TWEAKING THE TILLOTSON

Outside their native U.S.A., the Tillotson diaphragm type carburettors tend to be a speciality of the British karter with the HL227A version being used on 100 c.c. motors in single unit form whilst twin set-ups of the same pattern are widely used in the 250 c.c. class. The HR18A is a big bore unit most frequently seen in single unit form in the Villiers Class whilst the HL250A is suitable for 100 c.c. motors being specified on the British ZED. This interest by British karters in diaphragm carbs has its origins in familiarity with the McCulloch diaphragm carburettors fitted to that range of engines before they were over-run by other makes. Terry Fullerton's World Championship win using a Tillotson has awakened fresh interest throughout the world in the potential of this unit and Borg Warner, who now manufacture it, have received a surprising number of enquiries in recent months.

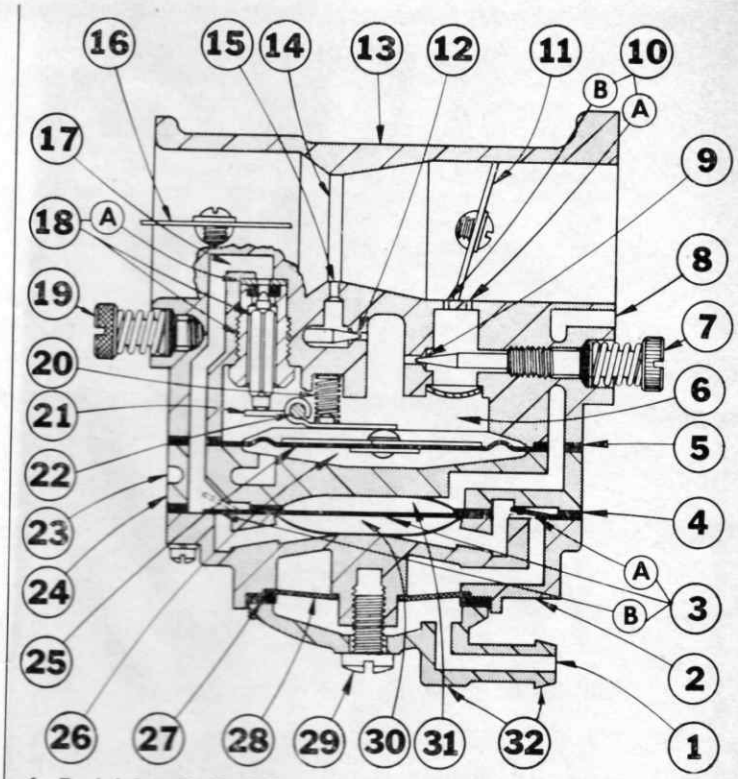
Currently Tal-Ko offer a standard HL227A at £10 or in bored and modified form at £16. The HR18A is £13.50 with a service kit for the first mentioned (RK45HL) is £2.72 whilst that for the big unit (RK1HR) is £3.75. A service for either carburettors is £1.50, any parts required naturally being extra. All these prices are exclusive of V.A.T.

When a HL227A is enlarged by Tal-Ko the inlet bore is increased to 29 m.m. and the venturi to 25 m.m. The former is concentric with the axis of the carburettor but the venturi must be bored off centre so that it is away from the check valve. Other modifications include removing and plugging the internal vent tube and providing alternative vent arrangements. Having discussed the types currently on the British market, let's go through the operating principles using the HL series as an example (the HR is very similar).

Construction data

The "HL" series carburettor is a lightweight, aluminium die cast unit composed of four basic parts: metering body, main diaphragm cover plate, fuel pump body and stainer cover. The diaphragm carburettor incorporates many of the same type components found in float type carburettors: choke, throttle, idle and main mixture adjustment screws, idle speed screw and inlet needle and seat.

