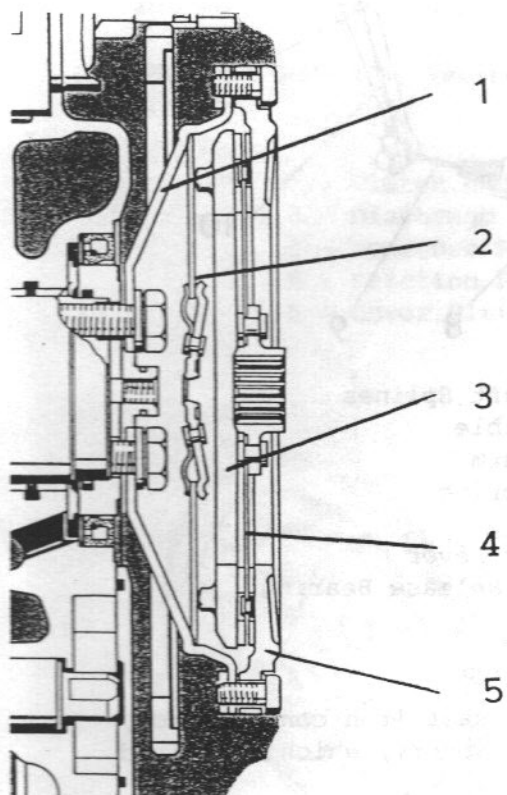


R - SERIES CLUTCH

Mike Fishwick



Later Type Clutch Assembly

- 1 - Clutch Body
- 2 - Diaphragm Spring
- 3 - Pressure Plate
- 4 - Friction Plate
- 5 - Cover Plate

Since the introduction of the /5 series in 1969, the R-Series BMW has used two types of clutch, both of which are basically similar. The main differences in the later clutch, introduced in 1981, are in the weight of the flywheel, the greatly reduced rotating mass providing more rapid throttle response, and the geometry of the clutch release arm, which moves the pushrod further, to disengage the clutch more fully. These modifications provide an improved gearchange, with a lighter and more progressive clutch action. This later clutch is similar to that used in the K - Series models.

Operation:

The R-Series clutch employs a single friction plate, which is compressed between two iron plates by a diaphragm spring. The iron plates are driven by the flywheel, while the friction plate drives the gearbox input shaft.

The inner iron plate - the **Pressure Plate** - is free to move axially when the spring pressure is released, as is the **Friction Plate** which is mounted on the splined input shaft. The outer iron plate - the **Cover Plate** - is bolted rigidly to the periphery of the flywheel.

The clutch is disengaged by the **Pushrod**, which is moved inwards, through the centre of the gearbox input shaft, to press against the centre of the **Diaphragm Spring**, causing it to become slightly concave, so releasing the pressure plate. The friction plate is then free to move slightly inwards, away from the cover plate, and therefore begins to slip freely between both iron plates.

