HEWLAND

ARROW

MODELS KE3 & KE4

100cc KART ENGINES

Maintenance and Overhaul Manual

HEWLAND ENGINEERING LIMITED · MAIDENHEAD · BERKSHIRE · ENGLAND

Hewland Engineering

ARROW

KE3 & KE4 100cc KART ENGINES

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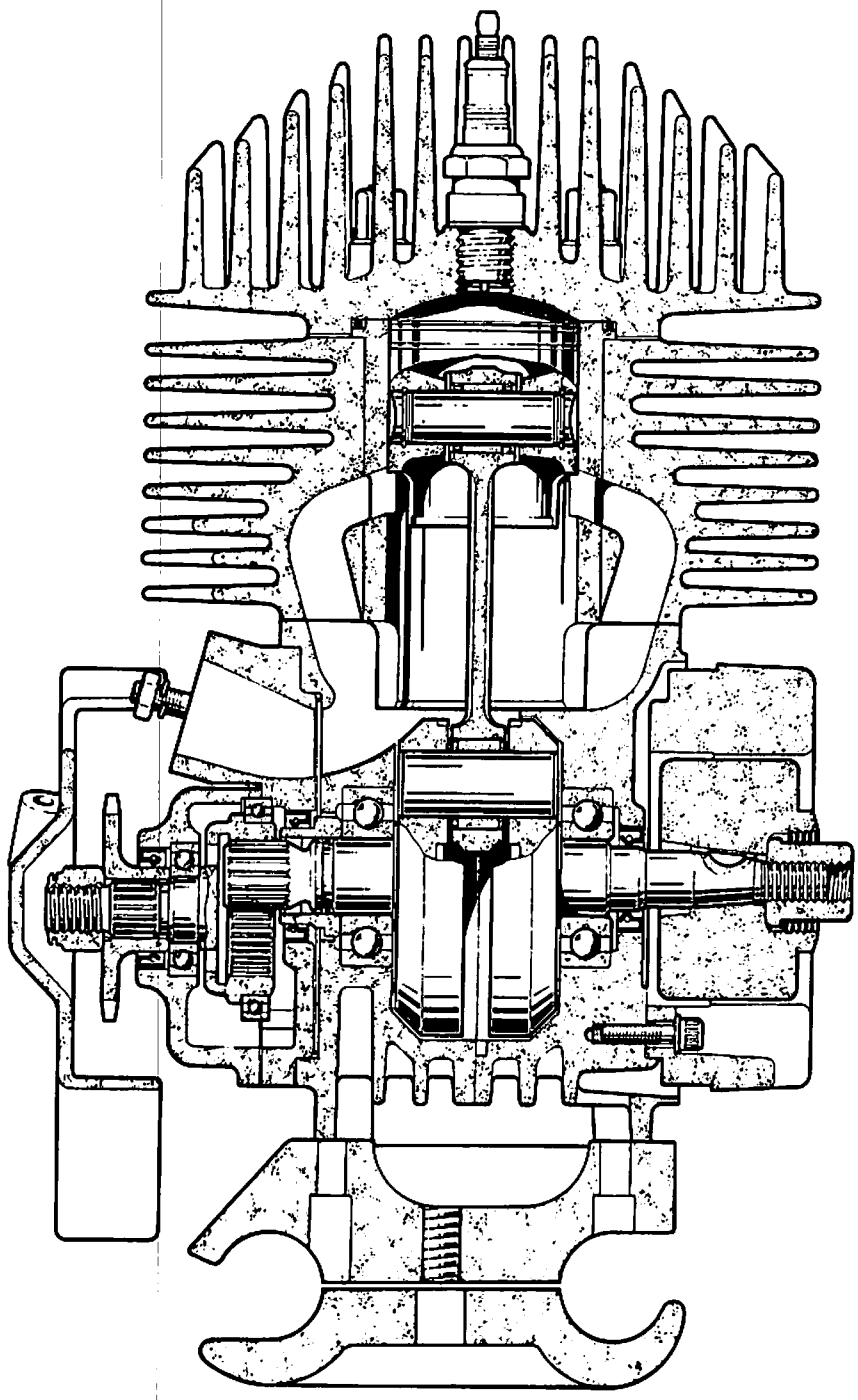

FIG.1 ENGINE – SECTION VIEW

INTRODUCTION

The Hewland Engineering designed 'Arrow' engine is of a high performance type developed for Kart racing. The engine is a 98.3 cc two-stroke with a bore/stroke of 50.8/48.5 mm equipped with a rotary valve induction system, designed to give a good spread of power from 7000 to a maximum of 16,000 rpm.

