# THIS IS OUR EXPERIENCE FROM A FULL REBUILD OF A 1960 G12 MATCHLESS

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(There was available a copy of a service manual covering this bike, but it is very sketchy in detail and provides a guide at the best of times. Pictures of the bike from a sales brochure were helpful. This was a learn-as-you-go experience!)

N.B All threads in aluminium on these bikes are BSF (British Standard Fine), or B.A (British Association)


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# ASSEMBLY ORDER FOR G12 650 MATCHLESS TWIN ENGINE

Clean out crankshaft oil passages and refit blanking plugs.

Fit and “stake” main bearing outer races.

Fit cam follower shaft to drive side crankcase.

Fit timing gear idle pinion shaft to timing side of the crankcase.

Fit the oil line reducing bushes to timing side crankcase and cover entry/exit holes.

Fit the crankcase drain plug.

Fit the main bearing inner race, spacer and halftime pinion to the timing side of the crankshaft; don’t forget the key on the halftime pinion! Tighten the holding bolt as best you can, it can be finally tightened when the motor is fully together.

Fit the main bearing inner race to the drive side of the crankshaft. Pull it up with the holding bolt and spacer to ensure the race is fully home on the shaft.

Fit crankshaft to centre main bearing web, use Graphogen, or a good assembly lube. Ensure free running.

Fit conrods to crankshaft, use Graphogen. Ensure free running.

Fit conrod protectors over rods to prevent damage.

Fit crankshaft assembly to drive side crankcase, use a light smear of jointing compound around the oil feed drilling on the centre main casting. When fitting this it is best to support the crankcase with the open side facing up. This will ensure the centre main bearing is not loaded, due to the weight of the crankshaft. Tighten the six bolts to 6ft/lb. These nuts should be a self-locking design, **but not nylock**. Check for free running.

Fit camshafts to drive side crankcase, use Graphogen.

Fit cam followers and spacers to drive side crankcase, use Graphogen on bearings and cam faces.

Fit camshaft tunnels to drive side crankcase.

Smear a little Graphogen onto the entire camshaft journals land smear some gasket cement, **not shellac type**, to the crankcase joint. Don’t forget the gasket for the oil filter housing!

Mate the two crankcase halves, tighten all crankcase bolts and ensure free running of all shafts. Note: the two faces for the cylinders may not match. The important thing is to have the camshafts and crankshaft running freely.

Fit the two camshaft gears. Don't forget the keys! Fit the intermediate gear and using a piece of aluminium, wedge the gears to allow the nut to be torqued up to 60ft/lb. (Both are left hand thread!). Using the same method, torque the half time pinion on the crankshaft to 50ft/lb.

Fit the oil filter assembly into the drive side crankcase and tighten.

Fit the exhaust camshaft oil timing bush and secure it with the blanking plug. Check to ensure the camshaft rotates freely. (The washer behind the plug must be 0.062" in thickness to avoid binding).

Fit the inlet camshaft blanking plug, with washer.

Time the camshafts to the half time pinion, using the marks on the gear faces.

Prime the oil galleries as best possible from the feed oil pump delivery drilling, using a pressure oilcan filled with the correct oil.

Fit the distributor/magneto/timing assembly and fit its drive gear.

Temporarily fit the timing case cover.

Check the piston ring gaps and fit rings to pistons.

Clean out the oil drillings in the two cylinders.

Fit the cylinder head studs to the crankcase mouths.

Fit the timing side piston to the con rod and then fit the timing side cylinder, use a smear of jointing compound on the cylinder base gasket. Remove the con rod protector as the piston enters the cylinder.

Fit the drive side piston to the con rod and then fit the drive side cylinder, use a smear of jointing compound on the cylinder base gasket. Remove the con rod protector as the piston enters the cylinder.

Fit temporary spacers above the cylinders to allow the cylinders to be torqued to the crankcases effecting a good seal at the cylinder bases. (This is important as the gasket face is very narrow and the oil gallery is subject to the full oil pressure and has a propensity to leak).

