SMITHS CAR HEATERS

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Manufacturers: Smiths Motor Accessories, Ltd., Cricklewood Works, London, N.W...

READERS of these articles will have noted how many of the components reviewed are engendered through the comparative limitations and inefficiency of the internal combustion engine. It therefore comes as a change to deal with a component which turns to advantage this very inefficiency.

The internal combustion engine produces power supplied by a fuel, which is converted into heat energy. This it does comparatively inefficiently, and in actual fact only a small percentage of the energy released is utilized to drive the vehicle, the remainder of the heat being necessarily wasted in cooling the engine to a temperature at which it will operate satisfactorily, in the exhaust gases, and so on. In the vast majority of cars water (or liquid coolant) is employed as an agent to transfer heat from the engine cylinder block and head to a radiator favourably placed in the airstream to dissipate the waste heat.

In early cars the water circulated in the engine-radiator system by the principle of the thermo-syphon, that is, circulation relied on the fact that the less dense hot water would rise to the header tank, sink through the radiator as it cooled, pass into the engine to be reheated, and so on. More efficient engines required a more positive circulation of coolant, and so the water pump was added. Although the word "pump" is normally used, no great pressure is developed, and "impellor" would be a better term.

The thermo-syphon system of cooling is to some extent self-regulating because no circulation takes place until sufficient heat is generated by the engine to cause circulation. When a water-pump is fitted, however, coolant will circulate as soon as the engine is started, which would mean that the engine would take a long time to reach its working temperature—a thing to be avoided as the greater part of engine wear occurs during this phase of operation. For this reason the circulation of water is controlled by a thermostat. This is a simple poppet valve operated by a bellows of thin metal containing a fluid. When the coolant surrounding the engine is below operating temperature, the valve prevents water from flowing through the top hose into the radiator, the comparatively small amount of coolant in the engine being circulated in a closed circuit. When the operating temperature of the engine is reached, the bellows expand, unseating the poppet valve and allowing water to circulate through the radiator. Note that the temperature at which the thermostat opens varies with different cars and that in some cases a "hotter" thermostat is fitted for use in winter. Always check that thermostat is to manufacturer's specification.

In early cars hot air from the radiator would find its way into the body of the car impartially in summer and winter. When more effective insulation and body-sealing was adopted, and body design generally improved, this hot air was excluded, and it soon became apparent that a heater for the interior of the car would be desirable. It would be possible, as has been done, merely to have collected, by ducting, some of the hot air from the radiator, but this has a number of obvious disadvantages.

The modern approach to interior heating is to employ a separate radiator inside or adjacent to the driving compartment. To provide a flow through the radiator in this position it is usually necessary to employ a fan. Recirculating heaters, that is, those which heat only the air which is already inside the car body, consist of these two basic units—a radiator and a fan. Heating and ventilating (or fresh air heater) units bring in fresh air from outside the body and heat it, if required, and have control valves for air and water flow.

Apart from ensuring the physical comfort of the driver the heater also serves to keep the windscreen clear of mist and frost and thus aids visibility and safe driving. In addition, the heating and ventilating unit has the effect of slightly pressurizing the car body, which prevents minor draughts and, incidentally, aids dust- and weather-sealing.

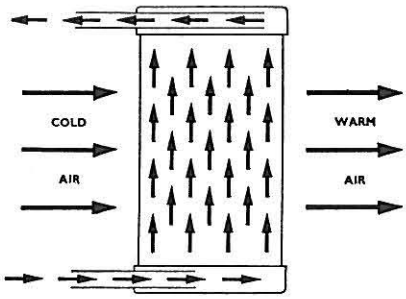
Smiths Motor Accessories, Ltd., provide heaters and heating and ventilating units for most British cars as standard or optional equipment. In addition to this "tailor-made" equipment, other types are sold as accessories suitable for many other models. For instance, one model is sold for use with thermo-syphon cooling systems in which a special water pump circulates water through the heater.

