

CAV

**DIESEL FUEL
FILTERS**

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OPERATORS BOOK

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DIESEL FUEL FILTERS

DIRT in diesel fuel is recognised as the main cause of wear in the engine fuel injection equipment. If attention is not paid to keeping the fuel clean, pump elements, delivery valves and injector nozzle valves will be subjected to scoring from the dirt and fine dust suspended in the fuel. Fuel cleanliness commences before fuel is placed in the supply tank, and the numerous publications on keeping diesel fuel clean, supplied by the fuel oil companies, are an indication of the importance attached to this aspect of diesel engine operation.

In addition to a clean fuel supply, the fuel entering the injection pump should be filtered, especially where diesel engines are working in dusty conditions. Normal practice is to fit the filter in the supply line from the fuel tank to the pump inlet.

C.A.V. laboratories have carried out a great deal of research on fuel filtration and the type of filter material required to ensure maximum cleanliness of the fuel. During this research the superiority of a special form of impregnated paper as a filtering medium was proved, and the result of this research is now embodied in the range of C.A.V. paper element filters.

The element supplied consists of specially impregnated paper wound round a central core to give a spiral form. The paper element is then enclosed within a thin metal canister. This method of element construction provides a filter area many times the size of that provided by other filters of similar dimensions.

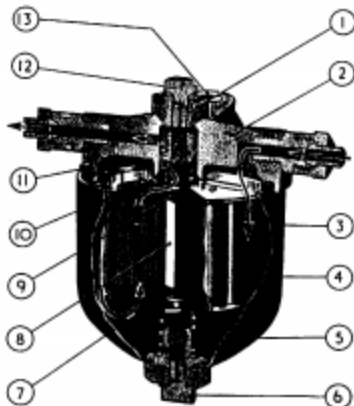


Fig. 1.
F2 Filter in section
showing fuel flow
through element.

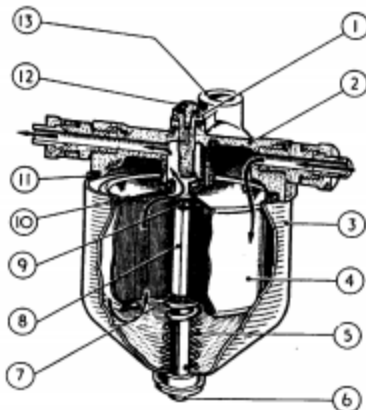


Fig. 2.
F2B Filter in
section

THE FILTER RANGE

Included in the range are the following:—

Single bowl filters	Types F2 and F2B
Single bowl filters with return flow connection	Types F4 and F4B
Twin bowl filters	Types 2F3 and 2F3A
Triple bowl filters	Types 3F3 and 3F3A
Single bowl-less filters	Type FS
Twin bowl-less filters	Type 2FS
Filter-Agglomerator-Sedimentor	Type FAS
Twin Filter-Agglomerator-Sedimentor	Type 2FAS
Simple Sedimentor	Type SS
Twin Simple Sedimentor	Type 2SS

The letter after the number in a designated type range, e.g. F2 and F2B, indicates a change in design.

Changes in design, application and fuel flow are discussed in the descriptive notes of a particular type.

F2 and F2B FILTERS

The main differences between the F2 and F2B filters are clearly indicated in Fig. 1 and Fig. 2.

Both filters are of the single bowl, cross-flow type and consist of:—

1. A cast aluminium head (2) incorporating inlet and outlet connections together with a mounting bracket.
2. A paper filter element contained in a metal canister (4).
3. A pressed steel bowl (3) together with drain plug (6) and centre stud (9).

The pressed steel bowl and the filter element are held in position against the aluminium head by centre bolt (1) which screws OVER the centre stud (9) on the F2 filter, and INTO centre stud (9) on the F2B type.

Two synthetic rubber 'O' rings (7 & 10) keep incoming unfiltered fuel oil separate from the outgoing clean filtered oil. Leakage between the two flows is prevented by the pressure of the spring (5) which keeps the 'O' rings pressed firmly against the element (4) and the aluminium head (2).

External leakage from the filter is prevented by tightening down bowl (3) on to gasket (11).

Provision is made in the aluminium head for the use of a gravity vent valve or a pressure relief valve, depending on the filter application.

These components are shown diagrammatically in Fig. 3 and either will replace the venting plug normally fitted to the venting orifice (13).

