valve sticking in body.

7. Faulty valve spring adjustment.

8. Broken needle valve spring.

9. Cracked injector body.

To Test Injectors

Connect the injector to an injector test pump, give the handle about ten strokes to expel all air, and observe the nature of the spray when pumping at about 2 strokes per second. If no test pump is available, connect the injector to the injection pump, so that the spray can be observed. Slacken the unions on the remaining injectors to prevent unburnt fuel being sprayed into the cylinder. Decompress the engine. Turn the engine, using a bar inserted into the hole cast in the driving coupling on the crankshaft torsional oscillation damper, and observe the spray.

When the injector is operating correctly, the spray from the nozzle spray holes should appear alike, and of equal length and free from streaks or jets of undivided fuel.

A sharp, high-pitched, metallic squeak should be heard whilst the injector is spraying.

The nozzle tip must remain dry after fuel cut-off.

Overhaul

To Dismantle and Clean Injectors

When dismantling injectors absolute cleanliness is essential. Needle valves are not interchangeable, care must be taken when dismantling to keep all parts with their original injectors.

1. Remove the injector end plug and withdraw the valve spring, discharge pressure adjusting washer, needle valve lift distance washer and needle valve. If the needle valve is tight screw a piece of 3 BA tapped rod into the tapped bore of the needle valve and draw it out.

2. Remove the nozzle locknut and nozzle.

3. Wash the needle valve, nozzle and injector body in clean fuel oil. Both faces of the nozzle flange, the inner face of the locknut and face of the body should be bright and without trace of damage. They must bed perfectly to ensure a pressure-tight joint.

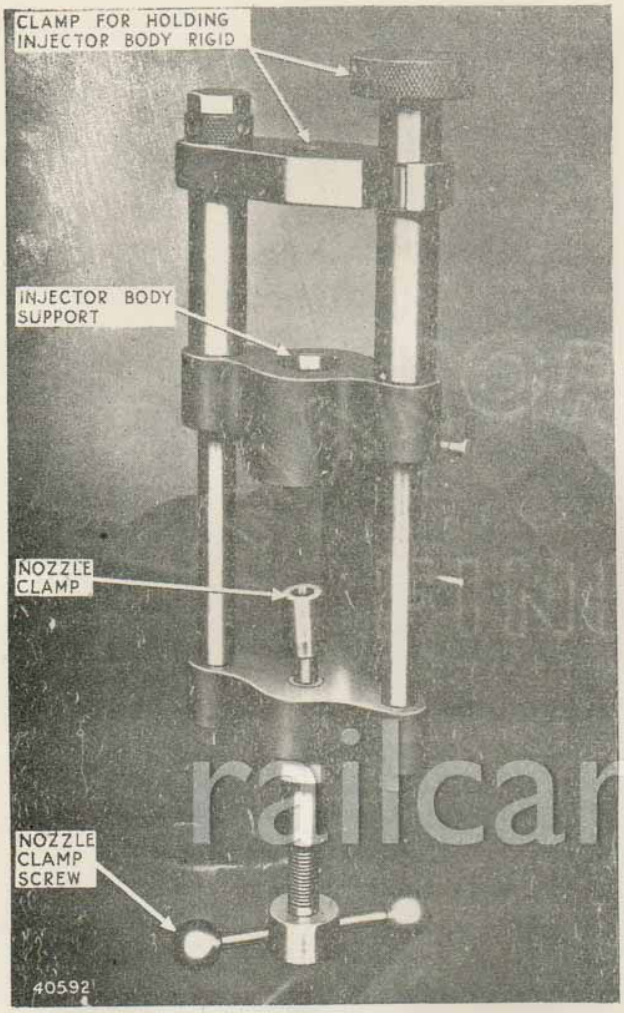


FIG. 52. INJECTOR SERVICING JIG.

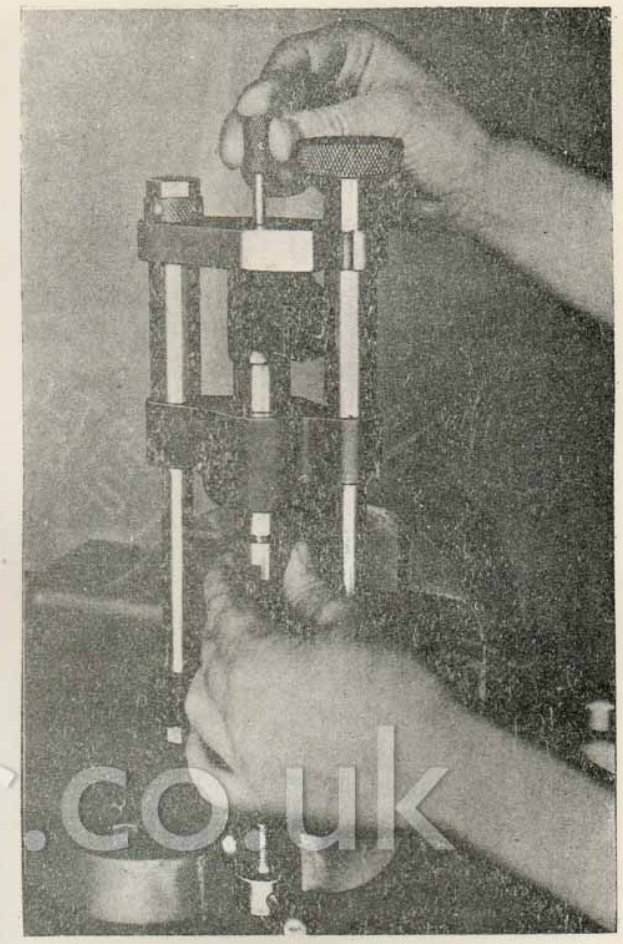


FIG. 53. CENTRALISING THE NOZZLE.

4. The stem of the needle valve must be free from high spots or scratches. If dirty or coked, clean with a fine brass wire brush.

5. Clean the nozzle seat thoroughly and clear the spray holes with a pricker. Brush through injector body bores and inlet adaptor. Flush out the inlet port drilling and nozzle with fuel oil. Finally rinse in clean white spirit before assembly.

To Re-lap Nozzle and Valve Seats

Use only the special fine grade lapping compound known as "2A.700.O.F.," supplied by the Carborundum Co.,Ltd., Trafford Park, Manchester,17.

When lapping, only use very light pressure.

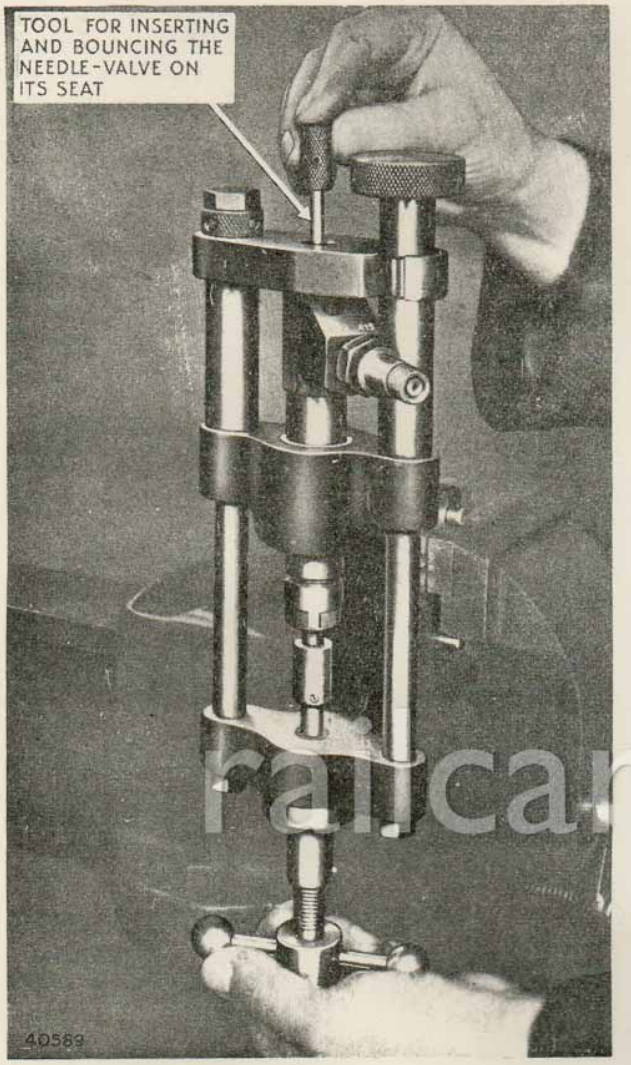


FIG. 54. CLAMPING THE NOZZLE.

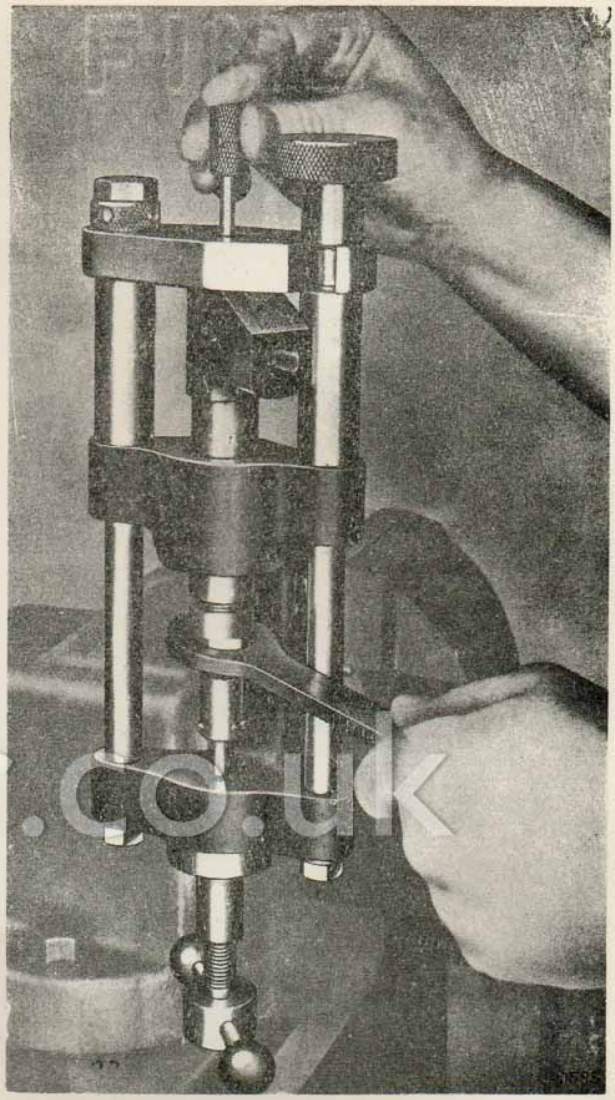


FIG. 55. TIGHTENING THE NOZZLE LOCKNUT.

Never give the needle or nozzle lapping jigs more than a few twists at a time between each test.

Wash away every trace of lapping compound, assemble the injector and test for a dry seat with a sustained pressure of 130 atmospheres. 1911 lb./sq.in. (134 kg./sq.cm.). If the seat does not remain dry, repeat the lapping operations until such a condition is obtained.

Assembly and Test of Injectors

The most important point to check when assembling an injector unit is the correct alignment of the nozzle in

relation to the bore in the injector body. If the alignment is not correct the unit will not function properly and failure will occur at very low mileages. The components should be thoroughly washed in white spirit or fuel oil and kept free from grit and dirt throughout the entire operation. Fluffy material should not be used to wipe any of the parts.

To Re-assemble Injectors

1. Check that all parts are perfectly clean and dry.

2. Fit the injector body in the jig (Fig.52).

3. Fit the nozzle and locknut and screw up the locknuts so that the nozzle can just be rotated with the fingers.

4. Screw the 3BA rod into the needle valve bore and insert the valve into the injector body.

5. Tighten the locknut slowly and carefully with the fingers, at the same time using the 3BA rod to bounce the needle valve rapidly on the nozzle seat.

This ensures perfect centralisation of the nozzle and needle, without which the injector will not operate correctly. When the needle valve bounces freely on its seat, tighten the jig clamp screw to hold the nozzle in position and finally, tighten the locknut with the ring spanner (Fig.55) taking great care not to knock the nozzle when fitting the spanner. When the locknut has been fully tightened a further and most important check that the needle valve operates freely, is the "Inverted Test" carried out as follows.

1. Remove the injector from the jig.

2. Hold the injector vertically in an inverted position. (Fig.57).

3. With the needle valve attached to the special tool, insert the needle valve into the injector body and push it firmly onto the nozzle seating.

4. Release the tool smartly for an instant, and check that the needle valve breaks cleanly from the nozzle seat without sticking or binding.

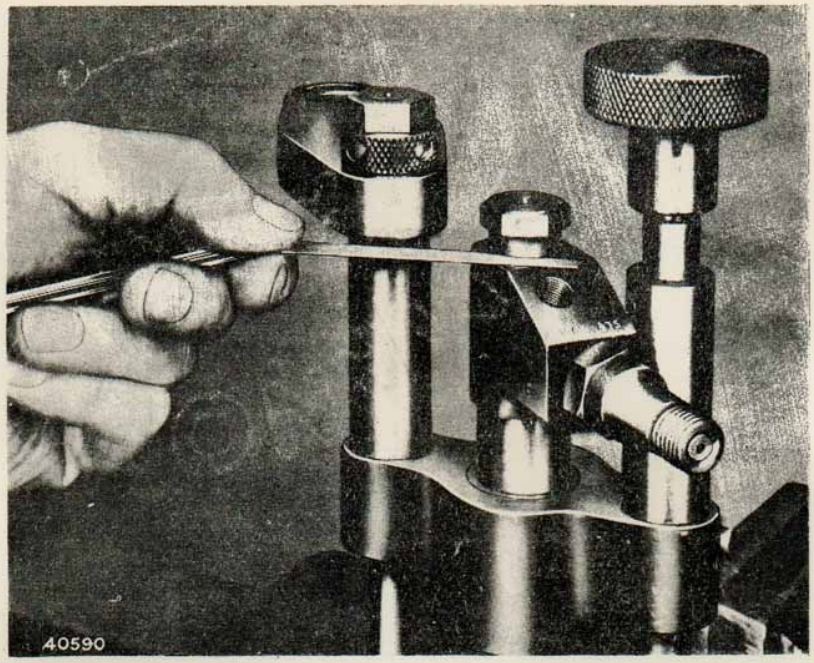


FIG. 56. CHECKING THE NEEDLE VALVE LIFT.

FIG. 57. THE INVERTED TEST.

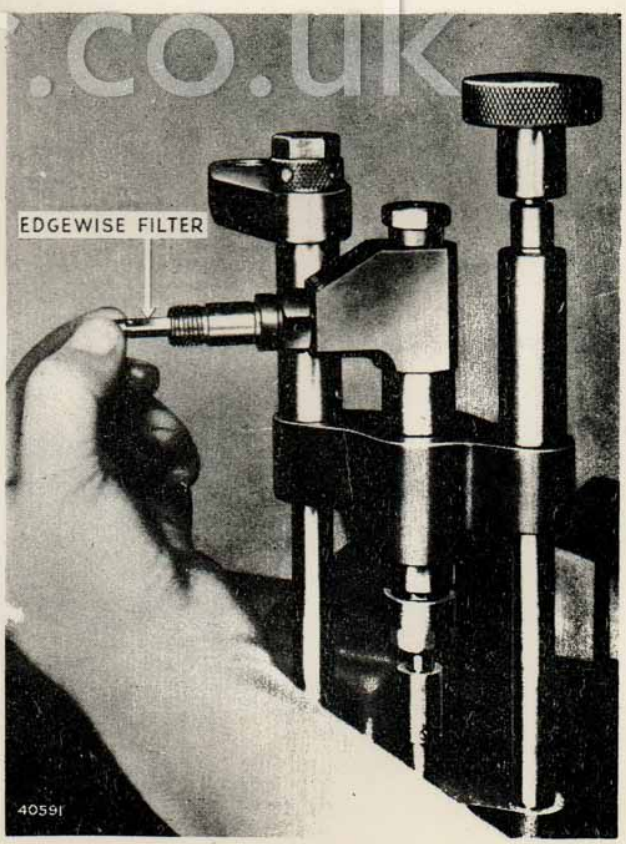


FIG. 58. FITTING THE EDGEWISE FILTER.

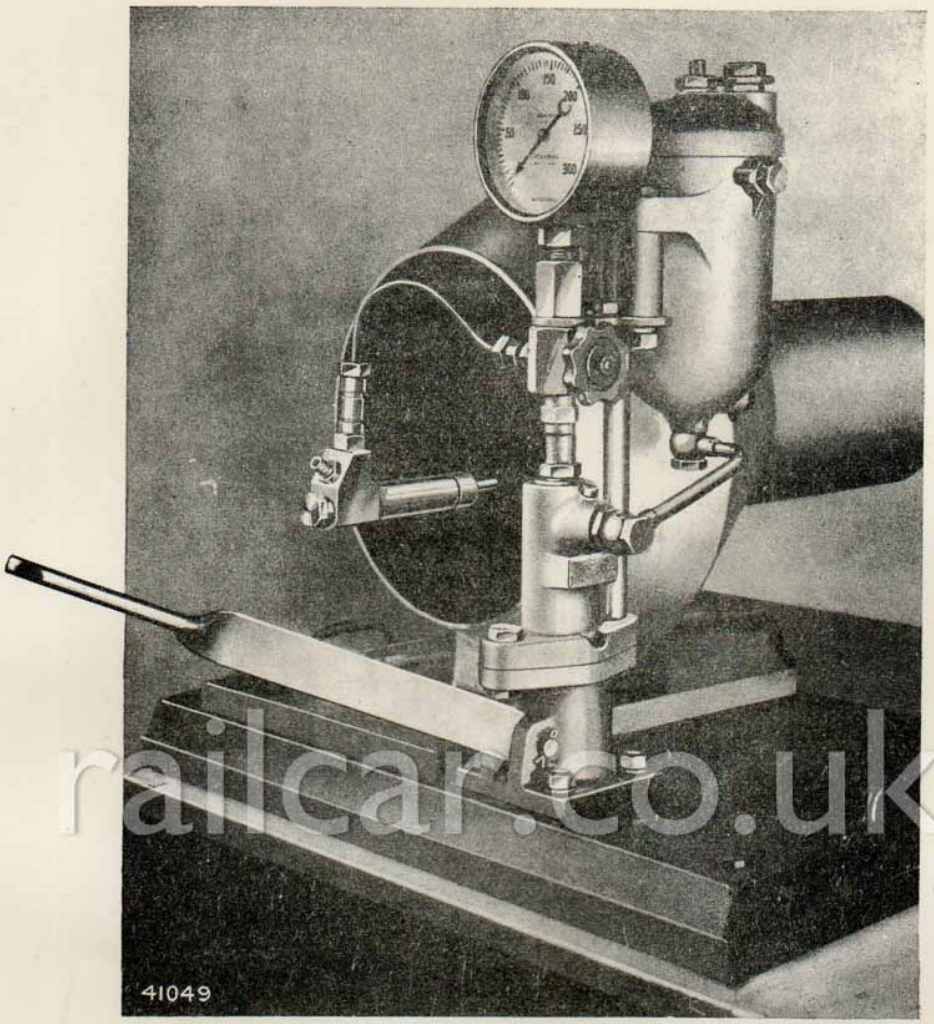


FIG. 59. INJECTOR TEST PUMP.

Make this test with the needle valve in at least four different positions on the nozzle seat. If the needle valve sticks in any one position then:

(a) Check the needle valve slides freely in the injector body.

(b) Check that the end face of the injector body and the end face of the nozzle are clean and fit flush.

(c) After these checks, re-align the injector body and nozzle in the jig, and again carry out the "Inverted Test."

5. Now assemble the needle valve lift distance washer, valve spring and discharge pressure adjusting washer

in the injector body and replace the injector end plug.

To Check and Adjust Injectors

This can only be done successfully with a specially designed injector test pump.

1. Connect the injector to the test pump; expel all air from the pump by pumping the handle for about ten strokes.

2. Carefully note pressure at which spray breaks when the pump handle is operated. The correct pressure is between 140 and 145 atmospheres (2,057 to 2,130 lb./sq.in.) 144.6 to 149.7 kg./sq.cm.

3. The seat must remain dry with a sustained pressure of 125 atmospheres (1,837 lb./sq.in.) 129 kg./sp.cm.

4. If the discharge pressure is not correct, check that the needle is free in the body; if this is in order adjust the spring pressure by inserting a discharge pressure adjusting washer of a different thickness. Re-check the discharge pressure.

5. Check that the needle lift is between .016 in. and .018 in. To do this remove the injector end plug and valve spring. Insert a .025 in. thick shim on top of the needle valve lift distance washer and replace the end plug. Screw down the plug by hand and measure the gap between the end plug and injector body, using a set of feeler gauges, (Fig.56). If this gap is between .007 in. and .009 in., the needle lift is correct. If the gap is not correct, fit a different thickness of distance washer and re-check; when a needle valve lift distance washer of the correct thickness has been obtained, remove the .025 in thick shim and assemble the injector for test.

6. Check the time for the pressure to fall from 90 to 40 atmospheres (1,323 to 588 lb./sq.in.). 93 to 41.4 kg./sq.cm. The limits for rejection, are as follows (at room temperature 40° F. to 70° F.):

Upper limit ... ... Fuel oil 14 secs.

Lower limit ... ... 4½ secs.

Main Fuel Filter

Description

The filter consists of a cast body and cap, housing a double filtering element consisting of an outer filter of cloth and an inner filter made up of felt pads (Fig.60).

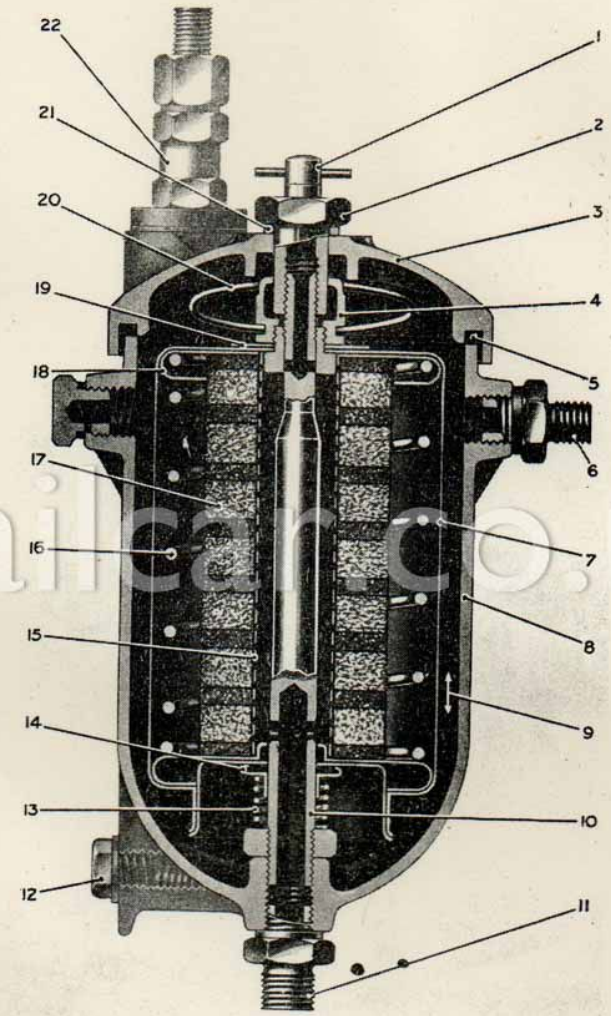


FIG. 60. THE FUEL FILTER.

1. Air vent.
2. Nut.
3. Cover.
4. Nut.
5. Joint.
6. Adaptor.
7. Cloth filter.
8. Casing.
9. Chamber.
10. Centre bolt.
11. Adaptor.
12. Sludge plug.
13. Spring.
14. Bush.
15. Support pipe.
16. Support spring.
17. Felt filter.
18. Plate.
19. Washer.
20. Filter element handle.
21. Packing.
22. Gravity vent valve.

Fuel is supplied to the filter by means of the fuel feed pump mounted on the injection pump. It flows into the chamber (9), through the cloth filter (7), on through the felt filter (17), into the passage of the centre bolt (10) and out by way of connection (11). A gravity vent valve is fitted to the top cover of the filter, this acts as an automatic vent and bleed.

Maintenance

When being used for the first time and after every cleaning of the filter, fill with clean fuel oil after removing vent valve assembly (22). Replace vent valve assembly and unscrew air vent (1) to free all air, then screw down when fuel is flowing freely.

Dismantling the Filter Element

1. Release nut (4), washer (19) then, after untying string the cloth can be removed.

2. Remove plate (18) and support spring (16) and felts can be pulled away from the support pipe (15).

Re-assembly is a reversal of the above, but the following should be noted:

When re-building the felt pack start with a thin felt, then a thick and thin felt alternately, using a total of seven thick and eight thin.

To Renew Cloth and Felt

The cloth filter should be examined approximately once a week for punctures or excess dirt and renewed if necessary. The filter cloth supplied by Leyland and C.A.V. service depots for this purpose is a special weave found by test to possess the maximum filtration qualities.

Providing cloth is changed regularly the felt element should only require renewal when engine is down for major overhaul. It is advisable when changing the filter cloth to clean the felt element. This is best done by applying compressed air to the support pipe, after suitably sealing the end, so that the air passes from the inside to the outside of the pads. This should be done immersed in clean petrol or paraffin. It is not sufficient merely to rinse the felt pack or brush it in fuel oil, as this may cause dirt removed to settle on the inside and subsequently pass into the injection system when filter is replaced on the engine.

TO REMOVE AND REPLACE ENGINE AND TORQUE CONVERTER

To Remove Engine and Torque Converter

1. Isolate the batteries at the battery cut-off switch.
2. Drain the cooling system.

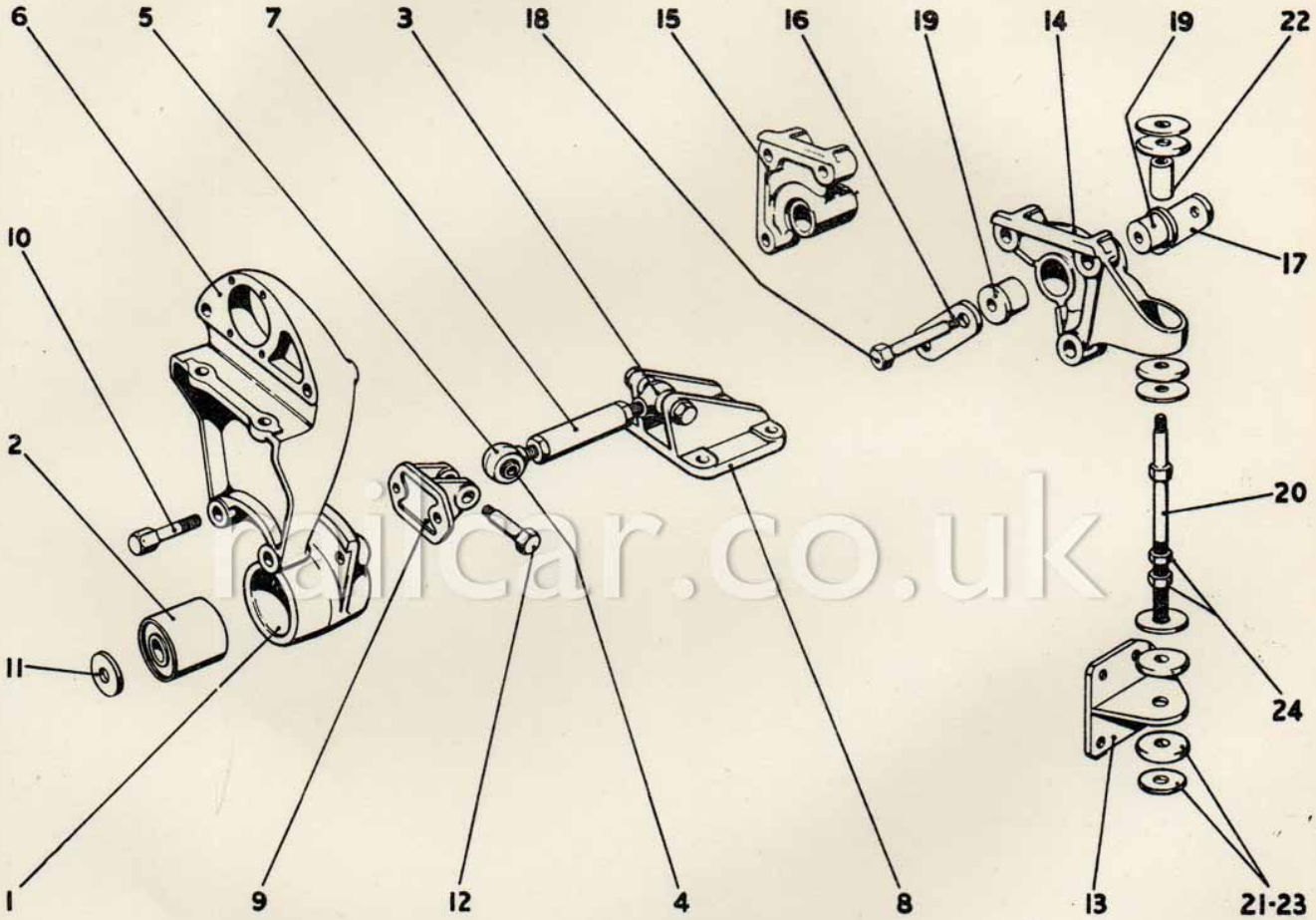


FIG. 61. EXPLODED VIEW OF ENGINE MOUNTING.

1. Engine support housing, front.
2. Bush.
3. Eye bolt.
4. Bush.
5. Eye bolt.
6. Support bracket, front.
7. Reaction stay.
8. Reaction bracket, crankcase.
9. Reaction bracket, cross-members.
10. Setscrew.
11. Washer.
12. Bolt.
13. Torque stop bracket.
14. Support bracket, rear, left.
15. Support bracket, rear, right.
16. Shackle.
17. Shackle.
18. Shackle pin.
19. Bush.
20. Torque stop rod.
21. Rubber bush.
22. Distance piece.

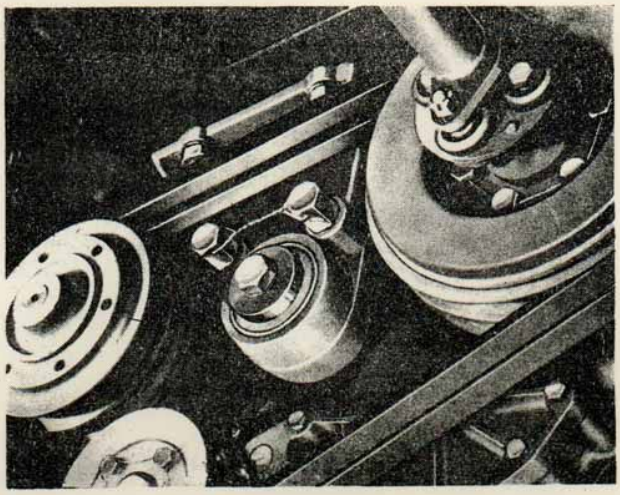


FIG. 62. ENGINE FRONT MOUNTING BRACKET.