Heater units are basically simple in construction and there is little to go wrong. If heater trouble is experienced it is usually found that the fault is due to the installation or a fault in the cooling system, and it is a mistake to assume immediately that the heater unit is faulty. If it is found that the heater unit itself is at fault, after checking on the other possibilities, Smiths operate a factory reconditioned unit scheme for the replacement of all major assemblies.

Operation

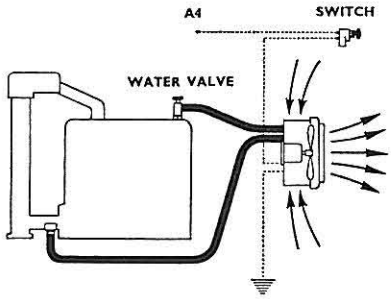
In all types of heater there are only two factors to be considered, air flow and water flow. Air flow is provided by a fan, a forward-facing air intake, or both while water flow is provided by the pump from water circulating in the engine. Thus the temperature of water passing through the heater is that maintained by the thermostat, to all intents and purposes.

The heater element consists of a hot water radiator which has two tanks linked by a series of thin metal tubes separated by corrugated metal strip. Hot water passes upwards through the tubes and heat is conducted to some hundreds of square inches of the surface of the corrugated strips. When air passes between

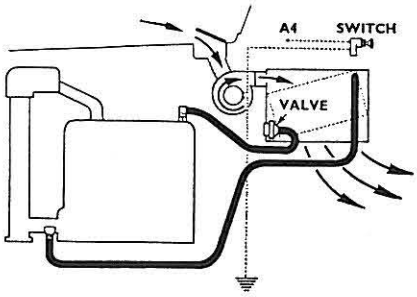


these strips, the heat is transferred to the air. The air is then ducted to the car interior or windscreen demisting apertures as required.

Heat output is measured by the volume of air heated in unit time and the temperature rise of the air which is heated. These two factors should be remembered because sometimes air output temperature is sometimes confused with the output of the heater. Output is rated by its equivalent in kilowatts.



Recirculating Heaters. As shown in the diagram, the recirculating heater consists of a hot water radiator connected to the top of the cylinder head and the bottom engine water outlet or equivalent points in the cooling system. Air is circulated by an electric fan which draws air in through the annular radiator and emits it from the centre of the core. Air flow is controlled by a rheostat switch, giving variable fan motor speed. Water flow is controlled by a simple water valve which is normally opened in winter, and closed in summer, to prevent local direct radiation from the heater core. In winter the output is controlled by the fan motor speed. Since only the air inside the car body is heated, the unit need have only a comparatively small output, because, owing to the recirculation of air, the intake temperature constantly rises, with a "snowball" effect on output temperature.

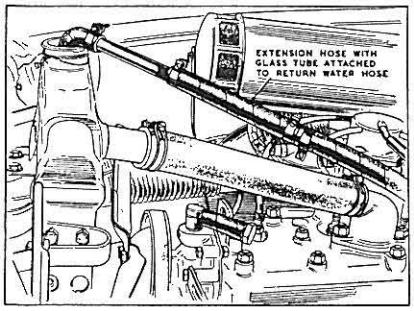


Fresh Air Heater. This system is more complicated and thus varies considerably in detail arrangement to suit different applications. However, the same basic features are common to all systems. In these heaters the radiator connections are the same, but instead of a simple water valve there is a cable-controlled valve on the heater unit itself. In some models this is an "on-off" valve, but the latest type gives different degrees of water flow between these limits. Air flow is through a forward facing air intake (usually), sometimes in the nature of flap on the scuttle, as shown, through the booster blower and via the radiator, enclosed in a metal box, to the heating and demisting outlets. Note that while the vehicle is in motion, and the intake vent is open, there will be a flow of air. This can be increased by switching on the booster blower.

