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If properly cleaned a good quality lubricating or insulating oil can be re-used over and over again for its original purpose, and the benefits which result are enormous.

Stream-Line Filter Plants for the purification of Lubricating, Insulating, Fuel and other oils are made in a range of sizes up to 450 gallons per hour.

Stream-Line Filters have set a new standard in oil purification and have enabled their many users to obtain a degree of purity hitherto unattainable on a commercial scale. Among the users of the far more than 30,000 Stream-Line Plants which are now in service in various parts of the world are the Royal Air Force, Central Electricity Board, War Office, Crown Agents and many important municipalities, public utility corporations and leading transport companies.

Brochure W/101 Oil Purification and the Modern Transport Engineer

Brochure W/102 Oil Purification and the Diesel Engine User

Brochure W/103 Oil Purification and the Electrical Engineer

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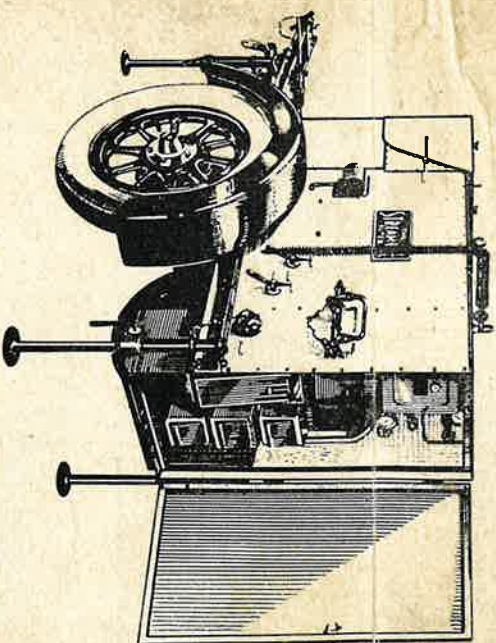
INSTRUCTIONS

A/S SKAFSÅ KRAFTVERK

for the use of **STREAM-LINE**

INSULATING OIL FILTERS

PORTABLE TYPES N & NX



These filters constitute the most advanced, efficient and convenient units for cleaning insulating oils. For further information see Brochure 103. Details of Stream-Line filters for lubricating oils are given in Brochure 101 (Transport) and Brochure 102 (Stationary Diesels).

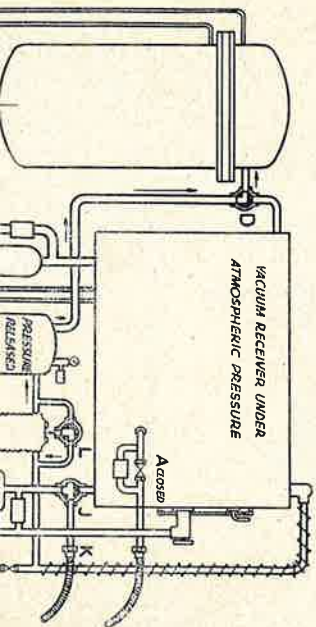
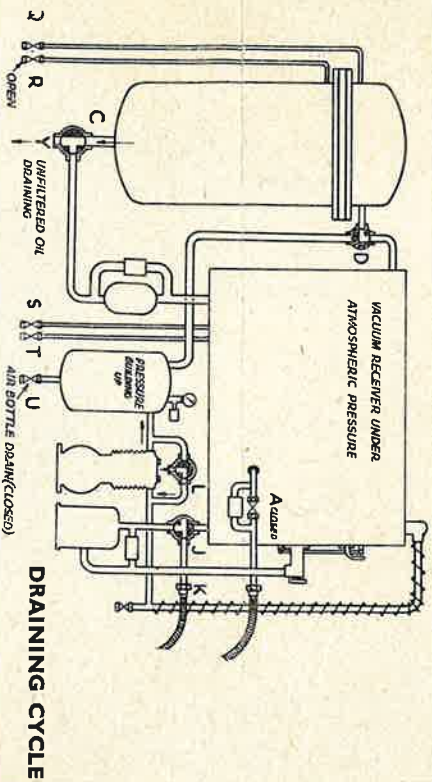
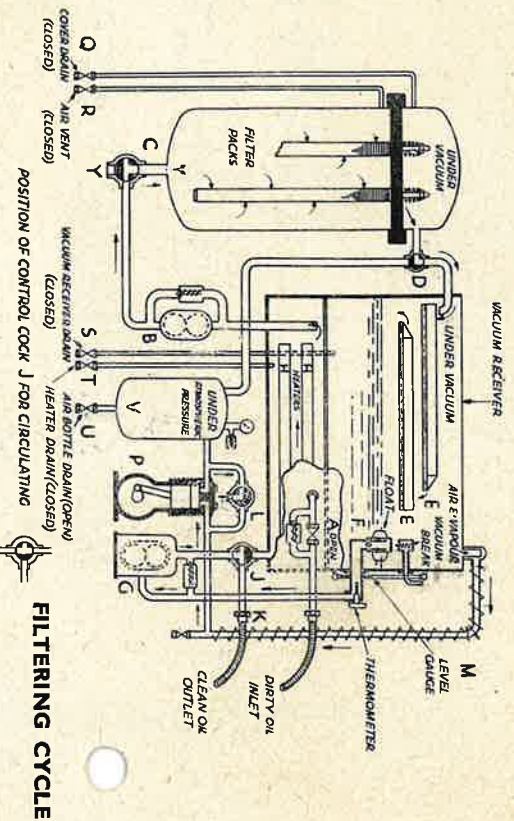
Portable STREAM-LINE FILTERS

