THE TC GEARBOX
An Overview

By Rick Storms tcstormer01@gmail.com

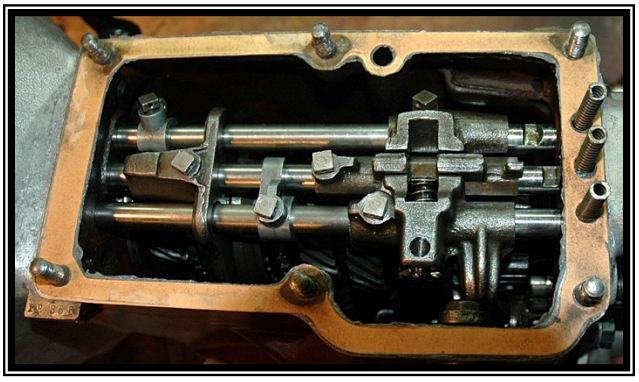
Recently I had the "opportunity" to rebuild the gearbox on TC 8230. Having absolutely no experience in this area I approached the job with some trepidation. The concept of a "black box" that some how converted the motion of the crankshaft into four forward and one reverse was a bit intimidating. But the alternative of spending a fair amount of money having someone do it for me, while I did not learn anything, was not very appealing. This is the first of two write ups, and covers a general overview of the internals of the gearbox. A second paper titled "Rebuilding The TC Gearbox" covers a step by step teardown and rebuild.

Before I began this project, I read all the literature / manuals I could locate on the TC gearbox. This included The Blower Manual, the TC Instruction Manual, the MG Autobook One by Kenneth Ball Brown, a paper titled The Gearbox Fitted to the XPAG by Neil Cairns, all the articles in the TSO CD on gearboxes, as well as, studying illustrations in both the Moss and Abingdon Spares catalogues. This paper is a report of what I learned and hopefully I can pass along some tips I acquired while doing this project. I would also like to thank Lawrie Alexander who reviewed this text and answered numerous e-mails during the rebuild.

In the following please refer to the TC Gearbox illustrated in the Moss Catalogue on page 12. The numbers in parentheses (nn) refer to the illustration numbers.

What's Inside The Box

When I first opened the gearbox, I was presented with a wonderful display of shafts, gears, wired nuts, and selector forks. I was also concerned regarding the number of parts packed into a tiny package. If I took it apart would I ever get it back together and in the correct alignment? I was mostly concerned about the selector forks and other parts attached to the sector shafts, the book said to mark these for correct reassembly alignment. Well I was pleased to find that the selector shafts were pre-drilled for the Lock Bolts (20) thus affording correct alignment when reassembled. In fact the entire gearbox is constructed (with only a few exceptions) using this methodology.



Selector Shafts

With the Remote Control Unit removed, the first things you will see across the top are the selector shafts. With the front of the box away from you, on the left is the Reverse Selector Shaft (4), in the middle is Third / Fourth Gear Selector Shaft (2), and on the right the First / Second Gear Selector Shaft (1). This may seem backwards, but remember

everything in the box works opposite to how you use the gear shift lever. When you are shifting into first gear the Selector Lever (38) is actually moving to the right and the rear pushing the first / second gear shaft backwards even though the shift lever is pushed to the left and forward.

Attached to the selector shafts are a variety of parts all held in place with Lock Bolts (20).

- On the reverse shaft (top to bottom) is a Steady (9). This helps support the shaft when the selector is pushing against the lock-out spring. Below this is the Reverse Selector (11); it is used to manipulate the Reverse Link (14) which in turn is connected to the Reverse Fork (7) which moves Reverse Gear (95). On the reverse selector is a Plunger (12) and Spring (13) which are held in place by a cotter pin. If you remove this item you will also find a spring and ball (not shown in the Moss catalogue) which is used to keep the end of the plunger in alignment with the face of the reverse selector. Be careful when removing the plunger, keep a finger or something over the hole in the top, otherwise the spring and ball will exit at a fairly rapid speed thus losing itself somewhere in the workshop. On the plunger you will find a notch; this faces the ball when you reassemble it. The purpose of the plunger is to keep you from shifting into reverse when moving through the other gears.

- The third / fourth shaft holds Third / Fourth Gear Fork (6). This is attached to the Third / Fourth Gear Striking Dog (75) which is used to shift between third and fourth gear. The gear fork also acts as a "stop" not allowing the movement of the selector shaft to move beyond fourth gear. Below the fork is the Third / Fourth Gear Selector (10). At the bottom end of the selector you will see a raised angle; this will hit the casing not allowing you move beyond third gear.