Unfiltered fuel enters the filter through the inlet port, passes down the outside of the element (4) into the base of the steel bowl (3), upwards through the filter element into the aluminium head (2) and out to the fuel injection pump through the outlet port.

Detailed servicing instructions for the F2 and F2B filters will be found on page 16.

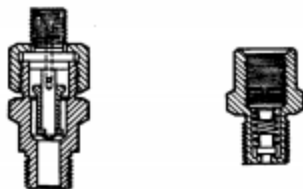


Fig. 3. (left) Gravity vent valve and (right) pressure relief valve.

F4 and F4B FILTERS

F4 and F4B filters are similar in construction to the F2 type filters but have a return flow connection to enable excess fuel from the fuel injection pump to return to the clean fuel side of the filter. The filter is designed for use with the C.A.V. distributor type injection pump, but can be used in any installation where a return to the clean side of the filter is required. Apart from the return connection to the aluminium head the F4 and F4B filters are identical with the F2 and F2B types. Servicing instructions are detailed on page 16.

2F3, 2F3A TWIN BOWL AND 3F3, 3F3A TRIPLE BOWL FILTERS

These filters are twin and triple bowl versions of the F2 type filters. The units consist of a single aluminium head casting with a separate bowl for each filter element. Galleries in the head casting provide for a parallel fuel flow through the elements. This arrangement gives a greater fuel flow than that obtainable from a single bowl filter and also increases the element life. If, for example, a single bowl filter is replaced by a twin bowl filter, the flow through each element will be halved, but the element service life goes up by approximately three times.

With the twin and triple bowl filters the design change letter A, following the filter type number, indicates the method of attaching the bowl to the head as described in the introduction. Servicing instructions for twin and triple bowl filters will be found on page 16.

FS FILTER

The FS filter is of the cross-flow type. The element is contained within a strengthened steel canister which forms an integral part of the filter assembly.

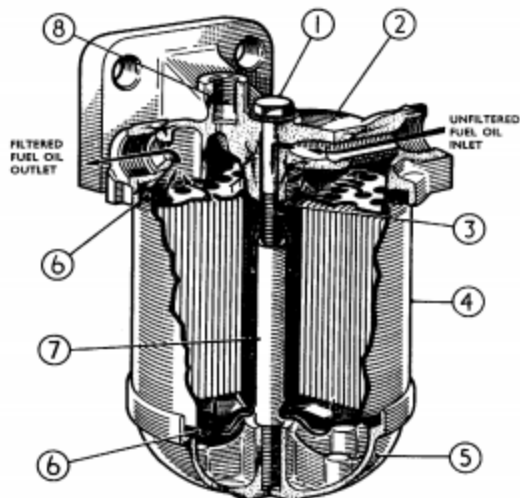


Fig. 4. FS Bowl-less filter, showing filter flow through element.

The construction of the FS filter and the two available directions of fuel flow through the assembly are shown in Figs. 4 & 5. The unit consists of the following component parts:—

1. A cast aluminium head (2) with inlet and outlet connections and a mounting flange.
2. A paper filter element enclosed in a strengthened metal canister (4).
3. A cast aluminium base (5) together with centre stud (7).

The three units are held together by centre bolt (1) which passes through the head casting and screws into the centre stud (7). Synthetic rubber sealing rings (6) located at the top and bottom of the filter element canister prevent external fuel oil leakage. The clean outgoing filtered fuel is sealed off from the incoming unfiltered fuel by a synthetic rubber 'O' ring (3) held in a groove on the filter head centre boss.

The filter head is supplied with galleries drilled to provide for either filter flow or agglomerator flow. Filter flow is illustrated in Fig. 4 which shows the incoming unfiltered fuel passing through the centre bolt housing and into the base (7). It then passes upwards through the filter element and out through the filtered fuel outlet port.

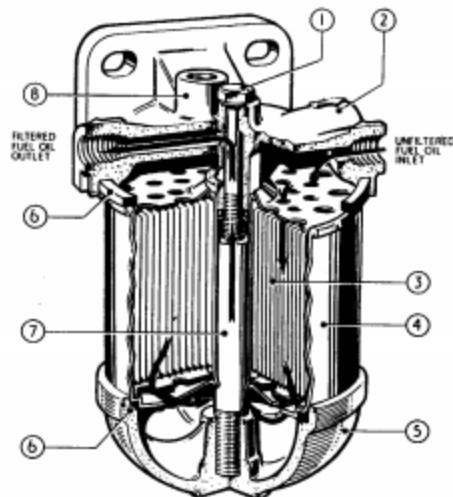


Fig. 5. Bowl-less filter, showing agglomerator flow through element.

