SPA
&
AFP/K

Fuel Injection Service Manual

AMERICAN BOSCH MARKETING DIVISION AMBAC INDUSTRIES INC. SPRINGFIELD, MASS. 01107

Supersedes Manual Pages D 3004/1 thru D 3004/1 e, Issued June, 1955

SERVICE INSTRUCTIONS
For
SPA (and AFP/K) PLUNGER TYPE
FUEL SUPPLY PUMPS

DESCRIPTION

The American Bosch SPA type fuel supply pump is a flange - mounted, variable - stroke, self - regulating, plunger type unit which builds up pressure to a predetermined value. The supply pump, which is cam driven (by one of the camshaft lobes in APE type pumps), draws fuel oil from the fuel tank through a primary filter and forces the fuel through the final stage filter to the injection pump. Supply pumps are available either with (Refer to Figure 1) or without (Refer to Figure 2) a hand primer assembly.

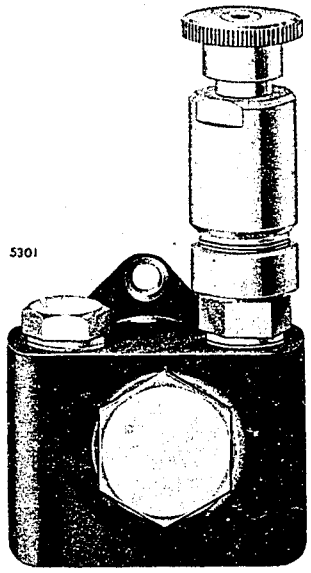

FIGURE 1 - SUPPLY PUMP WITH HAND PRIMER

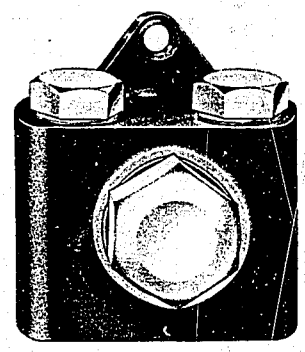

FIGURE 2 - SUPPLY PUMP WITHOUT HAND PRIMER

OPERATION

As the injection pump camshaft rotates from the top - of - stroke position toward base circle, the supply pump plunger is forced toward the camshaft by a spring. This plunger movement serves two purposes:

1. As the plunger moves inward (downward in Figure 3 A), the increasing volume above the plunger creates a suction which opens the inlet valve and closes the outlet valve. The suction effect causes fuel to flow from the tank and fill the chamber above the plunger.
2. At the same time, the plunger, through its inward movement, compresses the fuel trapped below it (the outlet valve being closed) and forces the fuel through the filter and to the injection pump.

As the injection pump cam rotates from base circle toward the top - of - stroke position, the supply pump plunger is forced away from the camshaft (Refer to Figure 3 B). This action creates pressure in front of the plunger which closes the inlet valve and opens the outlet valve. Further outward movement of the plunger forces the fuel trapped in front of it through the outlet valve. However, since the decreasing volume above the plunger equals the increasing volume below the plunger, no fuel is supplied to the injection pump; it only moves from the chamber above the

