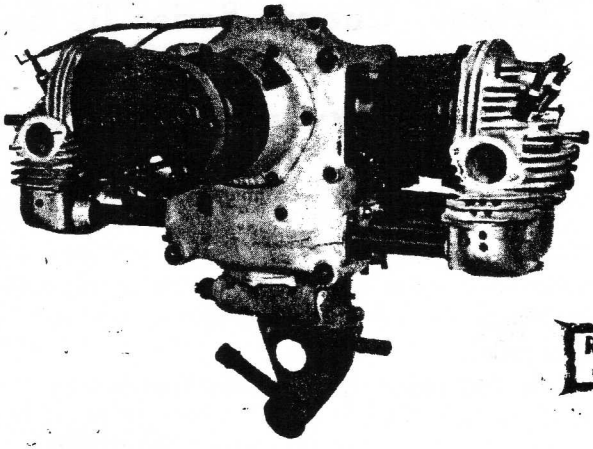

The 31/36 H.P.

"Bristol"

CHERUB SERIES III
AIRCOOLED AERO ENGINE

A brief description, with Notes on Installation, Running and Maintenance.

Designed and Manufactured by—

THE BRISTOL AEROPLANE CO., LTD.,

FILTON - - BRISTOL.

Telegrams:
"AVIATION, BRISTOL."

Telephone:
3906 BRISTOL.

The "Bristol" Cherub Series III Engine.

Leading Particulars.

Type	Aircooled horizontally opposed twin.
Cylinders	Aluminium head, overhead valves.
Bore and Stroke	3.54" × 3.80" 90 m.m. × 96 m.m.
Total swept volume ...	75 cu. ins. 1228 c. cs.
Compression ratio ...	5.5 to 1
Normal speed and power	32 B.H.P. at 2,900 R.P.M.
Max. for not more than 5 minutes	36 B.H.P. at 3,200 R.P.M.
Propeller	Direct Drive L.H. tractor.
Engine rotates	Clockwise looking on front.
Carburettor	1 Zenith special Cherub model, Type 36 A.K.B.
Altitude control	Extra air to diffuser.
Lubrication system ...	Pressure 40 lbs./sq. inch.
Oil pump	Duplex gear type, 1 scavenge 1 feed.
Ignition	Dual. Double Pole Watford T2.—2. Magneto.
Rotation	½ engine speed clockwise looking on driving end.
Spark plugs	2 per cyl. K.L.G. 14 mm type 360A.
Ignition timing	35°E. at full advance.
Tachometer drive ...	¼ engine R.P.M.
Tachometer rotation ...	Anticlock looking on drive housing.
Valve clearances	.015 at valve.
Starter gear	Impulse starter on magneto, and primer connections to inlet ports.
Complete dry weight ...	100 lbs.
Fuel recommended ...	Aviation spirit with 25% Benzol.
Oil recommended ...	Castrol "R." Pure treated Pharmaceutical castor, or Shell super heavy Aviation.

Rated consumptions, at normal R.P.M. :—

Fuel	2 gallons per hour.
Oil	1 pint ,,

Some Successes of the "Bristol" Cherub Engine.

At every flying competition in which aircraft fitted with the "Bristol" Cherub aircooled engines have taken part during 1924 and 1925 in Great Britain, Germany and U.S.A. the Cherub-engined machines took premier awards.

In the British Air Ministry Competitions held at Lympne in 1925 six of the seven events competed for were won by aircraft fitted with "Bristol" Cherub engines.

In the 1925 competitions held at Lympne Aerodrome on August 1st, 2nd and 3rd, the "Bristol" Cherub engine maintained this wonderful record, for in the six races included in the programme five first prizes were won by Cherub-engined aeroplanes, including 1st, 2nd, 3rd, 4th and 5th in the race for the Grosvenor Cup, and Cherub-engined aircraft took three out of four first prizes in the competitions for altitude, and speed over a measured course! More than this there was not a single case of failure or breakdown of any kind with any ungeared Cherub engine throughout the whole competition.

At the New York Air Meeting held in October, 1925, every first prize offered for light aircraft was taken by the Powell Racer, the only participating machine fitted with a Cherub engine.

