AMAL

FUEL PUMP, Type 136/AD/2

made for

BLACKBURN AIRCRAFT LTD.

CIRRUS MAJOR 150.

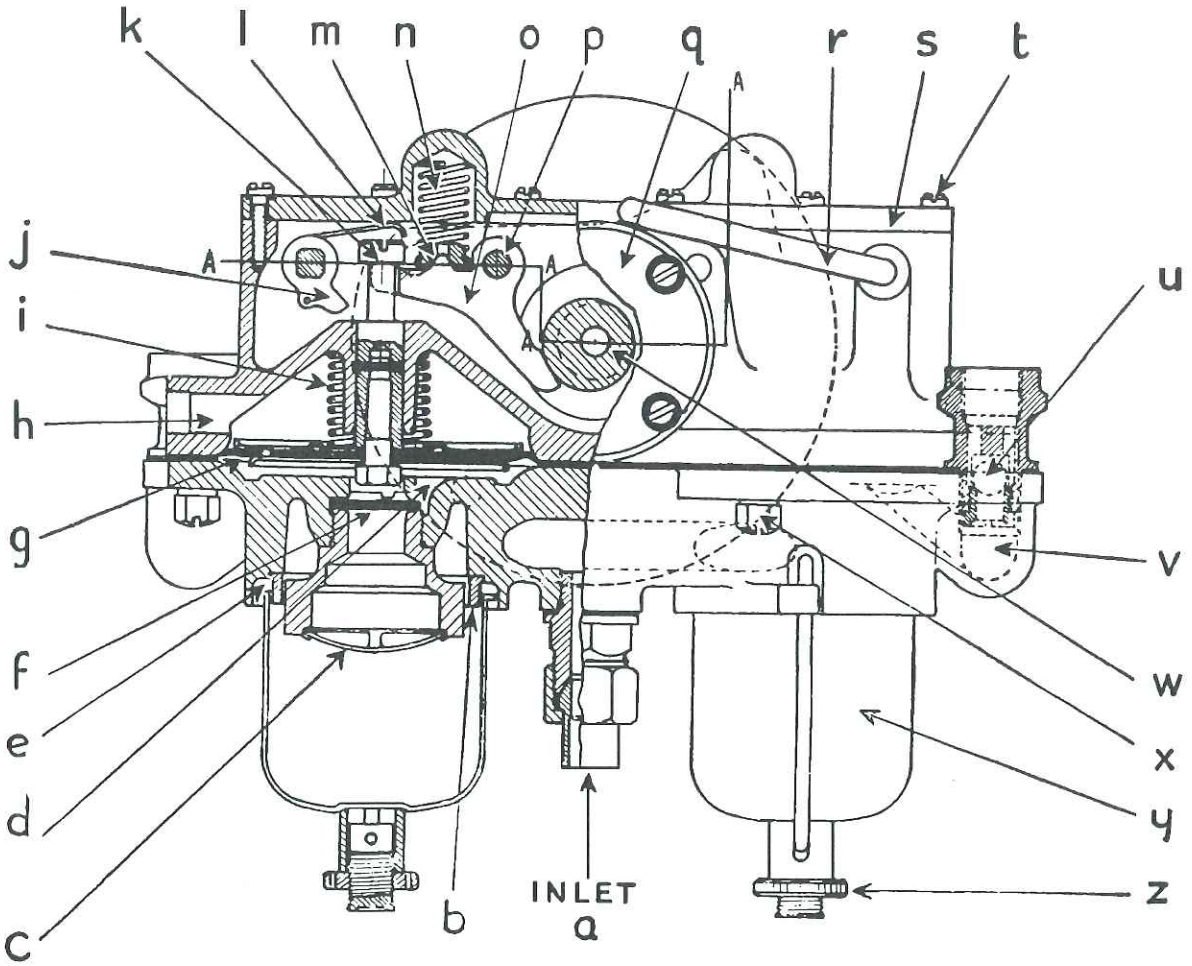
LIST OF PARTS.

The italic letters before the Part Nos. indicate where the part may be found on the diagram of page G2.