3. Disconnect top and bottom water joints.

4. Remove fan-drive propeller shaft.

5. Disconnect compressor pipe connections.

6. Detach throttle control rod.

7. Remove the rubber hose between the inlet manifold and the air cleaner.

8. Disconnect and remove feed pipe to lift pump and return pipe near oil relief valve.

9. Disconnect wires to solenoid stop-control on fuel pump governor, and delayed action switch.

10. Disconnect pipe to oil pressure switch.

11. Detach cables from starter motor.

12. Uncouple exhaust pipe at exhaust manifold.

13. Drain fluid from torque converter.

14. Disconnect all pipes from torque converter feeding remote units.

15. Break the transmission at the torque converter coupling flange and slide the propeller shaft clear.

16. Uncouple reaction stay at top of crankcase.

All interconnected parts have now been disconnected.

17. Take the weight of the engine on suitable lifting gear, split the engine front mounting bracket by removing the two setscrews (Fig. 62). Detach the two engine rear mounting brackets from the crossmember by removing three setscrews from each bracket.

    The engine and torque converter together with mounting brackets can now be lowered to the floor as a complete unit.

To Replace Engine and Torque Converter

Replacement of engine and torque converter is a reversal of the above procedure.

ENGINE BLOCK AND CAMSHAFT

Description

The engine block is a one-piece casting; the cylinders being fitted with dry cast iron liners, shoulder located.

The camshaft is carried in seven pressure lubricated bearings which are setscrew located on the under side of the engine block, the thrust being taken on the front bearing only. The drive is transmitted from the front of the crankshaft through helical gearing.

Overhaul

To Remove Camshaft

1. Remove engine from vehicle.
2. Remove the rocker gear and extract the push rods.
3. Remove oil return pipes, tappet gallery, bottom covers and extract the tappets.

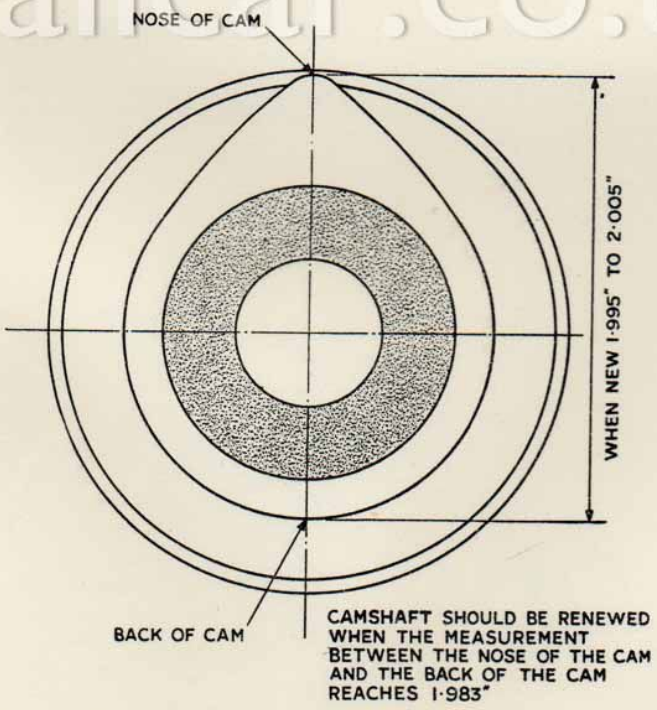


FIG.63. CAM WEAR DIAGRAM.

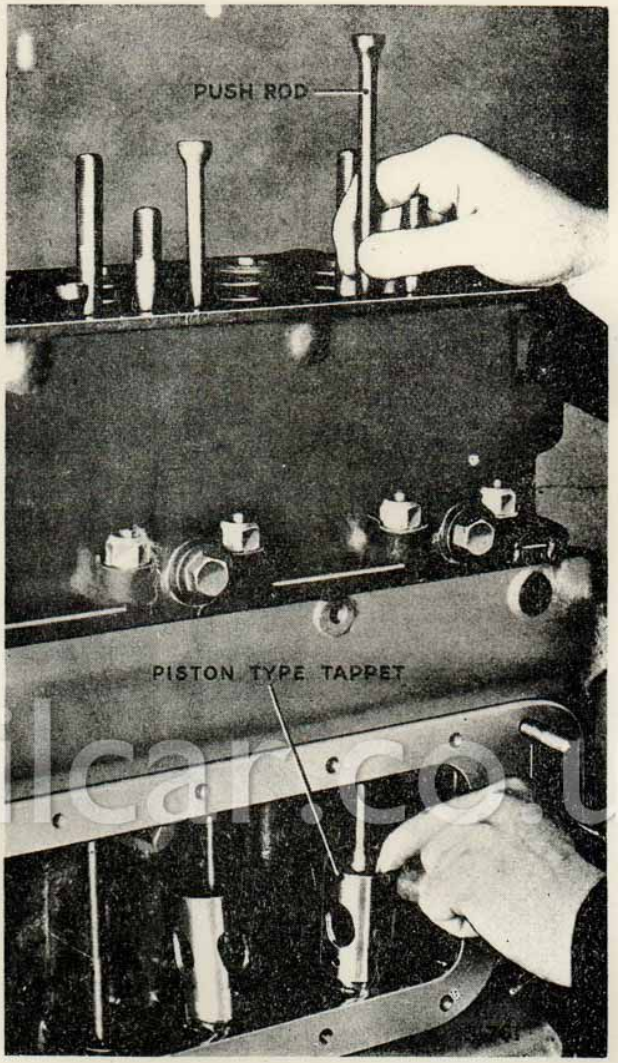


FIG. 64. REMOVING PUSH ROD AND TAPPET.
(Engine in Stand)

4. Remove driving flange, vibration damper, and 1 in. B.S.P. bolt, then remove pulley with the special tool.

5. Remove water pump, engine mounting bracket, and tensioner pulley bracket.

6. Now remove timing case, taking care not to damage the oil seal housed in the bore surrounding the crankshaft end.

7. Remove the four setscrews and locking plates securing the gear to the camshaft and withdraw the gear,

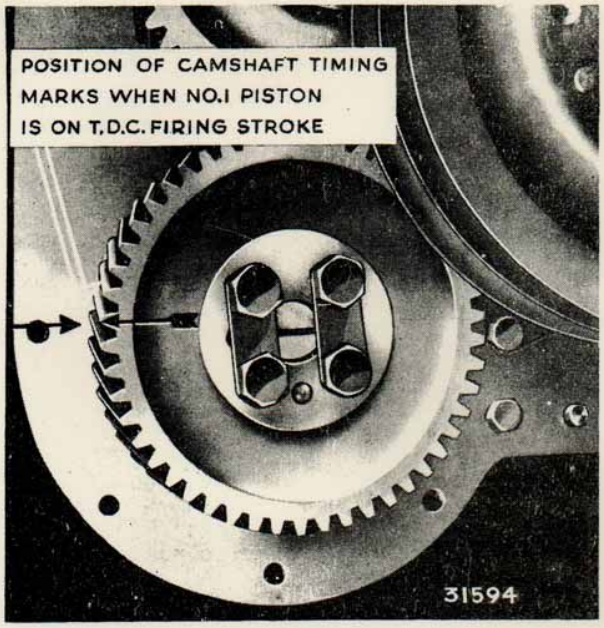


FIG. 65. CAMSHAFT TIMING MARKS.

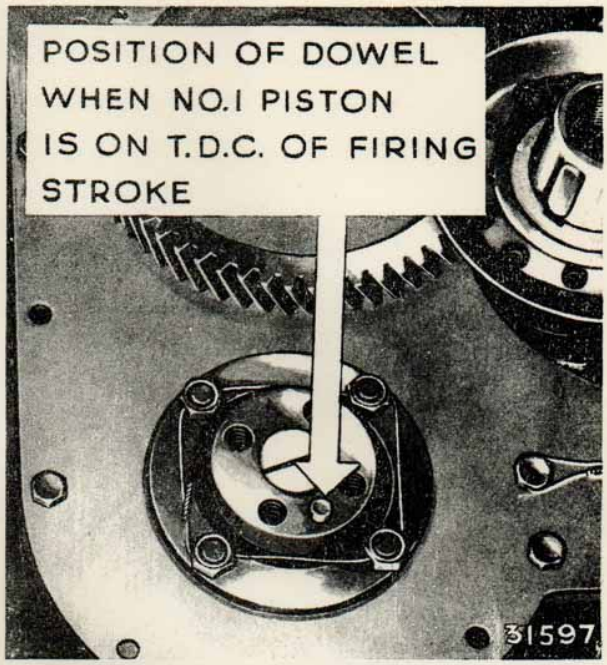


FIG. 66. GEAR LOCATION IN CAMSHAFT END.

taking care to note the position of the timing mark on the gear in relation to the mark on the timing back plate when No.1 piston is on T.D.C. of firing stroke.

8. Remove the four setscrews fixing the camshaft thrust washer, and withdraw the camshaft.

9. To remove the camshaft bearings, take out the locating setscrews and drive out the bearings with a suitable drift. The intermediate bearings are interchangeable.

10. To drive out the rear bearing, it is necessary to remove the clutch, flywheel and block half of flywheel housing.

11. Check all bearings for wear and renew when diametrical clearance exceeds .010 in. Normal end-play of the camshaft with the retaining plate tight up and adjusting shim in position is .004 in. If the end-play is .008 in. to .010 in. the shim should be removed.

To Refit Camshaft

Refitting the camshaft is a reversal of the previous procedure.

Take care that the bearings are not burred when replacing them.

To Time the Camshaft

1. Turn the engine until No.1 piston is on T.D.C. of the firing stroke.

2. Fit the camshaft gear so that when the dowel hole in the gear locates on the dowel in the camshaft end, the arrows on the gear face and timing back plate are in line (Fig.65), that is 90° to the outer face of the engine block.

3. Refit the locking plates and tighten the setscrews securely. Make sure that the locking plate tabs are turned over after the setscrews have been tightened.

Cylinder Liners

At overhaul the liner bores should be measured and if the maximum diameter exceeds 4.8 in + .020 in. at the top, new liners must be fitted.

To Remove and Insert Liners

1. The cylinder liners are pre-finished ready for inserting in the engine-block. A special tool (No.259467) has been designed both to extract the old liner and to insert the new one in the block.

2. Before fitting new liners, thoroughly clean out the cylinder bores and lightly smear them with thin oil. This will facilitate removal of liners on subsequent occasions.

Note: Cylinder liners must not project more than .002 in. from the face of the engine block.

CONNECTING RODS AND PISTONS

Description

The connecting rods are alloy steel stampings of exceptionally rigid design, drilled to provide intermittent oil spray for cylinder wall lubrication. The big ends have steel-shell type, lead-bronze bearings with the bearing surface indium-coated. The small ends are bushed.

The pistons are of special aluminium alloy, fitted with three compression and two scraper rings. A toroidal cavity in the piston crown forms the combustion chamber. The hollow gudgeon pins are located in the pistons by circlips.

Overhaul

To Remove Connecting Rods and Pistons

The dimensions of the crankshaft are such that the pistons cannot be withdrawn through the crankcase; they can, however, be withdrawn through the cylinder bores.

Care should be taken not to scratch the bores when removing or replacing the connecting rod assemblies.

To Separate Pistons from Connecting Rods

1. Remove the gudgeon pin circlips.

2. Heat the pistons in boiling water and tap or push the pin out while the piston is hot.

Note: The gudgeon pins must not be forced in or out of the pistons when cold. The pins are an interference fit in the piston bosses when cold and an easy push-fit in the small-end bushes.

To Assemble Piston and Connecting Rod

1. Heat the pistons in boiling water or in an oven before the gudgeon pins are inserted. The oven temperature must not exceed 150°C.

2. Fit pistons to connecting rods with the offset combustion chamber in the piston heads on the same side as the oil spray hole in the connecting rod big-end (Fig. 30).

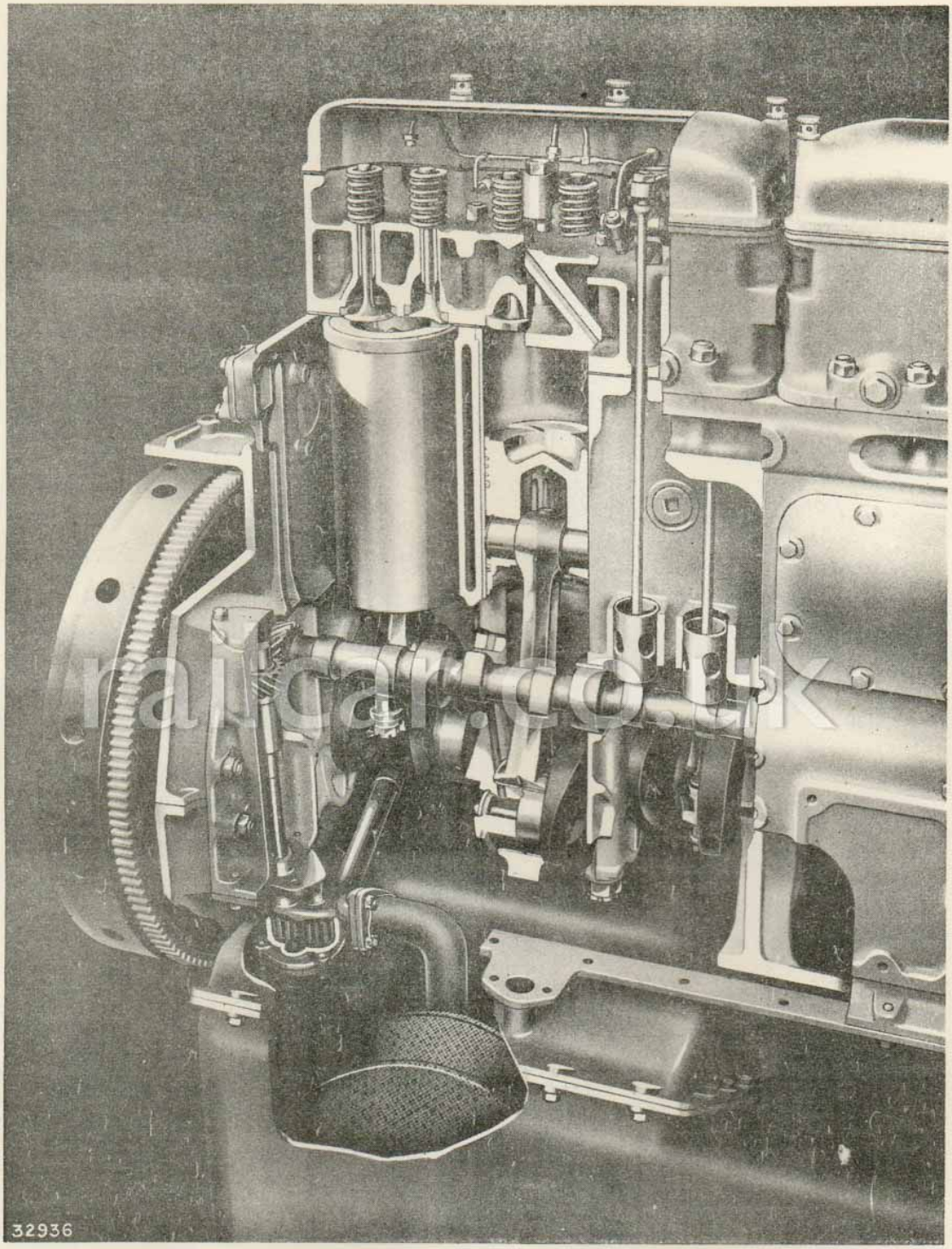


FIG. 67. CUT-AWAY SECTION OF UNDERSIDE OF ENGINE.
(Engine in Stand)

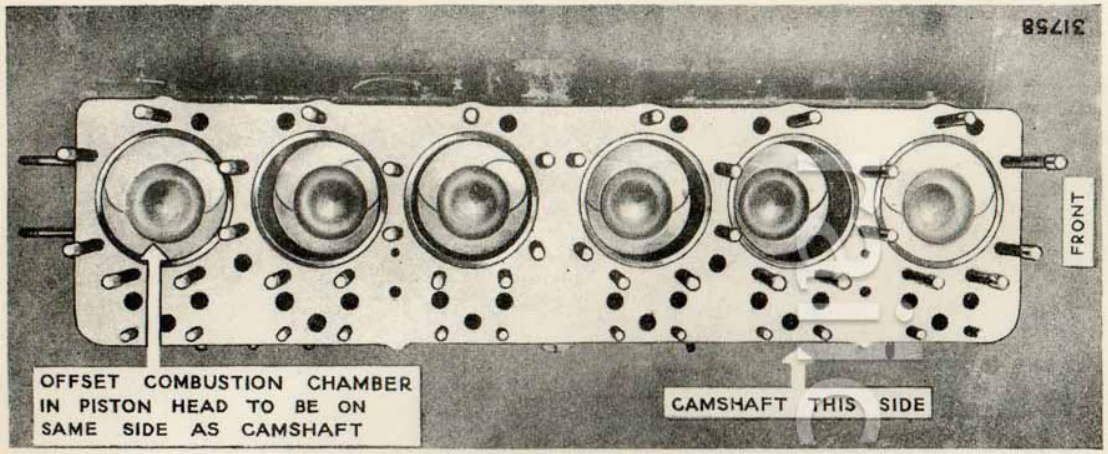


FIG. 70. POSITION OF OFFSET COMBUSTION CHAMBER IN PISTON HEADS IN RELATION TO THE CAMSHAFT.

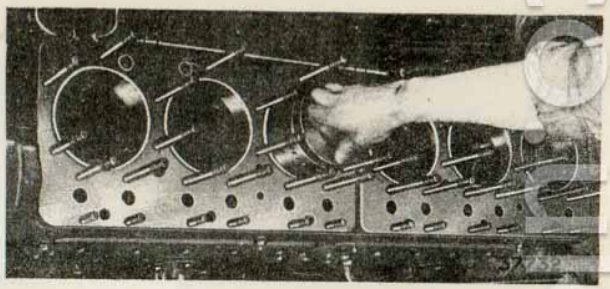


FIG. 68. FITTING THE PISTON.

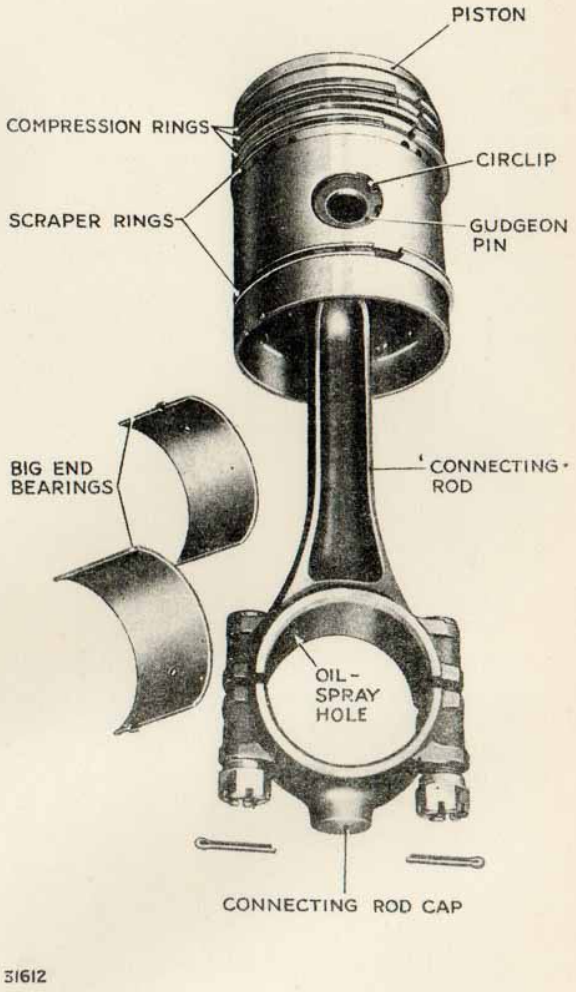


FIG. 69. PISTON AND CONNECTING ROD ASSEMBLY.

To Fit Piston and Rings

1st, 2nd, 3rd grooves	Fit compression rings, these are plain, tapered rings, with a gap cut at 90°
4th and 5th grooves	Scraper rings, slotted, ring gap cut at 90°

The initial piston ring gap is .020 in. to .027 in. Renew rings when side clearance in groove exceeds .015 in.

To Replace Connecting Rods and Pistons

1. Wipe the crankpin and bearing surfaces with a clean rag and lightly smear with clean engine oil both crankpin and lead-bronze surface of bearing shells.

2. Fit the connecting rod assemblies with the offset combustion chamber in the piston heads and the oil spray hole in the big ends on the same side as the camshaft (see Fig.70).

3. The connecting rod bolts must be tightened to give an overall bolt elongation of .006/.008 in. This dimension should be measured by micrometer.

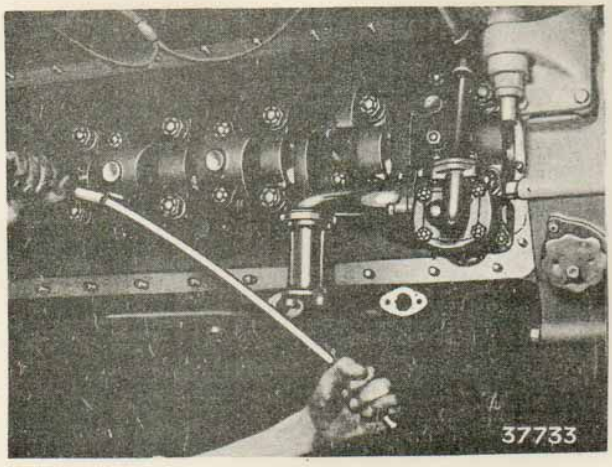


FIG. 71. FITTING BIG-END BEARING CAP.

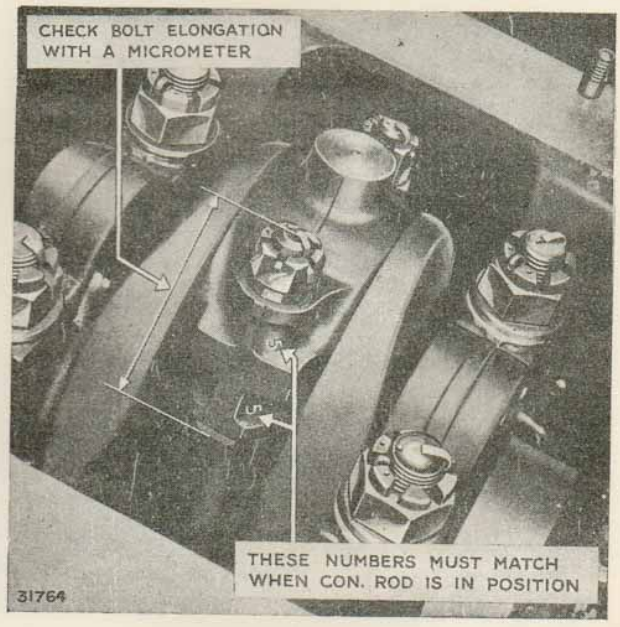


FIG. 72. CONNECTING ROD IN POSITION.

4. On no account must the nuts be slacked off to bring the pin holes into line. If the pin holes will not line up with the correct bolt elongation, the nut must be filed to bring the pin holes into line, care being taken to keep the faces true. Fit the split pins and slack off nuts just sufficiently to "nip" the split pins.

Note: Two alternative types of piston are fitted in this engine. The piston rings, circlips and gudgeon pins are identical in both types and the above instructions apply in both cases.

CRANKSHAFT AND MAIN BEARINGS

Description

The crankshaft is supported in seven lead-bronze, steel-shell, indium-coated, main bearings. The oil hole in the crankpins are drilled eccentrically to reduce centrifugal loading and also to act as sludge traps to protect the big-end bearings.

A labyrinth oil seal at the rear end of the crankshaft prevents loss of oil from the engine-block and a felt sealing ring fitted in the right-hand and left-hand halves of the flywheel housing prevents engine breathing (Fig.75). A large diameter flywheel, fitted with a renewable cast iron clutch facing, is bolted to the crankshaft rear end flange. The bolt holes in the flange and flywheel are drilled out of pitch, so that the flywheel can only be mounted with the timing plunger holes (drilled in the flywheel rim) in correct relation to the throws of the crankshaft, for timing purposes.

A rubber bonded vibration damper is bolted to the pulley at the front end of the crankshaft.

The starter gear ring (Fig.79) is spigoted and bolted to the flywheel so that its position can be changed as local wear takes place. It is reversible and can be turned completely over to obtain further service.

Overhaul

To Fit New Bearings and Thrust Washers

Normally by the time the main bearings require replacing, the crankshaft will need to be removed for regrinding, the instructions for these two latter operations being detailed later.

However, if at any time one or more bearings should have to be renewed or removed for inspection, this can be done satisfactorily without removing the engine from the vehicle.

1. Remove the injection pump, exhauster, and starter motor.

2. Remove the outer sump, suction oil filter, inner sump, and oil pump.

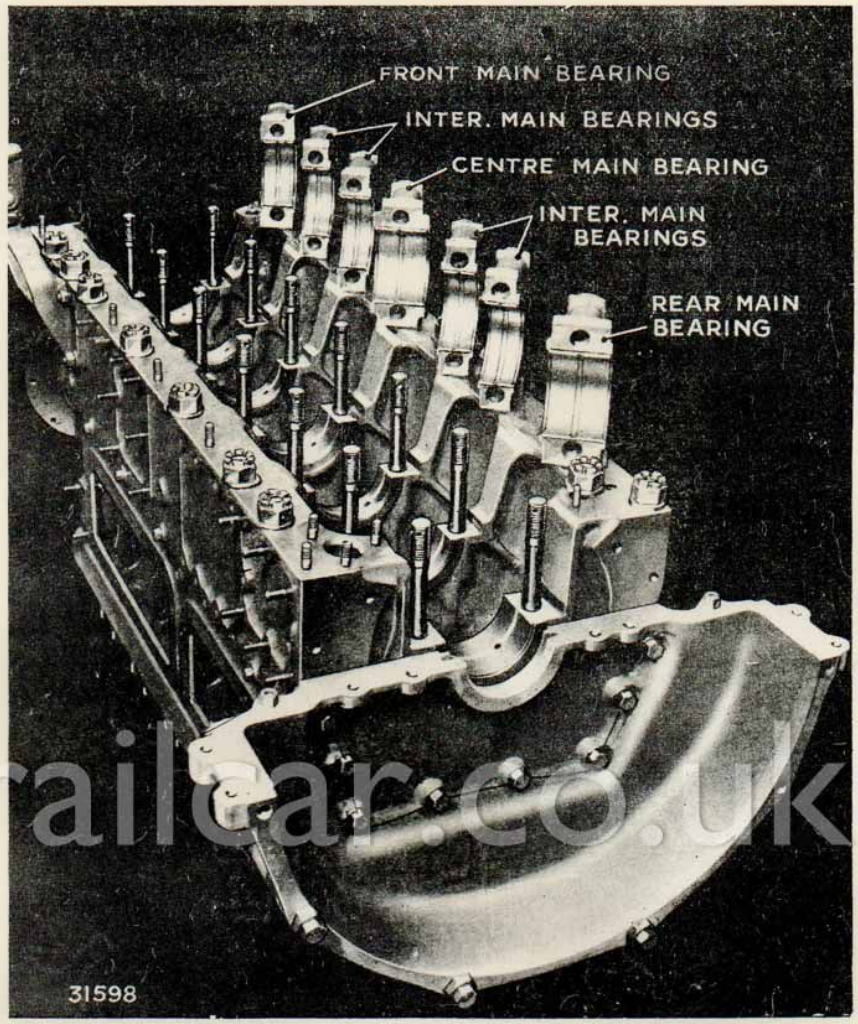


FIG. 73. ENGINE BLOCK AND MAIN BEARINGS.

3. To renew or inspect an individual bearing only, take off the cap of the bearing in question.

4. Slacken all the remaining bearing cap nuts one or two turns to facilitate removal of the top halves of the bearings.

5. Remove the lower half of the bearing from the cap, push out the top half of the bearing by rotating it on the crankshaft, using Leyland tool No.245872, which should be placed in the oil hole in the journal, for the centre main bearing use Leyland tool No. 245869, this is placed on the bearing cap stud.

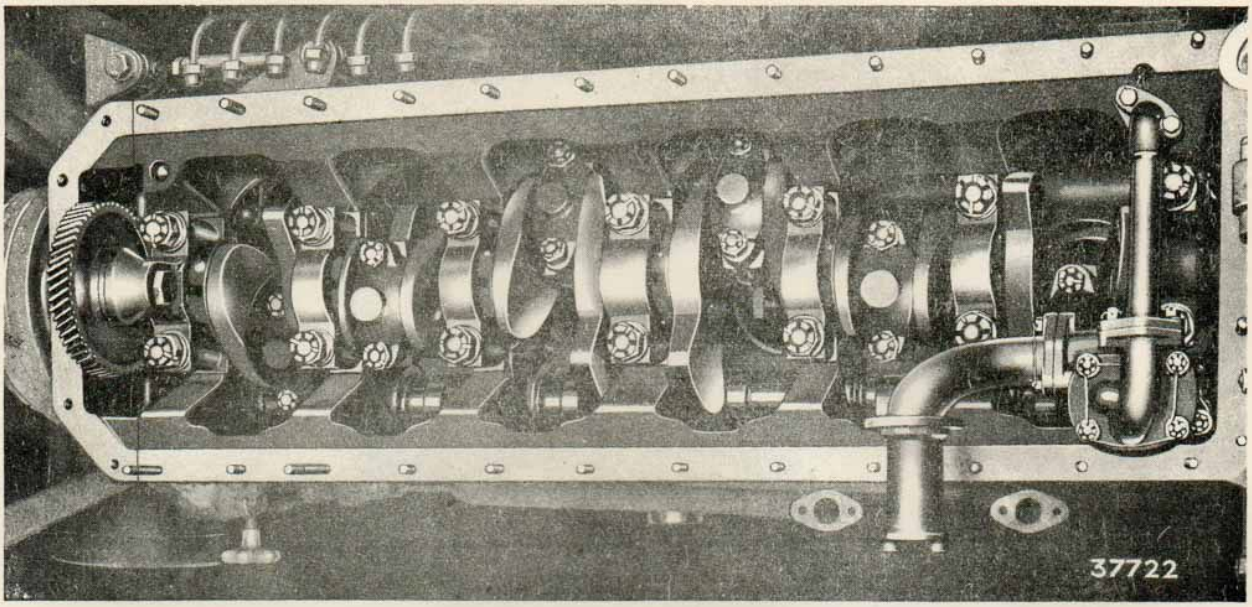


FIG. 74. CRANKSHAFT IN POSITION.