At the International Flying Meeting at Munich in September, 1925, the Messerschmitt Monoplane fitted with the Cherub engine obtained the first prizes both for speed and for altitude. In this case again this was the only Cherub engine in the competition. In a letter received from Dipl Ing Willy Messerschmitt, dated May 3rd. 1926, he states:—"I am very pleased with the first Cherub engine which you supplied to me and it is to-day still running like clockwork. The aircraft is in the possession of the Fürth Sportflug and it has had no respite."

OFFICIAL TYPE TEST.

In December, 1925, a standard engine was submitted to the 100 hours' Air Ministry Type Test, run under Air Ministry supervision, according to the latest schedule, similar to that called for on British standard service aero engines.

This test was successfully completed, without replacement or dismantlement, in ten non-stop runs of ten hours' duration, at normal R.P.M., together with the usual high speed and high

power tests. The average power developed at normal R.P.M. on the final five minutes of each ten hour non-stop run was 34 B.H.P. while the average consumptions for the whole of the 100 hours were :—

Fuel 1.92 Gallons per hour.
Oil 0.68 Pints ,,

The power developed by the engine improved throughout the run ; on the final power curve taken at the completion of the test the engine developed :—

34.5 B.H.P. at 2,900 R.P.M.
36.0 B.H.P. at 3,200 R.P.M.

At the conclusion of the test the engine was stripped for examination, and, in the words of the official report, " the condition of the engine was excellent."

IMPROVEMENTS IN THE SERIES III CHERUB ENGINE.

In the latest type Series III " Bristol " Cherub engine several improvements have been incorporated as compared with the earlier engines making for increased reliability and long life. The principal of these are :—

1. Bore increased to 90 m.m. Capacity increased to 1228 c.cs.
2. Amended cylinder head design with new type valves and triple valve springs.
3. Extra gas ring and new design scraper ring.
4. Floating bush big end bearing construction with forced feed lubrication.
5. Dual ignition Watford double pole H.T. magneto and two K.L.G. new type 14 m.m. plugs per cylinder fitted.
6. Large capacity ball journal bearings to crankshaft.
7. More robust, smaller and more symmetrical crankcase with dry sump.
8. Pressure feed lubrication by engine driven duplex gear pump, 1 suction 1 pressure unit. Filter embodied in the suction system.
9. Larger diameter mounting bolts fitted and rear of engine modified, allowing easier attachment of engine mounting.
10. Special Cherub type Zenith carburettor tucked up more snugly to the engine with new float mechanism. Robust 4 bolt flange attachment.
11. Automatic ignition control, interconnected with throttle. Altitude control interconnected with throttle ensuring automatic return to ground position when throttle is closed.

Description.

CRANKSHAFT.

The crankshaft is a case hardening alloy steel stamping of ample dimensions, carried in four bearings; the crankcase is an aluminium casting split vertically on the engine centre line and provided with separate front and rear covers.

BEARINGS.

There are three main journal bearings. The front one is of the deep groove type, located in the nose of the conical front cover, and transmits the propeller thrust from the crankshaft to the case. The other two are of the double row self aligning type, and situated adjacent to the crank throws, one in front and the other behind, and are housed in the front and rear half crankcases respectively. The tail end of the shaft is supported in the rear cover by a plain white metal bearing which provides an oil seal, allowing oil to be supplied through the hollow tail end and drilled oilways to the big end bearing. On the shaft between the two rear bearings a spur wheel and two spiral gear wheels provide drives for the camshaft tachometer and magneto and oil pump respectively.

CONNECTING RODS.

Connecting rods are alloy steel forgings with hardened liners, pressed into the big ends, the proportions of which are such that the rods may be threaded over the shaft. When in position, the split bronze floating bushes are inserted and the two halves secured to each other by high tensile steel screws which are locked by split pins.

PISTONS.

The pistons are of aluminium alloy fitted with three rings, the lower one of which serves as a scraper and returns surplus oil from the cylinder walls through drain holes in the piston skirt. The hollow gudgeon pins float both in the piston bosses and in the connecting rod small ends and are located endways by bronze buttons pressed into their open ends.

CYLINDERS.

