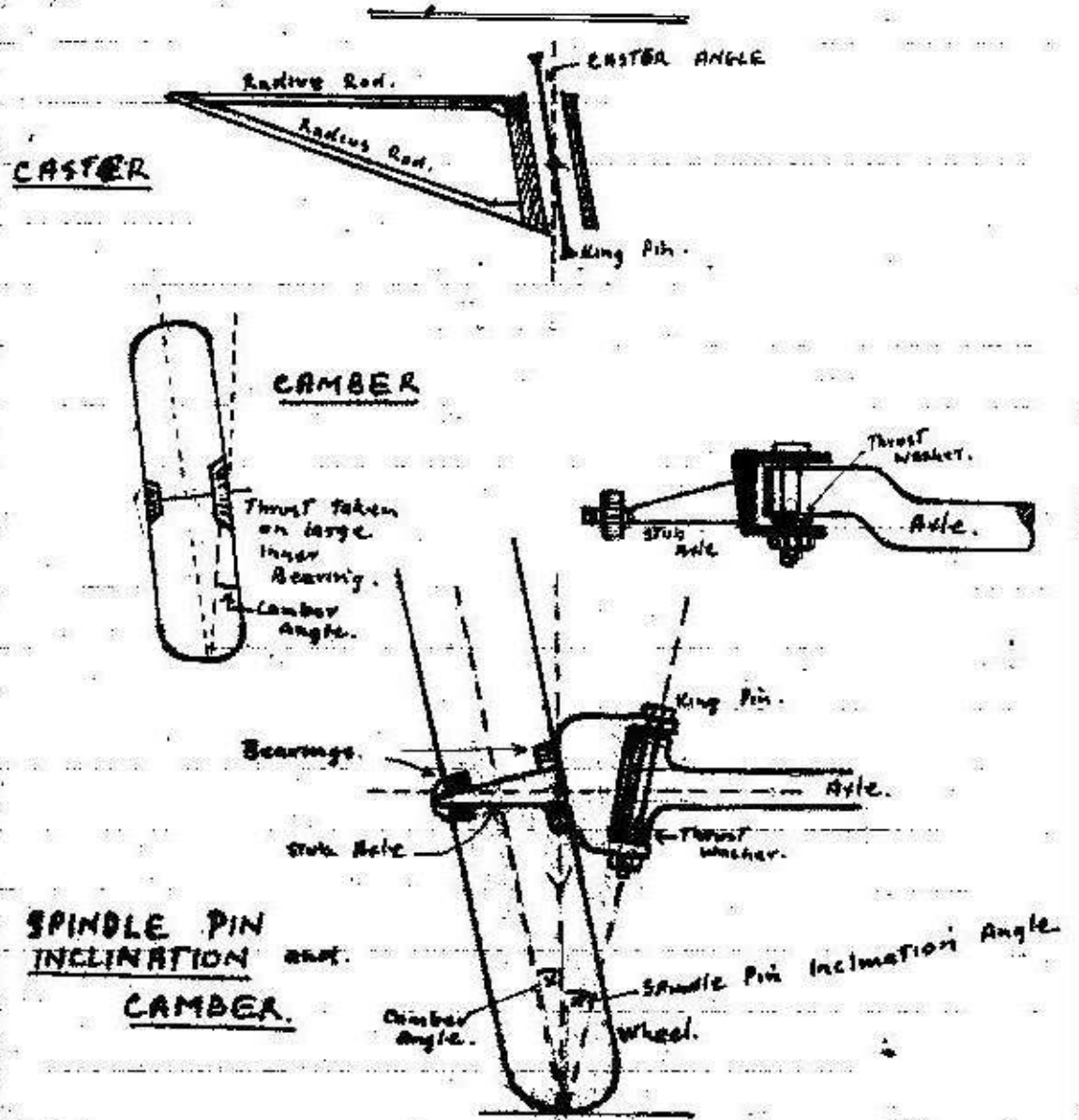


the inclining downwards of the spindle (or stub axle) out of the horizontal which in turn places the wheel out of vertical. The purpose of camber is to place the load on the large inner bearing of the wheel. The camber is increased as the stub axle is turned to the rear (banking the wheel, as when cornering).

