PUBLICATION
P.697

instruction manual for hydrostatic fan drive

serck technical advisory service

A record is kept of every unit and when information or spares are required, it is only necessary to quote the serial number and type number on the nameplate. A service and repair organisation is available for maintenance, cleaning and overhaul of Serck equipment at short notice.

The Serck policy is one of continuous improvement and the Company reserves the right to modify the equipment described in this manual without prior notice.

section 1 general description, operation, individual components

general description

The drive consists of a fixed displacement hydraulic pump driven from a suitable power take-off and coupled hydraulically to a fixed displacement hydraulic motor on which the fan is mounted. A controller, sensitive to the coolant temperature, governs the speed of the hydraulic motor through by-pass regulation of the hydraulic fluid. The fourth component is an oil tank containing the hydraulic fluid and housing magnetic filters.

This is the basic system. There are several variants available. These may include radiator shutters operated by hydraulic rams which are connected to the hydraulic circuit (Fig. 1) or a twin controller actuated by two cooling fluids (Fig. 1a). Various sizes of controllers are available to suit the particular application. A plurality of pumps and/or motors may be used in parallel when required but only one controller can be fitted to any complete system.

Fig. 1

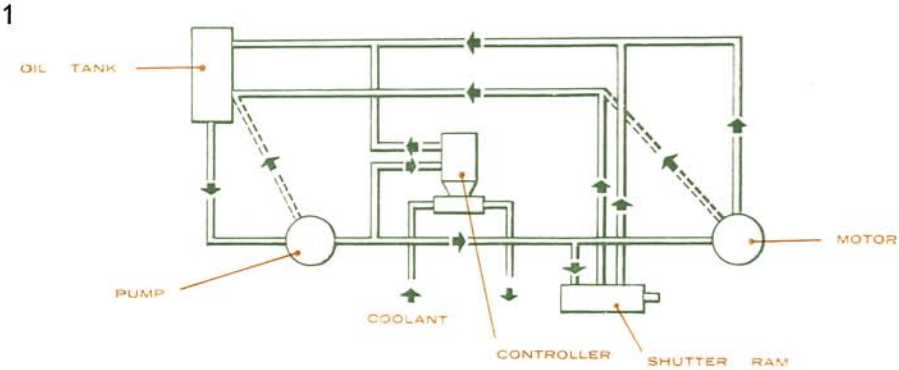
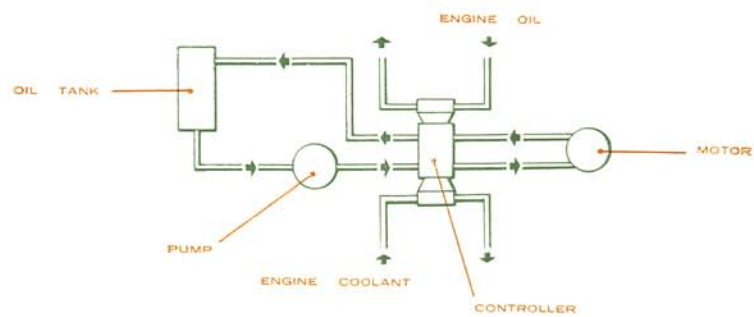


Fig. 1a



basic system

operation

On starting, the hydraulic pump begins to rotate and the hydraulic fluid is wholly by-passed through the controller so that the fan motor does not rotate. When the coolant approaches the pre-selected temperature, a thermostatic element in the controller actuates the hydraulic by-pass valve, causing some of the fluid to pass to the fan motor, which then starts to rotate. The speed of the fan increases until there is sufficient cooling to maintain the coolant at the pre-selected temperature. As the load on the engine is increased, so the fan runs at a correspondingly greater speed, always controlling the coolant at the desired temperature. The fan speed, however, will always vary with pump speed for any given coolant temperature but will automatically correct itself within about one minute as the controller responds to the new working conditions.

system with shutter ram

Shutters fitted to the radiators can easily be operated from the hydraulic system. The pressure from the hydraulic circuit is led to a hydraulic servo ram which operates the shutters. These are arranged to open at the bottom end of the fan speed curve just as the fan starts to rotate. Correspondingly, they are closed again just as the fan stops rotating. The radiator shutters close when no cooling is required and help to maintain temperature stability in the system.

system with twin controller

When there are two fluids to be cooled in the radiator equipment and only one fan to provide the cooling air, a twin controller can be incorporated.
In a twin controller the position of the valve is controlled simultaneously by the temperature of two separate fluids (e.g. engine jacket water and lubricating oil). The position of the valve and hence the speed of the fan depends upon which thermostatic element is extended farthest and thus the air flow is controlled by whichever fluid is nearest to its maximum design temperature at any particular instant. This system can also be fitted with shutter ram control.