FOR INSULATING OIL are made in a range of sizes, working on the same general principles. In each particular size there are two commonly-adopted arrangements: type N, mounted on castors for wheeling about on a level floor; and type NX, which is the same filter plant but mounted on a pneumatic-tyred trailer. The filter is a self-contained weather-proof plant. It may be used either for pumping from a dirty oil tank, through the filter, to a clean oil tank or for dealing by circulation with oil from a transformer circuit breaker or other unit.

REQUIREMENTS FOR OPERATION

- The following items are necessary for operation of the plant:
- Dirty oil hose and clean oil hose of length to suit requirements. The dirty and clean oil connections on the filter, unless ordered otherwise, are of standard hose connection size (male B.S.P. thread one size larger than hose bore) and are given below.
 - Drain tank into which the oil from the filter body may be drained.
 - Sludge tank or bucket to collect the sludge on cleaning back with compressed air. The *minimum* capacities of these are given.
 - Sufficient oil to fill the filter before commencing to circulate. This will normally be kept in the filter after the initial filling.
 - Electrical connection to the filter. The filter is provided with a plug and socket or terminals according to circuit. A wiring diagram of the plant is sent with each filter and the full heater load is as given below.

Size	N3	N7	N19	N37	N61	N91	N7×20
Hose Connections	B.S.P. 3/4"	3/4"	1"	1 1/2"	1 1/2"	2"	3/4"
Bore of Hose	1/2"	1/2"	3/4"	1"	1"	1 1/2"	1/2"
Drain Tank	3 Galls.	3	6	30	40	65	3
Sludge Tank	1 1/8 Galls.	1 1/2	1	2	4	6	1/2
Oil to fill plant	3 Galls.	7	16	44	66	115	7 1/2



BRIEF DESCRIPTION OF FILTER

Please refer to Fig. 1. Oil is drawn by the metering pump B through valve A into the heater chamber, where it is heated by immersion heaters H¹. The metering pump suction pipe extends nearly to the top of the heater chamber so that the heaters always remain immersed. The oil then passes through the cock C to the filter, which consists of a number of columns of specially prepared paper discs, each held under compression by means of a spring at the top of its guide rod. Only clean oil can pass between the paper discs, and all solid matter is retained at the outer surface of the packs.