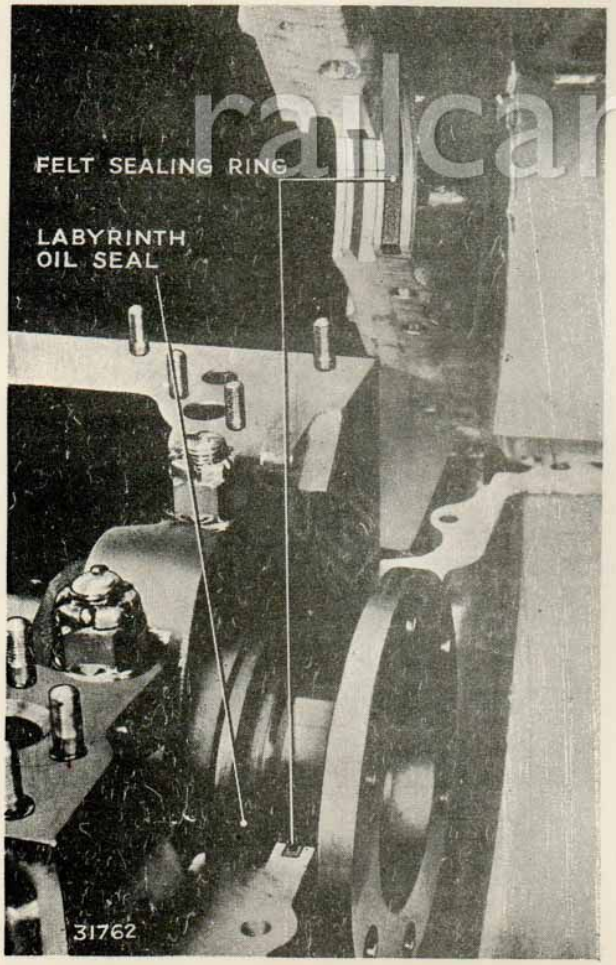


FIG. 75. LABYRINTH OIL SEAL.

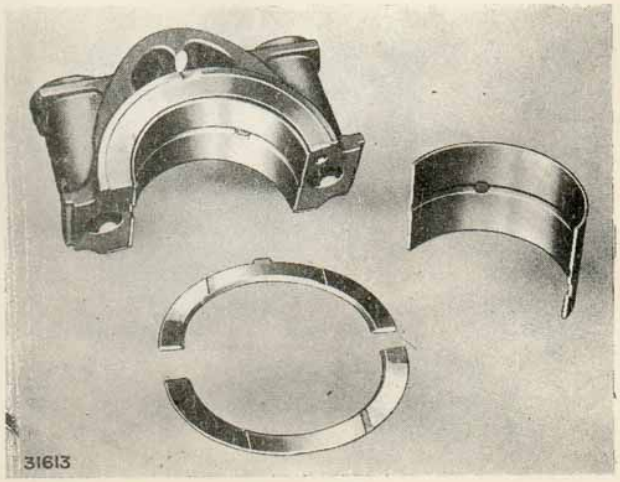


FIG. 76. CENTRE MAIN BEARING AND THRUST WASHERS.

FIG. 77. CHECKING CRANKSHAFT END - PLAY.

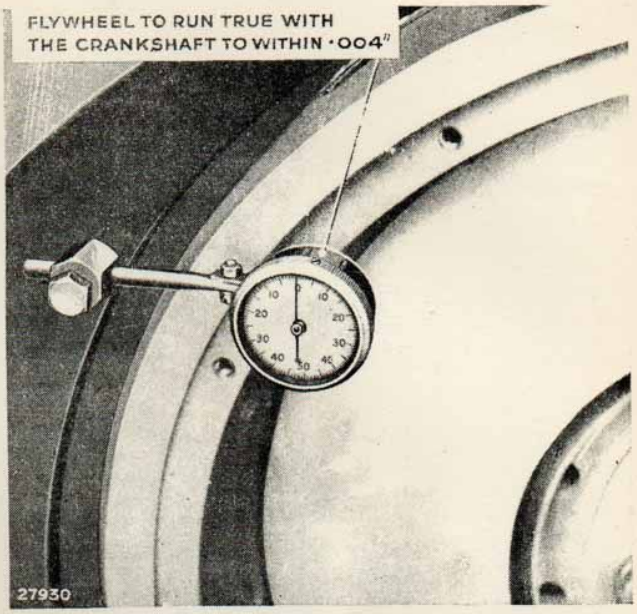


FIG. 78. CHECKING FLYWHEEL FOR RUNNING TRUE.

6. Inspect the old bearing shells and if they require renewing insert a new half-bearing in the top and also fit a new half-bearing in the cap. If the old bearings are under size, replace by a new bearing of the same size.

7. Thrust washers can be renewed by the same method as described for the bearings. The bottom halves of the washers are tongue-located in the bearing caps and care must be taken to ensure that the tongues fit correctly in the caps.

To Remove Crankshaft

1. Remove engine from vehicle, and place on a suitable stand.

2. Remove injection pump, exhauster, and starter motor.

3. Remove outer sump, suction oil filter, oil pump, flywheel, and the sump half of the flywheel housing.

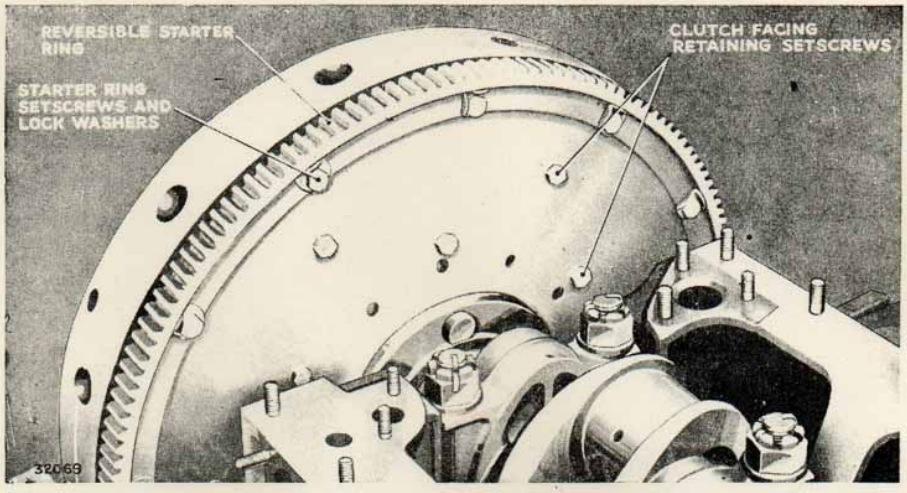


FIG. 79. REAR VIEW OF FLYWHEEL AND STARTER RING.

4. From front end of crankshaft remove propeller shaft driving flange, inner sump, vibration damper, and 1 in. B.S.F.bolt, then withdraw the driving pulley from the end of the crankshaft.

5. Remove water pump, engine mounting bracket, and tensioner bracket, then remove the timing case.

6. Disconnect the connecting rods and push them clear of the crankshaft.

7. Remove main bearings caps, taking out front main bearing cap and idler gear as a complete unit.

8. Lift out the crankshaft.

To Replace the Crankshaft

Main bearing caps, bearings and nuts must be refitted in their original positions and, for this purpose, the caps and engine-block nuts are stamped with index marks A,B,C, etc., starting from the front of the engine. When correctly assembled all marks must correspond.

1. Fit the top halves of the main bearings in their correct seatings; check that the shells bed down correctly.

2. Flush out the crankshaft oil holes and smear the main bearing journals with clean engine oil.

3. Lower the crankshaft carefully into position, replace the main bearing caps in their correct positions, and tighten down, fitting the nuts to their original studs when possible. A torsion spanner set at 260 to 270 lb./ft. should be used to tighten the bearing cap nuts.

4. Ensure that the timing gear mounted at the front main bearing is correctly meshed with the gear on the crankshaft.

5. Check the crankshaft end-play. This should not exceed .014 in.(Fig.77).

6. Fill the crankshaft oilways with clean engine oil.

7. Refit the connecting rods. The initial big-end clearance should be .0018 in. to .0037 in. and should be renewed if it exceeds .008 in.

To Regrind the Crankshaft

When regrinding journals and crankpins, the end faces must not be ground. If the location faces of the centre bearing have been damaged, the width should be increased to 2.710 in. to 2.712 in., otherwise the dimensions should remain at 2.700 in. to 2.702 in.

After grinding support the crankshaft at the front and rear journals. Check the relative eccentricity of the centre main journal; this must not exceed .003 in. in radius - total run-out of .006 in. The permissible error between one bearing and its neighbour must not exceed .003 in. (total clock reading).

It is not permissible to straighten a crankshaft in a press.

The crankshaft should be re-nitrided at the second and fourth regrinds.

Check the main bearing diametral clearance. This should be within the limits .0020 in. to .0042 in. when new bearing shells are fitted. Bearings should be renewed when diametral clearance exceeds .009 in.

When refitting the flywheel to the crankshaft, check that the flywheel runs true with the crankshaft to within .004 in., as shown in Fig.78.

To Skim the Clutch Facing Plate

If the clutch facing plate is deformed it may be skimmed down. It is permissable to skim off .0313 in., after this figure is exceeded compensation must be made by fitting skim plates (.064 in. thick) between the clutch facing plate and flywheel. A maximum number of three skim plates may be fitted, if two or more are fitted the standard retaining setscrews (Fig.79) must be replaced by setscrews .125 in. longer. It is not advisable to skim more than .100 in. from the clutch facing plate, but when considering the number of skim plates required it is important to allow for the amount skimmed from the clutch back plate, see Clutch Chapter.

ENGINE LUBRICATION

Description

System

Engine lubrication is on the wet sump system, the oil being circulated by a gear-type oil pump.

Oil is drawn from the outer sump well through a suction filter, and pressure-fed by the pump through an oil cooler and a full-flow cloth-element filter, into the main lubrication system.

The crankshaft main bearings, big-end bearings, idler-gear for camshaft drive, and cam shaft bearings, are supplied with oil through oilways drilled in the engine block.

A supply is tapped off the front main bearing to lubricate the idler gear transmitting drive to exhauster and injection pump drive gear. The cylinder walls and gudgeon-pin bushes are lubricated by splash and intermittent spray from oilways drilled in the crankpins and connecting-rod big ends. (Fig.805).

The rocker gear is also lubricated by an intermittent feed from the second and fifth camshaft bearings via horizontal

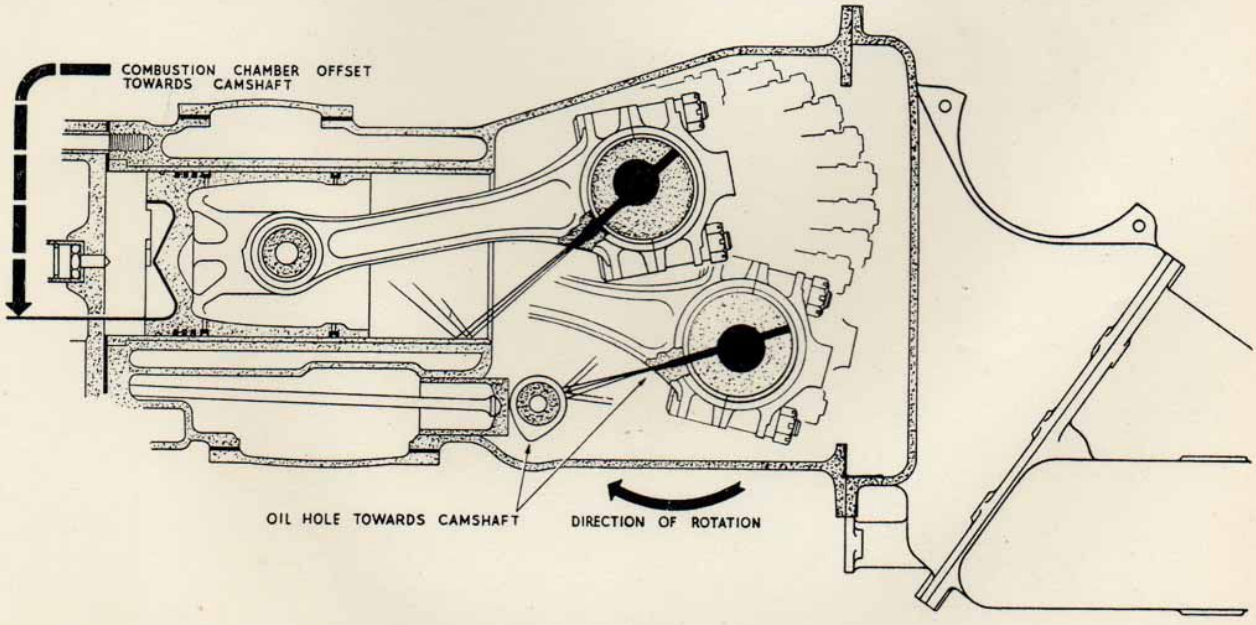


FIG. 80. CYLINDER WALL LUBRICATION.

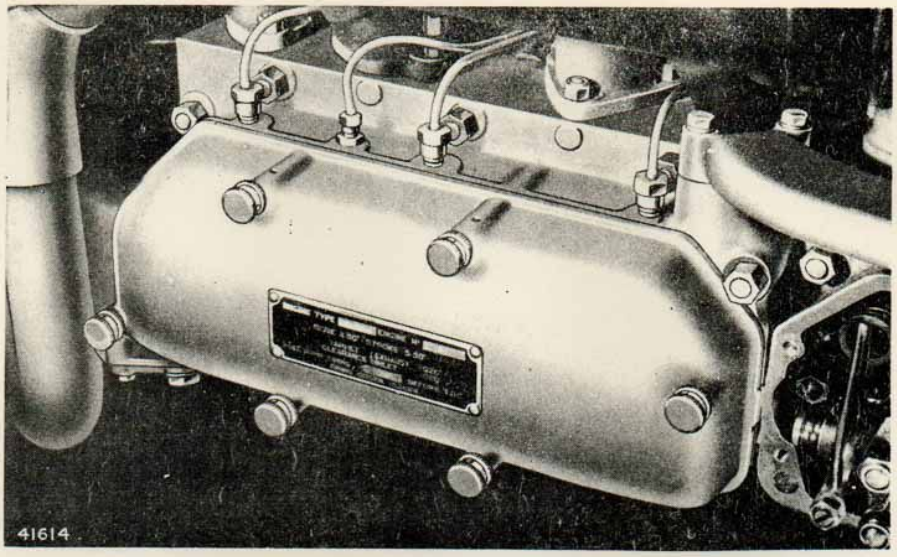


FIG. 81. AIR BREATHER HOLES IN VALVE COVER BOSSES.

oilways drilled in the engine-block and heads, through the centre rocker shaft support bracket on each head, along the tubular rocker-shafts to the rocker levers. A hole drilled in each rocker lever carries a supply of oil to the top of the rocker in order to lubricate the contact surfaces between the valve cap and rocker lever. Oil is returned from the valve operating gear via two external pipes, running from the tappet gallery bottom covers to the inner sump.

The system is provided with a relief valve mounted on top of the engine block at the rear left-hand side; it consists simply of a spring-loaded valve provided with an adjusting screw. Oil by-passed by this valve spills back into the main sump well.

Crankcase breathing is effected through holes drilled in the top four valve cover holding down bosses (Fig.81), and vented to atmosphere by a venturi type breather, attached to the inner sump near the front (Fig.82).

Oil Pump

The oil pump is housed at the rear end of the engine-block and consists of spur gears, shaft driven from the camshaft by spiral gears. At the outer end of the camshaft driven-gear, a tongue transmits the drive to the pump spindle, on which is pressed a spur gear, the woodruff key being used only to position the oil hole supplying lubrication to the spiral gears and thrust face.

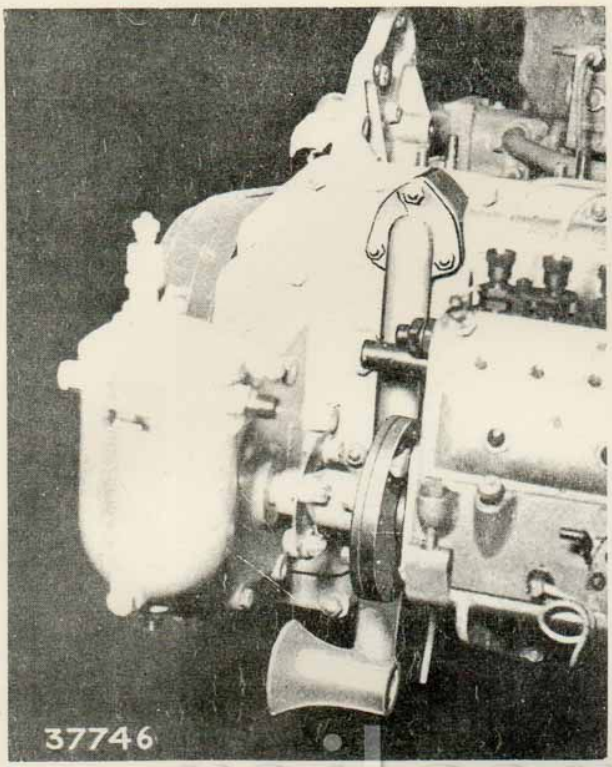


FIG. 82. VENTURI BREATHER.

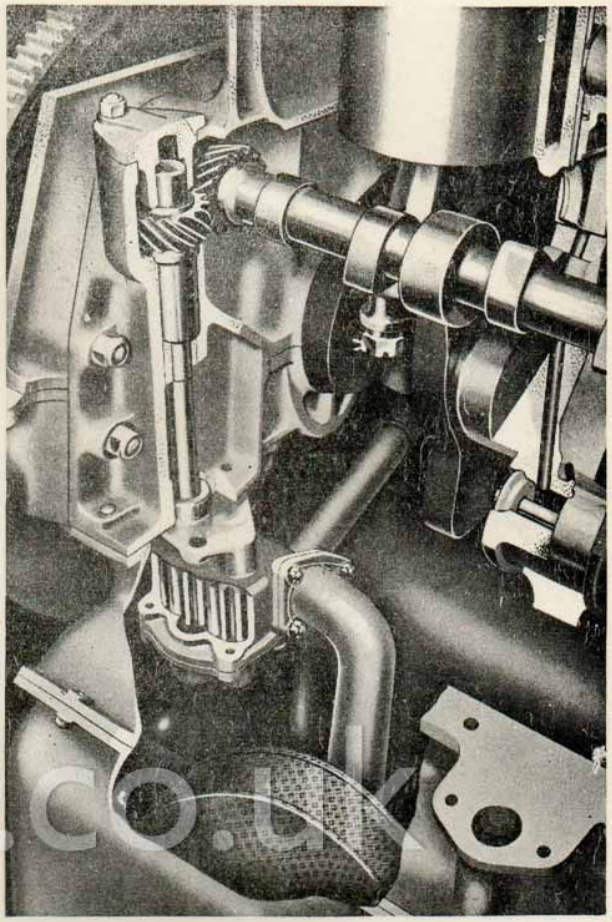


FIG. 83. OIL PUMP DRIVE FROM CAMSHAFT (Engine in Stand)

Engine Oil Filter

The engine oil filter is of the full-flow cloth element type and is mounted at the rear of the engine-block at the right-hand side. The oil is drawn from the outer sump well and pressure fed into the filter housing, where it is cooled, filtered and discharged into the main lubrication system.

A by-pass valve, fitted in the top of the filter-housing, passes oil direct to the engine in the event of the filter element becoming choked. The by-pass valve pressure is set before leaving the factory and should not be altered.

The filter, a metal former covered by a sleeve-shaped filter-cloth secured with cotton twine, is designed to give maximum filtration area (Fig.89.)

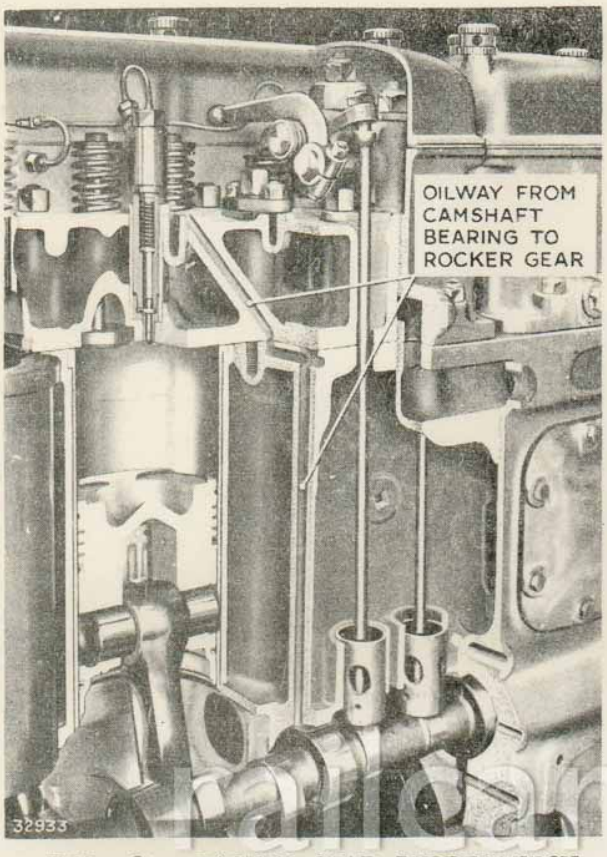


FIG. 84. ROCKER GEAR LUBRICATION.

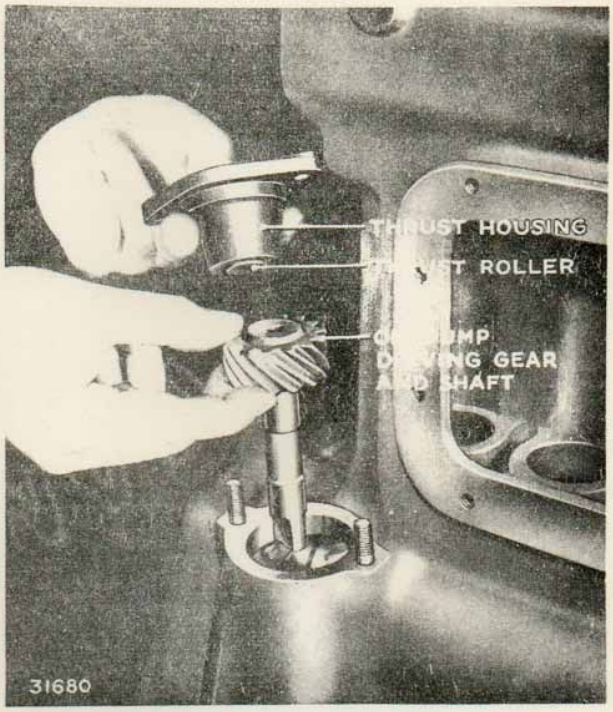


FIG. 85. FITTING OIL PUMP DRIVE GEAR AND THRUST HOUSING (Engine in Stand)

To prevent vibration the filter is spring-loaded at the base (Fig.88), and a felt washer at the top of the filter prevents unfiltered oil passing into the main system.

A drain plug is provided in the bottom cover of the filter housing.

Maintenance

Sump

The oil sump capacity is 4 gallons (18.4 litres) as shown by the full mark on the dipstick which should be checked daily, see Lubrication Chart. The engine oil should be changed every 5,000 miles.

Engine Oil Filter

The filter cloth should be changed every 5,000 miles.

1. Drain filter through the drain plug in bottom plate.

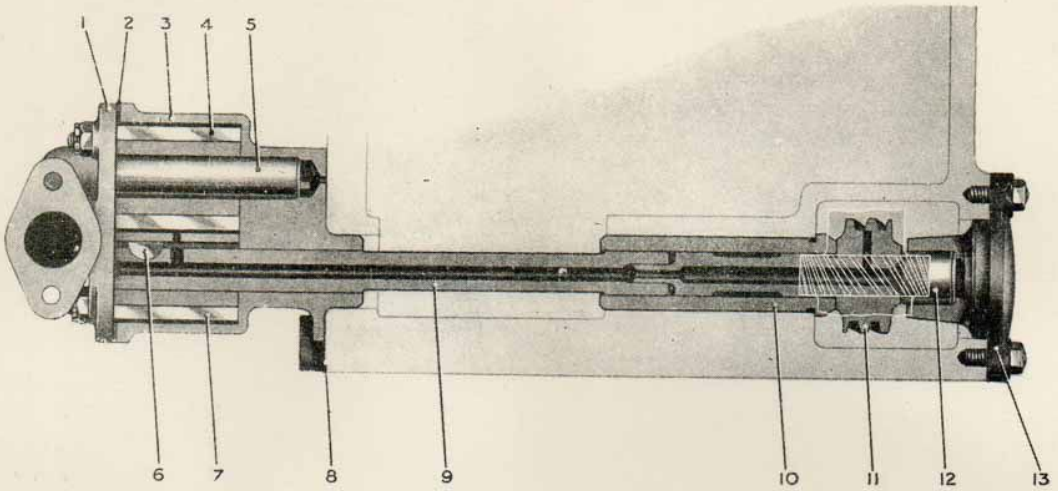


FIG. 86. PLAN VIEW OF OIL PUMP AND DRIVE.

1. End cover.
2. Joint.
3. Pump casing.
4. Idler gear.
5. Idler spindle.
6. Key.
7. Pump gear.
8. Joint.
9. Driving spindle.
10. Bush.
11. Drive gear and shaft.
12. Thrust roller.
13. Thrust housing.

2. Remove bottom plate; the filter element will then drop out.
3. Remove filter cloth from metal former by unfastening cotton twine.

When assembling filter be sure the felt washer is in position on top of filter element.

Suction Filter

The sump suction filter should be removed and washed in paraffin every 20,000 miles.

To remove the suction filter, it is only necessary to drop the outer sump and remove the two setscrews securing the filter basket to the oil suction pipe.

Relief Valve

To adjust the relief valve, remove the cover, slacken the

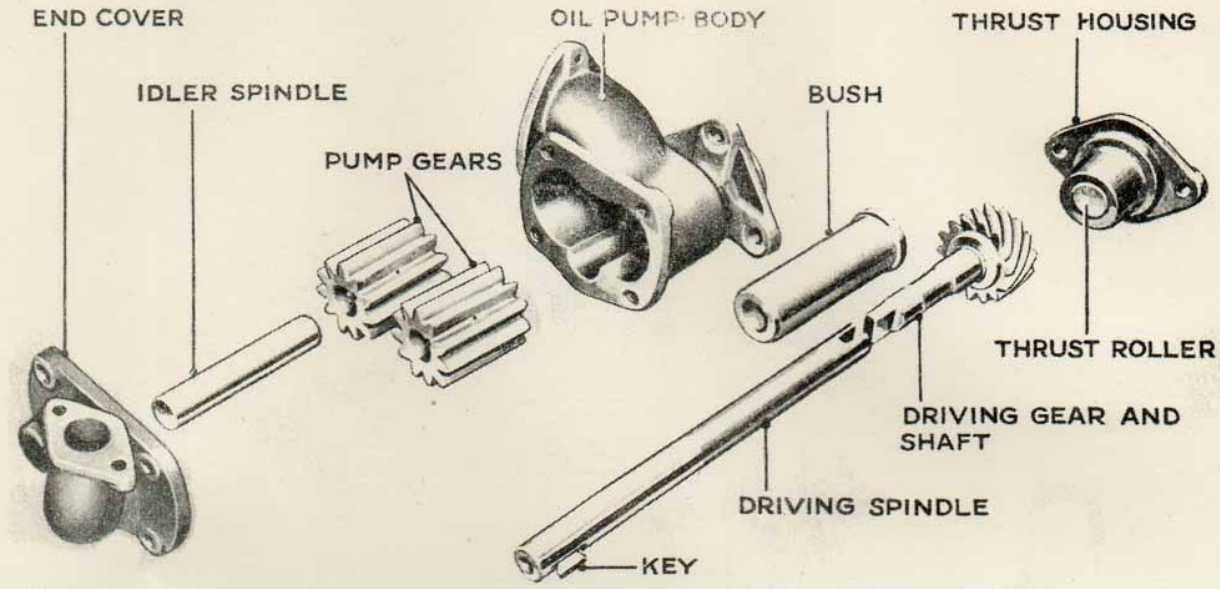


FIG. 87. OIL PUMP AND DRIVE DISMANTLED.

locknut and turn the adjusting screw. Screw in to increase and out to decrease the pressure. Lock the screw and replace the cover after adjustment.

The valve should be adjusted to give a maximum pressure of 60 to 70 lb./sq.in. with a warm engine running at full throttle.

When setting the oil pressure, an oil-pressure gauge must be included in the oil-circulation circuit; this can be done by inserting and oil pressure gauge in the adaptor, feeding the oil pressure switch.

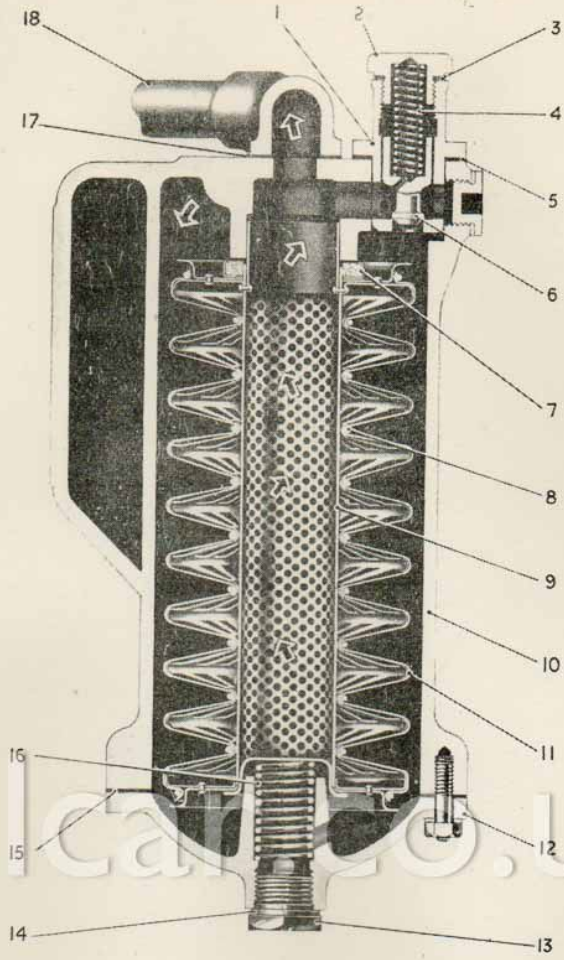
Overhaul

To Remove the Oil Pump

1. Remove the injection pump, compressor or exhauster, and starter motor.

2. Remove the outer sump, suction filter and inner sump. Disconnect the oil feed pipe from the crankcase face.

3. Remove the three nuts securing the pump body to the crankcase and withdraw the oil pump.



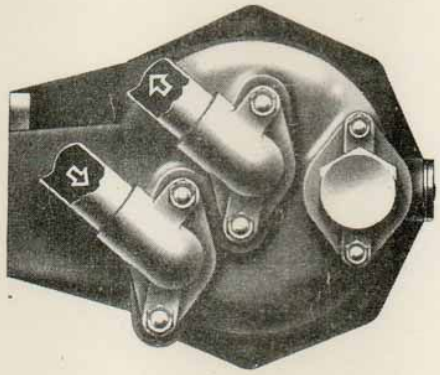


FIG. 88. THE OIL FILTER.