Since the air to be heated is constantly at the temperature of the outside air, it is apparent that the fresh air heater must have a greater output than a recirculating heater operating in the same conditions. By a system of flap valves and the water flow valve it is possible to vary the temperature of air entering the car from that of the outside air to "hot," and to control the quantity and temperature of air diverted to the windscreen. The manual controls are usually in the form of a quadrant with two levers, one for controlling the condition of ventilating air entering the car body, the other the condition of air reaching the windscreen. In some cases the motor switch is incorporated in the ventilation control. In other cases a control is provided for the air inlet vent, which must be open for the heater to operate, for without air flow there is no heat output. Despite the varying ways in which controls are arranged, and the types of control, an understanding of the theory of operation will enable their correct use to be deduced if no information is available on the specific model. The various positions of the controls of a $3\frac{1}{2}$-kW fresh air heater and position of the flap valves inside the air box in a typical application are shown.

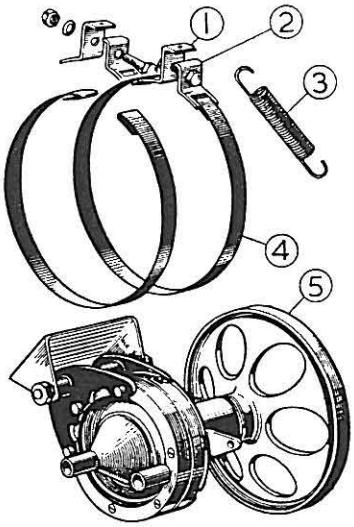
Service Operations

Bleeding. This operation is necessary to eliminate or check for air or steam locks.



Disconnect heater return hose at end where it connects to engine cooling system, plugging return point to prevent loss of water. Fit loose end of return hose with a bleeder pipe, a piece of glass tube and a further piece of hose as shown in diagram. Lead end of bleeder pipe to radiator cap; this is not only to prevent loss of water, but also to ensure that end of pipe is at right height. Start up engine and speed up so that water is forced *under pump pressure* through heater and out through bleeder pipe into radiator. Air or steam in system can be seen in the form of bubbles passing through glass bleeder pipe. Continue operation until no more bubbles appear.

Fitting Water Pump. (Auxiliary for thermo-syphon cooling systems.) Check diameter of dynamo and bend clamp bands (4) on corresponding mark on band.



Fit one of each of the clamp buckles (1) and (2) in bend of band, and clamp in vice.

Pass these bands through pump bracket and also round dynamo, and adjust the position so that the pump pulley runs squarely in the centre of the fan belt. Secure the bands with the $\frac{1}{4}$in B.S.F. screws, nuts and washers supplied.

Pump spring (3) is then attached to clamp bracket and pump bracket to insure that pulley (5) is kept in contact with belt. Spring tension must be sufficient to drive pump, but not so great as to distort belt.

Installation. It is absolutely essential that there should be no air leaks at any hose joint or union and that hoses are not kinked. When demister tubes are installed care should be taken to ensure that they are not kinked, because any obstruction to air flow will affect balance of air supply to the orifices. When recirculating heaters are fitted it is important that the inlet and outlet pipes should be at the top, or as nearly vertical as possible. If they are to one side heater will not operate correctly (due to difficulty in clearing air locks). When fitting upper connection on side valve engines tap off water at as high a level as possible, as a position immediately on top of the cylinder head may give rise to steam locking.

Fault Finding

LACK OF AIR FLOW

Heater Fan, or Blower Rotor, Not Rotating

Should a heater fan or blower rotor fail to rotate, check in the following order:

(a) Electric Wiring. See that connections are made and that no lead is disconnected or broken. Check fuses.

(b) Fan or rotor fouling. Make sure that fan or rotor is free to rotate. Adjust setting on motor spindle if necessary. On circular heaters fan screw can be reached through demister outlet port. On separate blower units rotor can be adjusted with small spanner or Allen key through intake.

(c) If checks on (a) and (b) are satisfactory, it is almost certain that the motor itself is at fault, but a final check can be made by applying the appropriate current (6 or 12 volt) direct to the motor leads. Return faulty motors for replacement.

Blocked or Restricted Fresh Air Intake

Forward facing intakes (including scuttle ventilators) are free to pick up any solid particles in the atmosphere simply by virtue of the vehicle's motion. Most fresh air intakes are provided with gauze filters, and these can collect mud, dust, insects, and so on, which are encountered on the road. Inspect the intake, and clean away any solid matter which has collected. Where a filter is not visible, one is usually provided pressed into the blower intake, and the flexible air hose attached to the blower intake has to be unclipped and pulled off to reach the gauze.