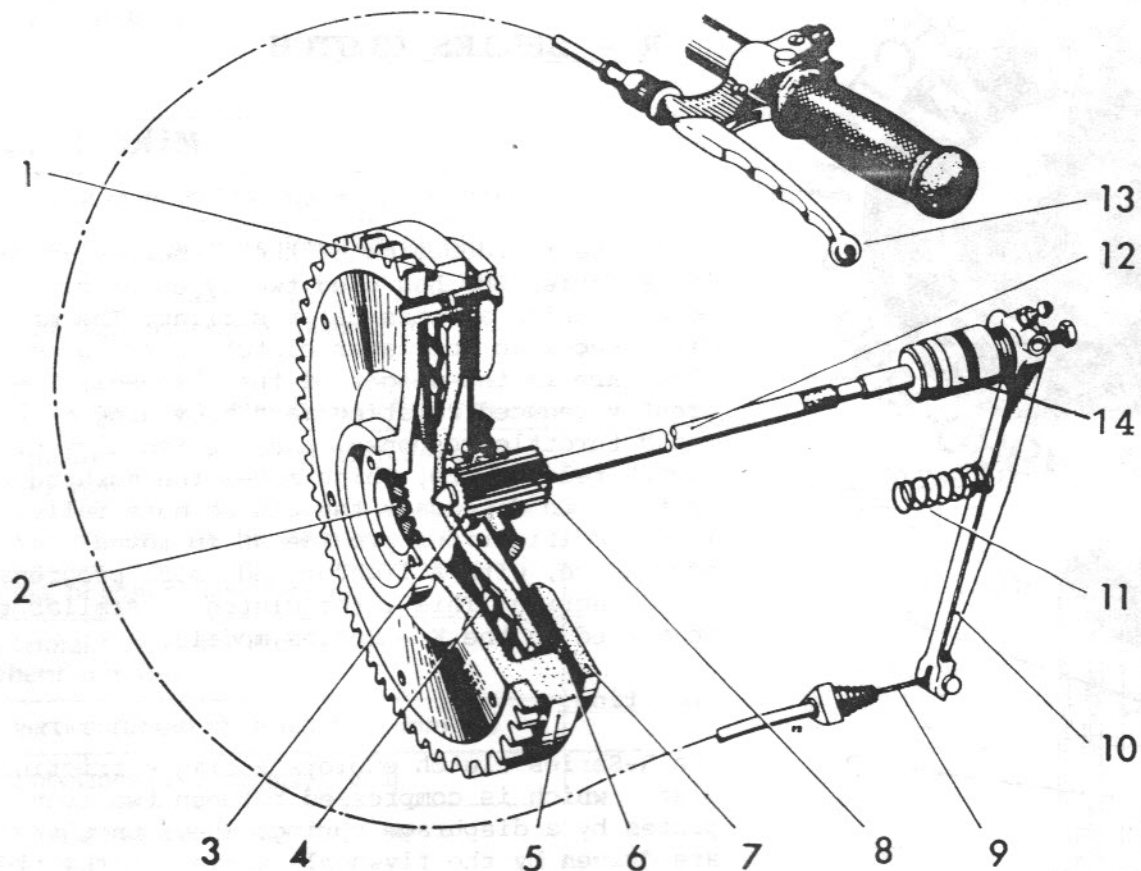
As the tip of the pushrod makes contact with the centre of the diaphragm spring it rotates at engine speed. The pushrod is mounted onto the **Release Bearing**, which prevents the rotation being passed into the **Release Piston** and the **Clutch Release Arm**, which is operated by the handlebar lever and held fully extended by an external **Return Spring**.

An oil seal prevents gearbox oil from travelling along the pushrod to contaminate the clutch plates.

A **Pushrod Adjuster** screw is mounted in the clutch release arm, which is used to set the correct amount of free travel for the pushrod.

A **Cable Adjuster** is situated at the handlebar lever to set the position of the clutch release arm where it will provide the maximum amount of leverage at the point of maximum opposition from the diaphragm spring.

Earlier Type Clutch Assembly (Five Series with Distance Pieces)



- 1 - Distance Piece
- 2 - Diaphragm Spring
- 3 - Friction Plate Splines
- 4 - Pressure Plate
- 5 - Flywheel
- 6 - Friction Plate Lining
- 7 - Cover Plate

- 8 - Input Shaft Splines
- 9 - Clutch Cable
- 10 - Release arm
- 11 - Return Spring
- 12 - Pushrod
- 13 - Handlebar Lever
- 14 - Piston & Release Bearing

Description:

Clutch Assembly: The earlier flywheel was of orthodox cast iron construction, with the starter motor ring gear shrunk around its periphery, which contained the clutch assembly.

This was replaced in 1981 by a lightweight steel pressing, to which the ring gear was riveted, and was shaped to support the diaphragm spring. The pressure and cover plates were bolted and dowelled to this pressing, which was now referred to as the **Clutch Body**.

The earlier type of clutch employed a pressure plate which was mounted on a steel diaphragm, the edges of which were bolted to the rear face of the flywheel by the bolts which also secured the cover plate. The flexible diaphragm permitted the pressure plate, and therefore the friction plate, to move forward when the spring was compressed.

