Figure 47: One shim was installed on each side of the main roller bearing for end float adjustment. The thicknesses here are 0.014" (0.365mm) and 0.015" (0.385mm).

Figure 48: The compressed and torn shim on the inner side of the timing roller bearing.

Figure 49: A shim fixed to a hexagonal nut with adhesive tape.

Figure 50: At high revs, the inner diameter of the shim is enlarged with a half-round file.

On both sides of the large roller bearing on the drive side there were thin imperial shims on the shaft (Fig. 39 and Fig. 47). We also found a metric shim on the inner side of the timing roller bearing. This shim was compressed, torn and was significantly larger than the shaft diameter of 22 mm (Fig. 48). These washers were installed at the factory to adjust the end float and, if necessary, must be adjusted to re-set this float.

Imperial shims for the driving side seem to be impossible to get in Europe (the shaft has 1 inch diameter) whereas it is easy to get metric shims for the timing side. Even in the UK they had changed to metric sizes[4]. One can increase the inner diameter of metric shims to inch sizes, though. This can be done with rudimentary tools. We taped a shim onto a large hexagonal nut (Fig. 49), connected it with a drill and enlarged it with a file by fast revs (Fig. 50).

Now the end float must be measured and then adjusted with matching shims to meet the specifications. The measurement must be done with the installed crankshaft and the two halves of the crankcase must be screwed together tightly. The measuring process is time-consuming, as one has to repeat the process several times, opening the housing and possibly adjusting the clearance with different shims. And because one works in the region of only a few thousandths of an inch, great care is necessary. If this work is not done accurately, the goal of a well-running engine will be spoiled. If one has access to a lathe, the drive side of the crankshaft can be clamped in the lathe chuck while the timing side is supported by the tailstock spindle. The side-to-side displacement of the crankcase is the end float. There is a good working alternative if a lathe is not at hand, as in our case. The displacement of the crankcase is the axial clearance again.

[4] Imperial shims can be found at McMASTER-CARR in the USA. https://www.mcmaster.com. Note that shipping to Europe costs 40 $US.


Figure 51: The gauge attached to the shaft.


Figure 52: The gauge positioned on the crankcase.


Figure 53: Testing for the correct end float with 2 thou backing paper.

We placed the entire unit on wooden blocks with the timing side down so that the axle does not rest on the bench but stops on the bearings.

First, we had to define a uniform method of measurement. For doing so the dial gauge was attached to the shaft and the height of various points on the case was measured (Fig. 51). Then the case was carefully removed from the wooden blocks and placed on the axis. The measurements were repeated. A second series of measurements was taken with the dial gauge on the crankcase and the height of various points on the crankshaft was measured (Fig. 52). The different measurement methods initially only served to find a reliable method in the first place that delivers repeatable results. Only when such a method has been found can the measurements of the end float be carried out with it. We decided on the procedure in figure 51 and stuck to it for all measurements.

Second, we had to calibrate our measurement setup. For doing so one needs to disconnect the gauge, then unbolt the case, separate the two halves, change the shim settings, bolt the case together again and attach the gauge - next measurement. Patience and calmness are required here. Before getting a reliable result at all, one must familiarize oneself with the whole procedure. And depending on the results, it will certainly be necessary to assemble and disassemble the crankcase many times to achieve a repeatable clearance. All our measurement results were reliably repeatable within 0.04 mm (2 thou).

An example: Our first end float was 0.5 ± 0.03mm (20 ± 1 thou). That is far above the desired value of about 6 thou and it matched with the thickness of the gasket installed. So, we pulled out the 0.5 mm gasket and took 0.05mm (2 thou) backing paper instead (Fig. 53). We then achieved a four measurement average end float of 0.17 mm (6.7 thou). That was already a bit strange because we expected something around 2 thou. We then waived a gasket completely. Four subsequent measurements delivered an average of 5 thou (0.14mm), almost the same value as with backing paper. A day later the same procedure delivered something around zero end float. We found out that the crankshaft was not moving as far as it might because the bearing races did not yet settled well in the crankcase. We used a brass punch (a block of wood does as well) to tap the races downwards. **Caution**: **Do not hit the crankcases or crankshaft at any time!**

We started a first series of measurements with no shims and applied some force to the shaft tip and the crankcase for each respective measurement (gravitation is mostly doing well). We measures thirteen times and got an increasing end float of 16, 22, 26, 31, 37, 39, 41, 51, 52, 53, 52, 53, 52 thou. Obviously the bearing races settled after some punches until a final end float of 50 ± 2 thou. For cross-checking we have put in a shim of 1 mm (39 thou) and did a new series with four measurements. We got 9.5, 8.5, 8.5 and 9 thou. That matched reasonably well within our measurement accuracies of about 2 thou.