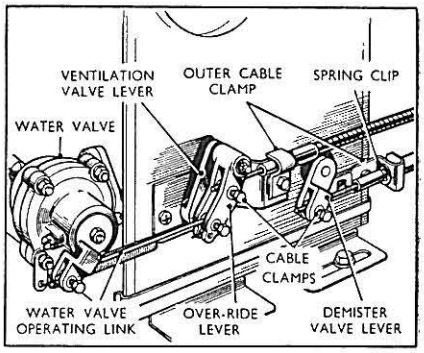
Heater Valves Inoperative (Fresh Air Heaters)

It is unlikely that valves in the heater unit itself will become displaced, or otherwise faulty, but the flexible cables controlling these valves can get out of adjustment due to "slip" where they are anchored at each end. Obviously, correct control over the air flow into the car, and on to the windscreen, depends upon the heater valves obeying the lever position on the control panel, and such will not be the case in the event of cable slip or incorrect anchoring. The best method of checking is as follows:

Heating/Ventilating Control Adjustment

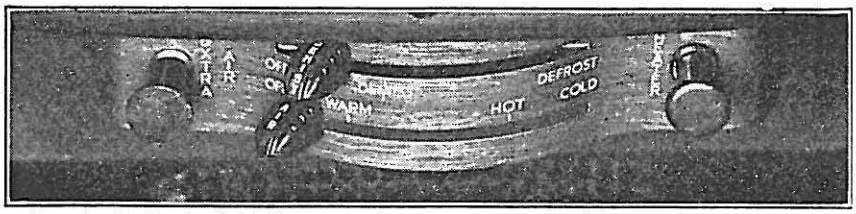
(a) Move ventilating control lever on facia panel to "off" position—the air valve lever on the heater unit should now be at its extreme forward position and negligible air should enter the car with the blower running (i.e., only reasonable valve leakage).

(b) Move ventilating control lever to "hot" position—the lever on heater unit should now be at its extreme rearward position with the water valve about to commence closing (i.e., with only slight movement of the water valve lever towards closed position).

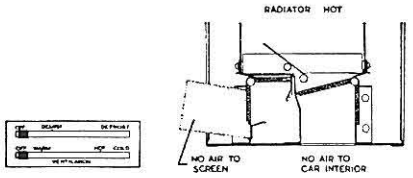


(c) If the correct operation (a) or (b) is not being obtained, the length of the inner member of the control cable must be adjusted. This may be done at the control end or the heater end, whichever is the more convenient. Slacken clamping screw in cable trunnion, slide cable through by an appropriate amount and re-tighten screw. Re-check as in (a) and (b) above.

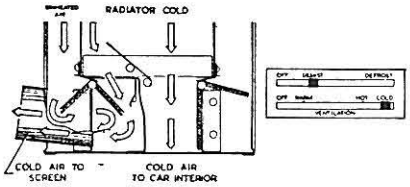
(d) Move ventilating control lever to "cold" position—the lever on the water valve should now be in the vertical position with the water flow to the heater cut off. After 2-3 minutes (with blower and engine running) air entering the car should



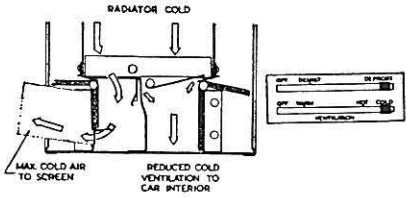
Controls of a Smiths 3½-kW heating and ventilating unit. In addition to the usual controls, in this case, there is a knob giving an extra supply of unheated air, on the opposite side to the heater motor switch



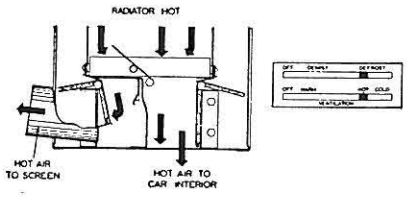
In the "Off" position of both heating and ventilating controls flap valves prevent the flow of air to the screen and the car interior