**At this point we mounted the engine into the frame.**

**Once in the frame and with the gearbox fitted, inner chain case fitted and ignition timing completed, engine assembly, as below, continued.**

Lap in the valves to their respective seats; clean all traces of grinding paste away.

Clean out the oil feed holes in both cylinder heads.

Fit the valve spring lower mounts.

Fit the valves to the guides and fit the valve springs, top caps and split collets. Use Graphogen on valve stems.

Assemble the rockers, shafts, etc on to the heads. Insert the pushrods down into the cam follower cups; use a smear of Graphogen on the ends.

Fit the cylinder heads, with their gaskets and loosely tighten the nuts.

Fit the inlet manifold, together with gaskets and use this to align the cylinder heads before torqueing them down.

Tighten the inlet manifold.

Torque down the cylinder heads. Go around the nuts several times, as the gasket will compress and reduce the torque on the studs.

Set the tappet clearances.

Loosely fit the rocker covers to the motor.

Loosely fit spark plugs to prevent any foreign matter entering the motor.

Insert some rag to the inlet manifold and exhaust ports to prevent foreign matter entering.

## ASSEMBLY ORDER FOR MATCHLESS G12 GEARBOX

Ensure gearbox castings are clean and dry.

Make the required gaskets.

Heat the main casting and fit the ball bearings races (if fully sealed remove the inner seal on the main bearing and both seals on the lay shaft one)

Heat the inner cover and fit the main shaft ball bearing race (if fully sealed remove both seals).

Fit the cam plate and selector quadrant so that with the cam plate indexed to top gear the quadrant has the second and third teeth visible through the selector fork track. The quadrant should be near the top of the gearbox casing with the roller radius in line with the top stud. Fit retaining cam plate and selector quadrant retaining bolts, washers and “O” rings, finger tight.

**Note*: (At this time it will pay to assemble the inner gearbox cover onto the case and screw in the indexing plunger body and spring so that it just touches the cam plate lightly. Rotate the cam plate from the top gear indexed position to the first gear indexed position to ensure the mesh between the cam plate and quadrant is correct. When correctly assembled the upper surface of the quadrant has a small clearance to the top of its slot in top gear and the lower surface just clears the bottom of the slot when the cam plate is rotated to the first gear position. If this is unable to be achieved you will need to re-mesh the cam plate and quadrant until you can achieve this full movement).***

Fit the sleeve gear through the main bearing and press it fully home.

Fit the oil seal, lip innermost, to the case, slide the spacer over the sleeve gear and fit the secondary drive sprocket. It may require to be pressed fully home.

Fit the securing nut (LH thread) and fully tighten. Fit the securing washer and locktite the small screw when fitted to the sprocket.

Fit the main shaft through the sleeve gear (lubricate first) and ensure it rotates freely. (It may require a 13/16” reamer to be run through if new bushes have been fitted and the secondary drive sprocket is tight on the splines).

Slide the third gear, complete with selector fork onto the main shaft and engage the drive pin in the end of the top cam plate track. Return the cam plate to the top gear position.

Fit the top and third gears to the lay shaft and fit the lay shaft into its bearing in the main case. Lubricate the bush before assembly.

Slide the second gear, complete with selector fork, onto the lay shaft and engage the drive pin in the lower cam plate track. Return the cam plate to the top gear position.

Fit the detent plunger, spring and housing to the gearbox case, screw fully home.

Fit the selector fork shaft through both selectors and screw fully home.

Fit the second and first gears to the main shaft.

Fit the first gear to the lay shaft.

Fit the pawl, spring and hollow plunger to the kick-start shaft and assemble this into the inner gearbox cover. Ensure the pawl is held in the non-engage position by its stop.

Fit the gasket to the main casting.

Fit the drilled roller to the selector quadrant and then fit the inner cover over the shafts and push fully home.

Fit washers and nuts and torque to 15-16ft/lbs.

Hold the secondary drive sprocket and tighten the main shaft retaining nut, lightly centre punch the nut into the provided groove.