The cylinders have steel barrels, but the inlet and exhaust passages are formed in the aluminium alloy heads which also carry the screwed in alloy steel valve seats, valve guides, valves and

springs. A deep spigot for the head is provided on the barrel with a flange to which the head is bolted. The spigot protects the vital joint which is formed by a copper ring spigotted and very carefully fitted in annular grooves cut in the head and barrel flanges. As the rates of expansion of aluminium and steel are different great difficulty is usually encountered in the maintenance of a really gas-tight joint with this type of head. In the Cherub heads this difficulty has been entirely overcome by inserting packing pieces of a special alloy, having an unusually low rate of expansion, between the cylinder heads and the heads of the securing bolts. This arrangement combined with the copper ring joint has proved so satisfactory that the ends of the bolts are rivetted over on their nuts, the head and barrel being regarded as one unit which need never be disturbed. The cylinders are secured to the crankcase by a spigotted and flanged joint, a Dermatine ring serving to make the joint oil tight.

VALVES.

Inlet and exhaust valves are of cobalt-chrome steel and are interchangeable. Three concentric springs are used on each valve. The valve operating gear is somewhat unusual and has distinctive features of considerable importance.

The camshaft which with its four cams is machined from the solid, runs across the crankcase below the crankshaft and is driven by plain spur gears of ample dimensions. The cams are of the constant acceleration type. The valves are operated by rocker shafts which run parallel to the cylinder axes from crankcase to cylinder head. These may be regarded as the precise equivalent of the normal type of rocker arm which is interposed between camshaft and valve in the overhead camshaft type of engine, with the single difference that a rocker which is operated through a finger, by the cams, is separated from that which operates the valves by a length of shafting. As the valve stems project from the cylinder heads radially relative to the cylinder bore, any difference between the expansion of the cylinder and that of the rocker shaft merely moves the valve stem slightly across the face of the operating rocker, but does not alter the valve clearance. A torsion spring fitted to the rocker shaft keeps the cams, finger, and operated rocker in contact and the whole valve gear is entirely enclosed.

MAGNETO.

As already mentioned, the magneto is driven by spiral gears from the rear end of the crankshaft. It is mounted on the rear cover by a flange and spigot and lies behind and parallel to the port side cylinder with the contact breaker readily accessible. The magneto is a double pole double slip ring type which fires two plugs in each cylinder. It is fitted with an impulse starter to render starting easy.

LUBRICATION SYSTEM.

The oil pump is located behind the starboard cylinder in an extension of the magneto housing on the rear cover where it also is readily accessible, and is driven by the same spiral gears that drive the magneto. It is detachable as a complete unit and consists of two independent gear pumps. At the bottom of the crankcase is provided a detachable oil sump containing an easily removable oil filter, the larger of the two pumps draws oil drained from the crankcase through this filter and returns it to the tank. The smaller or feed pump supplies it under pressure through drilled oilways to the big end bearings and the bushed bearings of the camshaft and intermediate wheel. This pump is provided with a spring loaded pressure adjuster, the byepassed oil being returned to the suction side of the pump. The spiral gears are adequately lubricated by oil collected in a well into which the lower gear dips. The bearings of this gear are automatically lubricated by the oil which flows from a similar but smaller well, special provision being made to prevent leakage through this bearing into the magneto housing.

CARBURETTOR.

The carburettor is a special type of Zenith with hand operated altitude control of the extra diffuser air type and is bolted to a cast aluminium induction T piece which is attached by studs and nuts to a broad facing on the underside of the magneto and pump housing on the rear cover. The throttle and magneto advance and retard are interconnected by a suitable arrangement of levers and links. The altitude control is independent except that it is closed automatically if the throttle is closed. The air intake to the carburettor is an exhaust jacketted steel elbow. The induction pipes run from the T piece parallel to the cylinders and are fitted into it with airtight expansion joints, and are provided with bosses to take primer jets.

MOUNTING.

The engine is mounted from screwed extensions on the ends of the four crankcase bolts at each corner of the crankcase.

A standard connection for a tachometer is arranged on the port side above the magneto.

Installation.

GENERAL.

A large size blue print of the installation diagram is supplied with each engine and will be found to give all particulars of the various connections required to be made when installing the engine.

The following notes indicate the important points to be considered and are for general guidance. The Bristol Aeroplane Company are at all times prepared to supply more detailed information and to give constructive advice upon installations, schemes or details submitted to them for their approval or comments.

MOUNTINGS AND COWLINGS.

The four corner crankcase bolts are formed with a collar and screwed extension at the rear for securing the engine to the mounting. In view of the torque characteristics of a two-cylinder engine, special attention should be paid to the rigidity of the mounting and the base made as wide as possible. The cowling of the engine should allow for the engine receiving a suitable supply of cooling air. For general conditions, the cylinder head and top two Steel Fins should be left exposed to the air.