	Part No.	Description
	136/082	Body (Top Half).
	136/091	Body (Bottom Half).
s	136/092	Top Cover
t	136/005	,, ,, Screw.
t	136/006	,, ,, Spring Washer.
n	136/007-1	Lever Spring.
m	136/008	Spring Cup.
p	136/009	Fulcrum Pin.
o	136/010	Lever Rocker.
r	136/095	Priming Lever (Straight).
r	136/096	,, ,, (Cranked).
r	136/094	,, ,, Felt Washer.
j	136/012-3	,, ,, Cam.
j	136/097	,, ,, Bush.
l	136/014-1	,, ,, Spring.
l	136/015	,, ,, Cotter.
g	136/019.	Diaphragm (per set of 4)
i	136/017-2	,, Spring.
k	136/016	,, Spindle.
g	136/018-1	,, Top Washer.
g	136/020	,, Bottom Washer.
k	136/021-2	,, Bolt.
k	136/022-1	,, ,, Fibre Washer.
	136/023	,, Rivet.
f	136/024	Inlet Valve Disc.
c	136/025	Filter Body }
c	136/068	Gauze. }
c	136/027	Filter Ring. }
b	136/028	Filter Body Lock Ring.
e	136/029A	,, Cup Washer.
y	136/030A	,, Cup Sump.
	136/055.	Oil Jet.
z	136/031-2	Stirrup.
z	136/063-1	,, Eyebolt.

	Part No.	Description.
z	136/033-1	Stirrup Distance Piece.
z	AGS939/9	Wing Nut.
u	140/009	Delivery Valve Cage
u	136/037-1	Delivery Valve Cage Valve Seating
u	136/038	,, ,, ,, Valve Ball.
u	136/056	,, ,, ,, Lock Wire.
u	136/036	,, ,, ,, Washer.
u	136/050	,, ,, ,, Union Nut.
u	136/051-1	,, ,, ,, Union Nipple.
x	136/039-1	Body Fixing Screw.
x	136/040	,, ,, ,, Spring Washer.
w	136/059	Camshaft.
w	136/042	,, Bearing.
w	136/043	,, Lock Bolt.
w	136/044	,, Lock Washer.
q	136/093	,, Bearing End Plug.
q	136/046	,, ,, ,, ,, Screw.
q	136/047	,, ,, ,, Spring Washer.
u	136/036	Delivery Valve Connection Washer.
	136/049-1	Inlet Union Connection.
	136/071	Spindle Bush.
	120/090	Drain Connection.
	120/036	,, ,, Washer.
	120/033-1	,, ,, Union
	120/032	,, ,, ,, Nut.
	136/036	Inlet Union Connection Washer.

DIAGRAMMATIC SECTION OF AMAL "DUPLEX" FUEL PUMP.



The pump is a self-contained unit attached to the engine by a flange. The drive is imparted by a rotary motion in either direction at half engine speed in accordance with the design of the engine maker. The pump as a unit has two sets of diaphragm pumps each independently operated, and although there is a common fuel feed inlet (*a*), each pump has its own filter, inlet valve and non-return outlet valve—the last named being coupled together externally to carry the fuel to the carburetter.

The working parts are reduced to a minimum. The cams operate the rocker arms, which lift the diaphragm spindles on the suction stroke and return springs impel the diaphragms down on the delivery stroke according to the delivery required.

Two sets of non-return valves are employed : each comprises a light non-metallic disc on the suction side over the filter and a ball valve on the delivery side, no springs being utilised in either valve, yet each valve functions perfectly.

The diaphragm of each pump is fourfold, made of a flexible impregnated fabric, supported on each side by light plates. The design is such as to minimise the movement on the diaphragm, and every delivery impulse is imparted

through a spring which is energised by the suction stroke. No weight of petrol is carried on the diaphragm. Long life of the diaphragm is thus assured, also because when the pump is running normally there is an incredibly small movement of the diaphragm.

In the unlikely event of the diaphragms puncturing, petrol cannot leak into the engine. Any petrol getting through would get into the air chamber above the diaphragm, and would be led safely away through an emergency pipe connection (*h*).

PRIMING.

The pump can be primed by the external hand levers when the fuel system is empty, without turning the engine. The priming device can be operated at any time, irrespective of the position in which the engine is stopped.

