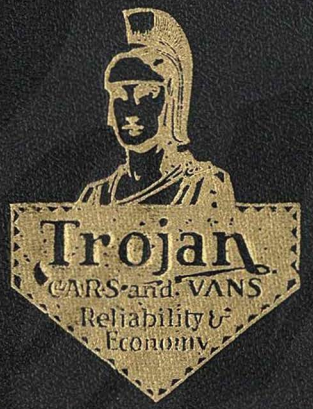
THIRD EDITION
MAY, 1928.

Trojan

SERVICE MANUAL



Manufacturers:
LEYLAND MOTORS
LIMITED
TROJAN FACTORY
KINGSTON-ON-THAMES

Sole Concessionnaires for Great Britain:
TROJAN, LTD.
HEAD OFFICE:
PURLEY WAY
CROYDON

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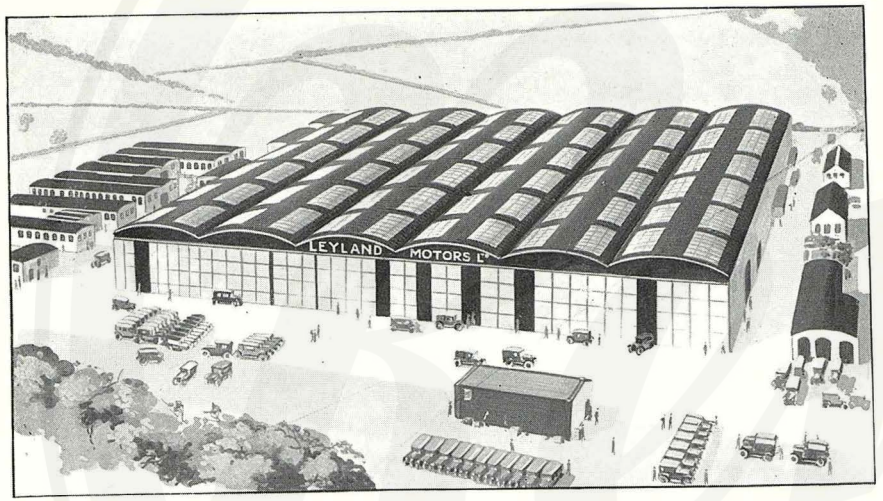


VIEW OF KINGSTON FACTORY

THIRD EDITION
MAY, 1928

Sole Concessionnaires for Great Britain

TROJAN LTD.
HEAD OFFICE:
PURLEY WAY
CROYDON

To whom all enquiries should be sent

CONTENTS.

Index .. .. i—vi

Introduction vii

PART I.

GENERAL DESCRIPTION OF THE DESIGN.

The Engine 1

Carburettor 7

Petrol Cock 10

Primer and Priming Pump 15

Engine Starter 18

Epicyclic Gearbox 20

Electrical Equipment 22

PART II.

REPAIRS AND ADJUSTMENTS.

CHAPTER

I. The Engine 26

II. The Electrical Equipment 37

III. Troubles—Their Diagnosis and Cure 41

IV. Carburettor and Petrol Supply .. 49

V. Transmission 52

VI. Springs and Axles 55

VII. Brakes and Steering 62

VIII. Wheels, Tyres, Radiator and Tank .. 64

IX. List of Service Tools 65

X. General Inspection at Service Garages 65

INDEX

	Art.
Acid Density	141
Accumulator (*see* Battery).	
Advance of Ignition (*see* Ignition).	
Air-petrol Ratio Defective	257-261
Amac Carburettor, Reference to	31a
Anti-reversing Device, Described	86–88
Axle, Front, Pivot Pins	416–422
Axle, Front, Removal of	404
Axle, Rear, Advantages	1.k
Axle, Rear, Assembling Shaft	407
Axle, Rear, Conversion	414
Axle, Rear, Dust Cap Loose	415
Axle, Rear, End Play	412
Axle, Rear, Fitting New Key	409
Axle, Rear, Removal of	402
Axle, Rear, Removal of Shaft	406
Axle, Rear, Slips Forward	356
Back-fires, Causes and Prevention of	86–88
Back-lash in Steering	450
Ball-end Pins	423
Bands, Fitting New Transmission	347
Base-firing, Causes of	206
Battery, Ascertaining Remaining Charge	144–147
Battery, Care of	138–150
Battery, Defective Connections	80a
Battery, Sending by Rail	150
Battery, Under or Overcharging	122–124
Bearings, Fitting Big-ends	111
Bearings, Fitting Main	114
Bearings, Testing	108
Big-ends, Fitting New	111
Big-ends, Knocking	225 226
Brake, Rear	441–446
Brake, Reverse as	447
Brake, Transmission	441 (Note)
Brushes (*see* Dynamo).	
Cam Spindle	441
Carburation Defective	257–261
Carburettor, Advantages	1.o
Carburettor, Amac, Reference to	31a
Carburettor, Cleaning	301
Carburettor, Description and Working of	26–31
Carburettor, Float Leaky	304
Carburettor, Main Jet Characteristic	26, 311, 316–321
Carburettor, Re-setting	320
Carburettor, Setting	307
C.A.S.T	203
Chain, Reasons for Using	1.h
Chain, Shortening	362–364a
Change Speed Control	61–70
Charging Battery (*see* Battery).	
Circuit Breaker (*see* Distributor).	
Clutch, Adjustment of	350–352
Clutch, Fierce	356
Cock, For Draining Water	486
Cock, Petrol	32–41a
Coil, Action of	76–78
Coil, Defective	164
Coil, Object of Resistance Wire	78
Coil, Position of Condenser	78a

	Art.
Comparison with Orthodox 2-Stroke Engines	10–12
Compensating Jet (*see* Carburettor).	
Compression Weak	227
Condenser	78a
Connecting Rods, Assembling	118 ii.
Connections, Accessibility of Switch Board	82
Contact Breaker (*see* Distributor).	
Controls, Convenience and Advantages of	1.m
Cost of Running	505
Crank Case Joint, Thickness of	118 vi
Current Fails	250–256
Cut-out, Action and Construction	80
Cut-out, Adjustment of	133
Cut-out, Effect of Failure	80a
Cut-out, Fails to Operate	80.b
Cut-out, Fitting a New	135
Cylinder Plugs, Removing	110
Cylinder Scored	109 vi. & vii
Dead Centre, How to Find	151
Decarbonising Engine	101
Density of Acid	141
Differential, Reasons for not using	1.k
Difficulty in Starting (*see* Engine)	203–205
Disc Wheel Buckled	483
Distributor, Action of	76
Distributor (*see* Locating Faults)	201–260
Distributor, Points Burning	80b
Distributor, Position of Condenser	78a
Dynamo, Adjusting Output	122–124
Dynamo, Burnt Out	80a
Dynamo, Description of	79–80
Dynamo, Fails to Excite	80a
Dynamo Fuse Blows or Melts	216–217a
Dynamo Fuse, Object of	80a
Dynamo Fuse, Size of	126
Dynamo Not Charging	125–132
Dynamo Overcharging	124
Earth Return System	81
Economy, False	14–15
Electrical Equipment, Advantages of	1.q
Electrical Faults (*see* also Battery and Dynamo)	201–260
Electrical Generator (*see* Dynamo).	
Electrolyte, Density of	141
Engine, Assembling	118 and 106
Engine Base Firing	206
Engine Bearings (*see* Bearings).	
Engine Compression Weak	227–235
Engine Consistent Missing on One Cylinder	215
Engine, Construction and Working	1–15
Engine, Cycle of Operations	2–9
Engine, Decarbonising	101
Engine, Dismantling	109–110
Engine, Erecting in Car	105–108
Engine, Erratic Missing	216
Engine, Exhaust Ports Choked	222
Engine, Features of	1.e or Foreword and 1
Engine, 1,488 c.c., Assembling	118 a–j
Engine, 1,488 c.c., Compared with 1,527 c.c. Engine	25a
Engine, 1,488 c.c., Interchangeability of parts	118k
Engine, Four-Strokes	207
Engine, Gradual Loss of Power (*see* Instruction Book).	
Engine Hesitates before Accelerating	208, 323
Engine, Hot	214, 228
Engine, Hunting	210–211
Engine Knocking, Causes of	225
Engine Lubrication	16–25

	Art.
Engine Missing at High Speeds	155, 303
Engine Not Running Satisfactorily	203
Engine, Removing from Car	102–104
Engine Running Backwards	86–88
Engine Runs on One Cylinder Until Warm	218
Engine, Section of	Figs. 1 & 36
Engine Starter, Description of	55–60
Engine Starting Difficulty	203–205
Engine Starts Easily and Stops Soon	212
Engine Stiff	224
Engine Suddenly Stops Firing	209
Engine Testing	106 & 108
Engine Timing (*see* Ignition).	
Engine Will not Accelerate Sharply	213
Epicyclic Gear, Assembling	346
Epicyclic Gear, Control	61–70
Epicyclic Gear, Engagement of Top Speed	66–69
Epicyclic Gear, Erection in Car	344
Epicyclic Gear, General Characteristics	1.g
Epicyclic Gear, Removal of	341
Epicyclic Gear, Seizure of	353–355
Excessive Priming	258
Exhaust Ports Choked	222
Faults, Locating	201–260
Features	Introduction or Foreword & 1
Fixed Axle, Advantages of	1.k
Flame Extinguisher Gauzes Carbonised	220
Flame Extinguisher Gauzes, Object of	13
Flexible Coupling, Objects of	62
Flexible Coupling, Removal of	103
Float Leaky	304
Foot Pump Primer (*see* Primer).	
Four-Stroking, Causes of	207
Front Axle (*see* Axle).	
Fuse, (Dynamo) Melts	80.D
Fuse, Main	242–243
Fuse, Size for Dynamo	126
Fuse, Testing Dynamo	125
Garage Inspection	501
Gauzes, Effect of Defective Petrol Gauze	39
Gauzes (*see* Flame Extinguisher).	
Gearbox (*see* Epicyclic Gear).	
Gearbox (*see* Reduction Gear).	
Gear Shaft, Removal of	342
General Inspection	501
Generator (*see* Dynamo).	
Gudgeon Pin, Fitting Oversize	116
Hand Pump Primer (*see* Primer).	
Horn Connections	Fig. 59
Hub Caps, Front Wheel	424
Hunting of Engine, Causes	210–211
Ignition Advance Described	83–85
Ignition Current	161
Ignition Distributor	76
Ignition, Not retarded for Hills	85
Ignition Suddenly Ceases	209
Ignition System Described	76–78
Ignition Timing	151–159
Ignition, Warning of Retarded	60, 84
Joint, Crank Case	118 vi.
Key, Back Axle	409
" Ki-Gass " Primer (*see* Primer).	
Knocking	225
Lamps Burn Out	80a
Lamps, not Bright	122–124
Lamps Fail	202a and 242 *et seq.*
Locating Faults	201–260

	Art.
Low Gear, Disengagement	70
Low Gear, Engagement	63–65
Low Gear, Fitting New Band	347
Lubrication (*see* Particular Part).	
Main Fuse (*see* Fuse).	
Manual, Objects of	1, a-d
Misfiring (*see* Engine).	
Mixture Defective	257–261
Mixture, Effect of Poor	14–15
Mixture, Effect of Rich	101
Mud Excluder Choked	260 ii.
Mud Excluder, Function of	27
Nuts Loose	502 (48)
Oil, Circulation in Engine	16–25
Oil Grooves in Bearings	III iv.
Oil, How Retained in Tank	40
Oil, Mixing with Petrol	40a
Oil Pipes, Attaching Unions	302
Oil, Proportion in Petrol	16
Oil, Quantity Added to Dry Engine	106
Oil, Separation from Petrol	40b
Oil Strainers	23
Oil Unmixed in Tank	40a
Oil Ways, Cleaning and Testing	109 x.
Pawl Operator Plate, Action of	57–60
Petroil, Correct Proportions	16
Petroil, Mixing	40a
Petrol Cock	32–41a
Petrol Gauzes Defective	39
Petrol Pipes, Attaching Unions	302
Petrol Pipes Choked	325
Petrol Reserve, Action of	36–39 & 41
Petrol Tank, Removal of	487
Petrol Tank and Reserve, Advantages of	1.n
Phantom Volts	144
Pipes, Attachment of Unions	302
Pipes, Choked Petrol	325
Piston Rings, Removing	109 ix.
Piston Rings, Seized or Scored	109 vi. & vii.
Piston Rings, Seizure, Cause of	224
Pivot Pins	416–422
Plugs (*see* Spark Plugs).	
Ports Choked	222
Power, Gradual Loss of (*see* Instruction Book).	
Pre-ignition	163, 225
Prevention and Causes of Back Fires	86–88
Primer, Foot Pump Type, Action of	44–54
Primer, Foot Pump Type, Defects in	49, 52–54
Primer, Gravity Type, Action of	35 & 42
Primer, Hand Pump, Conversion to	239c
Primer, Hand Pump, Failure to Operate	239a–b
Primer, Hand Pump, General Description of	54a
Primer Out of Order	232
Priming, Excessive	258
Radiator, Frost	486
Radiator, New Rubber Ferrule	485
Radiator, Removal of	484
Radiator, Too Cool	230
Radiator Water all Gone	228
Radiator Water Boiling	229
Rear Axle (*see* Axle).	
Reduction Gearbox, Aligning	359-361
Reduction Gearbox, Removing and Dismantling	357
Reserve Petrol, Action of	36–39 & 41a
Resistance Wire in Coil, Object of	78
Retarded Spark (*see* Ignition).	
Reverse, Fitting new Bands	347
Rich Mixture (*see* Mixture).	
Rings, Removal of	109 ix.

	Art.
Roller Bearing Engine Assembling	118a–j
Roller Bearing Engine Compared with Plain Bearing Engine	25a
Roller Bearing Engine, Interchangeability of Parts	118k
Scored Piston (*see* Piston).	
Scored Cylinder	109 vi. & vii.
Screws Loose	502 (48)
Service Tools, List of	500
Short Circuit	241–249a
Silencer Choked	219
Slow Gear Engagement	63–65 & 70
Spark, Magnitude of	162
Spark (*see* Ignition).	
Spark Plugs, Choice and Care of	163
Spark Plug Troubles (*see* Faults).	
Springs (*see* Flexible Coupling).	
Springs, Objects of Special	1.j
Springs, Removal	401–404
Springs, Rivets Loose	405
Starter Gear, Assembling	119–121
Starter Gear, Description of	55–60
Starter Gear, Lever Stiff or Works up	231
Starting, Difficulty in	202a–205
Steering, Ball End Pins	423
Steering, Features of	1.l
Steering Troubles, etc.	450–461
Stops, in Gear Control, Described	65
Sumps, Oil	16–25
Suspension System, Description	1.j–k
Switch, Automatic Control (*see* Cut-out).	
Switch Block on Dynamo	124
Switch Board Connections, Accessibility	82
Switch Board Connections, Loose	202a
Tank, Baffled	40a–ii.
Tank, Petrol, Removal of	487
Taper Cotter Bolts, Assembling	449
Tell-tale Spring, Setting	121
Testing Newly Assembled Engine	106-108
Third Brush Regulator	122
Throttle Opening Insufficient	223
Throttled Petrol Supply	212
Throttled Petrol Supply, Testing for	303
Timing Ignition (*see* Ignition).	
Tools, List of Service Tools	500
Top Speed Engagement	66–69
Torque Tube, Divisible	403a
Tracking Front Wheels	460
Transmission Bands, Fitting New	347
Transmission, Reason for Chain Drive	1.h
Trojan, Advantages of	1.r
Trojan, Primer (*see* Primer).	
Trojan, Principles controlling Design	1.b
Troubles, Their Diagnosis and Cure	201–260
Tyres, Fitting New Solid	482
Tyres, Regrooving 2 in. Solid	481
Undissolved Oil, How Retained	40
Unmixed Oil in Petrol Tank	40a
Voltage of Battery	143
Water (*see* Radiator).	
Warning of Retarded Spark	60–84
Warning of Retarded Spark, Setting Spring for	121
Weak Compression	227–235
Wheels, Buckled	483
Wheels, Disc, Advantages of	1.p
Wheels, Front Hub Caps	424
Wheels, Tracking Front	460
Wire, Fuse (*see* Fuse).	
Wiring	Fig 59

INTRODUCTION.

1.a The object of this manual is to enable those in charge of Trojan cars to understand these vehicles and get the best out of them. The introduction outlines the general principles guiding the designer in his break away from non-essential conventions in motor car design and explains broadly how it has been possible to secure the remarkable qualities which characterize the Trojan.

Thereafter a description of the mechanism and its action are dealt with in Part I and information with regard to treatment, adjustment, dismantling and assembling in Part II.

1.b The Trojan is not just a small edition of a large car—its design does not seek to obtain the effects produced by large car mechanism by utilizing parts smaller or of inferior material—a process which involves no diminution in the numerous adjustments and attentions characteristic of the complicated design of ordinary motor vehicles. The design has, subject always to the use only of sound engineering methods, been directed to simplicity and reliability but the car resulting being different from ordinary cars must be treated accordingly and because of the differences from typical practice even the experienced automobile engineer will find this book worthy of perusal.

1.c The compilation of this "Service Manual" has been prompted by the circumstance of the Trojan's design. The Manual indicates in non-technical language with the aid of a number of simple illustrations, the mechanical and maintenance differences which this advanced line of design has involved. A perusal of its pages by those who may, from time to time, have to render Trojan service, whether as enthusiastic amateurs or maintenance experts, should serve at once to indicate the simple nature of the principal units, the entire absence of complications and the numerous instances of ingenuity which characterize the design. This Manual is not in any way intended to supplant the small Instruction Book which is issued with every car.

1.d The Trojan makes a special appeal to many thousands who have waited for the appearance of a car of this kind before daring to become the possessor of "something to get about on." Such users, as a rule, will show little inclination to know more of the anatomical details of the machine than those of their lawn mower, their sewing machine or their telephone receiver—and they will be quite right! In the hands of the general user the machine will function with no more specific care than is indicated on the ordinary Garage Maintenance Card. Beyond that, in the rare event of trouble arising, or of a replacement part being required in the usual course of wear and tear, the service man is, as a rule, called in. Nevertheless the enthusiastic amateur or owner who so desires can, with the aid of the present publication, deal with the ordinary happenings which may be expected in the course of thousands of miles of running.

1.e *The Engine.* The four-cylinder engine works on the two-stroke principle and is valveless. It has only seven separately moving parts, as compared with from twenty-six to forty-three in an ordinary four-cylinder four-stroke engine. The seven moving parts can be withdrawn from the engine in one unit.

The absence of poppet valves and their tappets renders the engine as a mechanism practically silent. The exceptional power given out at low speeds makes the Trojan an ideal top-gear vehicle, both on hills and in traffic.

Decarbonising troubles and foul plugs are eliminated.

1.f Engine lubrication anxieties do not exist. As the oil is mixed with the petrol, the supply of oil cannot fail until the petrol has run out, when, of course, the engine stops. (Art. 40a).

The system of lubrication, as explained later, enables the inexperienced user to obtain maximum economy of oil.

The distribution of gases makes the engine remarkably light on petrol compared with ordinary " two-strokes " and even compared with four-stroke engines running on light throttle, as is usually the case on the road.

1.g *Epicyclic Gearing* as is common knowledge gives the easiest and sweetest means of changing speed. It will stand the greatest abuse and gives an emergency brake of remarkably efficient character. Comparatively it is not cheap to manufacture, but when, as in the Trojan, the control is effected by the orthodox gate change and clutch pedal, it is the ideal system.

1.h *Transmission.* The chain as a drive in ordinary car practice is out of fashion as its use is usually associated with noise, but the duplex chain compares favourably with many transmissions on this point. Further it still holds the field for such strenuous transmissions as are demanded in racing cars, motor cycles and heavy commercial vehicles.

Owing to the liveliness of the back axle when traversing bad roads, it is not commercially possible totally to encase the chain, nor indeed is it desirable so to do, bearing in mind the importance of keeping down unsprung weight, but the vertical plate between the wheel and the chain under the mudguard protects the chain from the worst of the mud and an excellent chain life is secured.

Further, the use of a chain, with the special spring system used, enables radius rods, torque rods and shackles with the expense of their maintenance, to be eliminated.

1.j *Springs.* With such an exceptionally flexible suspension the large amount of energy which has to be stored up in the springs necessitates a large amount of the highest quality steel; the springs are consequently heavy compared with those of most small cars. Thus in spite of the large deflection, there is an ample factor of safety, and the system of riveting, apart from being necessary for this design, avoids the customary bolt right through the centre of all the plates, which is a great source of weakness.

To absorb the road shocks effectively without using pneumatic tyres, the springs have to be very flexible, and it is impossible to design a simple spring to suit both heavy and light loads; the addition of extra passengers or luggage, farther back than is provided for in the standard design will cause the back springs to come down on the buffer stops, but if required an auxiliary spring system is available at but little extra cost, which without sacrifice of comfort with light loads gives efficient springing with heavy loads.

1.k *The Rear Axle.* The real axle is very light though strong, which fact enables the wheels to follow the irregularities of the road surface. The chain drive being at the side, the absence of a differential and the great distance apart of the springs, bring the inertia forces as well as the weight of the car very close to the supporting wheels, and there is no mass of metal and no bolted joints in the centre of the axle, i.e., in the weakest place.

The width apart of the springs, combined with the rigid attachment to the axles, make the car very stable and give it a high rolling period in spite of the low bouncing period: conditions, essential for comfortable riding, which are found in combination only on the most expensive cars.

The absence of the differential not only makes the car hold the road much better, but it prevents it from

skidding round in grease, and makes it possible to go through fairly deep snow and over soft grass.

The Front Axle combines strength with lightness, and the whole is made from forged steel without the inclusion of any castings.

1.l *The Steering*, although reversible, has a big reduction and is so constructed that mere wear causes a negligible amount of back lash. Irreversible steering is desirable on heavy, high speed vehicles, but with light cars of moderate speed it is preferable and safer not to attempt to absorb the whole of the road shock in the steering gear. Springs are provided in the ends of the steering coupling rods, which, besides helping to absorb shocks, take up any wear, and so save maintenance costs and back lash in the joints.

1.m *The Controls* are so arranged that everything can be operated from the driver's seat, and even the incapacity of a leg or the left arm does not seriously inconvenience the driver.

The Mixture Lever is a refinement lacking on many cars, with the result that if the carburettor on such a car is tuned up and set to give economical running, little power is obtainable until the engine gets hot and the pick up and hill climbing are impaired even when hot.

The Primer provides the equivalent of flooding the carburettor and can be operated without leaving the driver's seat.

1.n *The Petrol Tank* is provided with a sump at the lowest point, in non-corrodable material, which enables water and sediment to be trapped and drawn off at intervals, and so avoids the possibility of these upsetting carburation. Petrol leaves the tank through a very fine gauze filter into pipes which stand above the bottom of the tank; water and unmixed oil are thus prevented from reaching the carburettor.

Petrol Reserve. The pipe from the main petr supply stands higher than the reserve pipe, leavi about a gallon of petrol for reserve purposes. Thu when the car is in regular use for ordinary utili purposes, the petrol need never be gauged, as th gallon remains after the main supply is exhauste

The main supply pipe is provided with a patente syphon top which cuts off the supply of petrol sudden when air gets into the syphon. Except for this, t intermittent supply of petrol caused by splashi over the stand pipe would result in prolonged irregul running, the reason for which might not be apparen

1.o *The Carburettor* is designed to give automatical the same petrol-air mixture under all conditions witho employing moving parts sensitive to the engine suctic and consequently subject to wear and to becomi noisy. Further, there are no adjustable parts to l accurately re-set after the carburettor has been con pletely dismantled.

The Float Chamber Needle is operated by the cent of the float without the use of levers to reduce i efficiency. The main jet is close to the float chamb and so is unaffected by the tilting due to road camb and hills.

The outlet from the sump in the float chamb cover and the outlets from the float chamber itse are well above the bottom so that a large amount sediment may collect without ill effect.

The Radiator, placed as it is inside a cowl enabl it to be cheaply renewed in the event of accident damage.

1.p *The Disc Wheels* are dished to withstan effectively the forces imposed upon them. The metho by which the solid tyre is held on the conical surface of the wheel flange and of the detachable rim enabl

all the advantages of "band tyres" to be obtained, without requiring the use of a large press for changing the tyres, which would necessitate sending the wheels away to have new tyres fitted.

The advantage of disc wheels from a cleaning point of view and their immunity from atmospheric conditions are well known.

The Punt-like Frame provides a strong, light means for carrying the various car units and keeps everything clean without the use of troublesome undershields. If smoke is produced, e.g., through speed bands rubbing or slipping, the driver is immediately warned before any damage is done.

1.q *The Electrical Equipment.* Nearly all motorists have trouble with their electrical equipment sooner or later, and for this reason very great attention has been given to this, with the idea of eliminating everything not absolutely necessary and so arranging the remainder that those with the minimum of electrical knowledge can follow it.

That the "earth" return system is unsatisfactory from an electrical equipment manufacturer's point of view is obvious, as he cannot make himself responsible for the earth return circuits. *When, however, the car is designed for an earth return system with earth connections efficiently electrically connected,* this earthing trouble disappears and not only is the quantity of wiring at once halved, and that used can be of lighter capacity, but the whole system becomes so simplified that it can be likened to a system of pipes carrying water or gas, being generated from some source of supply and being led to the various places required.

Reference to the wiring diagrams, Fig. 59, and the Instruction Book will show, for example, how the current for the head lamps leaves the positive of the battery by the pink wire which takes it to the switch; thence it passes via the black twin wire to the head lamp where it is earthed; if the current were not earthed here it would have to be returned to the negative of the battery by another wire. The wiring diagram is not conventional and may offend the eye of an electrician, but it clearly shows the disposition on the car, and the colour of each cable makes it easily identifiable. By merely removing the switch board cover, all the terminals and the ends of the wires are visible and accessible.

1.r *In conclusion* the low cost of the car is due to the elimination of parts and not to the use of inferior workmanship or material. Aluminium die castings and steel stampings are largely used. Although ball bearings are used in every important place, the design is such that only eleven ball bearings (excluding those in the dynamo) are necessary, although many cars contain as many ball bearings in the back axle alone.

Again although the engine is started from the driver's seat, the confusing complication and attendant unreliability of the ordinary electric self-starter is replaced and avoided by a few simple levers.

Shackles, dumb irons, radius rods, torque tubes and universal joints are eliminated. The simplicity attained results not only in greatly reduced cost of overhauls but in greatly increased reliability, while the economy of the engine in fuel and oil, coupled with the use of solid tyres, reduces the running cost to a minimum.

It is well to remember, therefore, that the ordinary troubles that beset the average owner of the conventional light car are not to be anticipated on the Trojan. To tackle the ordinary maintenance work of a Trojan on lines which have been considered satisfactory for the normal type of car, may not be the easiest way to go about the work of keeping the Trojan in order—the problems to be met with are generally simpler, and they are more easily cured. It is the purpose of this Manual to set out those problems, and to indicate the simplest way of dealing with them.

PART I.

GENERAL DESCRIPTION OF THE DESIGN.

THE ENGINE.

CYCLE OF OPERATIONS.

2.—Figs. 2, 3 and 4 represent a vertical section through one pair of cylinders, and Fig. 1 represents a vertical transverse section through the inlet ports, *i.e.*, through A.A. in Fig. 2.

The Trojan engine contains two distinct and separate crankcases. The right hand cylinders share a common combustion chamber, and the left hand cylinders are similarly connected.

3. Before considering the cycle of operations proper, it will be helpful to realise how the explosive mixture of air and petrol passes from the carburettor into the cylinders. The pistons act as a pump. In receding from the crankcase they create therein a partial vacuum, until the skirt of the lower piston uncovers the inlet port, which opens up communication between the carburettor and the crankcase.

4. The space in the crankcase is thus filled with an explosive mixture drawn from the carburettor, which mixture, on the return of the pistons, becomes compressed, and is driven through the transfer port as it becomes uncovered by the head of the upper piston.

5. This compression in the crankcase, and transfer of the new charge into the combustion chamber, is effected in every complete revolution of the crank, *i.e.*, in two strokes of the pistons. On the other side of the pistons, namely, the side remote from the crankcase, the processes of charging, compression, explosion and exhaust are effected. As the Trojan engine, being a two-stroke, has an explosion occurring in every two strokes of the pistons, it will be obvious that one stroke cannot be devoted to each of the processes, as is the case with the four-stroke engine. In two-stroke engines, two operations are dealt with in each stroke; in one, the charging and compressing, in the other, the exploding and exhausting.

6. In order to follow *STROKE* 1 (*CHARGING AND COMPRESSING*), let us assume that the pistons are at the limit of their travel away from the combustion head, and that the upper piston has uncovered the transfer port. The mixture already in the crankcase, as explained above, is admitted into the upper cylinder, and passing through the communication port into the lower cylinder, fills both. The pistons, in travelling towards the combustion head until they reach their opposite limit, compress the mixture.

7. On *STROKE* 2 (*EXPLODING AND EXHAUSTING*), ignition occurs when the pistons are approximately at their nearest point to the cylinder head, exploding the mixture and driving the pistons away from the head, until, near the outward limit of their travel, the exhaust port is uncovered by the head of the lower piston, which allows the burnt gases to escape to the silencer (Fig. 3).

This completes "the cycle of operations." The transfer port again opening immediately afterwards, allows the new charge to enter, driving before it any remaining burnt mixture, and expelling it before the exhaust and transfer ports close again for the new cycle.

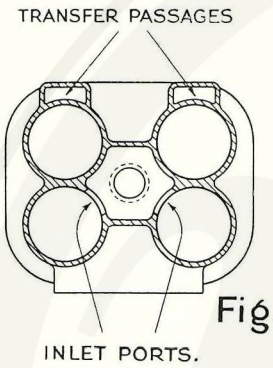


Fig.1

SECTION THROUGH AA.

Fig. 2. I Carburetted air entering vacuous crankcase

IV Compression complete, spark explodes the charge

Fig. 3 II. Compressed explosive mixture in crankcase about to enter cylinder through transfer port.

V Explosion complete, burnt gases escaping through exhaust port. The new charge is about to enter and take the place of the burnt gases.

Fig. 4 III. Transfer from crankcase to cylinders complete, and compression in cylinders about to commence.

