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Although these forks have not been manufactured for over twenty years, several thousand of them must remain in use. It is therefore worth recounting the changes made to this suspension, which was used from the 'Five' Series of 1969 to the advent of the 1981 model year.

Many owners of early /5 models experience a very poor ride quality, their forks responding to large bumps in the road, but not to smaller irregularities. The usual alignment checks, such as pumping the forks against the brake with all clamping bolts slackened, followed by progressive tightening, generally proves to be ineffective. The use of thinner fork oil simply reduces rebound damping to unacceptable levels without curing the basic problem.

The cause of this problem is one of mechanical stiffness, due to a combination of manufacturing tolerances and the small clearance between the piston rod and the damper nozzle ring. If the piston rod is slightly off-centre, it can bind against the bore of the nozzle ring.

The small clearance is necessary to provide damping, by means of a restriction against the oil flowing between the slider (below the stanchion) and the stanchion bore as the forks operate.

The original damper nozzle was a threaded ring, which carried the rubber rebound buffer on its upper surface. It was screwed into the base of the stanchion by a peg spanner and retained by a circlip.

BMW's answer was to replace the damper nozzle by a pair of threaded rings (31 42 1 232 046) of a larger bore, with recessed surfaces facing each other. This recess contained an aluminium nozzle ring (31 42 1 232 045) which was just able to slide between the threaded rings. Leakage between this nozzle and the threaded rings was therefore minimal, while maintaining the original clearance against the damper piston rod. The new nozzle was therefore able to 'float' laterally in its housing between the threaded rings in response to any misalignment of the piston rod, while maintaining the original bump damping rate.

This modification prevented any binding, but retained a damping rate sufficiently soft to provide the 'boulevard' ride quality which many owners favoured. The components involved can be fitted to any fork originally equipped with the one-piece damper nozzle, which were built before R50/5 no.2904276, R60/5 no.28411811, and R75/5 no.2987432.

The threaded rings cost (at 2002 prices) £15.75 each, but can usually be safely re-used from later accident-damaged forks. The nozzle rings cost only £5.75 each.

Many owners of the 'Fives' suffer from reduced ride height due to wear in the original springs, which were always regarded as being rather soft, the recommended replacement being the spring later fitted to the R100RT. Although slightly shorter than the originals, they offer a higher spring rate and most riders find them to be ideal. (Read on for details).

As not all BMWs were purchased with the same ride/handling qualities in mind, many riders were simply grateful that their dentures now remained in place, but others remained critical of the 'falling lift' syndrome when the brakes were applied with determination. This problem was later exacerbated when twin disc brakes were fitted.

The factory therefore increased the bump damping rate, this being achieved by deleting one pair of the lateral orifices at the base of the damper rod. This reduced the oil flow within the damper rod, while maintaining the smaller parallel path through the damper nozzle, and therefore reducing the overall flow rate.

This modified damper rod (31 42 1 234 474) was fitted from late 1975 and could be retrofitted to earlier /6 Series models. This was fitted as standard equipment from R90S no.4081153, and as was available when optional Special Equipment (such as when twin discs) was specified, from R60/6 no.2921589, R75/6 no.4020748, and R90/6 no.4050948. US-specification models affected were from R90S US no.4980520, R60/6 US no.4920637, R75/6 US no.4940641 and R90/6 US no.4967803.

New damper rods are not cheap, now costing £66.56 each, but the aluminium damper nozzle provided BMW's engineers with a means to provide a cheap and easily-fitted method of increasing the damping rate for owners of older models. This took the form of an alternative damper nozzle ring (31 421 1 234 506) with a smaller bore of 15.5 mm (compared to the standard bore of 15.7 mm) and was identified by a groove machined around its periphery. Even this component remains available, and costs only £5.44.

This increase in damping rates calls for a similar increase in spring rates, and is best satisfied by use of the R90S springs. These springs can be identified by their length and wire diameter, the basic type being 31 42 1 231 538 (4mm wire, 567 + 12mm long) and were also fitted to the later /6 Series models from R60/6 no.2910998, R75/6 no.4012043, and R90/6 no.4044461. At under £10 each they are something of a bargain.