Fit the clutch actuating lever support together with the large ball bearing into the main shaft bearing recess and secure with the threaded ring. When tightening ensure the slot is aligned to the clutch cable entry point so no distortion occurs when the clutch is actuated. Fit the clutch actuating lever and its two-piece fulcrum, secured with a 2 BA screw and self-locking nut.

Assemble the outer cover with the gear lever return spring fitted under the retaining plate.

Fit the gear lever shaft “O” ring into the recess provided, do the same with the kick-start shaft “o” ring.

Fit the large flat washer over the gear lever shaft and assemble the selector pawl assembly to the gear lever shaft, not forgetting the “O” ring fitted to this shaft.

Fit the selector pawl spring, straight leg uppermost, over the inside shaft, ensuring the two legs are fitted into the grooves on the retaining plate.

Fit the outer cover gasket to the dowel pins projecting from the inner cover.

Carefully assemble the outer cover to the gearbox, fitting the actuating peg into the quadrant roller, the inner shaft into its bush and ensure the selector pawl spring is not trapped between the selector assembly and the inner bush. Push fully home and torque the 5 retaining screws to 6-7ft/lbs.

Fit the drain plug and securely tighten.

Fill with approximately 300cc oil and ensure the gearbox is able to select all 4 gears, up and down. You will need to be rotating the input and output shafts to achieve this.

Loosely fit the level plug and clutch inspection cover to the outer case.

# FITTING MOTOR AND GEARBOX INTO THE FRAME

If the bike is being completely rebuilt, fit the swing arm assembly to the frame, lube the bushes first and don't forget the felt washers around the outside of the bushes.

Centralise the pivot tube and lock in place with the two cotter pins.

Cover the lower frame tubes with a cloth to protect the paint, leaving a gap where the motor mounts to the lower frame rails.

Fit the engine to the lower frame rail mount and insert the through bolt, leave it loose at this stage.

Fit the two engine/gearbox plates to the rear of the motor, (the middle mount is 7/16"), leave all bolts loose.

Tilt the motor as far forward as possible, (protect the frame from paint damage). At this point it will be possible to site the gearbox into its mounting holes in the plates. The bolt with a thin section head is fitted to the bottom gearbox mount; this provides clearance for the centre stand, again, leave the bolts loose.

Carefully bring the whole motor/gearbox unit back to the normal position, insert the square section mounting shaft and its spacers right through the two frame rails. Now fit the two bolts through the rear most holes, lining up with the casting in the saddle tube. Leave loose.

Fit the centre stand to the frame. This is a difficult operation, as you need to overcome the tension of the spring. Two hardened steel top hat bushes are fitted to the stand with their heads innermost; lubricate the outside surface of these bushes with grease and fit to the stand. Fit the hook of the stand return spring to the hold in the right-hand engine plate. Fit the spacer between the two bushes, inside the spring and ensure the long leg of the spring is engaged with centre bar of the stand. Fit the 5/8" shaft with the tapered ends through the frame, stand, spacer, stand and frame. The washers used for this shaft have a locating register that fits into the outside recess in the frame, tighten the nuts and ensure the stand operates correctly.

Fit the front engine mounting plates to the front of the crankcase and the two frame down tubes, complete with spacer.

Fully tighten all mounting bolts, shafts, etc. apart from the square section shaft, which requires the footrests to be fitted prior to being tightened. Leave the gearbox free to pivot to allow the primary chain case assembly to be fitted. (Note: the two exhaust pipe mounting nuts are fitted to the lower front engine mounts).

## ONCE INSTALLED INTO THE MOTORCYCLE FRAME

Fit the side stand and spring to the frame, ensure it functions correctly. (Note: fit the side stand pivot bolt with the nut uppermost, this allows the stand to be removed with the primary chain case in situ).

Fit the inner chain case, complete with breather hose, to the motor, with the gearbox shaft entering through the sliding seal. Carefully align the case to the motor and secure with the 3 Csk screws and the stud. Use a silicone jointing compound between the motor and the chain case.

Fit the oil sealing ring, primary drive engine sprocket and spacer.