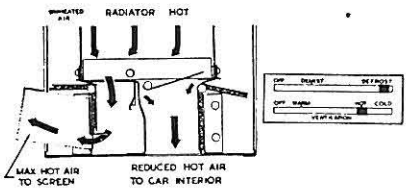
In warm weather when a general supply of cool air is desired, the ventilating control is moved to "Cold" and the screen air control to "Demist." The water valve is shut and the air flow is as shown



For maximum air circulation at head level, in warm weather, the ventilation control is moved to "Cold" and the screen air control to "Defrost", when more air is diverted to the screen from the supply to the interior



In cold weather the ventilation control is moved to a position between "Warm" and "Hot" and the screen control to "Demist". Hot water is now passed through the radiator and the air is divided between screen and interior. For maximum heating, screen control is moved level with ventilation control at "Hot", and motor switched on

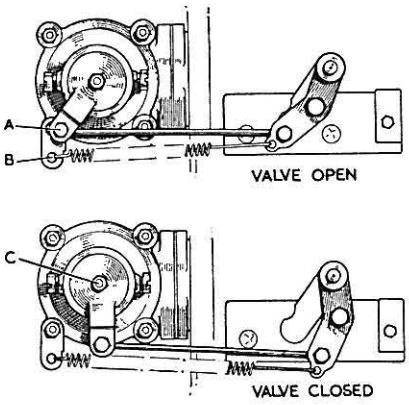


In freezing conditions when ice forms on screen, the ventilation control is set at "Hot" (or "Off" in extreme conditions) and the screen control moved to "Defrost". Major quantity of hot air is then directed on to screen

be cold. If this is not so, it indicates that water is still flowing through the heater core. This may be checked by removing top (return) water connection hose and observing whether water is issuing from the heater core when the engine is running at normal speed, the open end of the hose being closed manually during running.

(e) If water flow is not entirely cut off, unhook the spring at B and loosen off hexagon screw A to release the link rod. In the "valve open" position, the water valve lever should move without any resistance, and as it reaches the "valve closed" position, a slight resistance to movement should be felt, due to the sealing diaphragm pressing down on its seating inside the valve.

If this resistance is felt *before* the vertical position of the lever is reached, or no resistance is felt at all, the necessary adjustment should be made by loosening



Adjusting water valve lever (earlier type)

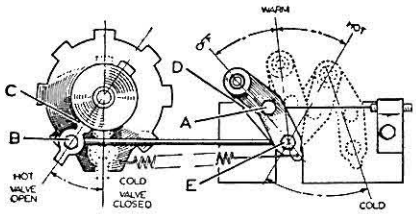
off the lock nut C and giving a slight turn to the centre screw—clockwise to increase resistance, anti-clockwise to reduce it.

If it is found impossible to achieve the necessary adjustment, the fault will be an internal one, and will almost certainly be due to a deformed diaphragm. The diaphragm should be removed by unscrewing the four hexagon screws which hold the two halves of the water valve body together. This operation can in most cases be carried out without removal of the valve from the heater unit. Fit a new diaphragm over the spigot of the centre screw, and press the flange into the body recess. Replace the body fixing screws and readjust as above.

Later type of water valve, identified by "castellated" body with no screws, is sealed on assembly. If diaphragm is faulty, fit replacement valve.

To Adjust Car Heat Cable with Later Type Valve

Set ventilation (or car heat) control on facia panel to "off" position. Slacken trunnion screw A. Rotate air valve lever D fully to "off" position. Rotate water valve lever C fully to "hot" position (trunnion D should now be approximately over air valve spindle centre). Tighten trunnion screw A.



To Adjust Relationship of Later Type Water Valve to Car Heat Air Valve

Set ventilation (or car heat) control on facia panel to "cold" position. Slacken trunnion screw B or E. Holding air valve lever D in "hot" position and water valve lever in "cold" position (i.e., vertical) tighten trunnion screw B or E.

Demisting/Defrosting Control Adjustment

(f) Move demisting control lever on facia panel to "off" position—the demist valve lever on the heater unit should now be at its extreme forward position and no air should pass through the windscreen nozzles with the blower running.