FILTERING.

Each pump is protected by a filter placed well above the bottom of each cup-shaped sump. Each sump can be removed quickly by loosening the nut under the stirrup.

LUBRICATION.

This may be effected by oily vapour from the engine penetrating into the pump rocker box through the cam spindle bearing, or alternatively, in some cases provision is made for a positive feed of oil to the rocker box with return to the engine through the cam spindle bearing. In all cases this important matter must be dealt with in conjunction with the engine designer.

OPERATION OF PUMP.

The shaft (*w*) carries an eccentric cam. This operates rocker arms (*o*) pivoted on the fulcrum pins (*p*). When the shaft (*w*) revolves the rocker arms (*o*) lift the spindles (*k*), to which are fixed the diaphragms (*g*), which are interposed between two light metal discs, so inducing petrol to flow from the tank up the pipe (*a*) into the filter sumps (*y*), through the filters (*c*), and the suction disc valves (*f*) into the pump chambers (*d*).

The shaft (*w*) continues to revolve, and the diaphragms (*g*) commence their downward stroke solely under the influence of the springs (*i*).

The suction valves (*f*) close, and the fuel is forced along the passages (*v*), past the delivery valves (*u*) and up the pipe to the carburetter.

When the carburetter float chamber is filled, the float will shut off the needle valve and the flow from the pump will cease with the spindle and diaphragm in a raised position, thus compressing the spring (*i*) which gives a predetermined pressure that cannot be exceeded under any circumstances of the pump's operation.

The rocker levers (*o*), under these conditions, can no longer give the spindles (*k*) any movement, due to the fact that they are raised beyond the point where the levers (*o*) engage the spindles. The levers (*o*) of the pump

supplying the carburetter then simply move backwards and forwards idly, and the pump can no longer deliver any fuel until such time as the needle valve opens in the carburetter float chamber to admit a further supply, but when this occurs the pressure in the pump chamber (*d*) then falls, and allows the spindles (*k*) to drop, and once more come in contact with the levers (*o*).

The springs (*n*) are for the purpose of maintaining the rocker arms (*o*) in contact with the eccentric (*w*) to prevent noise, and have no action on the fuel pump itself.

The priming levers are operated by hand, bringing the toes of the priming levers (*j*) in contact with the spindles (*k*) so working the diaphragms with a longer movement than given by the cam ; about a dozen slow strokes are all that should be necessary for petrol to reach the float chamber of the carburetter. When this occurs, and the float chamber is full, the resistance to movement of the priming lever (*r*) will gradually diminish, until it is felt that it ceases to act. This means that the float chamber is full, and the diaphragm is raised under the pressure so produced in the pump chamber (*d*) and no further actuation of the priming lever is necessary.

The priming levers (*r*) are held back, when not in use, by the return springs (*l*).

The inspection cover (*s*) can be removed for examination of the rockers and movements of the spindles.

HINTS ON DISMANTLING AND RE-ASSEMBLING "DUPLEX" MODEL.

1. INSPECTION OF FILTERS (*c*) OR SUCTION VALVES (*f*).

Unscrew the knurled nut (*z*) and swing the stirrup to one side. The filter cup or sump will then come away exposing the filter, which can then be screwed out, bringing with it the suction valve disc (*f*). The only thing to be looked for here, is an accumulation of dirt, there being no springs of any sort in this valve.

When replacing these parts, not forgetting the valve disc (*f*), see that the cork washer (*e*) is in good order. The screwing in of the filter will cause the locking ring (*b*) to rotate as the external keys of the filter slide into the grooves in the lock ring. The lock ring is held securely under the washer when the filter cup is tightened up petrol-tight by nut (*z*).

2. INSPECTION OF DELIVERY VALVES (*u*).

The delivery pipe should be removed and the connection screwed out from the body. Nothing need be looked for here in these valves, but an accumulation of impurities can be washed out. These parts cannot be taken to pieces owing to a locking pin.