The unit is of lightweight construction comprising alloy head, barrel and crankcase.

An interesting optional design feature is the use of a reduction gear arrangement housed within the output shaft assembly, which eliminates the chain problems associated with conventional small sprockets.

ENGINE DATA

Specification

Bore/Stroke:		50.8/48.5 (Max re-bore = 51.2 mm dia.)
Capacity:		98.3 cc
Ignition:		Electronic (Motoplatt type 9600903)
Carburettor:		Tillotson type HL317A
Gearbox ratio:	where fitted	12:27 (2.25:1 reduction)
Gearbox oil:		SAE EP80/90
Oil capacity:		26 cc (1 Fluid ounce)
Weight:		Engine = 11.8 kgs (26 lbs)
		Mounting clamps = 0.76 kgs (1.7 lbs)
		Total weight = 12.56 kgs (27.7 lbs)

Timing Data

Inlet:	Opens 45° ABDC Closes 65° ATDC
Exhaust port:	Opens 85-86° BBDC
Transfer port:	Opens 63-64° BBDC
Ignition advance:	1.8 mm–2.0 mm (0.071 to 0.079 ins.)

Miscellaneous

Standard exhaust flex length = 3½ ins.

Combustion chamber volume = 8.0-8.5 cc including plug orifice

Spark plug:	Champion N54R or equivalent
Chain tension:	½ in. min. sum total up and down in most tight position.
Fuel/Oil Ratio:	20:1