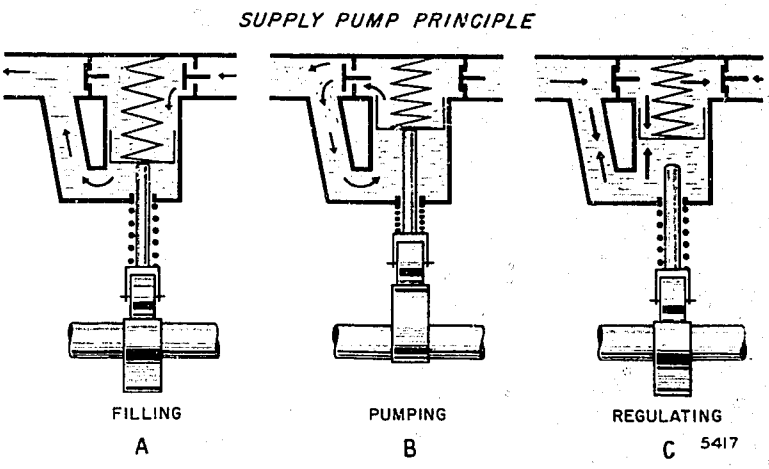

FIGURE 3 - SCHEMATIC DIAGRAM OF SUPPLY PUMP OPERATION

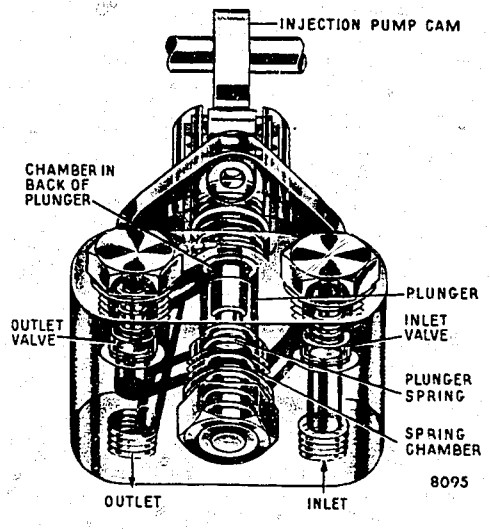

FIGURE 4 - PHANTOM VIEW OF SUPPLY PUMP

plunger to the chamber below the plunger. This completes one pumping cycle.

The above pumping cycle will continue as long as the injection pump uses enough fuel to prevent the fuel pressure from balancing the spring force on the plunger. When the fuel supply pressure balances the spring force on the plunger, the supply pump plunger remains stationary in the outward position (Refer to Figure 3 C) despite cam movement. This action prevents further pumping until the pressure drops enough to permit the plunger to resume operation. The pumping and self-regulating cycles are completely automatic and continue as long as the engine is running.

It is recommended that an overflow valve assembly, containing a spring-loaded valve, be used in the injection pump fuel outlet to provide a "thru-flow" system. Such a system allows trapped vapors and air within the fuel supply system to be carried away.

Some SPA fuel supply pumps are equipped with a manually-operated hand primer assembly which is installed directly over the supply pump inlet valve. The hand primer, which, in essence, is located between the inlet and outlet valves, provides positive priming action when required. Hand primer operation is as follows:

When the hand primer plunger is lifted, suction raises the supply pump inlet valve off its seat and fuel flows into the hand primer barrel. As the hand primer plunger is pressed down, the trapped fuel flows through the supply pump spring chamber, opens the outlet valve and is forced into the supply lines and injection pump.

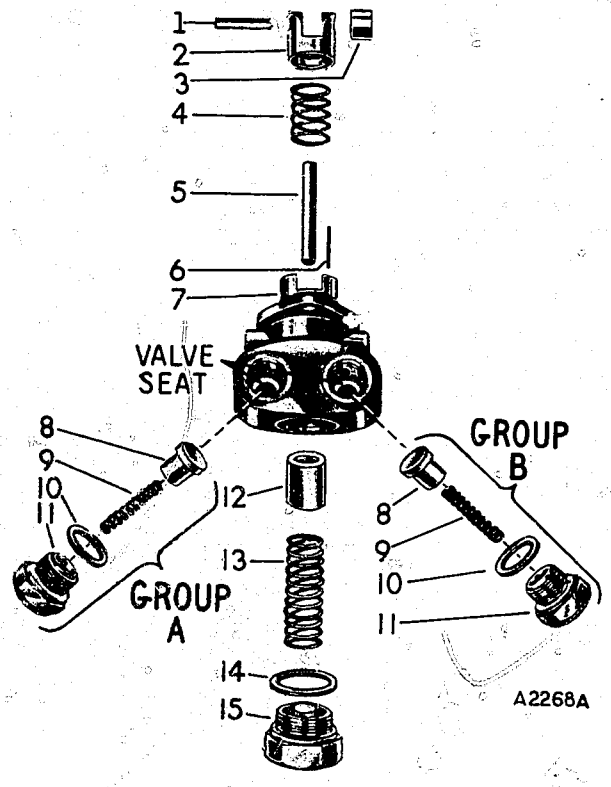

FIGURE 5 - EXPLODED VIEW OF SPA SUPPLY PUMP

SECTION 1 — DISASSEMBLY

NOTE: Numbers in parentheses refer to illustration numbers in Figure 5.