The thin cover plate was fully machined, and therefore inherently well balanced. The assembly is therefore balanced by drilling into the thicker flywheel.

The later pressure plate was secured to the clutch body by three flexible curved steel straps. These straps are maintained in tension by the rotation of the clutch body, so transmitting the torque of the engine to the inner face of the friction plate. The flexible straps also permit the same forward movement as was provided by the earlier diaphragm.

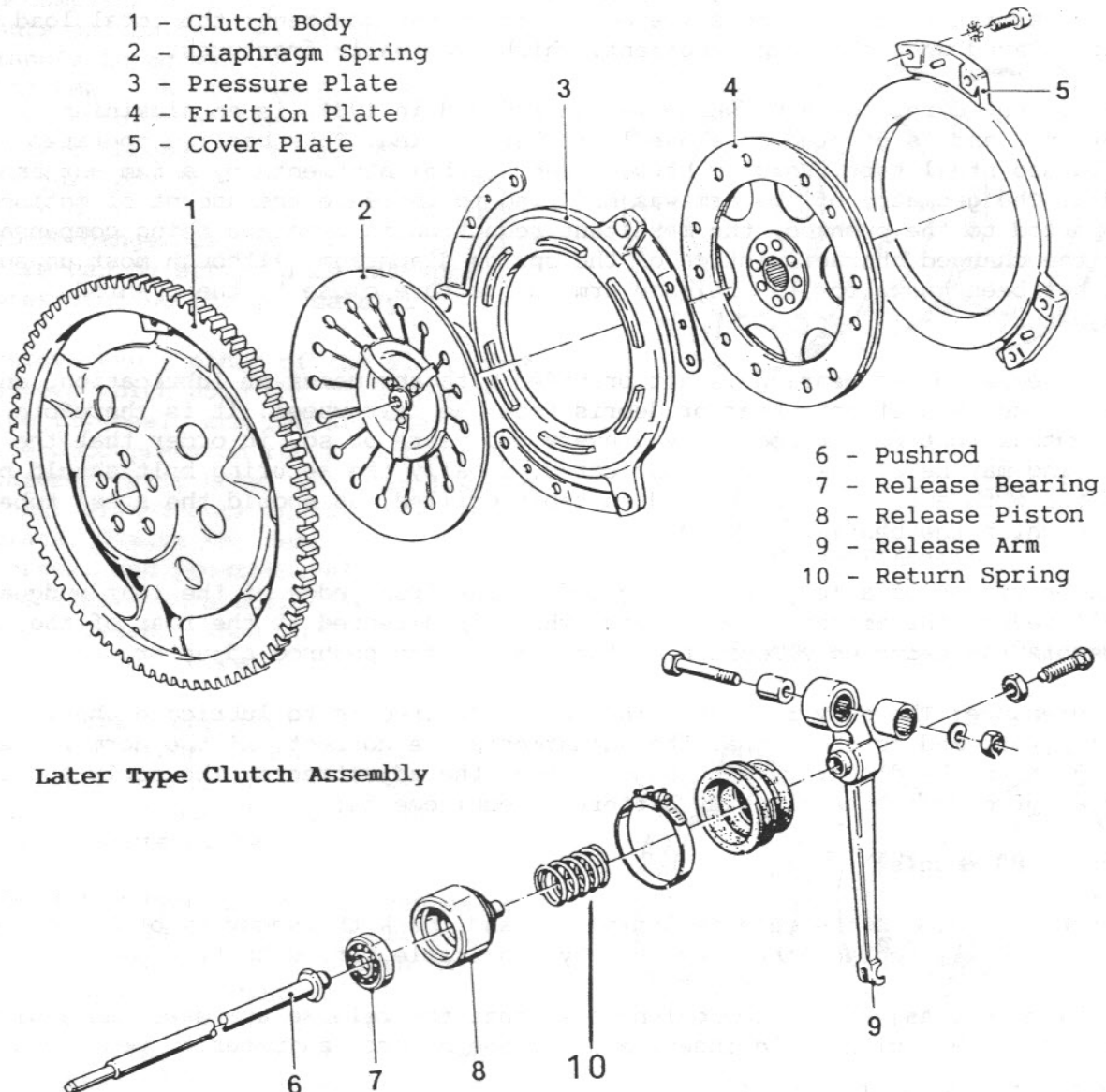
The cover plate was a casting, and therefore provided sufficient "meat" for the removal of metal to also balance the pressed clutch body.