FUEL SYSTEM.

The fuel supply pipe should be $\frac{1}{4}$" O/dia. by 20 s.w.g. (.036") to suit the nut and nipple on the carburettor union, joint to be made with silver solder.

A petrol filter must be included in the feed from the tank and the piping must be suitably secured to prevent undue vibration. Approved flexible connections of the petroflex type should be included, one close up to the carburettor and one close to the filler should be sufficient.

To ensure a sufficient supply to the engine under all conditions, the carburettor union should be disconnected and the flow measured under the condition of the minimum head. This flow must be at least at the rate of 36 pints per hour, of course with the filter in action.

Connections for priming are provided on the elbow of the cylinder induction pipe and to ensure easy starting a primer should be fitted, a suitable type being the "Athmos" weighing al out

12 ozs. and obtainable through the Bristol Aeroplane Company if required. Whatever type is fitted provision must be made for shutting off the primer when not in use.

OIL SYSTEM.

A separate oil tank is required, installed so as to give at least a slight positive head. Piping must be suitably supported to prevent vibration and should include an approved type of flexible connection between the engine and tank.

The capacity of the tank should allow for two pints for circulation purposes plus two pints for each hour's duration of flight, the duration being based upon the petrol tank capacity. If an oil cock is fitted between the tank and the engine pump, it should be locked in the open position tc prevent the possibility of running the engine with the oil turned off.

A detachable oil filter is provided in the engine sump, ensuring the oil being kept thoroughly clean before returning to the tanks. As no filter is provided in the feed system every care must be taken to ensure cleanliness of the oil when filling up and facilities must be provided for flushing out the oil tank after every 25 hours' running. An overload pressure gauge must be fitted in the cockpit reading up to 60-lbs./sq. inch.

AIR INTAKE AND EXHAUST SYSTEM.

To ensure efficient carburation, especially at temperatures below normal, an exhaust heated air intake is provided. The outlet from the exhaust for this is left to suit the installation and it should be led clear of the machine, the mouth being arranged to obtain an ejector action.

A support from the bulkhead will be required to allow fo possible flexing of the engine mounting. This support should not hold the pipe too rigidly.

CONTROLS.

The Magneto Control is automatic, being interconnected with the throttle control.

Altitude control is provided, but unless the machine is intended for altitude work, the control should be locked in the ground or rich position. If altitude control is used, it should be noted that an interconnection with the throttle is already provided on the engine ensuring the altitude control being pos tively returned to the ground position when the throttle is closed, and therefore the cockpit controls must allow for this to occur automatically.

Both throttle and altitude control levers are adjustable within a fairly wide range to suit the convenience of installation. The levers are left by the makers to be pinned by the Aeroplane manufacturers in the most convenient position.

PROPELLERS.

These can be two bladed of the wooden or Reed duralumin type, but it is desirable that they should have sufficient mass to provide a flywheel effect, and it is essential that they are in proper balance. The actual diameter and pitch will depend upon the machine and its normal operating conditions and performance, but upon receipt of these particulars, The Bristol Aeroplane Company are prepared to advise a suitable propeller.

Installing the Engine.

UNPACKING.

The standard Bristol packing case measures approximately 24″×24″×32″ and weighs complete with engine, etc., approx. 190-lbs. It contains the engine complete with all items shown in full lines on the installation drawing, together with the tool kit if supplied with the engine.

To unpack, remove cover. This is marked "Remove this side first." Remove the two coach bolts $\frac{3}{8}$″ dia. securing the wooden block supporting propeller hub end. Remove the four nuts and tab washers from the $\frac{5}{8}$″ dia. screws projecting through the bottom of the case. Turn case with open side uppermost, lift engine clear of case, and rest upon the long extension screwed on the four corner crankcase bolts.

The wooden block on propeller hub can be removed, but the extension on the crankcase bolts should be left on until the engine is ready for installation unless a suitable stand is available. A simple and readily improvised wooden stand resembles an inverted form, the two uprights supporting the engine under the induction pipe and rocker shaft tubes; to give ample bearing surface and stability the upright should be about $1\frac{1}{2}$″ thick by 9″ wide, spaced about 13″ apart and about 12″ long to give clearance to the air intake.