(1) axial piston pumps and motors

individual components

A standard range of these units is available. Fig. 2 shows a cross-section through a typical unit. In general it is preferable for the pump and motor units to run in opposite directions. The standard direction of rotation is MR/PL (motor right, pump left). The direction of rotation can be reversed; however, this involves an interchange of the inlet and outlet pipes on the unit and an adjustment in the position of the control plate whilst the unit is running and should only be carried out by a Serck Service Engineer.
On all installations where the pump is direct driven, a flexible coupling should be fitted. When the drive is by V-belt, no other flexible member is required. To damp out vibration and noise generated by the prime mover flexible hoses are sometimes fitted to pump connections.
The standard type of axial piston pump/motor unit has a parallel shaft with fitted key. A collar on the inner end of the driving shaft locates the axial position of the driving or driven members and it is important that the coupling, pulley or fan should abut against this collar. On units which have a taper shaft this does not apply. Fans, pulleys, couplings, etc., are secured by means of a set bolt which screws into a tapped hole in the end of the shaft. Pulleys, fans and couplings should be pressed and not driven on to the shaft.

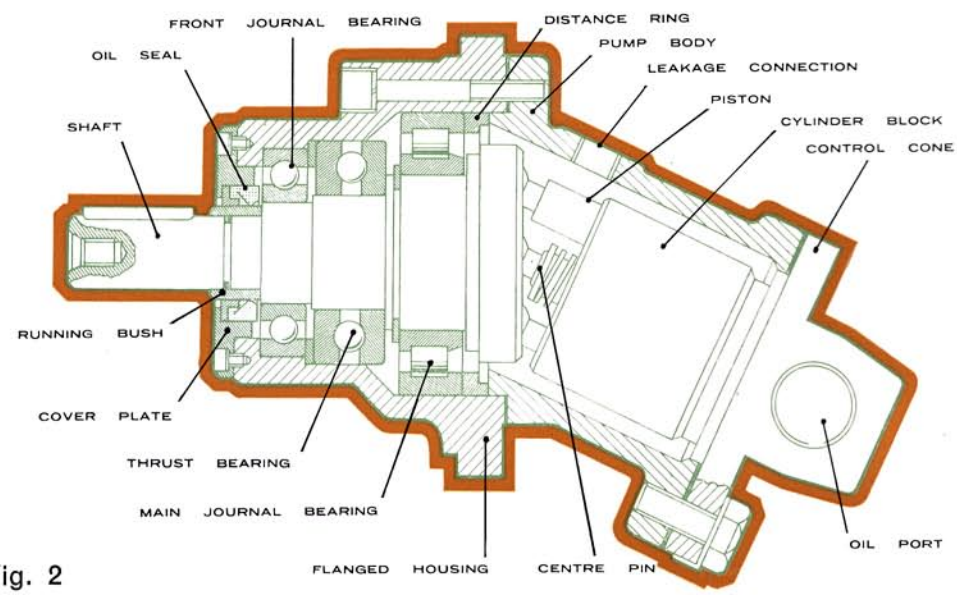
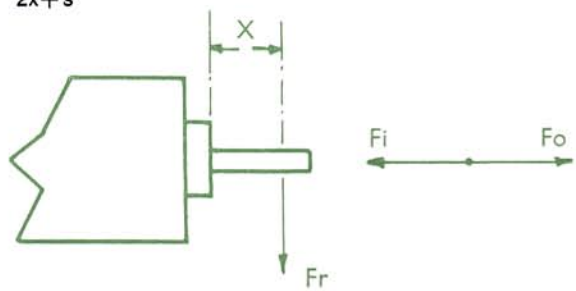


Fig. 2

The table and sketch below illustrate the permissible forces on these shafts:—

Type	Inwards Forces Fi		Outwards Force Fo		Side Loads at distance x		Distance x	
	lbs.	kg.	lbs.	kg.	lbs.	kg.	ins.	mm.
4.12.05 4.12.09	175	80	64	30	Side load is limited to the weight of a normal fan.		No belt or chain drives permissible.	
4.12.03	175	80	85	40	185	84	.75	19
4.16	350	160	175	80	415	190	1.0	25
4.20	505	230	260	120	630	290	1.25	32
4.25	780	350	395	180	935	425	1.5	38
4.32	1,280	580	640	290	1,590	710	2.00	51

For a side load acting at a distance greater than x, the permissible force is reduced in the proportion $\frac{2x}{2x+s}$ where s is the increase in distance.