The clean oil then passes through cock D to the vacuum receiver which is maintained under vacuum by pump P. The combination temperature and vacuum causes complete evaporation of all water in the oil as it passes through the vacuum receiver and, in the case of the larger types, over one or more trays E. E. Water vapour, air and other gases are drawn through condensing pipe M and discharged by the vacuum pump through cock L to atmosphere. The clean dry oil is drawn through the sleeve valve F by the clean oil pump G, and delivered through cock J to the clean oil outlet K. The valve F is float-operated and closes before the level of the oil in the vacuum receiver falls to that of the outlet, so keeping the outlet oil-sealed and preventing vapour from passing out with the oil. If for any reason the oil should tend to rise too high in the vacuum receiver, the float arm comes into contact with a small spring-loaded valve which, on opening, admits air to the vacuum receiver and so, by reduction of vacuum, allows the clean oil pump to deal with the surplus oil.

When the filter is started up from cold, the cock J is turned so that the pump G, delivers oil back to the heater, thus circulating the oil in the plant until working temperature is attained. The solid matter accumu-

drained of oil through cock C, and cock L is turned to put the suction of pump P to atmosphere, thus pumping up the air bottle V. This pressure air is then released into the filter cover by turning cock D, and forces its way through the filter packs in the reverse direction to filtration, cleaning away all solid matter through the outlet Y.

TEMPERATURE CONTROL

As the full heater loading may not be required after the initial heating up period, switches are arranged (except in the case of the three-phase N3) so that some of the heaters may be switched off. The exact arrangement for a given plant is shown in the wiring diagram; usually 1/2 or 1/3 of the heaters can be cut out.

The filters fitted with thermostatic control the heater circuit is switched on or off by a push-button switch controlling the main contactor (white button in for "on"). Alternatively, a tumbler switch may be fitted for this purpose. A wiring diagram showing the complete electrical arrangement is supplied with each filter.

HEATER CHAMBER RELIEF VALVE

In order to prevent unnecessary pressure in the heater chamber during circulation, a lightly-loaded relief valve is fitted across the dirty oil inlet valve A, so that excess oil in the system may pass back through the dirty oil hose.

DRIVE

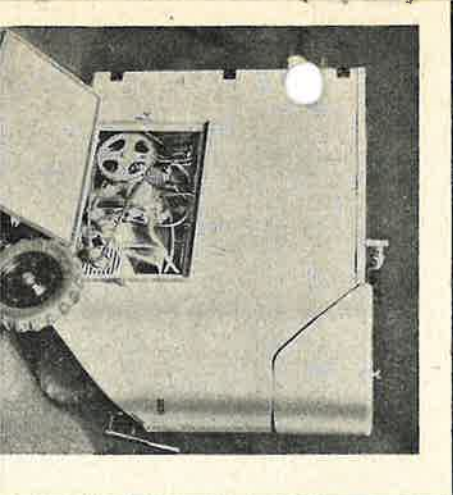
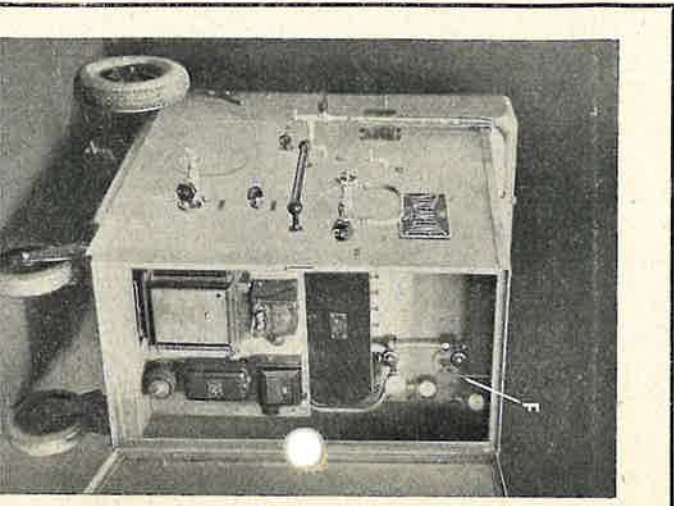
The three pumps B, G and P have a common drive by electric motor, the motor switch usually being situated at the top left hand side of the control panel. Note that the motor spindle must rotate as shown by the arrow.

GAUGES

These include thermometer for oil temperature, vacuum receiver oil level gauge, vacuum gauge, and pressure gauge for compressed air when cleaning.