1. Bye-pass valve body.
2. Plug.
3. Plug washer.
4. Spring.
5. Joint.
6. Piston.
7. Felt washer.
8. Cotton twine.
9. Filter body.
10. Casing.
11. Filter element.
12. Bottom cover.
13. Drain plug.
14. Copper washer.
15. Joint.
16. Spring.
17. Joint.
18. Outlet pipe.

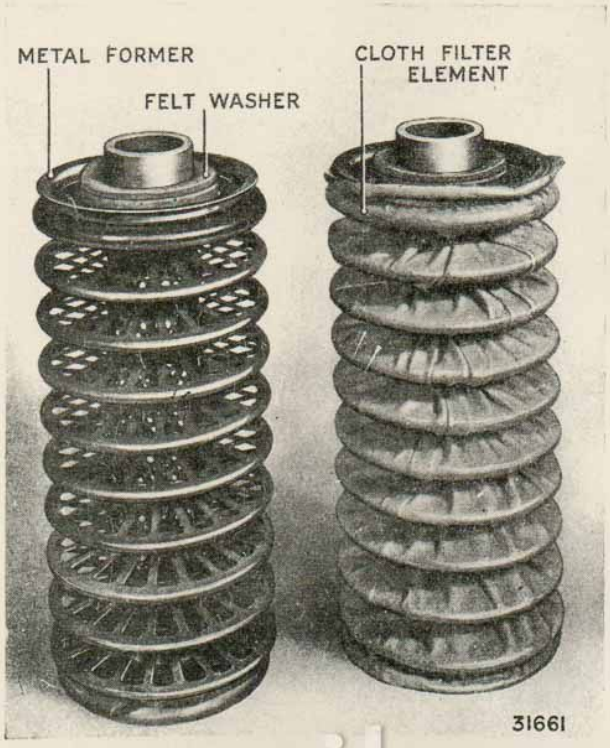


FIG. 89. OIL FILTER BODY AND ELEMENT.

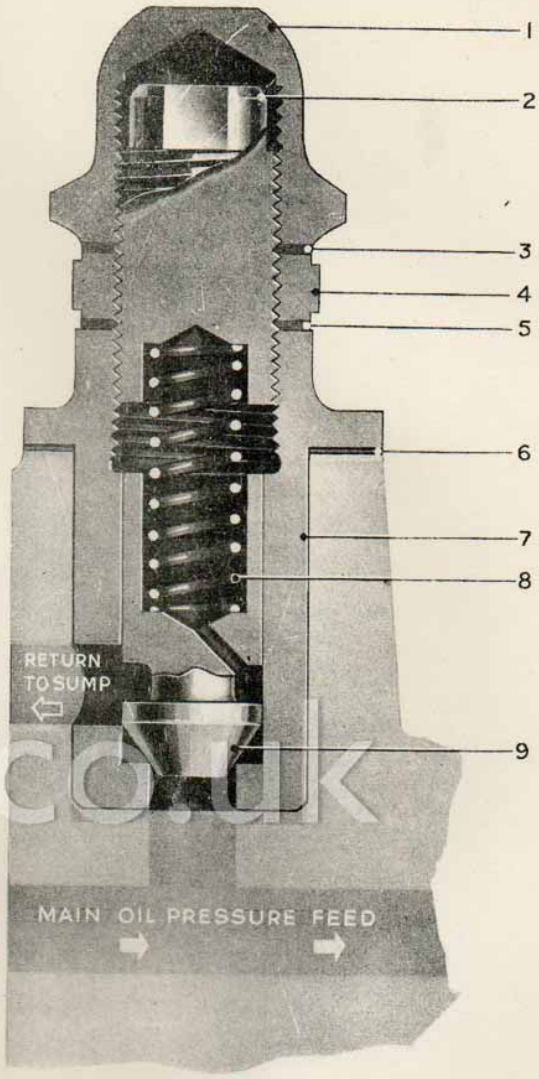


FIG. 90. OIL PRESSURE RELIEF VALVE.

1. Domed nut.
2. Adjusting screw.
3. Copper washer.
4. Locknut.
5. Copper washer.
6. Joint.
7. Relief valve-body.
8. Spring.
9. Oil relief valve.

To Dismantle the Pump

1. Remove the oil pump end cover and withdraw the gear and spindle.

2. All parts should be examined for wear and checked against the limits as laid down in the Data.

3. To inspect the oil pump driving gear. Remove the thrust housing at the rear under side of the engine block and withdraw the gear (Fig. 85). Backlash between the two gears should be .004 in. to .008 in.

To Assemble and Refit Oil Pump

Reverse the operation for removing and dismantling oil pump. Ensure that an oil-tight joint is made between the pump end cover and casing.

TIMING GEARS

Description

The hardened and ground timing gears have single-helical teeth. The drive to the camshaft on one side of the crankshaft and to the injection-pump and compressor on the other, is distributed through two identical idler gears, the one for the camshaft being mounted on the engine block, and that for the injection-pump and compressor, on a lug cast on the front main bearing cap. Each idler gear is carried on a spindle and bolt, and runs on a floating bush, thrust being taken by two special washers.

The idler gear, mounted on the engine-block, drives the camshaft gear direct. Whilst the idler gear mounted on the front main bearing cap drives a gear wheel mounted between the injection pump and compressor.

The gear is carried in ball and roller bearings, mounted in a housing and bolted in the injection-pump and compressor drive gear casing, and transmits the drive to the compressor at the front, and to the injection-pump at the rear.

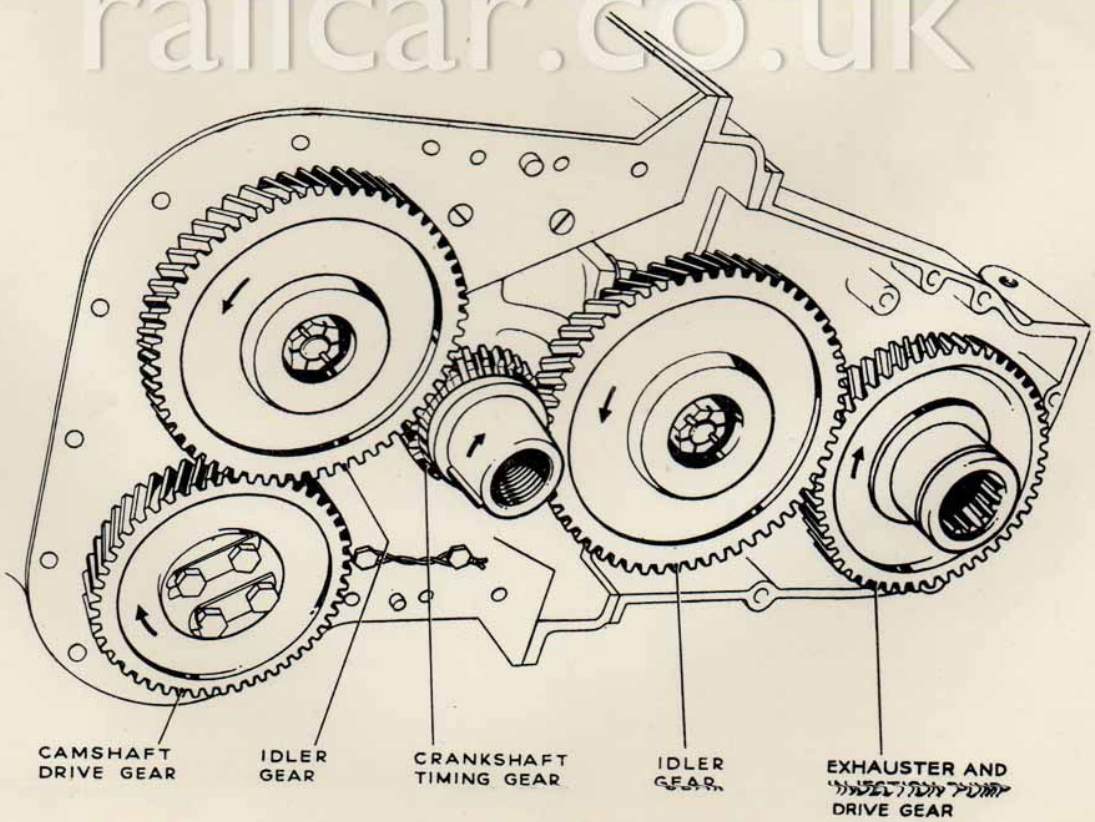


FIG. 91. THE TIMING GEARS.

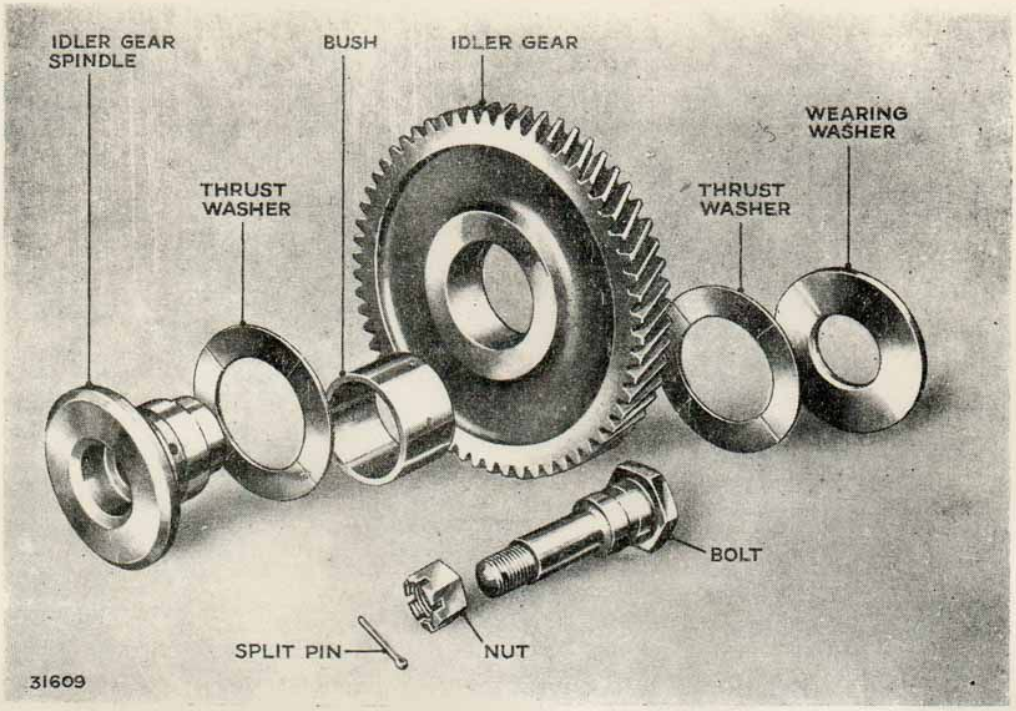


FIG. 92. IDLER GEAR DISMANTLED.

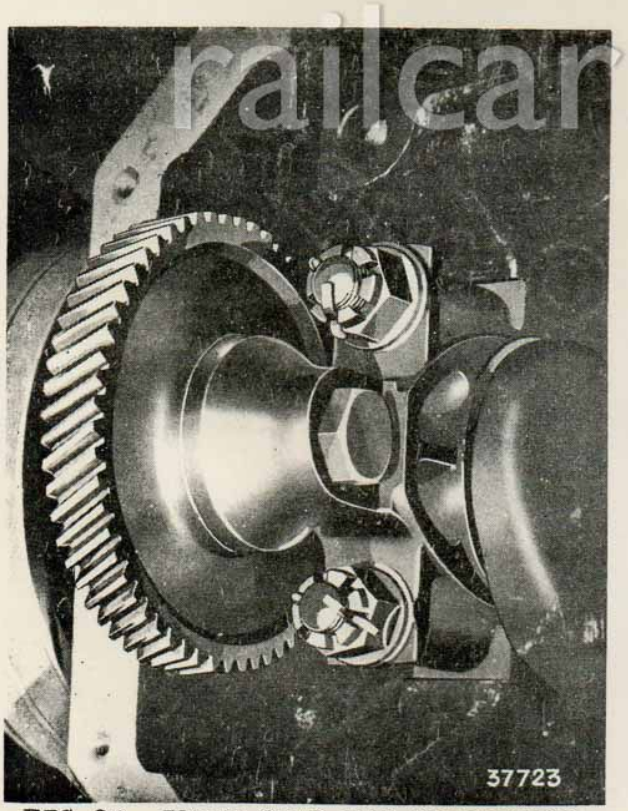


FIG.93. IDLER GEAR FOR COMPRESSOR. AND INJECTION PUMP DRIVE GEAR.

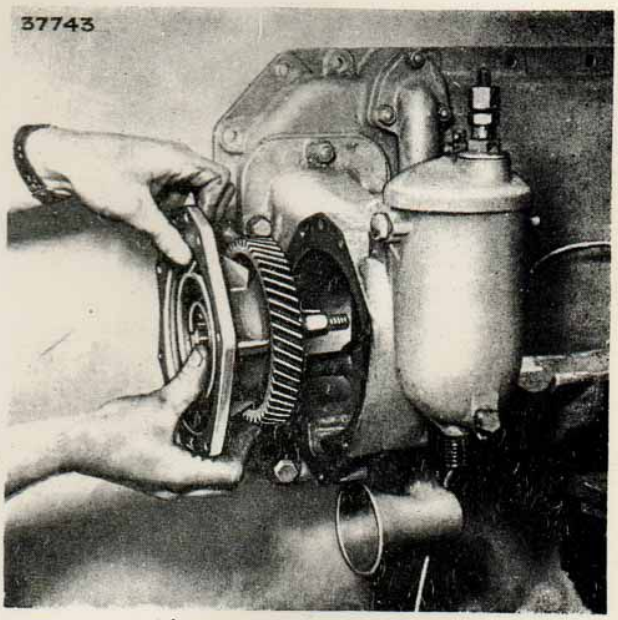


FIG. 94. REMOVING COMPRESSOR AND INJECTION PUMP DRIVE GEAR.

Internally-cut teeth in the extended hub of the gear, mesh with a small mating gear on the compressor shaft. Drive to the injection-pump is transmitted by a short shaft formed with the gear. The shaft runs through an oil seal fitted in the rear of the gear casing and is connected to the injection-pump by a flexible coupling.

Dismantling Compressor and Injection Pump Drive Gear Assembly.

1. Remove the two circlips in front of the ball race.

2. Press the gear out of the housing and races. The outer race of the roller bearing will remain in the housing. The four holes drilled in the back of the gear enable the inner race to be pressed, or driven off the gear. The two slots cut in the housing enable the outer race to be pressed out of the housing.

AIR COMPRESSOR

Description

The compressor is mounted at the front end of the engine and driven by the timing gear train at half crankshaft speed. It is a two-cylinder, single stage, air cooled machine. The rotation of the compressor crankshaft moves the piston down the cylinder drawing air in through the suction valve, on the return stroke the air is compressed and discharged through the delivery valve. The incoming air is filtered by the engine main air filter.

Lubrication

Oil is supplied to the compressor through a pipe connected to the engine main oil gallery and fed through a port, to an annular groove machined in the compressor crankcase end flange. Holes drilled in the white metal main bearing allows oil to be fed to the drilled passages in the crankshaft and so to the big end bearings. The pistons, gudgeon pins and crankshaft ball bearing are lubricated by splash feed. Surplus oil drains back through the compressor end flange into the compressor and injection pump drive gear casing.

Maintenance

The only maintenance required is at vehicle overhaul periods.

If the compressor is slow to build up pressure in the reservoir or fails to do so and provided there are no leaks from external pipes, the valves should be removed and examined. This does not necessitate the removal of the cylinder head. The removal of valves is described in the ensuing paragraph.

Overhaul

Valves

These are removed by unscrewing the caps and cages, lifting out the spring holder and then the valves. These should be dismantled, cleaned and inspected. If the valves springs are in bad condition they must be renewed. Should the valves require refacing, fine grinding paste can be used, valves must be lapped on a flat surface, and all traces of grinding paste remove before assembly. If it is necessary to fit new valves care must be taken to see that the valve

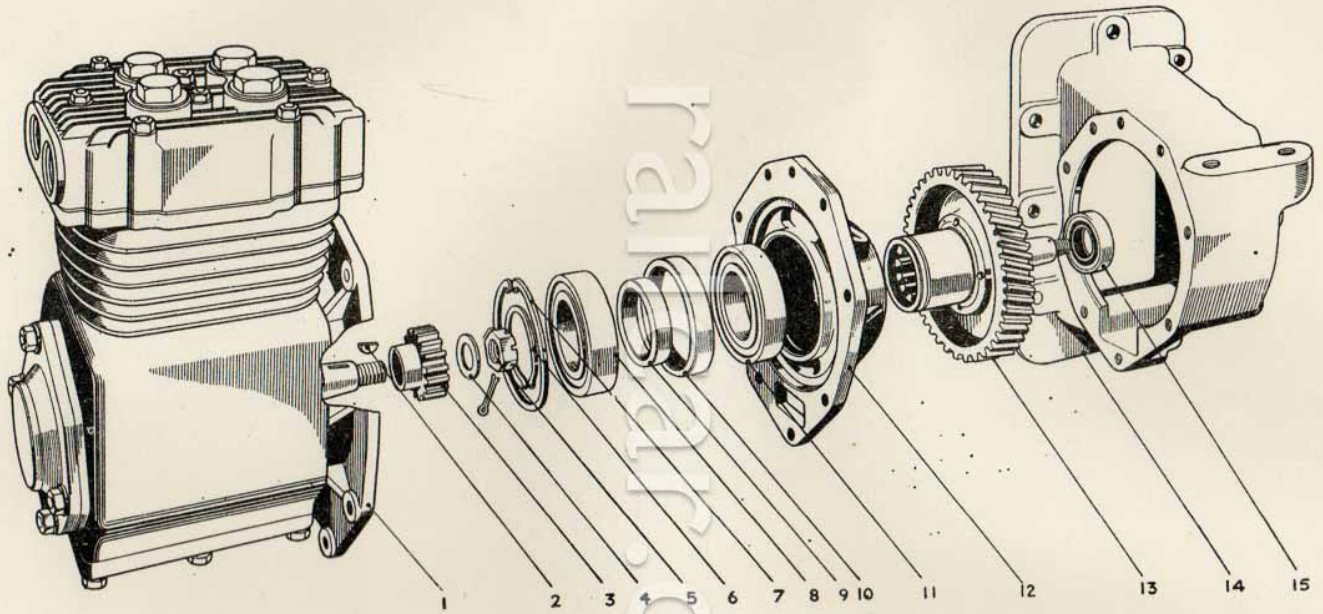


FIG. 95. EXPLODED VIEW OF COMPRESSOR AND INJECTION PUMP DRIVE GEAR.

1. Compressor.
2. Key.
3. Driving dog.
4. Washer.
5. Nut.
6. Circlip inner.
7. Circlip outer.
8. Ball bearing.
9. Distance piece, inner.
10. Distance piece, outer.
11. Roller bearing.
12. Bearing housing.
13. Injection pump and compressor driving gear.
14. Injection pump and compressor drive gear casing.
15. Oil seal.

seats do not project below surface of cylinder head. If they do, grind them flush. Should the spherical spring require replacing (aluminium head only) the concave side must face upwards. On assembly it is advisable to renew the copper asbestos washer. No jointing compound should be used.

Cylinder Head

Any carbon deposit should be removed from the head and pistons. When replacing the head use a new gasket, if no standard gasket is available, one may be made from brown paper (.005 in. to .006 in. thick). The head should be drawn down evenly, tightening centre nut first.

To Dismantle the Compressor

1. Remove the compressor from the engine.

2. Remove the cylinder head complete.

3. Remove the bottom plate.

4. Disconnect connecting rods and push pistons and rods through top of cylinder bore.

5. Remove driving dog from end of crankshaft and remove bearing cover from opposite end of compressor.

6. Withdraw bearing housing, ball bearing and crankshaft complete.

Pistons and Rings

Piston play should be checked and if in excess of .010 in., piston or liner should be renewed (see instructions re liners).

Check the compressor and scraper ring gap, and side play; renew if the gap is in excess of .010 in. The minimum gap is .003 in. with .001 in. to .002 in. side play.

Connecting Rods

New small end bushes are supplied without oil holes, and slightly under size on internal diameter. After pressing bush into connecting rod, drill out hole to .125 in. dia.,

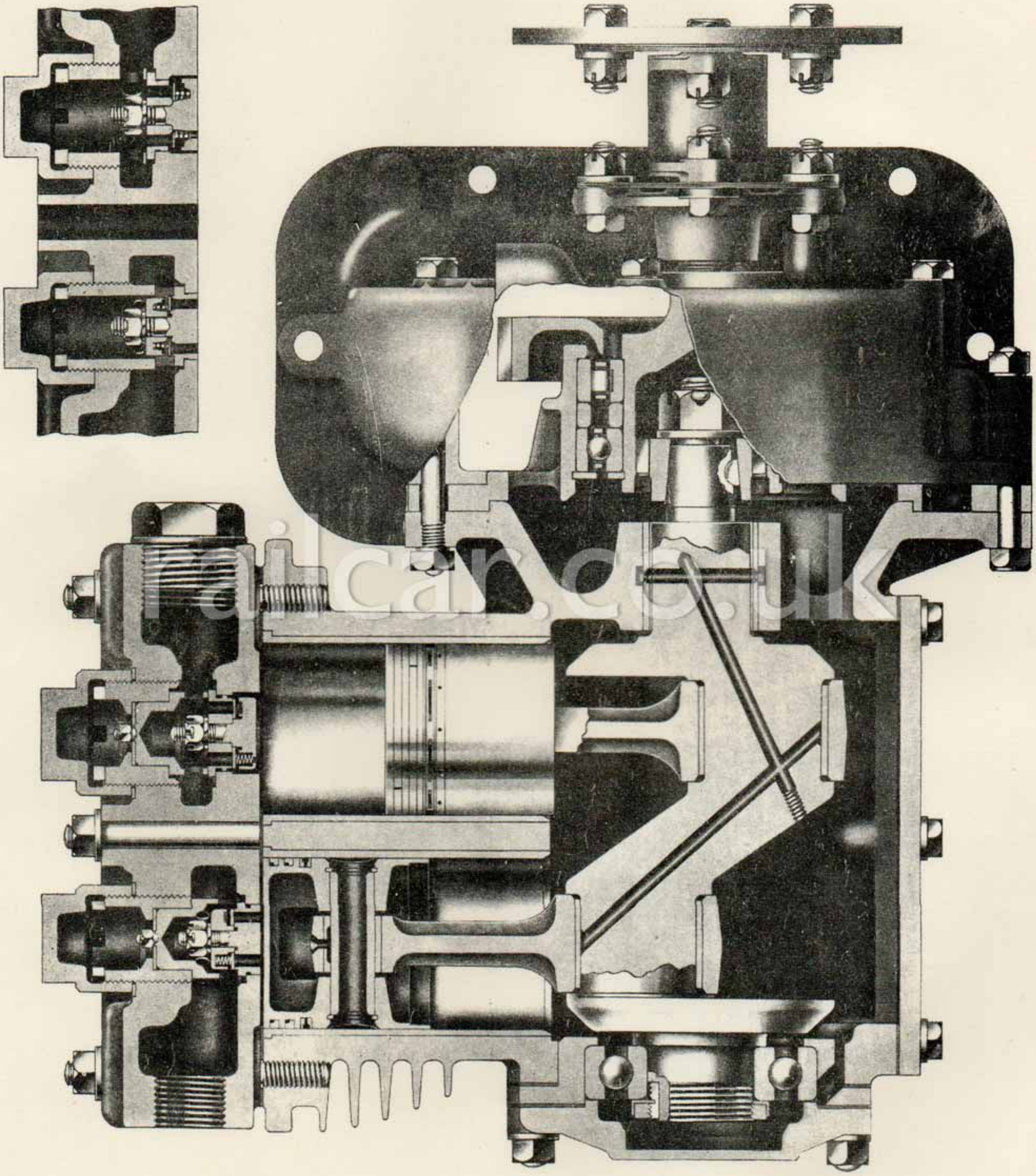


FIG. 96. THE COMPRESSOR.

(Aluminium cylinder head in situ. Cast iron cylinder head shown separately.)

this should register with oil groove on internal surface of bush. The bush should then be reamed out to .6255 in. to .626 in.

Big End Bearings

These are white metal steel backed bearings, and should be renewed if any play is felt. It is not permissible to scrape these bearings. When fitting the bearings ensure that the nicks in each half bearing locate in the corresponding nicks in the rods and caps.

Main Bearings

Both, the white metal steel backed bearing, and the ball race should be renewed if any sign of wear is observed.

Liners

New cylinder liners should be fitted if the internal diameter exceeds 2.760 in. The old liners may be removed by an extraction tool. If one is not available or extraction difficult, heat the cylinders and crankcase evenly, until liners can be removed, continue to heat until new liners can be pressed home with finger pressure. Ensure that the liners do not project above the surface of the cylinder block. Allow the casting to cool evenly.

COOLING SYSTEM

Description

Water drawn by the pump from the bottom tank of the radiator is circulated through the engine block and cylinder heads, and evacuates through four holes, one in each cylinder head connected by the water manifold, and one in each water gallery cover connected to the water manifold by an outlet pipe.

A thermostat, fitted in the front end of the water outlet manifold (Fig. 98) enables the engine to reach the correct running temperature in the shortest possible time. The thermostat valve seals the outlet to the radiator while the water is cold, but allows it to circulate through the block and heads until the water temperature rises to 185° F., when the valve opens and brings the radiator into full operation.

Draining the Cooling System

The system is drained by opening the wheel-valve at the bottom near-side of the radiator. If the engine is supplied as a separate unit, a wheel-valve is fitted to the engine water inlet pipe (Fig. 97).

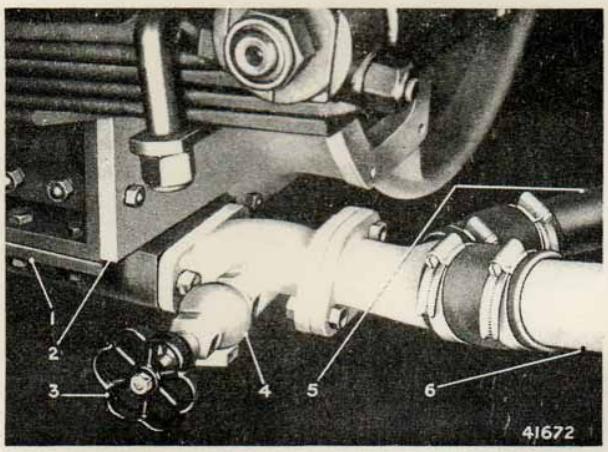


FIG. 97. WHEEL VALVE FOR DRAINING THE COOLING SYSTEM.

1. Radiator.
2. Fan cowl.
3. Wheel valve.
4. Valve body.
5. Radiator outlet pipe.
6. Radiator filler pipe.

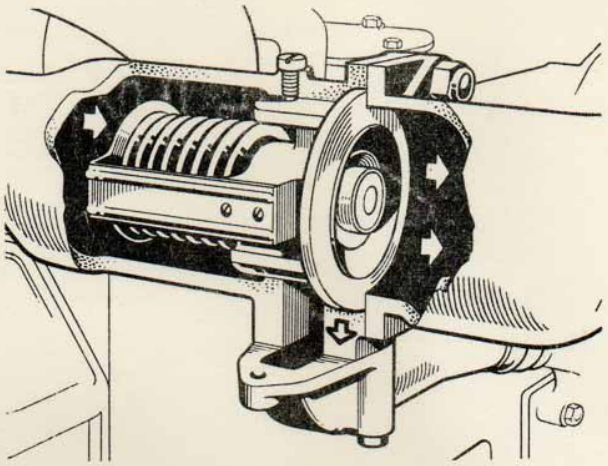


FIG. 98. THERMOSTAT IN POSITION.

When draining the system as a precaution against frost.

1. Park the vehicle on level ground.
2. Open the wheel-valve.
3. Display a notice marked "No water" in a prominent position on the vehicle.
4. When all the water has drained off close the wheel-valve.

Radiator

The radiator is located under the floor of the vehicle and forward from the engine. It is flexibly suspended from the frame on rubber pads. Each mounting bracket is secured by three setscrews to a bracket on the radiator side standard. (Fig.100). A flat tube cooling stack, aluminium top and bottom tanks, together with two side standards, are the main components. A cowl enclosing a six-bladed fan is secured to the radiator by nuts and studs.

The radiator is filled from a reserve tank in the roof of the vehicle, through a pipe running into the radiator outlet pipe. A small auxiliary tank in this pipe line houses, a water level switch, A breather pipe from the top tank connects with one from the auxiliary tank to the reserve tank in the roof.

Overhaul

To Remove Radiator

1. Drain the cooling system.

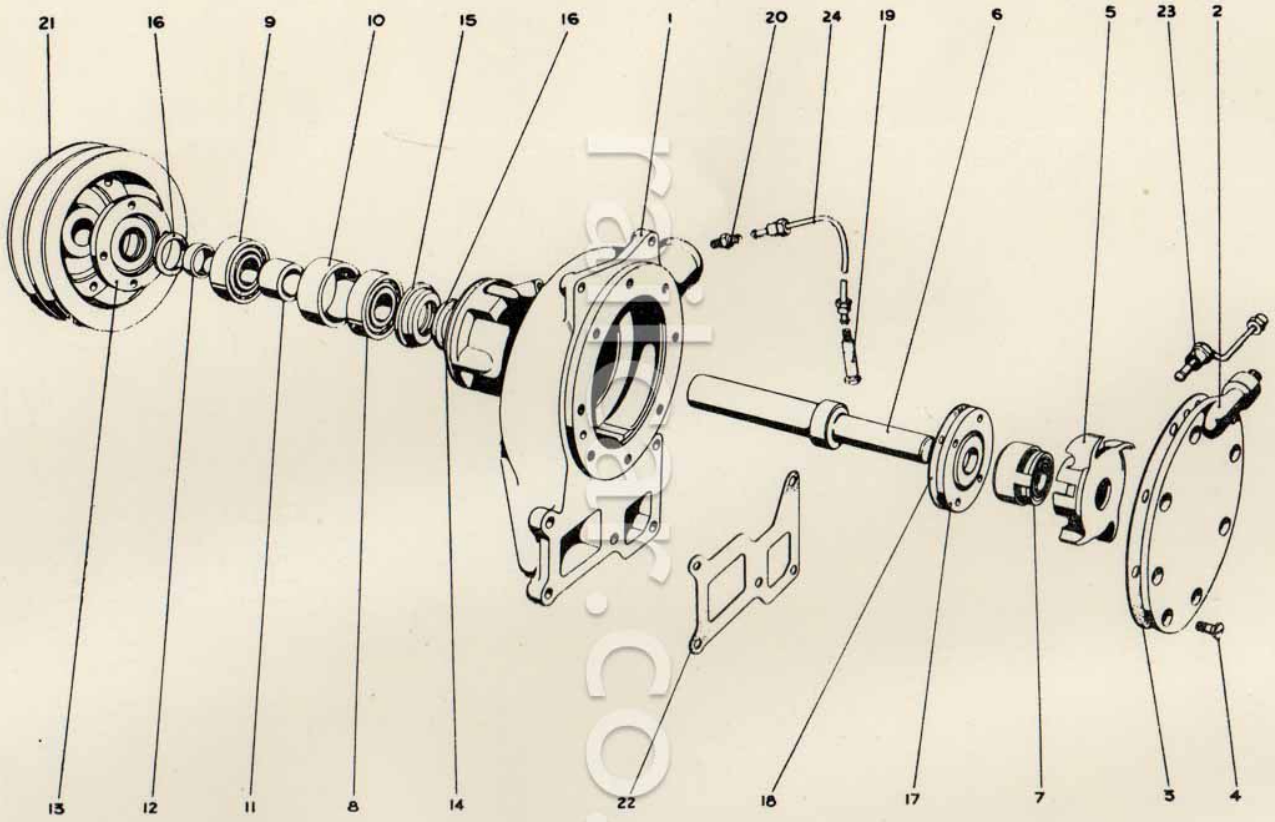


FIG.99. EXPLODED VIEW OF WATER PUMP.