1) Clamp pump housing (7) in a soft-jawed vise with the valve spring retaining screws (11), or hand primer (not illustrated), facing upward. DO NOT CRUSH HOUSING BY OVER-TIGHTENING VISE.

2) If applicable, remove hand primer assembly and adapter fitting (not illustrated).

3) Remove valve spring retaining screws (11), gaskets (10), springs (9) and inlet and outlet valves (8) from pump housing (7).

4) Reposition pump housing (7) in vise with the plunger spring retaining screw (15) facing upward.

5) Remove plunger spring retaining screw (15), gasket (14), spring (13) and plunger (12) from pump housing (7).

6) Reposition pump housing (7) in vise with the tappet roller (3) facing upward.

7) Remove tappet retaining pin (6) with a suitable drift pin.

8) Remove tappet and roller assembly (1 through 3), tappet spring (4) and spindle (5) from pump housing (7).

9) Remove tappet pin (1) and roller (3) from tappet (2).

SECTION 2 — CLEANING

1) Wash all parts in Varsol or an equivalent cleaning agent.

NOTE: Bendix, Magnus and Karbonoff cleaners can also be used; however, springs and painted components should not come in contact with such cleaners as their action will almost immediately remove plating and soften paint.

2) Dry parts thoroughly with filtered air.

SECTION 3 — INSPECTION

PART	INSPECT FOR FOLLOWING CONDITION(s)	CORRECTIVE ACTION WHEN REQUIRED
1) Tappet Pin (1)	Scoring or excessive wear. Excessive play between pin and roller.	Replace Pin.
2) Tappet (2)	Cracks. Scoring or excessive wear on O. D., pin hole or spring seat.	Replace Tappet.
3) Roller (3)	Scoring, scuffing or excessive wear on O. D. or I. D. Excessive play between roller and pin.	Replace Roller.
4) Tappet Spring (4)	Breaks, nicks or wear. Flat spots on coil.	Replace Spring.
5) Spindle (5)	Wear, scoring, scuffing or out-of-round O. D.	See Note 1
6) Pin (6)	Bent. Loose in pin hole in housing.	Replace Pin.
7) Housing (7)	Cracked or damaged flange or housing wall. Worn tappet bore.	Replace Housing.

- Continued -

PART	INSPECT FOR FOLLOWING CONDITION(s)	CORRECTIVE ACTION WHEN REQUIRED
7) Housing (7) Cont'd	Pitted, damaged or scored valve seat.	Refinish smooth. (See Note 2)
	Worn, scored or damaged spindle bore.	See Note 3.
8) Check Valves (8)	Damaged, worn or pitted valve seats. (These must be clean and smooth)	Replace Valve(s). (Refer to Figure 6)
	Excessive wear from spring contact.	
9) Springs (9 & 13)	Breaks, nicks or wear. Flat spots on coil. Insufficient tension (compare with new spring from stock).	Replace Spring(s).
10) Gaskets (10 & 14)	Replacement at overhaul is recommended.	Replace Gaskets.
11) Screws (11 & 15)	Damaged threads, hex head or gasket seat. Excessive wear from spring contact.	Replace Screw(s).
12) Plunger (12)	Damage, excessive wear, scoring or scuffing, rust or corrosion, pitting.	Replace Plunger. (See Note 4)

NOTES

1. If spindle requires replacement and housing bore is not scratched, scored or worn excessively, a new spindle can be installed. Select the largest standard spindle that can be inserted into the housing bore. It must slide freely and smoothly for the entire length of its working stroke. If the spindle sticks or binds, polish the spindle and its bore with tallow, TSE 7723 (Bacharach code 66-0660).

