THE XPAG – XPEG WATER PUMP

My first new car was a 1951 Morris Minor convertible. It had a slightly less than 1 liter side-valve, flat-head engine. Cooling was by a thermo-syphon system that had been widely used on pre-WW2 cars. When Claude Bailey designed the XPAG engine, he added a water pump to the Morris engine to boost the natural action of the hot water to rise. It was not positive displacement like an oil pump, but merely assisted the flow of the water.

I acquired my TF-1500 in the early 70s knowing little about it even though I had driven a new one in 1955. I didn't even know that it had a wood-framed body. It turned out that the crankshaft was broken, the wiring was burned up, the wood was rotted and sheet metal was covered with bondo. A complete rebuild was undertaken. During this period, I purchased an "all brass" water pump from Clover Machine Works in California which advertised a stainless steel shaft, a six-blade impeller, sealed bearings and a modern industrial-type seal. The same pump was advertised by Moss Motors in the August 1980 issue of *TSO* on page 63 for $77.50. It was referred to as the best water pump available for your MG and one that would cure your cooling problems.

I drove the TF on many long trips and didn't have any serious cooling problems, although the fan blades often required tightening and there was some leaking around the gasket. At the 1996 GOF in Ottawa, I put the TF through the Safety Fast inspection and learned that the fan blades were so loose that they would have gone through the radiator if they hadn't been installed backwards! (Reinforcing plates should face forward; rear blade has offset holes.) I discussed my problem with others at the banquet and afterwards, a small group assembled around my car in the underground garage to help remedy the problem. One person thought that original water pumps had tapered shafts (my brass one didn't) and that that was the cause. Another offered me the use of his garage the following day. Fortunately, through a group effort and adequate tools the fan blades were reversed and tightened on the shaft. This was the start of my interest in water pumps. In reading *TSO*, the *Octagon Car Club Bulletin*, ("OCCB"), and Safety Fast ("SF"), I have noted the following water pump problems:

1. Loose pulley and fan blades,
2. Leaky gasket,
3. Leaky seal,
4. Improperly installed pulley, and,
5. Wear on the face of the impeller shaft.

Replacing leaking water pumps was a common occurrence on cars 20 to 50 years ago. One could go to an auto parts store, obtain a rebuilt pump and install it without much cost or trouble. Jack Gillis publishes *The Car Book* every year to rate the new cars. He estimates maintenance costs over the life of a car by listing the cost of nine repairs that typically will have to be made. The first on the list is replacement of the water pump. It is a recommended practice to replace even a non-leaking water pump on newer cars when other repairs, such as replacing a timing belt, have made the pump easily accessible so as to avoid a large labor expense when the pump does eventually fail. This concept is applicable here since the workshop manual states that if the pump needs to be serviced, the first step is to "remove the radiator." In the case of a TF, it states that the tie-bar between the valances should also be removed. This is not a task to be undertaken on the side of the road or in a parking lot. I have

done it, but as you will see from the following, it is only a temporary fix that will have to be repeated.

WATER PUMP DESIGN

In order to determine the kind of repair to be made – whether to replace parts or whether to replace the pump or pulley – it is best to understand how the pump works and any weak points it may have. If your car is driven so little that the pump never fails, what follows is only of academic interest. The following illustration is from page D.5 of the TD and TF Workshop Manual.