Pushrod: The early type of pushrod was of all steel construction, with a stepped portion towards the rear, into which was wrapped a felt strip to act as an oil seal. Due to the compression under which the seal is placed when inside the input shaft, it **cannot be inserted from the rear of the gearbox** without use of a tapered sleeve to progressively compress the felt; insertion from the front of the gearbox, however, does not present undue problems.

The 1981-pattern pushrod is of uniform cross section, oil sealing being performed by a small spring-loaded lipped seal mounted in the rear of the gearbox input shaft.

Release Bearing: The early bearings were of the radial roller type, which are basically unsuited for high speed applications such as this; as the peripheral speed at the outer ends of the rollers is considerably greater than that at their inner ends, they cannot roll, and therefore skid between the faces of the release piston, until they become flattened, so promoting further skidding and wear on the piston faces.

The 1981-pattern bearing is a ball race, which does not suffer from any problems.



Release Piston: The earlier pistons were made in two sections, and were originally of hardened steel, the inner faces of both sections acting as the outer races of the roller-type release bearing. The outer section carried a lipped seal to prevent loss of gearbox oil.

This original pattern was superseded in 1981 by a one-piece aluminium type, the inner face of which carried one outer race of the ball-type release bearing; the other outer race took the form of a steel disc, mounted on the stepped end of the pushrod. The outer face of the piston carried a hardened steel boss, upon which the pushrod adjuster operated.

The lipped seal was replaced by a convoluted plastic boot, which sealed the outer face of the rear section to the gearbox casing, and also contained the release arm return spring.

This pattern of piston was eventually also superseded in 1986-87 by one which contains a release bearing of the orthodox deep groove thrust type; the outer end of the pushrod is inserted directly into the bearing inner race.

Release Arm: The original release arm was a steel forging, which pivoted on a steel pin between the abutments on the rear gearbox cover. Lubrication was provided by a grease nipple. The exposed return spring was fitted between the release arm and the gearbox rear cover.

The release arm pivot pin was prevented from falling out by means of a spring clip, fitted into a groove around the pin, between the arm and the lower gearbox abutment. The spring clip has been known to fall out - or corrode away - so permitting the pin to slide out of the upper abutment; the total load is then placed upon the lower abutment, which eventually fractures.

The improved release arm, which was introduced in 1981, is an aluminium forging, and is pivoted on a needle roller bearing. This bearing operates on a hardened steel tube, secured between the gearbox abutments by a 6mm nut and bolt. The geometry of the arm was modified to increase the amount of motion imparted to the pushrod, the resultant reduction in leverage being compensated by the changed characteristics of the spring diaphragm. Although most unusual, it has been known for the release arm to fracture close to the pushrod adjuster.

The needle roller bearing is not provided with any means of lubrication, and is in the path of any water or debris from the rear wheel. It is therefore essential that the arm be removed every two years or so, in order that the bearing may be cleaned and relubricated. Ideally the securing bolt should be fitted with a grease nipple, and suitably drilled, as should the steel tube upon which the bearing operates.

The provision of a long mudflap, glued to the front edge of the rear mudguard, will reduce the amount of water etc. which is directed at the rear of the gearbox, so reducing corrosion of the bearing and pushrod adjuster.

Maintenance: The only routine maintenance required is to lubricate the release arm pivot, and to check that the adjustments are correct; if the normal free play at the handlebar lever changes, check the adjustments. The early and late types of clutch have slightly different requirements:

1969 - 80 Models:

Monthly: Grease the release arm pivot, and check the security of the spring clip. Ideally replace the steel pin by a suitable fitted bolt.