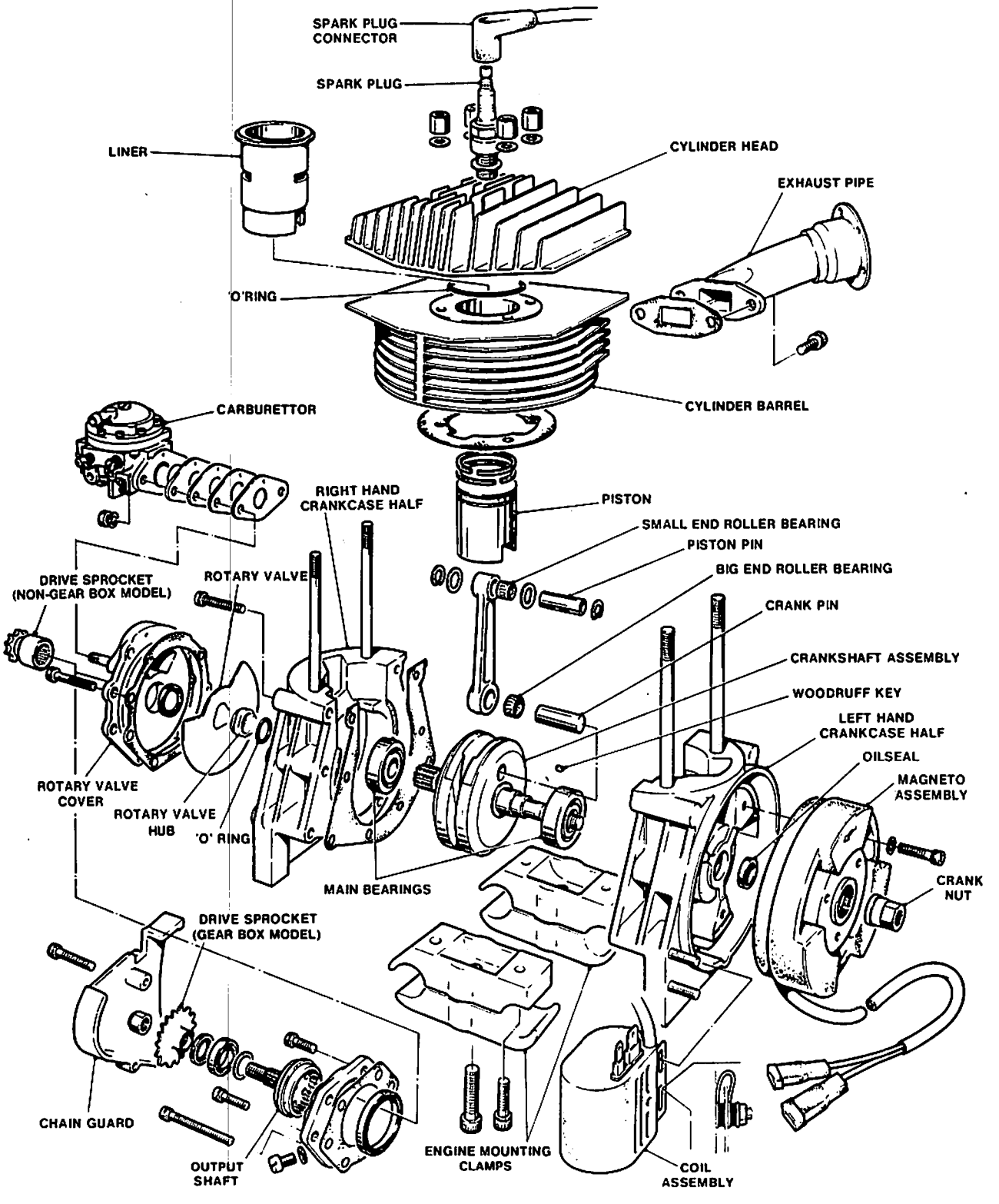

FIG.2 ENGINE – EXPLODED VIEW

DISMANTLING PROCEDURES

Magneto and Coil

1. Slacken and remove crankshaft nut from magneto side, and, with the aid of a Motoplatt extractor, remove rotor from taper, collecting 'Woodruff' key from shaft.

2. Remove stator securing cap screws (3 off 5 mm) together with washers, and detach stator. Remove coil from crankcase together with rubber bushes and earth lead.

Note: Removal of stator and coil is only necessary if main bearing removal is envisaged, and requires heating the crankcase.

Gearbox Assembly and Rotary Valve

3. Slacken drive sprocket nut, slacken and remove output shaft assembly attaching screws, and separate assembly from rotary valve cover plate (a light tap with a hide mallet may be necessary to break the joint).

4. Unscrew rotary valve cover attaching screws and remove rotary valve cover and valve. The rotary valve drive hub is normally a tight fit due to the 'O' ring and should be removed at a later stage. (See Note.)

Note: Engines without gearboxes use sprockets (secured by an 8 mm cap screw) which are internally splined to fit directly over the gear cut on the crankshaft, and an 'O' ring is not fitted under the rotary valve hub.

Cylinder Head and Barrel

5. Slacken and remove the four cylinder head nuts, detach cylinder head from barrel together with 'O' ring.

6. Rotate engine to approximately B.D.C., and lift cylinder barrel from crankcase with care to avoid piston ring breakage.

Piston Assembly

7. To separate piston assembly from connecting rod, remove piston pin retaining circlips, push out piston pin, remove piston and collect thrust washers. Separate small end needle rollers from connecting rod. Remove rings from piston, inspect and renew if damaged or worn.

Crankcase and Crankshaft

8. Remove the four screws securing crankcase halves, and tap gear end of crankshaft to separate (see notes 1 and 2).

Notes: 1. When the crankcase halves begin to separate, ensure that they are parting square with respect to the dowel. Should tilting occur, remedy by tapping the bottom of the crankcase half, adjacent to the dowel.

2. After the crankshaft has been driven part way through the race, the rotary valve drive hub will separate from the 'O' ring, and may be removed. (Gearbox models only.)

9. If required, the 'O' ring may be prised out with a scriber, or alternatively left in position, and driven through bearing race.

10. Remove crankcase half (rotary valve side), and lift out crankshaft from the opposite crankcase half, ensuring that the oil seal is not damaged by crankshaft thread.

Main Bearings and Bearing Oil Seal

11. Inspect main bearings, and, if found to be damaged, worn or 'rough' in operation, renew at this stage in the following manner:

(a) Lightly drive out oil seal with a screwdriver, heat the crankcase halves with a blowlamp or in an oven until the race can be tapped out.

(b) Clean bores and oilway thoroughly, reheat cases and fit new bearings ensuring that they are fully inserted into their respective bores.