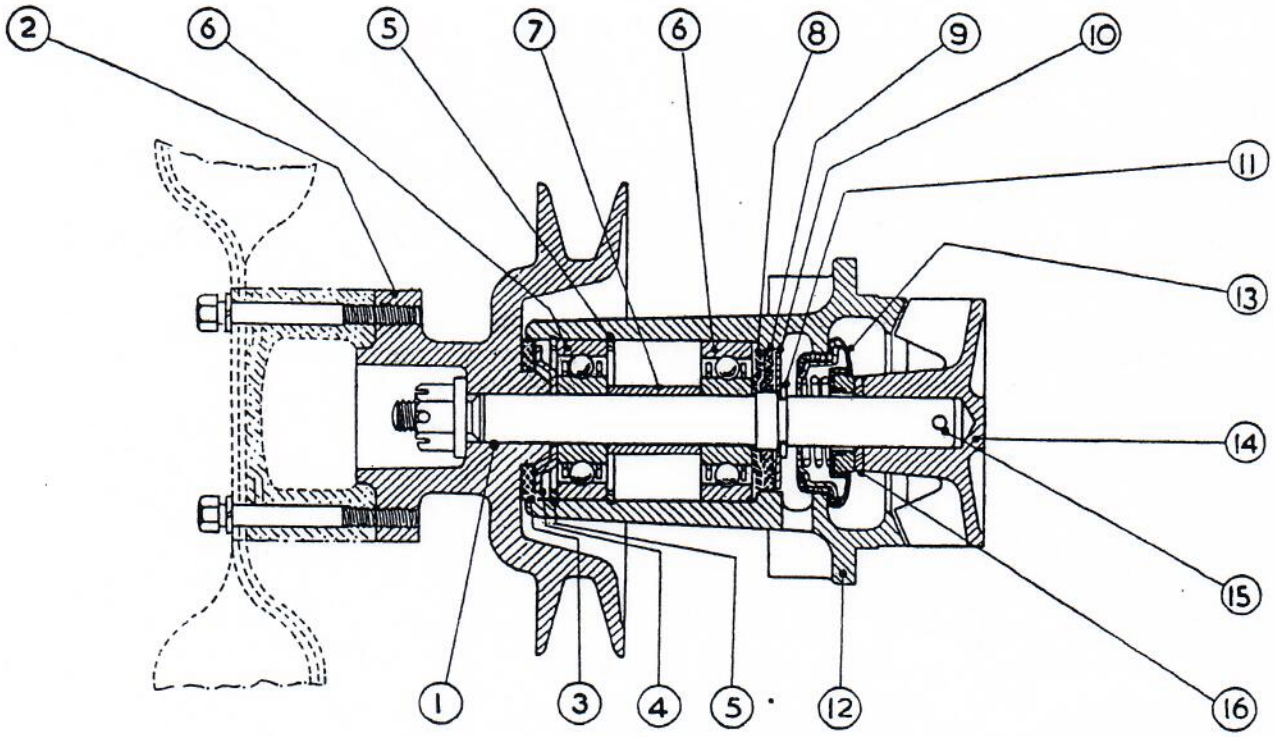


Fig. D.6.

The assembly of the later type water pump.

1. Spindle.
2. Fan pulley.
3. Felt washer (front).
4. Retaining cover (front).
5. Bearing circlips.
6. Bearings.
7. Distance tube.
8. Retaining cover (rear).
9. Felt washer (rear).
10. Retaining washer (rear).
11. Pump spindle circlip.
12. Pump body.
13. Seal.
14. Impeller vane.
15. Taper pin.
16. Gland seating washer.

Other than a water seal change and the addition of a grease nipple at Engine XPAG/TD/6482, the design did not change. A four-vane impeller is attached by a taper pin to a 12 mm shaft which is turned by the fan belt on a pulley attached to the front of the shaft. The shaft runs in two ball bearings which are separated by a spacer. The front bearing is normally held in place by two large circlips which fit into grooves cut into the pump housing on either side of it. Used water pumps have been found with only one circlip for the front bearing. The position of the rear bearing is fixed by the spacer and the fact that the shaft has a raised shoulder which prevents it from going through the inner race of the rear bearing when the nut, which secures the pulley to the shaft, is tightened. Pumps have also been found with a circlip retaining the rear bearing. The back of the rear bearing is seated against a shoulder on the inside of the pump housing. Its rearward movement is thereby restricted and, obviously, it must be the first to go back in on reassembly. The seal is made of synthetic rubber with a carbon ring on the impeller side. The seal is spring-loaded so that the carbon ring is kept in contact with a smooth boss on the front of the impeller. This is the sealing surface so the distance between the front of the impeller and the shoulder on the shaft is critical because it determines the pressure of the impeller on the seal and the clearance between the impeller vanes and the pump housing. My measurements indicate an impeller vane clearance of .008" – .010" so that any decrease of this distance could lead to early wear of the seal and/or the impeller vanes coming into contact with the back of the pump housing. The seal has a dish-shaped brass washer on the inside to locate the spring and keep it in tension against the inside of the carbon ring.