Agglomerator flow takes advantage of the fact that when fuel containing fine water droplets is passed through a porous medium such as the filter element, the water droplets will join together (or agglomerate) into larger droplets which may then be removed from the fuel by sedimentation. Fig. 5 shows the FS filter arranged for agglomerator flow. Incoming fuel entering through the inlet passes downwards through the filter element into the base and then upwards through the centre tube and out via the filtered fuel outlet. Abrasive particles are retained by the filter element and the water particles are deposited in the base to be drained off at convenient intervals. Certain models of this filter have a nylon drain plug incorporated in the base for this purpose.

As with the F2 type filter the venting orifice Fig. 4 (8) can be fitted with a gravity vent valve or a pressure relief valve as required, instead of the air venting plug normally fitted.

The filtering area provided by the FS filter element is identical with that provided by the F2 filter element but it should be noted that F2 and FS filter elements are not interchangeable.



Fig. 6 (a).
Standard filter head, Type F2,
showing inlet and outlet ports.

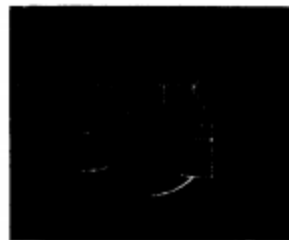


Fig. 6 (b).
Standard filter head, Type FS,
showing inlet and outlet ports.

The standard F2 filter head shown in Fig. 6 (a) has single inlet and outlet connections and is intended for use in installations employing in-line pumps where fuel return is not required.

The standard filter head shown in Fig. 6 (b) has two inlet and two outlet connections to provide alternative piping connections for different types of engine installations. It is suitable for both distributor type pumps and in-line fuel injection pumps, but when used with a distributor type pump the fuel return from the pump will be to the unfiltered fuel side of the filter. Closing plugs are fitted to the connection ports not used for pump connections.

In both heads the inlet and outlet bores are suitable for olive type connections or for the use of banjo bolts and fittings.

Servicing instructions for the FS filter are given on page 21.

2FS TWIN BOWL-LESS FILTER

This filter is a twin version of the FS type filter and has a common head casting and mounting flange, with two separate elements. It provides alternative arrangements for fuel flow.

1. Series flow—for engines working in exceptionally dirty conditions.
2. Parallel flow—for engines requiring double the fuel flow rate of that provided by the single FS filter.

Service instructions for the 2FS filter are detailed on page 21.

FILTRAP SYSTEM S.S. Unit—F.A.S. Unit

The Filtrap system of fuel oil filtration and water separation is designed to give the best possible protection against abrasive matter and water carried in the fuel. The system consists of two parts; first a simple sedimenter, and second, a filter-agglomerator unit.

A "cut-away" view of the simple sedimenter is shown in Fig. 7. Incoming fuel is fed into the unit above the sedimenter element and passes through a clearance between the sedimenter cone and the sedimenter wall. Sedimentation takes place in the lower transparent bowl and the fuel, relieved of the larger droplets of water and the larger particles of abrasive matter, passes out of the unit via ports in the central portion and galleries in the head. Accumulated water and solid matter is visible in the transparent bowl and may be drained off through the drain plug provided in the base.

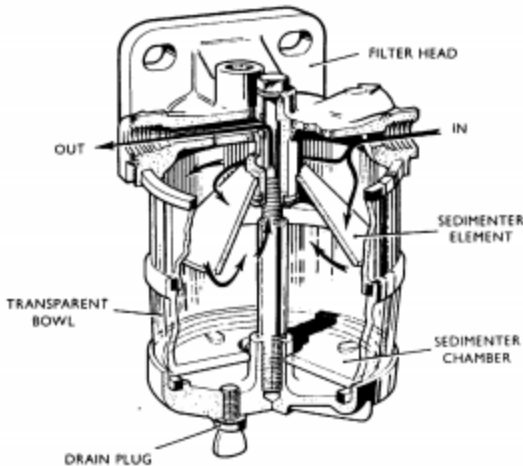


Fig. 7. Simple Sedimenter, Type SS.