N3 & N3X FILTERS

The N3 Filter has no metering pump; both the N3 and the N7 models are fitted with a throttle valve for regulating filtration rate; this valve is placed between cock D and the vacuum receiver and is situated under the re-



Operation

PLEASE REFER TO FIG. 1

STARTING UP

- 1 For N3 and N7 sizes only.—See that the throttle valve, situated under the removable bonnet, is not closed. It must be set later (see Filtering—1) to give a rate of 5 gallons per hour for the N3 or 15 gallons per hour for the N7; when once set it should not require subsequent adjustment. This valve is not fitted on the larger filters.
- 2 Test all drain cocks on plant, C, Q, R, S, T and on transformer or other Unit to be filtered for any settled water, which must be drained out.
- 3 See that vacuum pump P is supplied with sufficient lubricating oil for the run to pick up.
- 4 Connect dirty oil inlet A to dirty oil valve on Unit by flexible hose. (When the filter is empty and it is desired not to lower the oil level in the Unit, the filter should first be filled from a separate supply.)
- 5 Connect hose to clean oil outlet K, leading the other end of the hose into the filter drain tank.
- 6 Turn control handles C, D, L and J to "FILTER."
- 7 Open air bottle drain cock U. Drain cocks Q, R, S and T should be closed.
- 8 Connect up electric supply to filter.
- 9 Open fully the dirty oil inlet valve and any valve in the dirty oil line from the Unit.
- 10 Switch on motor.

CIRCULATING

- 1 When oil appears in the bottom of the gauge glass and commences to be delivered at the clean oil outlet, turn control handle J to "CIRCULATE."
- 2 Close dirty oil inlet valve, leaving open all other valves in the dirty oil line to the Unit.
- 3 Switch on all heaters, and continue circulation until 70° C. is attained.
- 4 Meanwhile connect the other end of the clean oil hose to the Unit, opening any valves in this line.

FILTERING

- 1 When the thermometer reaches 70° C. turn control handle J to "FILTER" and open dirty oil inlet valve A.
 - 2 For N3 and N7 sizes only.—Set throttle valve (see Starting Up—1) if this has not already been done.
 - 3 The temperature should thereafter be maintained within a few degrees of 80° C. by regulation of the heater switches, or, if thermostatically controlled, this temperature will be maintained automatically. If, with thermostatic control, the oil enters the filter warm and it is possible to switch off an auxiliary heater switch while still maintaining the temperature, this should be done as it leads to more economical working.
 - 4 The vacuum indicated should not be less than 27".
 - 5 The filter may now be allowed to continue working until the job in hand is completed.
- After a day's work or on completing a particular job, the filter must be cleaned by reversal with compressed air; otherwise the sludge will cool, harden on the packs and subsequently be difficult to clean off.

SETTING DOWN

- 4 Turn control handle L to "DRAIN."
- 5 Close valves on Unit and uncouple the hoses from the Unit, leading these ends into the filter drain tank, which must be placed under the filter drain cock C. The hoses are still connected to the filter.

DRAINING

- 1 Turn control handle C to "DRAIN" and open filter air vent cock R, draining oil in filter body into the drain tank.
- 2 Close air bottle drain cock U and start motor. The air bottle will then be charged while the filter is draining.
- 3 When draining is complete, place sludge tank under the filter drain cock C and close air vent cock R.

CLEANING

- 1 When pressure gauge reaches 45 lbs. per sq. in. (air bottle relief valve should lift at not more than 48 lbs. per sq. in.) turn control handle D to "CLEAN."
- 2 In a few minutes all sludge will be ejected from the filter.
- 3 Repeat cleaning if desired by turning handle D to "FILTER" until 45 lbs. per sq. in. pressure is again reached, and then to "CLEAN," allowing sludge to drain out.

REFILLING

- 1 Turn control handles L and D to "FILTER."
- 2 Turn control handle C to "FILTER" (so that metering pump B delivers to filter body).
- 3 Open air bottle drain cock U.
- 4 Remove sludge tank.
- 5 Dip dirty oil hose into oil in drain tank.
- 6 Open dirty oil inlet valve A.
- 7 When all the oil previously drained out has been taken up, close dirty oil inlet valve A and turn control handle L to "DRAIN." This breaks the vacuum and prevents oil being drawn out of the filter body into the vacuum receiver.