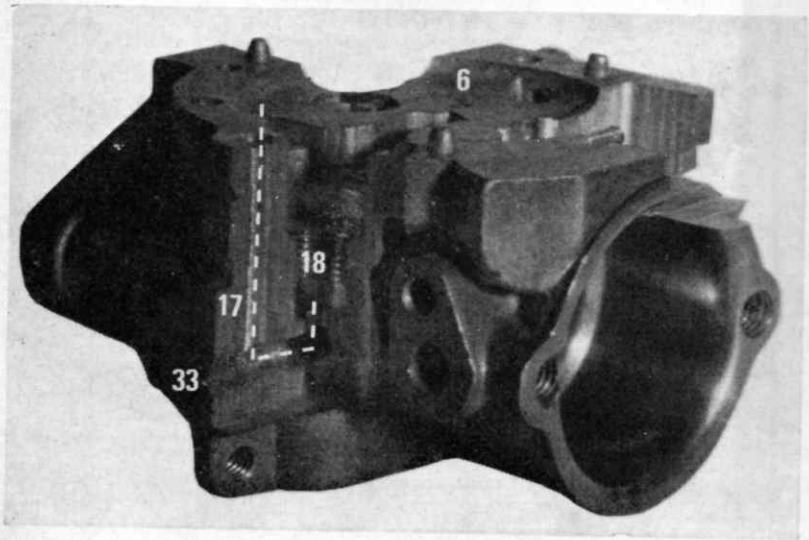
Two styles of main and idle adjustment screws are available: "O" ring type and spring loaded packing type. Both types are designed to perform the dual purpose of sealing the metering chamber and providing adjustment screw friction.



1. Fuel Inlet; 2. Fuel Pump Body; 3. Fuel Pump Diaphragm; 3a. Diaphragm Pump Inlet Valve; 3b. Diaphragm Pump Outlet Valve; 4. Fuel Pump Gasket; 5. Diaphragm Cover Gasket; 6. Metering Chamber; 7. Idle Adjustment Screw; 8. Impulse Channel; 9. Idle Fuel Adjustment Orifice; 10a. Primary Idle Discharge Port; 10b. Secondary Idle Discharge Port, (there is a third Idle Port on HL227A); 11. Throttle Shutter and Shaft; 12. Main Fuel Adjustment Orifice; 13. Body; 14. Venturi; 15. Main Fuel Discharge Port, (this has a brass body containing a nylon ball on the HL227A); 16. Choke Shutter, (absent on HL227A); 17. Fuel Inlet Supply Channel; 18. Inlet Needle and Seat; 18a. Copper Gasket; 19. Main Adjustment Screw, (Tommy bar end on the HL227A); 20. Inlet Tension Spring; 21. Inlet Control Lever, (equipped with a fork-end on the HL227A); 22. Fulcrum Pin; 23. Atmospheric Vent Hole on HL250A but brass tube vent into carburettor bore on unmodified HL227A's; 24. Diaphragm Cover; 25. Diaphragm; 26. Atmospheric Chamber; 27. Strainer Gasket; 28. Fuel Inlet Screen; 29. Strainer Cover Retaining Screw; 30. Fuel Chamber; 31. Pulse Chamber; 32. Strainer Cover; 33. Lead plug, (not shown).

A special insert, housed in a brass cage, forms a seat for the inlet needle. An inlet tension spring exerts a pre-determined force on the inlet control lever which holds the needle on its seat.

A metering diaphragm is subjected to engine suction on the metering chamber side and atmospheric pressure on the vented



Fuel passes down the "fuel inlet supply channel" (17), along and then back up to the "inlet needle and seat" which normally occupies the space at 18. No matter how carefully glass-fibre tanks are made, loose filaments of glass can find their way through filters to block 17 and 18. If the alloy needle valve at 18 wears at the tip then the effect may be for the fuel to drop back down the petrol pipe when the kart is still. Castrol R can stick the valve 18 to its seat unless the carburettor is flushed clear. Watch for a weeping plug at 33. Note: this carburettor is inverted compared with the sectional drawing.

side. Atmospheric pressure on the vented side pushes the diaphragm toward the inlet control lever, opening the inlet needle to allow fuel to enter the metering chamber, from which it is then delivered into the mixing passages.

The vented side of the metering diaphragm may be vented either directly to the atmosphere, or in the case of a balanced carburettor, may be balanced (internally vented) to the choke bore. The balanced type can be recognised by a brass tube in the choke bore which is connected internally to the vented side of the diaphragm. The purpose of internal balance is to offset the enriching or choking effect of a partially dirty air cleaner.

Some carburettor metering systems include a ball check type main nozzle. These can be identified by the brass cage located in the venturi choke band of the body casting. The ball check valve allows fuel to flow into the mixing passage and prevents air from flowing into the metering chamber.