The remaining pieces – the felt washers, retaining covers, rear washer and circlip – are not involved in the functioning of the pump but serve to keep grease from escaping from the bearings or from their becoming contaminated. Those parts are all eliminated when sealed bearings are used as they are in my brass water pump and currently rebuilt water pumps. The design also includes a small drain hole to check for leaking and a grease fitting to lubricate the bearings. (Unnecessary when sealed bearings are used.)

In the official parts list for the TF, the felt washers (Nos. 3 & 9) are described as dust excluders, the retaining covers (Nos. 4 & 8) are described as dust covers, and the gland seating washer (No. 16) is neither listed nor included in the illustration of water pump parts. The woodruffe key, which is designed to keep the pulley from turning on the shaft, is not shown or listed in the above diagram but is in the parts manual. The diagram is misleading at No. 14 above. The impeller shaft hole goes all the way through the impeller.

DESIGN PROBLEMS

The attachment of the pulley to the shaft is critical. Should the pulley become loose and wobble on the shaft, the fan blades can destroy the radiator. Owners have widely reported "wear in the hole of the pulley so that is did not fit the shaft." (OCCB, 8/07; 5/09; 12/09). The cause of the wobbling pulley can be deduced from the diagram. The "V" groove in the pulley for the fan belt is offset towards the engine rather than being directly above the point of contact on the shaft. This produces a constant offset force on the pulley rather than a straight downward force. The fact that the pulley is merely a slip fit, rather than an interference fit, on the shaft hastens the wear. An interference fit appears to be the standard on British-made cars. In *Robert Bentley's Repair Manual for British Cars* by John Organ (1970) on page 309, it states that if an old water pump is to be stripped and overhauled rather than replaced, some

form of hand press will be required to press the impeller and the fan blade hub from the main spindle. That is certainly not the case with the pump under discussion although the shaft is a press fit in the impeller and in the bearings.

The woodruffe key is inadequate to carrying a load. Mike Allison, one of the foremost authorities on MGs and the author of two books, has stated:

> In M.G. cars of all ages, there are keys which locate various components, some are the "half-moon" Woodruffe Key, notably used for engine components, while others are the parallel key, such as the steering wheel key on the earlier cars. They have one feature in common, and that is that they are used to provide location of the two parts in a given state of assembly: AND THAT IS ALL! At no time should a key take any of the driving load, if it does it will shear. This is because the material of which it is made is fairly soft so that it is easy to file to size. When you fit a new key, only use one supplied by a specialist or a good engineering supplies firm: it is absolutely essential that the correct grade of steel is used.
>
> All the drive is taken, or should be taken, by a good fit between the two components. Assuming there is a taper fit, when the parts are tapped together without a key, they should stick, and only come apart with the aid of a sharp tap. (SF 1/95, p. 25) (Emphasis in original.)

Obviously, a taper fit between the shaft and the pulley would prevent the problem of the wobbly pulley. The only reason for not employing a taper fit is that it's an expensive option.

Was the factory aware of this problem? Did it take any remedial action? Yes and no. Since water pumps only fail on cars that are driven extensively, it was not a problem for everyone. The factory's solution was to provide a replacement pump with a new pulley fitted ***at a low price***. The following is from *MG Midget TA-TF 1936-55 Autobook* by Kenneth Bell, Autopress Ltd., 1968 at page 49:

> Before deciding to overhaul the water pump, it should be noted that if components of the pump are worn, a replacement pump can be supplied on an exchange basis at a much lower cost than that of the individual parts. Pumps are available for most models and are supplied complete and ready to bolt on, ***complete with pulley*** but less fan blades. (Emphasis added.)