12. If the oil seal is damaged, renew with new seal outer face 1/32 in. proud of case.

Rotary Valve Cover Oil Seal

Gearbox Models

13. Press out rotary valve cover oil seal if damaged or worn and fit new seal ensuring that the flat face is towards the rotary valve (as shown in cross-section illustration), and that the inner face should be 1 mm below valve cover inner face. In this manner, sufficient clearance is provided between the seal and triangular section of valve drive hub.

Non-gearbox Models

14. Assemble the seal in opposite position to that described in para. 13 and shown in Fig. 1.

Crankshaft (Gearbox Models only)

15. Inspect crankshaft gear teeth and mating gear of output shaft assembly for damage or wear.

Gearbox Assembly

16. To dismantle output shaft assembly, remove drive sprocket and nut and drive output shaft and large bearing from housing, ensuring that the clearance shim (if fitted behind small bearing) is retained. Inspect and renew oil seal if required.

Note: Certain dismantling and assembly operations require the use of special tools and equipment and should be returned to the manufacturer. In particular, this applies to the crankshaft assembly and cylinder barrel liner.

ASSEMBLY PROCEDURES

Crankcase, Cylinder and Head Assembly

1. Fit crankcase gasket (0.005 ins.) to inlet (spigoted) side crankcase half, and slide crank into position. Assemble opposite crankcase half to spigot and dowel and push fully home. If crankshaft end float is detected, fit the four crankcase securing screws and tighten.

2. Measure the end float which should be 0.002-0.007 ins. and adjust as follows:

   (a) For a measured end float of less than 0.002 ins, substitute a 0.010 ins. gasket for the 0.005 in. gasket previously fitted.

   (b) For a measured end float in excess of 0.007 ins., the gasket must be removed, and a joint made with a non-setting jointing compound.

3. Fit piston rings to piston and, with a suitable mandrel or machined down piston pin (slightly smaller in diameter, and just long enough to fit between piston bosses), fit piston to rod as follows:

   (a) Fit needle rollers to connecting rod small end, slide mandrel through so that an equal amount projects either side of the rod to which the washers are fitted.

   (b) Slide piston carefully into place, line up rod and push piston pin into place thus displacing assembly mandrel.

   (c) Fit new circlips ensuring that they seat properly into the grooves and with the 'ears' at the bottom.

4. Fit cylinder base gasket (of the same thickness as previously fitted), fit cylinder to crankcase carefully to avoid ring damage.

5. Fit head 'O' ring and cylinder head, and tighten down cylinder head nuts evenly to a torque of 10-12 lbs. ft. Ensure that the 'O' ring is not trapped.

Squish Clearance

6. It is essential that the squish clearance is checked whenever a new piston is fitted irrespective of whether the cylinder has been rebored or not, and that cylinder base gaskets giving the correct clearance are fitted.

7. The squish clearance is the area where at T.D.C., the piston crown, (with the exception of that part directly below the hemisphere), comes very close to the head.

8. A length of 18 s.w.g. (.048") Multicore or similar soft solder wire obtainable from most hardwear or electrical shops should be purchased and used as follows:

9. Assemble the top half of the engine in the usual manner using either the cylinder base gasket previously fitted, or a new one of the same thickness, and torque the cylinder head nuts down to 10/12 ft. lbs.

10. With sparking plug removed and the engine turned to a little before or after T.D.C. insert the end of the solder wire through the plug hole in such a way that it lies across one half of the piston crown with its end touching either the left or right hand side of the cylinder wall. Using an 18 mm spanner on the magneto nut, turn the engine slowly up to and over T.D.C. This will compress the solder to exactly the clearance between the head and piston. Remove the solder, which will be seen to have been flattened at the end for about 3/8" and have a pronounced lip right at the end due to the increased clearance over the ring at this point. With sharp scissors cut off this lip. It is important not to leave a burr, and also to ensure that the lip alone is removed, as only the tip of the flattened solder is to be measured, the thickness of which should ideally be 0.030". Having obtained a measurement, cut off the flattened end completely, and repeat the procedure on the opposite side.

11. The two readings should be similar, but should there be a difference, the lower reading should be taken as correct.

12. If this is less than 0.029" or greater than 0.034" the cylinder base gasket must be changed for one which will bring the squish clearance within these limits.