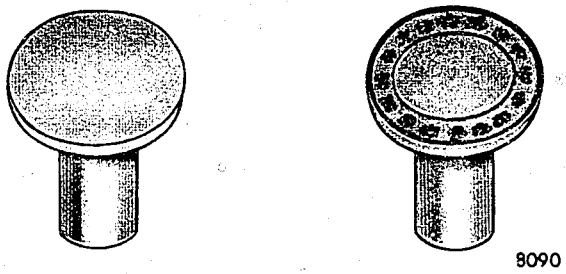

FIGURE 6 - NEW AND WORN VALVE SEATING SURFACES

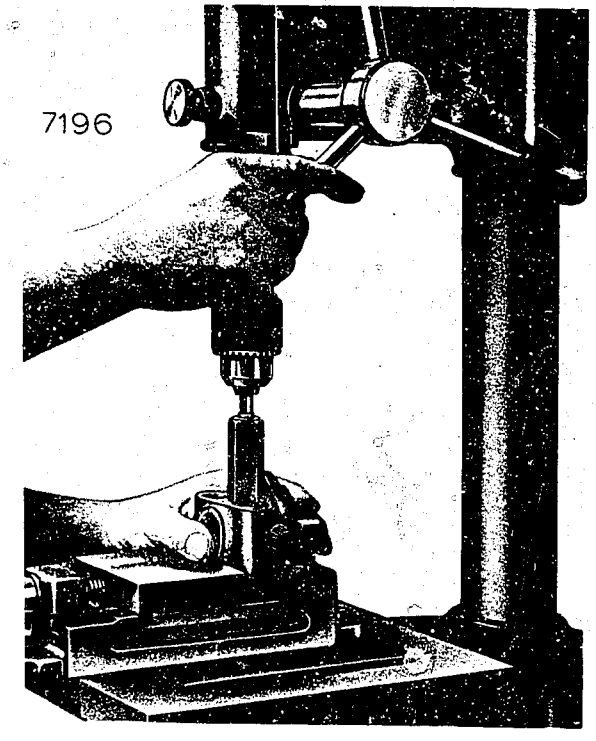

FIGURE 7 - RECONDITIONING VALVE SEAT

2. Damaged, scored or pitted valve seats can be refinished with tool TSE 7914 (Bacharach code 72-0122) and a drill press (Refer to Figure 7).

3. Refer to Section 4 for instructions for refitting an oversized spindle.

4. If plunger requires replacement and housing bore is not scratched, scored or worn excessively, a new plunger can be installed. Select the largest standard plunger that can be inserted into the housing bore. It must slide freely and smoothly for the entire length of its working stroke. If the plunger sticks or binds, lap the plunger to the bore with lapping compound BM 10007 (Bacharach code 66-0360). If the largest available plunger is loose or the housing bore is badly worn, the housing (including spindle and plunger) or supply pump must be replaced.

SECTION 4 — REFITTING AN OVERSIZED SPINDLE

1. Place a number three (No. 3) twist drill in a drill press chuck.

2. Clamp the supply pump housing securely in position beneath the drill (Refer to Figure 8).

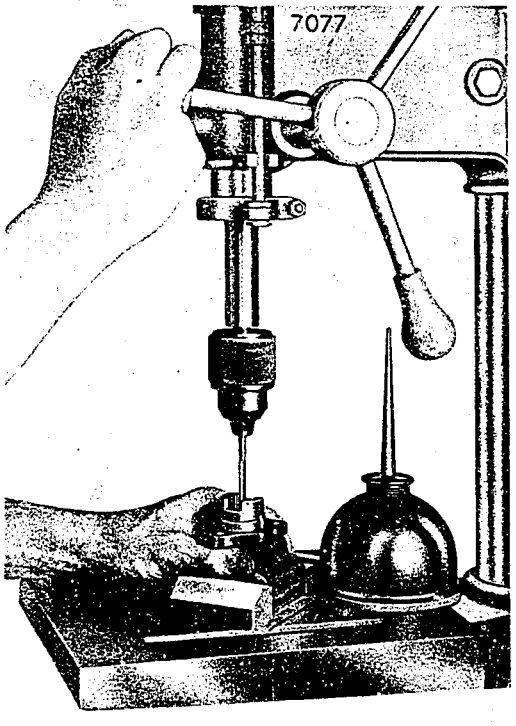

FIGURE 8 - DRILLING OR REAMING SPINDLE BORE

3. Run the drill through the spindle bore in the housing and simultaneously lubricate the drill and housing bore.

4. Wash (clean) housing to remove all chips from the spindle bore.

5. Remove drill from drill press chuck and install reamer TSE 7943 (Bacharach code 72-0141).

6. Carefully run the reamer through the spindle bore in the housing and simultaneously lubricate the reamer and housing bore.