Spindle pin inclination. In addition to tipping back the spindle pin the upper end is also tipped towards the centre of the car. The purpose of the inclination of the spindle pin is to locate the centre line of the spindle pin so that it intersects the centre line of the wheel at a point near the surface of the road. Toe-in is the inclining of the wheels at the front out of parallel and is determined by the camber angle & caster. The purpose of toe-in is to counteract the outward drag of the front wheels due to camber.

Toe-in on Maxwell Motorcars, 30 cwt & 3 ton is zero.
Toe-in on B.S. Vans & utilities is $1/16"$ to $3/32"$.



Differential.

The rear wheels of a vehicle, when cornered, turn at an unequal speed, the outer wheel travelling the greater distance. If both wheels were fixed, skidding and excessive tyre wear would result. The differential allows the rear wheels to rotate at different speeds, meanwhile, maintaining the drive to both wheels.

Component parts of differential.

Drive pinion shaft and pinion
Crown wheel & spider housing or cage.
Spider and planet wheels assembly.
Sun wheels and rear axles.

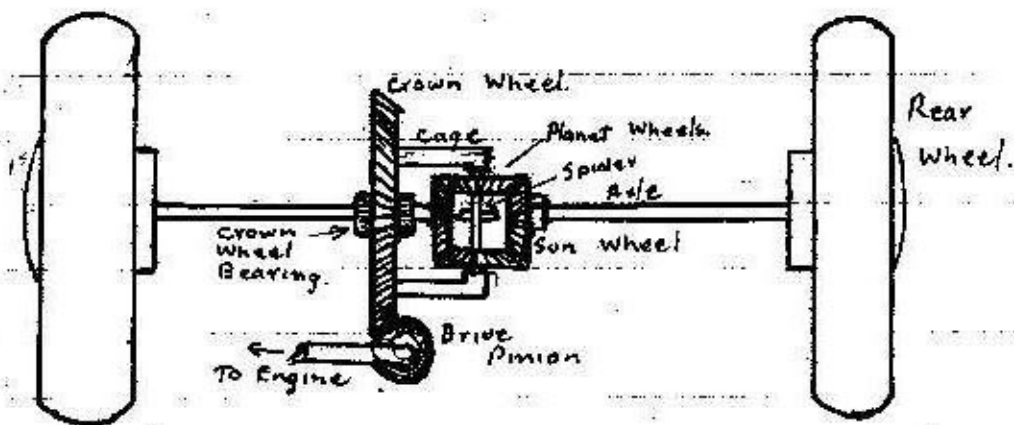
Maintenance of a differential.

Oil at correct level and correct grade

Bevel gear type SAE 160. Hypoid. G.O. (SAE 90)

change oil every 5000 miles and check every 1000 miles

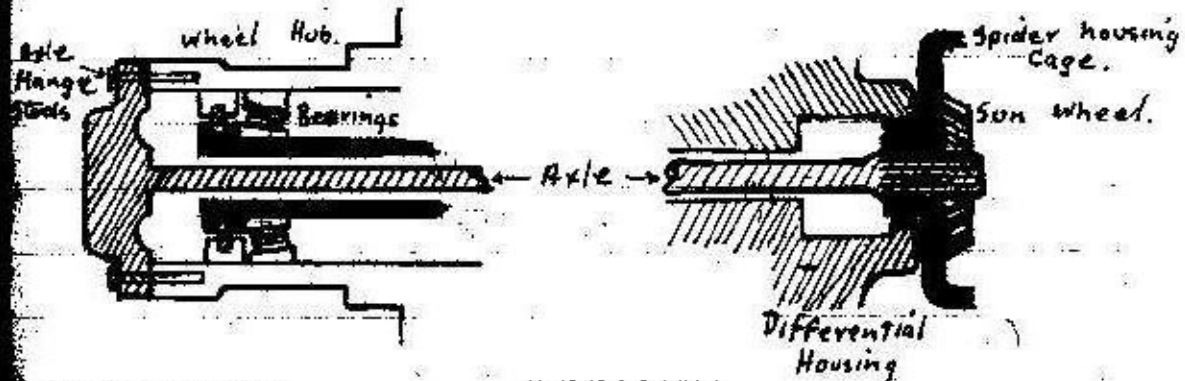
Keep all nuts and bolts tight.