VI. III. Repeats.

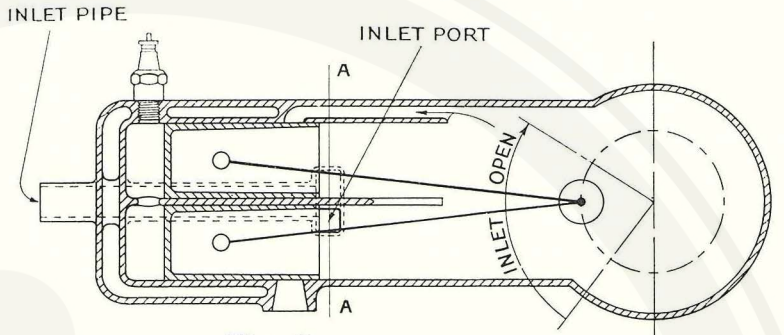


Fig.2

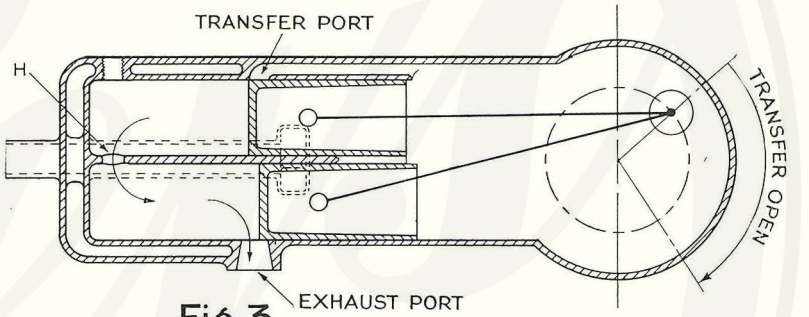


Fig.3

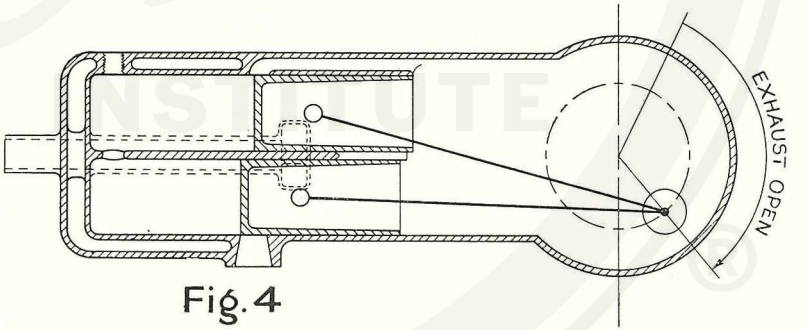


Fig.4

8. If the reader will follow the Roman numerals in sequence, in Figs. 2, 3 and 4, he will be able to trace the passage of a "single charge of gas" through the engine.

9. A careful study of these diagrams will show that the bottom or "exhaust piston" always moves in advance of the top or "inlet piston"; in this principle lies one of the most important features of the engine.

10. In an ordinary single-piston, two-stroke engine, the three ports are controlled by the movement of one piston. The exhaust port must, of necessity, open before the transfer port, as in Fig. 3, and, consequently, it must close after the transfer port on the compression stroke. The result is that the inertia of the exhaust gases in the exhaust pipe, tends to leave a partial vacuum in the cylinder; or, alternatively, if the exhaust port is opened later, that is, barely enough to relieve the cylinder pressure, a blast of exhaust gas takes place through the transfer port into the crankcase.

11. Fig. 3, however, illustrates how, in this duplex engine, the exhaust port opens well before the transfer port, and Fig. 4 shows how it closes before the transfer port. Briefly, the advance movement of the exhaust piston, compared with the inlet piston, enables the exhaust port to be opened early and closed early, as shown by the curved arrow in Fig. 4; the transfer port opens late and closes late, as shown by the curved arrow in Fig. 3, and the inlet port opens early and closes early, as shown by the curved arrow in Fig. 2.

12. Another disadvantage of the single-piston, two-stroke engine, is the tendency for a large percentage of the new charge to pass straight across the piston and out of the exhaust port before the latter is closed, and before compression is commenced. In the Trojan engine, the incoming charge tends to drive the burnt gases before it along the length of the cylinder, instead of across the cylinder. Some of the new charge undoubtedly passes through the communicating hole H (Fig. 3), but, as it continues to drive the burnt gases before it, only a very small percentage of the new charge escapes from the exhaust unused. The quality of the charge in the inlet cylinder is far superior to that in the exhaust cylinder, and, as the plug is in this cylinder, the possibility of misfiring on light throttle is much less likely to arise. The inferior mixture in the exhaust cylinder, in most cases, could not be fired with a sparking plug, but is fired by the combined action of the explosion flame rushing through H, and the heat of compression produced by the explosion which has taken place in the inlet cylinder. This arrangement, then, not only makes the engine particularly efficient, but also enables it to be run on very light throttle without misfiring. Furthermore, the eddy currents produced by the differential movement of the pistons, causing the gases to oscillate through the hole H, maintain turbulence and increase the velocity of propagation of flame.

OBJECT OF FLAME EXTINGUISHER GAUZES.

13. With a very poor mixture the combustion is slow, and if flame extinguisher gauzes were not fitted, the lingering flame of ignition would then fire the incoming charge during transfer, would pass down the transfer passage and would fire the contents of the crank chamber. This is known as a "base fire." As the piston recedes from the crank chamber, the smoky exploded charge would blow out through the carburettor. This is more likely to occur on light throttle. The gauzes, placed as they are, cool and extinguish the lingering flame, and are themselves cooled by the new charge passing through them.

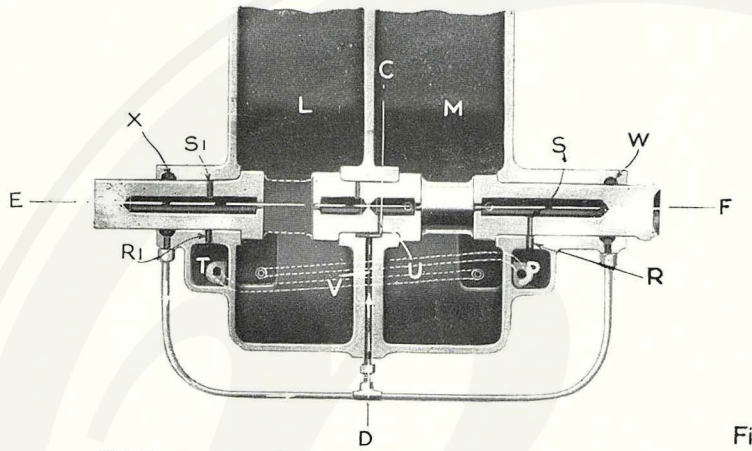


Fig.5. *Horizontal Section thro' Crankcase at A.B.*

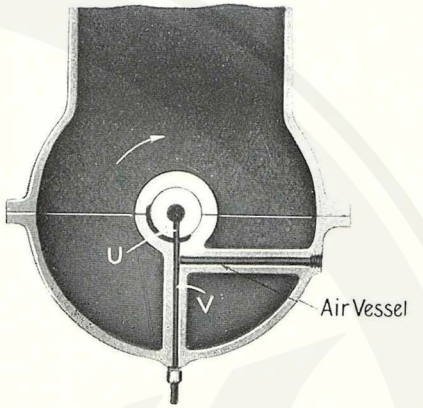


Fig.7. *Vertical Section thro' Crankcase Partition at C.D.*

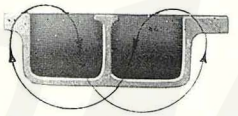


Fig.9. *Direction of Oil Flow in Fig.6.*

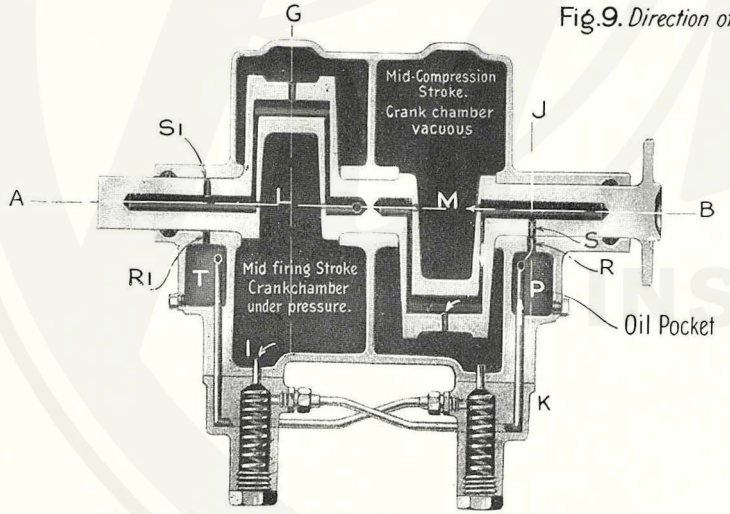


Fig 6 *Vertical Section thro' Crankcase at E.F.*

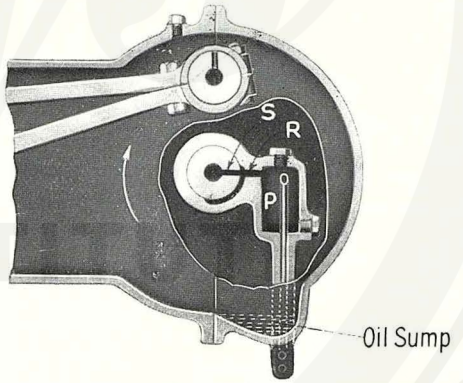


Fig.8. *Section thro' Crank Chamber at G.H. & Oil Pocket at J.K.*

14. If, however, the engine were continuously run on a starved mixture, the flame continually playing against the gauzes would carbonise the oil on them, and destroy their function.

15. **It is, therefore, false economy to drive on such a poor mixture, quite apart from the fact that the petrol so used will fire too slowly to be effective in driving out the piston.**

LUBRICATION SYSTEM.

16. Oil is supplied to the sump in the first instance by the petroil system, but in a new form, which effectually removes the old standing objection, namely, that of imperfect oil circulation. The oil is contained in the same tank as the petrol, the correct proportion of half a pint of oil to two gallons of petrol being ensured by a simple measuring device. (Art. 40a.) After passing through the carburettor, whence it issues in the form of a fine spray, the oil is carried along the inlet pipe, and passes with the explosive mixture into each side of the crankcase alternately as the respective inlet ports are opened. The petrol takes the form of a gas as it vaporises at a low temperature, and allows the oil to fall into the sump of each crankcase. From here the oil is circulated, without the use of separately operated pumps and valves, through two almost independent circulatory systems:—(a) The "figure '8' system," in which the oil is circulated from the crank chamber sumps to the outside main bearings, then to the big ends or crank pins, from which it is thrown on to the cylinder and crank chamber walls back to the sumps. Fig. 9 indicates the direction of flow in the form of a figure 8.—(b) The central bearing system, in which oil is taken from the outside ends of the main bearings to the central main bearing, thence to the big ends and back to the sumps.

17. *THE FIGURE 8 SYSTEM:* Figs. 6 and 8 represent vertical sections through the crankcase of engines previous to No. 5,000, while Figs. 10 and 11 apply to engines subsequent to No. 5,000.

18. The holes R and R_1 in Figs. 6 and 10, and the oil pockets P and T in Fig 6, are shown, for clearness, under the crankshaft bearings, *i.e.*, they are brought into the plane of the paper. The true positions of these parts are shown in Figs. 8 and 5.

19. In Figs. 6 and 10 the under sides of the approaching pistons are producing pressure in the crank chamber L (see also Fig. 8). At the same time, the receding pistons in chamber M are producing suction, or a partial vacuum; when the holes S and R are in coincidence, this suction is communicated to the oil sump of the chamber L, through the hollow crankshaft (see window in Fig 8).

20. Oil which has gravitated into the little oil sump I is subjected, from above, to the pressure in L, and, from below, to the suction in M; it therefore rushes in the direction of the arrows to the hollow crankshaft. It lubricates the main bearing while passing through the holes R and S, and centrifugal force carries it down the drilled web of the crankshaft to the big end bearing, from which it is thrown on to the walls of the cylinder and crank chamber.

21. It will be noted that since the holes in S_1 and R_1 in the other main bearings are remote from one another the oil flow on this side is momentarily arrested.

22. When the crankshaft has rotated through half a revolution, the reverse action takes place, viz., the

pressure in M and the suction in L cause a rush of oil and air from the chamber M to the left main bearing and big end. For each stroke the tendency is for all the oil to be driven from the one side to the other, so that, for each revolution, the passage of the oil decribes a "figure 8," as indicated in Fig. 9.

23. The oil is quiescent in the bottoms of the sediment-collecting sumps in Figs. 6 and 10, and the coiled spring Y prevents the passage of particles, which might stop up the oil passages.

24. Fig. 11 shows how the sump for the left crank chamber is in communication with the right main bearing, and vice versa; it also shows how these sumps are jacketed with exhaust gases to prevent the condensation of petrol with cold engines in cold climates.

25. Figs. 5 and 7 explain the lubrication of central bearing and big ends; suction in M is communicated through the hollow crankshaft, and through the hole U to the pipe V and the communicating air vessel. After half a revolution L becomes vacuous, and this vacuum again sucks at V; as the two strokes behave like a double-acting pump, a continuous vacuum in the air vessel is produced.

Engine Lubrication System (Hot Foot)
(Subsequent to Engine No. 5000)

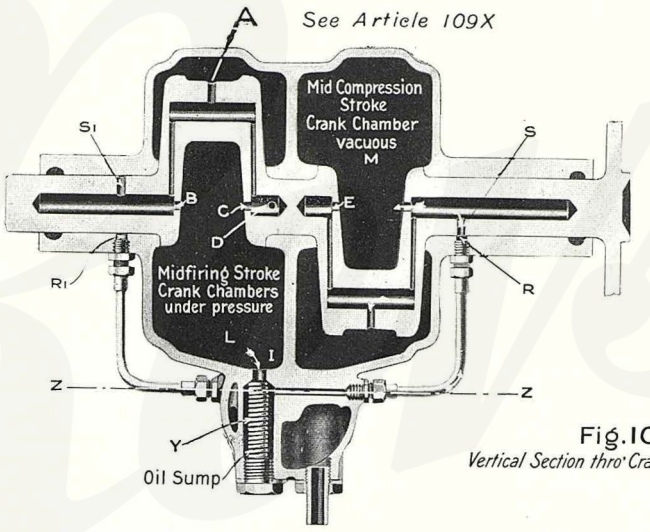


Fig.10.
Vertical Section thro' Crank Chamber.

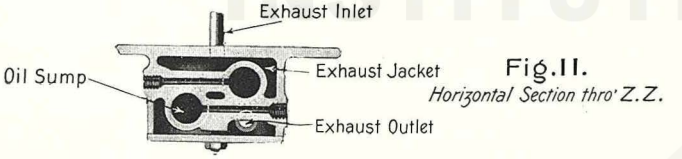


Fig.11.
Horizontal Section thro' Z.Z.

This vacuous air vessel is in communication with two annular grooves W and X, at the ends of the main bearings, and sucks the oil (which is fed by the "figure 8" system and rapidly flows outwards along these bearings) back to the centre bearing, and thence to the big ends, as already explained; at the same time loss of oil from the ends of these main bearings is prevented.

NOTE.—The description in this article applies to engines both before and after No. 5,000.

THE 1,488 c.c. ENGINE.

25a. Engines with the letters X.L. before the engine number have a displacement capacity of 1,488 c.c. instead of 1,527 c.c. They are fitted with roller bearings

in the big-ends, and each crankshaft is built up with three separate parts secured together by means of the crank pins. (Fig. 11a).

The cycle of operations and system of lubrication are the same as previously described except that the oil passes on the outside of the crank webs to the big-ends instead of through holes drilled in the webs.

Although the capacity of this engine is less, the superior port area and balance enable the engine to give more power.

CARBURETTOR.

25b. Cars previous to 9,323 are fitted with the Trojan carburettor, illustrated in Figs. 12 and 13. Cars subsequent to 11,397 are fitted with the Trojan-Amaccarburettor Figs. 12A and 13A.

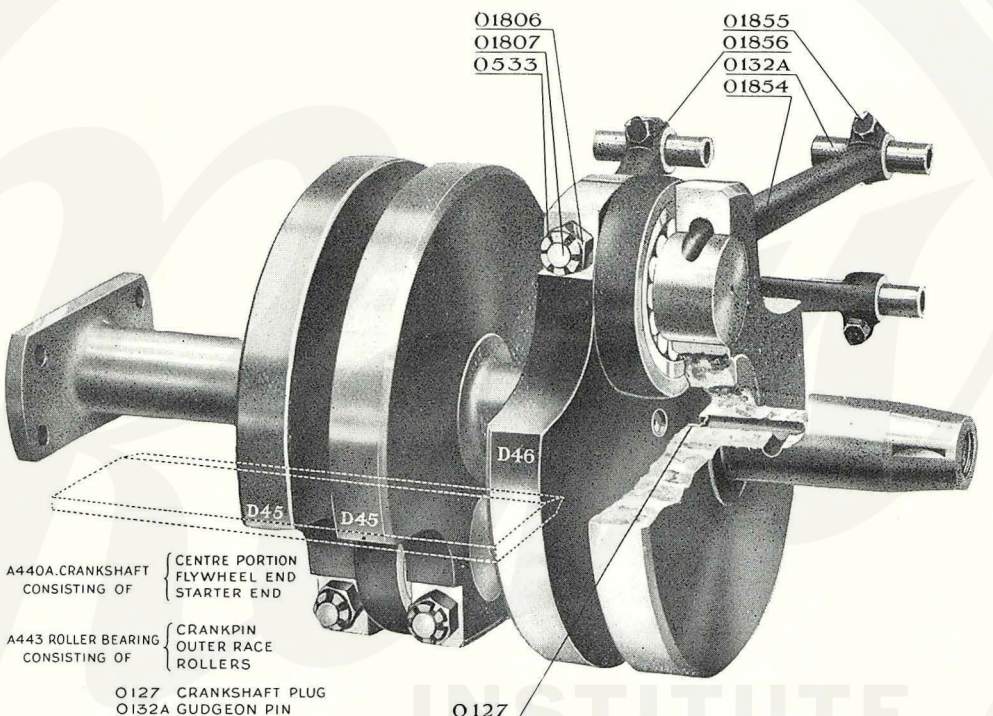


Fig. 11A.

Words in italics in the following description apply to the Trojan carburettor only.

26. Figs. 12 and 12A represent the construction of these carburettors; these are spread out diagrammatically, in order to bring the essential features all into the plane of the paper; Figs. 13 and 13A are true plan views, showing the correct disposition of the parts.

The petrol from the tank enters the filter sump through a copper pipe, and then passes through the needle valve into the float chamber. When the petrol reaches the level as shown by the dotted line, the bouyancy of the float closes the needle valve. From the float chamber the petrol passes through the hcle M to the main jet control, which is a submerged jet directly operated by the mixture lever. From here the petrol can flow to the carburettor jet through the hole N, or to the compensating jet through the hole P, depending upon whether the throttle is open or closed. When the throttle is wide open, the suction on the carburettor jet is considerable, and the proportion of

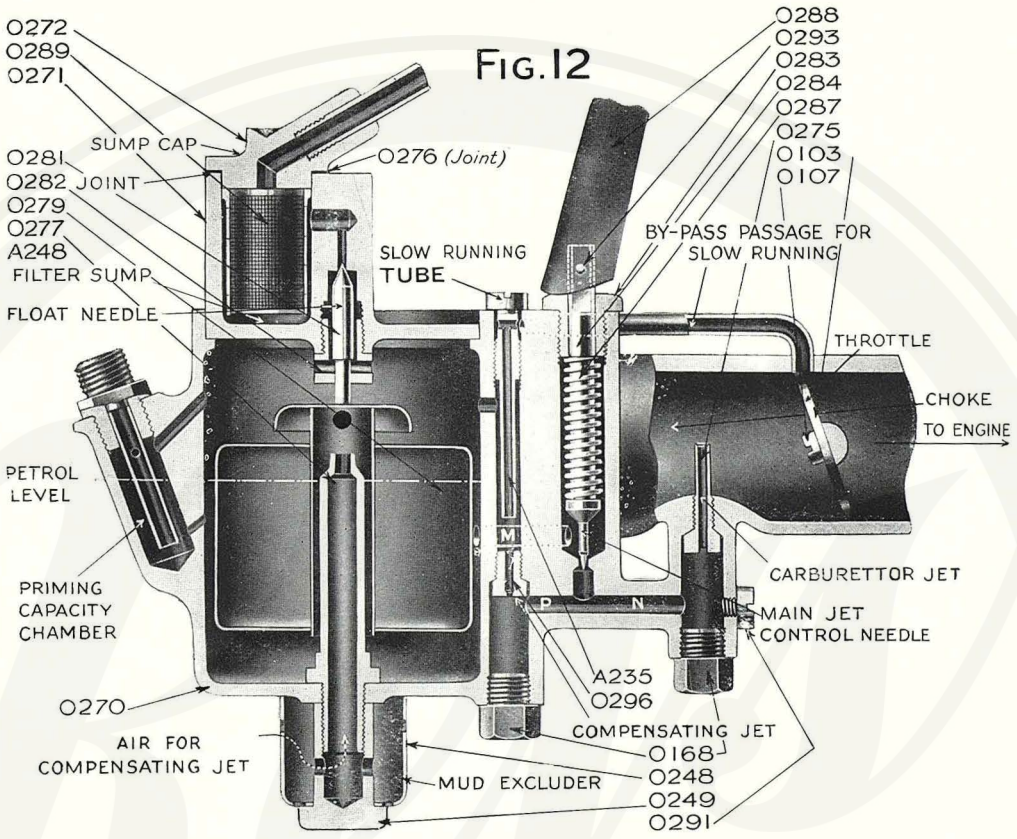
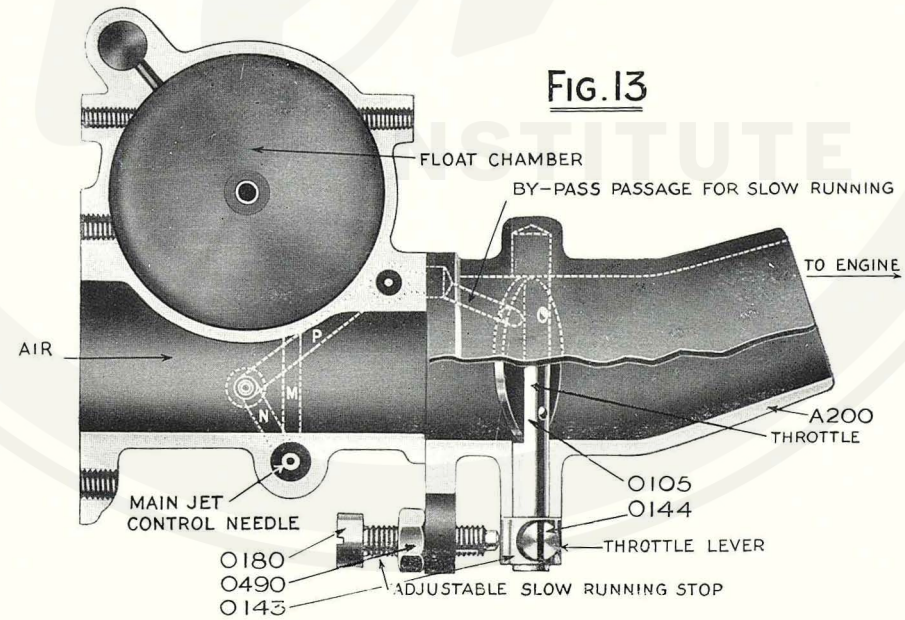

0272
0289
0271
SUMP CAP
0281
0282 JOINT
0279
0277
A248
FILTER SUMP
FLOAT NEEDLE
PETROL LEVEL
PRIMING CAPACITY CHAMBER
0270
AIR FOR COMPENSATING JET
0276 (Joint)
SLOW RUNNING TUBE
0288
0293
0283
0284
0287
0275
0103
0107
BY-PASS PASSAGE FOR SLOW RUNNING
THROTTLE
CHOKE
TO ENGINE
CARBURETTOR JET
MAIN JET CONTROL NEEDLE
A235
0296
COMPENSATING JET
0168
0248
0249
0291
MUD EXCLUDER
M
P
N

FIG. 13


FLOAT CHAMBER
BY-PASS PASSAGE FOR SLOW RUNNING
TO ENGINE
AIR
P
M
N
A200
THROTTLE
0105
0144
THROTTLE LEVER
MAIN JET CONTROL NEEDLE
0180
0490
0143
ADJUSTABLE SLOW RUNNING STOP

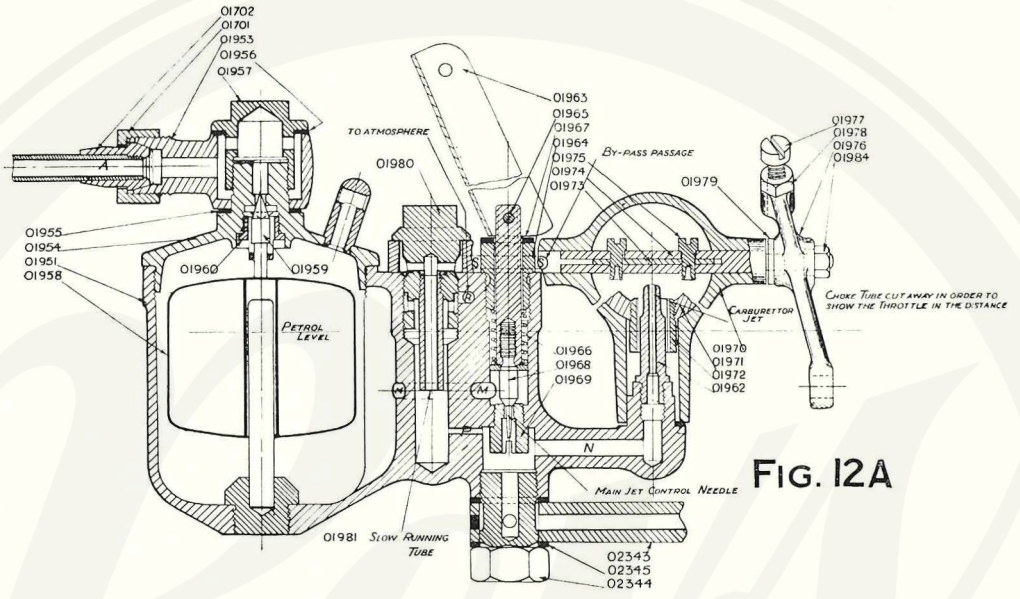


FIG. 12A

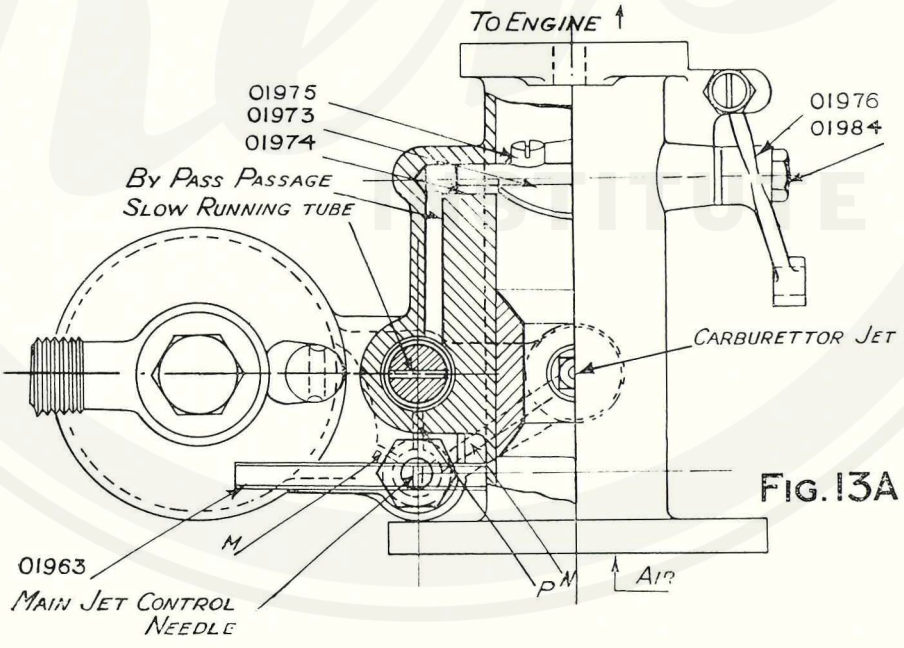


FIG. 13A

petrol to air increases as the suction increases, *i.e.*, if the jet size were set to give a correct mixture at low engine speeds, then at high engine speeds the increased amount of air would take more than a similarly increased amount of petrol, and the mixture would be too rich. This behaviour, which is referred to later (Arts. 311, 316 and 321), as exhibiting "main jet characteristic," would be unavoidable if the compensating jet did not exist, or if it became accidentally choked.

27. The increased suction on the carburettor jet at high engine speeds is prevented from taking too much petrol by the provision, in the compensating jet, of an orifice of the right size, which allows air to pass with the petrol to the carburettor jet when the suction is considerable. This air *enters the float chamber through the mud excluder up the float standard and* passes down round the tubular extension of the slow-running tube, through the compensating jet to the carburettor jet.

SLOW RUNNING.

28. When the throttle is nearly shut, the suction on the carburettor jet is negligible, but that on the by-pass passage is great, and petrol and air pass—as a rich mixture—up through the very small hole in the slow-running tube to the engine side of the throttle, where they are diluted to form a correct mixture by the air passing the nearly closed throttle.

"PICK UP."

29. A carburettor may give the correct mixture for slow running and also for fast running, but, nevertheless, may give a bad "pick up" because, when the throttle is suddenly opened, the carburettor setting is right only for moderate and high speeds, whereas the engine is actually running slowly. With these carburettors, when the engine is running slowly, with the throttle nearly shut, there is petrol above the compensating jet up to the level of the slow running tube. When the throttle is suddenly opened, this petrol momentarily plugs the compensating jet, and so prevents air from passing and mixing with (thus reducing the mixture strength of) the petrol sucked om the carburettor jet.

30. This momentary plugging of the compensating jet allows the engine to accelerate, after which the compensating jet will supply air in the proportion required.

Conversely, when the throttle is suddenly closed the mixture is momentarily impoverished, until the air above the compensating jet is replaced by petrol.

31. The priming capacity chamber represented on the left of the Figs. 12 and 13 takes no part in carburation, so its description is dealt with under priming (Art. 47).

31a. Cars between 9,322 and 11,396 are fitted with Amac Carburettors, particulars of which will be found in the Amac booklet supplied with the tool kit.

THE PETROL COCK.

32. The petrol cock as fitted to cars previous to No. 5,000 is represented in Figs. 14-20. At first sight, this appears to be a complicated piece of mechanism, but it is simple for the number of functions it has to perform.

33. Besides controlling the supply of *petrol to the carburettor* and *withholding water and dirt*, it supplies a measured quantity of *petrol for priming* purposes, retains a gallon of *petrol for reserve* purposes, and also prevents *undissolved oil* from passing to the carburettor.

34. Fig. 17 represents the plug in the "off" position, in which position petrol may enter the priming capacity through either the main supply syphon or the reserve stand pipe, the displaced air being able to escape through the air vent shown in Fig. 15.

PRIMING (CARS PREVIOUS TO 5,000).