1. Water pump casing.
2. Backplate.
3. Joint.
4. Screw.
5. Impellor.
6. Driving shaft.
7. Water pump seal.
8. Ball bearing.
9. Roller bearing.
10. Distance piece (outer)
11. Distance piece (inner)
12. Distance piece.
13. Bearing cover.
14. Joint.
15. Retainer.
16. Felt washer.
17. End cover.
18. Joint.
19. Greaser.
20. Adaptor.
21. Pulley.
22. Joint.
23. Vent pipe.
24. Pipe (greaser to casing).

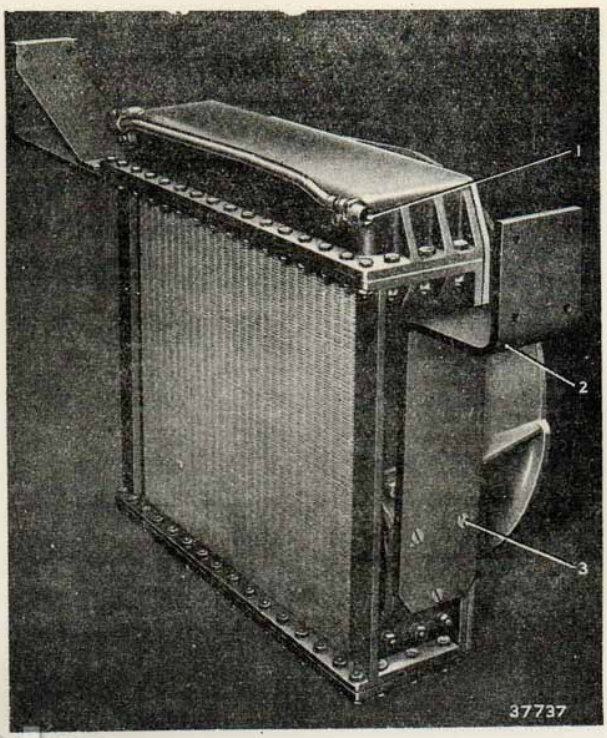


FIG. 100. TYPICAL RADIATOR AND MOUNTING BRACKETS.

1. Overflow pipe adaptor. 2. Mounting bracket. 3. Setscrew.

2. Disconnect the filler pipe and outlet pipe at the flange.

3. Disconnect the top water joint, and overflow pipe.

4. Disconnect layrub driving shaft.

5. Take the weight of the radiator and remove the three mounting setscrews from each bracket.

The radiator top and bottom tanks are removable. The one-piece cooling stack cannot be dismantled and should be renewed as a complete unit should it be defective. When refitting top and bottom tanks use new joints and paint with red lead before fitting.

Water Pump

The impellor-type water-pump, mounted at the front end of the engine-block, is driven from the crankshaft by pulley and twin belts (Fig.101). A spring-loaded, self-adjusting, carbon seal unit (Fig.102), carried on the driving shaft, completely isolates the impellor chamber from the ball and

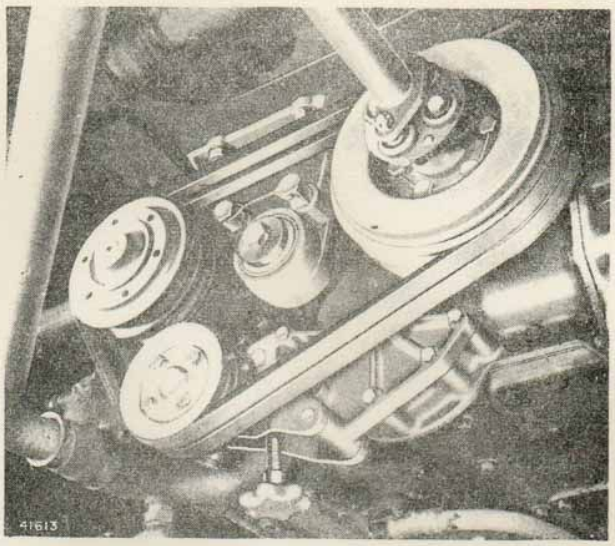


FIG.101. WATER PUMP DRIVE AND VEE BELT ADJUSTMENT.

roller bearings. The bearings are lubricated through a pipe and limited supply grease nipple located on the engine oil filler ; loss of grease being prevented by felt washers.

To Dismantle Water Pump

1. Remove water-pump back plate.
2. Using the two 5/16 in.B.S.F. holes drilled in the end face of the impeller for fixing withdrawal tool, withdraw the impeller from the driving shaft.
3. Withdraw the carbon seal unit.
4. Remove inner cover and press the driving shaft out of the pulley and bearings, pressing from the pulley end of the shaft.
5. Remove outer cover and distance piece, then press out bearings and retainer, pressing from impeller end of pump.

Renewal of Carbon Gland Unit

The carbon seal unit should not require attention for long periods, but if at overhaul the rubber is damaged, or the carbon excessively worn, a new seal unit can be obtained from Leyland Service Department.

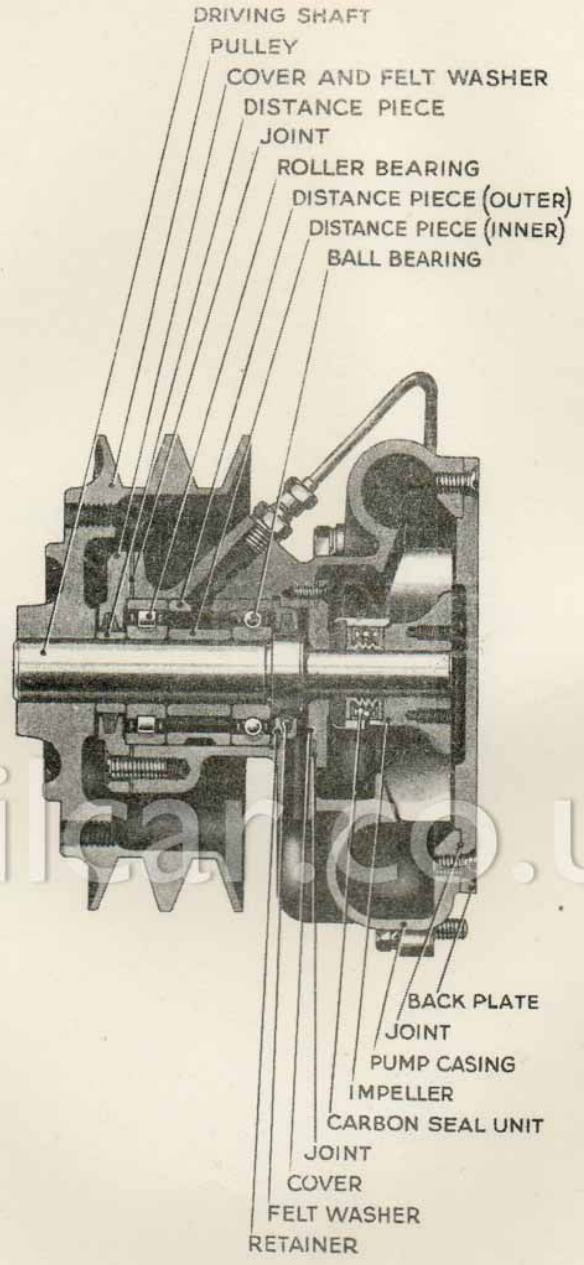


FIG. 102. SECTION THROUGH WATER PUMP.

To Re-assemble Water Pump

To re-assemble the water pump, reverse the procedure for dismantling.

NOTE:
It is important that the driving shaft end and the impeller end face should be flush when in position, as this determines the correct spring pressure on the sealing face of the carbon gland. When pressing the impeller in the driving shaft, care should be taken that the tongue on the seal unit locates correctly in the driving slot cut in the impeller (Fig. 102).

FAN AND FAN DRIVE

Description

A six-bladed fan cools the radiator. The fan is secured by nuts and studs to the fan-shaft, which is carried in ball and roller bearings housed in the fan cowl. The fan-shaft is driven through a layrub propeller-shaft from an adjustable driving-shaft which is supported in ball and roller bearings in a housing swung from the frame and positioned by a tensioner bar.

The driving shaft carries a three groove 'V' belt pulley with belts driven from the auxiliary drive bearing belt pulley, driven by layrub propeller shaft from the front of the engine crankshaft.

Lubrication

Limited-supply grease nipples are provided on the side of the driving-shaft housing and at the drive end of the fan-shaft. Both grease nipples should receive lubricant once a month. (See Lubrication Chart.)

The Layrub propeller-shaft requires no lubrication.

Maintenance

Adjustment of the triple V-belts is effected by slackening the locknuts, and operating the nuts positioning the saddle and pin on the tensioner bolt, thus altering the position of the driving shaft. It is important not to overtighten the V-belts, as this may cause premature bearing wear.

The bolts on the Layrub propeller-shaft must be kept dead tight; it is advisable to check these once a month.

Overhaul

To Remove and Replace the Fan Drive

1. Remove all V-belts.
2. Detach and remove propeller shaft.
3. Drop the drive housing assembly from the crossmember.

4. Remove radiator, fan and cowl complete. (See "To Remove the Radiator.")

5. Remove fan and cowl complete from radiator.

Replacement is the reverse of the above procedure; but the following points should be noted:

1. Before fitting the V-belts check the alignment of the pulleys, and adjust if necessary. Adjustment is effected by removing or inserting packing washers between the flange and pulley fitted to the driving shaft.

2. If new V-belts are fitted, these should be matched together. It will be found that each belt bears either the number 2, 4 or 6, and all three belts should bear the same number whether it be a 2, a 4 or a 6.

To Dismantle and Re-assemble the Fan Cowl Assembly.

1. Draw pulley and flange from shaft; two 7/16 in. B.S.F. tapped holes are provided for the use of a drawer.

2. Remove end cover from pulley end of shaft.

3. Withdraw layrub drive coupling flange.

4. Remove end cover from propeller-shaft end of housing.

5. Press out ball and roller bearings and distance pieces. Re-assembly is a reversal of the above procedure. If assembly has been carried out correctly the end of the driving shaft should be flush with the face of the flange.

To Dismantle and Re-assemble the Fan and Cowl Assembly.

1. Remove grease nipple from end of fan-shaft.

2. Detach the fan.

3. Withdraw V-pulley, and remove end cover.

4. Press-out fan-shaft, and remove cover from fan side of cowl.

5. Press-out ball and roller bearings and distance pieces.

Re-assembly is a reversal of the above procedure.

Overhaul of Layrub Propeller Shaft

The rubber inserts on the coupling require replacing when disintergration of the trunnion block and wire gauze screen becomes obvious.

1. Remove the propeller shaft.

2. Remove the coupling from the shaft.

3. Separate the two halves of the pressed-steel housing, by removing the four clamping bolts.

4. Remove the rubber blocks from the pressed-steel housings.

5. Press from the rubbers the spigoted trunnion sleeves. If the spigot is worn, the sleeve should be discarded, and the bolt holes in the shaft flange examined for ovality.

6. Press the steel trunnion sleeve into the new rubber block, using a round-nosed pilot, the shank of which is turned down to fit the bore of the trunnion sleeve. The use of petroleum jelly as a lubricant facilitates assembly.

7. Press the sub-assemblies of rubber blocks and trunnion sleeves into the steel housing. This operation is eased by the application of soapy water.

8. Bolt the two pressed-steel housings together.

9. Refit the coupling to the propeller shaft, the radiused washers must be placed under the heads of the bolts with the radiused edges towards the rubber, and the bolts must be pulled up dead tight.

10. Check that the four clamping bolts are tight.

AIR CLEANER

Description

Air drawn from the atmosphere, first passes through a centrifugal precleaner. On entering the precleaner, the air is given a swirling motion by the turbine blade-like baffles, particles of grit are flung to the outside of the air spiral, and are eventually ejected through the slots at the end of the precleaner, the air flow is then reversed and passed into the main oil bath filter, where it is filtered in two stages, Firstly by reversal of the air flow, and impingement upon the surface of the oil, and secondly by passing the oil laden air through a filtering element.

Fig.103 shows the action of the air cleaner through the speed range, the action of the precleaner is the same at all engine speeds.

No Air Flow

The oil levels shown are maintained only when no air is passing through the cleaner.

Engine Speed-Low

The oil level in the outer chamber is lowered with a consequent rise behind the baffle. The air strikes the free surface of the oil, and is deflected upwards, leaving a certain amount of the impurities in the oil. But some impurities are carried upwards, mixed with the air, and oil mist; these are removed when the air passes through the element. All oil and sludge drains from the filter element back into the oil bath.

Engine Speed-High

The action of the air filter at high speeds is the same as at low speeds, except the level in the outer chamber is still further lowered, and the level behind the baffle consequently rises and spills over the baffle, giving additional oil to the upward air flow.

Overhaul

Wash and blow out the pre-cleaner.

FIG. 103. OPERATION OF AIR CLEANER.

Unscrew the clamping bolts, drop the filter unit from the top cover and remove to a suitable place for cleaning. Remove the element and wash it thoroughly in petrol or paraffin. Clean thoroughly in petrol, paraffin or fuel oil, the baffle assembly, element support, and bowl. Examine the element carefully for punctures or any damage. Assemble the filter unit and fill with oil to arrow point on the oil level indicator inside the bowl. Refit the filter unit to the top cover.

ENGINE ELECTRICAL EQUIPMENT.

DYNAMO AND CONTROL

Description

The dynamo and control system includes dynamo, regulator and battery.

The dynamo is a four-brush, shunt-wound, single-field type, externally controlled by a current voltage regulator.

As the dynamo and regulator are part of the charging system, separate tests should only be made after the whole system has undergone certain tests, which may assist in localising trouble.

Before removing the dynamo for overhaul these tests will indicate if any defect is present or adjustment is required.

Operation Tests of Dynamo and Control

Check state of battery charge, by testing specific gravity.

Connect an ammeter to the terminals provided on the control board. The ammeter used must not include an external shunt, and must have a full-scale deflection of 0-60 amps., e.g. C.A.V. type A4134T.

Fully Charged Battery and Low Charge

These conditions indicate that the system is operating correctly.

Check by noting charging rate at medium dynamo speed.

Turn the engine with the starter for about ten seconds, start up the engine and note that charging rate is higher, falling off after a short period.

Fully Charged Battery and High Charging Rate

This indicates that regulator is not controlling dynamo voltage correctly.

An excessive charging rate will probably cause the dynamo fuse to blow.

FIG. 1. THE DYNAMO.

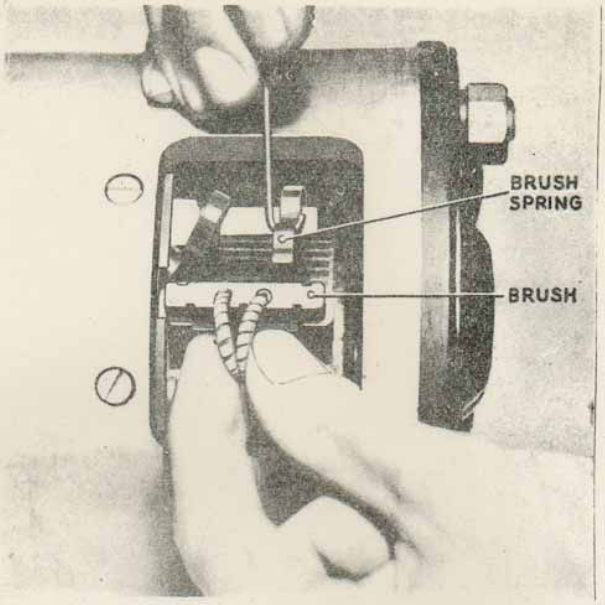


FIG. 2. CHECKING BRUSH IN GUIDE.

Can be caused by:

1. Regulator out of adjustment.
2. Faulty winding in regulator, which stops it operating.
3. Short circuit between charging circuit and dynamo field either in regulator or dynamo. This prevents the resistance from being inserted in the field circuit when regulator contacts are open.
4. Poor connection between regulator and dynamo.

Low Battery and No Charge

Can be caused by:

1. Loose connections or damaged wiring. High resistance will cause regulator to operate as though battery fully charged.
2. Dynamo faulty.
3. Regulator out of adjustment or faulty.
4. Cut-out hot operating - contacts not closing.

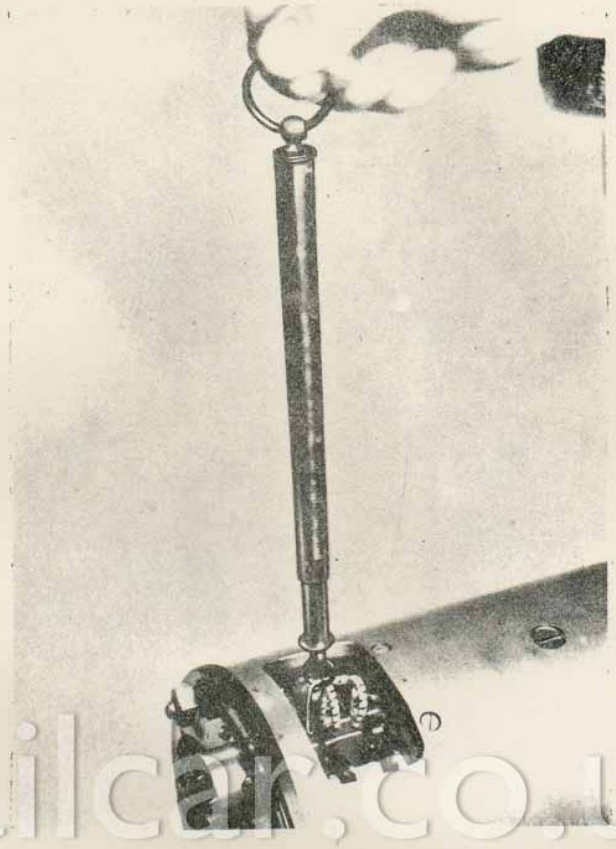


FIG. 3. CHECKING BRUSH SPRING TENSION.

In the event of any of these faults being found apply further tests given under Dynamo and Regulator.

Maintenance

The lubricator at the driving end should be filled with grease at overhaul and should require no attention during running. The bearing at the commutator end requires no lubrication betweem overhauls. Check brushes every 25,000 miles for wear and free movement, see Brushes.

Operation Tests of Dynamo on Vehicle

It is not possible, owing to its position, to make an open circuit test direct on the dynamo or to do any work on it.

If during the following tests a broken cable is indicated the test should be repeated with a test harness connected to the dynamo.

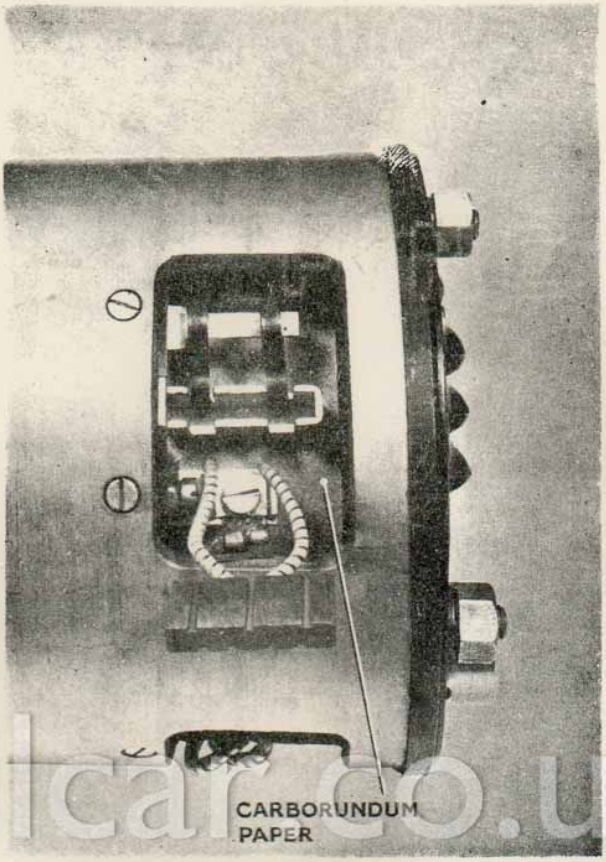


FIG. 4. BEDDING DYNAMO BRUSHES.

1. Check that the dynamo is not loose in its mounting.

2. Switch off all lights and accessories.

3. Remove cover plate from control board.

4. Disconnect cables marked D+ and F from the control board.

5. Connect D+ and F cables to the positive terminal of a moving coil voltmeter, with a range of 0-40 volts, and the other voltmeter terminal to D- on the control board.

6. Start engine and run at normal idling speed.

7. Gradually increase engine speed until a reading of 27 volts is shown on the voltmeter.

   Run dynamo at a speed of 2,000 r.p.m., corresponding to an engine speed of 1,000 r.p.m.

If the voltmeter shows:

i. No reading. Connection from dynamo to control board may be open. Brush gear or internal connection may be at fault.

ii. Very low reading throughout speed rise. Field winding may be faulty.

iii. Low reading throughout speed rise. Armature winding may be faulty.

8. Remove dynamo, take off brush inspection cover and examine brushes and commutator.

Hold back brush springs, Fig.2 and move each brush up and down in its holder by gently pulling flexible connection. If movement is not perfectly free, remove the brush from its holder, wipe brush and inside of holder with a rag moistened in petrol or spirit and test again; if still not free, lightly remove high spots with a smooth file.

Replace the brushes in exactly their original positions.

Brushes must not be worn below 1/2 in.

Check that brushes are bedding properly, see Brushes.

If the commutator is dirty, pull back brush springs, Fig. 2 and lift the brushes from commutator surface, wedging them in lifted position with the springs. Clean the commutator by holding against it a rag moistened in petrol or spirit whilst the armature is rotated.

9. Repeat the running test of dynamo. If voltage does not rise, overhaul is required.

If the voltage is correct, test the regulator; see Regulator.

Dynamo Trouble Hunting

If Operation Tests indicate dynamo trouble, further tests must be carried out.

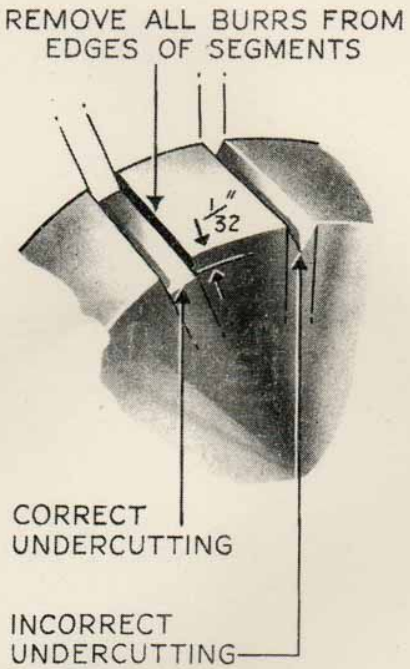


FIG. 15. UNDERCUTTING THE COMMUTATOR.

No Output

Remove the brush gear inspection cover and check for:

1. Worn or sticking brushes.

2. Worn or pitted commutator bars. Burned bars with others fairly clean indicate open coils.

If brushes are making good contact and commutator appears clean, the test lamp should be used. Use a 12-volt battery and a 12-volt 36-watt bulb in series with the part being tested. Connect lamp and one test prod to battery positive, other prod to battery negative.

Note : When testing field coils use a 12-volt battery and 12-volt 12 watt bulb. (36-watt bulb unsuitable for testing field coils). Always pass current in normal working direction to avoid reversing polarity, i.e., connect battery positive to the end of the field which goes to terminal 'F'.

1. Connect test prods to positive, negative or 'F' terminals and body of dynamo; if lamp lights, dynamo is earthed.

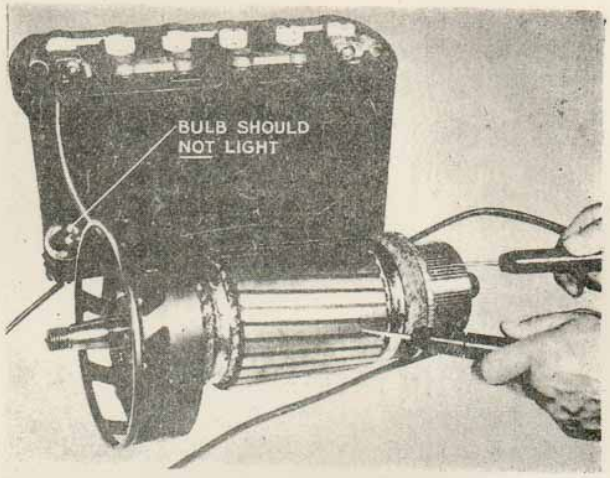


FIG. 6. TESTING ARMATURE FOR EARTH.

2. Lift both negative brushes (connect to negative terminal) and wedge with the springs. Connect test prods to positive terminal (positive brush connection) and body; if lamp lights, either the armature or the positive brush gear is earthed. Lift and wedge both positive brushes; if lamp no longer lights, the fault is in the armature.

3. Connect test prods to terminal 'F' (field connection) and body; if lamp lights either the field winding or the negative brushgear is earthed. Remove field lead from brushgear; if lamp no longer lights the fault is in the negative brushgear. Remove the inter-connector between the brush holders and test between each holder and the body.

4. If field is not earthed connect test prods between terminal 'F' and field tag on brushgear (or negative terminal if connected) with terminal 'F' to battery positive.

No light indicates open circuit in coils.

Full brightness of lamp indicates complete short circuit of field.

With all four coils in order the lamp will come to a low brightness in about two seconds. With serious short circuits in one or more coils the lamp will come up more quickly to a higher brightness. The resistance of all four coils in series should be about 18.6 ohms.

If brushgear is not earthed, test for short circuit between brush holders or opposite polarity.

To test armature for internal shorts place on "growler" and test, see Testing Dynamo Parts.

Unsteady or Low Output

1. Test brush spring tension.

2. Inspect for sticking brushes.

3. Inspect commutator.

Excessive Output

If caused by dynamo, fault is usually short circuit between positive field and positive brush connections, see Operation Tests. Check with test lamp between terminal D+ and DF with positive brushes lifted.

Noisy Dynamo

Check for loose mounting, worn bearings or badly seated brushes.

Brush Spring Tension

Check brush spring tension by hooking spring balance in small curl at end of each spring and pulling radial to commutator until the spring just leaves the brush, as shown in Fig.3. The correct tension is 12 to 16 ozs.

High tension will cause rapid brush and commutator wear. Low tension will cause low output, arcing and pitting.

Check pigtail connections from brushes for tightness.

Test for insulation from rest of dynamo.

Poor connections in charging circuit cause excessive voltage with burned field and armature windings. In field circuit they cause low output.

Brushes

Replace brushes if worn to 1/2 in., using only the grade supplied by manufacturers.

FIG. 7. TESTING FIELD COIL FOR EARTH.

Brushes must be free in their guides, blow with air pressure or, if oily, wipe brush and inside of holder with a rag moistened in petrol or spirit. If still not free, lightly remove high spots with a smooth file.

Check that brushes are properly bedded. To bed them, rise brushes and pass a strip of fine glass or carborundum paper under two adjacent brush holders, rough side out, bring out the ends through the other two brush windows, let down brushes and draw to and fro a few times, making the last pass in the direction of rotation of the armature, see Fig. 4.. Repeat for the other two brushes and then blow out dust.

Commutator

The commutator must be clean and smooth.

Clean with rag moistened in spirit or fine glass paper held against surface whilst armature is rotated. Blow away dust on completion.

If commutator is rough, pitted or has high mica, remove the armature and skim up the surface in a lathe, using a keen tool, preferably a diamond tool, to leave a smooth finish. Unless a diamond tool has been used, polish with fine glass paper.

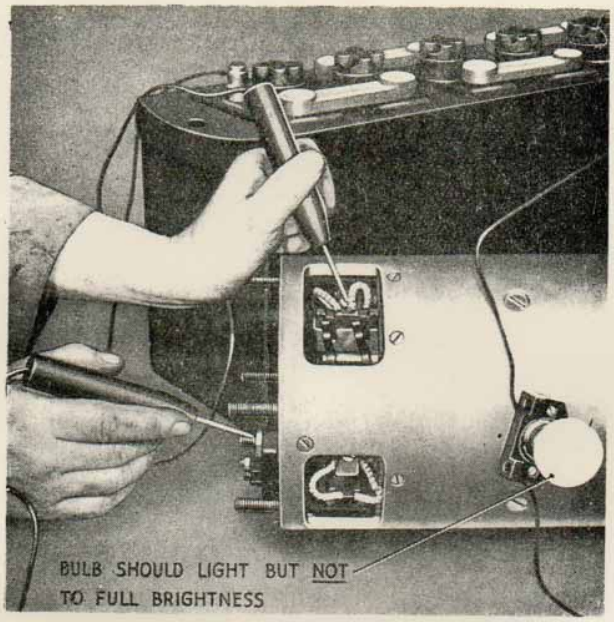


FIG. 8. TESTING FIELD COIL FOR INTERNAL SHORT.

Undercut the mica as shown in Fig.5. This can be started with a three-cornered file and finished with a hacksaw blade ground to the width of the mica.

Remove mica over full width to a depth of 1/32 in.

To Dismantle the Dynamo

1. Remove the coupling and key from the driving end of the armature shaft.
2. Unlock and remove the fan clamping nut; remove fan.
3. Remove the four tie-bolts.
4. Remove the cover.
5. Remove the circlip from the commutator end of the shaft, lift and wedge all brushes and press out the armature with the driving-end shield. The commutator end bearing will remain in the end-shield.
6. Remove four screws from the driving-end shield to release the inner bearing cap.

7. Separate armature and end-shield, leaving the inner bearing cap, inner roller race and cage on the shaft and the outer roller race in the end-shield.