- Lastly is the first / second shaft. On this shaft is a Stop (8) that will hit against the front of the casing stopping the movement of the shaft from going beyond second gear. At the bottom is the First / Second Gear Fork (5). This attaches to the First / Second Gear and Striking Dog (90) and is used to shift between first and second gear. It also acts as a stop not allowing you to move beyond first gear.

The Selector Lever (38) sits within the cut out created by the reverse selector, third / fourth selector and first / second fork and is used to push the shafts forward and backwards, thus shifting from gear to gear.

When you remove the selector shafts you will see a series of notches at one end. There is a single side notch on both the reverse and first / second gear shafts, and two side notches on the third / fourth gear shaft. On their top surfaces, the reverse gear shaft has two notches and the other shafts have three.

These notches are used to lock the shafts in place. This is controlled by five Balls (22) and three Springs (21). When the selector shafts move forwards and backwards, the balls engage and disengage in the notches. The balls and springs on the top lock the shaft in place when you are in gear or neutral. On the reverse shaft the bottom notch is for neutral and the top is used for reverse. On the other shafts, the center notch is for neutral while the top notch is for the lower gears (first / third) and bottom notch for the higher gears (second / fourth). When the top springs and / or balls become worn it can cause the gearbox to "pop out of gear."

The two balls that reside within the casing on either side of the third / fourth gear selector shaft are used to prevent the shafts from being in more than one gear at a time. There is a pin that runs through the middle shaft side notches that can push the balls back and forth. There is just enough room, when the gearbox is in neutral, and the notches are lined up, to allow any one of the shafts to move. When one of the outside shafts moves the notch will move. This will push the ball towards the middle shaft which in turn will push the pin and the ball on the opposite side, thus locking both the center shaft and opposite side shaft. When the center shaft moves the notch moves with it pushing both balls outward locking the outside shafts.

First Motion Shaft

Looking at the gearbox from the side (refer to the Moss illustration) starting at the front is the First Motion Shaft (56); it is connected to the crankshaft on the left and inserted in the other end is the front of the Main Shaft (50). The first motion shaft is held in place by a nut (64), the First Motion Shaft Bearing (58) and a series of Needle Bearings (57) where it comes in contact with the main shaft. This allows the first motion shaft to turn independently of the main shaft. At the right hand end of the first motion shaft you will see two gears. The helical gear is used to transfer motion to the Laygear (66) and the conical protrusions which are part of the fourth gear synchromesh mechanism. The shaft ends with a smooth cone shaped surface which is half of the metal clutch used by the synchromesh.

Layshaft

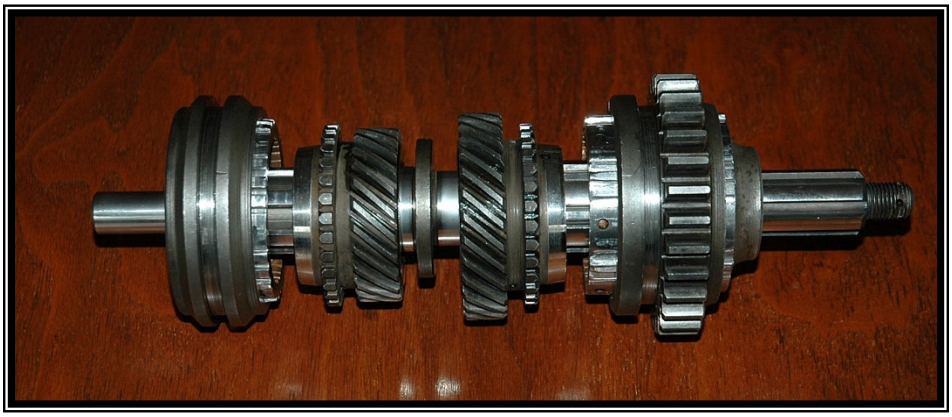
Moving down in the gearbox is the Layshaft (68). It is sometimes referred to as the Second Motion or Cluster Shaft. Mounted on this shaft is the Laygear (66). This set of gears turn freely on the layshaft using a series of Needle Bearings (67) and is held in place by the layshaft which extends through both ends of the gearbox casing. The layshaft is then locked into place by using a Lock Bolt (69). At either end of the layshaft are the Thrust Washers (73 & 74). The purpose of these washers is to limit movement

along the axis of the shaft and to absorb the thrust loads caused by the helical gears working against each other.