Arrangement of a simple differential

Rear Axle.

Full floating type



Two other types. (a) Overhung. (b) Semi floating axle.

Trouble Shooting

Diagnosing automobile trouble requires thought and reasoning. If the principle and construction of an engine is understood trouble shooting should be easier. First, find out, what is the trouble and what would cause it. There are 2 essentials necessary in all automobile engines

1 petrol for the engine

2 a good hot spark at the spark plug

No adjustments should be made on any parts tampered with, unless the cause of the trouble is known. Otherwise, adjustments that are already correct may be destroyed. The problem should be analyzed.

Engine fails to start

1 Lack of fuel. Fuel line must be free from obstruction

2 Lack of ignition current, may be due to failure to turn switch on, or broken

on disconnected wire. Amp. meter needle will move when ignition current flows through the battery bracket point.

3 Faulty spark plugs, due to excessive amount of oil in engine and too long use, whereby the point become coated with carbon. Spark plugs should be removed & cleaned or renewed

4 Carburettor choke valve must be closed tightly when starting.

Engine Stops

1 Lack of fuel.

2 Disconnected wires

3 Lack of air

4 Carburettor flooding

Engine misfires

1 Broken or disconnected wiring

2 Foul spark plugs.

Tests The plugs should be short circuited one after the other by touching a hammer on screw-driver from the metal of the

cylinder to the terminal of the spark plug when one is reached which makes no difference to the running of the engine this is probably the faulty plug. Remove clean & test. Porcelain insulation may be cracked.

3 Points of plugs improperly set. Points too close together or too far apart, may cause missing.

4 Loss of compression in any cylinder. To locate cylinder weak in compression the engine should be turned over by hand. Valve may be stuck or dirt under it.

Tappet clearance should be checked. It is possible to have clearance between valve & tappet & yet have imperfect valve seat.

5 Water in fuel. (Carain tanks & refill)

6 Overheating

7 Carburettor adjustments must be checked.

Loss of Power. Engine will run but will not pull the car under a heavy load. May be due to :- too rich a mixture, valve not seating, less than normal tappet clearance, Ignition improperly timed, lack of oil or water, lack of fuel due to obstruction in fuel pipe or carburettor, pump screen filter dirty, dragging brakes, engine overheating, loss of compression.

Lack of compression due to :-

1. Faulty cylinder head gaskets.
2. Insufficient tappet clearance
3. Valves or rings not seating properly.

Popping back through carburettor

This usually indicates too lean a mixture and may be caused through dirt in the carburettor.

Inlet valve holding open.

Water in fuel.

Air leaks in intake manifold connections.

Incorrect ignition timing or
limited spark advance
Secondary wires connected to incorrect ^{plugs}
Improper kind or defective spark plug
Engine Overheats - caused by:-

Lack of proper lubrication
Stoppage in water circulation or
lack of water
Fan belt slipping. (tighten up)
Imperfect gas mixture
Ignition timed late or running with
retarded sparks or limited spark plug advance

Engine Knocks. Mainly ^{caused} ~~caused~~ by
connecting rods bearings loose
Crankshaft bearing loose
Faulty ignition lubrication or
diluted oil
Loose or broken piston
Carbon in cylinders - overheating
Incorrect ignition timing

Operation of the Four-cycle Combustion Engine

Introduction The four stroke engine can be compared with the operation of an old time ball-loading gun. This consists of four operations.

- (1) Charge inserted down barrel
- (2) Charge rammed or compressed.
- (3) Charge ignited by fire (and exploded)
- (4) Barrel cleaned of excess gases & soot.

The cannon ball can be imagined as the piston connected to a crankshaft which revolves & returns the piston to the cylinder top again.

The barrel can be imagined as the cylinder. The igniting of the charge has the same duty as the spark plug igniting petrol gases by an electrical spark.

The charge (or explosive petrol gases) are compressed because they are much more volatile and produce more power in the ^{start}

✓
After the gasses have been exploded they are expelled as exhaust through an outlet valve.

The four strokes of the cycle are

(1) Intake (or suction)

(2) Compression

(3) Ignition (or power)

(4) Exhaust.

(MATER)

Component Parts of an engine (Ford V8).

(1) Engine block and head.

(2) Cylinders 8. (combustion chambers)

(3) Pistons 8.