INSTALLING THE ENGINE.

Remove the screwed extensions used for packing the engine from the rear ends of the crankcase mounting bolts, but do not remove or slacken the bolts themselves. Fit engine in mounting, pull nuts up tight and lock with split pins.

Before connecting up fuel and oil pipes, make sure that the blanks fitted to all unions by the engine makers before despatch have been removed. See that after final bending, all fuel and oil pipes are annealed and finally the interiors thoroughly cleaned from scale, etc. The tachometer drive is located on the rear of the engine on the top and facing the port side. It is suitable for the standard British driving shaft.

A lubricator is provided on the magneto housing for lubricating the impulse starter, and also to enable it to be washed out with paraffin occasionally to prevent sticking. An $\frac{1}{8}$" hole drilled is provided in the lower portion of the housing to allow the paraffin to drain away.

The crankcase breather is screwed into the top of the crankcase.

FITTING PROPELLER AND HUB.

SPECIAL NOTE.

Before the propeller is fitted we think it advisable to impress upon all likely to handle this engine of the extreme personal danger, owing to the efficacy of the impulse starter, of even partially turning the engine when it is in working order. To prevent mishaps due both to over familiarity and lack of familiarity with this engine, it is customary in the running sheds of the Bristol Aeroplane Co., Ltd., to consider the engine as always on contact, and to disconnect both sets of sparking plugs when the engine is standing bye.

Before fitting the hub, lightly smear the crankshaft taper and feather key with a thin oil and push hub on by hand. Hubs should not be interchanged without checking the fit with marking. The hub should bear harder upon the larger diameter of the taper than on the small diameter. Screw the .920" flats hexagon nut (right hand thread) in to the end of the shaft and pull up as tight as possible. The collar on the front end of this nut binds against the hub and forces it home on to the crankshaft. The slotted screwed sleeve, which has an external left hand thread, is now screwed into the end of the propeller hub and the .920" flats hexagon locked by means of the flanged tab washer secured to it by the 4BA bolt. The slotted screwed sleeve is solely to assist in the withdrawal of the propeller hub from the shaft, which is done by removing locking washer and bolt unscrewing the .920" flats hexagon nut, the collar on which binds against the slotted screwed sleeve and forces the hub off the shaft. The crankshaft key ensures the hub always being fitted in the same position relative to the crankshaft and the propeller itself should always be positioned in the same relation to hub and shaft as detailed in the notes on starting the engine.

The propeller should be a good fit on the hub barrel, the bolt holes being a clearance fit.

The full bearing area of the flange plates must be utilised and the faces of the propeller boss must be square with the hub flanges, before tightening up of bolts. After pulling up the bolts, which should be done evenly and progressively, the track of the blades should be checked and the maximum error should not exceed $\frac{1}{8}$ of an inch, measured at approximately $\frac{3}{4}$ radius of the blade.

The nuts should be finally locked with split pins.

Running Notes.

Before running the engine :—

1. Note previous Special Note on danger of turning engine.
2. Examine all nuts ; see that they are quite tight and safely locked.
3. Check the valve clearances.
4. With plugs disconnected check the timing of the magneto and impulse starter. Note that the latter is functioning by pulling engine over slowly and listening for the click. If this click cannot be heard, the impulse starter is probably clogged up ; wash out with paraffin through lubricator and drain hole and lubricate sparingly with a suitable thin oil.
5. See that propeller is tight on its hub and the hub tight on the shaft.
6. See that there is plenty of clean oil in the tank and that the oil cock, if fitted, is turned on.
7. See that petrol tank is filled with clean approved fuel, and that the fuel is fed to the engine through a suitable filter.

STARTING THE ENGINE.

The key to easy starting is the successful operation of the magneto impulse starter, combined with suitable doping through the connection provided on the cylinder induction elbow. Before attempting to start the engine get familiar with the action of the impulse starter. To do this, disconnect both sets of plugs and slowly pull the engine round. (Note that rotation is clockwise looking on propeller), listening for the click of the impulse starter, which is easily audible and synchronises approximately with the impulse starter spark and is timed to occur late on the firing stroke

of each cylinder, that is, once per revolution. Get this position fixed in your mind and, if necessary, alter propeller in hub until the blade is in the most convenient position when the click occurs. On Bristol machines blade is approximately at 4 o'clock looking on the front of the engine.

