Chapter I

THROTTLE VALVES, TYPE T.V.A. AND T.V.B.

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

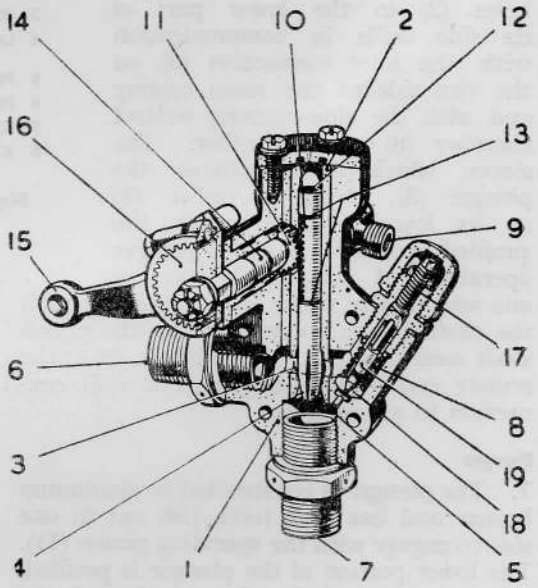
1. The throttle valves described in this chapter are the basic types T.V.A. and T.V.B. Two suffix numbers and a letter are added to each type designation to indicate respectively the series, installation code, and calibration code, thus identifying the variations of basic types as fitted to different engine installations. The TVA3 (*fig.* 1) is used as a basis for description in this chapter, the main difference between this type and the TVA4 (*fig.* 2) is that the pinion and shaft of the latter are lubricated by a small tapping off the fuel inlet passage in the throttle valve. Differences between the TVB types are given at the end of this chapter (*fig.* 4 *and* 5 respectively).

2. The function of the throttle valve is to regulate the flow of fuel to the engine. It is a plunger type of valve and is operated by a rack and pinion mechanism which is connected to the throttle lever in the cockpit.

DESCRIPTION

General

3. Essentially the throttle valve consists of a profiled plunger operating in a sleeve in the main body casting, having inlet holes in communication with fuel at pump delivery pressure, and an annular orifice in the outlet line to the accumulator (where fitted) and burners. Rack teeth in the side of the plunger engage with a pinion carried on a shaft, and an operating lever on the end of the shaft is connected to the throttle control lever in the cockpit.

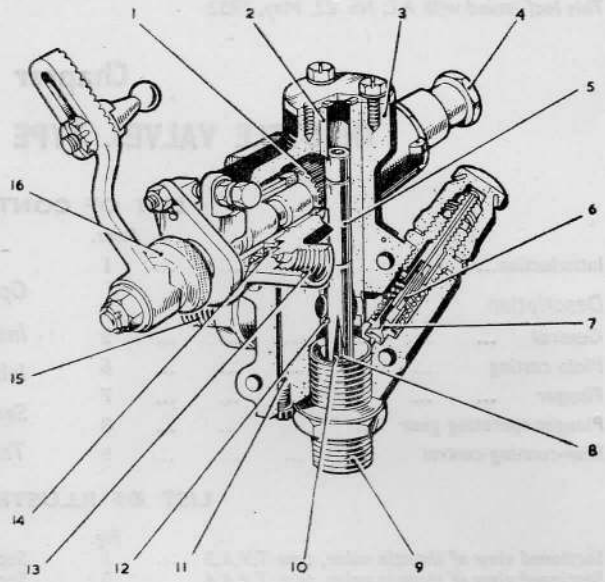


1 MAIN CASTING
2 SLEEVE
3 INLET HOLES
4 ANNULAR OUTLET ORIFICE
5 PLUNGER
6 FUEL INLET
7 FUEL OUTLET
8 SLOW-RUNNING CONTROL CHAMBER
9 SPILL CONNECTION TO ATMOSPHERE
10 RACK TEETH
11 PINION
12 PRESSURE BALANCING HOLE
13 PRESSURE BALANCING GROOVES
14 SHAFT
15 OPERATING LEVER
16 ECCENTRIC LEVER BOSS
17 SLOW-RUNNING ADJUSTING SCREW
18 ORIFICE BODY
19 PISTON

Fig. 1. Sectioned view of throttle valve, type T.V.A.3

4. A chamber, in communication with both inlet and outlet passages, houses a slow-running control assembly. This consists of a flexibly-mounted piston which slides in a slotted orifice plate, the degree of opening of the orifice slot being regulated by an adjustment screw to which the piston is flexibly attached.