35. On turning the petrol control handle to the left, Fig. 18, the measured quantity of petrol flows from the priming capacity to the primer, its place being taken by air entering through the air vent, a

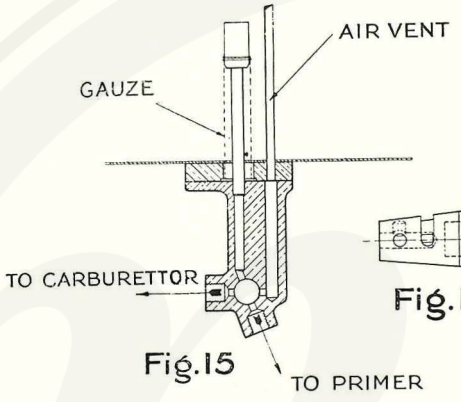


Fig.15

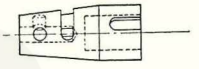


Fig.14

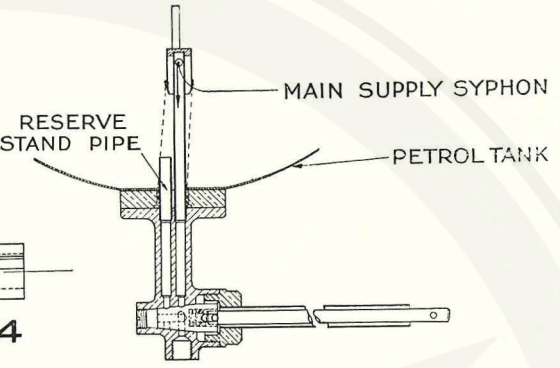
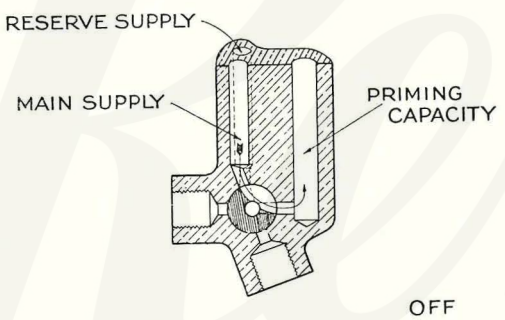


Fig.16



OFF

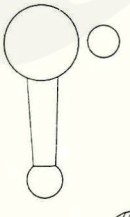
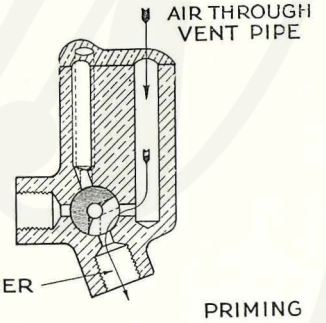


Fig.17



PRIMING

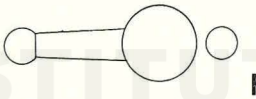
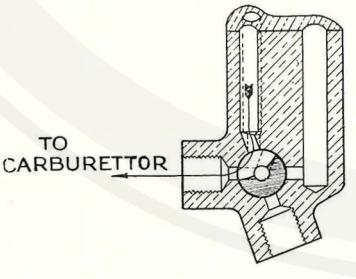


Fig.18



ON

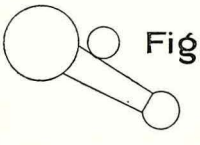
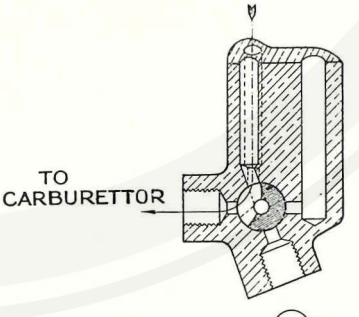


Fig.19



RESERVE

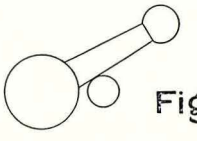


Fig.20

pipe which extends right up to the tank filler opening. It will be seen that, in order to supply more petrol to the primer, the petrol control handle must be returned each time to the "off" position for a couple of seconds, to enable the priming capacity to refill.

RESERVE PETROL.

36. When the petrol control handle is in the "on" position, Fig. 19, petrol from the tank can pass through the fine gauze and the main supply syphon, to the carburettor float chamber. If this main supply syphon were to consist of an ordinary open-ended stand-pipe, the petrol supply would not be cut off suddenly as the level sank below the top of the pipe, because petrol would splash into the top of the pipe, giving an intermittent supply for perhaps ten miles and causing the driver to suspect ignition trouble, choked petrol pipe, etc.

37. The patented syphon top, however, allows the petrol to syphon over for some time after the level has sunk below the top of the pipe, because the fine wire gauze wetted with petrol also acts as a tube impervious to air. As the petrol level sinks, the partial vacuum inside the syphon breaks the petrol film on the gauze, sucks air through the gauze, immediately destroying the syphon action and suddenly shutting off the petrol in a manner which leaves no doubt in the driver's mind.

38. When the petrol supply thus ceases, the driver should at once turn the petrol control handle in a clockwise direction, Fig. 20, and, if the clutch is left in engagement, firing will recommence in a few seconds. Petrol is now supplied through the reserve stand-pipe, Fig. 16, and the left hand end of the plug, Fig. 14. The tank should be replenished at the first opportunity.

39. It will now be apparent that, as the successful action of this device is dependent upon the wetted gauze being impervious to air, a punctured gauze or defective binding, Fig. 15, will bring about the intermittent firing troubles associated with an ordinary open stand-pipe.

UNDISSOLVED OIL.

40. If the reserve stand-pipe were flush with the bottom of the tank, not only would water and grit tend to gravitate into this pipe, in the event of the gauze filter becoming defective, but, on replenishing the tank with petrol and oil, some of the oil would settle undissolved; if, then, the control handle were turned to "reserve," this oil would fill the float chamber and cause trouble. The projecting reserve stand-pipe effectually eliminates this source of trouble.

MIXING THE OIL WITH THE PETROL.

40a. Care should be taken to ensure that the oil is properly mixed with the petrol; without this precaution there is a danger that the oil, which is heavier than the petrol, will fall straight to the bottom of the tank, and will not mix. This is liable to happen under the following circumstances:—

(*a*) When an empty tank is refilled by first putting in the whole proportion of oil, and then following with the six or seven gallons of petrol.

(*b*) Constantly travelling on good level roads.

(*c*) Careful driving (particularly in cold weather).

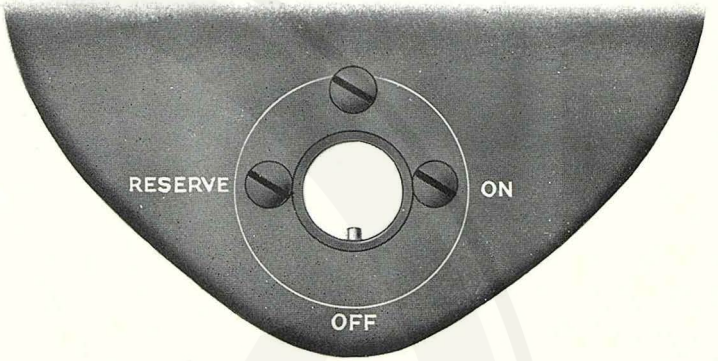
It will be noticed that all the conditions above named minimize the "wash" at the bottom of the tank.

To ensure good mixing:—

i. The oil may be mixed with the petrol in another vessel before being added to the tank.

ii. The half-pint of oil in the petroil measuring funnel may have petrol added to cover the crossbar, the two then being thoroughly stirred before the oil is allowed to leave the funnel.

iii. If the oil is kept in bulk, it may be rendered miscible by thinning it down with one-tenth of its volume of petrol, and mixing thoroughly.



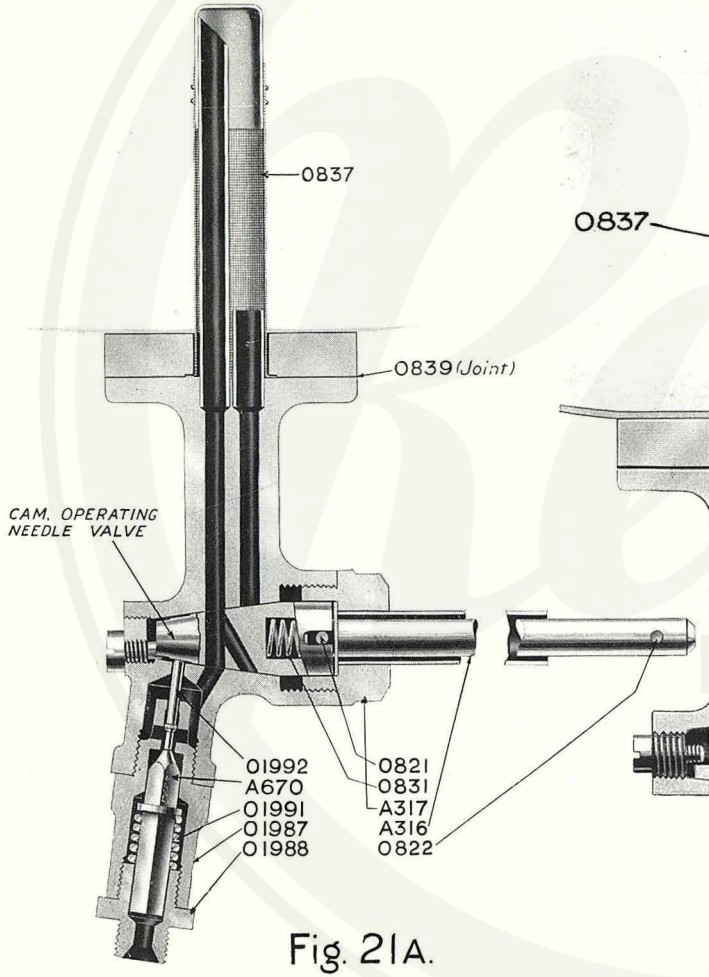


Fig. 21A.

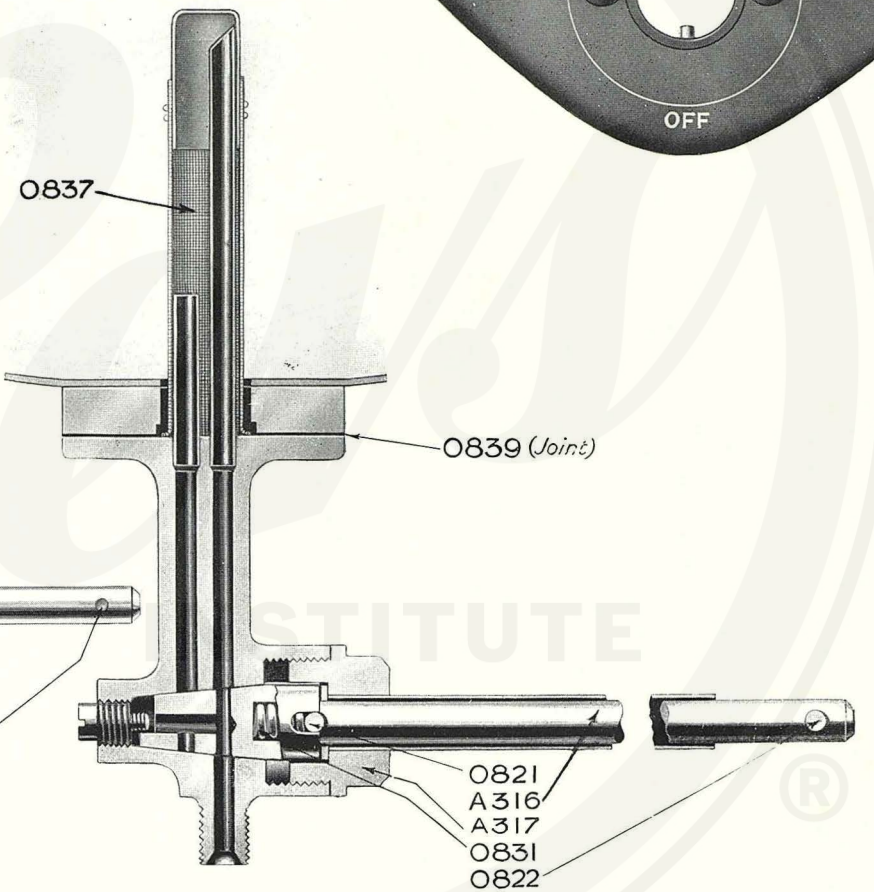


Fig. 21

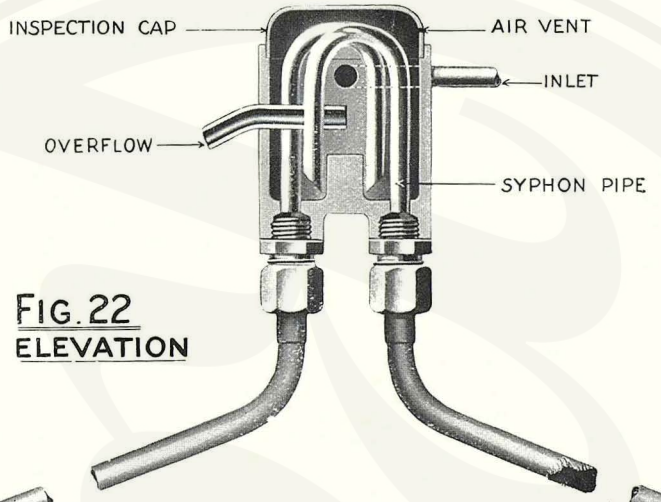


FIG. 22
ELEVATION

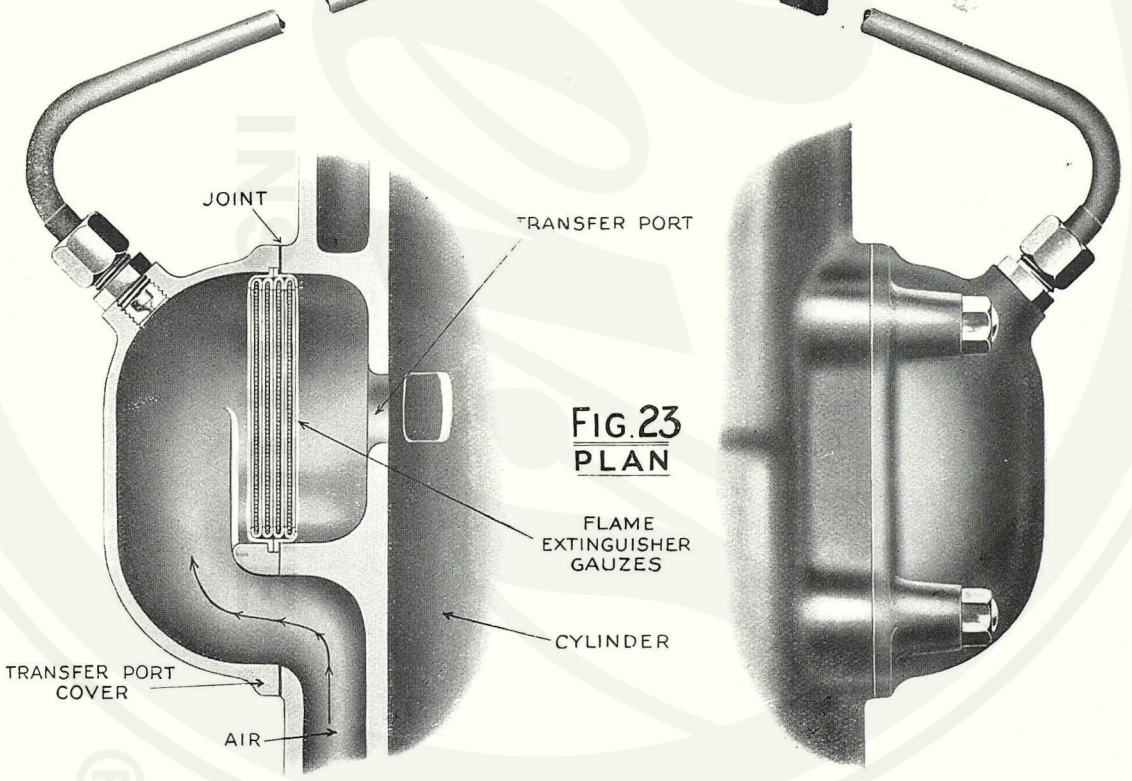


FIG. 23
PLAN

Precautions are unnecessary under the following circumstances:—

i. If no more than two gallons of petrol and the half-pint of oil are added to the tank at one time, because if the addition is made to a fairly empty tank the motion of the car will produce adequate "wash," while if the tank is fairly full when more petrol is added, sufficient oil will already be dissolved therein.

ii. If the tank is fitted with a mixing baffle (tanks so fitted are marked with the letter "B" on the left end), which is the case with all cars delivered on and after December 11th, 1925.

40b. Although the oil is heavier than petrol it never separates after it has once been mixed.

41. Fig. 21 and 21A represent a simpler type of petrol cock fitted to cars after 5,000. These cars have a separate pump for priming, hence the cock is simplified by the exclusion of priming devices. The plug is represented in the "on" position; moving the petrol control handle through a right angle turns the petrol "off," and a further movement of a right angle puts the short or "reserve" stand-pipe in communication with the float chamber, as previously described in Art. 36. Art. 40 explains how grit water and undissolved oil are retained.

41a. In the cock shown in Fig. 21A the taper plug is made with a wide angle to make it easier to turn. Possibility of leakage is eliminated by the needle valve, which is opened in either the "on" or the "reserve" position, and which is readily detachable for inspection.

PRIMER AND PRIMING PUMP.

PRIMER (CARS PREVIOUS TO 5,000).

42. Fig. 22 shows a sectional elevation of the gravity primer, and Fig. 23 an outside view and sectional plan with the transfer covers on the engine. The primer is an intermediate receiver between the priming portion of the petrol cock and the engine transfer ports. It has three duties to perform:—

i. To distribute the priming charge equally to each half of the engine.

ii. To retain the priming charge until the engine is rotated.

iii. To act as a safety device to prevent petrol from flowing into the engine while the car is standing, as the result of tampering with the petrol control handle, or of a leaky petrol cock.

43. The first of these duties is effected by providing the lower part of the primer with a dividing wall. The second because the petrol can only be drawn from the primer into the engine by the sucking action of the rotated engine, and the third, because, when the engine is stationary, should the petrol cock be leaking, petrol fills the primer and then flows through an overflow pipe on to the ground, thus prohibiting any petrol from flowing down the pipe into the engine itself.

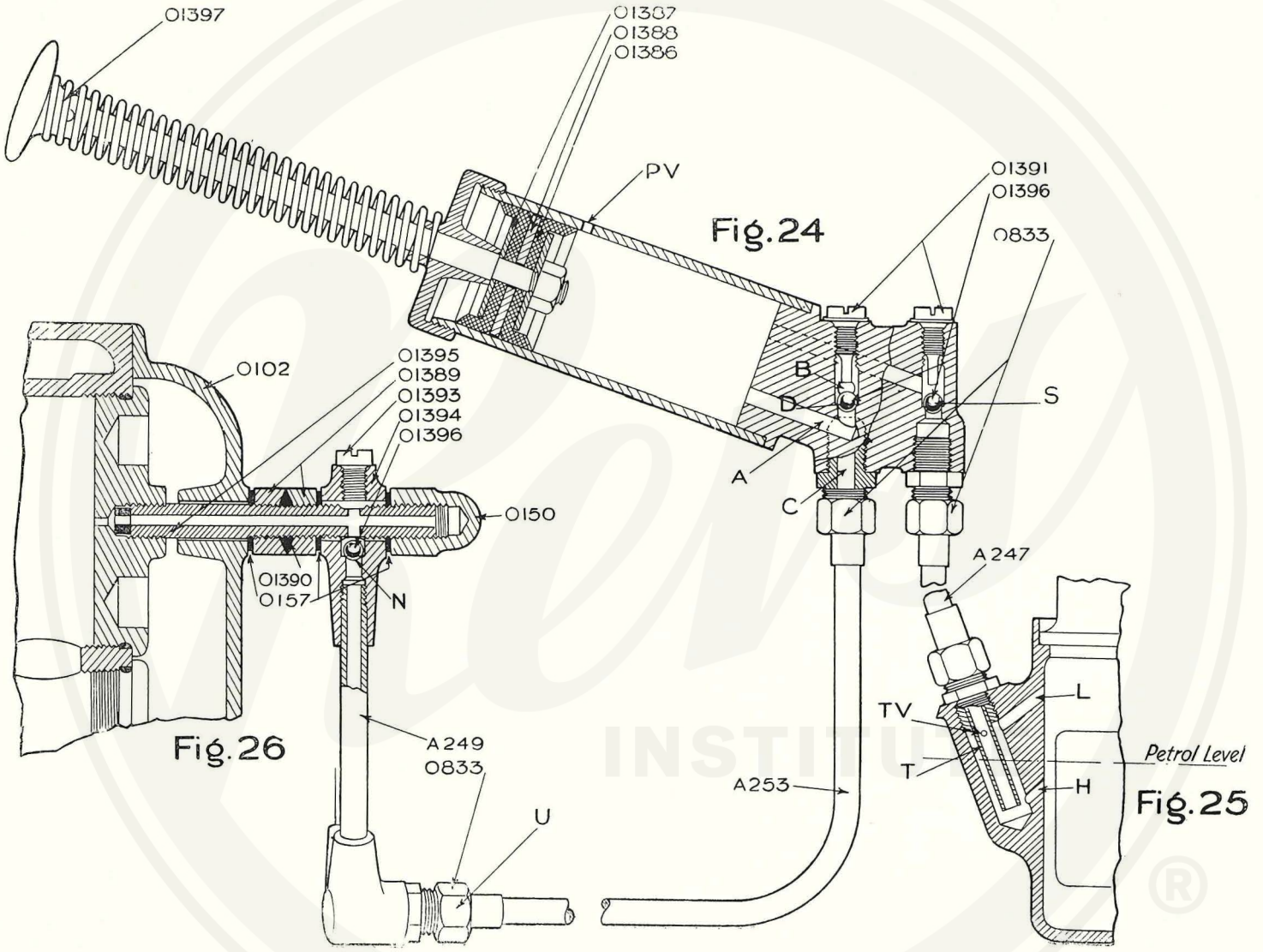
FOOT PRIMING PUMP.

44. Cars between Nos. 5,000 and about 11,300 are fitted with a foot-operated priming pump, which draws a measured quantity of petrol from the carburettor float chamber, and delivers it, with a quantity of air, right into the engine combustion chambers.

Fig. 24 represents the pump. The downward movement of the plunger is effected by the foot, and the spring 01397, thus compressed, gives the return or suction stroke.

45. The pump has a delivery valve D, and a suction valve S. During the suction stroke, the valve D is sucked on to its seat, or closes while S lifts, allowing petrol and air from the priming capacity chamber to enter the barrel of the pump.

46. When the plunger is depressed S closes, and the petrol and air are delivered down the passage A, up past the valve D, through the hole B, and down the


01397
01387
01388
01386
PV
01391
01396
0833
Fig.24
0102
01395
01389
01393
01394
01396
B
D
S
A
C
0150
01390
0157
N
A247
L
TV
Petrol Level
T
H
A253
A249
0833
U
Fig.26
Fig.25

passage C, into the pipe which eventually bifurcates, one branch leading into each cylinder head past a non-return valve N.

PRIMING CAPACITY CHAMBER.

47. Under ordinary circumstances the petrol level in this chamber is as represented by the dotted line in Fig. 25; hence it may be said that this chamber contains a "measured quantity" or dose of petrol. When the pump draws on this chamber the petrol contained therein passes up the tube T first and is followed by air which passes through the large passage L. More petrol slowly percolates through the small hole H, and re-establishes the "measured quantity" of petrol.

48. If a driver primes and pulls (*i.e.*, operates the engine starting lever) alternately, a full dose of petrol is pumped each time, but, if he gives a couple of strokes of the pump in rapid succession, the suction of the pump takes air through T so much more readily than the petrol flows through the small hole H, that a couple of strokes in quick succession will deliver but little more petrol than one stroke. There is, therefore, little chance of the engine becoming over-dosed, while the quantity of air delivered may actually get this dose of petrol into the cylinder heads more effectually.

CYLINDER HEAD PRIMING VALVE.

49. The construction of this is clearly represented in Figs. 26 and 66. The nuts 01389, and the drilled studs 01395, serve to retain the water jacket cover 0102. The countersunk faces of these nuts squeeze a lead washer 01390, on to the thread of the stud, in order to prevent water from creeping from the water jacket, along the outside of the stud and back through the centre into the combustion chamber, where the presence of very little water will render engine starting difficult.

50. The cap nut 0150, and the valve body 01394, can be removed, if necessary, for cleaning purposes, without disturbing the water-jacket joint.

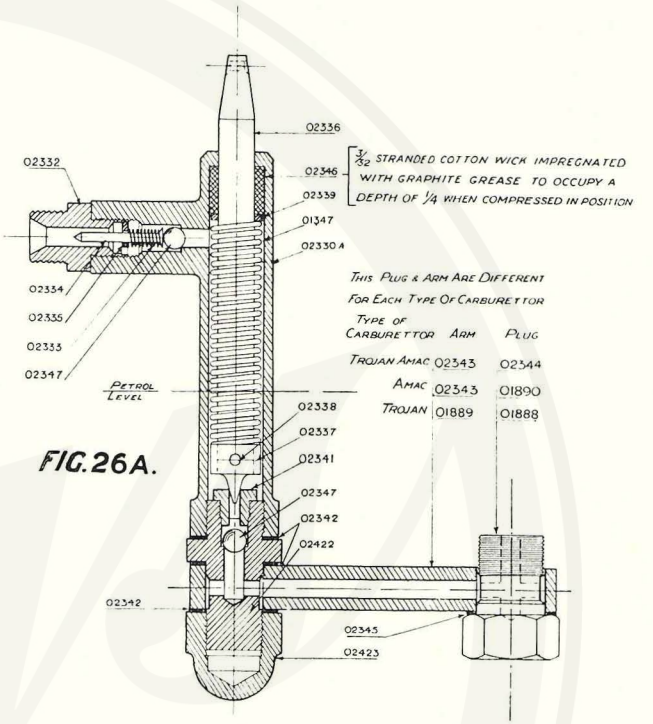


FIG. 26A.

HAND PUMP PRIMER

ATOMISING THE PETROL.

51. The fact that the dose of petrol is pumped first (Art. 47), and is followed by a considerable volume of air, tends to atomise or blast the petrol into spray, thus favouring the conditions for explosion and reducing the likelihood of liquid petrol collecting in the combustion chamber.

During the suction stroke the petrol is atomised into the pump, and during the delivery stroke liquid petrol tends to cling to the surfaces and in the corners of the passages, and does not precede the air right from the capacity chamber to the combustion head.

52. An air vent PV, Fig. 24, is provided to prevent a vacuum from being formed under the pump plunger. If the underside of the plunger were not kept at atmospheric pressure, and a hot engine were allowed to stand and cool slowly, the air in the combustion chambers would contract, causing a partial vacuum in the pump barrel. This vacuum would be transmitted to the priming capacity chamber, and as the contraction would take place slowly, the small hole H would be able to maintain the petrol level, and, hence, a large quantity of petrol might be drawn into the combustion chambers.

53. The tube vent TV, Fig. 25, is insufficient by itself to prevent petrol from being sucked over by the vacuum, and, therefore, the air vent PV is a very necessary provision.

54. *IMPORTANT.*—It is imperative that the pump spring should be strong enough to return the plunger right to the top of its travel, and uncover the vent PV.

HAND PUMP PRIMER.

54a. Cars between Nos. 11,300 and 14,420 are fitted with the "Ki-Gass" primer, a small pump on the instrument board which pumps petrol, without air, from the petrol pipe into the transfer port covers.

Cars subsequent to No. 14,420 are fitted with the Trojan primer shown in Fig. 26A. This pumps petrol without air and it is secured to the carburettor and operated from the instrument board.

54b. The lower end of the plunger is fitted with a needle valve, which is provided to shut off the petrol definitely.

It is important that the petrol should be cut off in this way when the primer is not in use, in order to prevent the engine from sucking petrol past the pump valves.

ENGINE STARTER.

55. When the starting lever is moved through an angle of about 60 degrees, the starter radius arm A 111, Figs. 27, 28 and 29, moves through nearly twice this angle.

The radius arm can move freely over an extension of the engine casting shown on the right of Fig. 28, and carries the pawl A 112. The main starter bracket 0201, is secured to the engine casting by means of six screws; it serves to retain the radius arm in position as well as to hold the pawl out of engagement when in the "home" position.

56. The distance piece 0214 is thicker than the pawl operator plate 0203, which fits freely over it, while 0215 is a washer or ring which retains the pawl operator plate in position. The latter is purposely curved or buckled before assembly, so that it has a slight frictional resistance to rotation by rubbing against 0215 and 0201. The ratchet disc 0217—which also carries the dynamo pulley—is keyed to the crankshaft.

ACTION OF PAWL OPERATOR PLATE.

57. When the radius arm is rotated it carries the pawl with it, and the pin in the latter moves to the end of a slot in the operator plate; hence the operator plate rotates also, but, owing to its slight frictional resistance to rotation, it does not move until the pin reaches the end of the slot.

Reference to Fig. 27 will show that, if the radius arm is moved in a clockwise direction, the movement of the pin to the end of the slot lifts the pawl, tending to make it engage with the ratchet disc. If, however, the radius arm is moved counterclockwise, the pawl is held out of engagement.