The laygear consists of four gears, three are helical cut and one is straight cut. Moving from left to right the first gear is used to connect to the first motion shaft. Next is third gear, it is connected to the Third Gear (79) mounted on the main shaft after that is second gear and like third gear is it connected to its counter part Second Gear (85) on the main shaft. All three of these gears are in constant mesh with each other. Thus when the first motion shaft is turning, so is the laygear, as well as, third gear and second gear on the main shaft. The last laygear, the straight cut set, is the first / reverse gear. This gear is not in constant mesh with either First Gear (90) on the main shaft or Reverse Gear (95). So when shifting into first or reverse, it is important to be at a full stop, with the clutch depressed, or the laygear will be spinning when attempting to engage either of these gears.

Main Shaft

Above the laygear is the Third Motion or Main Shaft (50). Mounted on this shaft are (from left to right) third / fourth gear Sliding Hub (76) along with the third / fourth gear Striking Dog (75); Third Gear (79); Second Gear (85); and finally the first / second gear Sliding Hub (91) with the combination second gear Striking Dog and First Gear (90). At this time you may ask “Where is fourth gear?” Well there is no fourth gear. Fourth is actually a one-to-one ratio and is achieved by locking the first motion shaft to the main shaft.



Second and third gears are free to rotate around the main shaft through the use of Needle Bearings (80) but can not travel forward and backwards and are locked in place using a

small Plunger (82) and Spring (83). The Lock Plate (81) and Split Washer (87) are used to hold the needle bearings in place while the Collar (88) and Lock Plate (81) are used with the plunger and spring to hold the gears in place. As stated earlier, these gears are in constant mesh with their laygear counter parts and are always turning. On the left side of third gear and the right side of second gear are the synchromesh conical protrusions and smooth cones.

The Sliding Hubs (76 & 91) are locked to the main shaft by splines but can travel forward and backwards on the shaft. So when the main shaft is turning so are the sliding hubs and striking dogs. Likewise the Striking Dogs (75 & 90) are locked to the sliding hubs by splines; they can travel forwards and backwards on the sliding hubs, but are held in place using six Springs (77 & 92) and Balls (78 & 93). When the gear is not in use, the balls rest in a grove in the center of the striking dog. The selector forks (5 & 6) mount in the deep groove on the outside of the striking dogs. On the inside of the striking dog there is a series of splines, these server two purposes, first to lock to the sliding hub and secondly to engage the conical protrusions when shifting gears. Inside of the sliding hubs are brass inserts, like the conical protrusions these are used by the synchromesh process (See Synchromesh below).

Note there is no built in alignment of the sliding hubs to the main shaft or the striking dogs to the sliding hubs. Before you remove these items it is wise to note their alignments to each other by using a permanent marker or a file.

At the far end of the main shaft is the Rear Flange (104). It is connected to the main shaft using splines and is held in place with a Castellated Nut (106) and a cotter pin. The rear flange is attached to the drive shaft, but also serves to drive the Speedometer Pinion (107).

<u>Reverse Gear</u>
Finally there is the Reverse Gear (95). It is mounted on its own shaft (96) and is free to spin on the shaft as well as travel forwards and backwards. When not in use it is stored in

a "pocket" within the rear Cover Plate (112). The Reverse Selector (11) attaches to the Reverse Link (14) which is attached to the Reverse Fork (7). The reverse fork sits in the deep groove on reverse gear and slides forwards and backwards on the Reverse Fork Selector Shaft (3).

Shifting into reverse causes the reverse gear to move forward and engage between the straight cut gear on the laygear and first gear on the main shaft. During this operation first gear on the main shaft remains in place thus reversing the rotation of the main shaft.

The Synchromesh

What is synchromesh? Well simply it is the ability to synchronize two spinning objects to match speeds. In the case of the gearbox, it involves either second or third gear and the main shaft, or the first motion shaft and the main shaft to create fourth gear. This is accomplished through the use of metal to metal cone clutches built into the sliding hubs and the associated gears and/or shafts.

When you shift; a sliding hub moves forwards or backwards along the main shaft and depending on which gear you are shifting into, engages second gear, third gear or the first motion shaft. When the brass metal cone clutches on the sliding hub engages the smooth conical end of the gear it causes the gear or first motion shaft to speed up or slow down to match the speed of the main shaft.

Fractionally later as you continue to push or pull the shift lever the springs and balls that are holding the striking dog in place give way and the striking dog moves in the direction of the gear or shaft. The splines on the inside of the striking dog engage the conical protrusions on the gear or shaft thus locking the gear or shaft to the main shaft. When you "miss a gear" (that lovely girding sound) it's the striking dog's inter splines missing the conical protrusions on the gear of shaft and not the actual gears.

Conclusions

After going through the entire rebuild, breaking down all the parts I came to the realization that this gearbox is not all that complicated. Yes, there are a lot of parts in a tiny space, but it is a very due able project for even an amateur mechanic such as myself. But, understanding how it works was half the battle.