5. A sectioned view of the throttle valve is shown in fig. 1 and should be referred to in conjunction with the description of the following sub-assemblies, into which the unit may be divided for the convenience of description.



1 PINION
2 SLEEVE
3 BODY CASTING
4 LOW PRESSURE CONNECTION
5 PLUNGER
6 PISTON ASSEMBLY
7 IDLING ORIFICE
8 AXIAL PASSAGE
9 FUEL OUTLET
10 SLOTS
11 DRILLING
12 ORIFICE
13 DRAIN
14 SEALS
15 FUEL INLET
16 ADJUSTMENT CLUTCH

Fig. 2. Sectioned view of throttle valve, Type T.V.A.4

Main casting

6. As shown in fig. 1, the main casting (1) has a cylindrical bore in which is fitted a steel sleeve (2). This sleeve has four radial holes (3) in the lower part of its side walls in communication with the inlet connection (6) on the one side of the main casting and with the slow-running control chamber (8) on the other. The sleeve, which accommodates the plunger (5), forms an orifice (4) at its lower end in which the profiled portion of the plunger operates. A cut-away portion in one wall of the sleeve is in alignment with the casting bore accommodating the pinion shaft assembly (11). An adapter (9) at the remote end of this bore forms a spill connection to atmosphere.

Plunger

7. The plunger is constructed in aluminium bronze and has rack teeth (10) cut in one side to engage with the operating pinion (11). The lower portion of the plunger is profiled, and movement of the plunger, through the operating lever (15) and the pinion (11), allows the area of the annular orifice to be varied in accordance with the setting of the throttle control lever in the cockpit. The plunger is balanced both axially and radially as follows:—

(1) Axially, by a hole (12) through its centre which ensures that the fuel both above and below the plunger is at fuel delivery pressure.

(2) Radially, by circumferential grooves (13) cut round the plunger.

Plunger operating gear

8. The plunger operating gear is illustrated in fig. 1. The operating pinion (11), which engages with the plunger rack (10), is an integral part of a steel shaft (14); a steel operating lever (15) is fitted to the opposite end of the shaft. This lever is splined to a steel eccentric (16), which locates with hexagon flats on the shaft, and is positively locked by means of a castellated nut and split pin. The splining permits of a wide setting range, while adjustment to the "throw" of the operating lever is provided by the eccentric.

Slow-running control

9. The slow-running control, illustrated in fig. 1, forms an adjustable by-pass between the fuel inlet (6) and outlet (7) connections. The steel orifice body (18) has a slot in its wall in communication with the fuel inlet hole, and an orifice in its base open to the fuel outlet connection. It is retained in position by means of a helical spring inter-

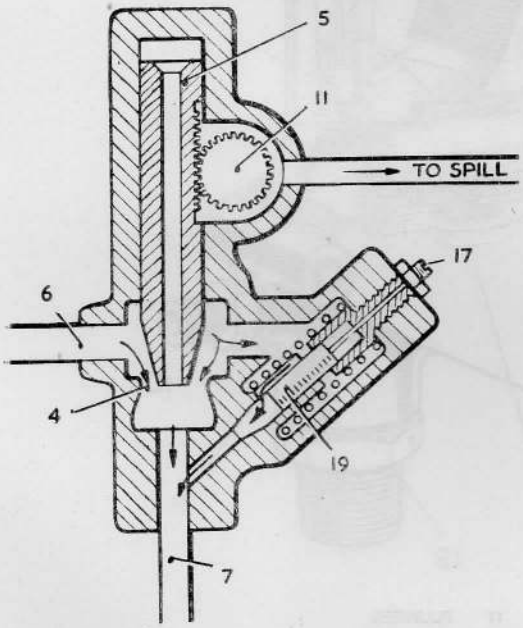
posed between the lower face of the adapter in which the adjustment screw is housed and the flange of the orifice body.

10. A steel piston (19) which is flexibly secured to an adjustment screw (17) slides in the bore of the orifice body. Adjustment of the screw will cause the piston to vary the area of the slot, thus allowing the flow of fuel through the slow-running control to be varied to suit the idling speed requirements of the engine.

OPERATION

11. The operation of the throttle valve may be followed by reference to fig. 3. When the engine is not running, the throttle valve lever is normally closed and the plunger (5) is at the bottom of its stroke; the annular orifice (4) is thus of minimum area.