NOTE: Early aluminum pump housings were originally provided with an annular groove in the spindle bore. Removal of this groove during machining will not affect supply pump operation.

7. Remove the housing from the machining fixture.

8. Wash the housing thoroughly to remove all chips and foreign material.

9. Select the largest oversized spindle that can be inserted into the housing bore. It must slide freely and smoothly for the entire length of its working stroke. If the spindle sticks or binds, polish the spindle and its bore with tallow, TSE 7723 (Bacharach code 66-0660).

NOTE: If the largest oversized spindle is loose, replace the supply pump or housing.

SECTION 5 — REASSEMBLY AND PRELIMINARY HYDRAULIC TESTING

1. Insert plunger (12) into its bore in the front of the housing (7), then install spring (13), new gasket (14) and retaining screw (15).

2. Clamp "flats" of supply pump housing (7) in a soft-jawed vise (do not crush housing), then tighten screw (15) to the following:

SUPPLY PUMP TYPE	REQUIRED TORQUE
AFP/K 16	30-35 Lb. Ft.
SPA 16	30-35 Lb. Ft.
SPA 22	50-55 Lb. Ft.

3. Dip the inlet and outlet valves (8) in clean test or fuel oil, then install the valves, large diameter first, into their bores in the housing (7).

4. Install springs (9), gaskets (10) and screws (11).

NOTE: If supply pump incorporates a hand primer assembly, it should be installed into the right hand (when facing front of pump housing) hole (inlet valve bore), along with any gaskets or adapters.

5. Reposition supply pump housing (7) upright in vise being careful not to crush housing, then tighten the screws (11), or hand primer assembly with or without adapter, securely. Do not overtighten.

6. Insert spindle (5) into its bore in the housing (7).

7. Fabricate a suitable 1/8" diameter service pin and, with the spindle all the way in, insert the service pin through the two holes in the tappet guide portion of the housing (Refer to Figure 9). This retains the spindle during hydraulic testing.

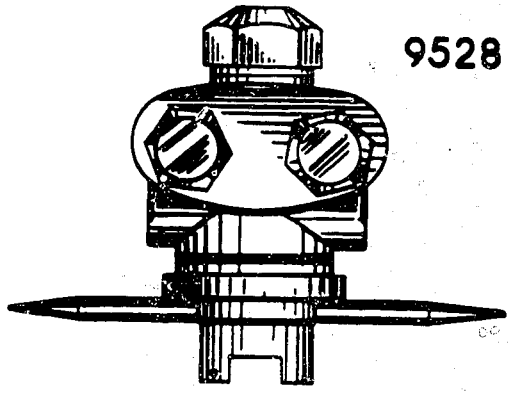

FIGURE 9 - SERVICE PIN RETAINING SPINDLE

NOTE: Fabricate a suitable fuel inlet stud from stud SD 7852 by rethreading the 14 mm x 1.5 mm thread with a 1/4" - 18 N.P.T. pipe die.

8. Install modified fuel inlet stud into fuel inlet hole in supply pump housing.

9. Install a standard 1/4" pipe plug into fuel outlet hole in supply pump housing.

10. Connect modified fuel inlet stud (in inlet hole) to nozzle test stand TSE 7722D (Bacharach code 65-030D) with high pressure tubing TSE 7764-80 (Bacharach code 67-0741).

11. Slowly operate the Nozzle Test Stand until a pressure of 300 P.S.I. is achieved.

CAUTION: DO NOT EXCEED A PRESSURE OF 300 P.S.I. FOR THIS TEST.

NOTE: Always check to make certain that all external connections are tight and that the Nozzle Test Stand is in good order.