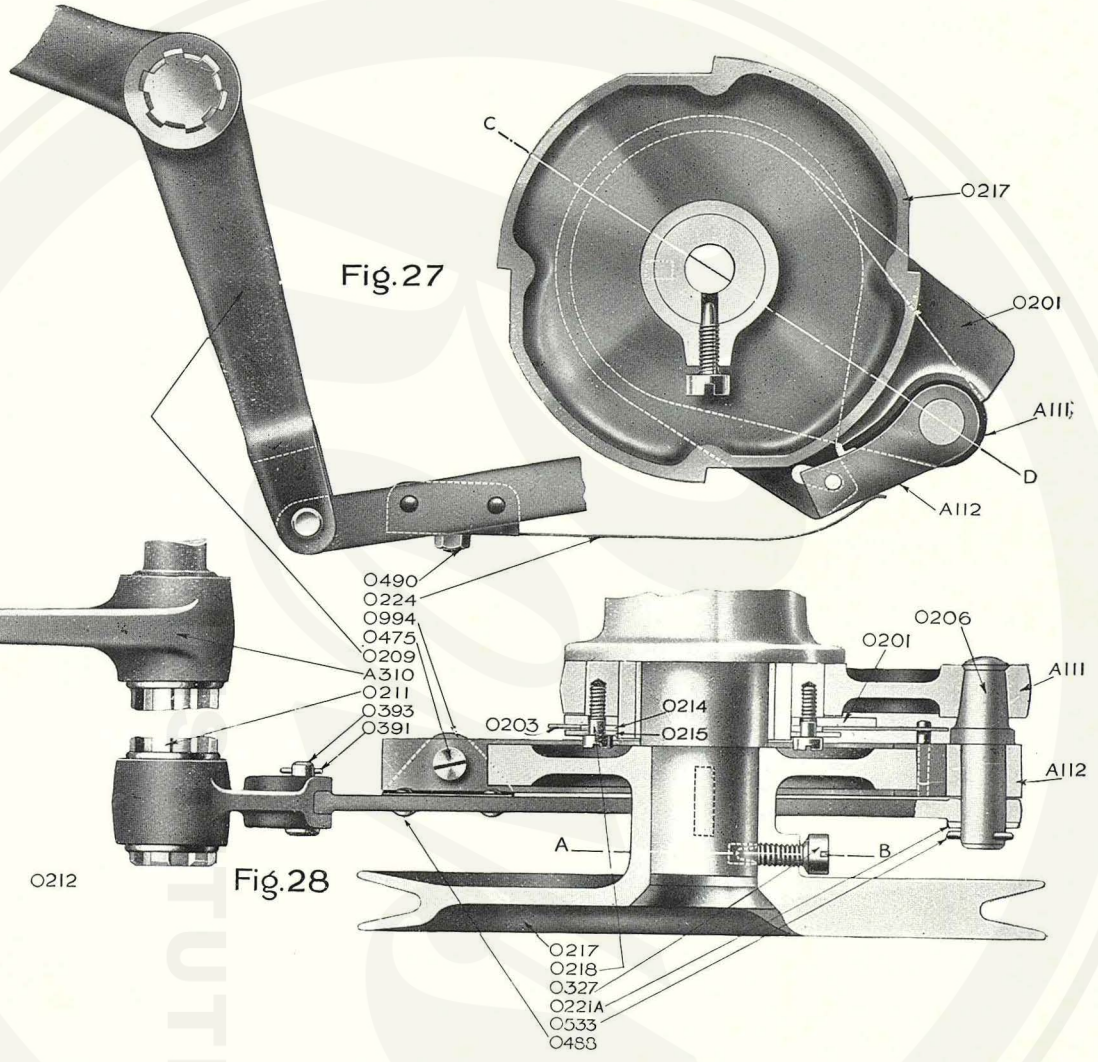


Fig.27

Fig.28

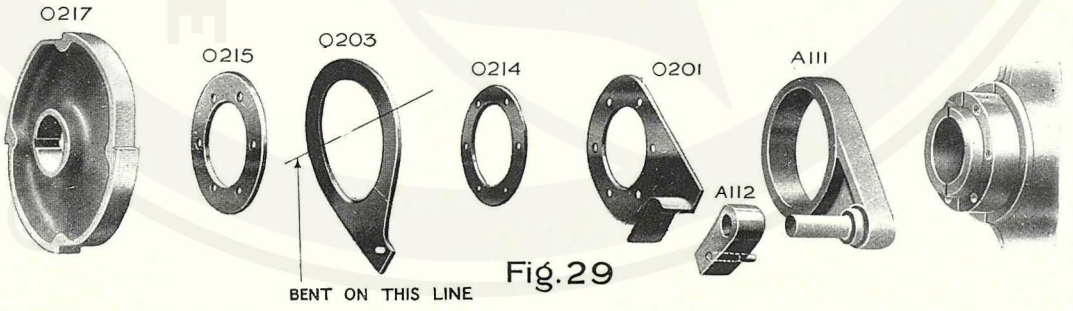


Fig.29

58. It will be seen that, when the starting lever is being pulled up, the pawl engages and the crankshaft is rotated, but, while the lever is being placed "home," the pawl is held out of engagement, and a silent return of the starting lever results.

59. It may be mentioned that the moment the engine fires, the ratchet knocks the pawl outwards, which advances the pawl operator plate, which, in turn, holds the pawl out of engagement.

60. Fig. 28 is not a true projection from Fig. 27, as each is drawn so as to give as much information as possible. If the starting lever is not pushed right "home," or if it subsequently works up, the pawl is not held out of engagement by the pawl lifter at the end of 0201, and the leaf spring 0224 causes the pawl to touch the revolving ratchet, giving a bell-like warning to the driver that the spark is retarded (see Art. 84).

EPICYCLIC GEARBOX.

61. This is carried on the gearbox shaft, the inner end of which is carried on a self-aligning ball bearing held in the flywheel boss, the outer end being carried on the ball bearing between the reduction gear pinion and the transmission brake drum.

FLEXIBLE COUPLING.

62. A flexible coupling between the gearbox and the engine is effected through the radial spiral springs; these springs form a universal joint as well as a very efficient flexible coupling, which prevents all shocks from the engine being transmitted to the gears.

The springs are purposely made just strong enough for their work under reasonable use and abuse, but if subjected to very rough treatment the springs will stretch, and ought to be renewed as soon as convenient; thus a buffer is provided for rough treatment, and consequent damage can be rectified easily, cheaply and when convenient, which would not be the case if the flexible coupling were strong enough to cause gear teeth or other parts to fail first.

CHANGE SPEED GEAR CONTROL.

(Figs. 30 and 31.)

63. As the top gear is capable of dealing with all ordinary conditions, only one emergency low gear is provided, and this is low enough to enable the car to climb any hill on which the road wheels can obtain a grip.

64. The fact that the low and reverse gears are not clutch-controlled in the orthodox manner may be inconvenient at first to an experienced driver of other cars, but the advantages of being able to go backwards and forwards on the change speed lever only, when manœuvring, without using the brake, outweigh the clutch-control objection.

65. The operation of the low and reverse speed bands will be understood by inspecting the simple mechanism.

The mechanism for operating the top speed is shown in Figs. 30 and 31, and consists of a goose-neck lever, fulcrumed freely at the bottom end to the change speed lever shaft, the movement of the top end being limited by the two stops A and B; it carries a rocking lever pinned to it at K. The top end of the rocking lever is connected to the clutch pedal, and the bottom end to the trunnion fork lever which operates the top-speed cone, and thus engages the top speed.

The movement of the rocking lever is limited by three stops: D, which acts on the clutch lever, and R and Q, acting on the trunnion fork lever. The manner of attaching the clutch spring to the rocking lever is shown in the diagrams.

Fig.30

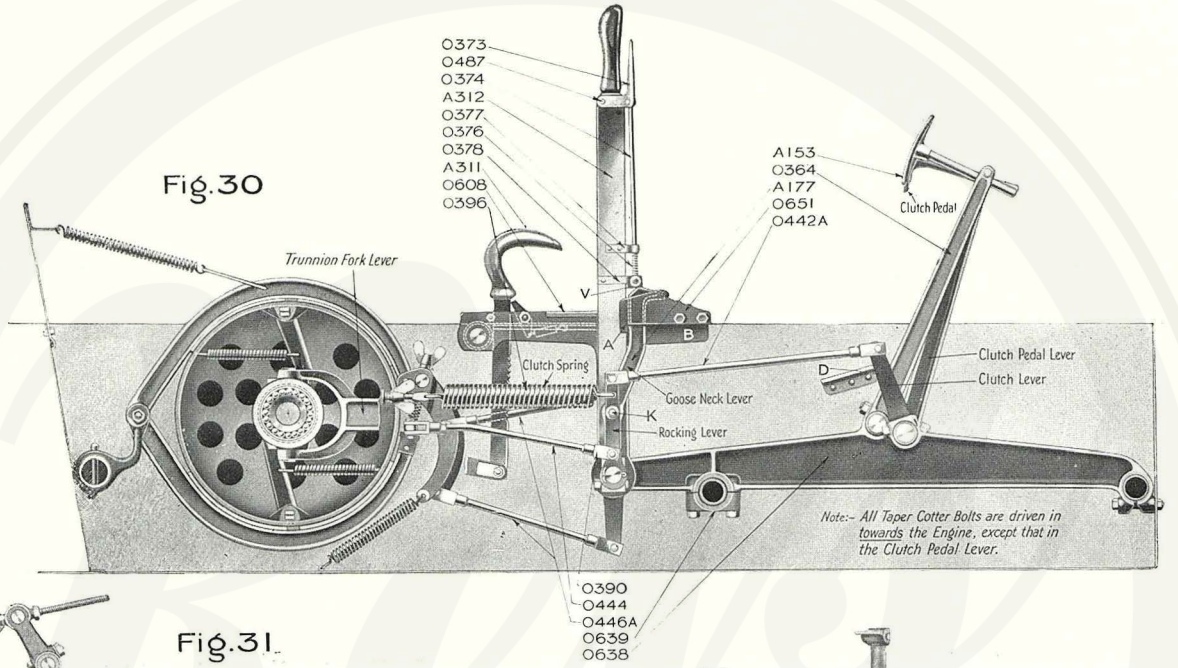
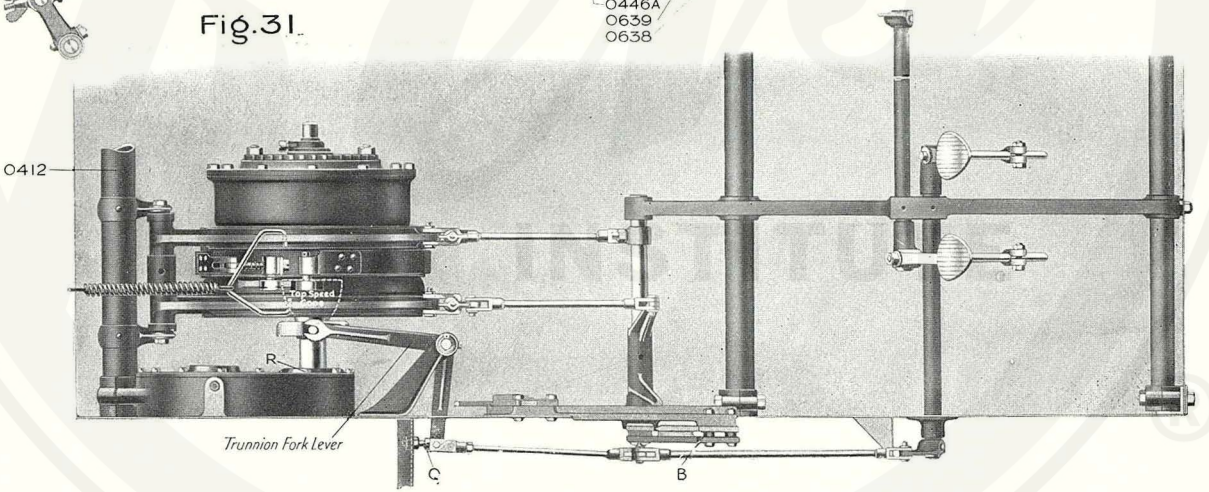


Fig.31



C

ENGAGING TOP SPEED (USING THE CLUTCH PEDAL).

66. The depression of the clutch pedal moves the top end of the rocking lever forward, and, as the bottom end cannot move backward owing to the stop Q, the middle point K has to move forward; this carries the goose-neck lever up to the stop B, at the same time extending the clutch spring.

The change speed lever is moved into the top-speed gate, behind the goose-neck lever, and holds the goose-neck lever against the stop B; the centre of the rocking lever is thus held in the forward position.

On allowing the clutch pedal to rise, the clutch spring pulls the top end of the rocking lever backward and the bottom end forward, the forward movement of the bottom pulls the trunnion fork lever up to the stop R and engages the top speed.

While the speed lever is in the top-speed gate, the depression or raising of the clutch pedal moves the trunnion fork lever to the stops Q or R respectively.

ENGAGING TOP SPEED (WITHOUT USING THE CLUTCH PEDAL).

67. The change speed lever is moved into the top speed gate; it has to push the goose-neck lever in front of it up to the stop B. This requires force, as the movement extends the clutch spring. This movement carries the point K forward positively.

If it were not for the clutch spring, the top end of the rocking lever would go right forward, and the pedal would depress itself; the clutch spring, however, checks this movement, and the bottom end of the rocking lever moves forward, and, moving the trunnion fork lever towards R, engages the top speed.

68. The fact that the clutch levers 0340 (Fig. 35) can only ride up the surface of the top-speed cone during relative rotation of these parts renders sudden engagement impossible, provided the spring is properly adjusted.

69. If, for instance, the change-speed lever is forced suddenly into the top-speed gate without "declutching," the trunnion lever moves only part of its travel towards R, when the clutch spring extends, and the clutch pedal depresses slightly of its own accord, rising again as the trunnion lever completes the engagement of the top speed.

It will be seen, therefore, that it is not possible by either means to engage the top speed sufficiently suddenly to endanger the transmission.

CLUTCH PEDAL DISENGAGEMENT OF LOW GEAR.

70. If the clutch pedal is depressed when driving in low gear, the change-speed lever is released and springs into neutral. The top end of the goose-neck lever, Fig. 30, is shaped so as to disengage the pawl V, when in low gear, and so prevents the engine from continuing its drive when the clutch pedal is depressed.

For the same reason the change speed lever must not be made to hold itself in reverse gear.

DESCRIPTION OF ELECTRICAL EQUIPMENT.

IGNITION.

76. The Delco-Remy system, which is well known for its simplicity and reliability, is employed; the main essentials comprise:—

1. A battery.
2. An induction coil.
3. A combined distributor and circuit-breaker.

77. Current is supplied from a six-volt battery to one end of the primary winding of the coil (see Fig. 59). From the other end a lead is taken to the insulated side of the circuit-breaker. When the "platinum points"* of the circuit-breaker are in contact, the circuit to the battery is complete because the none

* These contacts are usually faced with tungsten instead of platinum.

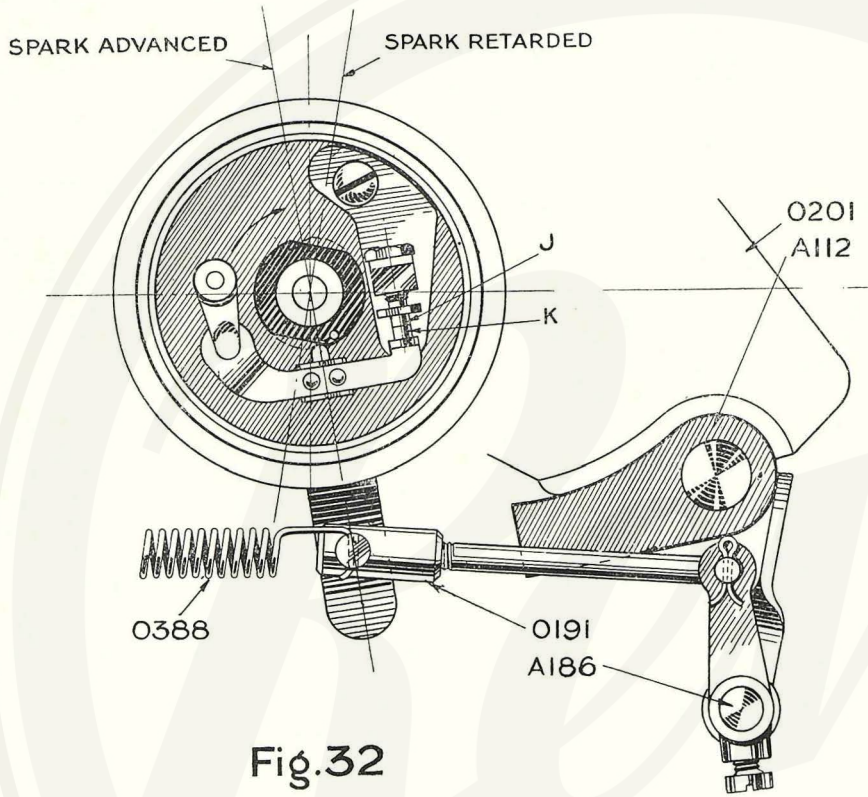
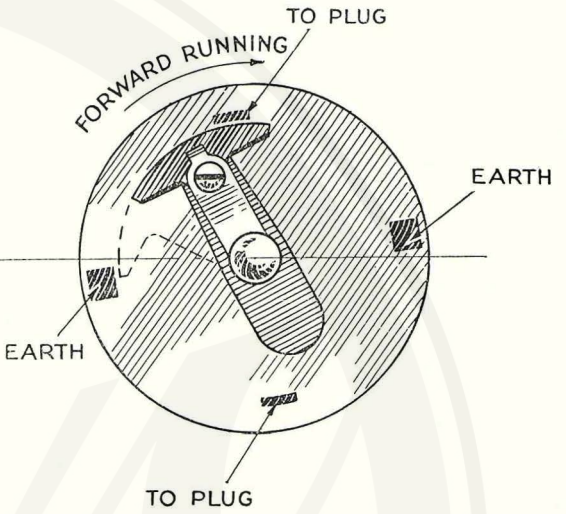


Fig.32



DOTTED LINES INDICATE POSITION OF DISTRIBUTOR ARM AND CAM, AT FIRING POINT, WHEN ENGINE REVERSES.

Fig.33

insulated terminal on the circuit-breaker is earthed to the frame, and the other end of the battery is also earthed. The "platinum points" are continually making and breaking this circuit as the engine rotates. When contact is made, the current passing through the primary winding of the coil causes the coil to become energised. When the contact is broken, a high tension voltage is induced in the secondary winding, which discharges across the gap of the sparking plug. The distributor segment takes this discharge to the plug in the cylinder which is in the firing position.

78. A length of resistance wire is fitted on the top of the coil; should the switch be left accidentally in the "on" position when the contacts of the circuit-breaker are together, this coil becomes hot, and limits the amount of current flowing through the primary coil, thus preventing it from being burnt out.

78a. Some cars have the condenser embodied in the coil, but on cars subsequent to 9,413, the condenser is attached to the outside of the distributor in a black cylinder $\frac{5}{8}$" diameter, $1\frac{1}{2}$" long. Hence a recent coil without a condenser cannot be used in conjunction

with an oil type distributor, but as there is no objection to two condensers, new distributors may be used with old type coils.

To ascertain whether a coil contains a condenser or not (presuming that it is not marked) connect the positive of a battery to E on the coil (Fig. 59) and the negative to the earthed base.

Attach 3″ of wire to M.C. with one end pointing towards, but $\frac{3}{8}$″ from, the base. Attach one end of a third wire to G, and flick the base with the other end. If a condenser is present a spark $\frac{3}{8}$″ long should occur between the base and the wire attached to M.C. In the absence of a condenser the spark will be less than $\frac{1}{16}$″.

DYNAMO.

79. The dynamo, which is of the current controlled type, has three brushes, two main, and a third which not only acts as a current regulator, but is also capable of adjustment, whereby the output is increased or decreased according to requirements. (Art. 122).

CUT-OUT (Fig. 59).

80. As the dynamo starts to rotate, current is generated in the armature, which energises the dynamo fields and builds up the armature voltage. The automatic cut-out has a shunt coil which is connected to the dynamo, and when the dynamo voltage reaches eight volts, the current flowing in this coil magnetises the iron core sufficiently to attract an iron plate, normally held away from it by the action of a spring. When attracted in this manner the plate causes two contacts to press together, completing the main circuit between the dynamo and battery. Current then begins to flow from the dynamo to the battery passing through a series coil in the cut-out. This gives additional attractive force to the iron core of the cut-out, ensuring that the circuit is maintained under all conditions, except when the speed of the dynamo drops to that point which gives a balance between the voltage at the terminals of the dynamo and that at the terminals of the battery. When this occurs current ceases to flow in the series coil of the cut-out, releasing the iron plate and breaking the main circuit between the dynamo and battery. In this way the battery is prevented from discharging through the dynamo when the latter is not charging.

80a. When the dynamo is first started the residual magnetism in the dynamo field pole pieces is practically always sufficient to cause a small current to flow in the armature (if not, see Articles 127 and 128), the whole of this current passes via the fuse in the switch block to the fields and so strengthens the field magnetism.

The stronger the fields the greater the armature voltage, and the greater the voltage the stronger the fields; hence the voltage would instantly rise to an excess if the cut-out did not switch the battery into the circuit to control the voltage.

80b. If the cut-out fails to operate, the fuse wire melts and so saves the dynamo windings from being burnt out. If, however, the battery connections are incomplete or defective, the voltage will rise sufficiently to burn out the car lamps before the dynamo fuse melts. If too large a fuse wire is used, the dynamo is in jeopardy and apart from this fact, the increased voltage will burn the points J and K of the circuit-breaker causing very irregular firing. (Art. 126.)

A greenish grey powder on the inside of the distributor cap indicates that the points have been running in an incandescent condition.

GENERAL.

81. The car has been particularly designed for an earth return system, and the earth connections are all electrically efficient. By adopting this system the wiring is much simplified and can be better insulated.

82. In order to get at the switchboard connections the cover can be removed, when all the terminals and ends of wires are immediately visible and accessible.

ADVANCE AND RETARD.

83. Fig. 32 shows the distributor in the advanced position, the position in which it is held by the starter pawl when the starting lever is right down. When the starter pawl is moved away by operating the starting lever, the spring 0388 retards the spark by rotating the whole distributor casing backwards through about 18 degrees, causing the spark to occur in the cylinder when the crank is about dead centre. On returning the starting lever to the down or "home" position, the starter pawl re-advances the spark.

84. Should the starting lever not be pushed right home, the starter pawl is not held free from the ratchet disc 0127 by the pawl lifter at the end of 0201 (Figs. 27-29), and a bell-like noise results, which calls the driver's attention to the fact that the spark is retarded.

85. Although it is customary with most cars to retard the spark when the engine is inclined to knock on hills, with the Trojan the spark should be kept fully advanced, and the mixture enriched.

ANTI-REVERSING DEVICE.

86. Ordinary two-stroke engines are liable to run backwards, but THE TROJAN ENGINE CANNOT RUN BACKWARDS. Fig. 33 shows how reversing and back-firing are prevented. The full lines show the position of the circuit-breaker cam and the high-tension distributor segment at the moment the spark occurs, when these parts are rotating forwards, *i.e.*, in a clockwise direction. The spark occurs when the points J and K are separated, *i.e.*, "break" contact. The dotted lines show the positions when these parts are rotating backwards.

87. Fig. 33 shows how the spark is taken to the sparking plug while running forwards, and the dotted lines show how it is carried to earth immediately any reversal sets in.

PREVENTION OF "BACK-FIRES."

88. A "back-fire," properly speaking, is the sudden reversal of the engine, due to the spark occurring too early for the engine speed. It can be caused in three ways:—

i. When the engine is cranked slowly by hand with the spark advanced. This is ensured against by the usual spark-retarding arrangements.

ii. Although the spark may be retarded, if the engine is rotated until "make" occurs, *i.e.*, K touches J, and then the engine is allowed to move back on compression till "break" occurs in the backward direction (the position indicated by the dotted lines in Fig. 33), then the spark takes place at about 40 degrees advance, which, but for the anti-reversing device, would result in a back-fire.

iii. With many engines (using coil ignition) back-fires may be caused still more frequently by the second "make" and "break." For example, the engine may be cranked rapidly past the first contact without firing the charge in the corresponding cylinder, the inertia of the flywheel carries nearly over the next compression, when it bounces on the compression, causing the "break" to occur with about 40 degrees advance, as indicated by the dotted lines, and, if this cylinder fires, there is a violent reversal. The anti-reversing device again earths the spark, and saves a back-fire. The same effect may be caused by the combination of slow cranking and a feeble explosion not quite powerful enough to carry over the next compression.

Many drivers will be unfamiliar with the causes of back-fires described in ii. and iii.

PART II.

REPAIRS AND ADJUSTMENTS

CHAPTER I.

THE ENGINE.

DECARBONISING.

101. The layer of carbon deposit varies with the richness of the mixture; continuous running with a mixture richer than normal increases, while a poorer mixture than normal decreases the deposit. The oxidising flame of a poor mixture burns any carbon deposit not in close contact with the metal walls. As the engine runs quite efficiently with this thin layer of carbon, *it should never be necessary to decarbonise,* because the process is constantly taking place during driving, if the carburettor is in proper adjustment.

REMOVING THE ENGINE FROM CAR.

102. As it is important to replace the engine in exactly the same position, it is advisable, before attempting to remove it, to mark the engine bearer tube on each side of the water jacket clip.

103. Remove the seat-supporting beam, dynamo, starter shaft, various pipe connections and six holding-down bolts. The 14 flexible coupling springs will also have to be removed, and to do this, first of all remove the outside screws and then in turn hold up each plate with a tommy bar while each inside screw is removed. (Fig. 34.) Do not remove the four bolts securing the flywheel to the crankshaft.

104. Remove the aluminium distributor housing 0182, the spark advance rod A186, the oil filter

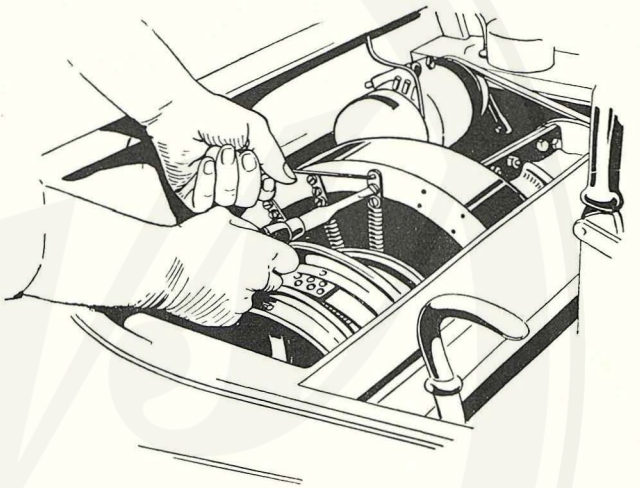


Fig. 34

inspection cover 01346, the exhaust box and the exhaust inspection cover 01882, if one is fitted. The silencer need not be disturbed nor the exhaust pipe flange 0145 detached. Slide the engine to the left to free it from the gearbox shaft, and backwards to free it from the inlet pipe before lifting.

ERECTING ENGINE IN CAR.

105. When the gearbox is in position, bolt the engine down securely in the old position to the marks mentioned in Art. 102. Assemble, in the reverse order

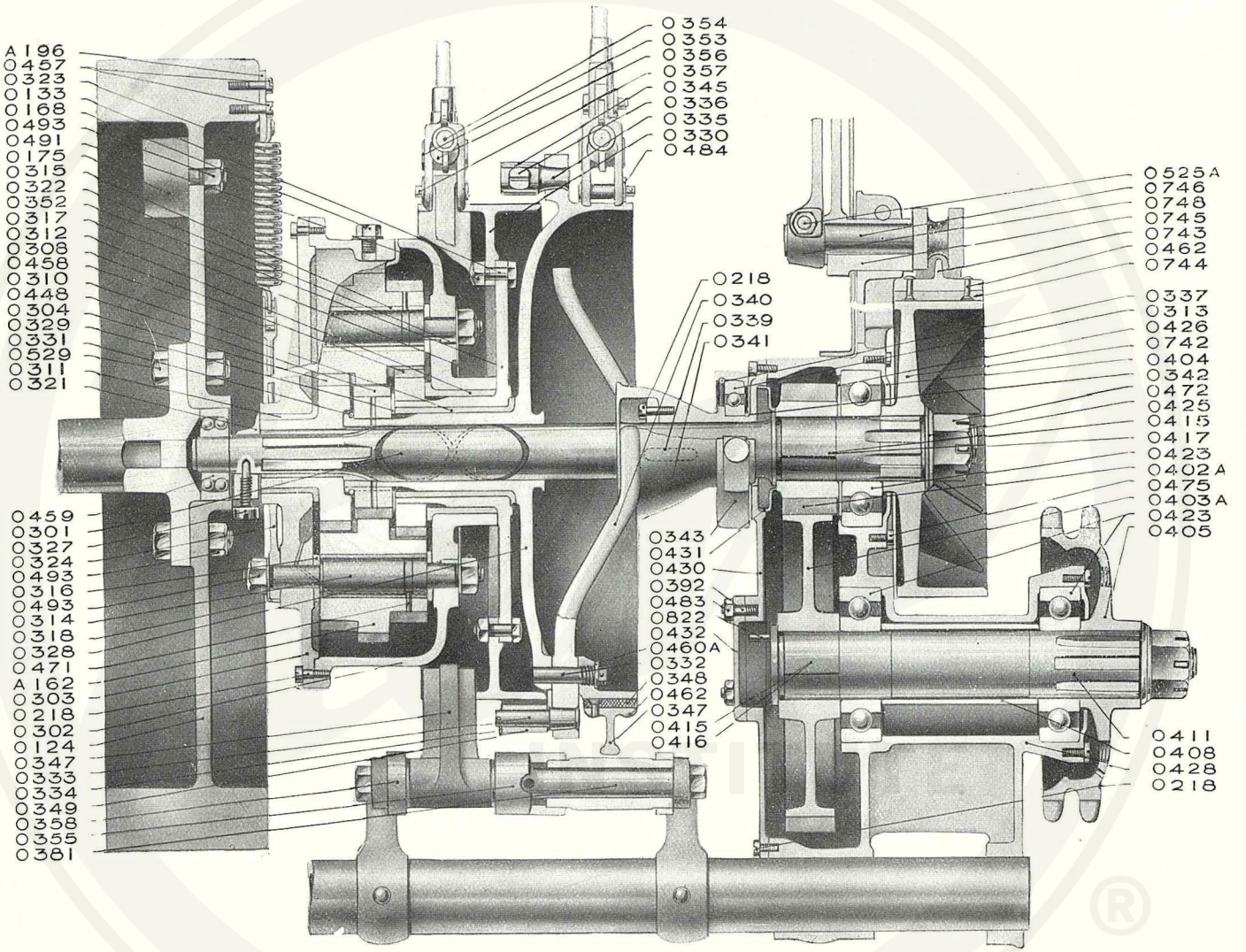

A196
0457
0323
0133
0168
0493
0491
0175
0315
0322
0352
0317
0312
0308
0458
0310
0448
0304
0329
0331
0529
0311
0321
0459
0301
0327
0324
0493
0316
0493
0314
0318
0328
0471
A162
0303
0218
0302
0124
0347
0333
0334
0349
0358
0355
0381
0354
0353
0356
0357
0345
0336
0335
0330
0484
0218
0340
0339
0341
0343
0431
0430
0392
0483
0822
0432
0460A
0332
0348
0462
0347
0415
0416
0525A
0746
0748
0745
0743
0462
0744
0337
0313
0426
0742
0404
0342
0472
0425
0415
0417
0423
0402A
0475
0403A
0423
0405
0411
0408
0428
0218