3. INSPECTION OF THE ROCKER GEAR, TO SEE MOVEMENT OF THE DIAPHRAGM SPINDLES, ETC.

Remove the screws (*t*), and the top cover plate (*s*) can be lifted off, exposing the priming lever arms (*j*), the camshaft (*w*), and the rockers (*o*). When replacing the cover (*s*) see that two springs (*n*) and their cups (*m*) are on the locating points of the rockers and that the levers (*j*) and springs (*l*), with their ends pointing up, are in place, then, as the cover is being pressed down against springs (*n*), insert a blade at each end of the cover to press the spring ends (*l*) horizontal to allow the cover to be screwed down.

4. GENERAL DISMOUNTING TO EXAMINE THE DIAPHRAGMS (*g*).

Proceed as in paragraphs 3, 1 and 2, then remove the screws (*x*), which hold bottom half of the casting to the rocker case, and also remove cover plate (*q*). The fulcrum pins (*p*) may then be punched out with an "L" shaped punch made to fit in between the attachment flange and the rocker casing. The rockers can then be removed. The diaphragms complete, with spindles and spring, will then drop out.

To renew the diaphragms, it is necessary to replace by a new unit of spindle and diaphragms, as in the assembled construction a lock pin goes through the spindle to secure the screw that clamps all parts together.

To re-assemble each diaphragm unit, place the spring (*i*) over the spindle, making sure it is concentric in the diaphragm top disc, and insert into the rocker casing and past the priming lever cam (*j*) by pressing the lever (*r*) inwards into a horizontal position. The rocker levers (*o*) are interchangeable, but each should be on its own pin and side ; they can now be inserted into place and the round end of the pin (*p*) can be pushed through into place.

Next turn the diaphragms so that the holes in the edges coincide with the screw holes in the body. Put two screws (*x*) into place at each end of the lower half of the casing and carefully bring the two halves of the castings together, threading the screws through the diaphragm holes and screw up loosely. Insert the remainder of the screws (*x*), not damaging the screw holes in the diaphragms, and screw up finger-tight. Next lift the diaphragms by pressing levers (*r*) outwards to the fullest extent and tighten up all screws (*x*) tight. Then refit bearing end plug (*q*).

5. Re-assemble as in paragraphs 1, 2 and, finally, 3, after inspecting the rocker movement to see that the diaphragm spindles work correctly.

6. If it is necessary to remove the pump camshaft (*w*), dismount the pump from the engine and remove the cover-plate (*q*), knock down, with a chisel, the lock washer lip and unscrew the hexagon-headed pin. The camshaft can then be knocked out through the attachment flange, carrying with it the

inside bearing, but under normal circumstances the camshaft should never be removed.

OBSERVE CLEANLINESS ALL THE TIME.

POSSIBLE REASONS FOR FAILURE.

This Duplex Pump has two independent pumps which are operated independently by rockers from a central cam. There might be a fault in one pump but not in the other.

The pump can only fail for two major reasons :—

Firstly failure of movement of the diaphragm.

(*a*) Due to the spindles (*k*) not working freely up and down, which fact can be checked by moving the top cover (*s*) and turning the engine over. The float chamber must be empty and the feed pipe (*a*) disconnected at the time.

(*b*) Or by the diaphragms having become loose on the spindle, or by actual mechanical breakage, which is very unlikely.

(*c*) The failure by rupture of the diaphragms is an unheard-of defect, and in the unlikely event of a puncture the pump would continue to work in a certain degree, but the leak of petrol could be seen dripping from the pipe or pipes coupled to connection (*h*).

Secondly due to external air leaks, which should be examined in the following order :—

(1). The connection between the filter cups (*y*) and the bottom half of the pump body and the cork washers (*e*). See that the nuts (*z*) are screwed up tightly and secured by copper wire, also that the jointing washers (*e*) are in good condition.

(2). Check over for air leaks in the fuel inlet connection (*a*) and the piping between the fuel tank and the pump, making certain that all the joints and unions are tight, and that there are no air leaks or leaks in the piping itself. The same remarks apply to the outlet connections at (*v*).

(3). Make sure there are no air leaks at the diaphragm joint between the two halves of the pump. The screws (*x*) must be screwed up tightly.

(4). Ascertain that there are no impurities lodged on the inlet valves (*f*) nor on the ball valve seatings (*u*), which would cause either of these valves to have an imperfect seating.