As Required: Adjust the cable length so that the release arm makes an angle of just under 90° with cable inner, and set the pushrod adjuster to provide 3-4 mm of free play in the cable.

1981 Models Onward:

3 Yearly: Remove the release arm, clean out the needle roller bearing, and relubricate. If the steel tube on which the rollers operate is worn, remove ridges with emery tape - the hardening is very deep.

As Required: Adjust the cable length to give a dimension of 200mm between the rear face of the gearbox front flange (Where the clutch cable outer is seated) and the forward face of the release arm (Against the cable inner) Set the pushrod adjuster to give 3-4mm of free play in the cable.

Every Five Years: Remove the gearbox, and clean the splines of the gearbox input shaft and the clutch friction plate. Relubricate with **Optimoly PL**

Replacement: **WARNING - The pre-1981 friction plate linings contain asbestos!**

Dismantling: Given that the gearbox has been removed, the clutch can be rapidly dismantled by the removal of the six bolts which secure the cover plate to the flywheel. **Before dismantling ALWAYS mark the flywheel, cover plate, pressure plate, and spring in order that they are replaced in the same relationship; otherwise the balance of the flywheel/clutch assembly will be lost!** This consideration is of particular importance on the later type of clutch, where the cast cover plate is also used to balance the pressed clutch body.

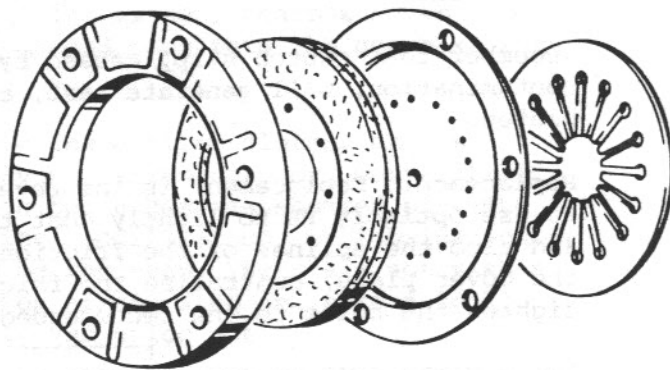
The older type of clutch requires that you have access to three decompression tools - really just nuts and bolts - which can be manufactured easily, or hired from the BMW Club. If manufacturing them, remember that they have a **fine metric thread - 8 X 1mm**. Although it is just possible to fit a 5/16 UNF thread, such practice has been known to be dangerous, as the UNF thread form can be stripped by the spring pressure! **Do the job safely!**

Remove every other of the six socket screws which hold the cover plate to the flywheel, and replace them by the decompression tools; screw their threads fully home, and then tighten their sleeve nuts against the cover plate. Remove the remaining socket screws, and progressively slacken the sleeve nuts until the spring is decompressed, when the cover plate will become loose.

Five Series and some very early six series clutches are fitted with 3mm distance pieces on the socket screws, between the cover plate and the pressure plate.

The later type clutch is even easier to dismantle - just undo all six socket screws by half a turn at a time, and the spring will be decompressed before the screws are removed. The cover plate can then be withdrawn from the three locating dowels. The pressure plate is attached to the flywheel (ie: Clutch Body) by riveted straps. Always replace the shakeproof washers below the screws, which are slightly smaller than those on the older clutch - 7 X 1mm.

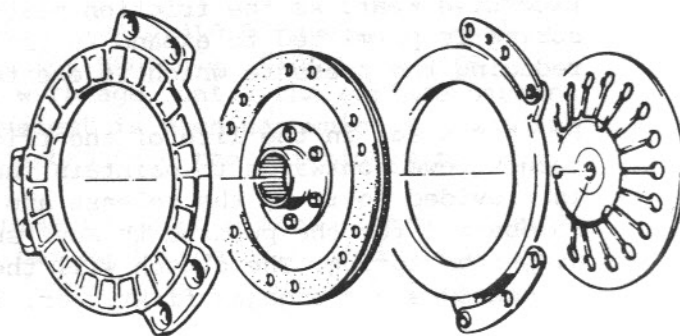
Components - up to 1980 model



Order of installation up to 1980 models

Use BMW centering arbor 21 2 650 when assembling.
Note balancing mark.