Fig. 35

A116 Assembly of Oil Pipes and Elbows
A196 ,, ,, Spring Drive Plate
A245 ,, ,, Lubricating Pipes (Complete with Unions)
O101 Engine Casting
O102 Water Jacket Cover
O106 ,, ,, ,, Jointing
O111 Engine Foot
O113 Crankshaft
O114 Cylinder Plug
O115 Water Jacket Cover Cap
O116 Crankshaft Bearing R.H.
O118 ,, ,, Centre
O119 Cover for Transfer Ports
O120 Inlet Pipe in Cylinder
O121 ,, ,, Nut
O122 ,, ,, Rubber Ring
O123 ,, ,, Cup Washer
O124 Flywheel
O127 Crankshaft Plug (*Hole in Centre*)
O128 Crank Pin ,, (*Blank*)
O129 Oil Hole Plug
O130 Connecting Rod
O131 Big End Bearing
O132 Gudgeon Pin
O133 ,, ,, Locking Screw
O135 Piston Ring
O136 Water Jacket Drain Tap
O137 Gudgeon Pin Locking Washer
O138 } Piston Ring Stop Brass
O138A } Piston Ring Stop Steel
O139 Jointing for Exhaust Pipe Flange
O140 Piston
O141 Container for Flame Extinguisher
O142 Gauze ,, ,, ,,
O145 Exhaust Pipe Flange
O188 Jointing for Transfer Ports
O149 Studs for Water Jacket Cover
O150 Nuts ,, ,, ,, ,,
O151 Crankshaft Bearing Peg
O152 Connecting Rod Bolt $\frac{3}{8}$" B.S.F.
O153 ,, ,, ,, $\frac{1}{4}$" B.S.F.
O154 Slotted Nut for Con. Rod $\frac{1}{4}$" B.S.F.
O155 Split Pin ,, ,, ,, $\frac{5}{64}$" Dia. 1" long
O157 Copper Asbestos Washer
O158 Peg for Con. Rod Bearing $\frac{5}{16}$" Dia.
O168 Plug for Oil Pocket $\frac{1}{8}$" Gas
O169 ,, ,, ,, ,, $\frac{3}{8}$" Gas
O175 Balance Weight on Flywheel
O176 Bolt $\frac{3}{8}$" B.S.F. 3$\frac{3}{4}$" Long
O178 ,, $\frac{5}{16}$" B.S.F. 3$\frac{3}{16}$" ,,
O181 Jointing for Crankcase
O185 ,, ,, Oil Pipe Elbows
O419 Stud $\frac{1}{4}$" B.S.F. 1$\frac{1}{2}$" Long
O457 Set Screw 2 B.A. $\frac{3}{4}$" Long
O477 Stud $\frac{3}{8}$" B.S.F. 4$\frac{7}{8}$" Long
O478 Stud $\frac{5}{16}$" B.S.F. 1$\frac{1}{4}$" Long
O480 Bolt $\frac{1}{4}$" B.S.F. $\frac{13}{16}$" Long
O491 Nut $\frac{1}{4}$" B.S.F. (Standard)
O492 ,, $\frac{5}{16}$" ,, ,,
O493 ,, $\frac{3}{8}$" ,, ,,
O527 Slotted Nut $\frac{3}{8}$" B.S.F.
O529 Bolt $\frac{3}{8}$" B.S.F.
O533 Split Pin $\frac{3}{32}$" Dia. 1" Long
O822 Peg $\frac{1}{8}$" Dia. $\frac{3}{4}$" Long
O833 Union

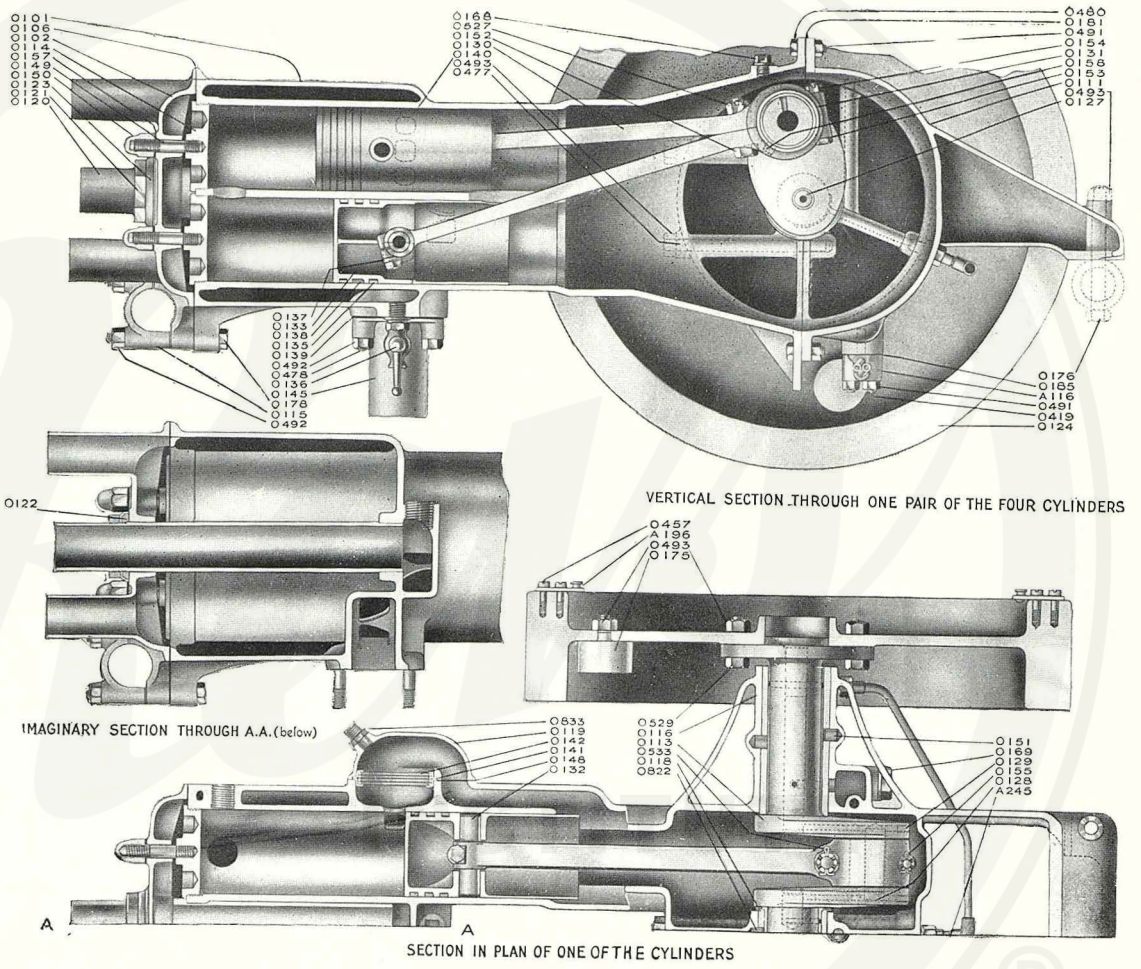


Fig. 36

to that of dismantling, the exhaust box, distributor housing, flexible coupling springs (service tool No. A377), pipe connections, etc. Fill the radiator.

106. Before starting the engine, add one ounce (the oil-squirt holds $\frac{3}{4}$ oz. when full) of oil to each side, through the plug holes 0168 in the top of each crank chamber. Replace the plugs, and ascertain that there is no oil leakage anywhere when the engine is running.

107. Check ignition timing (Arts. 151-159) and oscillation of distributor (Art. 83).

108. If the engine in question has been dismantled, and has not been tested, run the car with one seat-box out, and inspect occasionally for local heating. Make several short runs at intervals before attempting a journey, and before testing its power on a steep hill.

DISMANTLING THE ENGINE.

109. i. Place the engine head downwards on a suitable cradle. (Fig. 37). (Service tool No. A372).

ii. Remove the flywheel, then the locating screw 0327, or the large screw in the end of the shaft, from the ratchet disc; withdraw the disc (service tool No. A371), and then remove the six cheese-headed screws 0218, and the starting gear.

iii. Take off the eighteen $\frac{1}{4}$" flange nuts, the eight $\frac{5}{16}$" nuts, and the two $\frac{3}{8}$" nuts between the cylinder barrels.

iv. Tap the engine foot with a mallet to break the joint, and lift off.

v. Lift out the crankshaft with bearings, con-rods and pistons, as one unit, bearing in mind that the pistons will contain oil. (Fig. 37).

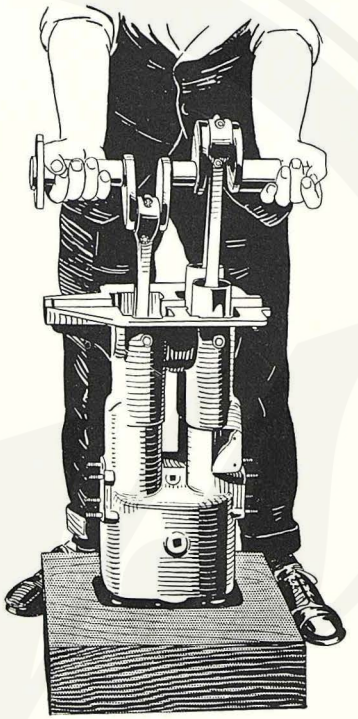


Fig. 37

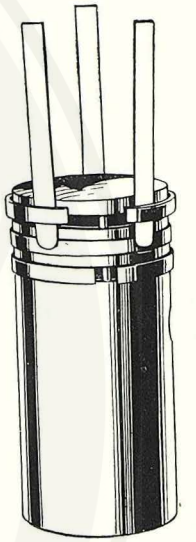


Fig. 38

vi. If a piston has seized in the cylinder, it may be necessary to remove the corresponding con-rods before lifting the crankshaft, and if the piston will not withdraw, the cylinder will have to be re-ground. (In this case the cylinder casting should be returned to the manufacturers with the piston still in the barrel).

vii. If the piston only is scored, it can be cleaned up with a fine file, but if the cylinder is badly

scored, lapping is not much use, and, unless it is re-ground, the piston is likely to seize again in the same place.

viii. Number the pistons, con-rods and big end " brasses " to facilitate re-assembly in their respective positions. This is most important.

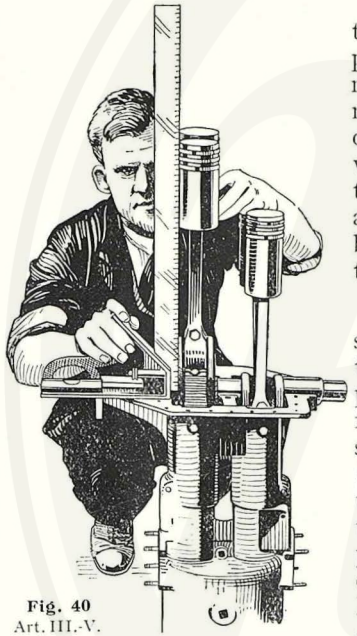


Fig. 40
Art. III.-V.

ix. Do not remove the rings from the pistons unless absolutely necessary. Removing and replacing rings must be done with great care, with the aid of three thin strips of sheet tin, about $\frac{1}{2}$" wide, slipped between the piston and the ring. (Fig. 38).

x. The oil pipes should be removed, and, together with the oil passages in the engine foot and in the crankshaft, be washed out (Art. 118). Petrol should then be squirted into the passages, with the proper outlets closed to ensure that there are no leakages or superfluous outlets; *e.g.*, petrol squirted in the crankshaft at A (Fig. 10) can escape at B, C, D and S; close three of these at once, and see if it escapes at the fourth, and so on till each has been tested; then close all four to see that it does not escape at E or elsewhere.

110. *WARNING.* The cylinder plugs 0114 are provided to facilitate moulding and machining, they are screwed tightly into position with cement, and should not be removed for any purpose.

FITTING BIG-END BEARINGS.

111. i. Using one half of the con-rod as a gauge, hold the two half " brasses " together in the hand, and see that they fit into the half-circle of the con-rod.

CAUTION. If too much metal has been removed from the shoulders, it must be made up by soldering on brass strips or shims; on no account must the con-rod halves be " let together " or filed in any way, neither must the " brasses " be rendered tight by being backed up with non-conducting paper or even metallic foil packing.

ii. If much white metal has to be removed, the " brasses " should be trued up in a chuck, and bored a few thousandths less than the diameter of the crank pin.

iii. Scrape the white metal to suit the crank pin in the usual way, by clamping the " brasses " on the crank pin with the con-rod, to mark the high places.

Bolt up tightly to test the final fit, which must be free when oiled, not sticky enough to support the weight of the con-rod and pistons at right angles. (Use crank shaft clamp service tool No. A375). All the preliminary bolting and unbolting should be done with the old bolts, and then new bolts fitted.

iv. Make oil grooves and chamfers, as in Figs. 43-46. (Service tool No. A376).

v. Place the cylinder casting head downwards, and use the machined crank chamber face as a surface plate. With the pistons and con-rods assembled to the crank pin, place the crankshaft in its main bearings, with the pistons upwards (not in the cylinder bores). With a square, placed on the machined casting face, see that the piston skirts are square with it. (Fig. 40).

vi. See that the centres of the gudgeon pins in both the inlet and exhaust cylinders are $2\frac{3}{4}$" apart, *i.e.*, that there is a $\frac{1}{4}$" parallel space between the piston skirts. (Fig. 41).

Fig. 41

vii. Carefully arrange the piston rings with regard to their stops, and lower the pistons into their respective cylinders; this will show whether the centres of the pistons come opposite the centre of the crank pin, or whether the con-rod is constrained sideways.

112. It may be necessary to set (or bend) the con-rods slightly to obtain these conditions, if the re-metalling has not been carried out with sufficient accuracy.

113. *IMPORTANT.* The bolts 0152 and 0153 are of special steel, and must not be replaced by mild steel bolts. When locking up the bolts, do not risk using old split pins in such vital places. In the assembled engine the heads of the bolts should be uppermost. If old " brasses " have been re-metalled, it is important to see that they fit the con-rod halves, and have not warped out of their true semi-circular shape. They cannot be made to fit by packing.

For re-assembling the engine see Art. 118.

FITTING MAIN BEARINGS.

114. i. Support the cylinder casting with the water-jacket cover downwards, arrange the " brasses " in position, the flywheel-end " brasses," with their square edges outwards, flush with the casting, and put the engine foot casting in position, as determined by the two locating pegs, to ascertain that the " brasses " all fit when the ten main bolts are tightened up. This is most important, as it ensures an oil-tight joint, and maintains the crank-chamber compression. A slight oil leakage at the flange may cause lubrication trouble. (See Caution, Art. 111, i).

ii. Previous to the usual scraping to suit the crankshaft, a special $1\frac{1}{2}$" diameter piloted reamer (service tool No. A378) should be put through.

iii. In early engines the starter side main bearing is not split, hence in the absence of a special reamer this bearing should be accurately trued up in a lathe, and bored to suit the crankshaft diameter (from dead size to one-thousandth larger). Ease this bearing by scraping until it can be pushed on the crankshaft.

iv. Assemble all the main-bearing " brasses " and the crankshaft, with con-rods removed, in the main engine castings, then dismantle, and remove the hard or high places by scraping, repeating the operation until the oiled crankshaft can be rotated by hand without the aid of the flywheel or tools, when the bolts are tightened on to a dry paper joint 0181.

v. Insert the oil holes and grooves, as in Figs. 47-58. The importance of working accurately to these drawings is obvious, because, if the holes are out of place, they will not register with the corresponding holes in the engine casting. Similarly, the circumferential grooves, if cut the wrong distance from the ends of the " brasses," will not register with the holes in the crankshaft, or, if not accurate in length, they will impair the oil circulation, as their action, when the engine is running, is similar to the valves of a pump. (See Arts. 16-25).

115. If the spiral oil-ways are made too long, or the spiral is completed, the oil will leak out or be blown right through the bearing.

FITTING A NEW GUDGEON PIN.

116. To fit an " oversize " gudgeon pin (diameter $\frac{11}{64}$") reamer the holes in the piston with a standard $\frac{11}{64}$" reamer, preferably the spiral type. Remove the tap bolt from the small end of the con-rod, wedge the slot open with a piece of sheet metal, clamp up, and put the same reamer through the connecting rod. When re-assembling the connecting rod to the piston, use a new locking plate 0137, the edges of which should be bent up to the flats of the bolt head with the aid of a blunt tool, as a sharp chisel might nick the edges and cause them to break off.

117. A special spanner (service tool No. 01470), with one straight jaw and the other inclined at 20 degrees, is required to tighten the tap bolt in the case of engines fitted with plain bearings.

117a. A long box spanner (service tool No. 01470a) is required in the case of engines fitted with roller bearings.

ASSEMBLING ENGINE.

118 i. Syringe out all oil-ways in shaft and engine foot with petrol, in order to clean them and to ascertain that the passages are clear. (Art. 109, x.)

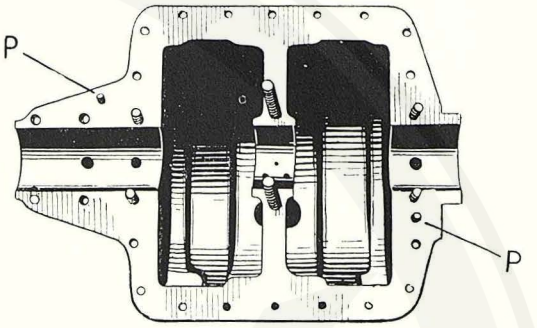


Fig. 42

Thoroughly clean the insides of the castings and all the parts, with rags and petrol. Waste must not be used, and, if paraffin is used, it should be cleaned off with petrol. Clean the crankcase faces, bearing houses, and outsides of the main " brasses " carefully with petrol. Then dry.

ii. Assemble the connecting rods with their pistons on to the crankshaft, each pair of rods on its correct crank pin, and arranged so that each piston will go back into its original cylinder. Use new split pins when locking up the big end bolts.

iii. Apply a *thin* layer of gold size or coach varnish with a brush free from oil, to the outsides of the " brasses," to their housings, and to both of the crank chamber facings, on cylinder casting and on engine foot.

iv. Apply a thin layer of engine oil to the cylinder walls, pistons and journal bearings.

v. Carefully arrange the piston rings with regard to their stops, and lower the pistons gently into the cylinders.

vi. Place the paper joint 0181 in position on the gold size. This joint is .005″ thick. Thicker jointing must not be used. This caution also applies to the joint under the engine foot 0185 when used.

vii. See that the two locating pegs (P.P. Fig. 42) are in position, and replace the engine foot, tighten up, and try round all the bolts a second time to obtain uniformity of tightness.

THE 1,488 c.c. ENGINE (ROLLER BEARING BIG-ENDS).

118a. The five constituent parts of the crankshaft (Fig. 11a.) should on no account be separated unless absolutely necessary, such as the necessity for changing a roller bearing or a con-rod.

When renewing a roller bearing it must be remembered that the pin, rollers and outer race form a unit and the parts are not interchangeable.

118b. When a new outer race has been pressed into a connecting rod the side faces of the latter must be recaulked as before in order to retain the race in the mid-position.

118c. To re-assemble the crankshaft, tap a chisel into the saw-cut of the centre portion, which will enable the new pin—with the rollers stuck in position with grease—to be inserted. The flat end of the pin should just project—say, .01″ beyond the disc face. Insert the bolt 01807 and tighten up tightly. Place the con-rod in position and see that it clears the disc by at least .020″ when rotated, if not, file the edges of the rod.

118d. Now assemble the outer portion—whether flywheel end or starter end—with a chisel tapped in the saw-cut, allow .004″ between the outer race of the roller bearing and the crank disc when the race is touching the other crank disc, *i.e.*, a total clearance of .004″.

118e. When assembling the crank shaft portions, care must be taken to make the numbers on the crank discs agree, see, for example, D45, D45, D46, D46 on Fig. 11a. When this is done the crankshaft oil holes each side of one big-end will be on the same side of the shaft as at S and V in Fig. 5. (See Art. 18.)

118f. Tighten the bolt 01807 lightly. Assemble the other outer portion in the same way.

118g. Accurately line up the outer crank discs with the two centre ones using a good straight edge (shown in dotted lines on Fig. 11a).

Put the crankshaft into the main engine casting as in Fig. 37, before assembling the pistons and see if it rotates freely. If it is sticky in places the alignment is probably bad, so remove the half brass of the centre main bearing and test each of the three main bearings of the shaft with a test dial indicator and re-align.

118h. After moving the discs on the pin the .004″ clearance should be re-checked, the remaining two bolts 01807 tightened, and the four nuts split-pinned.

118j. Assemble the pistons and test alignment of these. (Art. 111 v.) Re-assemble the engine as per Art. 118.

118k. Interchangeability of parts. The roller bearing crankshaft cannot be used to replace the plain bearing shaft in a 1,527 c.c. engine.

With the exception of the pistons and rings the parts are not interchangeable, as the gudgeon pin is shorter, and the gudgeon pin locking screw 01855 is longer than 0133 (both of which are in special steel). The flywheels also are different. (Art. 153a.)

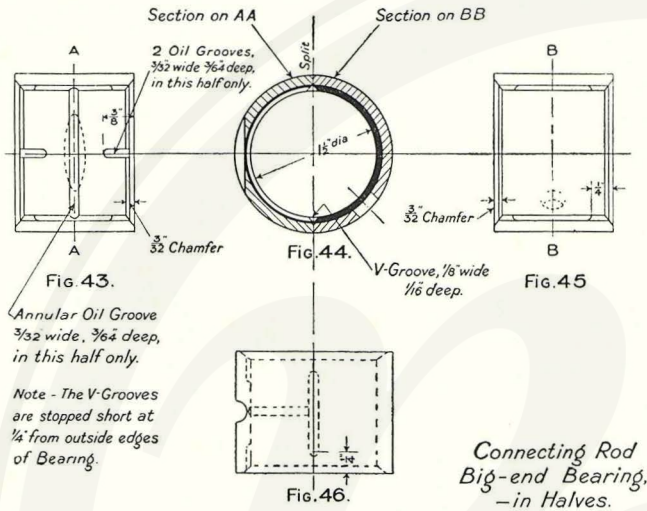


Fig. 43. Fig. 44. Fig. 45. Fig. 46.

Connecting Rod Big-end Bearing, —in Halves.

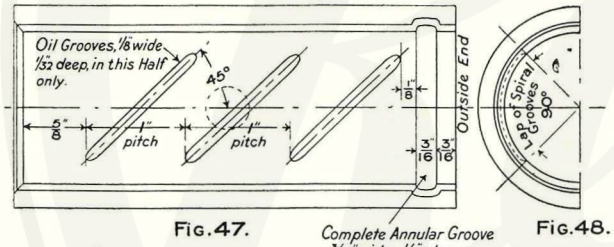


Fig. 47. Fig. 48.

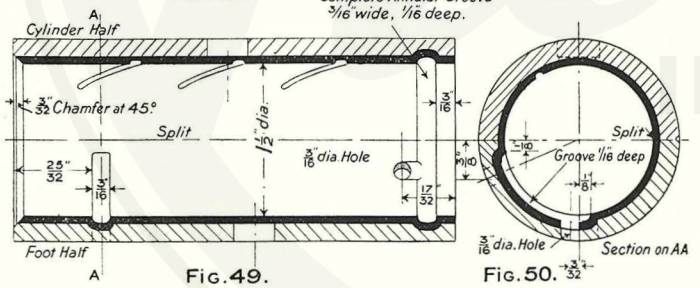


Fig. 49. Fig. 50.

CRANKSHAFT BEARING - FLYWHEEL END - IN HALVES

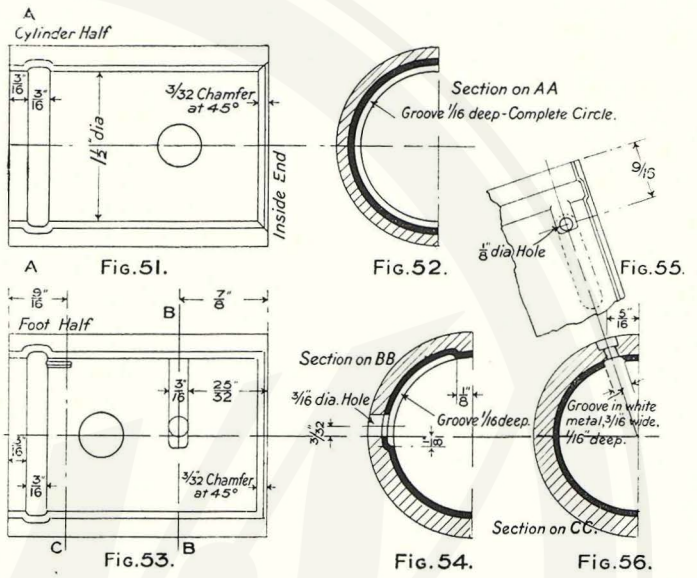


Fig. 51. Fig. 52. Fig. 55. Fig. 53. Fig. 54. Fig. 56.

CRANKSHAFT BEARING - STARTER END - IN HALVES.
(FORMERLY SUPPLIED UNSPLIT)

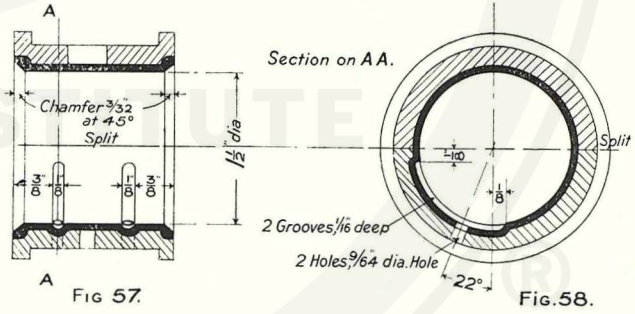


Fig 57. Fig. 58.

CENTRE CRANKSHAFT BEARING - IN HALVES.

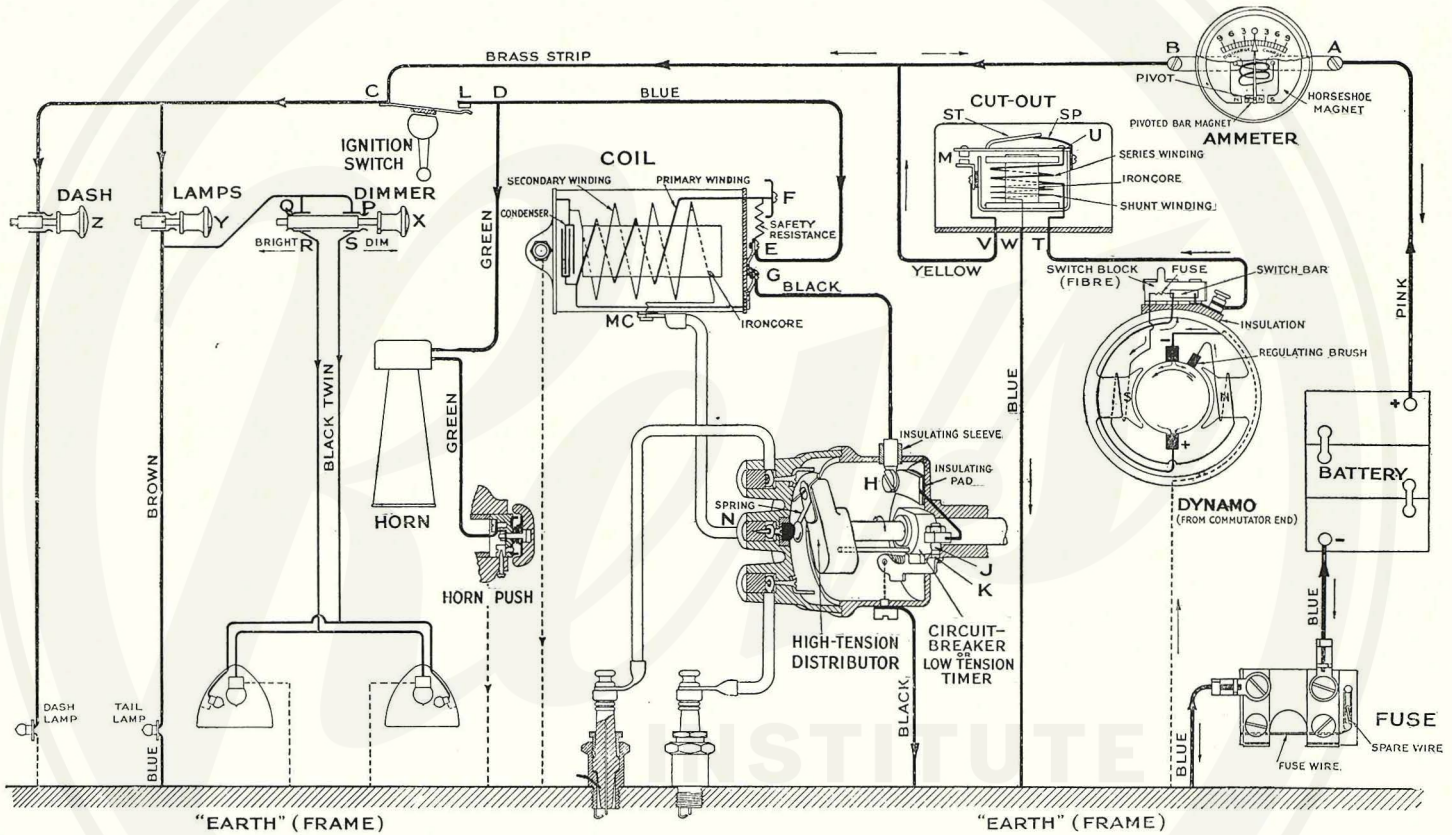

BRASS STRIP
B
A
PIVOT
HORSESHOE MAGNET
PIVOTED BAR MAGNET
AMMETER
C
L
D
BLUE
CUT-OUT
ST
SP
U
M
SERIES WINDING
IRONCORE
SHUNT WINDING
V
W
T
YELLOW
IGNITION SWITCH
COIL
SECONDARY WINDING
PRIMARY WINDING
F
CONDENSER
SAFETY RESISTANCE
E
G
BLACK
MC
IRONCORE
DASH
LAMPS
DIMMER
Z
Y
Q
P
X
BRIGHT
R
S
DIM
GREEN
SWITCH BLOCK (FIBRE)
FUSE
SWITCH BAR
INSULATION
REGULATING BRUSH
PINK
BLACK TWIN
BROWN
GREEN
HORN
HORN PUSH
INSULATING SLEEVE
INSULATING PAD
H
SPRING
N
J
K
HIGH-TENSION DISTRIBUTOR
CIRCUIT-BREAKER OR LOW TENSION TIMER
BLUE
BLACK
DYNAMO
(FROM COMMUTATOR END)
BATTERY
+
-
DASH LAMP
TAIL LAMP
BLUE
FUSE
SPARE WIRE
FUSE WIRE
"EARTH" (FRAME)
"EARTH" (FRAME)

FIG. 59

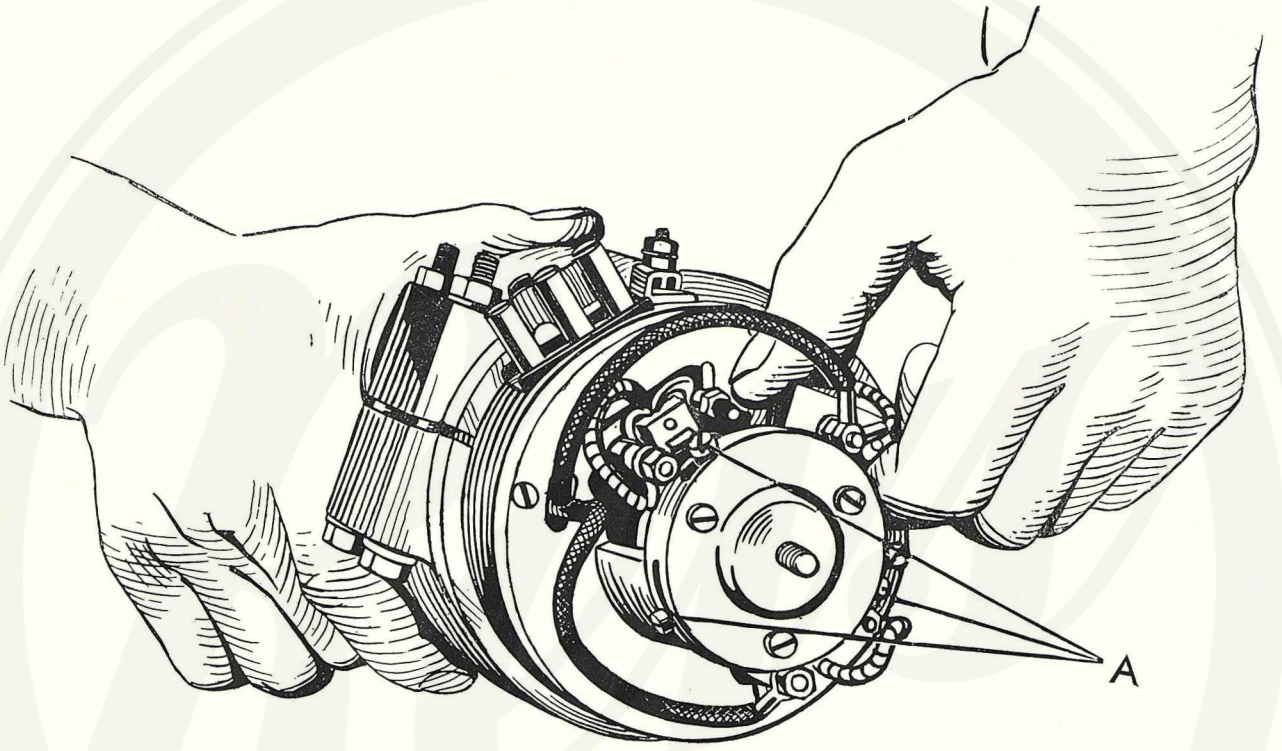


Fig. 60 (See Art. 122)

119. *ASSEMBLING STARTER GEAR.* In re-assembling the starter gear, the pawl operator plate 0203 should not be flattened; it is a loose fit between its retaining plates, and it should be curved before assembling to give it a slight frictional resistance to rotation.