8. Remove the commutator end-shield.

9. The brush holders are mounted individually in the yoke and should not be removed unless faulty, as accurate alighment is necessary. Before removing the two screws to release a brush holder, the interconnection with the opposite holder should be disconnected.

The field coils should not be removed unless when tested a fault is found, in which case it will be necessary to remove the pole shoe screws and pole piece. To fit the pole shoes a pole shoe expander is required. If this is not available the poleshoes should not be removed.

To Reassemble the Dynamo

1. If field coils have been removed, fit them over the pole shoes so that they bed down as closely as possible at the tips. Place the pole pieces and field coils in position with the carcase standing vertical and insert the screws. Place the pole shoe expander between the poles and tighten to its fullest extent. Drive the fixing screws right home, using a wheel-operated screwdriver.

2. The coils must be positioned in the yoke so that the coil to be connected to the terminal is near the dowel at the commutator end, i.e., the coil with the long lead coming out alomg the length. The coil to be connected to the brush gear is that with the long lead coming out across the end and must be placed to the left of the above coil looking at the lead end.

3. Check the polarity by connecting a 12-volt or 24-volt battery to the field leads, battery positive being to the field terminal. A compass needle held against each pole face in turns should show alternate polarity with "S" at the pole near the dowel.

4. If the brush holders have been removed, great care is needed to engage the short spigots on the mouldings insulating the nuts with the holes in the thin insulating

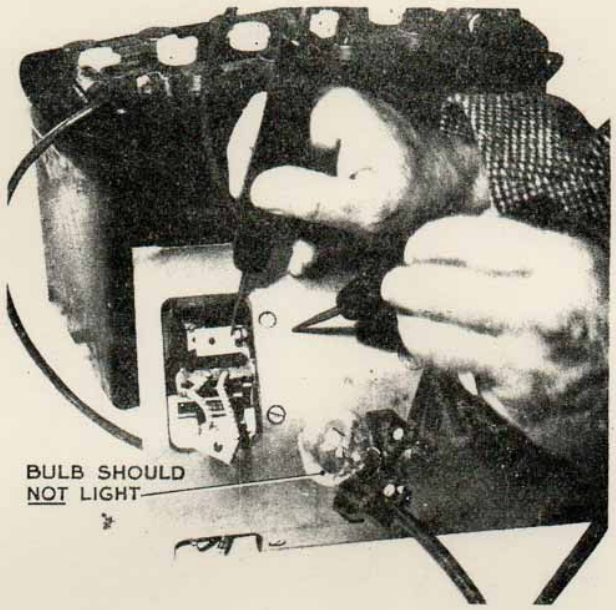


FIG.9. TESTING BRUSH HOLDER FOR EARTH.

plate between holder and yoke. Before the brush holders are fully tightened they must be aligned by passing a steel bar 1½ in. x ¼ in. x 10 in. through opposite holders in which it must be a close fit. Check that the 1½ in. face is at right angles to a bar laid across the end of the yoke.

5. Brush springs must be pushed on to their posts until they click into the retaining recess.

6. Moisten felt oil seals in driving-end inner bearing cap and in driving-end shield with a little oil. If new felts are required they should be soaked in oil for twenty-four hours before fitting.

7. Fill recess in driving-end inner bearing cap, with Shell Nerita 3 grease and assemble cap on armature shaft followed by the bearing collar.

8. Assemble the bearing inner race on the shaft and press up to the collar.

9. Assemble commutator-end bearing in its end shield with the sealed side nearest the commutator and fit the end shield to the yoke locating on the dowel.

10. Pass armature into yoke and press into the commutator-end bearing, supporting the inner race; fit circlip.

11. Half fill both bearings and fill bearing recess and lubricator feed hole in driving-end shield with Shell Nerita 3 grease. Screw in lubricator screw until flush with end shield and remove any excess of grease that exudes into bearing recess.

12. Fit driving-end bearing outer race into end shield and fit end shield to yoke, locating on dowel.

13. Fit four screws through driving-end shield into inner bearing cap.

14. Fill recess in commutator-end cover with Shell V.W.grease and assemble to end shield.

15. Fit fan, tighten clamping nut, lock with countersunk screw and caulk the screw.

Testing dynamo parts

All tests must be carried out on non-conducting material.

Fields for Continous Circuit

Connect field coils in series with a 12-volt battery and a 12-volt 12-watt bulb.

Connect battery positive to field terminal and battery negative to tag.

Lamp should light but not to full brightness, no light shows break in coils. In this case replace coils.

Armature for Earth

Connect lamp from armature core to commutator, see Fig.6. Light indicates earth.

Field Coil for Earth

Connect test lamp from field to dynamo body, see Fig.7.. Light indicates coils are earthed. Check insulation.

Brush Lead to Terminal

Connect test prods in turn to each pair of brush holders and its appropriate terminal. No light indicates break.

Field Coils for Internal Short

Connect test lamp between terminal and coil negative brush, see Fig. 8. If lamp lights to full brilliance there is an internal short. Replace coils.

Brush Holder for Earth

Connect lamp from brush to frame, see Fig. 9. Light shows faulty insulation.

Brush Gear for Short Circuit

Connect test prods between adjacent brush holders. Light indicates short circuit, possibly between holder and inter connector.

Armature for Internal Shorts

Place armature on growler, place saw blade along core, rotate armature and test each slot in turn. If blade vibrates, there is an internal short.

Clean out between armature segments and test again. If blade still vibrates, armature is shorted. Replace armature.

Armature to Commutator Leads

Check soldered joints. If loose, re-solder, using resin flux. Don't use acid flux for electrical repairs.

CONTROL BOARD

The control board contains the voltage regulator, cut-out and main dynamo fuse.

Regulator and Cut-out

The regulator consists of two vibrating elements which control the insertion of resistance in the dynamo field circuit; the current regulator comes into operation when the current tends to exceed a predetermined value, the voltage regulator then becoming inoperative; the voltage regulator operates if the voltage tends to exceed the set value, the current regulator being then inoperative. The voltage regulator is temperature-compensated to give a falling voltage with rising temperature.

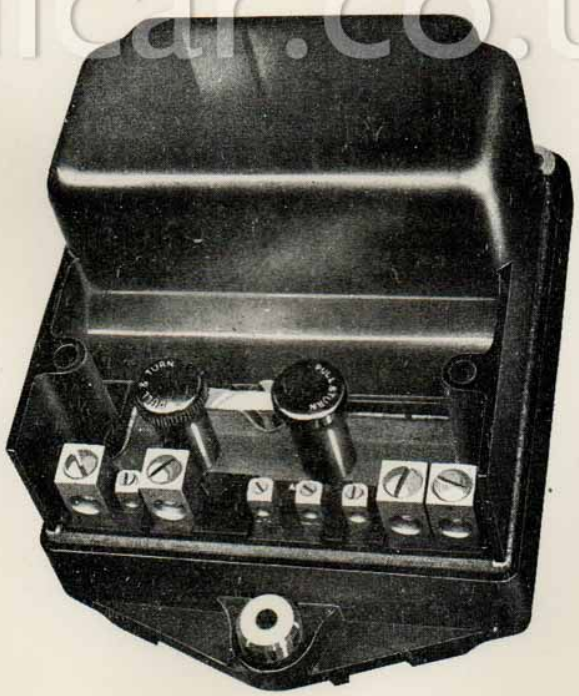


FIG.10. THE CONTROL BOARD.

A low battery is given a constant charging current (current control) until its terminal voltage reaches the setting of the voltage regulator after which the voltage is maintained constant (voltage control) and the charging current tapers off at the e.m.f. of the battery rises to the fully charged value.

Operation Tests

Testing Regulator and Cut-out on Vehicle

If operation tests indicate faulty voltage regulator or cut-out, these can be tested without removing from the vehicle.

Voltage Regulator

To test open circuit voltage of regulator:

1. Open battery isolating switch.
2. Switch off all lights and accessories.
3. Connect positive lead of a moving coil voltmeter to D+ terminal and the second voltmeter lead to D- terminal, see Fig.11.
4. Run the dynamo at a speed of 2,000 r.p.m., for 30 minutes. The voltmeter should show between 28.6 and 29.6 volts when hot. If it does not, it may be possible to correct the setting without removing the regulator from the control board, see Resetting Regulator, Voltage Setting.

Current Regulator

Close battery isolating switch, switch on all lamps, internal and external, and leave them on for half-an-hour unless the battery is already low. Plug in the ammeter, see Dynamo Operation Tests, wedge the armature of the voltage regulator and run the dynamp as above, leaving the lamp load on. The armature should read between 54 and 56 amps., and if it does not the current regulator may possibly be reset in situ, see Resetting Regulator, Current Setting.

Cut-out

1. Connect battery + and - to control board.

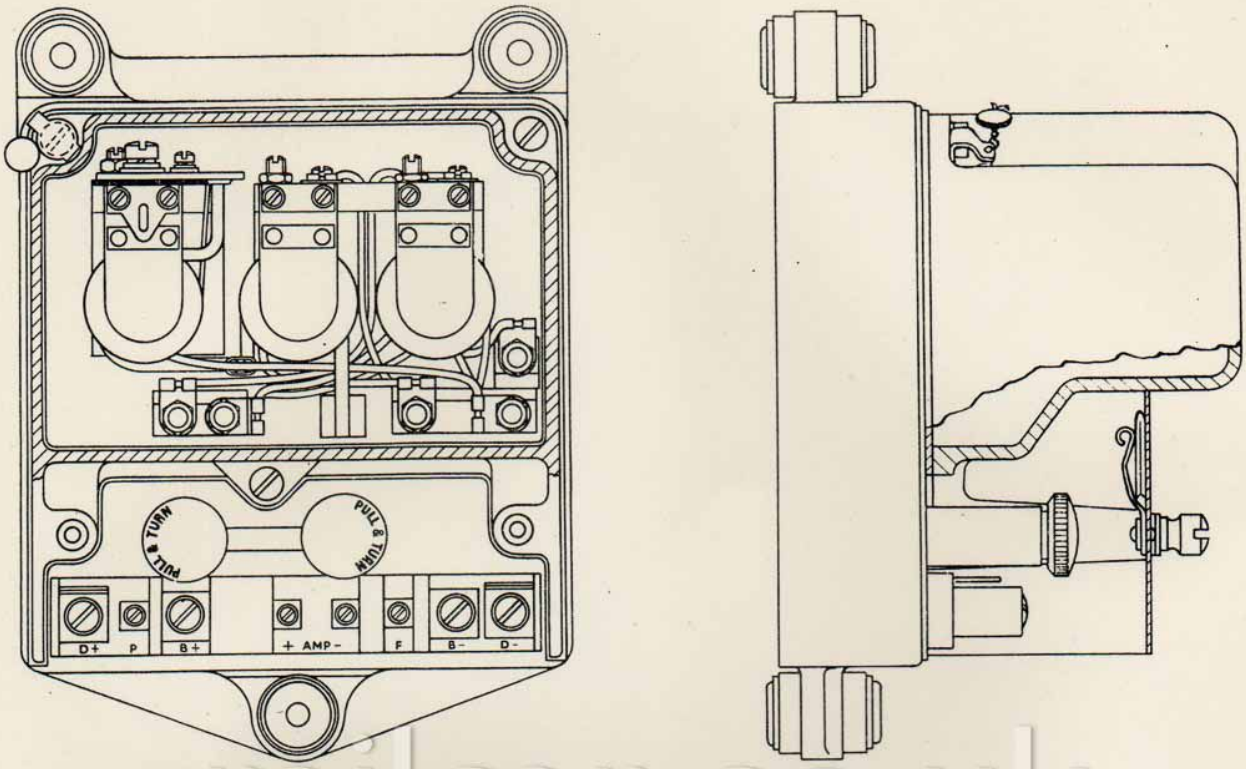


FIG. 11. SECTIONS THROUGH CONTROL BOARD.

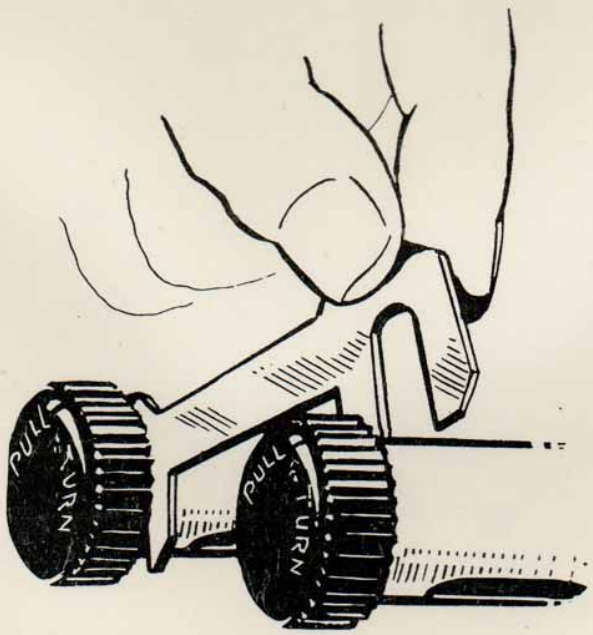


FIG. 12. DYNAMO FUSE.

2. Switch on all driving lamps.

3. Connect moving coil voltmeter across D + and D - on control board, see Fig.11.

4. Speed up the dynamo gradually, noting increase in voltage until peak voltage is reached, at which the voltmeter needle will flick back to a lower voltage. This peak figure is the cutting-in voltage and should be between 27 and 27.5 volts. If it is not, the unit must be re-set or renewed.

Dynamo Fuse

Check if dynamo fuse is blown. If it is,inspect batteries for defective cell or cells, and excessive charging setting of regulator.

The fuse is 120 amp.strip type, see Fig.12, spares are held in a clip under the cover.

Replacement fuse must be the same value and material as the one removed. The fuse value in amps. is stamped on one end of the strip.

To remove, pull up and turn the fuse post knob.

Electrical Setting

Voltage Regulator to be set first.

1. Remove main fuse on the control board and connect a moving coil voltmeter across the D + and D - terminals.

2. Run the dynamo up to a speed of 2,000 r.p.m. and set the voltage regulator (right-hand limb looking on front of board) to 30.1 to 30.6 volts by means of the lower adjusting screw (C) Fig. 14.

3. Stop and restart the dynamo several times, making slight adjustments each time, until the setting repeats itself within the prescribed limits.

4. Screw in stop screw (D) very slowly, with the set running, until the voltage begins to rise, and then screw back three-quarters of a turn and lock in position with nut.

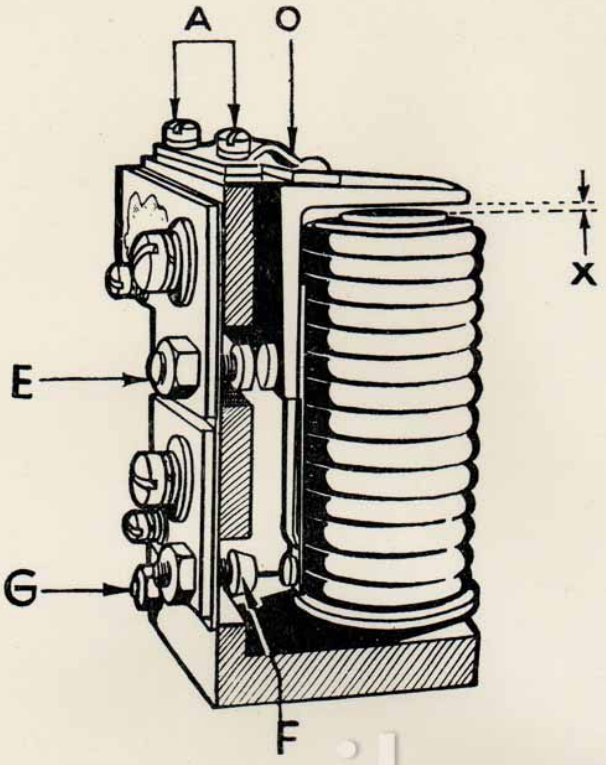


FIG. 13. THE CUT-OUT.

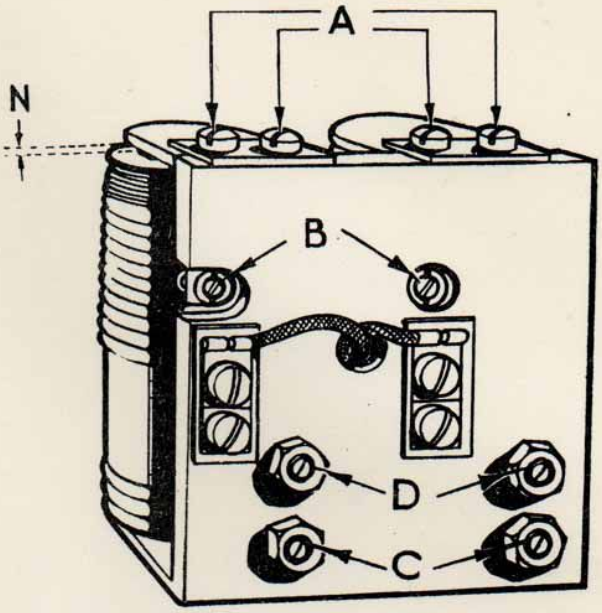


FIG. 14 THE REGULATOR (REAR VIEW).

To Reset the Regulator

Mechanical Setting. To be made with regulator cold (20°C.).

Armature

1. Slacken off screws (A) attaching the flat armature springs to the frame. See Fig.14.

2. Slacken off adjustable contacts (B).

3. Slacken off auxiliary and stop spring adjusting screws (C) and (D).

4. Press armature down firmly on to core, so that back of armature is against frame.

5. The gap (if any) which appears between the top of frame and underside of the armature hinge spring must be closed by inserting packing pieces until contact is established with the spring. Care must be taken against using an excessive thickness of packing and so distorting the spring.

6. Tighten screws (A) attaching armature hinge spring to frame.

Note: With armature pressed down it should touch the core at front or rear and a maximum gap of .005 in. can be allowed between the parts not touching. A .002 in. feeler should not enter between the back of armature and frame. See Fig.15.

Contacts Setting

7. Adjust moving contacts (B) until gap (N) between tip of armature and core lies between 0.045 in. and 0.050 in. when the contacts are closed.

8. Lock contact (B) in position with nut.

9. When stop screw (D) is fitted, screw in until it just touches bronze stop spring, then screw back three-quarters of a turn and lock in position with nut.

Current Setting

Similar to voltage setting, but to be obtained with current 54 to 56 amps.

1. Connect an ammeter having a suitable range, to the ammeter + and - terminals on the control board, or if using an external ammeter connect in series with the D + lead.

2. Replace the fuse and switch on all available lamp load, or if setting away from vehicle apply a dummy load of 55 amperes.

3. Run the dynamo up to a speed of 2,000 r.p.m. and adjust the current to 55 ± 1 amperes by means of the lower adjusting screw (C) on the current regulator (centre limb).

4. If the current does not respond to movement of the screw, more load should be added to the battery and allowed to discharge for a time.

5. Whilst carrying out the operation of setting the current regulator, the voltage across D + and D - should be approximately 27 volts. It should in no case be above 28 volts.

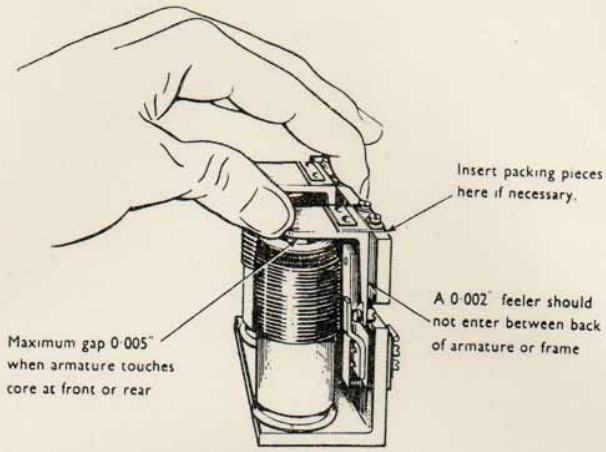


FIG. 15. THE REGULATOR.

6. Stop and restart the dynamo several times, making slight adjustments each time, until the setting repeats itself within the prescribed limits.

7. Screw in stop screw (D) very slowly with the regulator on current-control, until the current begins to rise and then screw back three-quarters of a turn and lock in position with nut.

Note:

1. The regulator must be set with the cut-out in position and in circuit.

2. The voltage regulator is temperature-compensated and the setting will drop after several minutes running.

To Re-set Cut-out

Mechanical Setting

Armature

1. Slack off screws (A) attaching flat spring to frame. See Fig.13.

2. Separate main contacts (E) and auxiliary contacts (F).

3. Insert .004 in. feeler between back of armature and frame.

4. Press armature firmly down on to core and back against feeler.

5. The gap (if any) which appears between the top of frame and underside of the armature hinge spring is to be closed by inserting packing pieces until contact is established with spring. Care should be taken against using an excess thickness of packing and so distorting the spring.

6. Tighten screws (A) attaching armature spring to frame.

Note: With the armature pressed down it should at least touch the core at front and rear and a maximum gap of .005 in. can be allowed between the parts and touching.

Contact Setting

7. Screw down main contacts (E) until gap between armature tip and core is 0.02 in. with armature held down.

8. With 0.008 in. feeler between main contacts (E) hold armature down and adjust auxiliary contacts (F) to touch.

9. Lock both contacts (E) and (F) in above positions.

10. With contacts in open position, gap (X) between armature tip and core should measure 0.005 in. This figure is obtained by bending armature stop (C).

Electrical Setting

1. Without disconnecting any cables from control board, switch on all available lamp load or if setting away from vehicle apply dummy load of 55 amperes. Connect a moving coil voltmeter having a suitable range across dynamo terminal D + and D - on either the control board or dynamo.

2. Speed up dynamo gradually noting increase in voltage as recorded on the voltmeter until a peak figure is reached, at which point the voltmeter needle will flick back to a lower voltage. This peak voltage is the cutting-in voltage and should be set at 27 to 27.5 volts.

3. Adjustment should be made by means of adjusting screw (G), the dynamo type G724-4 being slowed down below cutting-in speed of 1,150 r.p.m. before each adjustment.

4. Lock adjusting screw (G) after cutting-in voltage has been set.

STARTER MOTOR

Description

The axial type starter motor is mounted on the right-hand side of the engine. Incorporated in it is the solenoid switch and overload clutch.

The field winding is divided into two main field coils and two auxiliary coils, each of the latter being made up of an auxiliary shunt coil and an auxiliary series coil. When the starter switch is operated, a small current passes through the auxiliary coils, causing the armature to rotate slowly. Simultaneously the magnetic field set up pulls the armature forward and brings the pinion gently into mesh with the flywheel ring.

This movement of the armature causes a tripping disc to operate the switch trigger, which releases the contacts of the solenoid switch and so completes the main circuit. The full current passes to the starter which exerts its full torque on the engine.

The overload device is a simple screw and spring loaded clutch arrangement, which has a slipping torque above the lock torque of the starter but below the shearing strength of the pinion teeth.

Lubrication

A large oil reservoir is incorporated into the drive-end shield, the service life of which is approximately 15,000 to 20,000 hours, before further lubrication is necessary.

Refilling can best be done at overhaul, when the following procedure should be adopted. When the driving-end shield is dismantled from the starter, insert the pinion into the bearing. Remove plug and pour into the reservoir approximately 12 c.c. of SAE.20 engine oil. Allow about 10 to 15 minutes for the internal wick to absorb the oil. Replace plug and wipe off any surplus oil which has run into the inside of the driving-end shield.

Operation Tests

If the starter does not operate satisfactorily, certain tests can be carried out whilst it is on the unit.

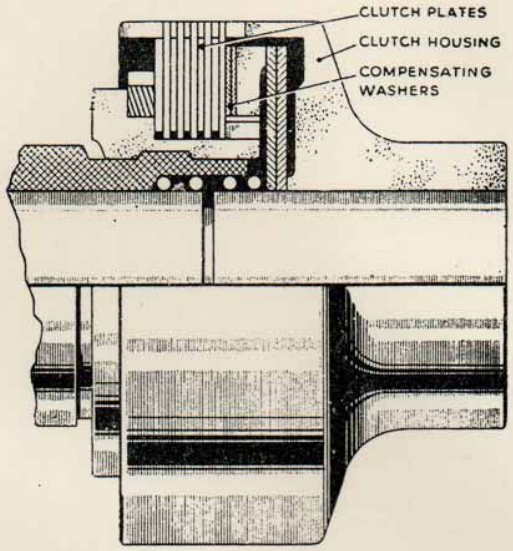


FIG. 16. STARTER MOTOR CLUTCH.

1. Check that battery is fully charged.

2. See that cable connections are securely made.

3. Push starter button; if starter does not operate, connect voltmeter between SOL terminal on starter and - terminal. Push starter button again. If no reading on the voltmeter, the fault is between the button and starter.

4. Push starter button, if solenoid clicks it indicates that the switch is working on first contacts only and full load current is not being applied to starter. Faulty armature adjustment or worn switch trigger can cause this.

5. If starter crashes into engagement, the switch trigger and plate may be worn on the step and slotted portions.

6. Intermittent starter operation with the starter button held down can be caused by second contacts on solenoid switch being burnt or starter brushes worn. Faulty connections on starter button or battery terminal posts can also cause this.

7. Worn bearing at driving end of starter will cause slow engagement and loss of power by the armature fouling the pole pieces.

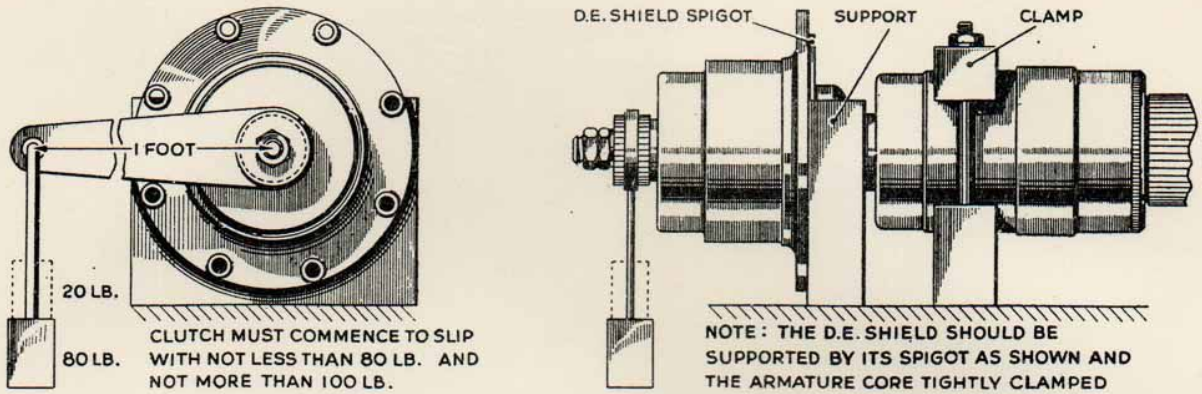


FIG. 17. TESTING CLUTCH SLIP TORQUE.

8. If the starter operates but does not turn the engine, clutch may be slipping or teeth may be worn.

To Remove the Starter Motor

Disconnect the three cables from terminals on the starter, remove the straps securing it in the cradle, draw out of the flywheel housing towards front of engine.

To Dismantle the Starter Motor

Armature, Clutch and Pinion

1. Remove nuts and take off commutator end cover.
2. Remove nut on plunger with tool C.A.V.SER 1.
3. Remove screws securing brush tags and lift brushes in their boxes and secure by wedging with brush springs.
4. Remove driving end shield screws, free end shield from yoke and gently withdraw armature assembly.
5. Hold armature securely, remove nuts in front of pinion, and withdraw pinion and end shield together.
6. Take out pinion spring.
7. Withdraw clutch and pressure plates from housing.
8. To remove armature spring and plunger, unscrew nut with spanner C.A.V. SER 3A.

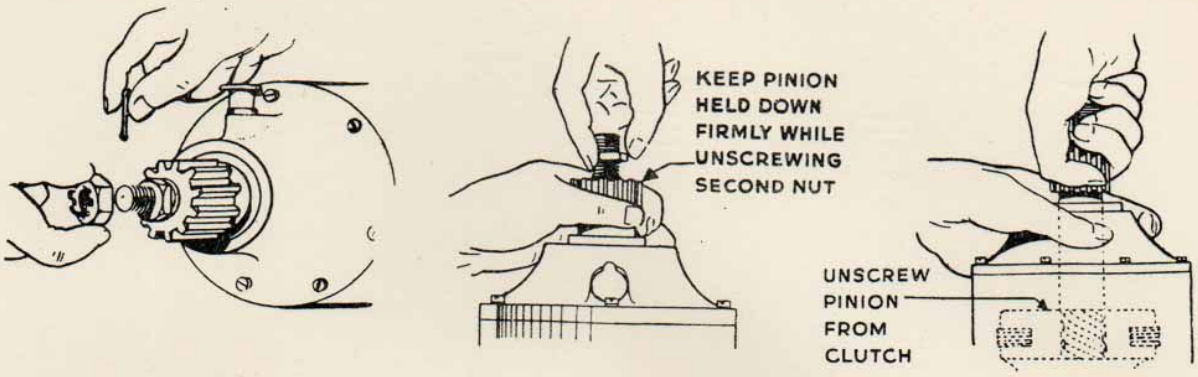


FIG.18. RENEWING STARTER MOTOR PINION.

Solenoid Switch

1. Remove screws securing positive terminal connector, main and auxiliary field connections to switch.

2. Remove nut on SOL terminal and take off switch connection.

3. Remove main terminal nuts and screw securing negative terminal connector to brush holder.

4. Take off main switch fixing screws and remove switch and negative connector together, taking care not to break connection.

Commutator End Shield and Brush Gear

1. Remove screw holding main and auxiliary field connections to connector at bottom of commutator end shield and the screw holding shunt connection to negative brush holder.

2. Remove end shield fixing screws and withdraw end shield and brush gear complete.

3. Remove the screw holding connector to brush holder.

4. Take off nut holding connector on stud.

5. Remove three screws securing brush holders, taking care not to break or lose the mica washers and three small bushes.

6. Remove the two brush holders complete with brushes still fitted in their boxes.

7. Remove large insulating bush and two large washers, noting position of shaped washer.

8. Remove main positive and solenoid terminals.

Field Coils

Remove pole screws and take off field coils. Pole pieces are marked 1,2,3 and 4 to correspond with numbers on the commutator end of yoke. They must be replaced in the same positions.

Overhaul

Armature Bearings

The bushes in the commutator end shield and driving end shield are machined in position. For replacement it is desirable that end shields complete with bushes are used as supplied for spares.

A special tool is required for removing and replacing internal bush in commutator end of armature.

Commutator

The commutator surface must be clean and free from uneven discoloration. There must be no deposit bridging between the bars.

Clean with fine grade glass paper, not emery. If in a badly pitted condition, skim up in a lathe. Take a very light cut and use preferably a diamond tool to obtain high finish.

After turning, or if mica is high, undercut mica to a depth of 1/32 in.; start with a three-cornered file and finish with a hacksaw blade ground to width of mica.