The axial piston units have a leakage connection. This connection is taken to the appropriate fitting on the oil tank.

(2) gear pumps

In certain cases gear pumps are used. The bearings of the gear pumps are self-adjusting for wear and self-lubricating. Any side thrust transmitted through the drive will affect the balance of the bearings and a direct drive either through a chain or "oldham" type coupling, is therefore most suitable. If a belt or chain drive must be used, the pull should oppose the hydraulic bearings load to prevent undue wear of the bearings. Please contact Serck if further information is required. Rotation of the gear pump is not reversible and must be specified when ordering. The pump may be mounted directly to an engine. Fig. 3 shows a typical unit.

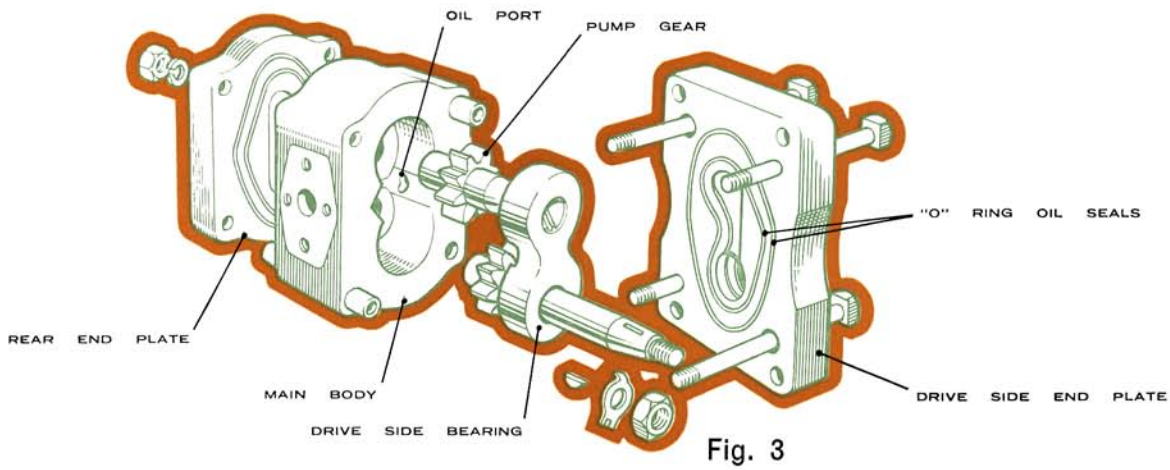


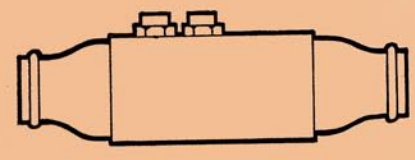
Fig. 3

(3) controllers

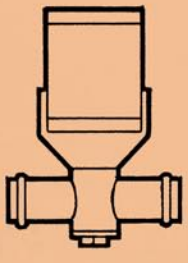
These are available in various types and sizes to suit different applications. The diagrams show the various types. The control temperature stated on the nameplate is the one at which the by-pass is fully shut, the fan thus running at maximum speed.

The controllers are set at our works and no adjustment is necessary. We strongly advise that any adjustments which may be eventually required be carried out by our own Serck Engineers; however, information on setting adjustment is available in the section on Removal and Replacement of Thermostatic Elements.

The coolant, the temperature of which is sensed by the controllers, must wash the thermal element and, depending on the type of fitting of the controller, it can either be put in a by-pass or on the main pipe, whichever is more convenient.



Series 1



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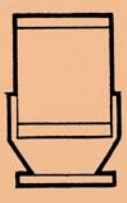
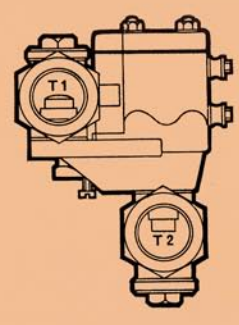
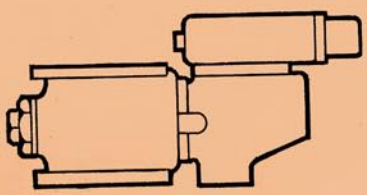


Series 4



Series 5



Series 7

(4) oil tanks

The tank should always be above the pump inlet with a pipe connection which has no sharp bends or restrictions along its length; it is also preferred that the length should not exceed 6 feet. It is advantageous but not essential that the tank should be high in the circuit; if it is very low all the hydraulic fluid will drain into it on close down and sufficient capacity must be allowed to prevent an overflow. A typical tank is shown in Fig. 4.