Third, we had to install the shims for the correct end float. To reduce the 50 thou „no shim“ end float we needed to correct with respective shims. We tried three shims of 0.3 mm (12 thou), 0.38 mm (15 thou) and 0.3 mm (12 thou) and obtained an end float of 0.18 mm (7 thou) instead of the expected 0.28 mm (11 thou). One can see from this inconsistency how difficult it is to get a repeatable result for the end float. We presume the typical measurement error of 2 thou and slight variations in the measurement setup are the origin for the 4 thou gap. However, after some additional rounds we found that the real „no shim“ end float was 46 thou. For the final setup we widened the inner diameter of a 1 mm (39 thou) metric shim from 25 mm to one inch by the procedure described above, placed it to the inner roller bearing driving side and got an end float of 7.3 thou from six repeated measurements.

Note that the above description does not reflect the real amount of work to find out the best end float procedure and final shim setup. It took us many rounds to understand what was going on and to get a good feeling for how to proceed best. One has to keep in mind that single measurements for a certain setup do not give reliable values, especially if the measurement error (in our case something like 2 thou) is in the order of magnitude of the required measurement accuracy. To take this into account, we usually performed six individual measurements for one measurement alone.

From the Marston Club we got information that the their crankcases didn't have a gasket installed. Of course, we wanted to be sure if a gasket was needed. Imagine the crankcase is leaking when everything is reassembled... Because we did not get a definitive answer for the 1937 year of manufacture, we decided to trust the expertise of the old engineers and do without a gasket. This was supported by the good surface quality of both halves. The crankcase has already at least once been opened and the last person who had opened it certainly applied the gasket. But dents and scratches were only local. One could still easily see the machining traces from the manufacture (Fig. 54).

Figure 54: Part of the crankcase sealing surfaces. It represents the most disturbed part. The other surface parts look better.

There is always a long break between the assembly of the crankcase and the actual completion of the engine. During this time the oil that was applied to the bearings drips away. We recommend a 50-to-50 mixture of roller bearing grease (e.g. SPHEROL) and engine oil for all crankshaft bearings but also for the cam assemblies and the gears. This provides important lubricant at the start. To lubricate the lower big end, push oil through the crankshaft channel until oil from the assembly appears. Use a non-detergent monograde oil to avoid 'moving'

Figure 55: Applying the non-hardening jointing compound Hylomar M to the two crankcase parts.

Figure 56: The crankcase just before being closed.

any trapped sludge. Before closing the crankcase, one can now engrave personal initials and the date on the inner crankcase as proof of the work done. It will be of great historical interest if someone opens it in the future. Only because of such initials of a former owner in the timing chain case we know that at least there has been work done before. All bearings are now reinstalled after the crankcase halves have been brought to temperature.

After cleaning the surfaces with alcohol one should use a small scraper to apply a coat of Hylomar to both surfaces (Fig. 55). One does this in one go as it is not easy to go back over an area (Fig. 56). The halves are then torqued diametrically again to 10, 15 and then 20 lb.ft to estimate the final end float.

Six final measurements delivered an average end float of 7.5 thou.

The Way Back

Figure 57: Cutting a new gasket.

Bolt size	Thread	lb.ft	Nm
1/4 inch	NC	6	8
1/4 inch	NF	7	10
5/16 inch	NC	12	16
5/16 inch	NF	13	17
3/8 inch	NC	25	32
3/8 inch	NF	28	37
7/16 inch	NC	37	48
7/16 inch	NF	45	60
1/2 inch	NC	54	71
1/2 inch	NF	65	90
9/16 inch	NC	70	95
9/16 inch	NF	85	115
5/8 inch	NC	108	145
5/8 inch	NF	130	175
3/4 inch	NC	185	250
3/4 inch	NF	220	300
7/8 inch	NC	310	422
7/8 inch	NF	360	490
1 inch	NC	440	595
1 inch	NF	518	700
Bolt size	**Thread**	**lb.ft**	**Nm**

Figure 58: Torque table for different bolts in pound-foot (lb·ft) and Newton meter (Nm). Note that the dimensions are bolt thread diameter, not bolt head sizes.