The movement of the pump diaphragm draws fuel into the fuel chamber and a reverse movement of the diaphragm forces fuel out of the fuel chamber through the inlet needle and seat into the metering chamber. Movement is caused by pulsations from the engine, acting on the diaphragm.

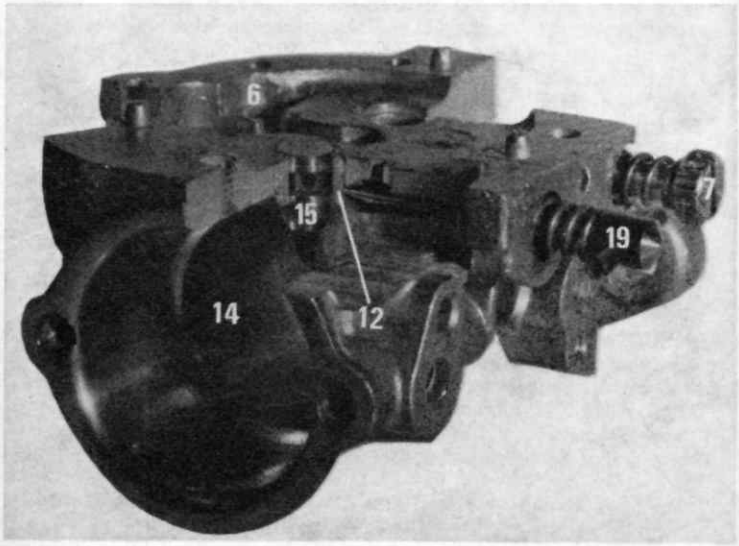
A plastic turret type inlet connection is the cover to the fuel strainer section of the carburettor and can be rotated 360 degrees for any required fuel connection location. The strainer consists of a fine mesh screen to insure clean fuel supply to the metering section of the carburettor.

HOW IT WORKS 1. Starting

As the engine is rotated with the bore blocked with hand, engine suction will be transmitted to the diaphragm fuel chamber through both primary and secondary idle discharge ports as well as the main fuel discharge port, creating a low pressure area on the fuel side of the main diaphragm. Atmospheric air pressure on the opposite side will force the main diaphragm upward causing the diaphragm button to depress the inlet control lever, overcoming inlet tension spring pressure, permitting fuel to enter through the inlet seat, by forcing the inlet needle off its seat contact, then into the fuel chamber side of main diaphragm, up through the idle and main fuel supply orifices and channels, and out the discharge ports to the engine.

2. Idling

When engine is idling, throttle shutter is in a partially open position. Engine suction is transmitted through the primary idle fuel discharge port to the fuel chamber side of main diaphragm via the idle fuel supply channel. Again, the main diaphragm is forced upward by atmospheric pressure, depressing the inlet control lever over-coming inlet tension spring pressure and permitting fuel to enter through inlet seat, by forcing inlet needle off its seat contact, and filling the fuel chamber side of main diaphragm. The fuel is then drawn up through idle fuel adjustment orifice and delivered to the engine through primary idle discharge port.



This "bored-out" carburettor shows why the enlarged venturi cannot be concentric to the enlarged inlet because of the necessity to leave sufficient material to retain the main jet nozzle (15). Inside is a nylon ball which acts as a one-way valve so that fuel can pass into the carburettor bore but air cannot get back to the metering chamber. Watch out for glass fibre blocking 15. Always treat the adjustment screws (7 and 19) gently — if forced, the seat (e.g. 12) or the needle tip, may be damaged. Note: this carburettor is inverted compared with the sectional drawing.

3. Intermediate

Fuel is delivered into and through the carburettor in the same manner as when the engine is idling. However, as the throttle opens and engine speed increases, more fuel is demanded from the carburettor and supplied to the engine by valving in the secondary idle discharge port located immediately behind the throttle shutter.

As the throttle shutter continues to open and engine speed increases, the velocity of air through the venturi creates a low pressure area at the venturi throat and diminishes the suction on engine side of the throttle shutter. When the pressure at the venturi throat is less than that existing within main diaphragm fuel chamber, fuel is drawn up through main fuel adjustment orifice and out main fuel discharge port into the air stream entering engine intake.

4. High Speed

As the throttle shutter progressively opens from intermediate position to full open position, the air velocity through the venturi increases and fuel is metered up through main fuel adjustment orifice and main fuel discharge port in accordance with the power requirements of the engine. The action of the main diaphragm is the same as previously described with suction required to operate the diaphragm being transmitted through the main fuel discharge port.