(4) Compression (on piston) rings² & oil scraper^{ring}

(5) Piston pins 8. Fully floating.

(6) Connecting rods 8 - little ends & big ends

(7) Big end liners 8.

(8) Crank-shaft (90° throws)

(9) Crank-shaft journals.

(10) Crank-shaft bearings 1, 2 & 3. (in Ford V8)

(11) Fly wheel (or starting motor ring gear)

(12) Timing gears. (In Fords. 2)

✓
(13) Camshaft and cams.

(14) Valves, guides & springs.

(Inlet valves & outlet valves)

(15) Gear type oil pump.

(16) Lubrication system.

(17) Water cooling system.

(18) Spark plugs 8.

(19) Carburettor.

(20) Spark distributing unit.

(21) Crankcase or sump.

(22) Fuel pump.

Action (of a simple 4 stroke engine)

The piston can move up and down freely inside the cylinder. The piston is fitted with compression rings to stop the exploded gasses escaping down ~~from~~ ^{past} the piston & cylinder walls. The piston is connected to the crankshaft by a connecting rod and piston pins. The larger end of the con.-rod (where it joins the crankshaft) is called the 'big end'.

and it floats on the crankshaft journal. The crankshaft is borne by bearings. At the rear end of the crankshaft is attached a flywheel to provide a balanced and smooth flow of power from the engine. The timing gears are connected to the other end of the crankshaft and camshaft. The camshaft is turned by means of power transmitted from the crankshaft by these gears.

The cams are flat oval-shaped pieces of steel which rotate with a wobbly motion (like a gramophone record with the hole drilled off centre). The cams operate the valves and make them open and close at the correct times in the combustion chamber. The valves are made to close tightly and instantly again by strong valve springs. There are two types of valves, (1) the inlet valve which when open permits fresh gases

to enter the combustion chamber, and (2) the outlet valve which allows the gases to leave when exhausted. The spark plug is the component at which a spark occurs in the combustion chamber to fire the gases.

Operation.

As the piston is drawn down, it is by the crankshaft revolving, the inlet valve opens and fresh gases enter the cylinder. The piston travels to the bottom of its stroke before the inlet valve closes again. When the piston comes up again the gases are compressed in the combustion chamber, under great pressure. Then, at "top dead centre", a spark is introduced into the chamber and the gases burn and expand instantaneously, developing great pressure against the chamber walls and piston. The piston, at once travels down, giving

✓
a power stroke which eventually is the power used to move a vehicle. When the piston comes up again the ~~ex~~ outlet valve opens and the exhaust gases are expelled from the chamber.

Hence, the four cycles of the 4 stroke engine

- (1) Piston down - petrol gases sucked in
- (2) " up - gases compressed greatly
- (3) " down - sparks, gases burn & expand
- (4) " up - exhausted gases expelled.

Lubrication

To stop seizing of the moving parts, oil is passed to all moving parts & gears usually under pressure, through pipes & either oil-wafts, by splash & oil mist. A gear type pump is used in Ford engines and a main oil gallery passes the oil to the various components.

Cooling To stop the engine becoming too hot, water is circulated through water jackets in the engine blocks & now

✓
the cylinder walls and cylinder head.

Heat developed in the combustion chamber is approx. 2700°F . which is almost the melting point of iron. Hence the need for cooling.

The fan draws air through the radiator and cools the water. The air is then blown on to the engine as extra cooling.

Maintenance 25/3/47.

For commencement of days duty.

Check level of fuel.

oil in sump.

water in radiator.

Start engine & check: - oil gauge & ammeter.

check tyres for underinflation.

vehicle lights incl. rear lights & windscreen wiper.

Daily maintenance on completion of days duty.

clean vehicle.

check level of fuel in tanks (rep. if necessary)

oil in sump

tighten up any loose bolts & nuts

make any minor adjustments.

Examine tyres for cuts, damage or underinflation

Report damage to tyres & inflate as may be

necessary. Report on G.17 any defect noticed

requiring any mechanical adjustment

500.

100 mile maintenance - including daily maintenance maintenance.

clean all greasing points before operation

Lubricate (a) Steering Group.

Jack up axle before operation

(1) Drag links. (one nipple each end)

(2) Tie rod (- - - side)

(b) Shackle Group.