Once this position has been fixed, always replace propeller in the same relation to avoid confusion.

To start the engine from cold, switch off the magneto, see that fuel and oil are turned on, turn on primer, give one pump and pull engine over sharply a complete revolution to prime, turn off primer, switch on magneto and slowly pull engine over compression with one hand, allowing propeller to fly out of hand as engine goes over compression and fires.

Always remember to pull engine over slowly, otherwise the impulse starter does not function correctly, if at all.

For a warm engine $\frac{1}{2}$ to $\frac{3}{4}$ of a pump from the primer should be sufficient.

FUEL RECOMMENDED.

The recommended fuel for this engine is a mixture of 75% Aviation Petrol, with 25% Benzol, giving a total aromatic content of 35% to 38% and specific gravity of approximately 0.770. This fuel will be satisfactory over a wide range of conditions, but should it be necessary to increase the percentage of Benzol the carburettor will probably require further tuning.

NOTES ON TUNING CARBURETTOR.

The standard carburettor is a special Cherub model Zenith, fitted with main, compensating and slow running jets, the principles of operation being explained in the Zenith handbook supplied with these instructions.

Each engine is tuned up on the bench by the makers for power, consumption, slow running and acceleration. The jets will vary slightly with each engine, but the approximate sizes as supplied are as follows :—

Choke	30 m.m.
Main jet	150—160 C.Cs.
Compensating	280—290 ,,
Slow running	70 ,,

The fuel level in the carburettor should be such that there is just a slight overflow from the main jet with the well cap removed.

These jet sizes given refer to calibrations in accordance with the B.E.S.A. Report No. 5030, and must not be confused with the Zenith Company's drill sizes.

When the engine is tuned up in the machine these jet sizes may require modification according to the operating conditions of the machine and the following general instructions for tuning are given.

POWER.

To increase the power, assuming that the engine is not already too rich, increase the size of the main jet.

ACCELERATION.

To improve the acceleration, assuming that the engine is not already too rich, increase the size of the compensating jet.

SLOW RUNNING.

This is controlled by the adjustable screw.

Turn clockwise to cut down extra air and richen mixture.

If slow running is bad despite tuning, possibly magneto is at fault. See notes on timing magneto.

POINTS REQUIRING ATTENTION.

With a new propeller the hub will probably require tightening up frequently for the first 20 hours' flying, and should be tried for play before each flight. The oil tank should be cleaned out at frequent intervals, approximately after 25 hours' running or a long stand bye.

The rocker clearances should be kept adjusted to .015" each. The oil filter in the sump should be cleaned after each 15 to 20 hours' running. Petrol filters should be cleaned out after every 15 to 20 hours' running.

The spark plug gap should be occasionally checked and set to .012" minimum and .015" maximum.

SETTING ROCKER CLEARANCES.

The rocker adjusting screws are readily accessible through the cut away rocker box. Adjustment should be made with the engine cold and both exhaust and inlet set to .015" clearance. Take care to pull lock nut up tight after adjusting clearances. The most important factor in the valve timing is the opening of the exhaust and the closing of the inlet valves. The average timing with cold engine and correct clearance is inlet valve closes 65° after B.D.C. and exhaust valve opens 70° before B.D.C. It should be noted that when propeller hub keyway is on bottom

centre, both pistons are on their top dead centre. Take up the slight strain on the rocker levers while making adjustments.

TIMING MAGNETOS.

The special double pole magneto fires two plugs in each cylinder. The magneto leads are numbered 1A, 1B, 2A, 2B, and it should be noted that 1A and 1B go to one cylinder and 2A and 2B to the other cylinder. The magneto should fire at 35° before T.D.C. when in the full advance position, that is, with the throttle full open. Under ordinary circumstances, no modification to the timing is required or should be made. The actual connection to the engine drive is by 180° dogs, so that it is a very simple matter to replace the magneto in its correct relationship. A vernier coupling is also provided to be used in obtaining correct setting when the magneto has been dismantled or replaced. When checking the timing, the timing lever should be in the full advance position, that is, with the throttle full open, and both sets of plugs removed or disconnected, to prevent the possibility of the engine firing accidentally.

Turn engine slowly in an anti-clockwise direction looking on the front until the contact breaker arm has passed the cam of the contact breaker ; now turn engine in a clockwise direction until the platinum points just separate ; this position should be 35° before top dead centre.