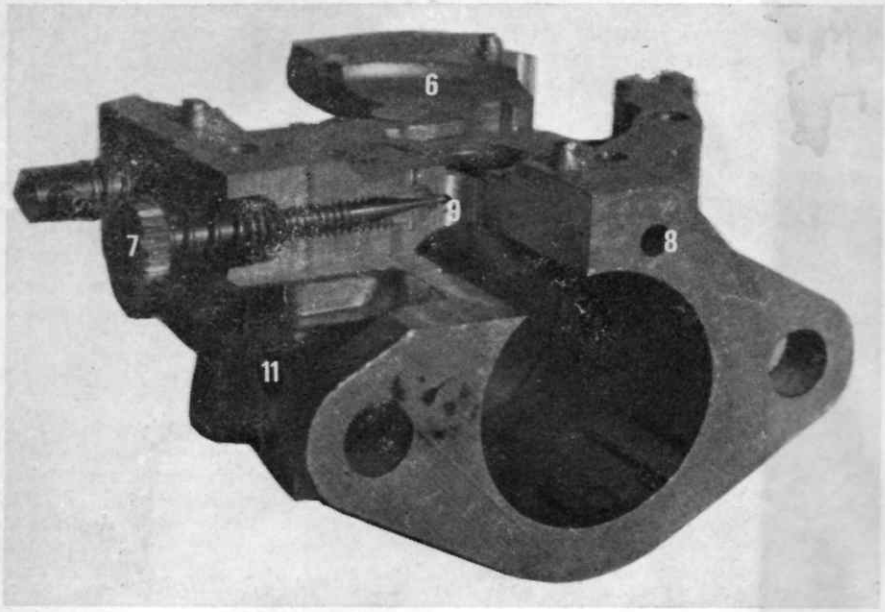
How to disassemble

Before disassembling it is IMPERATIVE to clean it of dirt.

1. Remove strainer cover retaining screw and plastic cover.
2. Remove strainer cover gasket and strainer screen.
3. Remove screws and fuel pump body.
4. Remove fuel pump diaphragm and gasket.
5. Remove main diaphragm cover plate.
6. Remove main diaphragm.
7. Remove main diaphragm gasket.
8. Remove inlet control lever fulcrum pin, lever and tension spring.
9. Remove inlet needle.
10. With a thin wall 5/16 in. Hex socket carefully remove the inlet seat. Remove inlet seat gasket. When reinstalling seat, tighten only from 25-35 inch-pounds or 34 Kg-Cm.
11. Remove idle and main adjustment screws.
12. When reinstalling "O" ring type adjusting screws, lubricate with 30 SAE oil to prevent seizing. Packing spring type adjustments do not require lubrication.
13. The ball check type main nozzle can be removed by tapping it out of the body casting into the venturi with a small punch. A replacement ball check nozzle should be pressed into the casting with the cross holes in line with the main adjustment needle. The brass cage should be pressed flush with the metering chamber casting.

Before reassembling the carburettor (in reverse order as outlined above), wash ALL components in clean petrol and blow off with compressed air. The channels in the metering body should be cleaned by blowing through the idle and main adjusting orifices.

All fuel passages in the three castings should be cleaned with compressed air. Do not clean orifices or passages with wires or drills as this might cause damage and incorrect operation of the carburettor.

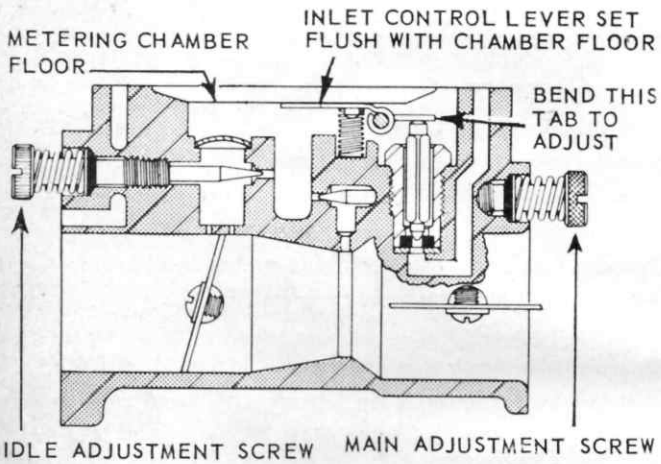


Tal-Ko sell a gasket for 5p with only one pulse hole to align with 8. This improves the seal on the opposite side, particularly if the flange has been worn away by the chain. Beware damage to needle tip and seat at 9 from overtightening. A good throttle pedal stop is necessary as strain will wear shaft and body (11). It is becoming difficult to get shafts rebushed and the carburettor may have to be thrown away. Diaphragms can fail without there being visible holes and cracks. Note: this carburettor is inverted compared to the sectional drawing.