Similarly, in *Tuning and Maintenance of M.G.s* by Philip H. Smith at page 82:

> The water-pump is of the normal type having a carbon-ring sealing-gland. This remains water-tight for a very long time. When it finally gives out, the pump must be changed for a service unit, as a complete assembly. Renewal of the carbon-ring only is a fiddling job, and not worth the trouble in view of the ease of obtaining a replacement pump ***at little expense***. (Emphasis added.)

An owner complaining of a wobbly pulley who decided to replace everything stated, "The replacement pump, bought 40 years ago for £5, came complete with a pulley." (OCCB, 12/07). Today, the cost would be about $260.00. It is understandable why the factory didn't change the design of the shaft and pulley. The engine was being phased out in

favor of the BMC "B" engine which was installed in the ZA Magnette in 1953. That engine would probably have been installed in the TF if it were not for the fact that it would have required extensive modification to what was basically a TD. TDs were assembled until 17 August 1953; the first production TFs were started on 3 September 1953. Time was of the essence.

There are various solutions to a wobbly pulley. Tightening the nut on the end of the shaft is not one; it will just loosen again. Over-tightening could possibly lead to breaking the front circlip. You can rebush your old pulley or buy a new one ($85.00 approx.). Another solution is a tapered shaft and pulley as described and illustrated in "*An Improved Water Pump*" on page 27 of *TSO* for February of 2009 (The Phil Marino modification). It should be noted that the pump labeled "NOS XPAG/XPEG WATER PUMP" is mislabeled if "NOS" is meant to signify "new old stock." As can be plainly seen, it has a sealed front bearing so it has obviously been rebuilt. The ultimate solution may be to use one of the totally new and "Uprated Water Pumps" being made in England by Racemettle Ltd. It reportedly has "re-designed needle-type long bearing, re-designed impeller with six vanes for more efficient circulation but very important (sic) an improved water seal unit on the impeller, which will be essential to avoid water pump failure after a long lay-up period but also the original four vane would be available if required ...." (OCCB 6/08). More details are available at www.racemettleltd.co.uk. which states, "Like many components on classic cars, the water pumps were designed to cost and to achieve minimum requirements that met the needs of the vehicles and road conditions at the time." The company recommends that you let them fit the pulley. From the illustration, it appears that the shaft may be splined. This would certainly cure this long-standing problem. Some owners believe that six vanes on the impeller could cause cavitation and that two should be removed. I have never experienced that problem.

REPAIR PROBLEMS

Replacement seals are no longer available. The rear of the housing must be machined and bushed for a seal that fits. Some suggested English seals and the various dimensions involved are found in the December 2007 issue of OCCB on pages 37-41. It also points out that even a new seal may leak if the face of the impeller has been scored, pitted or run-out. If the chamfered edge of the seal housing is chipped or pitted water may leak around the outside of the seal. On original pumps, the impeller was attached to the shaft by a taper pin. I have examined four replacement shafts and seven replacement impellers and none of them had a hole for a taper pin. Since the shaft is a press fit in the impeller with .0002" to .0003" of interference, the taper pin was unnecessary in the first place since there is virtually no resistance to the impeller's motion. Two of the shafts, which were from MG parts suppliers, did not even have a shoulder on the shaft. Instead, there was a removable ring the size of the shoulder with its rearward movement limited by a circlip. Once sealed bearings are used and the felt and washers have been eliminated, the shoulder serves no useful purpose and is not included on the tapered shafts referred to above. The impellers were of three types: cast iron, brass, and a hard black plastic material which had a bronze contact ring. Failures of the last one have been reported. Apparently the heat of the engine and coolant caused separation of the bronze contact ring from the plastic impeller. All had six vanes except the cast iron which had four. Since the shaft is a tight fit in the impeller and the bearings, the shaft can be pressed through the

bearings from the front until the large end of the taper is about .003" from the front bearing. The impeller can then be pressed onto the back of the shaft until its vanes are .005" to .010" from the pump body. One has to make sure that he has a seal that will be making contact with the impeller.