Fig. 8 illustrates the filter-agglomerator unit where the smaller water droplets and the small abrasive particles remaining after preliminary sedimentation are removed. Since the desired properties of agglomerator and filter elements are similar, a single filter element is used for both functions. Fuel entering from the top of the filter passes through the filter-agglomerator element into the sedimentation chamber in the base of the transparent bowl. Particles of solid matter are filtered out in the normal manner and are retained in the filter element. Droplets of water, forced through the pores of the filter, agglomerate and form large drops which separate from the fuel by sedimentation and accumulate in the base of the housing. The fuel, free from solid matter and water droplets, then passes upwards through the element centre tube to the outlet connection in the unit cover. The accumulated water, visible within the transparent bowl, may be drained off by unscrewing the drain plug provided.

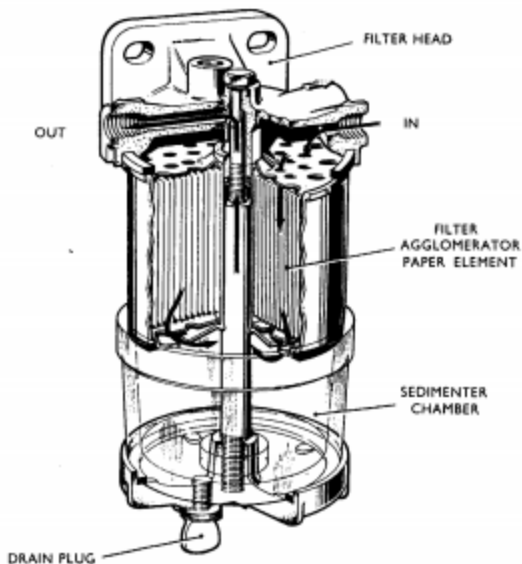


Fig. 8. Filter-Agglomerator-Sedimenter Type FAS.

MAINTENANCE AND SERVICING

Absolute cleanliness is essential when carrying out periodical inspection and servicing of C.A.V. fuel filters. Most troubles with fuel injection equipment can be traced to dirt in the fuel, and it is essential when opening fuel lines to atmosphere that the line ends are sealed off to keep out dirt and grit.

The drain plug fitted to the filter bowl should be removed periodically and any impurities which have collected, drained off. The engine manufacturer's instruction manual should be consulted to ascertain the periods recommended for this draining operation.

Filter choking is usually due to waxy deposits from the fuel. If choking occurs in an unreasonably short time this may be caused by a contaminated fuel supply. If the source of this contamination is in the engine fuel system we recommend that the fuel tank and supply lines are cleaned before continued operation.

Paper elements cannot be cleaned and when choked must be discarded.

In view of the widely differing conditions of operation which have to be catered for, precise instructions for servicing intervals cannot be stated for paper elements, and operators are advised to follow in the first place the recommendations laid down in the engine manufacturer's instruction book.

The period at which it will be found necessary to change the filter element will vary according to the type of fuel used, bulk storage installation, settling or pre-filtering before filling the vehicle tank and the local conditions under which the engine concerned is working. This may easily be as short as three months or as long as twelve, but it is not expected that it will be outside this period although exceptional circumstances may make it so. In view of the possibility of premature choking by unusually waxy fuel, we suggest that a spare element is carried in the tool box until a suitable servicing interval can be determined.

Draining off accumulated water, sludge and solid matter from the bases of the Filtrap units may be done at any convenient interval when the water or sludge level visible inside the transparent bases rises to a pre-determined point. On no account should the water level be allowed to rise to the top of the transparent section in either the S.S. unit or the F.A.S. unit.

Ideally, bulk storage of fuel should be so arranged that each delivery of fuel is allowed to stand for a few days before use. This will allow a large proportion of the solids which are suspended in the fuel to settle to the bottom of the tank, and this sedimentation is an important factor in prolonging the service life of the filter element.

If the fuel injection equipment is to function efficiently interference with fuel filters should be forbidden and filters should be disturbed as little as possible.

F2, F2B, F4, 2F3, 2F3A, 3F3 and 3F3A FILTER ASSEMBLIES

In the text which follows, the figures in brackets refer to Fig. 9.