(1) All spring shackles. (insert grease
gaps through, report any frozen shackles.)

(c) Spring Group.

clean spring leaves (jack chassis up
by frame, taking weight off spring hangers
& lubricate leaves with brush.)

(d) Clutch Linkage.

Clutch release shaft. (one nipple
each side of clutch housing.)

Clutch pedal (one nipple)

(e) Brake Linkage.

(1) Brake pedal. (one nipple)

(2) Rear brake shaft. (- - - each side)

- (iii) Oil joints of connections of operating linkage not connected by grease nipples.
- (iv) Check security of all joints on actuating linkage.

(f) Propeller Shaft Components.

- (i) Propeller shaft splines.
- (ii) Universal shaft bearing.
- (iii) Universal joints. (if fitted with grease nipples.)

(g) Spring Saddles.

- (i) Nipple each side. (enclosed test shaft models.)

(h) Engine Groups.

- (i) All joints of engine controls (on complete check operation).
- (ii) Fan shaft bearing (check belt for slack 1").
- (iii) Pump shaft bearing (check gland for leakage).
- (iv) Distributor shaft bearing. (oil if not fitted with grease cup or nipples.)

(i) Fuel lines.

- check fuel pump for sediment.
- petrol tanks tap if any.
- pipe line & joints for leakage.

Various Battery Movement Parties

						NUMBER OF PERSONNEL	
B.C.'s PARTY	x.	x2	M/c1	H.	M/c2	13	
"O" PARTY	RE	M/c3	M2	RF	M/c4	M3	20
G PARTY	GE	M/c5		GF	M/c6	12	
BHQ PARTY	Y	M/c7	M1			10	
GUN GROUP	K1	M/c8	K2	TLE	M4	21 69	
	E1-6	M/c9	F1-6	M/c10	M/c11		
AMMUNITION GROUP	L1	-	L4			18	
B ESCHELON	Q1	-	5			23	
					TOTAL	186	

Organisation of Battery for Manoeuvres

CAMP OR PARTY	NAME OF VEHICLE	SUB-UNIT and TYPE OF VEHICLE	PERSONNEL	RADIO FREQUENCY	REMARKS
B.C.'s PARTY	X	ARMoured OP CARRIER	MAJOR., 2 SIGS R/T 1 OPA.	F1	WIRELESS SET
	X2	BTY HQ Van (15) GS	1 DRIVER 1/L		FOR BC. as required
	Mk1	BTY H.Q. M/L	B.C.'s ORDERLY C.P.O.		
	H	BTY H.Q. 15CWT (WIRELESS)	2 CPO A's 2 R/T SIGS 1 Dvr 1/L	F7	Wireless SET.
	M/C2	BTY HQ M/L	C.P.O.'s ORDERLY		
"D" PARTY	RE	Armoured O.P. CARRIER	E Troop Comdr. O.P.A. 2 SIGS R/T	F1	WIRELESS SET O.P.A. to drive
	M/K3	E Troop M/L	E TYP NCO SIGS		
	M2	E TROOP 15CWT	1 sig line (TP C.P.) <u>PERSONNEL</u> 1 sig line (OP) 2 SIGS (MAINTENANCE) 1 Dvr 1/L		Hand Cable Layer
	R.F	Armoured OP CARRIER	F Troop Comdr. 2 SIGS R/T O.P.A.	F2	Wireless SET. O.P.A. to drive.
	M/C4	F TROOP M/L	F TROOP NCO SIGS		
M3	F TROOP 15CWT	1 sig line (TP C.P.) <u>PERSONNEL</u> 2 sig line (OP) 2 SIGS (MAINTENANCE) 1 Dvr 1/L		HAND CABLE LAYER	

CAMP OR PARTY	NAME OF VEHICLE	SUB-UNIT & TYPE OF VEHICLE	PERSONNEL	RADIO FREQUENCY	REMARKS
"E" PARTY	GE	E Troop 15CWT WIRELESS	E TROOP G.P.O.	F1	Wireless SET.
	M/C5	E TROOP M/L	1 O.P.A. 2 R/T SIGS 1 Dvr 1/L E TROOP T.S.M		
	GF	F TROOP 15CWT WIRELESS	F TROOP G.P.O.	F2	Wireless SET.
	M/C6	F TROOP M/L	1 O.P.A. 2 R/T SIGS 1 Dvr 1/L F TROOP T.S.M		
B.H.Q. PARTY	Y	H.Q. 15CWT GS	A.C.P.O. 2 CPO A's. 1 Dvr 1/L		
	M/K7	HQ M/L	BTY SIG SGT		May Favor in B.C.'s Party if required.
	M1	H.Q. 15CWT	2 SIGS C.P. <u>PERSONNEL</u> 2 SIGS maintenance 1 Dvr 1/L		Mechanical CABLE LAYER.