Testing Armature

Place armature in "growler" and test in same way as dynamo, see Testing Dynamo Parts.

Clutch and Pinion

Renew clutch plates and pinion if worn.

Test the clutch for slip torque by rigging up as shown in Fig.17.

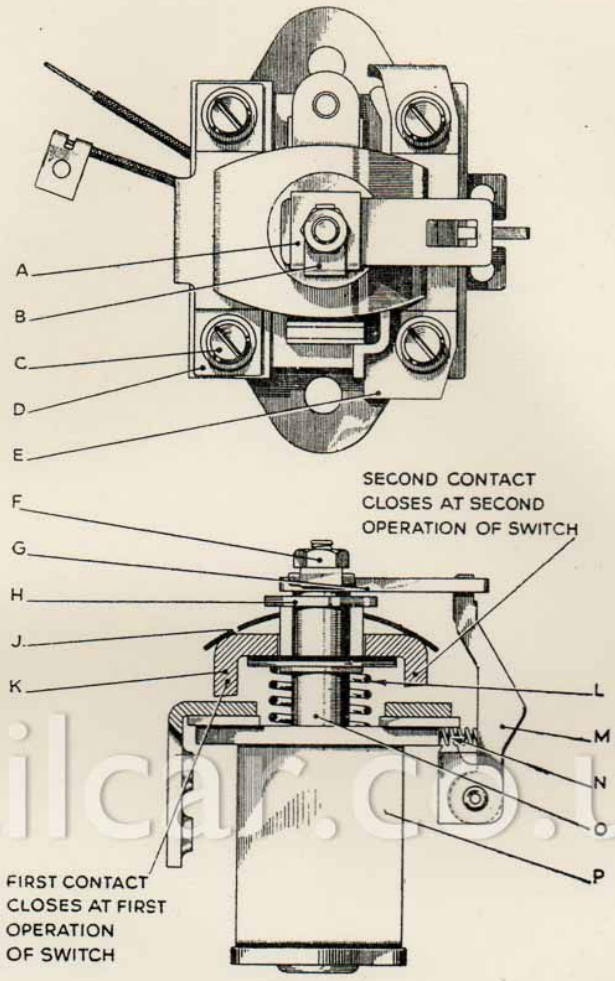


FIG. 19. SOLENOID SWITCH.

Insert the clutch plates, alternatively bronze and steel, five of each, starting with a bronze plate so that the last one will be steel to take the pressure of the small springs. Smear the parts lightly with Shell Nerita 3 grease.

Check that a new pinion has the same number of teeth as the old one, and test thread in the inner race of clutch for smooth action. See that the pinion spring has not lost compression.

Fit the small initial pressure springs with the large diameter end in the clutch race holes.

Feed the pinion through the end shield, lifting the felt lubricating pad to prevent damage.

Replace pinion spring and engage pinion with inner race of clutch.

Push the pinion home against spring pressure and replace the nut and locking nut on the shaft. Check that the nuts are up against the shoulder on the shaft before inserting split pin.

To Test Clutch for Slip Torque

After assembly the clutch must be tested for slip torque.

Rig up the clutch as shown in Fig.17, with an arm one foot long and apply weight to the end.

When newly assembled the clutch must be adjusted to slip at 100 to 115 lb.ft. and tested ten times. Then adjust to slip at 80 to 100 lb.ft.

If the clutch slips at less than 80 lb.ft. torque, a compensating washer (Fig16.) must be fitted between clutch plates and back ring. Washers are available .004 in. and .006 in. thick, and one or more must be inserted as required.

To Renew Pinion without dismantling Starter

If pinion teeth are badly worn, a new pinion can be fitted without dismantling starter if considerable care is used.

1. Remove split pin and castellated nut (Fig18.) from shaft.

2. Stand starter on end, pinion uppermost. Loosen thin shaft nut, keep pinion held down firmly against spring pressure and take off the nut.

3. Whilst still maintaining resistance against spring, turn pinion slowly in opposite direction to rotation when driving, anti-clockwise from pinion end. Gradually release pressure whilst turning until pinion is unscrewed from clutch and free to remove from end shield.

   It is essential to do the operation slowly and carefully to avoid disturbing the clutch plate.

4. Check that pinion has same number of teeth as the old one.

5. Carefully insert pinion into end shield until it meets

resistance, then turn slowly in direction of starter rotation, clockwise until forward movement is felt. This indicates that the pinion has engaged with clutch plates.

6. Push pinion into end shield to full extent against spring pressure. Hold in position and screw on thin shaft nut. Screw on castellated nut, tighten and insert split pin.

Field Coils

Test field coils without removing them from yoke.

Connect them in series with a 12-volt battery and a 12-volt 12-watt bulb. The bulb should light to indicate unbroken connection through field windings when:

1. Prods are applied to negative brush gear connector and moving switch contact.

2. To positive brush gear arm and moving switch contact.

3. To positive brush gear arm and fixed switch contact to which field coil is attached.

Bulb should not light when:

4. Prods are applied to starter yoke and any ends of field coils. This shows earthed coils.

There is no easy way of testing for internal shorts as resistance is already very low. If a short is supected fit a new set of coils and compare performance.

When replacing coils, see that auxiliary coils are assembled on pole pieces 1 and 3. Fit coils over pole shoes so that they bed down as close as possible at the tips.

Replace pole pieces with numbers corresponding with numbers on yoke. Place the pole shoe expander between the shoes and tighten to fullest extent. Drive the fixing screws right home with a wheel-operated screwdriver.

Brush Gear

Check that the brushes are free in their guides and flex leads are free for movement.

Positive and negative brush holders must be insulated from one another and from rest of starter.

Test insulation with test lamp in same way as dynamo, see Testing Dynamo Parts.

Check brush spring pressures by hooking spring balance under springs. The correct tension is 18 to 24 oz.

Replace brushes if worn so that the flexibles nearly touch the bottom of the slot in the brush holders.

Bed brushes to commutator with fine glass or carborundum paper. Don't reverse brushes after bedding.

Solenoid Switch

1. To dismantle switch, release locking washer (B), Fig.19, remove nut (F), catch holding plate (A), trigger catch (G), bridge piece (K) with flat spring and insulating washer. Take care that trigger spring (N) does not fall out when catch is removed.

   Note position of washers (Q) and (R), Fig.20, as the thin ones are used for adjustment. The washer (S) acts as a spigot for return spring.

2. Remove fixed contacts by taking out retaining screws (C), Fig.19.

   If contacts are dirty, clean with spirit or fine carborundum paper.

   Badly pitted fixed contacts may be refaced once (see Fig.21) after packing up the contacts with .032 in. insulating plates, C.A.V. parts 5632/29A and 5632/30A, behind the existing insulation. The dimension from the top of the contact to the underside of the solenoid endplate should be from .333 in. to .337 in.

   Check pressure of return spring(L). When compressed to 1/2 in. length it should have a pressure of 5.lb. ±5 oz., renew if not within limits.

   Check pressure of trigger spring: it should have pressure 12½ to 16 oz. when compressed to 7/32 in.

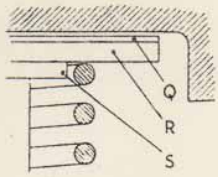


FIG. 20 ARRANGEMENT OF PACKING WASHERS OF BRIDGE PIECE.

Check that insulating bush (H) is an easy fit in bridge piece and is not distorted.

If winding is damaged or broken, fit a new switch. Lightly smear the plunger (O) with vaseline at point of entry into body, also at point of contact between flat spring and bridge piece.

Re-assembly and Adjustment

If contacts have been re-faced, air gaps will require adjustment.

Adjusting washers (Q), Fig.20, must be removed and replaced until correct air gaps are obtained. Washers are available .004, .008 and .012 in.thick.

The air gaps are shown in Fig.19.

First contacts .040 in. ± .004 in.

Second contacts .142 in. ± .008 in.

Trigger clearance .079 in. ± .004 in.

Fit new locking washer (B) for the armature nut.

Testing Solenoid Switch

After assembly apply the following tests with the switch in a horizontal position:

Force to overcome return spring in OFF position

5 lb. ± 5.oz.

Force to overcome return spring in ON position

29 lb. ± 2 lb.

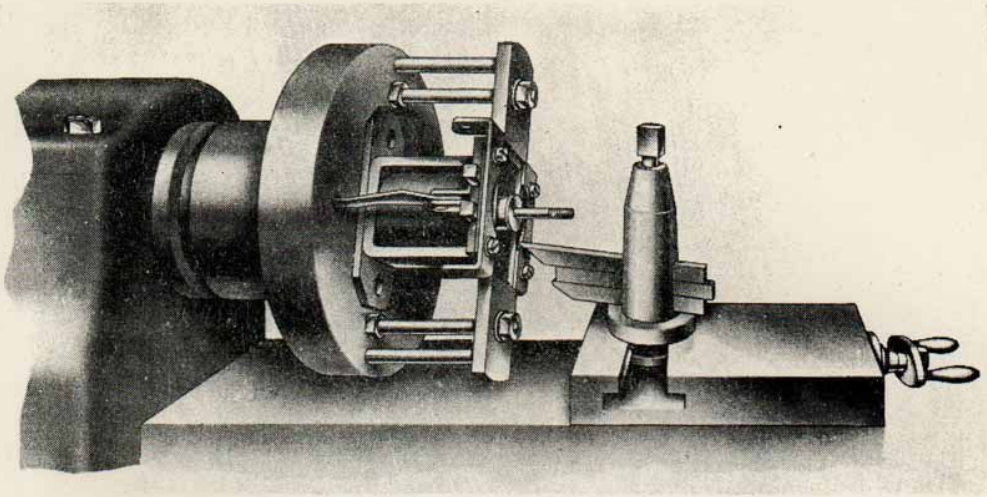


FIG. 21. SIMPLE FIXTURE FOR HOLDING SWITCH IN LATHE.

Force to overcome spring tension of trigger (M) applied at peak of tripping face with switch in OFF position 16 oz. ± 1½ oz.

Switch must operate on both contacts at 12 volts ± 1v.

Give switch a test of a few seconds duration at twice normal voltage to ensure that trigger operation is correct. Faulty assembly or rounding of step will cause the catch to slip.

To Re-Assemble the Starter Motor

To re-assemble, reverse the dismantling operations.

Assemble brush gear on commutator end shield and fit assembly to yoke. See that securing screws are tight.

Fix the solenoid switch in position and join up the field connections.

Feed the armature and clutch assembly into the casing. The brushes must be raised in their boxes to allow commutator to pass.

Check that all connections, both internal and external, are clean and tight.

Checking Performance

Before fitting starter to engine a rough test may be made.

Connect a 24-volt battery to the main starter terminals, battery positive to starter positive. Connect a lead from battery positive to SOL terminal through a push button switch. Insert a piece of paper between the second contacts of the solenoid switch.

Operate the push switch and starter should revolve in a clockwise direction, viewed from pinion end, and the pinion move approximately one inch forward, where it will remain revolving slowly so long as the push switch is closed. Don't prolong the test.

Release the switch and remove the paper from the solenoid contacts. Operate the push switch again momentarily and the starter should work as before but at a higher speed.

TORQUE CONVERTER.

TORQUE CONVERTER

GENERAL DESCRIPTION

The Leyland hydraulic torque converter is a device which replaces the function of the intermediate gears in a comventional gearbox, in that it automatically multiplies the engine torque as required. The maximum efficiency of operation when no torque amplification is required is obtained by the provision of a direct drive, in which case the rotating parts of the converter are permitted to come to rest by the provision of a free wheel. By this means hydraulic losses due to churning are eliminated and over-running is made possible. A free wheel is also provided in the direct drive, again making over-running possible. In this way the railcar can coast in either converter or direct drive.

Direct drive or converter drive can be engaged as desired by means of a double-acting clutch operated by a double-acting air cylinder mounted on the clutch housing.

The complete torque converter unit is most conveniently considered as three separate units :

1. The double-acting clutch.
2. The torque converter.
3. The free wheel.

Clutches.

The two plate clutches are carried on two large splined hubs, Fig. 2, keyed on the taper ends of two concentric shafts, a single pressure plate, housed between the two clutch plates, serving to engage the desired drive. The pressure is supplied by twelve springs, Fig. 3, operating toggle levers so arranged that as the liners wear the pressure increases, thus obviating slip due to part worn liners.

The inner clutch plate, Fig.2, is mounted on a solid shaft, which passes right through the unit and is

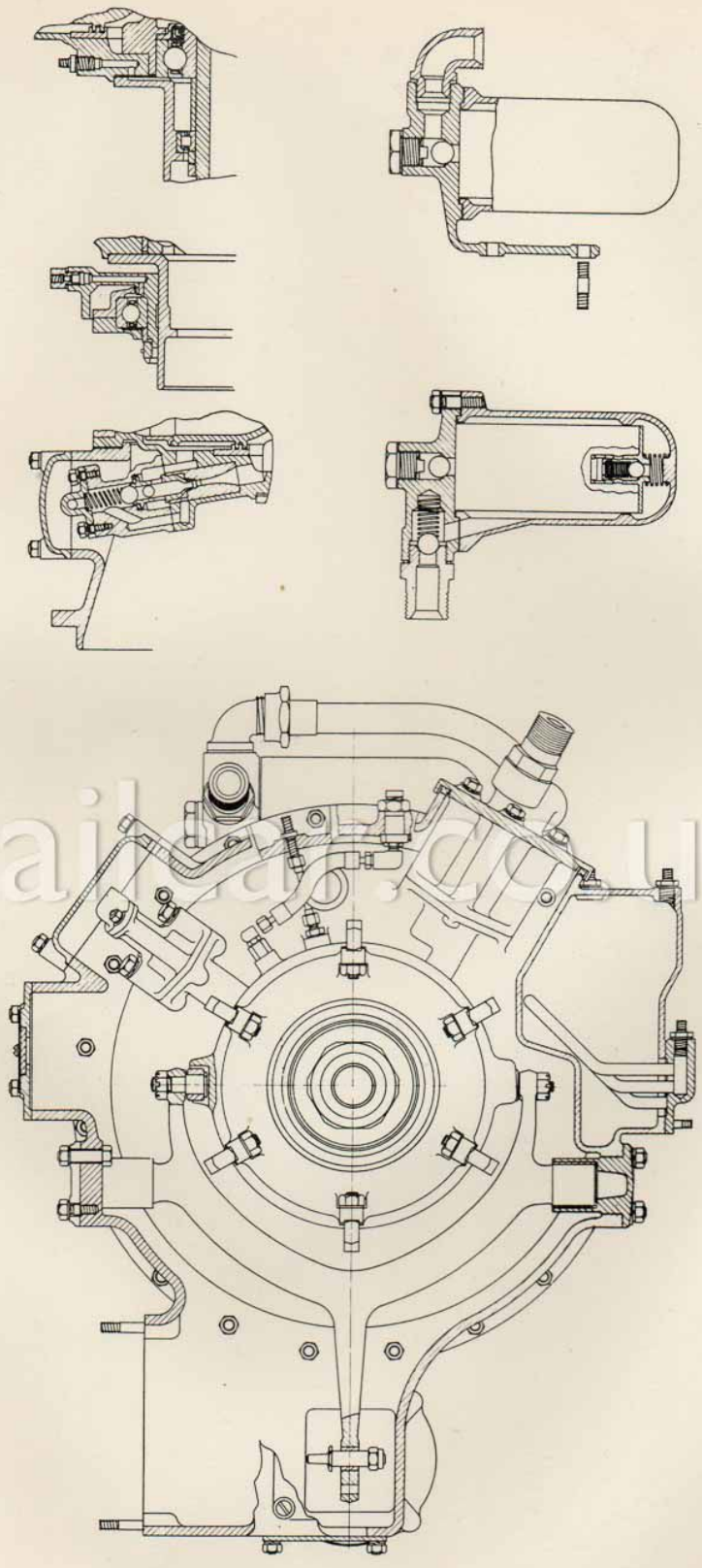


FIG. 1. TORQUE CONVERTER. (FRONT VIEW)

connected to the propeller shaft by a coupling and companion flange. This clutch when engaged gives direct drive.

The outer clutch plate is similarly mounted on a hollow shaft which carries the converter pump wheel. When this clutch is engaged the drive is taken through the convertter.

The pressure plate, Fig.3, is located on three driving pegs and is held in engagement by the twelve springs acting through the toggle levers, the tips of which are located in the withdrawal-housing jaws. The operating fork, Fig.2, is carried in bushes located in the clutch housing and operates through a large withdrawal bearing. The withdrawal bearing is lubricated from a nipple on the clutch housing.

Torque Converter.

Essentially the torque converter is a three-stage reaction turbine, the fluid operating in a closed circuit. The pump wheel, shown in Figs. 2 and 7, which is driven through the clutch already mentioned, is of the familiar centrifugal type. The turbine wheel is provided with three sets of blades and is mounted on a hollow shaft which transmits the drive through the free wheel. Two sets of guide blades are interposed between the first and second and second and third stages of the turbine wheel.

Operatinn of Converter.

The fluid, which completely fills the casing, is given velocity by the pump wheel when the engine is speeded up and the energy thus generated turns the turbine wheel. The guide blading is so arranged that the circulating fluid, after impinging on the first stage turbine blading, is redirected on to the second stage and again on to the third stage. The effect of thus utilising the fluid pressure in three stages is to multiply the engine torque up to a maximum ratio of 5 to 1.

There is considerable difference in pressure in the fluid before and after leaving the pump wheel and this difference is utilised to operate the injector, Fig. 4, for replenishing the converter with fluid and to circulate the fluid through the cooler.

The fluid in each case leaves the converter casing from a high-pressure point and for re-entry is directed to the region of lowest pressure.

Excessive leakage of fluid to the bearings is prevented by special seals, Fig.2, a centre seal preventing short circuiting between the pump wheel and turbine wheel. A very slight leak is permitted to lubricate the seal faces and the fluid so passing flows through suitably arranged ducts and piping to a small sump. The fluid is evacuated from this sump and returned to the reserve tank by means of the ejector situated on top of the reserve tank. The operation of this ejector, shown in Fig.6,, is automatic and is as follows. A pressure pipe from the converter is connected to the ejector nozzle, The fluid in the casing being under pressure, is forced along this pipe and through the nozzle, thus increasing its velocity, which causes a vacuum to be established in the annular space around the nozzle. This annular space is in communication with the sump by way of a pipe, and fluid that has leaked into the sump is lifted to the reserve tank. A gauze filter protects the nozzle from dirt.

In the event of more fluid passing the seals than the ejector can evacuate, the surplus is allowed to leak on to the road by means of a pipe in the sump. The overflow pipe is arranged to form an air trap so that when the ejector has emptied the sump, air, which tends to oxidise the fluid, is not sucked in. The small quantity of air in the sump is caused to circulate until fluid again enters the sump.

To keep the converter casing full of fluid an injector, shown in Fig.4, is provided. This operates by utilising the difference in pressure in the converter casing to cause a flow of fluid through the venturi nozzle, Fig.4. A vacuum is thus established around the annulus and fluid from the reserve tank is drawn in as shown and delivered under pressure to the converter at a point where pressure is low. The pressure in the converter is limited by the pressure-relief valve, which cuts off the supply by by-passing fluid when the casing is full.

Under extreme conditions of operation the fluid is heated up somewhat and is liable to gasify. To prevent the temperature becoming excessive a special radiator is provided and connected by pipes to the high and low pressure sides of the converter. An efficient filter is provided

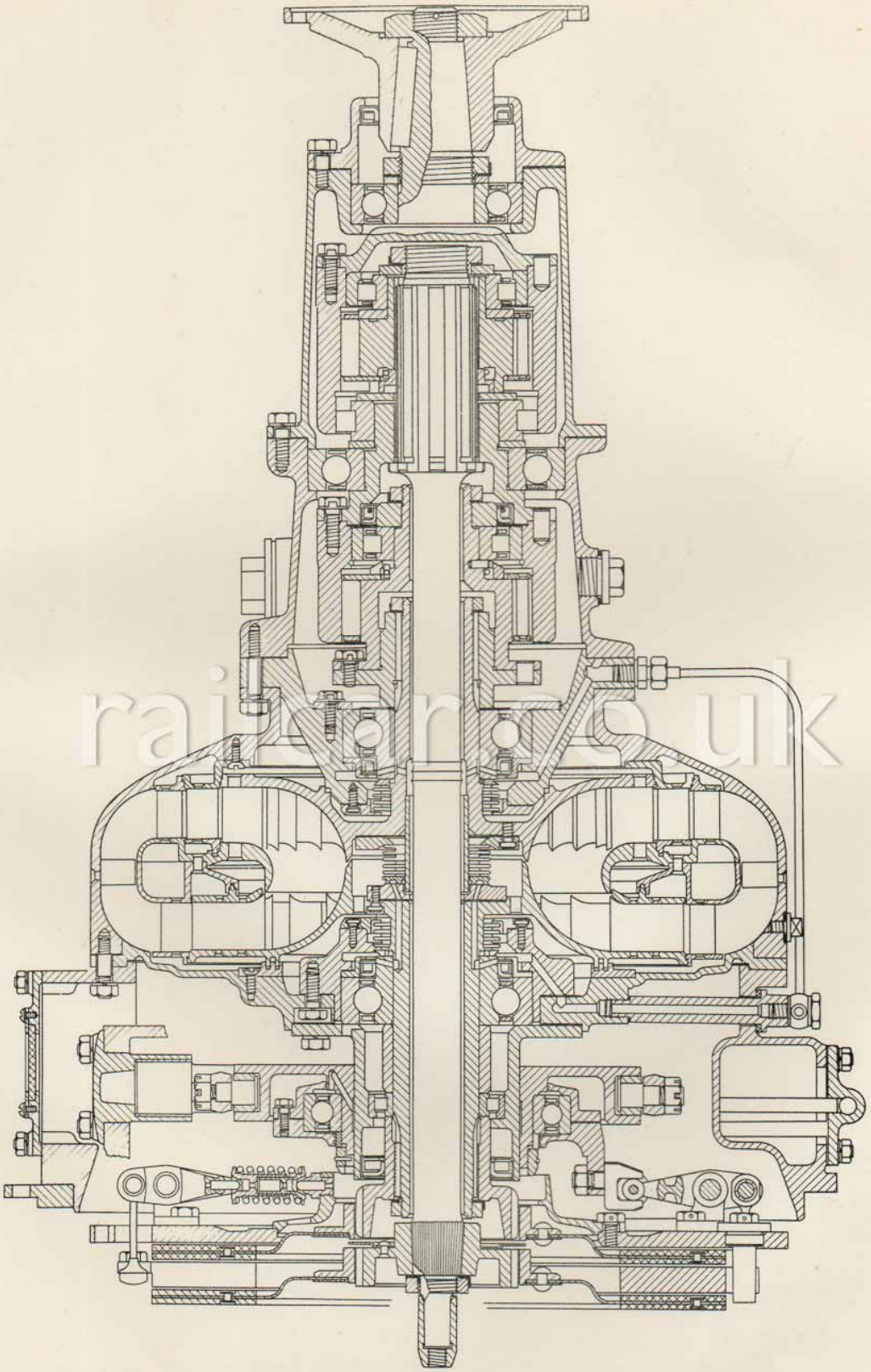


FIG. 2. SECTION THROUGH TORQUE CONVERTER.

between the radiator and the point of re-entry to the converter.

Gas which forms while the converter is running is automatically evacuated by the ejector.

The fluid used is a mixture of Aroclor and Shell Tellus 15 (see Converter Fluids).

Free Wheels.

The free wheels for converter and direct drives are of the roller type and are housed in casings secured to the rear of the converter casing.

The cam of the converter drive free wheel is mounted on a splined shaft driven by the turbine wheel and the outer race mounted on the splined part of the direct drive shaft.

The cam of the direct drive free wheel is mounted on the splined portion of the direct drive shaft, and the outer race is fixed to the short output shaft carrying the companion flange for the propellor shaft.

Change Speed.

Change of speed is effected by an electro-pneumatic control system which operates to move the piston in the double-acting air cylinder mounted on the clutch housing. The piston rod is connected at its outer end to the end of the clutch-operating lever.

Movement of the clutch-operating lever and air piston towards the engine engages the direct drive, and movement in the reverse direction engages the converter drive.

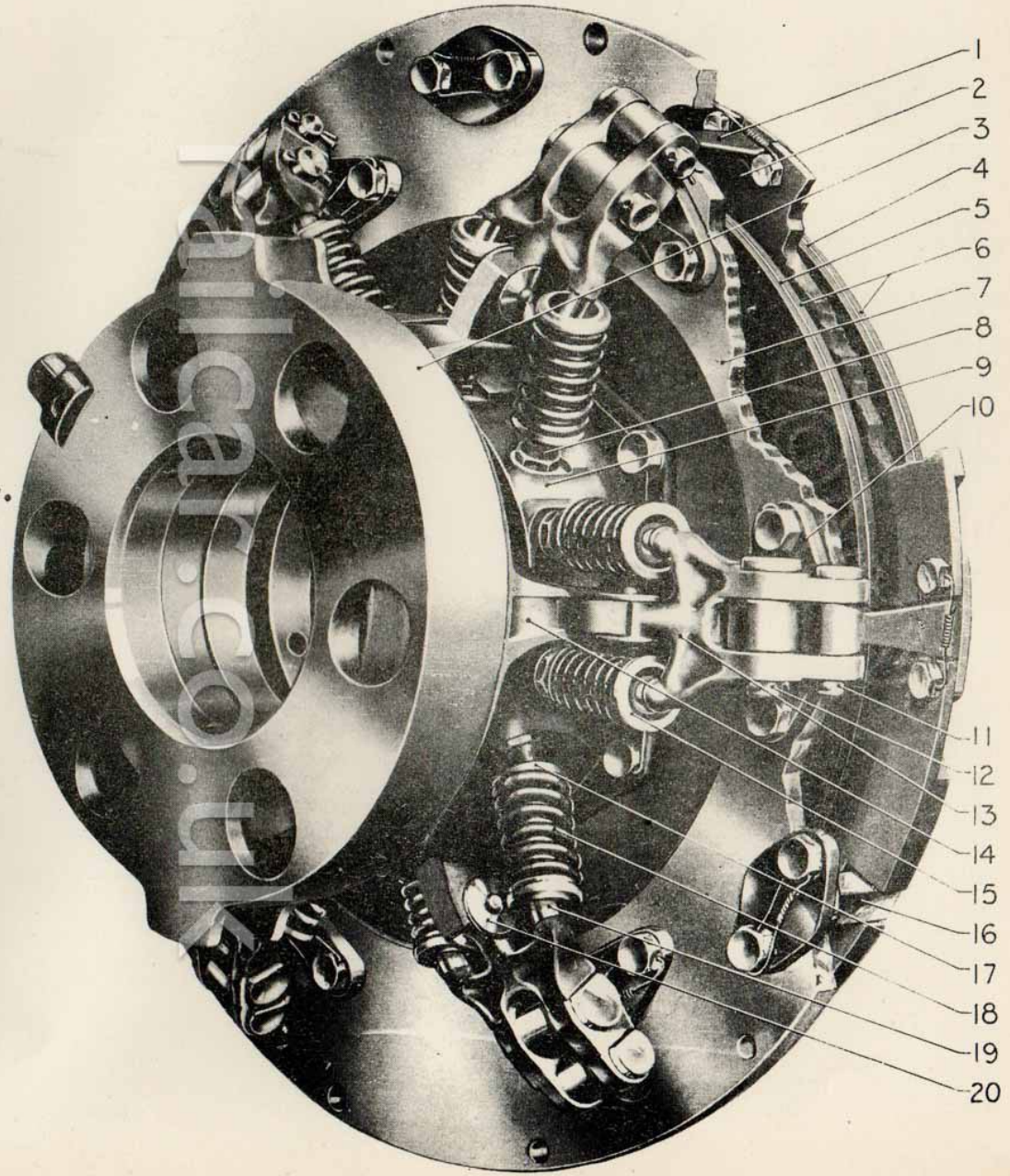
The action of the electro-pneumatic control system is explained in "Controls".

LUBRICATION AND MAINTENANCE

The clutch withdrawal bearing and pump wheel bearings are fed from lubricator nipples on the clutch housing. (See "Lubrication Chart"). Only a small quantity of lubricant should be given at a time to prevent the possibility of any reaching the clutch faces.

FIG. 3.
CLUTCHES AND OPERATING MECHANISM.

1. Lever for Pressure Plate.
2. Pressure Plate.
3. Throwout Sleeve.
4. Clutch Plate (outer)
5. Clutch Plate (inner)
6. Clutch Liner.
7. Driving Plate.
8. Holder for Roller.
9. Spring Support.
10. Bracket for Toggle Lever.
11. Pivot Pin for Toggle Lever.
12. Fulcrum Pin for Toggle Lever.
13. Toggle Lever.
14. Withdrawal Plate.
15. Spring Retainer (outer)
16. Driving Peg.
17. Spring Retainer (inner).
18. Clutch Spring.
19. Roller for Spring Retainer.
20. Washer for Toggle Lever.



Converter Fluid.

The fluid used in the converter is a mixture of 40% Aroclor and 60% Shell Tellus 15.

The level of the fluid in the reserve tank can be checked on the gauge, and a filler cap is provided. When filling up the reserve tank great care must be taken to ensure that the fluid is perfectly clean.

An efficient gauze filter is fitted in the filler and this must not be removed or damaged.

The above-mentioned points should receive attention as follows :-

1. Clutch Withdrawal Bearing.

Fortnightly through the nipple, using gear oil.

2. Pump Wheel Bearings.

Fortnightly through the nipple, using gear oil.

3. Reserve Tank.

Check level daily and replenish if required.

4. Clutch Spring Retainers.

A few drops of penetrating oil can be given monthly with advantage.

The following points in the fluid system should receive attention as given below :-

1. Ejector Filter.

Remove the filter weekly and clean with paraffin. Disconnect the pressure pipe at the union, as shown in Fig.5, unscrew the cap, and the filter with holder can be unscrewed.

2. Radiator Filter.

Remove the filter element monthly and wash in paraffin. Fit a new element if the old one is badly choked.

FIG. 4.
SECTION THROUGH INJECTOR.

1. Cap for Injector.
2. Spring for Injector.
3. Housing for Injector.
4. Ball for Injector.
5. Nozzle for Injector.
6. Diffuser for Injector.

The radiator element can be removed by detaching the filter body and extracting the element.

3. Reserve-Tank-Filler Filter.

Remove weekly or if choked and wash in paraffin. The filter can be removed by unscrewing the filler cap.