13. Due to manufacturing tolerances, the standard gaskets of nominally 0.005", 0.008", 0.010" and 0.016" vary by up to ± 0.003", and this variation can sometimes be turned to good effect when setting squish clearances.

14. If for example the squish clearance is found to be 0.028", and the cylinder base gasket when checked by micrometer measures 0.016", then the addition of a standard 0.008" gasket will increase the squish to an unacceptable 0.036". If a few gaskets of each size are on hand it is a simple matter to select either two of say 0.010" each which will give a squish clearance of 0.032", or one from the thicker range of 0.018" which will give 0.030" clearance.

15. It is as well to remember that gaskets compress by up to 15% after use and while this is not really worth taking into account when using a single thin gasket, it does begin to become important if two or three gaskets totalling upwards of 0.025" have to be used.

16. In this case it is better to aim for a squish clearance at, or slightly above the normal top limit of 0.034" in the knowledge that this figure will reduce after running. These rather large variations sometimes occur due to differences in piston crown height.

17. As a matter of course, check the clearance after running, and at reasonable intervals thereafter, and readjust if it falls more than 0.002" below the normal setting bottom limit of 0.029".

Ignition Timing

18. The ignition must be timed to 1.8-2.0 mm (0.071-0.079 in.) before T.D.C, accomplished as follows.

19. Fit Woodruff key and rotor to crankshaft and tighten crankshaft nut to a torque of 50 lbs ft. Assemble stator plate with 5 mm screws and washers but do not tighten at this stage.

20. Fit dial test indicator fitted with a suitable extension to spark plug thread.

21. Position piston at T.D.C. with indicator set to zero, ensuring that indicator has at least 3.17 mm (0.125 in.) travel from normal rest position.

22. Rotate crankshaft backwards until pointer has moved 1.9 mm (0.075 in.). Hold crankshaft in this position and rotate stator on elongated slots until the timing marks on rotor and stator coincide exactly. Lock up stator screws and recheck timing marks.

Note: Even if the stator has not been removed, every time the rotor is removed from the shaft taper, this check should be applied.

Rotary Valve and Gearbox Assembly (Gearbox Models)

23. To check oil seal/rotary drive hub clearance, fit rotary drive hub into rotary valve cover fully home. Without 'O' ring in crankshaft groove, gently slide drive hub onto crankshaft gear end, (any radial position will suffice) and, holding rotary valve cover firmly on its joint face, check that the drive hub can be pushed forward at least 1 mm before it abuts against the main ball race. Should this not be the case, the seal must be pressed out a little further.

24. When clearance is satisfactory, remove rotary valve cover and drive hub, fit new 'O' ring to crankshaft groove and position engine at T.D.C.

25. Lubricate inside of drive hub and locate on crankshaft gear so that any one of its triangular faces is positioned at the bottom (see Fig. 3).

Fig. 3 Rotary Valve Drive Hub

26. Fit rotary valve so that the leading edge of valve is about to start closing lefthand port edge. (See Fig. 4.)

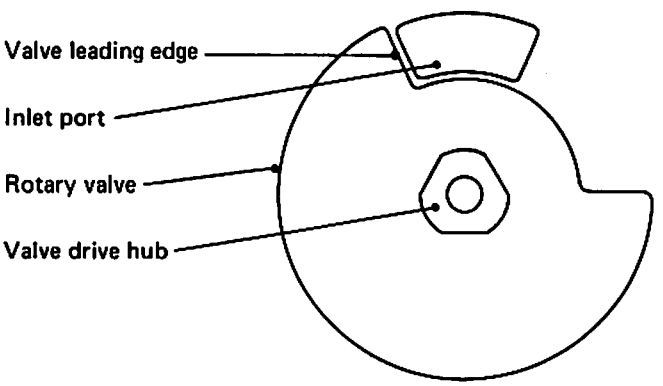

Fig. 4 Rotary Valve Timing (Piston at TDC)

27. Fit rotary valve cover together with new gasket and secure with the two top screws (M6 x 70 mm).

28. Fit output shaft assembly together with gasket but without large diameter bearing. Ensure the shim, if fitted, is between the rear of output shaft and small bearing.

29. Hold in position and observe that the shaft can be moved backwards and forwards slightly (i.e. that the gear face is not hard against drive hub).

Note: The following checks are necessary only if new bearings have been fitted to output shaft assembly or crankcase.