OVER →

GROUP OF PARTY	NAME OF VEHICLE	SUB-UNIT & TYPE OF VEHICLE	PERSONNEL	FREQUENCY	REMARKS	GROUP OF PARTY	NAME OF VEHICLE	SUB-UNIT & TYPE OF VEHICLE	PERSONNEL	FREQCY	REMARKS	
G U M G R O U P	K1	H.Q 15cwt wireless	CAPTAIN 2 RT SIGS 1 Dvr 1/c	F1	Wireless Set.	GUM GROUP (CONTD.)	F TROOP (2 SECTIONS)		AS FOR E TROOP.			
	M/C8	H.Q M/C	CAPT'S orderly				GUNS	RIGHT SECTION				
	K2	H.Q 15cwt	1 Bdr clerk. 2 SIGS WIT 2 AA Gunners		RAF Wireless Set A/T Rifle + 200 Rounds AALMG + 1000 Rounds			TRACTORS FI-3				
	T.L.E	E TROOP 15cwt Personnel.	E TROOP Leader 1 G.P.O.A. 2 AA Gunners 1 Sig Line (T.P.C.P.) 1 Dvr 1/c		AALMG + 1000 Rounds A/T Rifle + 200 Rounds			LEFT SECTION				
								TRACTORS FU-6				
								M/C10		F TROOP M/C		
								M/C11		B.S.M.		
	M4	E TROOP 15cwt Personnel.	1 Sig L/T (OP) 1 Sig L/T (T.P.C.P.) 2 SIGS MAINTENANCE 1 Dvr 1/c		HAND CABLE LAYER.			L1		3 Ton G.S.	5 GNS AMM. NOS. 1 Dvr 1/c	184 Rds. (25 Pkt) OR 220 " (18 Pkt)
								L2		3 " "	4 BATMEN. 1 Dvr 1/c	" "
								L3		3 " "	4 BATMAN 1 Dvr 1/c	112 Rds (25 Pkt) OR 134 " 118 "
								L4		3 " "	BDR Dvr 1/c SPARE Dvr 1/c	CANNOPLAGE STORES. PETROL
		E TROOP GUNS	2 sections Each					Q1		3 Ton G.S.	B.Q.M.S. 10clerk 1 Storeman 1 Dvr 1/c	"Q" STORES.
	RIGHT SECTION					Q2	3 " "	MOTOR MECHANIC TECHNICAL STOREMAN EQUIPMENT REPAIRER 1 Dvr 1/c	M.T. STORES.			
	TRACTOR E1	Nos. 1-4 Driver mechanic 1 Dvr 1/c										
	TRACTOR E2	"										
	TRACTOR E3	Nos 5-6 of each gun SPARE Dvr OR MOTOR MECHANIC 1 driver 1/c				M/C12	H.Q M/C	FITTER M.T.				
	LEFT SECTION					Q3	3 Ton G.S.	Bdr. COOK 2 COOKS 1 Sanitary Man 1 Dvr 1/c	COOKING SETS & RATIONS			
	TRACTORS E4-6	do.				Q4	3 Ton G.S.	2 AA GNS 2 COOKS. 2 BATMAN 1 Dvr 1/c	AALMG + 100 ROUNDS A/T Rifle + 200 " COOKS OFFICERS MESS COOKING SETS RATIONS			
	M/C9	E TROOP M/C	FITTER (GUN ACTIV)		note a certain number of smoke shells may be carried.	Q5	H.Q 3TON (SMB) WATER TANK	WATER DUTIES man 1 Dvr 1/c				

GUM GROUP (CONTD.)

AMMUNITION PETROL GROUP

B ESCHELDON (RATIONS)