The fan blades are attached to the pulley by four long, thin bolts that go through a distance piece. The front of the distance piece is solid so that the nut on the front of the shaft can only be accessed after removal of the distance piece. In my experience and that of others who have reported (OCCB, 8/07), the distance piece is super tight and very difficult to remove while the pump is still on the car. To alleviate this, since I was tightening my fan blades so often, I had notches cut around the back of the distance piece so that it could be pried off with a screwdriver. Getting access to the four fasteners that attach the pump to the block is extremely difficult if the pulley is not first removed. Modifying a 13 mm wrench for the lower left nut has been suggested (OCCB 8/07). I highly recommend at least two people – preferably with small hands and long fingers – for removal of the water pump without having first removed the radiator. It is easier on a TC or TD than on a TF. Since the latter is what I drive, I have had more experience (and cut hands and fingers) with that model.

Since the pulley is keyed to the shaft, it is difficult to install properly if the pump is on the car. The usual procedure is to slightly recess the front of the key (which is curved on the bottom) so that it won't foul the matching groove in the pulley. Then position the pulley on the shaft at a point where you believe (possibly through marking) that the key and the pulley will line up since you can't see the key at this point. Then, if the pulley does not just slide over the key, one usually slightly rotates the pulley until it "catches" on the key and can be pushed back. The trouble with this is that if you can rotate the pulley and move it back and forth with your hand, it's too loose and will start to wobble after extensive use. If you don't drive the car much, it probably will never show up. If you install the pulley on the shaft before installing the pump, the four nuts and bolts will be extremely difficult to access. The engine steady bracket (held by the bottom stud and bottom bolt) must be put in place before the pump is moved fully back against the block. Another problem can occur if the woodruffe key, instead of leveling itself, kicks up so that the pulley appears to be tight, but isn't. At this point, you can't see the inner race of the front bearing or the front retaining cover where the pulley makes contact. This can stress the pulley and cause it to crack along the line of the keyway resulting in part of it breaking away. (OCCB 4/09)

If the radiator and water pump have been removed, I recommend installing helicoils in all of the stud and bolt holes. The threads tend to become worn and rounded over time. An 8 mm x 1 helicoil installation kit is one of my better tools. It is also useful on the aluminum sump holes which are often stripped. When installing the pump, with the radiator in place, care is required in placing and sealing the gasket between the pump and the block. It is easy to damage or move the gasket causing a leak.

I had heard of fan blades breaking and causing substantial damage. At the GOF Central in French Lick, Indiana, I had just started up from a stop sign on a rally when I heard a loud noise. I thought I must have run over something or that something had fallen off. I backed up, went over the same road, but found nothing. Later, I found that a fan blade had broken off and hit the engine steady bracket with such force that it put a substantial gouge in it. The broken fan blade was lying on the suspension cross member. I have switched to the 7-blade MGB plastic fan which fits perfectly. It even seemed to fit

more perfectly when installed backwards! (The fan blade distance piece should go in front of the fan blade assembly.) Since switching to the type of improved water pump described in the February 2009 issue of *TSO*, (although I did it ten years ago), I have had no further problems with leaks or wobbly pulleys. People who don't drive much probably won't have trouble with the original equipment.

CONCLUSION

The adequacy of the original design to fulfill its purpose when these cars were new is now irrelevant. The cars and their water pumps are now 55 to 60 years old. I doubt that any of them are completely original. Time alone will cause the seal to perish. Mileage will cause the hole in the pulley to enlarge. The only relevancy of understanding the design is to use this knowledge in determining the best way to repair your water pump when it does fail. No one wants to remove the radiator and its attachments to replace a leaky water pump or a wobbly pulley. A wobbly pulley can be removed and replaced *in situ* with another pulley that is not too tight a fit on the shaft or one with a tapered fit. A tapered fit, however, necessitates prior removal and modification of the water pump shaft. Once a tapered shaft pulley has been substituted, it can be removed and replaced with relative ease as can the water pump. This can usually be done without removal of the radiator.