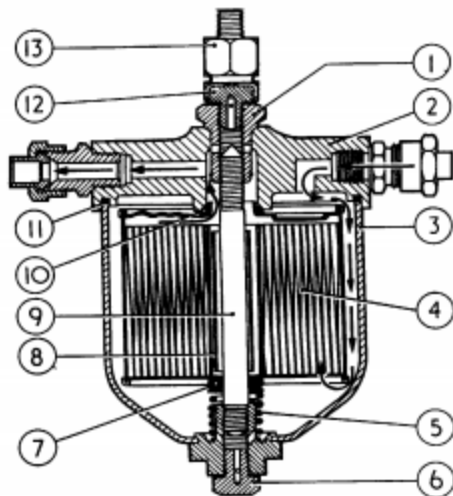
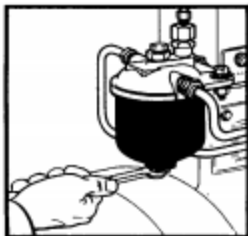
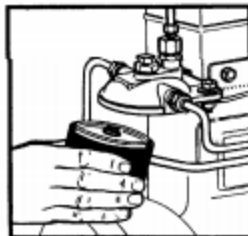


Fig. 9. Type F filter in section.

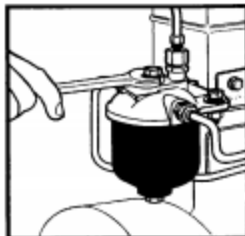
1. Before attempting to service the filter remove all external dirt from the assembly. If the filter is fed from a gravity tank turn off the fuel supply before dismantling the filter.



3. Unscrew the cap nut (1) to release the bowl (3).



2. Unscrew drain plug (6) and slacken off vent plug (12) to allow fuel oil to drain from the filter bowl. If the drain plug orifice is blocked and the fuel cannot drain, replace the plug (6).



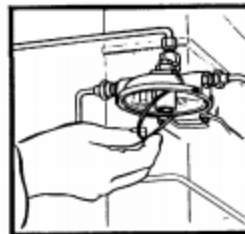
4. Withdraw the bowl (3) and the element (4) from the top casing (2).



6. Remove and discard the filter element.

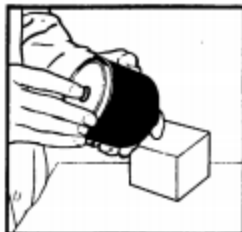
WARNING—The triangular spacing sleeve (8) and the lower sealing ring (7) may stick and be withdrawn when the element is being removed. **DO NOT DISCARD THE SLEEVE OR LOWER SEALING RING**; they will be required for the replacement element. Remove the drain plug (6) and clear any blockage in the drain plug orifice and in the drain holes in the centre boss. Clean out the steel bowl and remove any deposited sediment from the internal surface of the bowl. Flush through the bowl and drain holes with clean fuel oil.

5. If the drain plug orifice was blocked and the fuel did not drain, push the element (4) down against the spring until the top of the element is level with the bowl. Swirl round the oil in the bowl and pour out to waste.

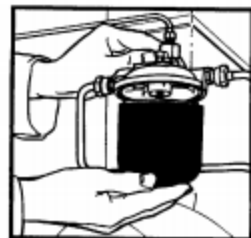


7. Inspect the large sealing ring (11) held in the groove in the head casting. Remove and discard it **ONLY** if damaged or defective in any way. Replacement sealing rings may be obtained from the supplier of the filter element. Clean out the head casting.

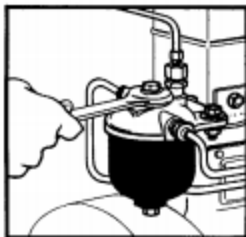
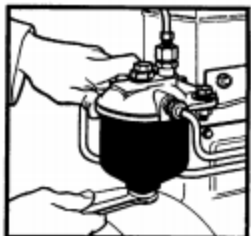
8. Fit the lower sealing ring (7) in position on the lower part of the centre stud (9). Push the triangular spacing sleeve (8) down to its correct position on the centre stud and fit the new paper element over the centre stud and spacing sleeve.



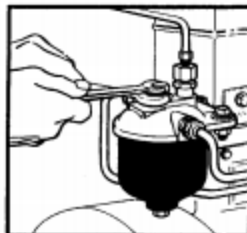
9. Offer up the filter bowl containing the new element to the head casting (2) and engage the cap nut (1) with the centre stud (9).



10. Make sure the thread of the cap nut (1) is correctly entered before tightening down the cap nut. Do not overtighten in an attempt to stop leaks.



11. Replace and tighten the drain plug (6).



12. Air vent and prime the system as laid down in the engine manufacturer's handbook and at the same time examine the filter for signs of leakage. It is important that this operation is carefully carried out otherwise air leaks in the fuel supply side will prevent efficient working. If a handbook is not available proceed as follows.

If the system is fed by a fuel feed pump and the filter is fitted with a gravity vent valve, a pressure relief valve, or a permanent air vent orifice, operate the hand priming lever or plunger of the feed pump until air-free fuel oil appears from the small vent plug (12) fitted to the cap nut (1).