This modification is particularly suitable for machines with twin disc brakes and those which are used with enthusiasm, such riders preferring SAE 10 or 15 grade oil.

As the damper nozzle exercised control over both bump and rebound damping, use of the small-bore nozzle increased damping rates in both phases of operation. This, of course, provided the opportunity to provide still greater compression damping by combining the later piston rod in combination with the smaller-bore nozzle ring. This modification generally performs best – for road use at least – with the BMW-recommended SAE 4 grade fork oil.

This combination was recommended for use only when the optional stronger fork springs were fitted, these being 31 42 1 323 017 (4.25 mm wire, 543 +12mm long) as was fitted to the R100RT. At £11.78 they are not expensive.

It should be remembered that the standard-bore aluminium nozzle ring was also used as the spring-loaded valve plate, fitted below the damper piston. When rebuilding these forks care must therefore be taken to ensure that the smaller-bore damper nozzle is not used in this position, or rebound damping will be unacceptably hard.

Noise was another recurring complaint with regard to these forks, this being a rattle generated by the action of the rebound damper valve plate oscillating against the damper piston when traversing repeated small bumps. With effect from early 1979 a rubber disc (31 42 1 232 763) was placed between the piston and the valve plate, so reducing noise and providing an enhanced sealing effect for only £3.03 each.

This modification was introduced from R80/7 nos.6205004 (low compression) R80/7 no.6030036 (high compression) R100T no.6050009, R100S no.6070010, R100RT no.6155061, and R100RS no.6095040. It can be also be retrofitted on older machines.

These forks require little in the way of routine maintenance – and usually receive none – but a little work will transform them. Needless to say, regular annual oil changes are a basic requirement. Oil capacities are 280 cc after overhaul, or 265 cc for normal refilling.

As with any rubber component which spends its life immersed in oil, the rubber valve plate disc should be replaced every few years, as failure to do so will result in reduced rebound damping. As replacement requires removal of the damper piston assembly, it provides a good opportunity to also replace the damper piston sealing rings, which seal the piston against the bore of the stanchion. A poor seal in this area will also reduce rebound damping.