Components - from 1981 model on



Order of installation for 1981 models on

Use centering arbor with BMW No. 21 2 660 when assembling.
Note balancing mark.

Examination: Check the iron plates for freedom from cracking, excessive wear (Look for deep lips at the sides) or scoring. It is not usually necessary to replace them, and it is possible to regrind them - the flat pre-1981 cover plate is particularly easy to resurface. Severe wear, which will produce a lip at the outer, unworn edge of the plate, can be removed by careful use of a grinder, or a mating bevel can be formed on the edge of the friction plate.

Check the friction plate for wear, and check that it has been seating fully. Make sure that the rivets which secure the splined hub are not loose, and that the splines are not worn.

**Friction Plate thickness (Up to 1980) is 6mm (Minimum 4.5mm)
(1981 on) is 5.5 (Minimum 4mm)**

Check the spring by laying it on a flat surface - such as a good mirror - and measure the height of each leaf. Check for cracks at the roots of the leaves.

Check that the pushrod is not bent or broken, and that the tip is unworn.

Oil contamination is unusual, as any oil passing through a worn rear crankshaft seal will be centrifuged away from the clutch. Any oil is likely to have been passed from the gearbox via either the pushrod seal or the input shaft seal.

Remember that clutch slip, caused by either a worn friction plate or oil contamination, will generate heat, and so can cause cracking of the iron plates.

Replacement: Replacement is the reverse of the dismantling procedure. Remember to use **Optimoly PL** to lightly coat the tips of the diaphragm spring fingers, and also the splines of the friction plate and input shaft. Before securing the cover plate, centralise the friction plate with a suitable arbour, and tighten the bolts to the recommended torque:

Cover Plate Bolt Torque:

1969-80	16.5 lb-ft
1981 on	15/16 lb-ft

Problems:

Very little goes wrong with these clutches; the cables seem to last for ever, and re-adjustment is not often necessary. Some of the early examples of the 1981 - type clutch had poorly hardened friction plate splines which sheared, and it has been known for the rivets securing the splined centre to become loose; these problems, however, are most unusual.

Excessive Wear: As the friction plate gradually wears down, the diaphragm spring is permitted to expand further outwards against the pressure plate, so reducing the pressure which is exerted on it. The clutch then begins to slip.

By this stage in the life of the friction plate the pushrod adjuster will have been screwed outwards to maintain the necessary free play; as the motion which is provided to it by the release arm is constant, it will have become impossible for the pushrod to move sufficiently inwards to fully compress the diaphragm spring. The clutch will therefore also drag, promoting horrendous crunches as one engages first gear, and similar effects on changing gear.

Broken Pushrods: The pre-1981 pushrod is prone to fracture at its stepped portion; this problem may well be repeated if a new pushrod is fitted, although the clutch does at least operate without problem. The root cause is that the diaphragm spring has begun to collapse, and the centre of the pressure plate is no longer concentric. A new spring is the only answer. Remember that the pushrod cannot be replaced (Due to the expansion of the felt seal) from the rear of the input shaft without a tapered sleeve to compress the seal.

Oil Seals: Although an unheard-of problem, it is possible that if the pushrod or gearbox input shaft seals were to fail, gear oil would find its way into the friction plate, with obvious consequences. Failure of the rear crankshaft seal, or even the oil pump cover seal, is not usually a problem, as the flywheel will centrifuge the oil away from the clutch.

Clutch Slip: Although this can be a function of excessive wear or oil contamination, cases have occurred where the clutch assembly is in excellent condition, with only slight wear apparent. The cause of the problem has proven to be the gearbox input shaft, which, due to a build - up of manufacturing tolerances in the shaft and gearbox casing, protruded too far into the clutch! The end of the shaft therefore contacted the splined boss of the friction plate preventing its rear face from bearing fully against the cover plate! The answer in such cases is to have the end of the input shaft ground down.