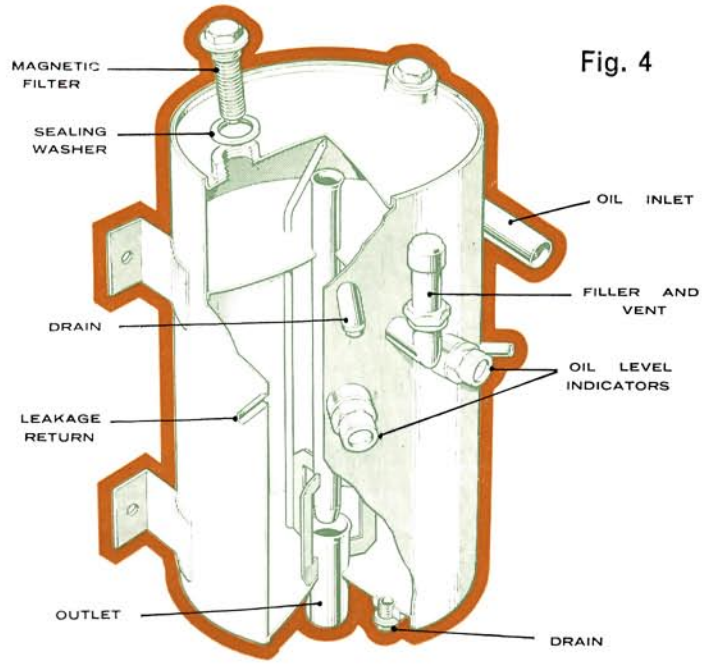


Fig. 4

hydraulic fluids

A list of recommended oils is shown below. Certain installations have exceptions to those shown but they must be approved by Serck Radiators Limited. Where straight (i.e. not HD) engine oils are used it is recommended that the oil be changed at half the mileage or time quoted for normal change periods.

any climate

Tellus "T" Oil 27
Esso Univis 54
B.P. Visco-Static
Shell X100 10W/30
B.P. Energol D.D. Multigrade

remarks

These oils are the most suitable for all round use but are more expensive than oils of a lower viscosity index.

tropics

SAE 20W/40
SAE 20 HD
SAE 30 HD
Shell Tellus 33
Esso Teresso 52
Mobiloil DTE Medium Heavy

A typical SAE 30 HD oil is the armed services OMD 110 and British Railways Spec. 662, Item 2 (a). These oils are to military specification DEF-2101-B.

temperate and subtropics

SAE 20 HD
Esso Teresso 52
Shell Tellus 33
B.P. Energol turbine oil 100-HB

OMD 110 is sometimes used in these areas; use of OMD 110 is subject to Serck Radiators Limited approval.

cold climates

SAE 10W HD
Tellus 27
Esso Teresso 43
Mobiloil DTE Light

A typical SAE 10W is OMD 40. Using too heavy a grade of oil will result in damage to pumps when handling cold oil, due to cavitation.

For equivalent oils in other makes, information should be obtained from Serck Radiators Limited.

general

If the installation is subject to relative movement between the hydraulic unit and the base to which the pipework is fixed, it is desirable that flexible hoses be put into the hydraulic circuit at appropriate places.
Before despatch each hydraulic unit is tested under working conditions. Controllers are set with the maximum fan speed temperature marked on the controller accurate to ±1°F.