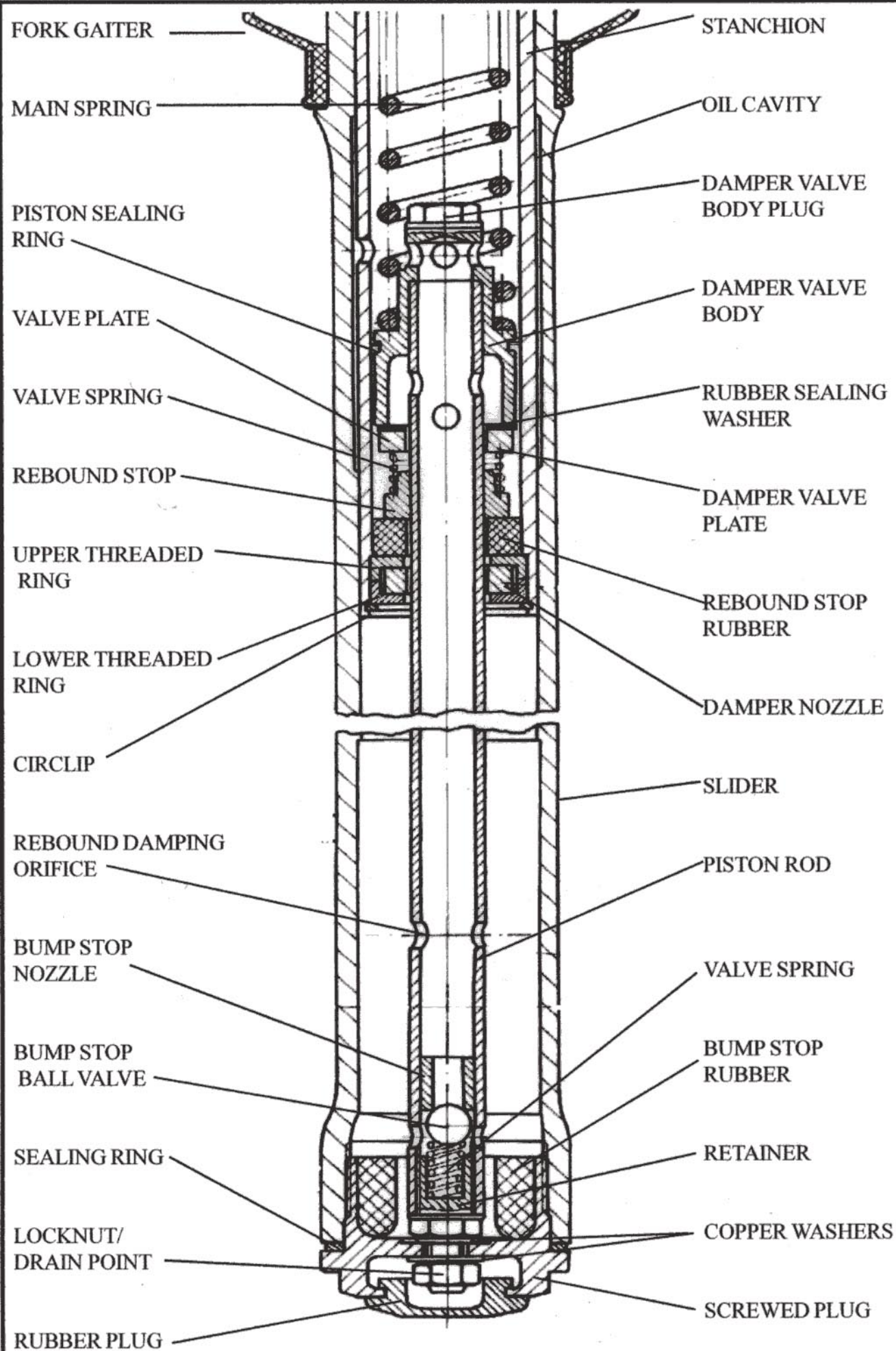
It is difficult to insert the piston rod assemblies into the stanchions, over the threads and step at the base of the bore. As the sealing rings can be damaged if forced it is advisable to obtain or manufacture a tapered sleeve to compress the rings before they enter the stanchion. The BMW tool, in either 546 or 341-4-700 form, screws into the base of the stanchion and removes all difficulty.

Other considerations are the rubber rebound buffer above the damper nozzle assembly, the similar bump buffer at the base of the slider, and the springs controlling the rebound damper valve plate and the relief valve ball inside the base of the piston rod. Naturally, the seals and the various copper sealing washers should all be replaced, and fork gaiters fitted to protect stanchions and seals.

Perhaps the most serious problem which can afflict these forks is that of wear in the alloy sliders, an early sign of which is repeated problems with leaking fork seals. There is a hole in the side of each stanchion, which bleeds a small quantity of oil into a narrow cavity around the slider bore for lubrication purposes. This is pressurised by the rebound damping, and if the sliders are badly worn oil can reach the seals.

Should this happen, replacement is the only answer. Although they are now difficult to obtain second-hand, the later forks used from 1981 to 1984 are a good alternative, permitting the use of improved brakes by courtesy of Brembo. Unless however one requires better brakes, this should only be necessary in cases of prolonged neglect. Thanks to BMW's policy of providing spare parts to component level at reasonable prices, including the most obscure modification items, there is no reason why these forks should not last for ever – or at least longer than the rider!

PRE-1981 FORK LEG (/7 SERIES - 1979 MODEL)



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It is difficult to insert the piston rod assemblies into the stanchions, over the threads and step at the base of the bore. As the sealing rings can be damaged if forced it is advisable to obtain or manufacture a tapered sleeve to compress the rings before they enter the stanchion. The BMW tool, in either 546 or 341-4-700 form, screws into the base of the stanchion and removes all difficulty.

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IMPROVE YOUR LEGS! Damper Valve Modification for 1981 Model Forks

Mike Fishwick

When the 1981 range of BMW models was launched, they represented the largest overall design change since the advent of the Five Series; while the only immediately obvious changes were the adoption of new forks, and Brembo brakes with a handlebar mounted master cylinder, there was in fact little commonality with the models of the previous year. . . little wonder that the 'Stroke Seven' suffix was dropped-these machines should have been regarded as the 'Eight Series'!