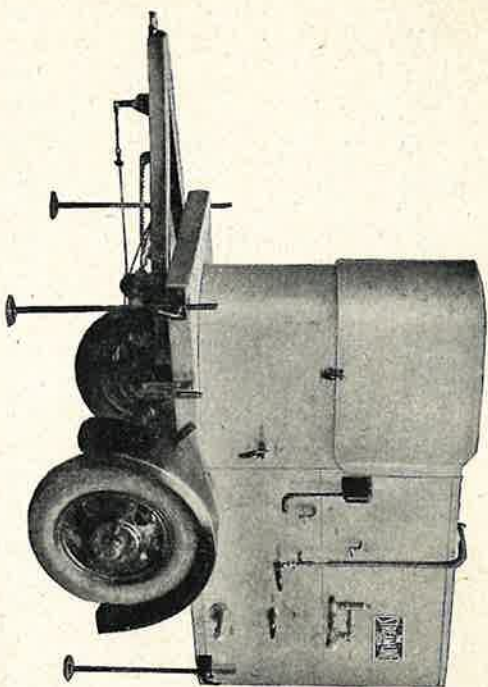


Fig. 4.—View of side panel of NTx Filter, showing control cocks.

Maintenance

OF FILTER PACKS

PACK SPRING ADJUSTMENT

When first used (and sometimes even during transport) the filter columns shrink, and shrinkage may continue a little for some weeks. This would lead to loss of compression and the possible passage of fine solid particles with the filtered oil if not adjusted by the means provided as described below.

While cleaning the filter in the usual way, open the cover drain cock Q with air pressure still on and remove any surplus oil in the cover. Do not refill with oil. Take off the removable bonnet over the filter cover and after removing any necessary pipework, take off the cover, being careful not to damage the joint ring. Tighten down the nut on each rod until the actual length of the spring is 2" for filter sizes N3, N7, N19; 3" for N37; $4\frac{1}{4}$ " for N61 and N91. (The filter type No. is stamped on the nameplate). Care must be taken while screwing down the compression nut that the filter rod does not revolve with the nut, as this would damage the papers. Replace cover, pipework and bonnet, and refill with oil.

IMPORTANT

The above adjustment should be made:

1. Before use, if more than two months have elapsed since leaving the makers; otherwise after the first 24 hours' run.
2. Again after the first fortnight's run.
3. Again after the first two months' run.

ADDITION OF PAPER

Little shrinkage should take place after this, but an occasional inspection should be made.

If, after an adjustment has been made, the compression nut reaches the bottom of the thread on the rod, or if the rods foul the cover on replacement, more paper should be added to the rods from the spare provided. For types up to N19 the whole pack unit must be lifted out over the studs, but for N37 and larger types each pack screws out of the division plate individually. The rod and pack can then