120. Fig. 28 will show that the pawl operator plate should be assembled over the distance plate 0214, and between the retaining-plate 0215 and the main starter bracket 0201. The shape of the plate resembles a comma, but it should be assembled so that the comma is the wrong way round (not upside down).

121. The tell-tale spring 0224 should be set to act on the pawl near the home position only, so that it causes the pawl to ring against the revolving ratchet disc when the starting lever is raised but an inch or two.

For Erecting and Testing the Engine in the Car see Arts 105-108.

CHAPTER II.

THE ELECTRICAL EQUIPMENT.

DYNAMO REGULATION.

122. The output of the dynamo should be 6 or 7 amps. at 20 m.p.h. If this is not the case, the third brush should be moved in the direction of rotation to increase the output, or moved backwards to reduce it. (See Art. 79 and Figs. 59 and 60.)

To move the brush it is necessary to loosen the three screws (A in Fig. 60) securing the brush holder to the dynamo body. *If the output is below 6 amps. make sure that this is not the result of belt slip or dirty commutator* (Art. 130) *before making fresh adjustments.*

122a. In winter, circumstances may render it difficult to keep the battery charged. During this season the output of the dynamo may be increased to, say, 10 amps., but the normal charging rate must be restored as soon as feasible.

123. If it is desired to fit more powerful head lamp bulbs, a larger battery is necessary, and the dynamo output should be increased. (Art. 122.)

124. If the battery is becoming overcharged, remove the switch block (Fig. 61), but do not disconnect the wire from the dynamo terminal which leads to T. (Fig. 59.)

DYNAMO WILL NOT CHARGE.

125. Test the dynamo fuse by short-circuiting the two back terminals (Fig. 59) of the switch block (which should be connected by the fuse) by holding a screwdriver against them while the engine is running at a good speed. If the ammeter then shows "charge," remove the switch block to see if the fuse is in position, and to see if the spring contacts are clean and tight in the dynamo terminals.

126. Not more than one strand of No. 34 gauge (.009" dia.) tin or lead *fuse wire*, not copper, must be used (Art. 80a and b). See that the terminal block piece on the dynamo is properly insulated, and not touching the metal of the dynamo body. (Fig. 61.)

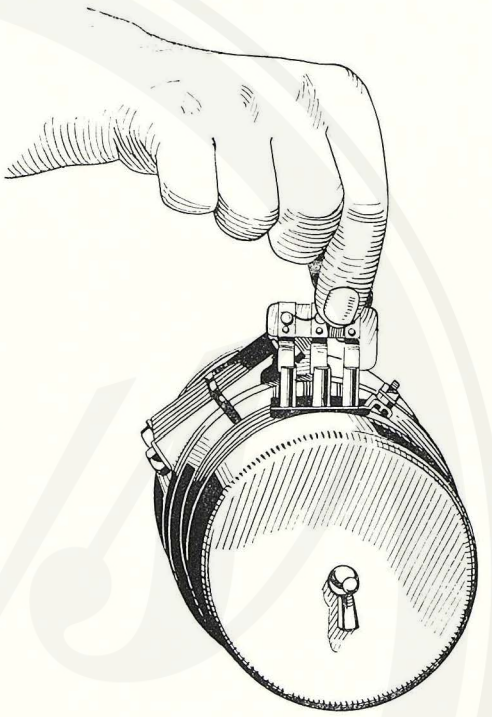


Fig. 61

DYNAMO WILL NOT START CHARGING.

127. This may be due to failure to "excite," *i.e.*, the low voltage generated by the feeble residual magnetism (see Art. 80a) may be insufficient to send the current through a film of dirt on the brush faces.

128. Test by speeding up the dynamo and lightly pressing together the contacts M on the cut-out;

this allows current from the battery to rush through the dynamo fields and start excitation.

128a. If the cut-out is sealed the terminals V and T (Fig. 59) can be momentarily short-circuited or connected together with a piece of wire.

129. *CAUTION.* Many motorists are apt to make a mistake when faced with these symptoms; when they find that bringing the contacts "M" together starts the dynamo charging, they presume that the points are defective, and commence filing; this is not the proper remedy; in fact, it is not a remedy at all, and will only result in spoiling the cut-out.

130. A little strip of the finest glass paper (not emery cloth) held against the revolving dynamo commutator, will probably remove the dirt which is causing the trouble.

131. The greatest care should be taken in any attempt to adjust the cut-out, as not only is it a finely adjusted piece of mechanism, but it constitutes a main switch, operating between the dynamo and the accumulator, so that a depression of the iron plate when the engine is not running might easily cause damage to it and the dynamo. In the above case (Art. 127), as the trouble is due to dirty dynamo brushes, the contacts M will be stationary, and not trying to make contact; it is, therefore, useless to try to adjust them.

132. On touching the contacts together, the ammeter shows a momentary discharge before it goes over to "charge," whereas, if the fault is due to dirty cut-out contacts, they would be trying to make contact, and, on pressure being applied, the ammeter would at once fly to "charge."

CUT-OUT ADJUSTMENT.

133. If the dynamo is allowed to slow up, the ammeter needle should slowly return to zero, but, if it goes past zero by more than one amp., the strip ST (Fig. 59) should be slightly bent to increase the force on the separating spring SP.

133a. If a sealed cut-out requires adjustment the seal should not be broken but another cut-out should be substituted for it, at a nominal cost if it is undamaged.

134. *CAUTION.* This bending must either be done while the dynamo is running or while a piece of paper is inserted between the contacts M, otherwise the battery becomes "shorted" through the dynamo.

FITTING A NEW CUT-OUT.

135. Of the three terminals, it is usually obvious which one has to be "earthed," but it is not obvious which is to take the green wire from the dynamo, and which the yellow to the ammeter.

136. Connect the "earth" terminal to the negative of a battery, and connect the positive of the battery to each of the other terminals in turn; the one which causes the contact M to pulsate has to be connected to the dynamo. (The pulse can be felt by pressing the finger lightly on the contact M.) The current is then passing from T to W, through the shunt winding (Fig. 59).

137. If, however, the "earth" terminal is not readily distinguishable, find which two terminals cause the contact M to pulsate (as in Art. 136); one of these is the "earth" terminal, and the other goes to the dynamo; to find which is which, connect the third terminal to the negative of the battery, and with a wire from the positive touch each of the two terminals in turn while the contacts M are held together; the "earth" terminal will show a feeble spark, visible in the dark, and the dynamo terminal will give a crackling "short."

CARE OF BATTERY.

138. The battery rarely receives sufficient attention, with the result that it is frequently incapable of commencing a second season, although, with normal care, it should last two or even three years.

139. If the terminal nuts become corroded, they should be removed, filed clean, and well vaselined.

The battery should not be lifted by the terminals, as it causes acid leaks to occur where the stems enter the case.

140. The electrolyte must be kept just above the tops of the plates by adding distilled water to compensate for that lost in evaporation, but the density should be checked occasionally, in case the loss is due to acid having been spilled.

141. The density should be about 1,230 for a charged battery, and not below 1,100 for a discharged battery. (Fig. 62.) If the battery becomes exhausted, as the failure of the lights will indicate, it should be removed and re-charged, and should not merely be allowed to charge and discharge in the ordinary course of running.

142. Batteries not in use should be recharged every month.

BATTERY VOLTAGE.

143. A six-volt battery shows about 6 volts on a voltmeter under most conditions, but the actual voltage gives little more indication of the remaining charge in the battery than the speed of the car indicates the amount of petrol in its tank.

BATTERY. PHANTOM VOLTS.

144. A battery which has recently been completely discharged, quickly recovers its voltage, and will show 6 volts on a voltmeter; these are called phantom volts, as they disappear directly the battery is put into use.

REMAINING CHARGE IN BATTERY.

145. To ascertain whether a battery has any useful charge left in it, test the volts with a voltmeter (or small 6-volt lamp); then, and at the same time, take about 5 amps. from the battery, and see if there is a voltage drop.

146. If the battery is fully charged, or even only a quarter charged, there will be an appreciable voltage drop directly the load of 5 amps. is applied, but no further drop. If, however, the battery is "empty," the volts will slowly fall right away.

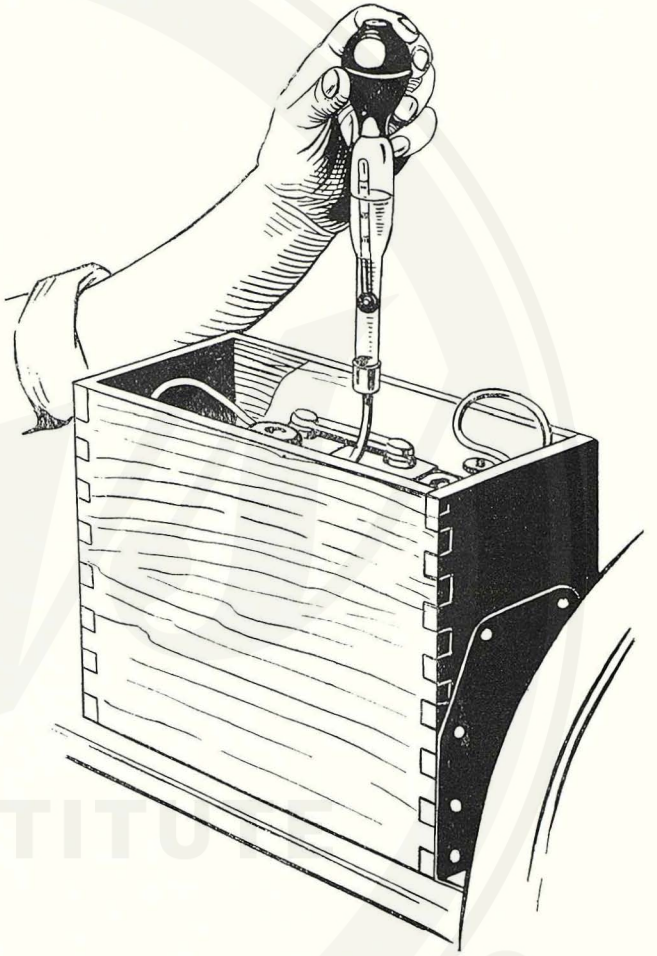


Fig. 62

147. The load of 5 amps. can be applied by switching on the head lights, connecting up an electric horn

or by using the primary of an ignition coil as a resistance.

148. Take as little out of the battery as possible, by dimming when convenient, and avoid leaving the car standing longer than necessary with the lights on.

149. The battery should be lightly wedged in its box; it should never be sufficiently free to move about.

SENDING BATTERIES BY RAIL.

150. The current regulations governing the despatch of batteries by rail can be obtained from the railway company with the special consignment form.

TIMING THE IGNITION.

151. *TO DETERMINE DEAD CENTRE.* Use a steel rule or straight-edge held against the projecting machined face of the crank chamber flange, scratch a line on the Stay for Driver's Seat Support Beam 01033, so that this scratched line lies in the same vertical plane as the main crank chamber joint.

152. Rotate the flywheel till the plain line on the flywheel rim coincides with the scratch on the Stay. The engine is now on dead centre. Note that the flat on the crankshaft flange is at right angles to the crank chamber joint. (Art. 153a.)

Move the flywheel backwards through 16 degrees (or $2\frac{1}{4}$"), when the mark on the rim, lettered A, should coincide with the scratch. This is the position for advanced spark, *i.e.*, with the starting lever down.

153. The balance weight on the flywheel moves with the left hand or No. 1 pair of pistons, hence, if the balance weight is forward, the pistons in No. 1 cylinders are on inner (or compression) dead-centre.

153a. In the case of a roller bearing engine (which has no balance weight) No. 1 pistons are on inner dead centre when the mark TDC No. 1 on the flywheel is uppermost. The flats on the crankshaft flange are then vertical and parallel to the crank chamber joint.

154. *TO ASCERTAIN POSITION OF ADVANCED SPARK.* With the starting lever right home, and the ignition switch "on," rotate the flywheel slowly forward till the ammeter shows "discharge," then switch off, and chalk the flywheel rim opposite the scratch; switch on again, and rotate the flywheel forward till the ammeter reads zero; this should occur when the line A coincides with the scratch. The chalk mark should be about 5" from that line.

155. If this is not so, it indicates that the contact point J requires closing up to give a gap of .015", or that the length of the flat on the circuit-breaker cam may be less than $\frac{3}{8}$". The distance on the flywheel is reduced if the circuit-breaker gap is increased. This distance is practically independent of the timing, but if it is too short, missing will occur at high speeds.

156. On the Garage Card is printed a warning that the gap between the circuit-breaker points should be tested every 1,000 miles. The reason for this special warning is that the ammeter continues to indicate that the "make-and-break" is functioning properly, although actually the points "J" and "K" may have gradually become too close to cause an effective spark. The gradual approach of these points is due to the wear which takes place where the cam operates on the circuit-breaker lever.

157. If the line A does not come opposite the scratch, the little lever welded to the spark advance rod A186 may have become bent, or the advance coupling rod eye 0191 may require adjustment. (Fig. 32.)

158. If the timing is quite wrong, the screw 0144 in the distributor driving arm 0184 has probably worked out of the hole drilled in the distributor spindle.

159. *TO ASCERTAIN THE POSITION FOR RETARDED SPARK.* With the starting lever up, and the switch "on," again rotate the flywheel slowly forward to see if "break" occurs at the circuit-breaker (as indicated by the ammeter returning to zero), when the dead-centre line of the flywheel is within $\frac{1}{2}$" of the scratch either way, the exact position being unimportant.

IDENTIFYING SPARK PLUG WIRES.

160. With the switch "on," oscillate the flywheel about the position "Break" when the balance weight is forward (towards the front of the car) (Art. 153a); the plug wire, which gives a spark to "earth" during this process, should be connected to No. 1 plug (left hand). It will be found that this wire comes from the top of the three connections on the distributor cap.

161. *CAUTION.* It will be noticed that the average current used for ignition while the engine is running is only about one amp., while about 4 amps. pass during contact; it is important, therefore, when carrying out the tests in Arts. 154-160, to keep the switch "on" only long enough to obtain the information required, in which case no harm will be done to either the battery or the coil.

MAGNITUDE OF SPARK.

162. Either plug wire, when disconnected from its plug, should give at least $\frac{1}{4}$" spark to earth when the engine is running slowly. Any less spark will not give perfect results. If any doubt exists, the distance should be measured, as a spark always appears to be longer than it really is. Do not be satisfied because you can see the spark jump the plug points, because the resistance to the spark, under the engine compression, is many times that in air.

SPARK PLUGS.

163. As most plugs get too hot in a Trojan engine, and cause pre-ignition, special attention must be given to the type used. In some types, the porcelains crack; others, with mica insulation, may stand the heat, but their insulation slowly fails, and may cause starting troubles for weeks. The Champion A63, with the points set .015" apart, gives the best results. The gap may be set to the same wire gauge as that supplied in the tool kit for the circuit-breaker; although on the small side, it is satisfactory because the gap burns larger with use.

On no account should the central electrode be bent, because, in doing this, the porcelain insulator may very easily be cracked or broken.

164. *DEFECTIVE COIL.* If a fault has been traced to a defective coil, there is no actual remedy other than replacement, but if the safety resistance between E and F (Fig. 59) has burned out, the blue wire may be transferred from E to F, until it is convenient to fit another resistance or change the coil.

CHAPTER III.

TROUBLES—THEIR DIAGNOSIS AND CURE.

GENERAL.

201. It must be borne in mind that, just as in human pathology, many symptoms are common to many diseases, so, in a motor car, such symptoms as over-heating, loss of power, knocking and missing, may accompany most faults, without necessarily assisting the diagnosis.

A sudden definite failure is much easier to locate than a growing defect, which may, during its development, give rise to various symptons; to cure these symptons as they arise does not necessarily result in putting the trouble right. A typical example is provided by the coil spark; as this gradually weakens, one cylinder becomes affected before the other owing to such variations as the sparking plug gaps, etc. This cylinder may then exhibit all sorts of troubles, such as faulty insulation, faulty high tension wires,

dirt in the distributor cap, and it may not be until the second cylinder feels the effect of the weakening coil spark that the real root of the trouble is located.

202. This further example will help to explain the difficulty: suppose the circuit-breaker screw H, Fig. 59, is not very tight, and corrosion or rust starts under the head, erratic missing may very slowly develop, and here the service-man may give great dissatisfaction to the car owner, because this main defect, coupled with a dozen insignificant ones, is just able to cause missing. It may be *temporarily* rectified by closing the plug points, by fitting a new plug, a new H.T. wire, cleaning the contact points, adjusting the gap, recharging the battery, increasing the dynamo output, changing the coil, etc., etc., or even keeping the car in a warm garage at night, and so it may be months before the real defect is hit upon. The actual defect may never be traced correctly, for it is possible that, in cleaning the circuit-breaker, screw H may have been removed and put back tightly, thus correcting the actual cause of trouble, while the cure will be attributed to the cleaning. See Art. 322.

202a With new vehicles it is desirable to remove the switch cover and tighten all the terminal screws, as during the first month or two these tend to become slack owing to the initial shrinkage of the back plate.

203. *If the engine will not run satisfactorily* there is something wrong with at least one of the four essentials, which are:—

i. There must be a good *Compression*, the engine must be free, and bounce on Compression (Art. 227).

ii. The *Air-petrol* ratio (*i.e.*, the mixture) must be correct. (Arts. 257-261.)

iii. The *Spark* must be at least $\frac{1}{4}$" long. (Art. 162.)

iv. The *Timing* must be right. (Arts. 151-160.)

204. The initial letters of these four essentials form the good mnemonic C-A-S-T In addition to this general "CAST formula," which will almost inevitably lead to the correct location of any fault, the description in the following pages of various special symptoms will be useful in enabling the cause of trouble to be traced quickly; in each case the necessary treatment is indicated.

DIFFICULTY IN STARTING.

205. *If the engine runs well, but cannot be started without pushing the car*, it indicates that probably the mixture is wrong (Arts. 257-261 and 307-324), but it may also point to one of the following causes:—

Primer not working satisfactorily. (Arts. 260vi and 232–239c.)

Circuit-breaker points too close. (Arts. 155 and 156.)

Circuit-breaker points dirty or burnt. (Art. 80b.)

Defective spark or plugs. (Arts. 162 and 163.)

BASE-FIRING.

206. Explosions in the crank chamber will blow smoke out through the carburettor muffler; this indicates a very poor mixture, or defective flame extinguisher gauzes. (Arts. 220 and 221.) A retarded spark (Arts. 151-158), although not the cause of base-firing, will tend to make it more frequent.

ENGINE FOUR-STROKES.

207. This means that the explosions occur at half the normal frequency because alternate charges misfire; and indicates a rich mixture at the speed at which four-stroking occurs.

Causes:—Main jet control needle 0284 (Fig. 12) stuck up, carburettor setting not automatic (Art. 310), air leak at carburettor flange joint or rubber connection on inlet pipe; it is rarely due to choking up of the compensating jet 0296, which can be cleared from above with fine wire after removing slow-running screw A235 (Fig. 12).

ENGINE HESITATES BEFORE ACCELERATING.

208. If this occurs when throttle is opened suddenly, it indicates that the carburettor is not giving the correct mixture when running slowly; try repeating the " pick-up " test, with the mixture lever in different positions, until the " pick-up " is good, then correct as described in Arts. 320-323. (See also description in Arts. 29 and 30.)

FIRING SUDDENLY CEASES.

209. This indicates a broken electrical connection (Arts. 250-256), a dead short (Arts. 241-249), or failure of petrol supply (Arts. 37 and 38, and 325 and 326). The ammeter will usually provide the clue to an electrical fault.

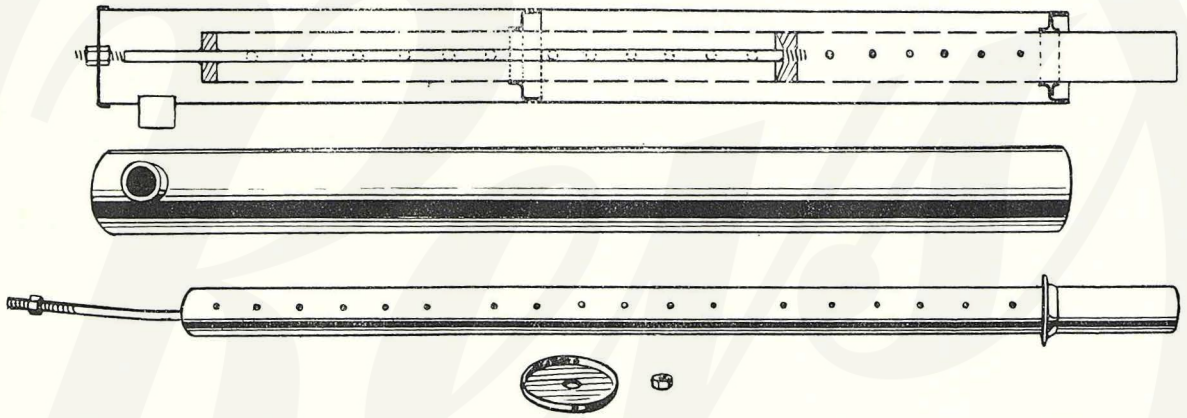


Fig. 63

HUNTING OF ENGINE.

210. If the engine races up and slows down, then races up again, it indicates insufficient length (in time) of contact at circuit-breaker (Art. 155). The spark plug points may be more than .020" apart, or the high-tension distributor segment may be burnt away locally, thereby increasing the gap.

211. This symptom will be more pronounced with the head lamps on, owing to voltage drop. The engine may hunt if the carburettor is not automatic, a condition which is due to restriction of the main jet, when the mixture may be correct at low speeds but too poor at high speeds. (Arts. 310-315. See also Art. 321.) It is rarely due to restricted petrol supply to the carburettor. (Art. 303.)

ENGINE STARTS EASILY AND STOPS SOON

212. This symptom indicates that the battery is run down (and recovers on standing), (Art. 144), restricted petrol supply to float chamber (which keeps emptying, and refills on standing; see Art. 303), or defective insulation on the secondary winding of the coil, causing internal sparking; the heat produced by the passage of sparks facilitates the passage of others. Test spark at plug wire (Art. 162); it will be good when the engine is cranked, but poor even when the engine is running slowly.

ENGINE WILL NOT ACCELERATE SHARPLY.

213. If the engine refuses to accelerate sharply or suffers gradual loss of power, or does not pull well, although firing regularly, it indicates any of the following: carbonised flame extinguishers (Arts. 220 and 221), choked silencer (Art. 219), retarded spark (Arts. 231

and 151-154), restricted petrol supply (Arts. 303, 325 and 326), exhaust port choked (Art. 222), leaky joints to transfer port covers, insufficient opening of throttle (Art. 223), incorrect mixture (Arts. 257-261), or friction loss somewhere, due to tight bearings (Art. 224), brakes or transmission bands rubbing (Arts. 348, 443 and 446).

213a. *Engine accelerates up to a point only.* If the engine misfires or ceases to pull when a certain speed is reached, a circuit-breaker defect is indicated (Art. 155), or a throttled petrol supply (Art. 303).

ENGINE RUNS HOT.

214. An engine running hot indicates retarded spark (Arts. 231, and 157 and 158), bad water circulation or tight bearings. Feel the main engine bearings (Art. 108).

CONSISTENT MISSING ON ONE CYLINDER.

215. This condition indicates defective plug or plug wire, but may be due to almost anything (see Arts. 162, 163 and 201-204).

ERRATIC MISSING.

216. Erratic missing on either or both cylinders, and at any speed, indicates, almost invariably, a bad or loose contact in the ignition circuit, but may be due to uneven or dirty circuit-breaker points. (Arts. 80b, 162 and 202a.) Erratic missing will occur if the black "earthing" wire to the distributor body is broken.

217. If this symptom is accompanied by frequent "blowing" of the dynamo fuse or by the lamps flashing bright or burning out, the loose or bad connection is either B or A on the ammeter; or one of the battery connections; or battery junction to "earth" (see Fig. 59); or to the "cut-out" contacts failing to make a sound electrical contact, owing to the presence of dirt or to bad setting of the stop used to limit the movement of the blade. (Art. 133.)

217a. If the earth connection from W (Fig. 59) is defective, this will cause the dynamo fuse to blow.

ENGINE RUNS ON ONE CYLINDER UNTIL WARM.

218. This is generally due to primer failing to supply gas to both cylinders, etc. (see Arts. 201 and 236), but it may, in very rare cases, be due to a cracked or porous cylinder or to a defective plug. The other symptoms accompanying a cracked cylinder are: difficulty in starting, a drop of water on the plug points, bubbles of gas rising through the water and the presence of oil and the smell of petrol in the radiator tank.

SILENCER CHOKED.

219. If choking of the silencer be the cause of the engine losing power, then that loss of power will have been gradual.

Remove the front cover from the silencer; if full power returns, clean out the silencer by taking it down and withdrawing the inner tube from the back. To remove this tube, put a piece of bar or metal plug in the back end, to prevent it from collapsing, and then grip it in the vice and pull the outside of the silencer off. Clean out the tube connecting the exhaust box to the silencer. (Service tool No. A369.)

FLAME EXTINGUISHER GAUZES CARBONISED.

220. Remove the transfer port covers (Fig. 23), and clean the gauzes with a nail brush and paraffin.

It is always advisable to use a new gauze to replace the one nearest the cylinder after cleaning, otherwise it will eventually disintegrate, and, possibly, cause a piston to jam or seize in its cylinder; if no new gauze is available, reassemble with the former inside gauze on the outside.

221. In re-assembling always use new joints 0148, as a defective joint affects carburation, lubrication and power. Stick two gauzes inside one container 0141 with a little stiff grease round the edges, place the joint 0148 round it, and insert this in the engine casting; stick the other two gauzes in the other container, while it rests in the transfer port cover. Then bolt cover up to engine casting.

It is important that the joint 0148 should be on the engine side of both containers, as shown in Fig. 23.

EXHAUST PORTS CHOKED.

222. Cars subsequent to No. 2392 are provided with a hand hole in the bottom of the punt, to enable the exhaust flange 0145 to be removed without removing the engine. Rotate the flywheel to bring the oil plug in the epicyclic gear box uppermost; the pistons will then cover the ports, thus preventing carbon from entering the cylinders while scraping is in progress.

INSUFFICIENT THROTTLE OPENING.

223. This will occur if any of the set screws involved in the mechanism becomes loose. It should be seen that when the accelerator pedal is fully depressed the carburettor throttle is quite open.

STIFF ENGINE.

224. Slacken the dynamo belt, pull the flywheel round, and, if the engine is uniformly stiff all the way round, the bearings are probably the cause; see if the outside main bearings are hot. (Art. 108.) If, however, it is fairly free about each dead centre, when the oil plug in epicyclic gear box is either right forward or backward, but stiff in other places, a piston is probably tight through seizure or, possibly, as in Art. 220. In either case allow the engine to cool; if a supply of cold water is available, drain and refill the radiator, add an ounce of oil to each side of the crank case, and try to get home.

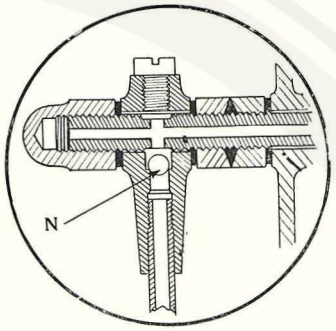


Fig. 66

KNOCKING.

225. This may be caused by slack bearings, pre-ignition (due to over-advanced spark, dirty combustion chamber (Art. 101), overheated engine or unsuitable sparking plugs), poor mixture, irregular firing, want of lubrication, or such external defects as transmission bands fouling, distributor spindle end-play, etc.

226. If the knocking is very loud, the white metal in one of the big end bearings has probably melted. Drive home in easy stages, at whatever speed the knocking ceases, or is least evident. As the melted white metal will probably clog the oil passages, it is desirable to add an ounce of fresh oil, every five miles, to the defective side of the engine. The defective side can be ascertained by removing the brass plugs, 0168 (Fig. 35), and looking for specks of white metal on these plugs or on the con-rods, viewed through the plug holes.

COMPRESSION WEAK.

227. The compression is usually rather poor in a freshly re-assembled engine, particularly if the piston rings have been handled carelessly, but it should steadily improve.

With the engine running, try oil on the sparking plug washers to see if they are tight, look for bubbles in the radiator, filled right up, to see if the compression is leaking into the water jackets (Art. 218). Broken piston rings and punctured piston heads are rare and cannot be located without dismantling. (See also Arts. 234-236.)

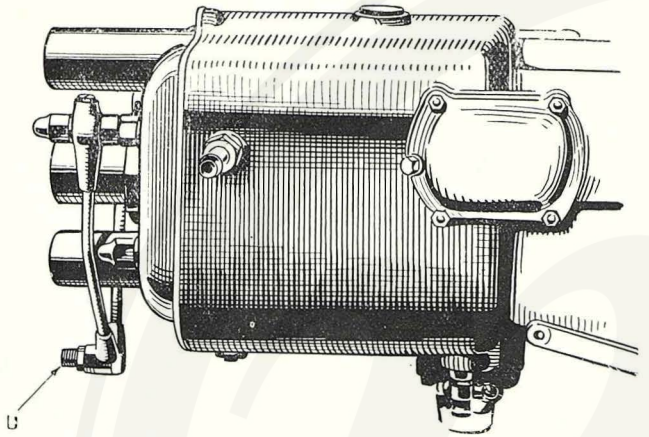


Fig. 65

HOT ENGINE.

228. If the engine has been run with insufficient cooling water, remove seat and floor boards to allow it to cool until it is possible to bear the hand on the cylinder casing, before replenishing the radiator.