12. Time the pressure drop from 300 P.S.I. to 150 P.S.I. - this must not be less than 10 seconds.

13. If the pressure drop time is less than 10 seconds, the unit is leaking excessively and must be visually inspected for leakage and corrected as follows:

LEAKAGE AT/BETWEEN	CORRECTIVE ACTION
a. Valve retaining screws (11) and/or hand primer assembly.	Replace gaskets (10).
b. Plunger spring retaining screw (15).	Replace gasket (14).
c. Through housing wall.	Replace housing or complete supply pump.
d. Between spindle (5) and housing (7).	Use larger spindle, refit oversized spindle or replace housing or complete supply pump.

NOTE: If leakage is present at the hand primer assembly, repair or replace hand primer and/or replace gasket(s).

14. Repeat the foregoing test, if necessary, until the unit is acceptable.

15. Disconnect supply pump from Nozzle Test Stand, then remove inlet stud, pipe plug and service pin.

16. Assemble roller (3) and pin (1) to tappet shell (2).

17. Assemble spring (4) over end of spindle (5), then insert tappet assembly (1, 2 and 3).

18. Depress tappet assembly and install the tappet securing pin (6) to its hole in the housing (7).

19. Stake the housing (7) slightly at each end of the pin (6).

SECTION 6 – TESTING

NOTE: The supply pump should be tested on the test stand after the fuel injection pump has been timed and prior to calibration.

1. Mount the supply pump on the fuel injection pump.
2. Connect a suction line from the fuel (test oil) tank to the inlet (right) side of the supply pump.
3. Connect a hose from the outlet (left) side of the supply pump through an accurate 0-60 P.S.I. pressure gauge and to the injection pump inlet (Refer to Figure (10).
4. Prime the supply pump and fuel lines.

NOTE: If the supply pump incorporates a hand primer assembly, it can be used to prime the system. The hand primer strokes should be smooth and full, and delivery must occur within 30 strokes. If more than 30 strokes are required to deliver oil, operation is not smooth or oil leakage is noted, the hand primer must be repaired or replaced and/or gaskets replaced.

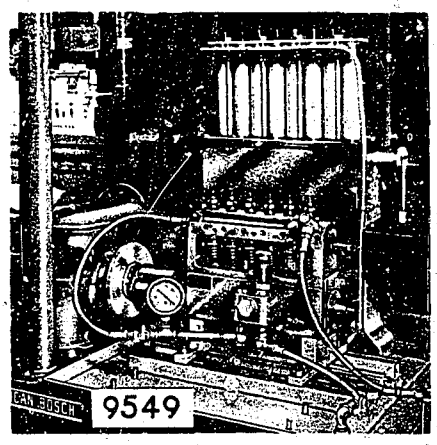

FIGURE 10 - TESTING SUPPLY PUMP

CAUTION. Do not exceed the maximum gauge pressure when testing the hand primer assembly.

5. Plug the injection pump outlet or overflow valve.
6. Operate the injection pump at low idle speed (200-300 R.P.M.).

NOTE: If the supply pump does not prime, loosen the outlet valve retaining screw (11) sufficiently to bleed out all air.

7. The supply pump must self-regulate at the following minimum pressures depending on pump type and plunger spring:

TYPE OF SUPPLY PUMP	PLUNGER SPRING	SELF-REGULATING PRESSURE
AFP/K 16 --- SPA 16 ---	SP 7919 WSF 2216A1X	20 P.S.I. Minimum
SPA 22 ---	SP 7914 SP 7992	35 P.S.I. Minimum
	WSF 2156A1X	20 P.S.I. Minimum

8. If the supply pump self-regulates below the above table, replace plunger spring and retest. If pressure is still low, disassemble, repair, reassemble and retest supply pump.

IMPORTANT: In all instances, the supply pump self-regulating pressure must be substantially higher than the overflow valve opening (regulating) pressure in order to compensate for pressure drop across the final stage filter.

GENERAL NOTE

Difficulties with the fuel supply system, apparently due to faulty operation of the fuel supply pump, may sometimes be traced to such causes as fuel (pressure) or air (suction) leaks in the fuel lines, clogged filters or leaky overflow valves.