Close examination of the 1980 and 1981 models reveals that no major assemblies are identical, and that the only items which survived the change were limited to the engine (Except for the ignition system, barrels, sump, air filter, and flywheel/clutch assembly) and gearbox (Except for the rear cover, clutch release mechanism, and input shaft) fairings, and sundry items such as mudguards, fork yokes, handlebars, and petrol tank. . . even the wiring harness is different.

Not all these changes met with the unqualified approval of existing BMW owners-when I took my R100 to its first Easter Rally in 1981, it was the only new model to be seen. . . I mingled unobtrusively with the owners of 'real' BMWs, and listened as they criticised virtually every change they could define. . .

One of the changes which was not obvious to the casual observer was that of the damping arrangements within the front forks-instead of being mounted on the sliding section of the fork leg, where they are isolated from the rest of the machine by the springs, they now lived in recesses at the base of the stanchions, in which they oscillated in sympathy with the motion of the forks, passing on a regular clonking noise to the rider.

After being castigated by the motorcycle press (As usual!) the initial reaction of BMW was to install shims below the valve body, to reduce this motion to an imperceptible level.

The rebound springs were also free to rattle merrily above the damper valves, which, while not exactly elegant engineering, could not be detected by the rider.

The modified valve, which we will refer to as the Mk1a, survived until 1982, when component stocks were exhausted, and was then replaced by the Mk. 2 type, which retained the original Orifice Plate above a valve body of reduced length, which was forced against the top of the recess by a special washer with spring tabs on its upper face. It was therefore no longer necessary for production workers to shim each valve, a time-consuming task.

A further modification employed in these valves was to discard the original steel washer, which was employed to control the direction of oil flow, in favour of a thick PTFE ring. Not only did this ring provide a superior seal around the damper piston rod, but it also made less noise in operation.

The machining of the recess in the upper face of the valve body was modified to accommodate the thicker ring, and also to reduce, by half, its overall travel between bump and rebound damping, so improving the control over the front wheel which the

dampers were able to exert, and reducing the rate of flow between the ring and the valve body, so increasing the bump damping rate.

Although the Mk2 version appeared to satisfy the critics, and more importantly the customers, it was obviously considered at the factory that a further improvement was required; so was born, during 1983, the Mk3 damper valve, which was destined to be the final stage of this evolution, before the advent of the current Monolever series.

This utilised the same basic valve mechanism of the Mk2, set in a body of greatly reduced length, in the base of which was a deep recess. This accommodated a spring, of identical type to that employed for full rebound control, which was in turn contained within a recessed base.

Not only did this spring provide an increased level of pressure to prevent the valve body from oscillating, but it also introduced a certain amount of 'give' into the otherwise inflexible operation of the rebound damping. This latter quality was obviously intended to be appreciated during violent transition from large amounts of bump travel to rebound, when the vast level of energy stored within the springs would normally be suddenly resisted by the dampers, with an associated shock loading to both the motorcycle and rider. Under these conditions the associated noise, as the valve body returned to its normal position, was obviously considered to be a worthwhile trade-off.

A further function of these springs is that of cushioning the operation of the hydraulic bump stops-the tapered sleeves fitted over the base of the damper piston rods, which progressively reduce the space available for oil to flow into the base of the damper valve as the fork approaches full compression.

My R100, known to one and all as Herman the German, had reached the 51, 000 mile mark, grown an RS fairing, and carried me all over Europe and Scandinavia. . . he looked and went better than ever, but still possessed a noisy ride of quite diabolical quality, in spite of my having modified the damper valves to Mk. 1a specification, and fitted Ultimate Source anti-dive springs, both of which had made small but definite improvements, as had the San Jose tubular fork brace, and the 10 grade fork oil.

The poor ride quality appeared to be promoted by small but sudden surface irregularities of short duration, a situation which could certainly be caused by poor damping, and which, on larger bumps, was aggravated by a lack of suspension travel-when fully loaded, there had never been no more than two inches of fork travel remaining. . . not the best situation on a machine once advertised as the 'Miestertourer'!