(g) Move demisting control lever to "defrost" position—the lever on heater should now be at its extreme rearward position.

(h) If the correct operation at (f) or (g) is not being obtained, adjustments must be made as for (c).

LACK OF WATER FLOW

Air Lock in Heater Matrix or Water Circuit

The most common of all water flow troubles is an air lock, and the recommended method of checking or its existence and ensuring its removal is by bleeding as described above.

On the subject of air locks, there is a condition which is called *persistent* air locking, and this simply means that after continued efforts to remove air from the system by bleeding, bubbles still pass along the glass tube with no sign of a solid column of water ever being produced. Persistent air locking can be caused by hose clips being insufficiently tightened, cylinder head gaskets not properly tightened down, and another cause, which is not nearly so rare as might be

imagined, is a cylinder head gasket which has blown internally. If tightening down of the cylinder head nuts and the checking of all clips fails to produce a solid column of water, then the cylinder head gasket should undoubtedly be checked. Upon examination, it may well be found that combustion gases are blowing across one of the gaps between the combustion chamber and water jacket apertures which will cause air locking in the system. This can happen without the performance of the engine being noticeably affected.

Faulty Thermostat

Faulty thermostats can, of course, quite easily be visually checked if the valve is in the open position, but it should also be remembered that a thermostat can be faulty due to the metallic bellows having gone "weak," resulting in early opening, and the easy way to check is in a saucepan of water heated over a gas ring, and check the opening temperature with a thermometer. If thermostat opens at temperature more than 5 deg C lower than that specified, replace. All Smith's thermostats have the correct opening temperature stamped on them (usually between 70-80 deg C, or 158-176 deg F).

Partially Blocked Radiator

It has to be admitted that it is not easy to establish whether the water tubes of a radiator are free from blockage, since if water flow is applied to one radiator pipe, water will flow freely from the other pipe if a reasonable proportion of the water tubes are free. As a general guide, however, if the condition of a cooling system is dirty, and there appears to be a considerable amount of rust sediment present, then it is reasonable to suspect that a proportion of this might well be lodged in the heater radiator itself.

If blocked, flush in normal and reverse direction under mains water pressure. If radiator is still blocked, replace.

Furred-up Water Hoses

Furred-up water hoses is another fault which can only be checked visually. Very few car owners keep the cooling system of their cars as clean as they should be, and minute particles of rust deposits from the water do in time "fur-up" water hoses. When the build up of solid matter is excessive, restriction to the normal flow of water will take effect, and hoses should be replaced. Also check that hoses are not "kinked" anywhere, as this is another cause of restriction. Check for soft spots on older rubber and canvas hoses, as inner layer of rubber sometimes breaks away and obstructs hose.

Water Valve Out of Adjustment (Fresh Air Heaters)

The screw down type of water valve normally used with recirculation heater installations seldom gives any trouble, but the lever type water valve used with heating and ventilating systems is a more delicate unit, and some slight adjustment may be necessary from time to time. The correct operation of one of these water valves can usually be assessed without its removal from the heating and ventilating unit, and this has already been described under the heading "Heating and Ventilating Control Adjustment."

Whilst on the subject of the heating and ventilating system water valve, it should be mentioned that there are two types. The most common is intended for simple "on" and "off" operation, but some cars are fitted with what is called the "metering" type. This latter valve has a longer lever travel, and over the length of this travel is determined the quantity of water which shall enter the heater radiator.

Fundamentally, both types of valve are of the same construction, but the method of internal operation differs. A rubber diaphragm achieves, not only the closing of the valve in the "on-off" type, but also acts as a water seal. In the "Metering" type, the closing, and predetermined opening of the valve, is by means of a calibrated plug which forms part of the rubber diaphragm assembly, and this diaphragm again acts as a water seal.

Less Common Faults

Heating and ventilating Systems Not Producing Cold Air in Summer.