Service hints

When reassembling the inlet control lever and spring, care should be taken to see that the spring rests in the well of the metering body and locates on the dimple of the inlet control lever (as illustrated below).

CAUTION: Do not stretch spring. Inlet control lever is properly set when flush with floor of diaphragm chamber.



Be certain main diaphragm, gasket and cover casting are carefully fitted over the three small pins cast in rim at bottom of metering body; also the fuel pump gasket, diaphragm and fuel pump body, over similar pins at bottom rim of main diaphragm cover casting. Evenly tighten fuel pump body retaining screws to insure complete seal of casting separations at both diaphragms.

Frequent cleaning or replacement of the fuel strainer will aid satisfactory operation of the carburettor.

CAUTION: Under extreme conditions of clogged idle fuel supply channel and discharge ports, it may be necessary to remove the channel welch plug. If so, it must be very carefully done in following manner:

1. Drill a $\frac{1}{8}$ in. diameter hole through the $\frac{3}{8}$ in. diameter welch plug. This hole should just break through the welch plug. Deeper drilling will seriously damage the body casting and its discharge ports located close behind the welch plug. On some models an additional smaller $\frac{1}{4}$ in. diameter channel welch plug is used. It is not necessary to remove this plug.
2. Carefully pry out welch plug, then clean discharge ports and cross channels. Now install new part 02531 ($\frac{3}{8}$ in. diameter, 1/32 in. thick) welch plug by placing it in casting shoulder, convexed side upward; then flatten to a tight fit with a 5/16 in. diameter flat end tool.

Trouble Shooting

CARBURETTOR FLOODS
Dirt or foreign particles preventing inlet needle from seating — Clean or replace the inlet needle and seat.
Stuck inlet lever — Replace or clean.
Spring not seated on lever dimple — Correct the assembly.
Diaphragm improperly installed — Correct or replace.
Fuel tank pressure build-up — Check tank vent.
Inlet lever adjusted too high — Adjust flush with chamber floor.

ENGINE WILL NOT ACCELERATE
Idle mixture too lean — Readjust.
Low inlet lever setting — Adjust flush with chamber floor.
Carburettor loose on manifold — Tighten.
Diaphragm cover plate loose — Tighten cover plate screws.
Diaphragm gasket leaking — Replace gasket.
Fuel channels plugged — Clean carburettor.
No fuel — Fill fuel tank.

ENGINE WILL NOT IDLE
Incorrect adjustment — Readjust.
Fuel channels plugged — Clean carburettor.
Inlet lever set incorrectly — Set flush with chamber floor.
Sticking inlet needle or lever — Replace or clean.
Pump pulse hole not aligned with flange hole — Align.
Throttle shutter cocked in throttle bore, causing fast idle — Adjust shutter position.
Faulty nozzle check cage — Replace nozzle assembly.
Welch plug does not seal — Replace welch plug.
Diaphragm vent plugged — Clean.
Tank vent not operating — Repair.

ENGINE RUNS OUT LEAN
Fuel pipe plugged — Clean fuel pipe.
Leak in fuel system from tank to pump — Replace pipe.
Pump pulse hole plugged or not aligned with engine pulse hole — Clean or correct alignment.
Pump valve flippers damaged or bent off ports — Replace pump diaphragm.
Dirty inlet screen — Clean filters.
Clogged fuel channels — Clean carburettor.
Incorrect inlet lever adjustment — Set lever flush with chamber floor.
Low fuel supply — Fill fuel tank.

CARBURETTOR RUNS RICH WITH MIXTURE SCREW SHUT OFF
Welch plugs not sealing — Replace welch plugs.
Ruptured pump diaphragm — Replace pump diaphragm.
Carburettor flooding — See above.
NOTE: Turn mixture screws carefully . . . **DO NOT FORCE MIXTURE SCREWS INTO SEATS.**