With a gravity feed system, turn on the fuel supply tap and open air vent plug (13) situated next to the cap nut (1). As soon as fuel free of air bubbles appears at the vent, tighten down vent plug (13). Repeat this operation with the small vent plug (12) fitted to the cap nut (1). It may be necessary to hold the cap nut with a second spanner to prevent it unscrewing.

NOTE:—After air venting the filter, the fuel injection pump must be vented.

When venting 2F₃ and 3F₃ filter assemblies, each filter must be vented individually.

**FS and 2FS
BOWL-LESS FILTER ASSEMBLIES**

In the text which follows, the figures in brackets refer to Fig. 10.

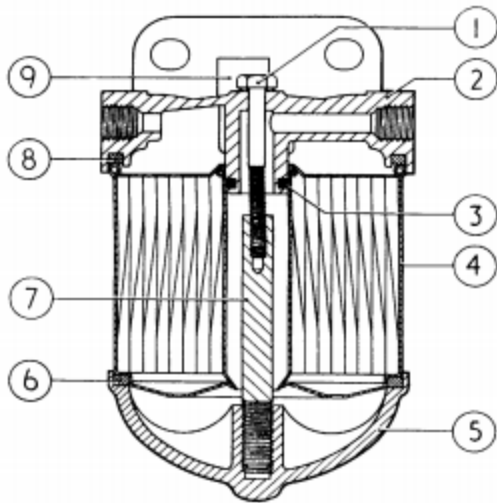
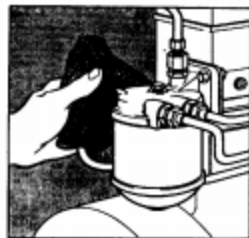
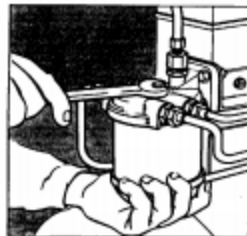


Fig. 10. FS Bowl-less filter in section.



1. Remove all external dirt from the assembly before attempting to service. If the system uses a gravity feed supply, turn off the fuel before dismantling the filter. Drain base if fitted with drain plug.

2. Unscrew the centre bolt (1) and at the same time hold the base of the filter to prevent it rotating.



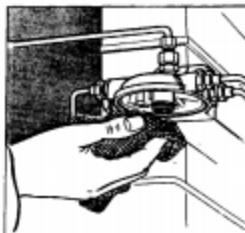
3. Release the filter element (4) complete with base (5) by pulling the element downwards, and at the same time turning slightly so that it comes free from the internal 'O' ring (3).



4. Detach and discard the element ensuring that the lower sealing ring (6) is retained. Clean out the base (5) and rinse out with clean fuel oil. Inspect the lower sealing ring for damage or imperfections and renew if necessary. If the base is provided with a drain plug, refit and tighten this plug.



5. Clean inside the filter head (2) with a clean brush or non-fluffy cleaning cloth. Pay particular attention to the groove which houses the sealing ring (8). Inspect the upper sealing ring (8) and the small "O" ring (3) for damage or imperfections and renew where necessary. New sealing rings may be obtained from the supplier of the filter element.



6. Ensure that the lower sealing ring (6) is correctly in place on the base and then place a new filter element (4) in position over the centre stud (7). The heavy rim of the element is uppermost when the element is correctly fitted.



7. Fit the base (5) and the element (4) to the filter head (2) and at the same time turn it slightly so that the element slides easily over the 'O' ring (3). Make sure the top rim of the element is seating squarely on the upper sealing ring (8) before tightening the centre bolt. Do not overtighten the centre bolt in an attempt to cure leaks. The bolt should be tightened to a figure of 6 to 10 lb ft torque (0.830 to 1.383 kg m).

8. Turn on the fuel and vent the system in accordance with the engine manufacturer's handbook and at the same time inspect the system for leaks. It is important that this operation be carefully carried out otherwise air trapped in the fuel supply side will prevent efficient working. If a handbook is not available proceed as follows.

For systems fed by a fuel feed pump and with a gravity vent valve, pressure relief valve, or a permanent air vent orifice fitted to the filter, it is only necessary to operate the feed pump priming lever until air-free fuel oil appears from the vent plug(s).

If the system has a gravity fed fuel supply open the air vent plug (9) situated next to the centre bolt (1). As soon as fuel free from air bubbles appears, re-tighten the plug.