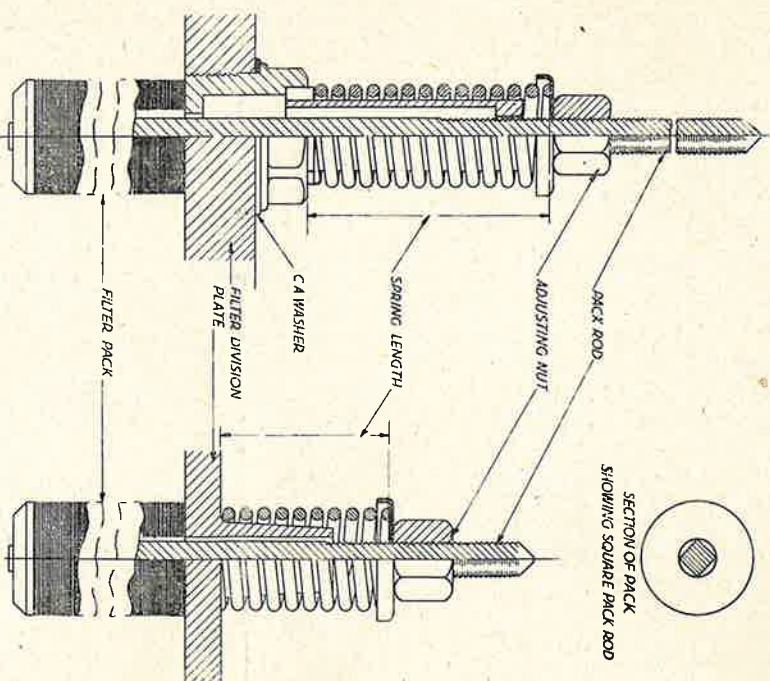


Fig. 5. Assembly of Filter Packs.

FITTING NEW PACKS

If attention has been given to the above operating and maintenance instructions the filter packs should last for a number of years without replacement. Fitting a new pack will be an investment well worth while if at any time (after long service) the filter gives low output or imperfect filtration in spite of the routine of maintenance as described on page 10.

GENERAL maintenance OF FILTER

Attention to the Operating Instructions will produce trouble-free service in all ordinary circumstances. The suggestions which follow are merely for guidance in case of any unusual departure from satisfactory performance.

Symptom	Possible Cause	Remedy
1. Low dielectric strength of filtrate	(a) Low vacuum. (b) Low temperature. (c) Pack springs not correctly adjusted. (d) Abnormal quantity of water in dirty oil.	See 3. See 4. See page 8. Test every drain cock on oil tank and filter for settled water and drain out any which is found. Circulate oil round the filter and oil tank until dielectric strength is satisfactory again.
2. Low output	(a) Regular cleaning has not been practised. (b) As (a) but accelerated by admission of abnormal quantity of varnish or compound into oil.	Clean thoroughly while hot. If not effective, remove packs (see "Addition of Paper," page 9). Keeping them end-compressed, scrape off the dirt adhering to the outside of each pack with a sharp edge, scraping firmly down the length of the pack, not circumferentially.
3. Low vacuum	(a) Joints not tight (b) Vacuum pump needs attention	See that suction hose and connections are perfectly air-tight. Tighten up all joints (it is generally necessary to do this once or twice with a new plant), glands, etc. Inspect valves and seatings—clean or adjust. If not effective, inspect piston rings which may require freeing.

Symptom	Possible Cause	Remedy
4. Low temperature	(d) For thermostatic plants : thermostat needs adjusting (b) Filtration rate may be too high. (See table page 3). (c) Supply voltage unduly low. (d) Heater faulty.	Remove thermostat cover and turn the adjusting knob a little towards the high mark. Repeat if necessary until correct temperature is obtained while "circulating." Throttle at inlet valve or, in the case of the N3-or N7 filter, at the throttle valve. As (b) until voltage is corrected. Check fuses. Remove heater cover and check connections or, if necessary, each heater. Replacements are seldom wanted.
5. High temperature	(d) For thermostatic plants : thermostat needs adjusting.	As 4(d) but turn knob towards low mark.
6. Incorrect air cleaning pressure	(d) Air bottle relief valve needs adjusting.	Adjust air bottle relief valve to keep pressure at 45 lbs. per sq. in. with pump running.

LUBRICATION OF PUMPS

For the vacuum pump a good quality medium grade lubricating oil should be used. This oil should be changed periodically, say every six months. The metering and clean oil pumps are self-lubricating.

RELIEF VALVE SETTING

The relief valves are set independently and with atmospheric suction to lift at the following pressures :

Clean Oil Pump	30-35 lbs. per sq. in.
Metering Pump	15-20 " "
Heater Chamber (Valve A by-pass)	2-5 " "
Air Bottle	43-48 " "

TRANSPORT OF FILTER

It is necessary to keep the filter body filled with oil when the plant is standing idle, and in fact this is the most convenient method of storing the oil required for circulating the plant. When, however, lightness becomes absolutely necessary for facilitating transport of the filter it is permissible to drain the whole plant *after thorough air cleaning*. It should be refilled as soon as possible after transport.