That the overall performance of the dampers was on the borderline was amply proven during the journey to Budapest for the 1986 FIM Rallye, when such shallow bumps, encountered at around 35 mph, caused violent tank slappers-the trip home was possible only by virtue of the steering damper being fully applied! Subsequent examination showed that the damper piston rings had worn slightly, which produced a definite 'floating on air' type of feeling. I therefore decided to cure both problems, by adoption of the Mk3 damper valves, and the use of Ultimate Source progressive fork springs. . . the standard springs are also progressively wound, but the replacements are appreciably longer.

The new damper valve components were readily available, and came to a total of less than £10. . . who said BMW spares are expensive?

Compared to the six/seven series forks, the 1981 pattern may be dismantled with ease-after removal of the spring via the top cap nut, and the alloy slider, which is secured by a 12 mm cap screw at its base (10 mm hexagon key) the damper valve and piston may be withdrawn from within the stanchion after removal of the internal circlip. Remove all sludge deposits, and maintain high standards of cleanliness throughout the procedure.

An opportunity is therefore provided to replace the fork seals, and to prolong their life by fitting fork gaiters-the best type are those produced for the R80GS-and to replace the sealing rings of the damper pistons.

Due to the presence of a sharp step at the top of the damper valve recess, and the threads at the top of the stanchion, it is easy to damage the fibre piston rings on installation, unless a suitable tool is available to guide the piston into the bore of the stanchion.

A suitable tool may be easily manufactured from a plastic 35mm film container-cut off the base, and remove a ¼" strip from the side; one or two layers of PVC tape around the original base end will provide a stepless transition to the stanchion bore.

Carefully bend the new fibre ring to conform with the profile of the piston, and liberally lubricate it before insertion – Slick 50 is ideal.

Installation of the new damper valves is basically simple, but requires that the spring loaded assembly be compressed into the base of the stanchion before the retaining circlip may be fitted. Remember to fit the rebound spring around the piston rod before inserting the valve assemblies.

A suitable compressor may be manufactured by use of a 6mm diameter rod, threaded at each end, and passed through the stanchion. A nut on the lower thread, with a large washer, will provide an anchor point, beneath the valve assembly, while a longer length of M6 thread on the upper end, with a suitable steel strip, will allow the valve assembly to be compressed into the stanchion base, and held while the circle is inserted.

As an alternative, an old clutch cable inner may be secured into the head of a long bolt, by looping through two holes drilled in the head, and passed inside the stanchion in the same manner as the above steel rod. A nut on the bolt is used to compress the valve from the top of the stanchion, while the lower end of the cable is locked below the valve assembly by use of a solderless nipple and a large washer.

Ensure that the circlip is correctly inserted-it should be capable of being rotated in its groove-as it is all which prevents the fork leg from falling off! Draw the piston rod down through the valve assembly, and reassemble the fork leg.

Unlike the originals, the Ultimate Source springs are progressively wound at one end only, and are ground flat at the ends; they should therefore be fitted with the close-pitched coils at the lower end, and will not accept the screw-in plastic end caps fitted to the original components. (No fitting instructions were provided)

As previously stated, these springs are longer than standard by some two inches, and therefore must be compressed before the stanchion cap nut may be screwed into position to preload the springs, so enabling them to carry their load without the usual amount of suspension movement. . . in other words, a greater amount of suspension travel is now available to absorb bumps, instead of being used up in supporting the machine and rider.

This task is easily accomplished by use of a standard two-legged puller-with the legs engaged below the top fork yoke, the thread may be used to force the cap nut and spring into the top of the stanchion. Do not forget to fit the cap nut sealing washer around the spring beforehand, and screw a suitable dome nut onto the end of the extractor bolt to protect the filler plug threads within the cap nut recess.

That's about it. . . all that is now required is to fill the forks, and replace the wheel etc, before riding into the sunset in comfort and silence!

The combination certainly works well-wheel movement is now well controlled, the forks are quieter, except on very poor surfaces, and ride height is increased. During the month after installation, I covered five thousand miles on Herman, including the journey to the FIM Rallye in Beograd, and noted a marked improvement in ride quality and cornering clearance.