12. When the engine is turned, fuel is delivered from the high-pressure fuel pump into the throttle valve inlet (6) and passes via the annular groove around the lower portion of the sleeve, the radial inlet holes and the annular orifice (4) to the fuel outlet (7); the fuel then passes to burners via the accumulator or high-pressure shut-off cock, according to the system employed.



4 ANNULAR OUTLET ORIFICE
5 PLUNGER
6 FUEL INLET
7 FUEL OUTLET
11 PINION
17 SLOW-RUNNING ADJUSTING SCREW
19 PISTON

Fig. 3. Schematic diagram of throttle valve, type T.V.A.3

13. When the plunger is at the bottom of its stroke (i.e., with the throttle control lever in the closed position), the area of the annular orifice together with the area of the slow-running by-pass allows sufficient fuel to pass to the burners for engine idling conditions.

14. To increase engine speed the throttle control lever is moved towards the open position thereby lifting the plunger, through the rack and pinion mechanism (11), to allow its profiled portion to uncover a greater area of the annular orifice and allow more fuel to pass to the burners.

15. When a decrease in engine speed is required the throttle valve lever is moved to the closed position to reverse the sequence of operations described above.

INSTALLATION

16. On the Derwent Mk. 5 engine the throttle valve is mounted on a bracket on top of the wheelcase on the starboard side and is secured with four 2 B.A. nuts and washers. In addition the following connections are made to the unit:—

(1) Large flexible pipe from the pump delivery connection to the throttle valve inlet connection.

(2) Large flexible pipe to the accumulator unit from the throttle valve outlet connection.

(3) Small flexible pipe, to the main atmospheric drain line, from the throttle valve spill connection.

(4) A ball-and-socket joint on the operating lever of the throttle valve connecting the adjustment rod to the chain driven sprocket operated by the pilot's controls in the cockpit.

For details of the installation of the throttle valve on other types of engine reference should be made to the relevant engine Air Publication.

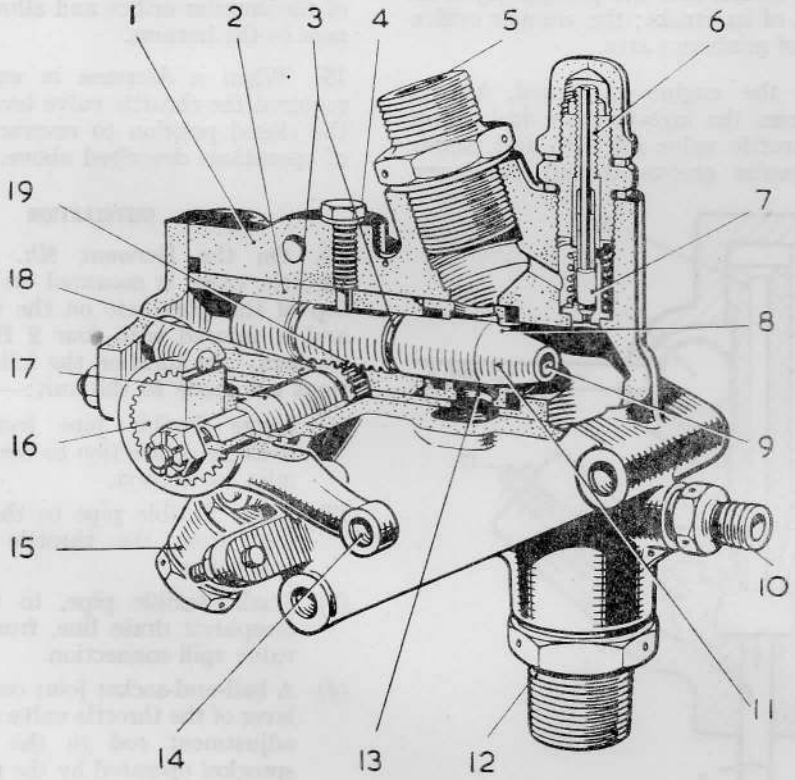
INHIBITING AND PACKING

17. The inhibiting and packing procedure is described in Vol. 2, Part 3, Section 6, Chapter 1, para. 65 and 68.

18. When the throttle valve is installed no servicing is necessary except for a constant check of all pipe connections and unions for tightness. No leakage from the valve is permissible, and if leakage is suspected joint washers must be inspected and replaced if necessary.

19. Before disconnecting pipes or connections always ensure that the low-pressure cock is closed. After completion of the work, re-open the cock and prime the fuel system, as air-locks or leaks will prevent the pump from delivering sufficient fuel. The method of priming the fuel system is fully described in the relevant engine Air Publication.