30. If satisfactory, remove and fit large bearing to housing, position on rotary valve cover and tap housing fully home. Fit and tighten screws in sequence.

31. Fit sprocket and, using a new self-lock nut, tighten to a torque of 45-50 lbs. ft. with the aid of a chain wrench.

32. Fill with EP80 gear oil to level plug. Refit level screw with new fibre washer and tighten securely.

Rotary Valve and Sprocket (Non-Gearbox Models)

33. Position engine at T.D.C. as described in para. 24, omitting 'O' ring.

34. Fit drive hub and rotary valve (paras. 25, 26).

35. Grease seal and fit rotary valve cover together with new gasket. Tighten screws securely in sequence.

36. Refit carburettor.

37. Slide sprocket onto shaft splines, hold with chain wrench and fully tighten 8 mm cap screw.

38. Re-fit coil and earth strap ensuring that:

(a) Rubbers are correctly positioned as shown (see items 42-46).

(b) Coil is sufficiently free to move on rubbers, and,

(c) A good earth contact is obtained.

39. Fit coil lead to spark plug.

40. Assemble engine mounting clamps to engine and tighten screws.

RECOMMENDED TORQUE SETTINGS

Cyl. head nuts	10-12 lbs.ft.
Magneto locking nut	50 lbs.ft.
Drive sprocket locknut	45-50 lbs.ft. (Gearbox models)