Ride height is increased, to the extent that the machine leans at an appreciably greater angle when on the side stand; I therefore extended the stand by fitting a section of one inch square steel tube to the foot. The 1981 side stand, incidentally, is quite superb-it can be operated while seated, stays down, and yet will flip up without disturbing the equilibrium of machine or rider if forgotten before pulling away.

I retained the Ultimate Source anti-dive springs, but have some reservations about their use, as, even when fully compressed, they reduce the total fork travel by one inch, and also prevent the hydraulic bump stops from operating. . . they do, however, perform the same basic function, with a little more progression, at the expense, when fully compressed, of becoming inflexible pieces of steel.

I also have misgivings about the lack of plastic end caps on the springs, which causes them to operate directly on the crowns of the aluminium damper pistons-the next step will be to manufacture PTFE 'top hat' bushes to prevent any wear taking place, the debris from which would damage the piston seals, or even score the internal bore of the stanchions.

Thanks to the combination of better damping and stronger springing, I have been able to use a lighter grade of fork oil, as the use of heavier damping was really only necessary to prevent running out of suspension travel with the original weak springs. I prefer 7½ grade oil, which provides a good ride quality without detriment to handling.

All things considered, the package works well-the damper valve modification is cheap and effective, and the new springs are of suitable strength to resist the loadings placed upon them. Lightweight riders may find that use of a one inch spacer above the standard spring will provide a suitable amount of preload with less expense.

1981 MODEL FORKS – OPERATION OF DAMPING SYSTEM

BUMP DAMPING: The ascending slider displaces oil from the lower chamber through the annular gap between the piston rod and the valve body, forcing the valve ring against the orifice plate. The oil enters the upper chamber via the gap below the ring, this restriction providing the damping effect. The orifice plate has a greater

total area than is available below the ring, and therefore does not exercise control over damping rates.

REBOUND DAMPING: Oil is forced, by the descending piston, on to the valve ring, sealing it against the valve body. The only path through which the oil may now be displaced is through the small orifice in the upper end of the piston rod, which passes a lower rate of flow than the gap below the valve ring, so providing stiffer damping under rebound conditions. As the slider descends, the volume of the lower chamber increases, and oil is drawn from within the piston rod via the orifice at the lower end of the piston rod.

Simple, isn't it? The areas of the gap below the valve ring and of the upper orifice in the piston rod determine the relative rates of bump and rebound damping, while the overall damping rates are dependant upon the viscosity of the fork oil.

As the oil enters the lower chamber by suction, rather than the more usual method of being forced through a restriction, it is essential that the fork oil possesses excellent anti-foaming properties.

1981 PATTERN FORKS – DISMANTLING PROCEDURE

1. Remove the front wheel, mudguard and fork brace, and brake calipers.
2. Drain the fork oil – it's best to vent the forks by removal of the filler plugs at the top of the leg (8 mm hex key). The fork oil will drain fully, while you have a cup of tea, without the need to 'pump' the forks.
3. Replace the wheel spindle in the forks, and undo the large cap screw at the base of each leg (12 mm hex key). The aluminium slider may now be withdrawn from the stanchion. Invert it, and shake to remove the spacer from the base.
4. Lever out the old seals, using a large screwdriver, and clean the inside of the legs – the base can often be full of sludge, particularly if water has entered through worn seals. Clean the outside of the stanchion.
5. Fit the new seals, by carefully pressing into place, and then driving into their bores by use of a large hammer and a suitable drift – a large socket is ideal. Ensure that the seal is square to the leg – check that it is level at the top.
6. Replace the spacer inside the leg, and slide up the stanchion. Replace the large cap screw, with a new sealing washer – I use copper ones – and when both are fitted, insert the spindle and tighten fully. Rebuild everything, replace the sealing washers on the drain plugs, and fill the legs with 220 cc of oil. That's it!

I recommend use of the R80GS type of fork gaiter; fit them before you replace the sliders. My R100 wore out 2 sets of seals in 10,000 miles, but is still on the third set (with GS gaiters) at 73,000. I use SAE 7½ grade fork oil, with stronger springs from Ultimate Source.

1981 MODEL FORK DAMPER SYSTEM WITH Mk.3 VALVE ASSEMBLY.
(BMW Part Numbers of modified components shown in brackets)