20. The TVB/1 and TVB/4 types of throttle valve are similar to the type TVA3 already described, though the body casting and general arrangement differ considerably. Basic differences from the TVA types may be seen in the cut-away sectioned view of the TVB1 type (*fig.* 4), and include a removable upper sleeve (2) and lower sleeve (13), the latter forming an orifice (8) for the main plunger. The upper sleeve is located by a setscrew (4) inserted in the main casting and projecting through the sleeve into a slot in the plunger thereby preventing it from rotating, also the top cover is secured with nuts and washers to studs in the main body casting communicating with the outlet



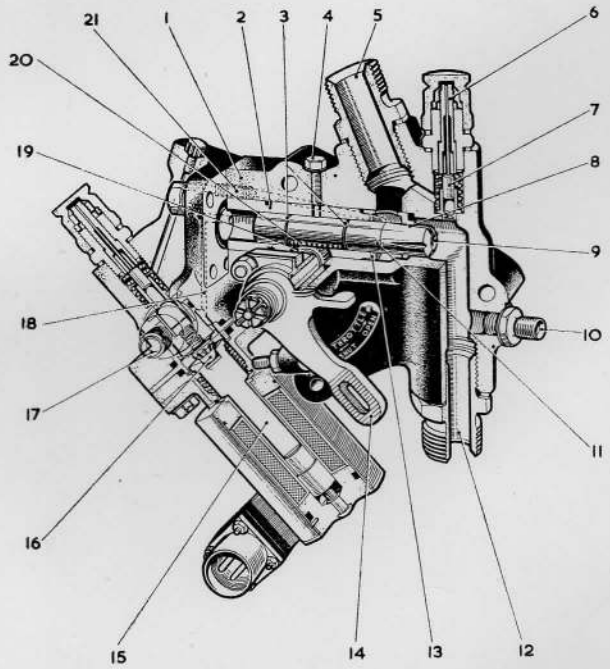
1 MAIN CASTING
2 SLEEVE
3 PRESSURE BALANCING GROOVES
4 SET-SCREW
5 FUEL INLET
6 SLOW-RUNNING ADJUSTING SCREW
7 PISTON
8 ORIFICE
9 PRESSURE BALANCING ORIFICE
10 PRESSURE GAUGE CONNECTION
11 PLUNGER
12 FUEL OUTLET
13 LOWER SLEEVE
14 OPERATING LEVER
15 SPILL CONNECTION TO PUMP SUCTION
16 ECCENTRIC LEVER BOSS
17 PINION SHAFT
18 PINION
19 RACK TEETH

Fig. 4. Sectioned view of throttle valve, type T.V.B.1

passage. In addition the spill connection (15) passes to the pump suction and not to atmosphere as in the TVA types. The TVB4 type (*fig.* 5), which is designed for use with engines equipped with turbo-starters, incorporates an additional by-pass similar to the existing slow-running control, but having a half-ball valve (16) operated through a solenoid (15). This solenoid is accommodated in a bracket casting (which replaces the cover plate) incorporating the re-positioned spill connection (17). This unit also has a re-designed operating lever (14) with an integral stop plate.

21. Under normal running conditions the solenoid valve is de-energised to seat the half-ball valve and close the passage (18), thus preventing any flow of fuel through the by-pass. During the starting period, however, the solenoid is energised by the operation of a remote switch to allow fuel from the fuel inlet (5) to be passed along the by-pass passage (21) in to the actual valve chamber, through the half-ball valve orifice. It is then passed through holes in the orifice housing and via the by-pass passage (18) and axial hole (9) in the plunger to the fuel outlet (12) to supplement the existing fuel supply and facilitate starting.

22. For installation particulars reference should be made to the relevant aero-engine Air Publication, but the Inhibiting, Packing and Servicing Instructions contained in this chapter apply to this unit also.



1 MAIN CASTING
2 UPPER SLEEVE
3 PRESSURE BALANCING GROOVES
4 SETSCREW
5 FUEL INLET
6 SLOW RUNNING ADJUSTMENT SCREW
7 PISTON
8 ORIFICE
9 AXIAL HOLE
10 PRESSURE GAUGE CONNECTION
11 PLUNGER
12 FUEL OUTLET
13 LOWER SLEEVE
14 OPERATING LEVER
15 SOLENOID
16 HALF-BALL VALVE
17 SPILL CONNECTION
18 BY-PASS PASSAGE
19 PINION
20 RACK TEETH

Fig. 5. Sectioned view of throttle valve, Type T.V.B.4

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