Twin bowl-less filters should be vented as follows.

Series flow: Vent both filters at the same time.

Parallel flow: Vent each filter individually.

After venting the filter the fuel injection pump must be vented.

When the engine has started it is advisable to re-vent the system to remove any air which may be trapped in the fuel lines.

NOTE:—Do not overtighten the centre bolt in an attempt to cure leaks appearing at the upper (8) and lower (6) sealing rings but dismantle the filter and examine the sealing faces and rings for damage. Overtightening may permanently distort the filter base.

FILTRAP WATER SEPARATION & FILTRATION SYSTEM

In the following text the numbers in brackets refer to Fig. 11.

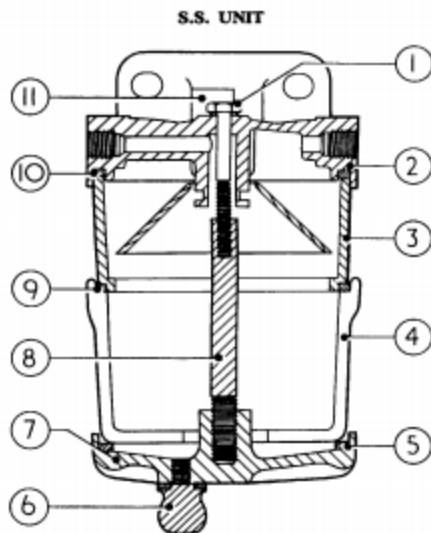
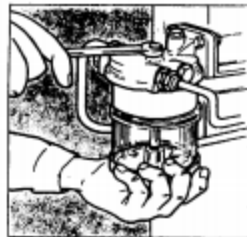


Fig. 11. Sedimentator, Type S.S. in section.



1. Clean off all external dirt before attempting to service the unit. If the sedimentator uses a gravity feed supply, **TURN OFF THE FUEL** before dismantling the sedimentator. Slacken off the thumbscrew (6) in the base (7) and drain the accumulated water and sludge.

2. Unscrew the centre bolt (1) and at the same time hold the base to prevent it rotating.



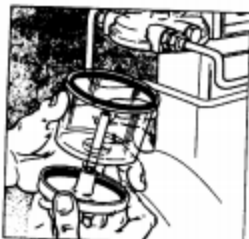
3. Detach the base (7) glass bowl (4) and sedimentator element (3). Separate the sedimentator element, the glass bowl, and the base. Inspect the centre sealing ring (9) and the lower sealing ring (5) for damage and renew any imperfect ring.



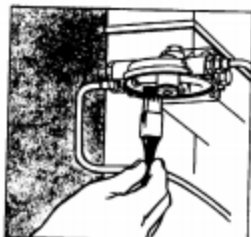
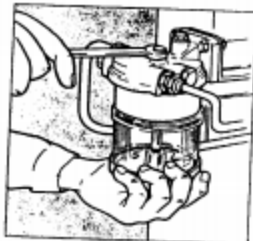
4. Clean the glass bowl and base and rinse them out with clean fuel oil. Clean and rinse the metal sedimentator element.



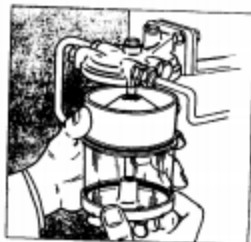
5. Clean out the sediment head (2) and inspect the upper sealing ring (10) for damage. Renew sealing ring if imperfect. New sealing rings may be obtained from the supplier of the filter elements.



7. Position the sediment element (3) (with cone pointing upwards) on the assembly of bowl and base. Ensure that the upper sealing ring (10) is correctly placed in the head (2) and offer up to the head the assembled element, bowl and base.



6. Ensure that the lower (5) and centre (9) sealing rings are correctly positioned and assemble the glass bowl (4) to the base (7).



8. Engage the centre bolt (1) with the centre tube and make sure the top rim of the sediment element is seating correctly before tightening the centre bolt to a torque figure of 6-8 lbs ft (0.830-1.106 kg m). Do not overtighten the centre bolt in an attempt to the centre cure leaks. Tighten the drain thumb-screw (6) hand tight only.

F.A.S. UNIT

In the following text the numbers in brackets refer to Fig. 12.