COOLING WATER BOILING.

229. When climbing long and severe gradients with a following wind, the cooling water may boil. There is no need for alarm when this occurs, since the engine functions perfectly well with the water boiling; in fact, it is better to have the engine too hot than too cool. The overflow pipe, however, should be kept free to carry away the steam, but its capacity should not be increased, otherwise, due to the boiling, much water will be thrown out.

Overheating may be due to a retarded spark or to insufficient lubrication. (Art. 214.)

COOLING WATER TOO COOL.

230. In cold weather, particularly on short runs, it is beneficial to restrict the flow of air through the radiator, by the usual radiator covers and blinds, or their equivalent.

STARTER LEVER WORKING UP, THUS RETARDING SPARK.

231. Should this happen continually, it will indicate that the starter lever retaining spring, which is fastened on to the side of the punt, is not bearing firmly enough against the side of the starter lever. To remedy this the top end of the spring should be set slightly more over towards the lever.

NOTE.—A "touch" of grease must be applied to this spring occasionally, or it will eventually cut through the starting handle.

PRIMER OUT OF ORDER.

232. **Cars previous to 5,000** are fitted with a *Gravity Primer* (Fig. 22). A leaky petrol cock will cause an overflow of petrol from the primer, but, on rare occasions, petrol vapour will find its way into the crank chamber, and render starting difficult.

Turn off the petrol cock, and disconnect the pipe from the cock to the primer; notice whether petrol drips.

233. *Primer fails to prime.* Test by disconnecting pipe from cock to primer, with the cock in the "off" position, and notice whether the measured quantity of petrol is delivered when the cock is turned to "prime." If not, the air vent pipe (Fig. 15) may be clogged with oil. Connect a piece of rubber tube to the pipe from the cock to primer, remove the tank filler cap, turn the cock to "prime," and blow through, turn the cock to the "off" position to fill the capacity chamber, then turn to "prime" and blow again. This time the measured quantity of petrol should be projected into the air.

See whether the primer pipe and transfer port cover joints are tight, and not blowing petrol out.

If an unusual quantity of petrol blows out of the primer during cranking, the transfer ports are probably leaking, or the centre main bearing of the engine may be allowing the crank chamber compression to leak from one side to the other.

234. **Cars between 5,000 and about 11,300** are fitted with a *foot pump primer* (Fig. 24). If the engine starts from cold without having been primed, or proves to have too much petrol to start at all, examine the pump to see whether the spring is strong enough to return the plunger past the air vent PV. (Art. 52.)

235. If one of the $\frac{3}{16}$" balls N *has been accidentally left out,* the explosion passes through the passages, making the whole valve box and pipe very hot, and melting the lead washer 01390. The engine compression is also impaired.

236. If one of the balls N *becomes stuck in its seat,* starting is rendered difficult, and, when the engine does finally start, it will run on one cylinder for some time before the other fires.

237. *To see if the proper passages are free,* and the balls operating, remove the cap nuts 0150 and operate the pedal pump, and observe whether there is a discharge of air and petrol from the ends of both drilled studs 01395. These studs can be pricked out by pushing a wire less than $\frac{3}{32}$" diameter through into the combustion chamber; the union U can be disconnected and blown through with the help of rubber tubing.

238. *Re-assembling ball valves.* If the priming valve boxes 01394 (Figs. 26, 65 and 66), or the priming pump valves are removed for cleaning, the balls should be replaced with plenty of vaseline (not common grease), otherwise they may drop out unobserved during assembly.

239. *The efficacy of the pump* can be tested by disconnecting the union at the pump delivery or at U, then operating the pump and seeing that air and petrol are delivered. Test by stopping up the delivery with a finger, when the pump should be harder to work.

239a. *Failure with hand pump primer.* Cars between Nos. 11,300 and 14,420 are fitted with the " Ki-Gass " primer. If it fails to function, disconnect the pipes at the unions on the transfer port covers (*see* Fig. 23) and operate the pump.

If no petrol is delivered, the plunger gland is leaking and either requires tightening or re-packing, or the suction pipe from the petrol cock to the pump is leaking, or one of the pump ball valves is stuck up.

239b. Cars subsequent to No. 14,420 are fitted with the Trojan hand pump primer (Fig. 26A). If it fails to function, disconnect the pipes as above.

The gland should never require adjusting, because the spring 01347 maintains a steady pressure on the packing.

It is most important that the plunger should return right home each time in order to shut the needle valve 02341 (Art. 260vi). To ensure this, the operating wire should be slightly slack.

If the plunger ever sticks up, it should be removed and polished and re-packed with fresh packing impregnated with graphite grease.

239c. If it is desired to convert from the foot primer to the hand operated type, a copy of drawing No. 05277, giving full instructions, should be obtained.

ELECTRICAL FAULTS.

240. In most cases the rough-and-ready practical method locates the trouble; if not, the following method is infallible, provided two defects have not occurred together, in which case one may possibly conceal the other.

241. " Short Circuit " is caused if any of the insulated wires or connections become accidentally " earthed "; a very large current takes this " short circuit " back to the battery, with the result that the ammeter goes to full " discharge," ignition ceases, the lamps scarcely glow, and there is usually a smell of burning rubber.

242. When there is a *main fuse* between the negative of the battery and " earth," this fuse instantly " blows " or melts when a " short " occurs.

243. The correct *fuse wire* to use is tin or lead (not copper), 19 or 20 gauge, .040″ or .036″ diameter, which can be depended on to melt at about 20 amps.

244. Immediately a short circuit is suspected, switch off everything, and tap the ammeter to see if it will return to zero. If it returns, insert a new fuse wire, try, in turn, each switch X, Y, Z (Fig. 59 and diagram in Instruction Book), and the ignition switch, one at a time to see which circuit has the "short," bearing in mind that the ignition switch also supplies the horn, which is the most frequent offender. (In early Trojans, the edge of the hole in the punt flange, at the bottom of the left side door post, has been known to cut through the insulation of the wires.)

245. If the ammeter does not return to zero, disconnect the pink positive battery wire without further delay. As the wire is removed it will give a crackling spark, which will show that the defect is between the positive of the battery and the switches, or in one of the switches.

246. Remove the screws securing the switch cover plate, and pull the plate right off by means of the lamp switches; momentarily touch the pink wire to the positive battery terminal; if it sparks, the "short" is between the switches and the battery; if not, one of the switches is faulty.

247. Disconnect the pink ammeter wire at A, and momentarily touch the other end of this wire to the positive of the battery; if it sparks, the "short" is in this wire.

248. If not, re-connect A, disconnect B, and again touch the pink wire to the positive of the battery; if it sparks, the ammeter is "earthed."

249. By this time the defective circuit will have been traced. The same method of elimination will trace the actual fault in any defective circuit.

249a. An effective, though barbarous, way for locating an elusive "short" is to substitute copper wire in place of the main fuse, connect up the battery and watch the wiring for smoke.

250. If the *current fails*, due to a wire breaking, or a connection becoming loose or detached, the current is unable to pass beyond the fault, and the line is said to be "dead."

251. For locating this type of fault, all the apparatus needed is a length of wire, preferably plain iron wire, 22 to 18 gauge; iron is not such a good conductor as copper. Connect one end of this wire to "earth" on the punt frame. A still better device is a length of insulated wire with either a 6-volt lamp or a voltmeter connected between one of its ends and "earth."

252. The free end of the wire can be touched momentarily to any of the points or terminals to be tested; for the sake of brevity, this will be described as "earthing" the point.

253. If, for example, the positive of the battery is "earthed" in this way, sparks will occur when using the plain wire; if using a lamp, the lamp will light; if using the voltmeter, 6 volts will be indicated.

254. We will presume that a plain wire is being used, and that it either does or does not "spark."

255. *Reasoning.* If the ignition circuit is "dead," but the lamps light brightly, the battery is obviously O.K., and need not be tested. If, however, everything appears to be "dead," first switch on the lamps, then "earth" the negative of the battery; it should give no "spark"; if it does, the lamps will light, and the fault is in the battery "earthing" wire; or, when a main fuse is used, this may have blown. If O.K., "earth" the positive of the battery; if no spark occurs, the battery is run down. If O.K., "earth" A, B, and C (Fig. 59), preferably C first, as it is so accessible. It should spark; if not, remove the switch cover and "earth" A and B till the fault is located.

256. If the ignition circuit only is "dead," switch on the ignition, and "earth" the points L (both blades), E, F, G, H, J and K in turn. They should all spark, with the exception of K. If O.K., turn the flywheel till the points J and K come together. If J sparks and K does not, the points are not really touching; if K sparks, it has somehow become insulated from "earth." Examine the black earthing wire.

The same system can be applied to any of the other circuits.

DEFECTIVE AIR-PETROL RATIO OR WRONG MIXTURE.

257. The mixture may be either too rich or too weak, and may exhibit one or other characteristic, either when the driver is endeavouring to start or when the engine is running.

WHEN STARTING.

258. *A rich mixture* may be caused by the following:—

i. Over-Priming. (Particularly with a hot engine.)

ii. Having previously switched off or having "stalled" the engine when it was running on a rich mixture.

iii. Main control needle of carburettor stuck up.

iv. In cars (previous to No. 5,000) with gravity primer, leaky petrol cock, as described in Art. 232. In cars (between Nos. 5,000 and 11,300) fitted with foot pump primer, plunger not returning "home" properly, thereby closing the air vent hole. (See Fig. 24 and Art. 52.)

v. The hole PV (Fig. 24), stopped up. (This is very unlikely.)

vi. In cars subsequent to No. 11,300. (See Art. 54b.)

259. *A poor mixture* may be caused by the following:—

i. The use of a very low grade of petrol in cold weather.

ii. Primer not working properly. Gravity Primer (Art. 233), Foot Pump Primer (Arts. 234-239). Hand Pump Primer (Art. 239a and b).

iii. Main control needle of carburettor not lifting.

WHEN RUNNING.

260. *A rich mixture* may be caused by the following:—

i. Main control needle of carburettor stuck up.

ii. In cars previous to No. 9322, mud excluder choked.

iii. Carburettor setting not automatic (Art. 310).

iv. Float needle-valve not closing properly.

v. "Red Spot" in wrong position.

vi. Primer stop valve not being shut off tightly (Art. 54b). This defect will cause the engine to stall when running light and re-starting will be difficult.

261. A *poor mixture* may be caused by the following:—

i. Throttled petrol supply, pipes or passages blocked (Arts. 325 and 326); filter gauze clogged.

ii. Leaky joints on inlet pipe or on transfer port covers.

iii. Float needle stuck up.

iv. "Red Spot" in wrong place.

CHAPTER IV.

CARBURETTOR AND PETROL SUPPLY.

CLEANING THE CARBURETTOR.

(For illustration *see* Art. 25b.)

301. As there are no adjustable parts, the whole of the carburettor may without anxiety be dismantled for cleaning; care must, however, be taken that all the joints are tight after re-assembly; the main jet (not the compensating jet), float standard 0277 and the outside plugs 0291 and 0168 should be jointed up with gold size or glue. (Fig. 12.)

The careless practice of dipping the screws in the size or glue is dangerous, as internal passages become stopped. The go'd size should be applied between the thread and the head with a match-stick.

PETROL AND OIL PIPES.

302. The petrol and oil pipes are rendered doubly secure by being screwed as well as soldered into the union nipples. The ends of the pipes are screwed a very short distance only, so that the unscrewed portion of the pipes is supported (see Fig. 12).

To repair a pipe connection, screw the end $\frac{1}{4}$ B.S.F. for $\frac{3}{16}$", tin about $\frac{5}{8}$" up, screw into position hot, say, in bunsen flame, then before cooling, allow a fillet of solder to form at the joint.

Make *new pipes* from $\frac{1}{4}$" diameter 20 gauge copper, annealed (softened) by heating to dull red.

303. If the petrol supply to the carburettor is restricted, the car will accelerate up to a point only, and then the engine will cease to pull. This may be confused with "Missing at High Speeds" (Art. 155). The cause may be proved by switching off the petrol and ignition directly this lack of power is evident. Stop and remove the float chamber cover; if the float is found to be hard on the bottom instead of floating, the supply of petrol has been restricted. Rectify as shown in Arts. 325 and 326.

LEAKY CARBURETTOR FLOAT.

304. To *test for leakage*, plunge the float under hot water to see if air escapes, in which case mark the place.

305. To *repair*, drill or prick the smallest hole possible, about $\frac{1}{8}$" from the bottom corner of the float; this prevents fluctuations of internal pressure, while a leaky seam is receiving attention. Plunge the float under hot water, with this hole downwards, till air escapes from the hole; this will remove any petrol.

306. Clean and solder the leak with a copper bit. Clean round the hole, and, with the point of the bit, quickly dab a spot of solder over the hole.

CARBURETTOR SETTING.

EXPLANATION OF TERMS.

307. The *power position* for the mixture lever on the mixture dial plate is the lowest position which gives maximum power. Any movement of the mixture lever from this place towards "air" will give less than the maximum power.

308. The *normal position* for the mixture lever is that at which loss of power, for lack of petrol, is just appreciable; this is the most *economical* position, and is marked with a *red spot*. The exact position should be checked occasionally by the driver as it varies somewhat with climatic and other conditions. It is bad to run with the mixture either too poor or too rich, as they both cause slow combustion and erratic firing.

309. The *power position* is usually one division above the *normal position*.

310. *Automatic setting*.—The setting is automatic when the carburettor gives the same richness of mixture under all conditions, that is to say, the position of the mixture lever which is best for speed on the level is also best for climbing a hill which causes the engine to run slowly.

311. If the hole in the compensating jet 0296 (Figs. 12 and 13) or the hole P (Fig. 12A) is too small, or if it becomes stopped up, the *power position* of the mixture lever will be much higher for slow than for fast running. The carburettor then has *main jet characteristics* instead of being automatic. (Art. 26.)

312. If the reverse obtains because too much air passes through the compensating jet, the carburettor is *over compensated*.

313. Best economy can only be obtained when the setting is automatic and cannot be obtained by merely reducing jet sizes.

314. *Setting the carburettor.*—This must be done with the engine hot, after, say, 3 miles or after 6 miles in cold weather.

A. Find the *power position* at full speed on the level or preferably up a very slight incline.

B. Find the *power position* up a hill of about 1 in 9, or failing a suitable hill, a load which reduces the speed to 12 m.p.h. with full throttle may be imposed by loading the car up a less gradient or by towing another car.

315. If the mixture lever position is lower for B than for A, the carburettor is *over compensated* and a smaller compensating jet is required.

316. If, on the other hand, the dial reading is lower for A than for B, the carburettor exhibits *main jet characteristics*, and a larger compensating jet is required (see Art. 320).

317. *Setting slow running device.*—This should be tackled only after the main setting is in order. The adjustment consists of varying the length of the brass tube A235 (Fig. 12) from $1\frac{1}{2}''$ as a minimum to 2″ as a maximum (measured from the under side of the head); or in varying the length of the projecting portion of the tube 01981 (Fig. 12A) from nothing as a minimum to $\frac{3}{4}''$ as a maximum; the longer the tube the richer the mixture.

318. To check setting, adjust throttle opening screw 0180 (Fig. 13) or 01977 (Fig. 12A) to run the hot engine at about 350 r.p.m. Let the engine run at this speed for about half a minute, with mixture lever in *normal position*, and suddenly and simultaneously close mixture lever and open throttle; the engine should race up and die down fairly quickly.

319. If the tube is too long, then petrol accumulates enough to keep the engine racing a long time, although the main jet is closed. If the tube is too short, the engine will not throttle down to run slowly, or will not pick up well when the throttle is suddenly opened.

RE-SETTING THE CARBURETTOR.

320. If a carburettor, after having once been in order, loses its automatic character, the size of the compensating jet will be suspected, but it is the last thing which should be altered, as the defect probably has another cause.

321. For example, main jet characteristic can result from the following causes:—Leaky joints at carburettor flange or at transfer port covers, dirt in compensating jet, a too short slow-running tube, a choked mud excluder under float chamber, or a choked muffler, while the symptoms of over-compensation are given by a choked petrol supply to carburettor, or a too long slow-running tube.

322. Defective spark plugs, choked silencer, choked flame extinguisher gauzes, discharged battery, dirty or badly adjusted contact breaker points and loose electrical connections may lead one to suppose that the carburettor setting is wrong.

323. *Pick-up.*—If the engine hesitates instead of responding quickly to the accelerator after running slowly, repeat the acceleration test with the mixture lever in different positions until the best place is found for this performance. If this position is above the *normal position*, the slow-running tube is probably too short, and vice versa; sometimes, however, a bad pick-up is due to the throttle screw 0180 (Fig. 13) or 01977 (Fig. 12A) being set to run the engine too slowly.

324. If it becomes necessary to re-determine the "normal position" of the mixture lever, owing to dismantling of the parts concerned, it should be remembered that the most economical running mixture is one which gives a little less than the maximum power; hence the *red spot* should be placed where loss of power just becomes appreciable.

CHOKED PETROL PASSAGES AND PIPES.

325. (For Carburettor passages see Art. 301.) It should scarcely ever be necessary to remove the petrol cock or the petrol cock filter to clear the passages (see Figs. 14-21A). If, after applying the test described in Art. 303, the float is on the bottom of the float chamber, turn on the petrol; there should be a good stream through the pipe. If there is, then remove the float chamber needle (Fig. 12), and blow both ways through the passage. Shake the float to see if it contains petrol (Art. 304).

326. If the stream is weak, remove the petrol pipe, blow through it, and connect a rubber tube to the petrol cock opening, turn on the petrol until the pipe fills, pinch the tube, and then blow the petrol back violently into the tank; repeat this several times, when the passages and filter should be cleared.

327. If the gravity type primer (cars previous to No. 5,000) receives no petrol, the passages may be blocked, or thick oil may have sealed the air vent pipe (see Art. 233).

328. Cars between 9,322 and 11,396 are fitted with Amac Carburettors, particulars of which will be found in the Amac Booklet supplied with the tool kit.

CHAPTER V.

TRANSMISSION (Fig. 35.)

REMOVING EPICYCLIC GEARBOX FROM CAR.

341. i. Detach the fourteen flexible coupling springs 0323, Fig. 35, by first removing the fourteen outside screws 0457. Place a piece of plain rod in each empty hole while each inside screw is being removed. (Art. 103, Fig. 34.)

ii. Loosen the screw 0327 in the locating collar about six complete turns, until the collar will move round on the shaft.

iii. Remove the low and reverse rods 0446A, and the low gear pull-off spring underneath the low speed drum. (Fig. 30.)

iv. Release the anchor shaft 0381 where fitted by taking the screws out from each end. The anchor shaft can be prevented from rotating by inserting a tommy bar in the centre of the shaft.

(Some of the early cars did not have this hole, and it may be necessary to drill a $\frac{3}{16}$" hole right through the distance ferrule 0355 and the anchor shaft 0381, in position). (See Fig. 35.)

v. Remove the small chain sprocket 0405 with the aid of the withdrawing screws 01161 (or with service tool No. A371), and with the same screws remove the transmission brake drum 0742, and remove the plate 0404.

vi. Withdraw the shaft with the special tool (service tool No. A370), or lever it out with jemmies or pinch bars.

The gearbox can now be lifted out.

REMOVING THE GEAR SHAFT.

342. If only the gear shaft needs removing, items ii. and vi. alone are necessary. Care must be taken, however, if the gear shaft has seized in the low speed drum bearing. When the shaft is being withdrawn, the drum 0328 must be kept back, and, in the absence of the special tool (service tool No. 01471), packing must be arranged between the drum and the reduction gearbox, at points where the fragile aluminium cover is supported.

343. If the shaft is too badly seized to come right through the top speed cone, draw it as far as possible, then remove the engine and epicyclic gearbox, knock cone back and file high places off shaft. It may still be possible to use the shaft again, if it is carefully cleaned up to be a free fit in the low speed drum sleeve.

ERECTION OF EPICYCLIC GEARBOX IN CAR.

344. Erect parts in the reverse order of dismantling and, after erecting, make sure that none of the parts detailed in Art. 341 has been omitted.

345. When securing the locating collar with the screw 0327, there may be some doubt as to whether the point of the screw has entered the hole in the shaft; to ascertain this, first screw up lightly in the wrong place, release the screw half a turn, then, when it is in the right place, the screw can be screwed in several turns.

ASSEMBLING OF EPICYCLIC GEARBOX.

346. i. The bushes 0312, 0310, and 0311 should be pressed inside the gearbox, the reverse drum hub, and gearbox respectively. Then reamer out until they are a very free running fit to the respective parts on which they run.

ii. Assemble the spindles 0314 and the washers 0316 in gearbox, insert pegs 0322, secure with locking plates 0317 the nuts 0493, assemble the reverse drum hub and drum complete into gearbox, and press the gear wheel 0308 into position; then place the washer 0329, and the gear wheel 0448, in such a position that the oil holes in the gear wheel corresponding with the holes in the slow-speed drum. (For removing gear wheels use service tool No. 373.)

iii. If the keep ring 0331 will not go into position, the rounded edges of the bushes may have to be scraped to enable the slow-speed drum to go farther in.

iv. Press the bushes 0315 into planet gear groups, reamer until they are very free running fits on their spindles. With $\frac{1}{8}$″ drill, follow through the hole already drilled in each of the smallest planet gear wheels, and insert the peg 0471 until it projects $\frac{3}{64}$″ inside the bush. Caulk the steel over the head of this peg to ensure that it cannot work back.

v. The two planet groups of gears can now be slid into position; the two groups must slide simultaneously, otherwise the correct meshing of the gears necessary to ensure an even distribution of the drive will not be obtained.

The advantage of this pin-and-groove system of assembling will be appreciated by those who have spent hours trying to assemble similar epicyclic planets. If one planet group has been assembled wrongly, it may be impossible to get the other one in at all, or, worse still, it may be assembled so that it drives against the other instead of sharing the drive.

vi. Insert the other two washers 0316, and apply gold size or coach varnish to the joint on gearbox and cover. Insert the inner ring for spring drive 0324, and the locking plates 0318, tighten nuts 0493, and then the screws 0218. Insert the shaft 0301, and keep collar 0321.

vii. Rotate the shaft to ascertain that the gears are all free endwise. Introduce about half a pint of engine oil through the oil plug hole 0168.

FITTING NEW LOW-SPEED OR REVERSE BAND.

347. Remove transmission band anchor shaft 0381 where fitted (the attachment to the chassis behind the gearbox), by undoing the set screws at each end (Art. 341, iv). Bring the anchor shaft to the top, and insert the new band under the keep-rings on the anchor shaft. Replace the anchor shaft in position temporarily, by replacing the screws previously mentioned, and see if the new re-lined band fits the drum properly.

348. If the lining does not conform to the curvature of the drum, the band must be removed and bent on the bench with a wooden mallet, until the desired fit is obtained. If anything, the lining should make contact on the drum at the heel end first rather than the toe. The anchor shaft can now be replaced and the set screws done up tightly, and the curved-lever pins in front of the gearbox inserted.

FITTING NEW TOP-SPEED BAND.

349. For band adjustment, see article in the Instruction Book, under the heading "Top-Speed Clutch Bands." After re-lining the bands, it is essential to shape the band carefully to suit the drums, otherwise the gears will be noisy in neutral, the bands will heat up, and will not grip properly when travelling in top.

350. The clutch stop Q (Figs. 30 and 31) is provided to prevent the top-speed cone 0341 from being forced against the low-speed drum by the clutch spring, thus producing wear, noise, and end-thrust on the ball bearing 0313.

351. The stop should be adjusted so that a thin card just fails to be nipped behind the top-speed cone. The stop in the other direction is the reduction-gear box cover R, and it is most important that the top-speed bands should not be adjusted too tightly to prevent this stop from being reached (see Instruction Book *re* "Further Tightening"). The length of the clutch fork rod 0444 is adjustable to enable the stops B and R to be encountered at the same time.

352. One of the bands is painted white to guard against one band being adjusted twice and the other being missed. For adjustment of "Low-Speed and Reverse Bands" see Instruction Book.

EPICYCLIC GEAR SEIZURES.

353. As there is relative motion between all the gear parts in neutral, low and reverse, it follows that if any part seizes, the gearbox has to rotate as a whole, and the car is put in top gear.

354. If the car tends to creep forward and, on investigation after driving, the speed bands are cool and not rubbing, a pending seizure is indicated; plenty of oil should be added to the gearbox.

355. If, however, it seizes up solid, the car can be driven home on top gear. To start the engine, push the car with the top speed in (do not make the seized parts worse by driving through them).

FIERCE CLUTCH.

356. With new cars the bands corresponding to the three speeds will all be somewhat fierce until the linings have bedded down, and the drums have become polished.

If the driver does not make due allowance for this temporary fierceness, the excessive strain on the chain will pull the back axle forward on the spring, and slacken the chain instead of unduly straining any part of the transmission. It is, consequently, very undesirable to attempt to fix the back axle absolutely rigidly to the spring.

REMOVING REDUCTION-GEAR BOX FROM CHASSIS. (Fig. 35.)

357. To remove the layshaft 0411, or the large gear wheel, it is necessary to remove the reduction-gear box 0428 from the chassis.

i. Remove the locating collar 0321 (Art. 341 ii).

ii. Remove the right hand back spring (Art. 401).

iii. Remove the hand brake lever 0748.

iv. Remove all the bolts around the box, including those inside the punt at the back, which hold the box to the torque tube 0412. (Fig. 31.) The whole box and gearshaft will now come away.

v. Remove the aluminium cover and chain wheel, support the machined face of the box on blocks, and press the shaft through.

358. In re-assembling this box, the reverse order should be followed.

359. *Alignment.* If these ground gears are not assembled in true alignment, *i.e.*, with their shafts parallel, the gears will be noisy.

360. To test alignment, remove the small chain wheel, and replace this by a disc (service tool No. 01474), rotate this to ascertain that the inside face runs dead true. Attach a scriber (thick copper wire)

under the nut securing the 6″ brake drum to the gearshaft, bend the pointed end of this wire nearly to touch the aligning disc. Rotate the shafts, and see that this distance (from the scriber point to the aligning disc remains constant during rotation.

361. To correct any error in alignment it is necessary either to move the front of the engine to the left or right on the front engine bearer tube, or to alter the thickness of one of the pieces of packing, between the engine foot and the torque tube.

NOTE. As the reduction gears are ground and mated in pairs, it is not usually feasible to renew one without the other.

SHORTENING CHAIN.

362. Release the eight (spring-chair) bolts. Pull the top of the right hand wheel forward, with a sudden jerk, to slacken the chain. Push out any one rivet with the special rivet-removing clamp, then push out the rivet next but one to it, thus removing a complete or double link, *i.e.*, 1½″ of chain. Join up the chain with a new rivet, and caulk its end.

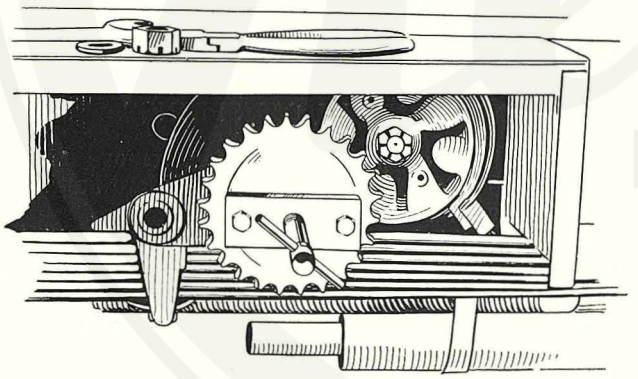


Fig. 70

363. In the absence of the special rivet-removing clamp, it will be necessary, in order to push out the rivets, to remove the chain and take it to the bench. Replace the chain over the sprockets, and tighten roughly by rotating the back wheel suddenly backwards. Adjust with chain-adjuster (see Instruction Book, article "Chain Adjustment").

364. It is not feasible to shorten the chain in this manner more than twice, because after a third shortening it would become out of pitch with the sprockets, and would persist in jumping the teeth.

364a. When it becomes necessary to fit a new chain the sprockets or chain wheels should also be renewed (service Tool A371), as it is false economy to run a new chain on worn sprockets. (Fig. 70.)

CHAPTER VI.

SPRINGS AND AXLES.

REMOVING REAR SPRINGS. (Figs. 71 and 72.)

401. Scotch the front wheels. Place a stout piece of board, 32″ long, under the back end of the punt, and jack it up high enough to relieve the load from the springs; remove the rear spring grip plates 0531, (Fig. 76), separate the back ends of the two bottom plates with a screwdriver, and withdraw the bottom plate entirely. (Service tool A374.) The remaining plates should be pushed to the bottom of the central spring clip 0739 and withdrawn all together.

402. It is generally more convenient to remove the back axle entirely; to do this, remove the chain (lift it off the front chain wheel without parting it anywhere), unscrew the brake wing nut, and take the axle out of the way. The axle has to be moved backwards and sideways so that the wheels clear the wings.

403. In re-assembling, the spring 0613 should be placed in position in the centre spring clip before the bottom or last plate is assembled, also, in the case

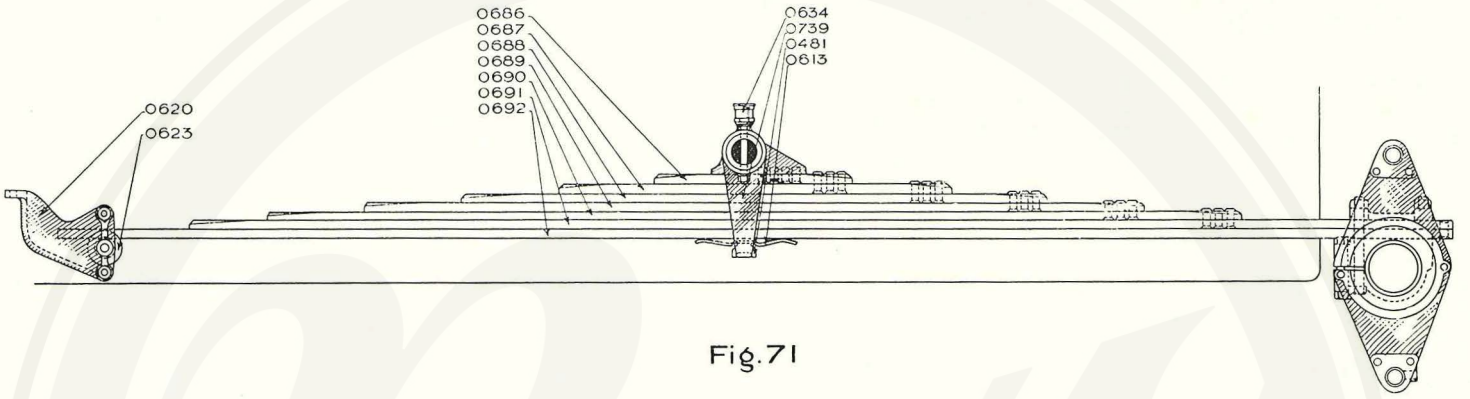


Fig. 71

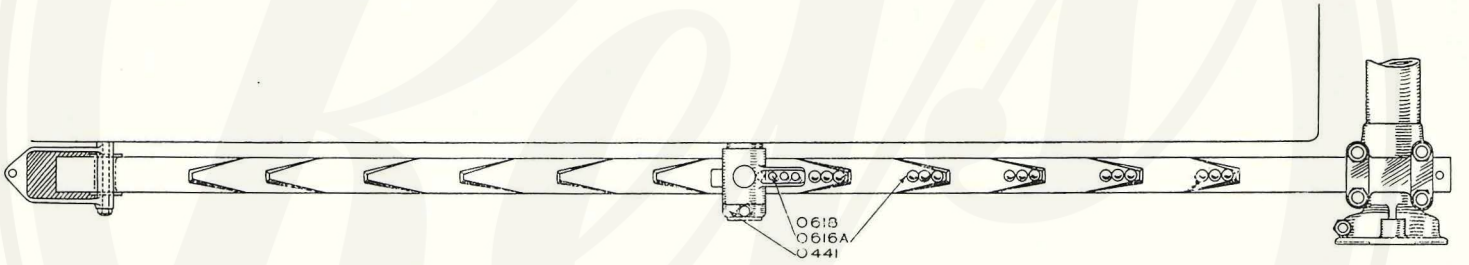


Fig. 72

of some chassis (depending on the total thickness of the spring), the make-up piece 0481 should be placed under the keep spring.