Complaints coming under the above heading are difficult to generalize but on heating and ventilating systems, due to their normal fitting within the engine compartment, they must obviously be affected to some extent by under-bonnet conditions. For example, air hoses are not of very robust construction, neither have they very great insulation properties; thus, if a fairly long length of hose is contained beneath the bonnet, it can be expected that this component will get very hot due to under-bonnet temperatures, and accordingly, unless the blower is switched on to promote a good air flow, air issuing into the car via the heating and ventilating unit, particularly in hot weather conditions, is liable to be warm. The only cure for this condition is some additional insulation between the heater air hose and the engine compartment to prevent heat pick-up.

Restricted Heater Intake Pipe.

This is not a common fault, but it has been encountered. Low heater output is accompanied by a "gurgling" or "running water" sound from the heater unit. When this has occurred it has been found that the heater intake pipe has been partially blocked where it leaves the engine.

Heat by Radiation from Heating and Ventilation Systems.

Another complaint which arises, again mostly in hot weather, concerns those cars where the heater unit is actually within the passenger compartment, e.g., Austin Cambridge. In this particular case, when the controls are in the "off" position, hot water is still passing through the heater unit since the water valve is not in the closed position, thus it is possible for the interior of the vehicle to be affected by radiated heat from the unit itself. In this case, one can only advise the motorist that the intended position of the ventilation control under warm weather conditions is at "cold." In this position, the water valve, being closed, is preventing the circulation of hot water through the unit and, therefore, the latter remains cool. It does mean, of course, that the cool air flow is being circulated within the car, since the ventilation valve is open to its fullest extent, but this should normally be ideal in the type of weather conditions under consideration.

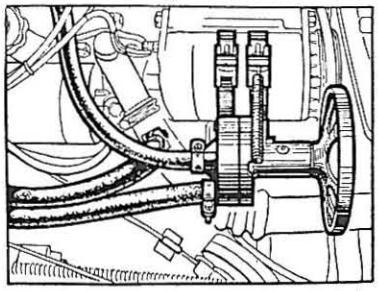
Heaters Working on Thermo-Syphon Cooled Systems Without Water Pump in Operation

Complaints are received from time to time concerning thermo-syphon cooled engines where the dislocation of the pump pulley from the fan belt does not prevent the operation of the car heater. This is known to be rather prone on certain Ford Prefects. Of course, the heater is not working at anything like normal efficiency, but under warm weather conditions, any operation from the heater will be a discomfort. The introduction of a water control valve between the supply connection in the top hose and the water pump inlet, overcomes this trouble, but from an engineering point of view this is not very sound practice owing to the fact that the water valve has to be adapted to the universal hose connector, thus applying considerably more weight to this accessory than it is intended to carry. Usually the addition of a water valve to this connector means the pulling away of the connector from the top hose in due course. This practice cannot be recommended.

The simplest possible procedure to overcome the objection of a heater working from a thermo-syphon cooled engine without the pump in operation is to drain and refill the cooling system, thus introducing an air lock, and this will definitely prevent the heater working. This air lock must, of course, be cleared in the usual way before the heater is required during the subsequent winter.

Fan Belt Wear with Auxiliary Water Pump.