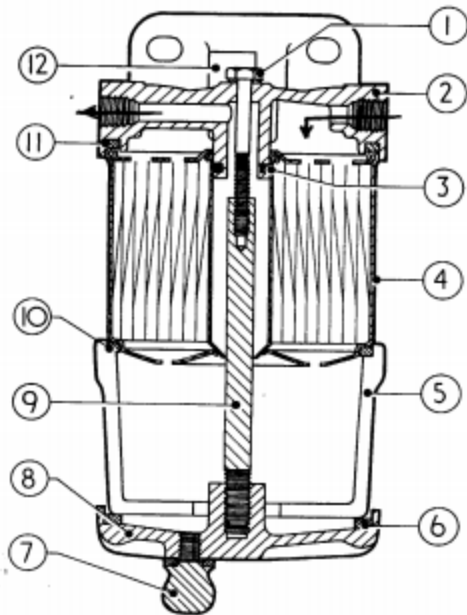
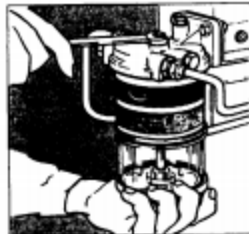


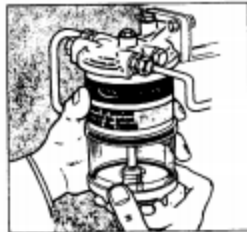
Fig. 12. Agglomerator, Type F.A.S. in section.

1. Clean off all external dirt from the unit before attempting to service. Unscrew the thumbscrew in the base and drain off accumulated water and sludge.



2. Unscrew the centre bolt (1) and at the same time hold the base of the unit to prevent it rotating.

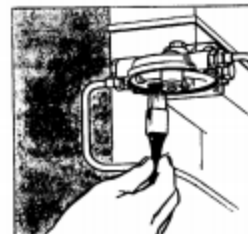
3. Release the filter element (4) complete with glass bowl (5) and base (8) by pulling the element downwards and at the same time turning it slightly so that it comes free from the internal "O" ring (3).



4. Detach and discard the element.



6. Clean out the glass bowl and base. Complete the cleaning by rinsing with clean fuel oil.

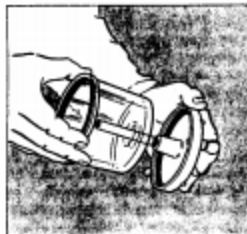


8. Assemble the base (8) and the glass bowl (5) after ensuring that the central (10) and lower (6) sealing rings are correctly positioned.

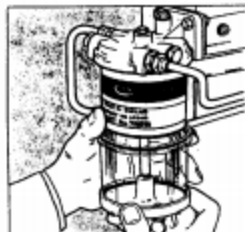
5. Separate the glass bowl (5) from the base (8). Detach and inspect the central sealing ring (10) and the lower sealing ring (6) for damage. Renew any imperfect ring.



7. Clean the unit head and inspect the upper sealing ring (11) and "O" ring (3) for damage. Renew any imperfect sealing ring. Replacement sealing rings may be obtained from the suppliers of the filter element.



9. Check that the upper sealing ring (11) and the "O" ring (3) are correctly positioned in the head and fit the new element to the head. Turn the element slightly when fitting so that it slides easily over the "O" ring.



10. Offer up the assembled base and bowl to the head and element. Guide the centre stud through the centre tube of the element and engage it with the centre bolt. Make sure that the rims of the element, glass bowl and base are seating correctly before tightening the centre bolt. Do not overtighten the centre bolt in an attempt to cure leaks.

The bolt should be tightened to a figure of 6-8 lb ft torque (0.830-1.106 kg m). Replace and hand tighten drain thumb-screw.

Turn on the fuel and vent the system in accordance with the engine manufacturer's handbook and at the same time inspect the system for leaks. It is important that this operation be carefully carried out otherwise air trapped in the fuel supply side will prevent efficient working. If a handbook is not available proceed as follows:—

For systems fed by a fuel feed pump and with a gravity vent valve, pressure relief valve, or a permanent air vent orifice fitted to the F.A.S. unit, it is only necessary to operate the feed pump priming lever until air-free fuel oil appears from the vent plug.

If the SS unit is on the suction side of the feed pump do NOT vent this unit.

Twin F.A.S. units should be vented as follows:—

Series flow: Vent both filters at the same time.

Parallel flow: Vent each filter individually.

After venting the units the fuel injection pump must be vented.

NOTE—Do not overtighten the centre bolt in an attempt to cure any leaks appearing at the sealing rings but dismantle the unit and examine the sealing faces and rings for damage. Overtightening the centre bolt beyond the recommended torque figure may permanently distort the base or filter element.