section 2 installation

important

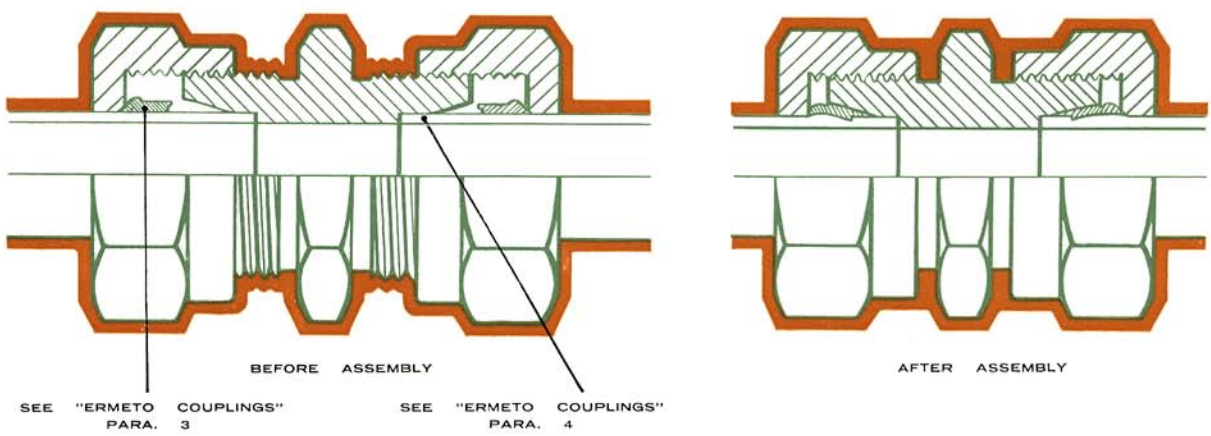
It is essential that care be taken to maintain all items scrupulously clean throughout. The ingress of any foreign matter will impair the efficiency and life of the equipment. All units are despatched in sealed condition and these seals should only be removed immediately prior to installation.

ermeto couplings

Ermeto couplings are fitted to ends of pipes by the following process:—

1. Cut end of tube square to its axis, file cut face flat and remove burrs inside and outside tubes.
2. Lubricate all parts with oil.
3. Slide nut and Ermeto ring over end of tube with the collar end of the ring towards the nut and the thin end of the ring towards the cone of the coupling body.
4. Grip the coupling body in a vice and insert the tube into the body, ensuring that the tube end butts firmly on the step at the base of the cone.
5. Position the ring in the cone, engage the nut and screw up till pipe is just gripped by the ring.
6. Screw up strongly with a spanner; the nut should be given 1¼—1½ full turns after the ring has gripped the pipe.
7. Dismantle the coupling and clean tube as below.
8. Remake the joint on site by inserting the tube into the body, engaging the nut and tightening strongly, using two spanners, one on the body and the other on the nut.

Fig. 5



pipe details

The sizes for which Ermeto nominal bore fittings are suitable is as follows:—

Nominal Bore	Approx. O.D.	O.D. Max.	O.D. Min.	Wall thickness
$\frac{1}{4}''$	$\frac{17}{32}''$	.541″	.533″	13 swg.
$\frac{3}{8}''$	$\frac{11}{16}''$	.682″	.674″	13 swg.
$\frac{1}{2}''$	$\frac{27}{32}''$	.850″	.842″	12 swg.
$\frac{3}{4}''$	$1\frac{1}{16}''$	1.066″	1.056″	12 swg.
1″	$1\frac{11}{32}''$	1.342″	1.332″	10 swg.
$1\frac{1}{4}''$	$1\frac{11}{16}''$	1.683″	1.673″	10 swg.
$1\frac{1}{2}''$	$1\frac{29}{32}''$	1.915″	1.905″	10 swg.

The material should be solid drawn steel with a tensile strength of 23 to 30 tons/square inch, fully annealed and descaled. (BSS806 class A).

treatment of steel pipes for hydrostatic drives

All pipes should preferably be bent cold.

Pipes must not be filled with sand or other filling to facilitate bending. After cutting, bending, and if necessary welding on bosses and bulkhead plates, all pipes must be treated as follows:—

(a) Remove all burrs and swarf.
(b) Degrease.
(c) Rinse in warm water.
(d) Pickle in 25% Dioxidene 170 solution.
(e) Rinse in warm water.
(f) Dry with warm air.
(g) Flush with hydraulic oil.
(h) Seal ends if not fitted into circuit immediately.

Cleanliness is essential at all times. If there is any possibility that dirt has entered pipes, or if they have been stored, the following simplified cleaning process may be used:—

(a) Flush with clean paraffin.
(b) Dry with warm air.
(c) Flush with hydraulic oil.
(d) Seal ends if not fitted into circuit immediately.

section 3 commissioning

After complete assembly of the fan control system, the following operations must be carried out when commissioning the set:—

1. Remove one of the oil tank magnetic filters and fill through the hole so uncovered.
2. Fill the tank with clean, filtered oil of the grade recommended to the level of the high level window and replace the magnetic filter. Filling can also be done via the removable breather as in (4) but it is a slower process.
3. Run the pump at its normal working speed. Certain types of controllers are not fitted with a manual control screw; in that case the fan will have to be caused to rotate by heating of the thermostatic element to a temperature near to its control temperature. Otherwise carry out the procedure as below:

Release the locking nut, when fitted, on the controller over ride screw and, using a suitable tool, screw this in until the fan is rotating slowly. There is some lost motion on the screw and this must be taken up before rotation of the fan will commence.