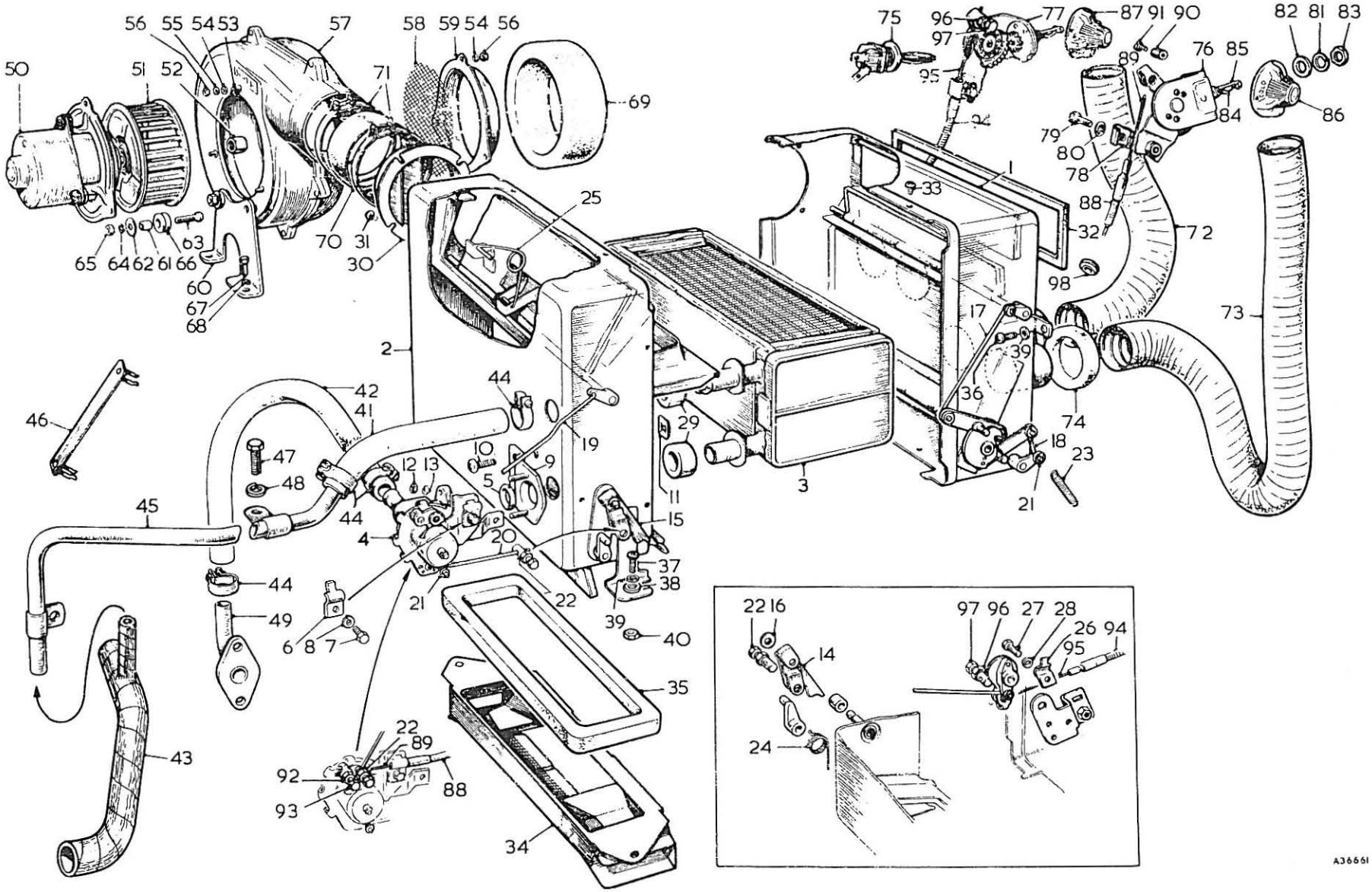
A further complaint which sometimes arises on thermo-syphon cooled engines is excessive fan belt wear due to the running of the water pump pulley on the outside surface. Experience suggests that with a fan belt of reasonable quality, excessive wear should not occur, and those cases which have been investigated, suggest two main reasons for the fan belt wear: (a) Water pump out of alignment resulting in the pulley giving a sideways thrust to the belt, therefore producing a stripping action, and (b) excessively tight water pump bearings resulting in pulley slip and consequent wear by friction on the belt.



It should be appreciated that the design of the water pump location by means of clamp bands round the dynamo is intended to produce a contact with the fan belt on the dynamo pulley itself, so that the belt is "clamped" between the two pulleys. Provided that the fan belt is of reasonable quality, this arrangement produces smooth running and should certainly not give rise to excessive belt wear.

Draining and Cold Weather Precautions

Note that where a heater is fitted draining the cooling system is not an effective frost precaution, since capillary action will retain some water in the heater water tubes. Thus it is recommended that when a heater is fitted, antifreeze should be used during the winter months. In any case draining and refilling the system will probably result in air locks which would entail frequent bleeding to give efficient heater operation. Where Smiths heaters are fitted, Bluecol antifreeze is recommended for use.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