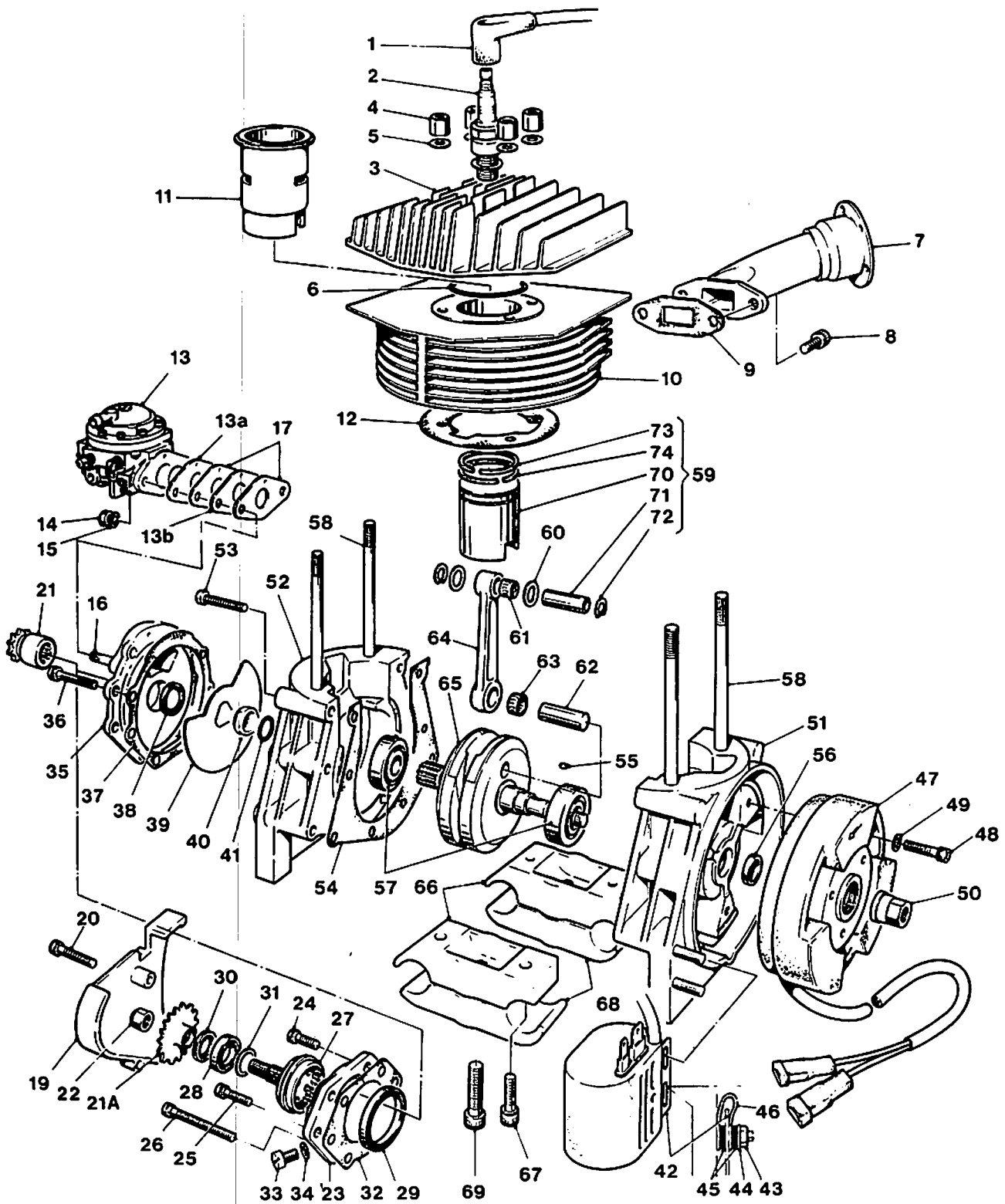

FIG.5 ENGINE - EXPLODED VIEW - PARTS

ILLUSTRATED PARTS LIST

Item No.	Part No.	Description	Qty.
1	KE3-202	CONNECTOR, spark plug, rubber	1
2	-106	PLUG, spark	1
3	-101	HEAD, cylinder	1
		ATTACHING PARTS	
4	-103	NUT, M8, cylinder head	4
5	-104	WASHER, M8, plain	4
		----------***----------	
6	-105	'O' RING, cylinder barrel to head	1
7	-114	PIPE, exhaust	1
		ATTACHING PARTS	
8	-194	SCREW, cap, skt.hd, M6 x 16	2
		----------***----------	
9	-115	GASKET, exhaust flange	1
10	-111	BARREL, cylinder, 3 port-TT	1
-	KE4-111	BARREL, cylinder, boost port	1
11	KE3-112	LINER, cylinder, 3 port-TT	1
-	KE4-112	LINER, cylinder boost port	1
-	KE5-112	LINER, cylinder 5 port-TT	1
12	KE3-113A	GASKET, barrel/crankcase 0.008 ins. thick	1
-	-113B	GASKET, barrel/crankcase 0.015 ins. thick	1
-	-113C	GASKET, barrel/crankcase 0.006 ins. thick	1
-	-113D	GASKET, barrel/crankcase 0.010 ins. thick	1
13	-211	CARBURETTOR (Tillotson type HL304A523)	1
-	-211A	CARBURETTOR (Bored)	1
13a	-213	RESTRICTOR, carburettor	1
13b	-213A	VENTURI, carburettor	1
		ATTACHING PARTS	
14	-214	NUT, M6, plain hex.	2
15	-215	LOCKWASHER, M6, s/coil, sq. sect.	2
16	-166	STUD, M6, carburettor	2
		----------***----------	

Item No.	Part No.	Description	Qty.
17	KE3-212	GASKET, carburettor	2
* 19	-221	GUARD, chain	1
-	-221B	GUARD, chain	1
		ATTACHING PARTS	
20	KE-195	SCREW, cap, skt.hd, M6 x 40	2
		---------- * * * ----------	
21	-181-9	SPROCKET, drive 9T	1AR
	-181-10	SPROCKET, drive 10T	1AR
	-181-11	SPROCKET, drive 11T	1AR
	-181-12	SPROCKET, drive 12T	1AR
* 21A	-181-16	SPROCKET, drive 16T	1AR
-	-181-17	SPROCKET, drive 17T	1AR
-	-181-18	SPROCKET, drive 18T	1AR
-	-181-19	SPROCKET, drive 19T	1AR
		ATTACHING PARTS	
22	-184	NUT, self-locking, ½ in. UNF	1
		---------- * * * ----------	
23	-171	HOUSING, reduction gear	1
		ATTACHING PARTS	
24	-193	SCREW, cap, skt.hd, M6 x 25	2
25	-193	SCREW, cap, skt.hd, M6 x 25	2
26	-192	SCREW, cap, skt.hd, M6 x 70	2
		---------- * * * ----------	
27	-172	SHAFT, output	1
28	-174	BEARING, ball, 17 x 35 x 8	1
29	-173	BEARING, ball, 45 x 58 x 7	1
30	-175	SEAL, oil, output shaft	1
31	-170A	SHIM, 0.005 ins. thick	AR
-	-170B	SHIM, 0.010 ins. thick — Select at assembly	AR
-	-170C	SHIM, 0.015 ins. thick	AR
32	-178	GASKET, output shaft housing	1
33	-176	PLUG, oil filler	1