403a. In cars subsequent to No. 15,087 the torque tube has been made with the right-hand end detachable to facilitate the removal of the rear spring clips 0739 or 02089 or the radius rod end 02503a (Long chassis).

The right-hand end of the torque tube is slotted and can be unscrewed after the two set screws, holding it, have been released.

REMOVING FRONT SPRINGS.

404. Jack up as with rear springs, remove spring-chair plate 0570, withdraw the bottom plate first, and proceed as with rear springs.

LOOSE SPRING RIVETS.

405. The drive of the chain and the drag of the brake, act through the plates of the spring from the bottom plate to the top plate; therefore, it will be seen that, since the bottom plate is secured to the

axle, and the top plate to the chassis frame, if the rivets were to come out there would be nothing to keep the axles in position.

Two rivets secure each plate in the front springs and three in the case of the back springs, therefore it would not be serious if one rivet became loose or worked out; if, however, all the rivets securing one plate to the next became loose, the spring would have to be dismantled and re-riveted.

If the trouble is in the long plates, re-riveting is quite simple, but if in the short plates, all the rivets in the plates below the defective one have to be cut out first.

It is important to obtain the type of rivet which fits the countersink.

CHANGING BACK-AXLE SHAFT.

Tapered Type (Figs. 74 and 75).

406. Scotch the front wheels, and remove the back axle from the car entirely, as set out in Arts. 401 and 402.

Remove the back wheels with wheel drawer. Service tool A321. The wheel drawer screw should be first tightened, and then given one blow with a hammer, to free the tapered grip. Release the ball-bearing clamping bolts at each end of the axle case, and, with a block of wood, drive the right-hand end of the axle shaft through.

407. When re-assembling, make sure that the inner races of the ball-bearings are knocked up to the shoulders of the shaft, while the three clip bolts, each end of the axle case, are quite loose; screw the wheels tightly home, spin the wheels and hit each end of the axle with a block of wood. Put axle in position under springs, and tighten the five bolts each end of the case.

408. It is important to get the wheels tightly home on the tapers. After tightly screwing up the wheel nut 0501, using a temporary washer, place a piece of very stout tube (over $\frac{3}{4}$" bore) over the end of the axle, and hit this with a hammer at the same time that an assistant is tightening the nut.

FITTING NEW KEY TO AXLE SHAFT.

409. The key must be made of tool or key steel; it must fit tightly on the sides, and be just clear, or but very slightly marked top and bottom. The key should be inserted after the wheel is on, but before the wheel is tightened home.

410. Use the locking washer 0509a, and bend up only one of the four ears with a blunt chisel.

411. *CAUTION.* It is essential to assemble in such a manner that the ball-bearings are not subjected to continual end thrust, as might be the case if the outer races were clipped in their housings before the inner races were right home.

TAKING UP END-PLAY.

412. If the whole assembly of the wheels and axle develops excessive end-play in the axle casing, owing to the clearance being excessive, remove both wheels, slacken the five bolts at each end of the axle case, tap the bearings inwards, rotate the shaft to see if it is quite free, and re-tighten the ten bolts.

Re-mount the wheels temporarily, and measure the clearance on the inside edge of the wheel hub. This can be done by allowing the wheel to compress a piece of lead previously laid over the shaft. Make the packing rings $\frac{1}{32}$" less in thickness than the clearance width as shown by the lead.

REAR AXLES—SPLINED TYPE.

(Figs. 76 and 77.)

413. Before assembling the axle shaft in the axle case, drive the wheels home on the splines with a block

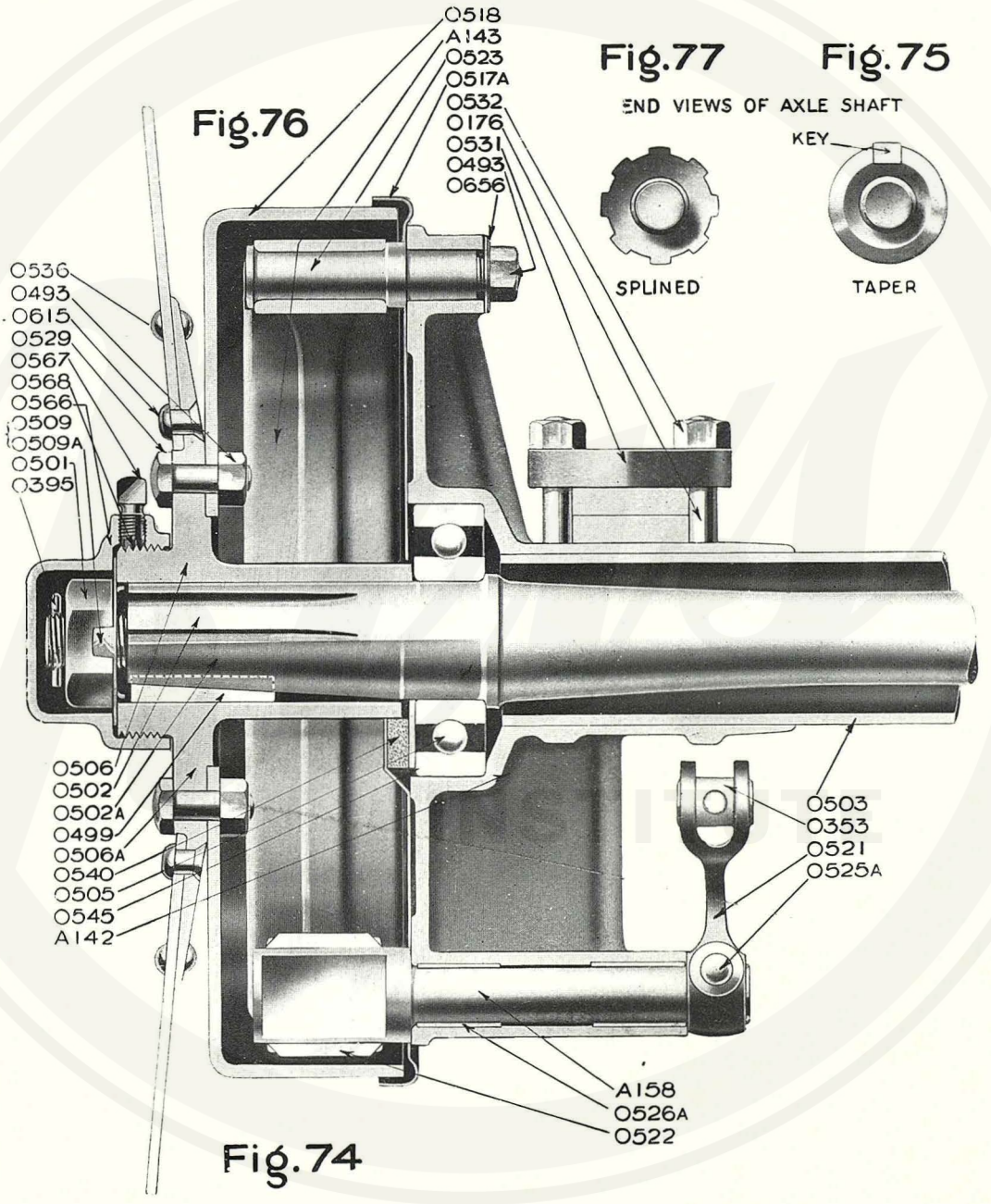


Fig.76
0518
A143
0523
0517A
0532
0176
0531
0493
0656
0536
0493
0615
0529
0567
0568
0566
0509
0509A
0501
0395
0506
0502
0502A
0499
0506A
0540
0505
0545
A142
A158
0526A
0522
0503
0353
0521
0525A
Fig.74
Fig.77
END VIEWS OF AXLE SHAFT
SPLINED
Fig.75
KEY
TAPER

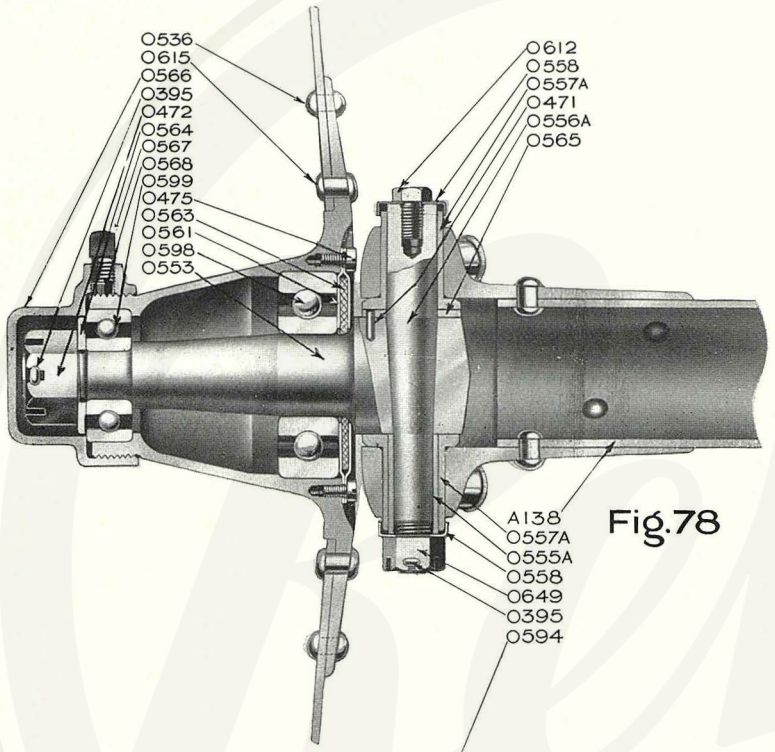


Fig.78

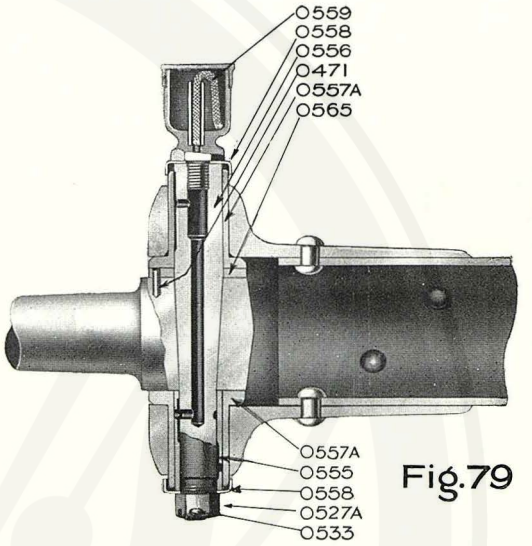


Fig.79

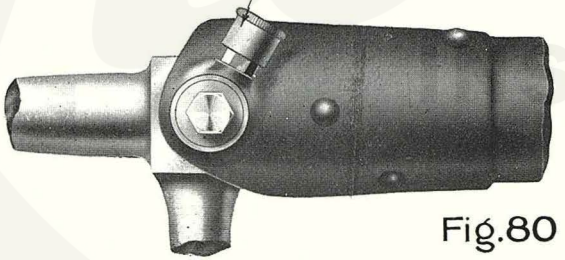


Fig.80

of wood while the shaft rotates on trestles (this saves the ball-bearings from being damaged).

Withdraw one wheel and proceed as with tapered type.

CONVERSION FROM SPLINED TO TAPERED AXLE.

414. The following new parts are required:

One axle shaft 0502A, and two nut-locking washers 0509A. Two hubs 0506A, Two keys 0499, One dust cap 0508A, and 48 $\frac{1}{4}$" rivets 0536, and 24 $\frac{5}{16}$" rivets 0615.

LOOSE BACK AXLE DUST CAP, 0508.

415. If this becomes loose on the right hand end of the back axle case, it makes a noise, and ceases to exclude dust, etc., from the ball bearing.

With the edge of a half-round file make three or four notches $\frac{1}{16}$" deep round the outside of the axle end 0507, and caulk the edges of the dust cap into these notches.

FITTING NEW PIVOT PINS.

416. The bushes 0557A must be scraped or reamered, if necessary, till the pins are quite a free fit, or seizure will result. Care must be taken that the correct types of pivot pin and distance collar 0555 and 0555A are used for each type of axle end, as indicated in Figs. 78 and 79.

417. Cars subsequent to No. 2561 are fitted with solid pivot pins (Figs. 78 and 80), each bearing being lubricated by means of a separate grease cup.

This is the more satisfactory type; reference to the figure will render the conversion quite simple when the necessary pins, collars, bushes and grease cups have been obtained.

STEERING PIVOT LUBRICATION.

418. The lubrication of the steering pivots is very important, and is too frequently neglected. The type with wick lubricator (Fig. 79) should not only have oil added occasionally, but steps should be taken to see that the wick is in order, that the oil is not too thick to flow, and that the parts do actually get their oil.

Grease and thick oil must not be used with this type.

419. *CAUTION.* If the pivot pin becomes loose in the stub axle, it is dangerously liable to break, and this condition should be looked for by seeing whether the nuts 0527A or 0649 (at the bottom ends) are tight.

420. If the nuts in question are not tight, remove the split pin, and tighten the nut at the same time that the top end of the pin is tapped with a hammer.

421. Similar precautions must be taken with the grease lubricated pivot pins (Fig. 78) (fitted to cars subsequent to 2,561), except, of course, that grease must be used, and the grease cups must be screwed right home after inserting grease, or they may shake off.

422. Apart from the DANGER of running with pivot pins loose in the stub axle, excessive wear is produced in the bearings and the tyres; the steering control also is impaired.

BALL-END PINS. (Fig. 82.)

423. The ball-end pins 0577 should never be removed, except in the case of a replacement, after which the thread should be caulked over the nut to ensure safety.

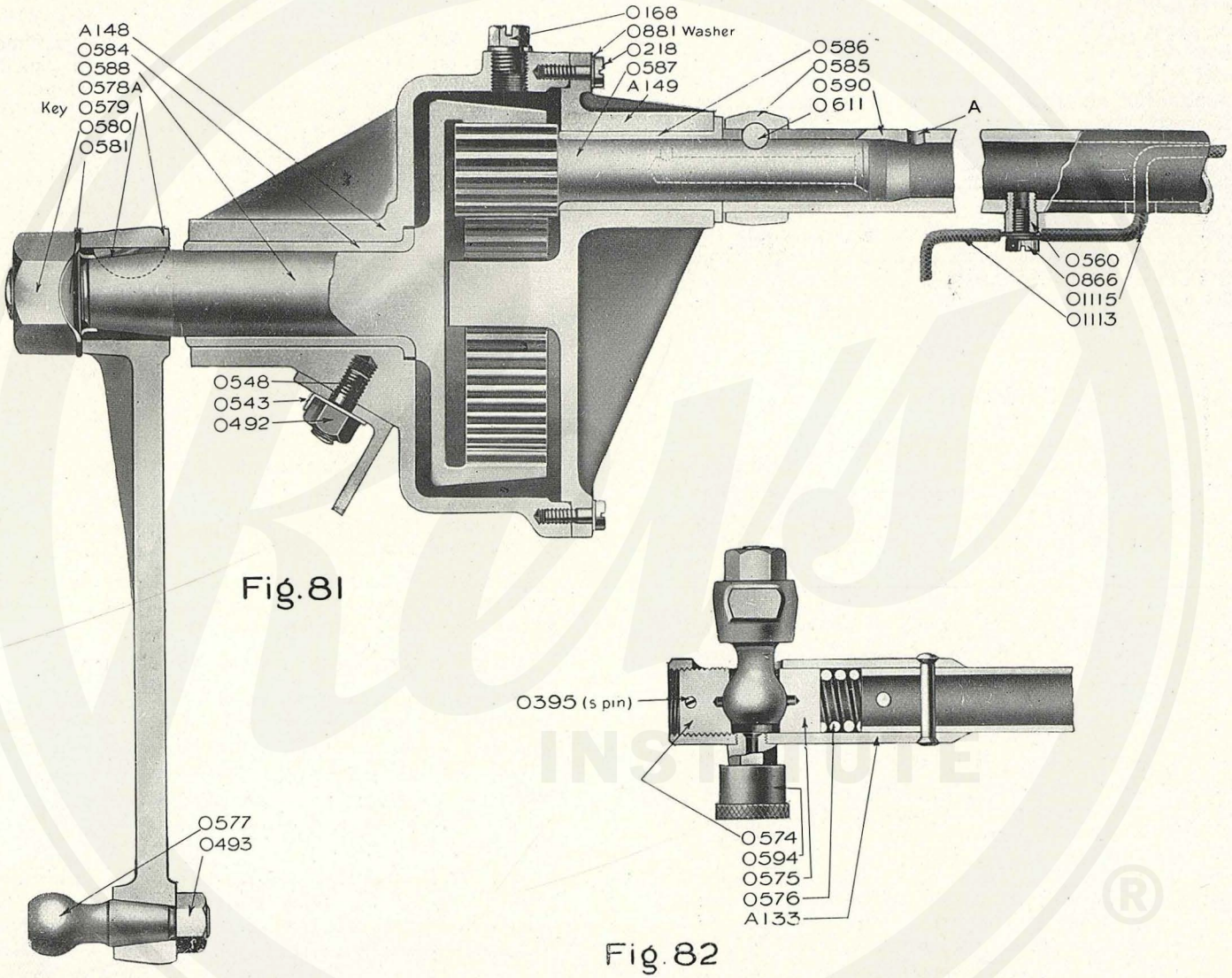

A148
0584
0588
0578A
Key 0579
0580
0581
0168
0881 Washer
0218
0587
A149
0586
0585
0590
0611
A
0560
0866
01115
01113
0548
0543
0492
0577
0493

Fig. 81

0395 (s pin)
0574
0594
0575
0576
A133

Fig. 82

It should be remembered that the object of making these pins detachable is not for the sake of detachability, but in order to combine the most suitable materials for both the stub axle forging and for the ball-end. To disconnect a steering rod, remove the steering rod end plug 0574; but do not interfere with the ball pins.

TIGHTENING FRONT WHEEL HUB CAPS.

424. Fig. 78 will show how the hub cap holds the outside of the outer ball-bearing tightly in position, and, as this bearing locates the wheel endways, it is important that the hub cap should be screwed right home, and locked.

CHAPTER VII.

BRAKES AND STEERING.

NOTE. For directions on adjusting transmission brakes, see article in Instruction Book, "Brake Adjustment."

REAR BRAKE INEFFECTIVE.

441. See that the cam spindle A158 (Fig. 74) is free in its bearing. If the short brake lever 0521 is verticle in the off position, a packing piece 0757 should be inserted under each of the brake shoe cam pads 0522.

442. If, although the linings are intact, and the mechanism is in order, the brake will not hold, grease is probably the cause; the brake drum and shoe linings should be cleaned with petrol, and all visible excess grease removed.

443. If the drum is mounted eccentrically, or if one shoe projects more than the other, braking will be very poor and the drum will run hot.

BRAKE SQUEAKS.

444. After a brake has got very wet, it sometimes squeaks on being applied, but the trouble usually passes off without attention. Do not oil the linings.

REAR BRAKE FIERCE.

445. Brakes sometimes become temporarily fierce after getting very wet. If the fierceness is chronic, try interchanging the shoes one with the other, and "rough" the lining with a rasp.

445a. If fierce after re-lining, burn in by running the car about 500 yards at full throttle, with the speed kept down to 10 m.p.h. by the application of the foot brake.

In bad cases of fierceness and violent chatter, with the 11" brake drum, reduce the overall length of the lining on each shoe to $9\frac{1}{2}$"—$4\frac{3}{4}$" each side of the centre.

THE LIFE OF A BRAKE LINING.

446. If suitable material is used, the brakes should not require re-lining for at least 10,000 miles with reasonable driving, except in very hilly districts.

Care should be taken that the brake camshaft is well lubricated and free in its bearing, and that the brakes are not binding or running hot.

USING REVERSE GEAR AS A BRAKE.

447. The reverse gear should not be used as a brake continuously, or it will become unduly hot, will emit smoke, and will cause wear in the gears.

448. Neither should the *hand brake* be used to bring the car to rest; it should be used when the car is left standing, and to assist the back brake when descending long hills.

449. It is important to remember that when replacing any of the *taper cotters*, they must all be driven in *towards* the engine, except in the case of the clutch pedal lever (Fig. 30).

TRACING BACKLASH IN STEERING GEAR.

450. Fig 81 will show how backlash may occur; through the tubular column not being tight on the pinion spindle 0587; between the drop-arm and the gear spindle 0588; between the hand wheel and the column; in one of the coupling rod ends (Fig. 82); or the box may be loose in the chassis.

The backlash can readily be located by getting an assistant to oscillate the steering wheel while the various connections are inspected.

451. Serious backlash practically never occurs in the gear teeth; the presence of appreciable slack, therefore, calls for immediate investigation and remedy.

STIFF STEERING.

452. Jack up the front axle and disconnect one end of the "pull and push" rod, or "drag link," by removing the steering rod end cap 0574 (not the ball-end pin, see Art. 423). It will then be easy to see whether the stiffness is in the steering box bearings or in the pivot pin bushes.

REMOVING STEERING BOX.

453. Take the bolt right out of clip 0585, raise the column slightly, disconnect the right hand end of the "pull and push" rod by removing cap 0574 (not the ball-end pin, see Art. 423), and remove the three $\frac{5}{16}$" nuts securing the box.

REMOVING STEERING COLUMN.

454. If it is desired to remove the column, take the bolt right out of the clip 0585, disconnect the horn wire from the column above the brake pedal; unscrew the fibre insulating bush, tie a long piece of thread to the end of the inside wire and push this wire inside the column, then draw the column upwards.

WEAR ON GEAR TEETH.

455. As the same two or three teeth are in mesh nearly all the time the steering gear is in use, any wear is very local. In re-assembling the steering box, the pinion may be put back in any position, and the unworn teeth brought into service; the drop arm has four key-ways, enabling it to be located by any of these on its shaft, so that the possibility of ever wearing out the steering gear is very remote.

CASTOR STEERING. (EXPLANATION.)

456. If the front axle be twisted in the spring table 0569 till the pivot pins are vertical, the car can be steered round corners, backwards or forwards, with the minimum force applied to the steering wheel, but the car will be most unpleasant to drive along a straight road, as it will wander from side to side. If, on the other hand, the pivot pins are inclined backwards through, say, 15 degrees, the car will keep straight, but will require considerable effort to bring it round sharp corners, and the wheels will straighten out again immediately the steering wheel is released.

457. The opposite occurs when backing; with excessive inclination of the pivot pins, the car is difficult to steer in reverse, as it tends to fly to full lock, considerable strength being required to hold it straight.

458. The best inclination is a matter of taste, a slope of about 6 degrees, with the car empty, being a fair average. However, some drivers, requiring considerable speeds, may prefer rather more inclination, and not object to the extra pull round corners, and the extra effort when reversing. When the Trojan is fitted with pneumatic tyres, better steering will be ensured by setting the pivot pins nearer the vertical than would be desired for solid tyres.

459. The design enables the driver to choose his own angle of inclination; he will thus, by a little experiment, be able to attain to his individual taste and driving comfort.

TRACKING THE FRONT WHEELS.

460. Jack the wheels off the ground and set them in a position as nearly straight as possible; make a chalk mark on the inside edge of each wheel rim. Turn the wheels until the chalk marks are at the back, and measure the distance between the two chalk marks. Then bring the marks to the front and measure again; the latter measurement should be from $\frac{1}{8}$" to $\frac{1}{4}$" less than the former.

If not correct, set one of the steering arms, cold, with a bending bar.

Using the same place on each wheel (*i.e.*, the place chalked), eliminates any inaccuracy which might occur if the wheels themselves were not quite true.

LUBRICATION OF STEERING BOX.

461. In some cases, with early cars, oil added in the steering column at A leaks out at the bottom instead of entering the box; it is then advisable to fit an $\frac{1}{8}$" gas plug, as in Fig. 81, to enable oil to be introduced directly into the box, as well as at A.

CHAPTER VIII

WHEELS, TYRES, RADIATOR AND TANK.

RE-GROOVING TYRES.

481. When the grooves moulded in the two-inch solid tyres wear out, the resilence is impaired, and the car will skid easily.

The tyres can be re-grooved twice before they are worn out, and a special tool 01170 can be supplied for the purpose. Grease the outside edge of the tyre to facilitate the passage of the cutter.

FITTING NEW SOILD TYRES.

482. When attaching the tyre rim to the wheel, first put the spring washers and nuts loosely on the 18 bolts, with gold size, varnish or paint on the threads. Then work round and round the wheel, tightening up equally and tightly. If a rim bolt becomes loose, it must be attended to immediately, or the trouble will spread to the others, and the holes will wear large.

BUCKLED WHEEL.

483. If a wheel becomes bent so that it runs out of truth, and the hub remains undamaged, it can be straightened, if a suitable tool or press is available, without fear of subsequent trouble.

REMOVING RADIATOR FROM CAR.

484. Remove the mud shield plate 0673, in front of the steering box, remove the top waterpipe coupling at the radiator, loosen its coupling to the engine, and twist the pipe outwards, towards the left of the car; remove the bottom water pipe coupling at the radiator, and push the pipe to one side.

Uncouple one end of the "pull and push" rod (Art. 423), jack up the front axle about four inches, and remove the four bolts holding the bottom water tank, which will allow the radiator to drop.

RENEWING THE RADIATOR FERRULE ONLY.

485. It is not necessary to jack up the front axle, as the radiator can be lowered sufficiently to enable the ferrules to be changed.

RADIATOR AND FROST.

486. If there is any risk of the car being exposed to frost, the radiator and engine water jackets should be drained by opening the cock 0136 under the left side of the water jacket.

It may be necessary to push a wire up from under the punt to displace sediment.

REMOVING THE PETROL TANK FROM CAR.

487. Loosen the top strap bolts (behind the dash), and remove the bottom strap bolts; unscrew the petrol cock gland tube A317 (Fig. 16), and withdraw the operating rod A316; turn the top waterpipe outwards, then the tank will come out.

CHAPTER IX.

500. LIST OF SERVICE TOOLS.

A321. Rear hub drawer. (Art. 406.) 12/9.

A369. Silencer reamer. (Art. 219.) 7/6.

A370. Gear shaft drawer. (Art. 341-vi.) 15/–.

A371. Drawer for sprocket and starter disc. (Arts. 364a, 109-ii, 341-v.) 5/3.

A372. Engine cradle. (Art. 109-i.) 18/9.

A373. Drawer complete for gearbox and gear wheels. (Art. 346-ii.) 9/–.

A374. Spring leaf extractor. (Art. 401.) 3/9.

A375. Crankshaft clamp. (Art. 111-iii.) 5/3.

A376. Main bearing grooving tool. (Art. 111-iv.) 3/–.

A377. Flexible coupling spring lifter. (Arts. 105 and 341.) 1/3.

A378. Reamer for crankshaft bearings. (Art. 114-ii.) £4 : 10 : 0.

01470. Spanner for tap bolt on con-rod (small end), (plain bearing engine). Art. 117.) 3/9.

01470a. Box spanner for tap bolt on con-rod (roller bearing engine). Art. 117a.) 3/9.

01471. Distance piece for withdrawing gearshaft. (Art. 342.) 3/9.

01474. Alignment disc for gearbox. (Art. 360.) £1 : 11 : 6.

CHAPTER X.

GENERAL INSPECTION AT SERVICE GARAGES.

501. Attention to the following points will ensure efficient running of the "Trojan," and agents and others should take every opportunity to look to these points when cars come to their garages.

502. *Front axle.* (1) Pivot Pins tight in stub (see if nuts at bottom ends are quite tight) and free in bushes. (2) Fork ends tight on axle tube.

Steering. (3) No back-lash. (4) Nut securing drop-arm tight. (5) Bolt tight in steering column clip 0585.

Back Axle. (6) Wheels tight on shaft.

Chain. (7) Adjusted and lubricated.

Wheels. (8) Rim bolts all tight.

Brakes. (9) Correctly adjusted. (10) Foot brake cam spindle A158, free.

Springs. (11) Greased and (12) Rivets sound. (13) Spring rollers and spindles in order.

Punt. (14) Torque tube bolts tight. (15) Punt free from oil or water (if not, trace source).

Wings. (16) Lamp brackets tight on wings and stay tube. (17) Screws on wing valances tight. (18) Wings rigidly secured. (19) Door locks and hinges oiled and in order.

Engine. (20) Flame-extinguisher gauzes clean. (21) Silencer clear.

Starter. (22) Lever remains down and (23) retaining spring 0208 greased.

Gearbox. (24) Full travel on top-speed cone (25) bands adjusted. (26) Gearbox locating collar 0321 tight. (27) Change-speed lever attachment to stump lever tight. (28) Catch plate and pawl in order.

Carburettor. (29) Float chamber clean. (30) Air vent free and (31) joint tight. (32) Throttle opens fully. (33) Misture lever not too free (34) all pipe joints tight

Ignition. (35) Distributor free to oscillate. (36) Spark advance operating over whole travel. (37) Timing correct. (38) circuit breaker points adjusted. (39) Segment spring giving proper tension. (40) No excessive sparking. (41) Plug points adjusted. (42) $\frac{1}{4}$" spark to earth at plug wires.

Battery. (43) Sufficient electrolyte and (44) box and terminals tight.

Dynamo. (45) Charging properly, (46) cut-out working and (47) correct size of fuse wire.

Loose Screws and Nuts. (48) After the first 500 miles and again after another 1,000 it is desirable to go over all the nuts and screws on the car, because all these tend to bed in with use and become loose. This applies particularly to door hinges.

SUMMARY.

503. POINTS NECESSARY TO RENDER THE CAR SAFE.

1, 2, 3, 4, 5, 6, 9, 10, 13, 35, 36, 37.

504. POINTS NECESSARY TO RENDER THE CAR EFFICIENT.

20, 21, 22, 24, 25, 29, 30, 31, 32, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 45, 46.

505. POINTS NECESSARY TO REDUCE RUNNING COSTS AND NOISE.

6, 7, 8, 10, 14, 15, 16, 17, 18, 19, 23, 26, 43, 44, 45, 46, 48.

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