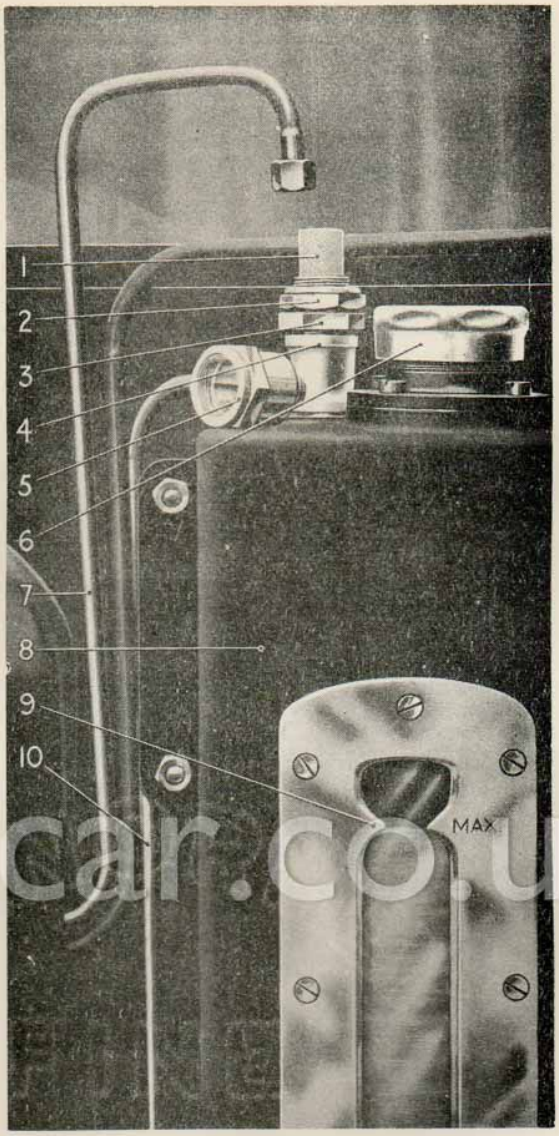


FIG. 5.
CLEANING EJECTOR FILTER.

1. Ejector Filter.
2. Ejector Filter Holder.
3. Ejector Nozzle.
4. Ejector Housing.
5. Ejector Filter Cover.
6. Reserve Tank Filler Cap.
7. Pressure Pipe to Ejector.
8. Reserve Tank.
9. Maximum Fluid Level Mark.
10. Suction Pipe from Sump.

4. Pipe Unions and Nuts.

Check over periodically all pipe unions and the nuts round the casing for tightness.

RECTIFICATION OF POSSIBLE FAULTS

It is strongly recommended that a Leyland Service Depot should be consulted if in doubt.

When carrying out any tests that require the engine to be run in converter drive, care must be taken to ensure that the car is run up to buffers, the hand-brake is hard on and that the wheels are carefully scotched.

Loss of Fluid from the Converter.

This may be caused by any of the following :

1. Choked Ejector Nozzle.

This would allow fluid leaking past the seals to accumulate in the sump and overflow on to the road, thus emptying the reserve tank. The ejector, Fig.6, should be removed, after disconnecting the pipes, by unscrewing from the tank, and thoroughly cleaned. If the nozzle (7) Fig.6, is choked it should be blown clear with air pressure and the filter should be thoroughly cleaned as outlined under "Maintenance". Replace the ejector, connect up the pressure pipe and check the action by running the engine in converter drive, when a vacuum should be established at the suction connection (6).

2. Leaky Pipe Connections.

Check all connections and also that pipes are not chafing. The system should be under pressure, that is engine running in converter drive, while inspecting for leaks.

3. Excessive Leakage Past Seals.

If fluid is still lost the seals should be tested. Remove the bottom seal leakage pipe (see Fig.2), leaving the drain holes from the seals open. Run car up to

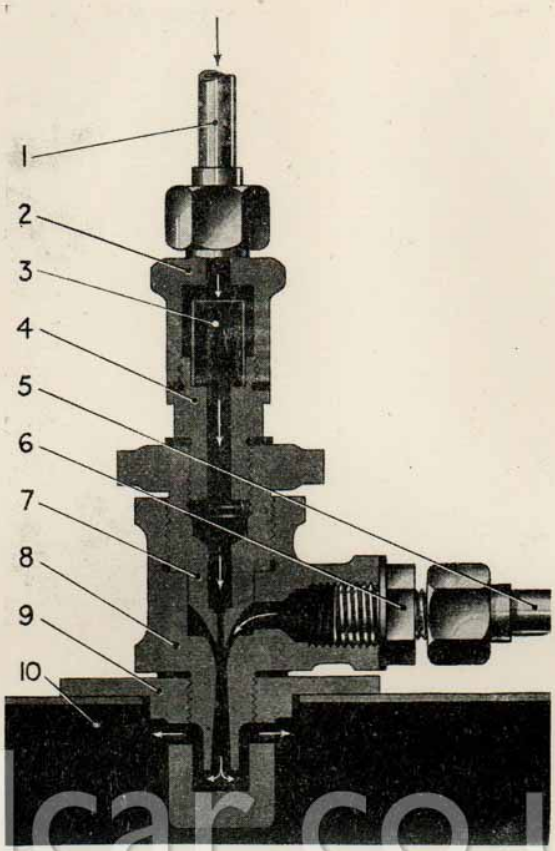


FIG. 6.
SECTION THROUGH EJECTOR.

1. Pressure Pipe.
2. Ejector Filter Cover.
3. Ejector Filter.
4. Ejector Filter Holder.
5. Suction Pipe.
6. Union for Suction Pipe.
7. Ejector Nozzle.
8. Diffuser.
9. Ejector Holder.
10. Reserve Tank.

buffers, or scotch the wheels, or prevent car movement by similar means, and apply handbrake hard and engage converter drive; run the engine full out for not more than one minute. As a guide it can be taken that if more than one teaspoonful of fluid is collected from either drain pipe in the minute, leakage from the seals is excessive. In this event the seals should be removed and very carefully lapped on the seal face to give a perfectly flat polished surface.

The leaded-bronze faces of the seals should be lapped on a selected piece of standard plate glass, about 1/2 in. thick, using special carburundum compound H.40. A surface table is eminently suitable as a support for the plate glass by placing a piece of rubber insertion between the table and the plate glass.

To test if the surface is perfectly flat, press a selected piece of standard plate glass on to the lapped surface. A spectrum of light should be seen over the surface, and if the spectrum is unbroken, the surface is perfectly flat, but if it is broken the surface is not perfectly flat, and should be again lapped.

Three cast iron laps are provided in the tool kit for lapping the ball race and hardened faces. If the faces are badly pitted, a preliminary lapping should be made, using a thin paste of carburundum powder, grade 1F, mixed with machine oil.

The three cast iron laps should be used alternately, and after using each once, they should be lapped on each other before using again. The finish lapping should be done with machine oil.

Do not clean the surfaces with loosely woven rags.

Poor Performance and Overheating.

First check over the engine and make sure that poor performance is not caused by engine defect. If the engine is in good order, loss of performance may be caused by :

1. Gas in Converter Casing.

Gas can be liberated by venting the pressure-pipe connection, Fig. 5, Fluid should escape as soon as the union is loosened with the engine stopped.

2. Choked Injector.

To remove the injector for inspection, drain the converter by removing the drain plug from the base of the casing, until the level is below the level of the injector. The fluid should be collected in suitable clean receptacles. Disconnect the feed pipe and unscrew the nuts securing the injector to the casing:

care must be exercised not to damage the injector by dropping or rough handling.

The most likely place for dirt or sludge to collect is around the nozzle (5), Fig. 4. Thoroughly clean the injector by washing in paraffin and blowing through with air. Check that pressure-relief-valve ball (4) is not sticking. Replace the injector, connect up the feed pipe and return the fluid to the reserve tank.

It may be found necessary to vent air from the top of the converter casing as already outlined. This operation should be carried out several times during the first few minutes the engine is run, care being taken to stop the engine before venting.

3. Converter Radiator Choked.

Mud or insects adhering to the radiator tubes can cause overheating. In this case all foreign matter should be removed from the radiator tubes.

Engine Revolutions Higher than Normal In Converter Drive.

This can be caused by :

1. Gas in Converter Casing.

Check for gas by venting as already outlined.

2. Clutch Slip.

To test for clutch slip allow the engine to pull at low revolutions in direct drive or accelerate in converter drive and change quickly into direct drive keeping the throttle wide open. If the engine revolutions do not rapidly decrease as direct drive is engaged the clutch is slipping.

Clutch slip may be caused by oil or grease on the liners or by the liners being worn out. In this case the converter must be removed and the liners cleaned up or new liners fitted (see "Re-Lining Clutches"). Clutch springs should be examined as a broken spring may cause slip. The clutch-spring retainers may be stuck, in which case a few drops of penetrating oil on each retainer may cure the trouble.

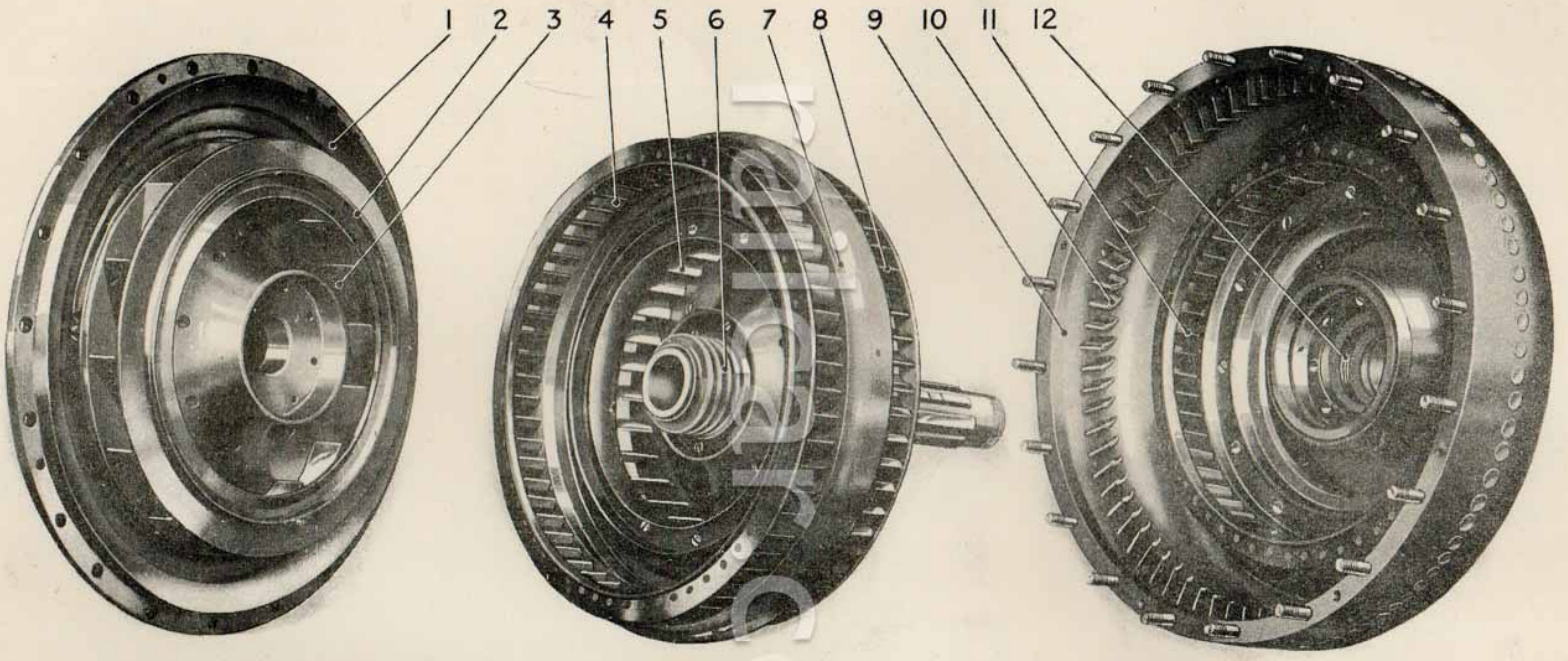


FIG. 7.
TORQUE CONVERTER DISMANTLED.

1. Front Cover Plate.
2. Pump Wheel Assembly.
3. Pump Wheel Blades.
4. 1st Stage Turbine Blades.
5. 3rd Stage Turbine Blades.
6. Centre Seal.
7. Turbine Wheel Assembly.
8. 2nd Stage Turbine Blades.
9. Converter Casing Assembly.
10. 1st Stage Guide Blades.
11. 2nd Stage Guide Blades.
12. Rear Seal.

A weak or broken injector spring can cause what appears to be clutch slip. Remove the cap and renew the spring if found to be at fault.

Failure of Free Wheel.

The free wheel can be tested for correct operation by changing from direct to converter drive at high speed. The engine revolutions should fall to idling speed with the throttle closed. If the engine speed does not fall the free wheel is not functioning correctly, and is possibly seized.

If the machine does not move forward when the throttle is opened in converter drive, the free wheel may be slipping. This may be caused by thick oil or grease, causing the rollers to stick.

REMOVAL OF CONVERTER UNIT

Drain all the fluid from the converter into suitable clean vessels and disconnect all pipes between converter and auxiliaries. Disconnect the propeller shaft at the front coupling flange and remove all the setscrews securing the clutch driving plate to the flywheel. This can be done with a short box spanner through the top opening in the clutch housing. Take the weight of the unit by means of a sling and blocks or pack up from the ground. Remove all the nuts securing the converter unit to the engine bell housing. The unit must now be swung back far enough to clear the flywheel housing spigot and the direct drive shaft from the spigot bearing. The unit can then be lowered to the ground and removed, care being taken not to damage the seal leakage pipes.

Removal of Clutches.

Take off the inner clutch plate (see Figs.2 and 3), unscrew the nut locking the hub on the taper and draw off the splined hub. Remove the operating-fork-bearing housings from the top and bottom of the clutch housing. The complete clutch can now be drawn clear of the housing.

Place the clutch on the bench, springs upwards, and with two bars under the throw-out sleeve, prise the sleeve upwards until it springs clear and can be removed. Remove

the pins securing the pressure plate to the toggle levers and withdraw pressure plate and outer clutch plate.

Re-Lining Clutches.

The clutch-plates should be re-lined when the liners have worn down to 1/16 in.thick. Renewals should be obtained from Leyland Service Depot and only tubular brass rivets should be used; the holes for these should be well counter-sunk. The liner should be mounted as evenly as possible to procure balance and the plate should be flat to within 1/32 in. when re-lined.

Reassembling Clutches.

Place the pressure plate on the bench with the outer clutch plate on top and place the clutch driving-plate over both. Check that the clutch plate is concentric with the pressure plate or the splines will not engage with the clutch-hub splines when replacing. Inspect all springs and examine the withdrawal bearing for undue wear; the bearing can be inspected by removing the circlip and unscrewing the retaining ring-nut.

Remove the toggle-lever-fulcrum-pins and fix the levers to the pressure plate by inserting the pins and split pins. Replace all springs in position and place the throwout sleeve with the toggle-levers in the jaws.

Pressure must now be applied to the face of the throwout sleeve to compress the springs. This can be done with a long bolt through the bench and a plate over the sleeve. Compress the springs until the fulcrum pins can be inserted, easing the toggle levers with a screwdriver if necessary. When all the fulcrum pins are home and split-pinned, press the throwout sleeve down until it springs into position.

Replacing Clutches.

Insert the operating-fork pins in the slots in the throwout sleeve and guide the arm through the opening in the clutch housing while the clutch is entered on the withdrawal sleeve and splined hub; if the splines fail to engage the clutch is not centralised.

Replace the stop plate and splined hub, taking care to see that the taper faces are quite clean; screw up the

nut and lock with the tab washer. The locking nut must be hammered hard up to ensure that the hub is tight on the taper.

Examine the operating bushes for wear and replace the housing in the clutch housing. Place the outer clutch plate in position on the splined hub.

Replacing Converter Unit.

It should be noted that two of the set-screws securing the clutch driving plate to the flywheel are closer together than the rest. This is to ensure that the clutch is bolted up with the T.D.C. marks on the clutch driving plate in the correct position. It is advisable to mark the 1 and 6 T.D.C. mark clearly with chalk so that it is easily found when inserting the setscrews. The unit should be slung as for removal and raised to the correct level, then pushed forward until the spigot joint is home. Replace and tighten up the nuts around the housing flange.

Set the engine on 1 and 6 T.D.C. position and rotate the clutch until the chalk mark at 1 and 6 position is at the top; the holes should then be in the correct position for inserting the setscrews. Tighten the set-screws hard, making sure that each is provided with an effective spring washer.

Connect up the propeller shaft. Couple up all pipes, taking care that the unions are tight; the converter is now ready for filling up with fluid.

Adjustment of Clutch Double-Acting Air Cylinder.

It is important that the clutch control lever should be adjusted properly when replacing, otherwise it will not operate properly.

Checking the torque converter lever setting is explained in detail under "Location and Correction of Faults," in "Maintenance"/chapter.

Filling up Comverter after Replacing.

With the tap between the reserve tank and injector closed, the converter fluid system should be filled from

the pressure point by using a hand pump, care being taken to filter the fluid thoroughly. Open the tap and fill up the reserve tank to the level on the gauge.

Start the engine and with the clutch in convetter drive and the engine running at idling speed, bleed the converter, collecting the fluid in a clean receptacle, until all air has been removed.

Warning.

Before using the convetter be sure that all taps in the fluid system are open or closed in accordance with the requirements of the system. Check that there is sufficient fluid in the system.

TRANSMISSION.

TRANSMISSION.

The transmission shaft has a flange yoke and fixed joint at the torque converter end and a flange yoke and slip joint at the final drive end. The flange and sleeve yokes are assembled on the trunnion journal with four needle bearing assemolies. The needle bearings, which are a light push-fit in the yokes, are self-contained, the needle rollers being assembled in the hardened bearing race. This race is retained and located by the bearing cap, which in turn is held by the lock strap and cap setscrews. Lubrication from the centre of the trunnion journal fills the oil reservoirs in each arm, then through a small hole direct to the needle bearing.

The bearings are protected against oil leakage and ingress of foreign matter by the bearing seal and the cork journal gasket. The relief valve, positioned between two of the trunnion arms, prevents damage to the seals when high-pressure lubrication is employed, and serves as an indicator to show when the joint is completely filled.

The sleeve yoke and slip stub shaft provide the extension and compression of the shaft in operation. A lubricator is provided to lubricate the splines, leakage being prevented by the felt washer and dust cap. No relief valve is fitted.

The shaft tubing is welded to the slip stub ball yoke in the case of a fixed joint.

LUBRICATION.

The propeller shaft joints are lubricated every 5,000 miles with oil through the lubricators, see "Lubrication Chart".

The specification of the above oil is given in the "Lubrication" chapter.

Do not over-lubricate to the extent that surplus oil and grease is flung by the shafts on to the frame and body. Wipe off any surplus which exudes from the relief valves after lubrication.

MAINTENANCE.

Check the tightness of all bolts, setscrews and nuts after the first 5,000 miles service of a new car or replacement transmission units.

Wear on the thrust races is located by testing the lift in the joint, either by hand, or by using a length of wood suitably supported.

Any circumferential movement of shaft relative to the flange yoke indicates wear in the needle roller bearings, or the sliding splines.

Check the Simmonds nuts on the companion flanges and flange yokes for tightness. If there is excessive noise or vibration from the transmission, look for:

1. The propeller shafts misaligned or out of balance due to faulty assembly.

2. Worn needle bearings.

3. Loose flange bolts.

4. Lack of lubricant.

5. Sprung propeller shaft tubes as a result of an accident.

If satisfied that there has been no over-lubrication, and there is still an excessive amount of oil thrown out of the joints, check for faulty seals or missing lubricators.

OVERHAUL.

1. Remove the bolts from the companion flanges at both ends of the shaft. Compress the shaft and remove it.

To Replace the Propeller Shafts.

Replacement is the reverse of the above procedure, but there are points to be watched.

1. Where a slip stub shaft has been removed from a sleeve yoke, it should always be replaced so that the arrow stamped on the shaft lines up with the arrow on the yoke.

2. When replacing, wipe the companion flange and flange yoke faces clean to ensure that the pilot spigot registers properly and the faces bed evenly all round.

3. The dust caps should be screwed up by hand as far as possible.

4. If the companion flanges have been removed from the final drive or torque converter, see that they are replaced hard up on the tapers.

To Dismantle the Propeller Shaft Joints.

1. Knock down the tabs on the lock strap and remove the bearing cap setscrews.

2. Remove the bearing caps.

3. Support the flange and sleeve yokes on two wood blocks with the lug of the sleeve yoke uppermost. With a soft-nosed drift, slightly smaller than the outside diameter of the needle bearing race, drive out the underneath bearing housing. The bearing will gradually emerge and can be removed finally with the fingers. Take care not to lose any needle rollers out of the bearing race. Reverse the joint and repeat the operation for the opposite bearing, using the drift on the exposed end of the journal trunnion.

4. Repeat operation 3 with lug of the flange yoke uppermost.

5. Seperate the yokes from the journal trunnion.

6. Unscrew the dust cap and pull the slip stub shaft out of the sleeve yoke.

Individual needle bearings can be removed from the joints in position on the vehicle. Have the bearing to be removed at the bottom of the joint, remove the bearing cap, and tap the uppermost yoke with a copper or hide hammer until the bearing begins to emerge and finally remove with the fingers.

Repeat for each bearing in turn.

To Examine Individual Parts for Wear.

1. Wash all parts except the seals in paraffin and dry thoroughly. Do not use compressed air.

2. The parts most likely to show signs of wear after long usage are the bearing assemblies and journal trunnions. Should looseness in the fit of these parts, load markings, or distortion be observed, they must be renewed complete, as no oversize journals or bearing housings are provided. It is essential that the bearings are a light drive-fit in the flange and sleeve yoke lugs. In the rare event of wear having taken place in the holes in the yokelugs, the holes will most certainly be oval, and the yokes must be renewed.

In the case of wear of the holes in a stub ball yoke, which is part of the tubular shaft assembly, it must be replaced by a complete tubular shaft assembly.

3. The other parts likely to show signs of wear are the sleeve yoke, or the slip stub shaft. A total of .010in. circumferential movement, measured on the outside diameter of the spline, should not be exceeded. Should the stub shaft require renewing, this must be dealt with in the same way as the stub ball yoke-i.e., a replacement tubular shaft assembly must be fitted.

To Re-assemble the Propeller Shaft Joints.

1. Assemble the needle rollers in the bearing races and fill with oil. Smear the walls of the race with vaseline if necessary to retain the needle rollers in place.

2. Renew the cork journal gaskets and retainers on the journal trunnion. The journal shoulders should be shellaced prior to fitting the retainers to get a good oil seal. Use a tubular drift to ensure that the gaskets and retainers fit down on the trunnion shoulders.

3. Insert the journal trunnion in the yokes. Tap the bearings into position at opposite ends of the journal trunnion in turn with a soft drift. It is essential that the slot in the top of the bearing race is in line with the bearing cap setscrew holes.

4. Replace the bearing caps, lock straps and setscrews.

5. If the joint appears to bind, tap the lugs lightly with a wood mallet, which will relieve any pressure of the bearing race on the end of journal trunnion arm.

6. When replacing a sliding joint on a shaft, be sure that the lugs on the flange and sleeve or stub ball yokes are in line. This can be checked by observing whether the arrows stamped on the sleeve yoke and slip stud shaft are in line. Screw up the dust cap over the cork and steel washers by hand.

7. Refill the joints and sleeve yoke with oil through the lubricators provided.

FINAL DRIVE.

FINAL DRIVE.

The final drive is of the double-reduction type, giving an overall reduction of 3.58 to 1. The unit is fixed to the bogie by anchoring arms cast integrally with the front bearing housing.

The gear case is split through the centre of the axle bearings and houses the input spiral bevel gear, two crown wheels, spur pinion and a large spur wheel.

The input spiral bevel pinion is mounted on Timken roller bearings and is in constant mesh with the two crown wheels, which rotate in opposite directions, mounted on roller bearings and ball thrust bearings.

The spur pinion and shaft is mounted on roller bearings in the crown wheels and is in constant mesh with the large spur gear pressed on the driving axle. The pinion slides axially to mesh with the internally-cut teeth in either of the crown wheels, according to which direction the car is required to move.

A double-acting air cylinder, mounted on the side of the gear casing, controls the movement of the spur pinion. Two three-contact switches are fitted to control the supply of air to the cylinder and to give a visual indication, by indicator light, when the gear is in full mesh.

The driving axle rotates in white metal bearings which are located by dowels in the gear casing.

Lubrication is effected by splash and a gear-type oil pump fitted on the side of the gear casing, and driven from the outer end of one of the crown wheels. Oil is delivered, under pressure, through a filter to the bearings. An oil filling hole is provided in the top of the rear casing. A combined filler cap and breather is fitted. The dipstick is located immediately behind the filler cap.

After the first 1250 miles, and thereafter at every 5000 miles, the following points should be checked:

1. The bearing housings should be removed and the bearings inspected.

2. That the electrical contact switches on the cylinder housing operate with a 3/32" movement of the piston.

3. The cylinder, piston, piston rings and oil seals should be inspected and renewed if necessary.

4. That the axle bearings, are receiving sufficient lubricant and that there is no sign of tearing in the white metal.

After 90,000 miles the unit should be dismantled and the component parts inspected for any sign of wear or loosemess.

OVERHAUL.

To dismantle the final drive.

1. Remove drain plugs and drain off all oil.

2. Remove the unit from the bogie complete with axle, and place a suitable support beneath the gear case.

3. Uncouple all pipe connections on the unit.

4. Remove the oil collectors from round the driving axle.

5. Remove the rear half of the gear case.

6. Remove the axle complete with wheels and examine the large spur gear pressed on the axle.

7. Remove the top inspection cover.

8. Remove the double-acting air cylinder and bearing housing complete with crown wheel and spur pinion. Make sure that the spur pinion is in mesh with the crown wheel so as to prevent any undue strain on the piston and connecting rod.

9. Remove the opposite bearing housing and crown wheel complete with oil pump.

10. Remove the front bearing housing complete with input spiral bevel gear.

11. Remove the oil filter cover. Withdraw filter and examine.

12. Remove the oil suction filter and examine.

To dismantle the Double-Acting Air Cylinder, Bearing Housing, and Spur Pinion assembly.

1. Remove the spur pinion thrust bearing locking nut and slide the spur pinion off the spindle.

2. Remove the double-acting air cylinder housing complete with contact switches, connecting rod and spindle.

3. Remove nut and locking washer from the end of the crown wheel and press the wheel out of the housing.

   If the small ball and roller bearings need renewing they can be pressed out of the housing by first removing the securing ring.

   The dismantling of the opposite bearing housing and crown wheel is similar, except the oil pump housing has to be removed before the crown wheel can be pressed out of the bearing housing.

4. Remove the plug retaining the spring-loaded plunger, on the double-acting air cylinder.

5. Remove the contact switches.

6. Remove seal housing and withdraw piston.

To dismantle the Oil Pump.

1. Remove cover.

2. Withdraw gears, driving and idling shafts.

To dismantle Input Spiral Bevel Pinion and Housing.

1. Remove split-pin and nut from end of pinion shaft.

2. Remove setscrews securing oil seal housing and withdraw companion flange and housing.

3. Remove nut and locking washer from the pinion shaft, and press the pinion out of the housing from the companion flange end.

Assembly of the unit is the reversal of the dismantling procedure..

Should the large offset roller bearings for the crown wheels require renewing ensure that the new bearing is replaced with the inner race standing proud of the end pace of the bearing housing.

Backlash of the bevel gears should be within the limits of .006" to .008", and the spur gears .004" to .008".

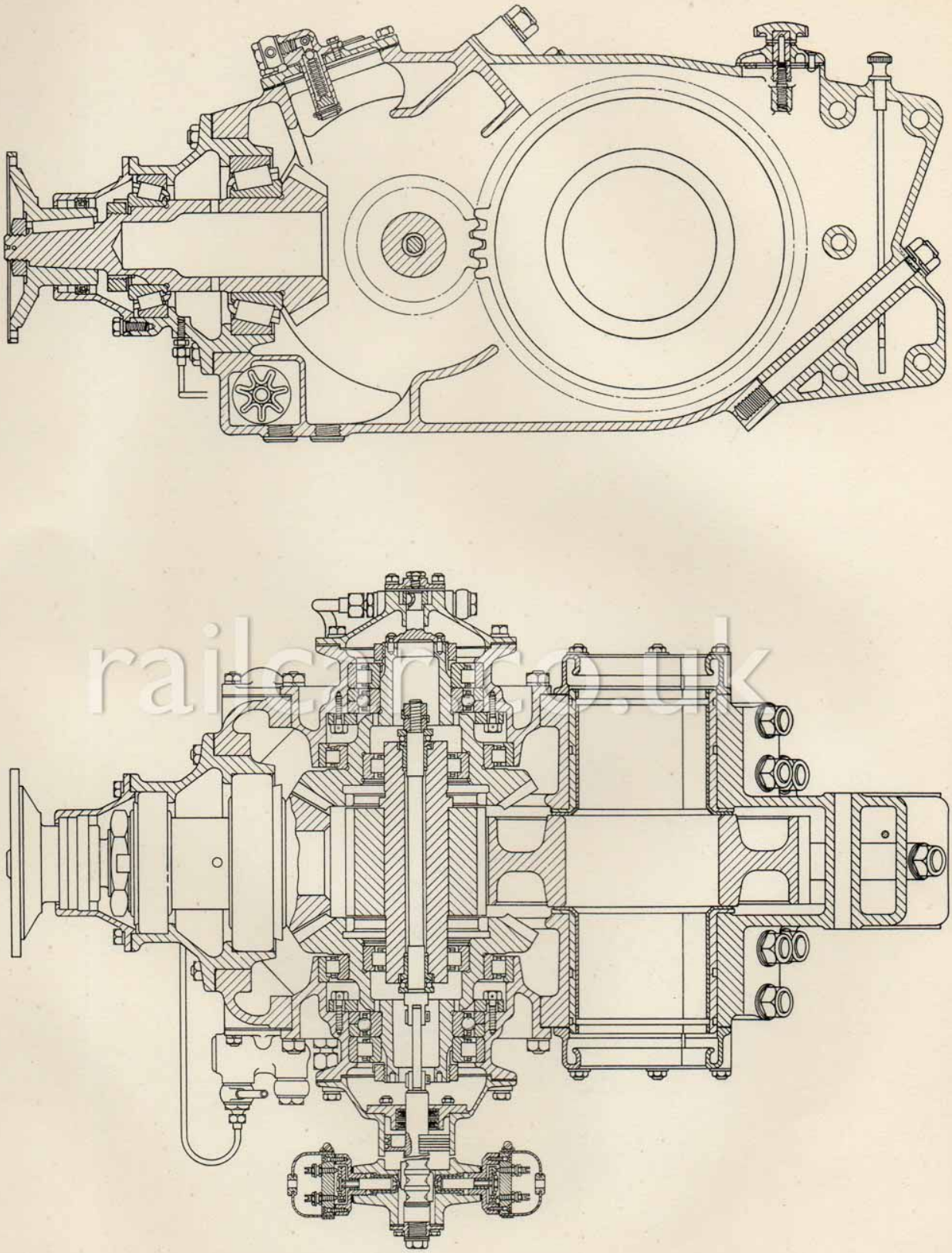


FIG.1. SECTION THROUGH FINAL DRIVE,

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