The earlier type of clutch can also slip if the exposed release arm return spring has corroded and broken; check this spring, and coat it with Waxoyl before the winter salt is around!

Seized Release Bearing: This is a problem confined to the earlier clutches; when the radial rollers become worn flat, and finally cease to roll, the rotation of the pushrod is passed on to the release piston, the exposed outer end of which can be seen to rotate against the adjuster screw. If this is allowed to continue, wear will take place to the piston, gearbox cover, and adjuster screw. The bearing may also break up and pass into the gearbox, with expensive consequences.

Failure to Release: This is also confined to the earlier clutch, and is usually due to the release arm pivot pin having fallen out, or, worse still, having slid out of one abutment, after which the other has sheared off. The fractured abutment can be repaired by welding, modification, or fabrication of a new one. The gearbox rear cover can also be replaced. These are not viable roadside tasks - if the clutch action becomes stiff, stop and take a look! Ideally replace the pin with a suitable bolt and nyloc nut.

The later type clutch has also, in at least one case, been known to fracture the aluminium release arm close to the adjuster.

Borg & Beck Friction Plates: The use of the so-called Heavy Duty friction plate manufactured by Borg & Beck appears to be attractive, as it is both thicker and cheaper; use of these components, however, is known to cause two problems:

Clutch Drag, due to the extra thickness of the friction material, which therefore reduces the amount of movement available when the spring is compressed; this effect is reduced with use.

Clutch Slip, caused by a reduction in the friction plate area due to swelling, particularly in the vicinity of the rivets. The generally fibrous nature of the friction material becomes more obvious with age, until the surface becomes uneven. Both effects appear to be more prevalent in machines which are not in daily use, where moisture is able to be absorbed into the friction material.

Although many riders are very happy with these friction plates, there are also many who are not; if in doubt stick to the original type of bonded plate, which is available from both BMW dealers and specialists such as Harman Services and Moto-Bins.

Lever Stiffness when hot is not unknown on the later monolever models, and is due to insufficient clearance between the gearbox casing and the release piston; the piston becomes warmer than the gearbox casing, and therefore expands more. While the official answer is to replace the piston, it is equally possible to reduce its diameter by careful use of emery tape.

Stiffness can also, of course, be caused by a damaged or worn cable, or a loose release arm pivot pin.

Specifications
(up to 1980 model)

Model	R 45/R 65	R 50 – R 80	R 90 – R 100
Thickness of material (diaphragm spring) mm (in)	2.6 (0.102)		2.8 (0.110)
Diaphragm spring pressure, installed kp (lb)	180–220 (396–485)		202 – 220 (445–485)
Height of diaphragm spring, relaxed mm (in)	15.2 ± 0.5 (0.598 ± 0.02)	19 ± 0.5 (0.748 ± 0.02)	17.4 ± 0.3 (0.685 ± 0.019)
Diaphragm spring diameter, pressed flat mm (in)	163 (6.42)	183 (7.20)	
Total thickness of clutch plate (with lining material) mm (in)	6 ± 0.25 (0.236 ± 0.010)		
Minimum clutch plate thickness mm (in)	4.5 (0.177)		
Extl. dia. of clutch plate mm (in)	160 (6.3)	180 (7.09)	
Max. lateral runout of clutch plate at periphery mm (in)	0.15 (0.006)		
Max. vertical runout of clutch plate mm (in)	0.3 (0.012)		
Max. imbalance in clutch plate cmg	6		
Operating clearance, measured at lever (cable) mm (in)	2 (0.08)		

Test procedure for diaphragm spring	When edge of spring is touching measuring plate, difference in height at spring tongues must not exceed 0.3 mm (0.012 in); when spring tongues are touching plate, vertical runout at edge of spring must be max. 0.8 mm (0.031 in)
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