It is most important that the impulse starter does not break the points before 5° and later than 10° after T.D.C. If magneto timing is O.K. this timing will be O.K. also. To check proceed as for magneto timing, but turn engine very slowly in a clockwise direction looking on the front, that is, in the direction of the rotation ; the contact breaker will dwell for an appreciable period before the sudden flick onwards which denotes the actual sparking time. Should this sudden flick forward fail to take place it is probable that impulse starter mechanism has gummed up. To free it, inject paraffin through lubricator on top of magneto housing, slowly revolving engine meanwhile until the impulse starter frees itself. The paraffin will drain out through small hole in back of case. Finally, give a few drops of fine oil similar to machine gun oil.

Should the slow running of the engine become erratic and tuning of the carburettor fail to correct this, possibly magneto spark at low speeds is defective in retarded position. To check this disconnect controls and try result of advancing timing ; if this improves slow running adjust interconnected controls so that magneto control travel is reduced, giving more advance at small throttle openings, but make sure that the advanced timing is retained correct, as called for previously. As full advance will be obtained at approximately 75% throttle, see that there is sufficient overrun to prevent controls being strained in the full throttle position.

LIFTING CYLINDERS FOR DECARBONISING.

This should be done after 100 to 150 hours' running, according to the conditions under which the engine has been operating. It should be noted that the aluminium head should never be removed from the steel barrel, the nuts being intentionally rivetted over to make the assembly a fixture.

To lift a cylinder proceed as follows, using the special tools provided with the engine.

Remove one nut securing the rocker box cover and two bolts $\frac{5}{16}$" dia. securing the rocker box to the cylinder head.

Detach induction pipe ring flange secured to the induction elbow by two $\frac{5}{16}$" nuts. Remove control tube steady bracket from port cylinder. Finally remove four nuts securing cylinder base flange to crankcase, and carefully work cylinder off, taking usual precautions to prevent damage to connecting rod and piston.

Attention should be paid to the unorthodox method of fitting the scraper ring, namely with the bearing land to the top of the piston, and this method should be adhered to when assembling the engine.

The rocker mechanism will be left in position and need not be removed. Note the dermatine oil retaining ring on cylinder spigot and see that it does not fall into the crankcase. Valves may be removed and reground in with the special tools provided and cylinder and piston should be carefully cleaned from carbon. Special care should be taken with the piston and rings ; if the gap when in position in the cylinder exceeds .020" or blowing has been taking place, new rings, obtained from the Bristol Aeroplane Co. should be fitted. The gudgeon pin floats in both piston and rod, phosphor bronze buttons being fitted to ends to prevent scoring of cylinder walls.

When re-assembling proceed in reverse order to above, fit new dermatine ring if necessary, and take care that it is properly housed and not jammed between the surfaced pulling up faces. Fit new or annealed tab washers to cylinder foot nuts and pull up tight, using only special " Bristol " deep jaw spanner. The valve clearance should be finally set to previous instructions.

FITS AND CLEARANCES.

Column 1 gives the fits and clearances at the first assembly, or when selecting spares for replacements.

Column 2 indicates the maximum wear permitted before replacement is necessary.

The Affix " S " indicates a positive clearance.

" " " T " " " negative " "

All dimensions are in INCHES.