Mount a degree wheel onto the drive side crankshaft and temporarily secure. Using a Dial Indicator find TDC. Rotate the crankshaft to the correct full advance position before TDC. The sprocket is hard so grind a small reference line on its surface in line with the inner chain case securing stud. Make up a small pointer and secure it under the nut in line with the line on the sprocket and secure. Fit the alternator rotor, don't forget the key! Tighten the retaining nut to 60ft/lb. Reset the two timing marks in alignment and then position the ignition to be strobed later and finally set. (We fitted a Boyer Bransen ignition to replace the distributor/coil set up). Set up a dial test indicator and check for run-out of the rotor, it must be within a max. of 0.005" or problems, as outlined below will be encountered.

Fit the clutch assembly to the gearbox shaft; do not forget to fit the clutch push rod! Ensure the sprocket spins true on the shaft and does not foul the rear chain case. (The rear friction plate fixed to the clutch centre can be bent if the correct puller has not been used to remove it from the splined gearbox shaft). Tighten the holding nut to 50ft/lb and then check the sprocket alignment, if OK, fit the primary chain and tension correctly.

Fit the gear and kick start levers.

Fit the clutch cable and set the correct clearances. Ensure the clutch disengages and the pressure plate spins true when the lever is pulled in and the kick-starter is operated.

Assemble the alternator stator into the outer primary chain case; don't worry about the leads at this time.

NB. The rotor/ stator clearance is difficult to check on these motors, but it must be done to avoid any contact. If contact occurs the magnetism of the rotor will be lost and the alternator will cease charging. (Don't ask how we know this!!) Check by winding a double layer of Sellotape on the rotor, assembling the outer case and turning the motor over a few times, then re checking for any evidence of contact. You may need to skim the outer surface of the rotor to gain the required clearance.

Do not fit the chain case gasket, or fill the lubricant at this time, as the ignition will require strobing once the motor is started. Fit and tension the primary chain.

Fit the secondary chain between the gearbox and rear wheel, tension it and check its alignment between the two sprockets.

Fit the secondary chain guard.

Fit the toolbox to the frame. There is a dogleg bracket which fits under the 3/8 nut on the top engine plate/frame saddle tube mount, line this up, fit the other two ¼ bolts and tighten all.

Fit the oil tank to the frame. This has two mounts on the top of the tank to the frame.

Fit the outer oil tank cover and secure it with the chrome custom screws.

Assemble and fit the air cleaner to the frame. This sits inside the oil tank and has a custom bolt/nut to secure it to the frame, tighten.

Fit the rear mudguard to the frame. There is a single fastened to a cross tube on the rear sub assembly of the frame, two small angled brackets that are fitted to the bottom front of the guard and the lower frame saddle tube, a bracket on each side which incorporates the top rear suspension mount bolt land is further fixed to the guard by two ¼ bolts on each side. Assemble all of this loosely and ensure all it square and aligned and then tighten all fittings. The number plate and tail light holder is fixed to the rear of this guard by two 5/16” bolts. Fit some upholsters beading between it and the mudguard to prevent fretting.

Fit the coil, rectifier and voltage controller to the frame and run the wiring.

Fit the oil lines from the oil tank to the motor fill the oil tank approximately half full. Bleed the timing gear chest. Using an oilcan, fill the filter cavity with clean engine oil until it can be seen emerging from the relief valve.

Fit the oil pump assembly to the timing gear chest, use gaskets and ensure they do not impede the oil flow to and from both pumps. Check all the timing gears have some backlash between them.

Lube the timing gears with engine oil, especially the intermediate pinion shaft.

Fit the timing cover to crankcase using a gasket.

Remove the rocker covers and pour approximately 500cc of oil, equally split, into the 4 valve recesses. Temporally fit the rocker covers.

Fit the carburettor, fuel lines, coils, wiring, spark plugs, etc.

Remove the level plug and fill the gearbox with the remainder of its oil to the correct level. Replace level plug.

## FRONT FORK REBUILD

After stripping and cleaning the forks re-assembly was commenced.

Check the plastic top slider bushes, both for wear and cracking. (We found the top of both bushes had started to separate).