* For models with gear reduction assembly

Item No.	Part No.	Description	Qty.
34	KE3-177	WASHER, fibre	1
* 35	-161	COVER, rotary valve (gearbox model)	1
* -	-161A	COVER, rotary valve	1
* -	KE4-161	COVER, rotary valve (boost port restricted)	1
		ATTACHING PARTS	
36	KE3-192A	SCREW, cap, skt.hd, M6 x 75	2
* -	-192A	SCREW, cap, skt.hd, M6 x 75	4
	-194	SCREW, cap, skt.hd, M6 x 20	3
		----------*** ----------	
37	KE3-165	GASKET, valve cover to crankcase	1
38	-164	SEAL, oil type 25357	1
39	-163A	VALVE, rotary, std. 45°-65° } select at	1AR
-	-163B	VALVE, rotary, 45°-72° } assembly	1AR
40	-162	HUB, rotary valve drive	1
41	-167	'O' RING, crankshaft to valve drive hub	1
42	-206	COIL, (Motoplatt type)	1
		ATTACHING PARTS	
43	-209	NUT, M6, nyloc	2
44	-215	WASHER, M6, plain	2
45	-204	BUSH, mounting, coil	4
		----------*** ----------	
46	-207	STRAP, earth	1
47	-201	MAGNETO (Motoplatt type)	1
		ATTACHING PARTS	
48	-196	SCREW, cap, skt.hd, M5 x 20	3
49	-208	WASHER, M5, plain	3
50	-205	NUT, crankshaft	1
		----------*** ----------	
51	-122	CRANKCASE, L.H.	1
52	-121	CRANKCASE, R.H.	1
		ATTACHING PARTS	
53	-191	SCREW, cap, skt.hd, M6 x 60	4
		----------*** ----------	

*For models with gear reduction assembly

Item No.	Part No.	Description	Qty.
54	-123A	GASKET, crankcase, 0.005 ins. thick } select at assembly	1AR
-	-123B	GASKET, crankcase, 0.010 ins. thick } select at assembly	
55	-203	KEY, 'Woodruff'	1
56	-125	SEAL, oil, crankshaft	1
57	-124	BEARING, main, 20 x 47 x 14	2
58	-102	STUD, cylinder head	4
59	-131	PISTON ASSEMBLY (50.6/50.7/50.8/50.9/51.0/51.1/51.2 – TT3 port)	1AR
-	KE4-131	PISTON ASSEMBLY (50.6/50.7/50.8/50.9/51.0/51.1/51.3 – 3 port boost)	1AR
-	KE5-131	PISTON ASSEMBLY (50.6/50.7/50.8/50.9/51.0/51.1/51.2 – 5 port)	1AR
60	KE3-142	WASHER, thrust piston	2
61	-143	BEARING, roller, small-end, 14 x 18 x 17	1
62	-153	CRANKPIN	1
63	-144	BEARING, roller, big-end, 18 x 24 x 15	1
64	-141	ROD, connecting	1
65	-150	CRANKSHAFT ASSEMBLY	1
66	-223A	CLAMP, mounting	2
		ATTACHING PARTS	
67	-197	SCREW, cap, skt.hd, M8 x 30	4
		---------- * * * ----------	
68	-223B	CLAMP, mounting	2
		ATTACHING PARTS	
69	-198	SCREW, cap, skt.hd, M10 x 35	2
		---------- * * * ----------	
70	KE3-136	PISTON, 50.6/50.7/50.8/50.9/51.0/51.1/51.2 TT 3 port } state size when ordering	1
-	KE4-136	PISTON, 50.6/50.7/50.8/50.9/51.0/51.1/51.2 3 port } state size when ordering	
-	KE5-136	PISTON, 50.6/50.7/50.8/50.9/51.0/51.1/51.2 5 port } state size when ordering	
71	KE3-134	PIN, PISTON	1
72	-135	CIRCLIPS	2
73	KE3-132	RING, piston, top } Supplied as a ring set	1AR
74	KE3-133	RING, piston, bottom } Supplied as a ring set	1AR