Component.	Column 1.			Column 2.
	Min.	Max.	Desired.	
VALVES.				
Inlet and Exhaust Valves in Guide (Diam.)	.003 S	.0045 S	.003 S	.006 S
PISTON CLEARANCES, DIAMETRAL.				
Top Land and Cylinder ...	.030 S	.033 S	.030 S	—
2nd and 3rd Land and Cylinder	.020 S	.023 S	.020 S	—
Top of Skirt and Cylinders ...	.014 S	.017 S	.015 S	—
Bottom of Skirt and Cylinders	.010 S	.013 S	.010 S	—
PISTON RINGS.				
Gap between Butts	.006 S	.008 S	.006 S	.020 S
Clearance in Top Groove (width)	.0055 S	.007 S	.006 S	.012 S
Clearance in 2nd Groove (width)	.0045 S	.006 S	.005 S	.010 S
SCRAPER RING.				
Gap between Butts	.006 S	.008 S	.006 S	.020 S
Clearance in Groove (width) ...	.0035 S	.005 S	.004 S	.008 S
GUDGEON PIN.				
Fit in Piston Bosses (diam.) ...	Nil	.0005 S	Light push fit	.002 S
Fit in Conn. Rod (diam.) ...	.001 S	.002 S	.0015 S	.004 S
CONNECTING RODS.				
Small End Float between Piston Bosses	.105 S	.145 S	.125 S	—
Floating Bush in Conn. Rod Liner (dia.)	.001 S	.002 S	.0015 S	.004 S
Floating Bush on Crankpin (dia.)	.001 S	.002 S	.0015 S	.004 S
Floating Bush on Crankpin (Side Clearance)	.002 S	.002 S	.002 S	.004 S
Conn. Rod on Floating Bush (Side Clearance)	.001 S	.001 S	.001 S	.003 S
CRANKSHAFT.				
Rear W.M. Bearing on C/shaft (dia.)	.001 S	.00275 S	.0015 S	.005 S
Thrust " " (dia.)	.0006 T	.0005 S	.0005 T	—
Front Main " C/shaft (dia.)	.0006 T	.0005 S	.0005 T	—
Rear " " " (dia.)	.0007 T	.0004 S	.0006 T	—
CAM SHAFT.				
Camshaft and Front Bush (dia.)	.0007 S	.0017 S	.0007 S	.003 S
" " Rear Bushes ...	.0007 S	.0017 S	.0007 S	.003 S

Component.	Column 1.			Column 2
	Min.	Max.	Desired.	
ROCKER SHAFT.				
Cam Rocker and Bush (dia.) ...	.001 S	.002 S	.0015 S	.004 S
Cam Finger Bush and Finger (dia.)	.0005 S	.0015 S	.001 S	.003 S
Cam Finger Pin in Rocker Bracket (dia.)	Nil	.001 S	.0005 S	.004 S
MAGNETO.				
Mag. Drive Spindle and Bush (dia.)	.001 S	.0022 S	.001 S	.005 S
INTERMEDIATE GEAR.				
Intermediate Gear and Bush (dia.)	.0005 S	.0015 S	.001 S	.003 S

TOOL KIT.

The Bristol Aeroplane Co., Ltd., can supply with each engine a standard kit of tools for use as indicated and only these special tools must be used when making adjustments to the engine. As the engine has been specially designed for lightness it is liable to be damaged by the use of unsuitable tools.

F.B. 2420	Open Jaw Spanner 2BA and 4BA.
F.B. 2977	,, ,, $\frac{1}{4}$" and $\frac{5}{16}$" (BSF)
F.B. 2054	,, ,, $\frac{3}{8}$" and $\frac{7}{16}$" (BSF)
F.B. 6902	,, ,, $\frac{9}{16}$" and $\frac{3}{4}$" (BSF)
F.B. 2055	Box Spanner 2BA and $\frac{1}{4}$" (BSF)
F.B. 2057	,, $\frac{5}{16}$" and $\frac{3}{8}$" (BSF)
F.B. 2319	Tommy Bar $\frac{1}{4}$" × 6"
F.B. 2320	,, $\frac{5}{16}$" × 8"
F.B. 6752	Box Spanner crankshaft front nut.
F.B. 8252	,, ,, rear ,,
F.B. 1435	Tommy Bar.
F.B. 5428	Cylinder Nut Spanner.
F.B. 5422	Oil Filter Cover Spanner.
F.B. 2049	Spark Plug Spanner.
F.B. 8442	Valve Spring Lifter.
F.B. 8443	Valve Spring Lifter Bridge.
F.B. 9402 F.B. 9403 F.B. 6836	Balance Weight and Bearing Puller.
F.B. 6800 F.B. 6803 F.B. 6802 F.B. 6801	Camshaft Timing Wheel Removing Tool.
F.B. 6821 F.B. 6822 F.B. 6823 F.B. 6824 F.B. 6825 F.B. 6826	Front Cover and Crankcase Removing Tool.
F.B. 9399 F.B. 9014	Valve Grinding Tool.
F.B. 9423	Magneto Points Spanner.
F.B. 9424	Carburettor Spanner.
F.B. 9425	Carburettor Jet Spanner.
F.B. 8853	Valve Guide Extractor.
F.B. 8854 F.B. 9803 F.B. 9804	Impulse Starter Extractor.