Check the condition of the stanchion tubes, pay particular attention to any pitting as this will rip the new seals in very short order. (Mild pitting can be addressed by having the stanchions hard chromed and ground, but get a price first as it by be cheaper to replace with new items).

Fit the uppermost circlip onto the stanchion. (You may need to carefully reshape this as its removal can distort it so it does not sit fully back in its groove. Also I found it necessary to carefully ensure it was fully seated in its groove by tapping it in with a hammer and pin punch).

Fit the hardened steel bush onto the stanchion and fit the second circlip, following the above procedure.

Re-assemble the damper tube and damper rod. Check to ensure the retaining circlip is fully seated in its groove.

Fit the damper tube assembly into the alloy slider, securing it with the special bolt and fibre washer.

Fit the washer over the stanchion and then the rebound spring, followed by the top bush.

Lubricate the bottom bush on the stanchion with some fork oil, insert the stanchion into the slider and drive the top bush into the recess in the slider with a slide hammer made to fit.

Carefully slide the oil seal over the top of the stanchion, lubricating it first and then carefully drive this home tin the slider, using the same slide hammer system.

Pour some further oil into the top of the slider, slowly, as you will get an airlock if too hasty and then operate the forks to ensure there is full free movement o the fork.

Fit the lower chrome fork shrouds into the sliders and screw in as tight as possible by hand.

Fit the lower spring mount (leather washer), the 3 anti rattle rubber sleeves and finally the top shroud with its leather washer once the spring is in position. Have both fork legs in this state for the next step.

**This is how we fitted the forks together, not having the correct tool!**

Carefully spread the lower triple clamp stanchion bore with a screwdriver to open it up.

Fit one fork leg through so that 200mm protrudes out the top. You will need to overcome the spring pressure to do this and a helper is most welcome at this stage! Ensure the top shroud is locating on the small lip under the triple clamp. Fit second fork leg to the same stage. Tighten both clamps to hold the legs in position.

Locate the lower headstock bearing race onto the bottom triple clamp. Fill the race with grease and assemble all the 3/16" balls, fit the top race over this. Have the upper bottom headstock race in the same state, filled with grease and the balls fitted.

Fit the two headlight brackets, their location pieces and the rubber mount to the stanchions.

Carefully fit the whole assembly up through the headstock on the frame, fit the top triple clamp over the two stanchions and the headstock shaft, engage the first nut onto the shaft and the stanchion nuts through the holes onto their stanchions. Help is required to assemble this without disturbing the races land losing some ball bearings in the process. Of course, if the correct assembly tool is available to pull the stanchion up through the lower clamps one at a time to the already fitted top clamp so much the better!

Once the whole lot is together, loosen the lower triple clamp pinch bolts and adjust the headstock for the correct play (none!)>

Ensure the two stanchions are fully home in the top triple clamp and then tighten the two pinch bolts.

Care is required to fit the front mudguard if no paint is to be lost. Once in position, clamp the right side to the slider using 5/16" BSF bolts, the left has two studs with unthreaded sections to mount the front brake torque arm and the mudguard stay. These need to be fitted using the locknut method
No tension should be apparent between the mudguard stays and the fork sliders, if it is there it will add to the 'stiction' of the fork operation.

## ONCE THE MOTOR IS STARTED

Check to see the oil is circulating to the rocker gear. If okay, then fit the gaskets and torque down the rocker covers.
Check to see the oil is returning to the oil tank.

Connect an ignition strobe and running the motor at approximately 4,000 rpm and set the timing according to the mark on the sprocket made earlier.

Refit the outer chain case complete the gasket, with the alternator leads secured to avoid entanglement with the drive chain, etc. torque the screws fully home.

Fill the primary chain case with the correct amount and grade of oil.

Fit the footrests, rear brake pedal, set the brake light switch.

After running the motor a short time check the oil level in the tank and fill to the correct level.

Go for a short ride and then let the motor cool completely. Re-torque the cylinder heads and reset the valve clearance. Repeat this after approximately 200km.

Check the chain tensions also at 200km.