4. Top up the tank with oil via the breather hole, and replace the breather cap. The pump need not be stopped.
5. Screw in the over ride screw to its limit. This will cause the fan to rotate at full speed. Leave in this state for thirty minutes. Meanwhile, examine the system for leaks, and if necessary tighten joints.
6. Fully retract the manual over ride screw and, when fitted, lock by means of the locking nut in this position.
7. Shut down the pump.
8. Remove, clean and refit the magnetic filters in the oil tank as follows:—
   (a) Unscrew by central hexagon boss.
   (b) Remove filter and clamp hexagon lightly in vice.
   (c) Remove filter cage by unscrewing hexagon nut at base.
   (d) Withdraw the cage from the central bar magnet.
   (e) Wash the cage in clean paraffin and wipe the bar magnet with a clean cloth to remove any particles adhering to it.
   (f) Reassemble the cage on to the bar magnet and screw down.
   (g) Refit the filter into the tank.

NOTE: Care must be taken that the bar magnet is not accidentally dropped, nor should it come into contact with either steel or iron objects, as this would reduce its effectiveness.
Before despatch each complete hydraulic drive is run under working conditions and during the run, all joints are checked.

section 4 servicing
leakage test, service check, removal and replacement of thermostat element flexible hoses

servicing

It is essential that care be taken to maintain all items scrupulously clean throughout. The ingress of any foreign matter will impair the efficiency and life of the equipment.

(1) Inspect the oil level in the tank weekly and top up to the level of high level window if necessary. If the oil level is appreciably down, inspect the system for leaks and tighten couplings, etc., if required.
(2) Remove, clean and refit the magnetic filters two weeks after commissioning and thereafter quarterly or at every change of oil. This must be done with the set shut down.
(3) Drain the hydraulic system through the drain holes at the bottom of the tank and refill with clean filtered oil of the specified type after the following periods:—
   Locomotives and Railcars — Every 30,000 miles.
   Shunting locomotives and stationary sets — Every 2,000 running hours.

1. Remove one of the oil tank magnetic filters and fill through the hole so uncovered.
2. Fill the tank with clean, filtered oil of the grade recommended to the level of the high level window, and replace the magnetic filter. Filling can also be done via the removable breather as on (4) but it is a slower process.
3. Run the pump at its normal working speed. Certain types of controllers are not fitted with a manual control screw; in that case the fan will have to be caused to rotate by heating of the thermostatic element to a temperature near to its control temperature. Otherwise carry out the procedure as below:—
   Release the locking nut, when fitted, on the controller over ride screw and, using a suitable tool, screw this in until the fan is rotating slowly. There is some lost motion on the screw and this must be taken up before rotation of the fan will commence.
4. Remove the breather cap. Top up the tank with oil via the breather hole. Replace the breather cap. The pump need not be stopped.
5. Replace all flexible hoses and thermostatic elements every two years; ensure replacements are of the right type and size.
   When replacing hoses, cut Ermeto ring on standpipe end of the old flexible hose and remove nut so that it may be re-used with the new flexible hose if desired.

leakage tests

Every twelve months during the course of the life of the equipment a leakage test should be applied to measure possible wear of the pump and motor units; the procedure is as follows:—

(1) Fit the pressure gauge in the pump outlet pipe at the appropriate fitting provided for that purpose.

(2) Run the set under manual control until the oil reaches normal working temperature of 122 deg. F. (50 deg. C.) and adjust pressure in the system to 1425 p.s.i. (100 ATÜ) approximately, or run the set at maximum pressure if this is below 1425 p.s.i.

(3) Measure leakage flow for one minute by disconnecting pipe between pump case and the tank and measuring flow from pump case in a graduated jar. Block the open pipe from the tank to reduce oil spillage whilst doing measurement.

(4) Replace leakage pipe.

(5) Check oil level in tank and repeat test for motor at the same temperature and pressure as in (2) above.

(6) Replace leakage pipe.