Submitted by

Gerry Risner
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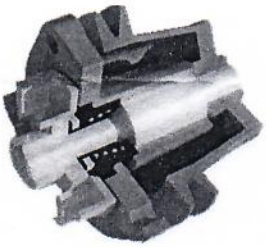
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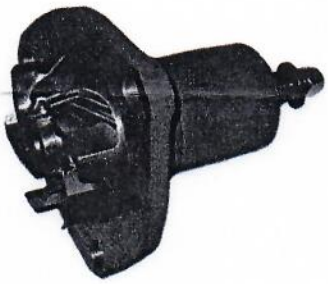


UPRATED WATER PUMPS

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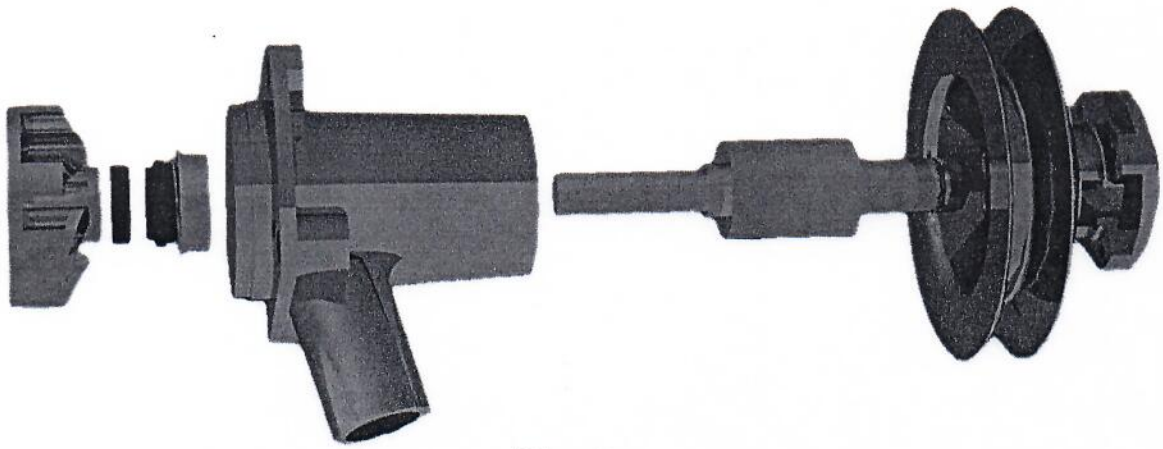
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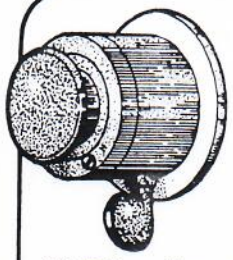
Speedometer Conversion Adaptor, $200. This box screws onto the gearbox and the speedometer cable screws onto the conversion box. This is used when you have changed from the standard gearing (ring and pinion conversion).

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NEW ARRIVALS by MOSS

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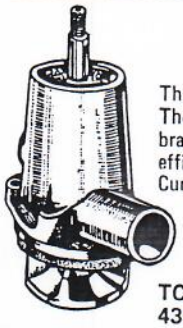
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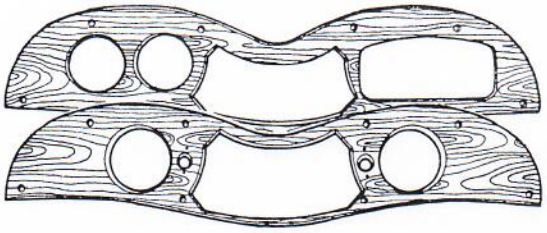
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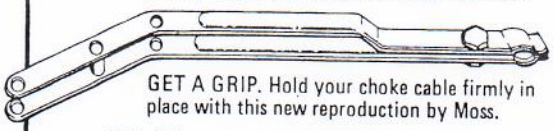
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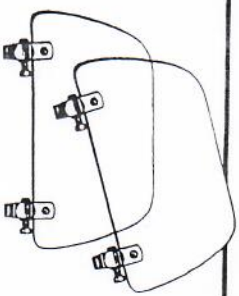
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