Size of Unit	Maximum Leakage	
	cc/1,000 revs.	pints/1,000 revs.
12	640	1.13
16	1,160	2.0
20	2,100	3.7
25	3,700	6.5
32	6,600	11.5
40	13,200	23
50	26,000	46
55	34,500	61

These figures apply for oil falling within the classification of SAE 20 and SAE 30 grades at 50°C. When SAE 10 oil is used, i.e., for cold climates or special testing conditions, then the leakage rate will be 80% higher.
If the leakage exceeds these figures, the unit should be returned for reconditioning to Serck Radiators Limited or an accredited agent.

service check

If the drive appears to be operating incorrectly the following check procedure should be adopted.

(1) Check oil level in tank; if down, check for leaks.

(2) (a) Run the pump at correct running speed.
(b) Screw in manual over ride screw in controller to its full extent.
(c) Fan should now run at its rated speed.
(d) If shutters are fitted check that they are open.
(e) If fan does not rotate, check that pump spindle is turning.
(f) Check for rotation, if incorrect check pipework; reversal of motor connections reverses rotation.

(3) If the mechanical side of the drive is satisfactory then check thermostat element.
(a) Run prime mover at normal running speed.
(b) Allow temperature of controlling fluid to increase to that rated on controller.
(c) The fan should now rotate.

removal and replacement of thermostat elements

Wherever possible operators are strongly advised to return the controller to Serck Radiators Limited for replacement of the thermostat element. The following procedure is included for the guidance of operators outside the United Kingdom.

The Series 1 controller is a throw-away unit and is not made to be dismantled.

removal and replacement of thermostat element in series 3 and 4 controllers

(1) Screw over-ride screw fully in.
(2) Detach thermostat carrier from controller by removing four set screws.
(3) Unlock and remove cap.
(4) Hold thermostat element and remove lock nut.
(NOTE: In some models there may be two lock nuts).
(5) On the neck of the element are a copper sealing washer, a collar, and one or more spacing rings. These rings can be used to adjust the operating temperature by a small amount. The rings are 1 mm. thick, removal of one ring lowering the operating temperature by 1 deg. C., and vice versa.

to assemble

(6) Replace spacing rings, collar and sealing washer on the element and fit into carrier.

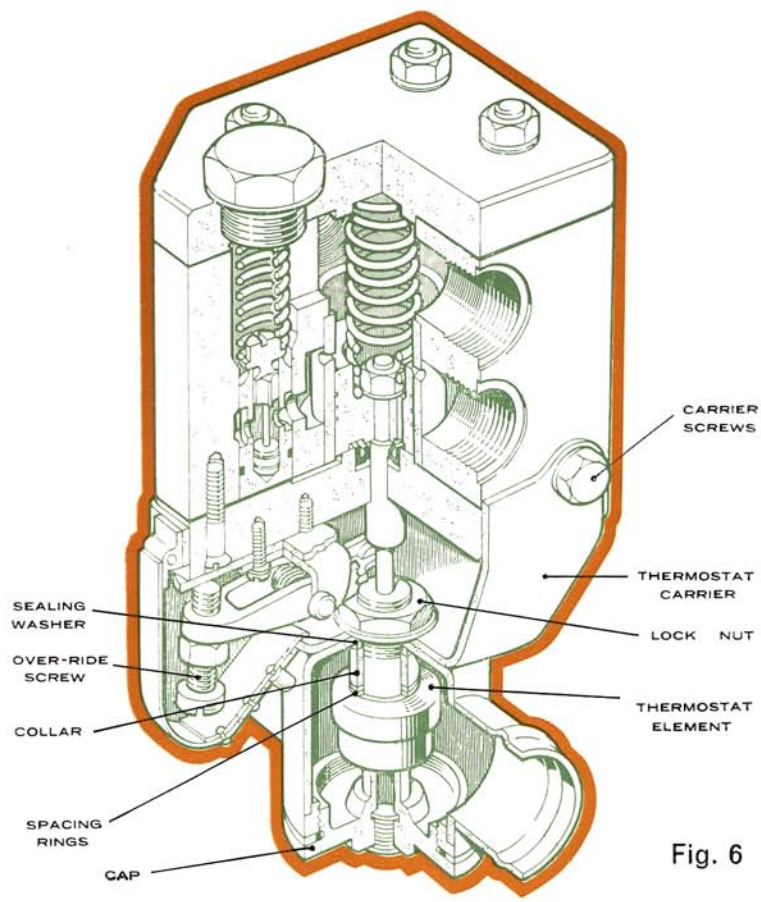


Fig. 6

removal of element in series 5 controllers

To remove element T2 on twin controller proceed as previously described for single controller, after removal of the carrier.

To remove element T1 it is only necessary to remove the lock nuts.

removal and replacement of thermostatic element in the serck series 7 control unit

(1) Screw hand over ride screw fully in.

(2) Remove adaptor with plug, locknut and screw attached.

(3) Remove element.

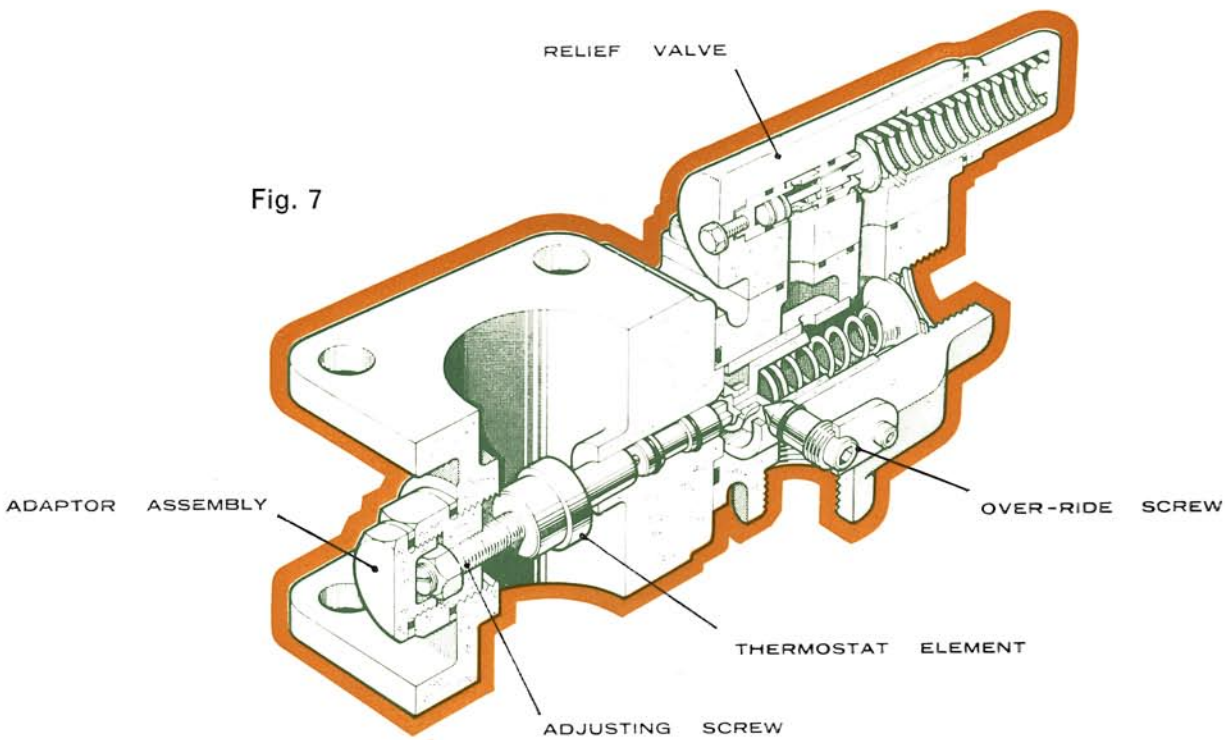
NOTE: A short length of metal tubing of suitable size to fit the Thermostat body is useful for convenient and safe withdrawal.

(4) Replace element by reversing above procedure, finally screwing back the hand over ride screw against the locking plate.

(5) When refitting the element it may be necessary to reset the operating temperature and this is best carried out while the fan is running on automatic control.

Remove the plug and loosen the lock nut. Turn the adjusting screw clockwise to lower the temperature and anti-clockwise to raise the temperature ($\frac{1}{2}$ turn per 1°C.). Do not try to lower the temperature below that marked on the nameplate as serious damage may be done to the controller when it reaches working temperature. Tighten the lock nut and replace the plug when the desired setting has been obtained.

Fig. 7



flexible hoses storage conditions

The following are the recommended conditions under which synthetic rubber hoses should be stored:

(1) Store flat and relieved of unnatural stress, i.e., not tightly coiled, and with no weight resting on them.

(2) Correct sealing caps should always be fitted.

(3) Store in a cool atmosphere, not exceeding 80 deg. F. (27 deg. C.) in which air should be circulated freely.

(4) Protect from direct sunlight and store away from electric motors.

(5) Prevent contact with oils, solvents or any substance likely to be harmful to the hose material.

Under these conditions, flexible pipes can be stored for periods up to four years.

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