When assembling the crankcases on the bench one should put dummy bolts through the holes that take the frame fixings, so that all holes are filled. And one should torque diametrically to 10, 15 and then 20 lb.ft with a torque wrench. This ensures that the bolts are all exerting the same force across the crankcase fixings. The crank/crankcase is about the only hi-tech part of a motorbike engine and if one wants good sealing and an unstressed crankcase a torque wrench is needed - it is not the absolute figure that matters, it's consistency (especially on aluminium) and working radially. Figure 58 shows a respective torque table. As the cases are aluminium the torque setting is lower than the maximum load. All crankcase bolts, except the three small ¼ inch ones, should be set at a maximum of 20 lb.ft. Only remove the dummy bolts when needed for assembly, replacing each dummy one at a time with the correct bolt. Do not oil any nuts/threads. Loctite the larger frame bolts.

Note on motor gaskets.
Paper seals are used at several locations: At the covers of the upper and the lower rocker box, at the cover for the timing chain, at the connection between inner primary chain case and crankcase and at the cover of the primary chain case. Gasket paper can be purchased cheaply and the gaskets can be cut from gasket paper using a cutter (Fig. 57). For a reliable sealing effect, a non-hardening sealant (e.g. Hylomar) is recommended, which is applied thinly to the gasket before assembly.

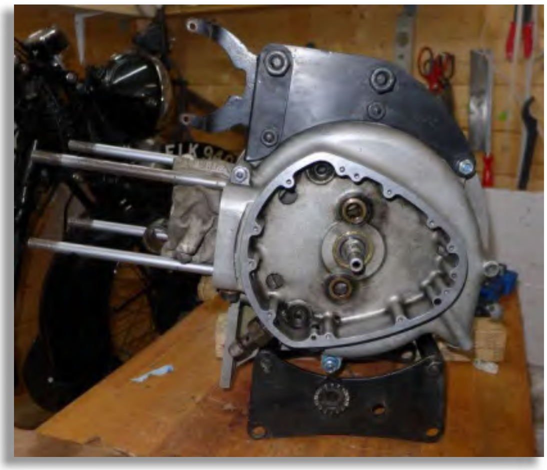


Figure 59: The crankcase is closed and the front and rear carrier plates attached. Note the two dummy bolts at the lower center and upper right.

Figure 59 shows the assembled crankcase in its front and rear carrier plates. Two dummy bolts still need to remain in their positions. It is the lower one in the front plate because this bolt goes through the lower frame connection and it is the one in the hole for the footrest bar.

With the help of the pictures and notes taken during disassembly one now goes back step by step towards the rebuild (Fig. 60).

First, the magdyno unit can be screwed back onto its platform behind the cylinder. The primary chain case can then be attached to the installed crankcase. A gasket was found between the two during disassembly. We replaced it, coated it on both sides with Hylomar M (Fig. 61), attached the inner primary case again (Fig. 62) and reinstalled the clutch.

Figure 60: The crankcase back in the frame.

Figure 61: The new gasket between the crankcase and the inner primary chain case is embedded in Hylomar.

Figure 62: Assembly of the inner primary chain case.

Figure 63: The loose front washer inside the clutch which covers its roller bearing. The respective back washer has a larger thickness.

Figure 64: An open camshaft with the internal spring mechanism.

Figure 65: Traces of the internal finger on the spring.

Caution: As noted above the rollers of the clutch roller bearing are freely moving in a housing consisting of hardened steel thrust washers that take any side forces of the clutch basket assembly. The washers and rollers need to be greased when re-fitting. The back washer has a larger thickness than the outer one. if confused the back washer will scratch on the sprocket hole rim of the inner primary chain case (Fig. 63).

The driving side is basically now ready for final assembly. Before closing the primary chain case and the rear chain case one should now adjust both chains for correct slack. That are 1/2 inch from top to bottom for the primary chain and 1 inch for the rear chain. During that procedure one must align both wheels. When everything is correct one can now fasten the top bolt for the gear box and close both chain cases.

On the timing side the central timing gear and the two camshafts are now reinstalled. The gears of the camshafts are divided into two parts (Fig. 64). In their cover there is a spring mechanism in which a finger engages. This mechanism can be used to preload the cover slightly by turning the finger on the spring (Fig. 65). It stops the gears making noise between being loaded and unloaded. It keeps the gears engaged in the same direction at all times, rather than the teeth chattering to and fro. This happens in the valve train after the load increase to open the valve, followed by a slackening after the cam lobe peak has been reached. It doesn't control the valve opening/closing, but only reduces the noise in the valve gear. So the drive is being taken through the gear with the peg and the rattle is being taken out by the gear with the spring.

With this load the two gear parts should be installed into the central gear. The timing markings on the gears of the two camshafts must again match with the crankshaft gear to get correct valve positions. Single marks on the inlet side, double marks on the exhaust side. Loctite the central nut.

By the Way: The Oiltank

Figure 66: After loosening the four tank mounting bolts, the tank can be pulled out to the side.

Figure 67: The oil feed plug with a mesh filter.

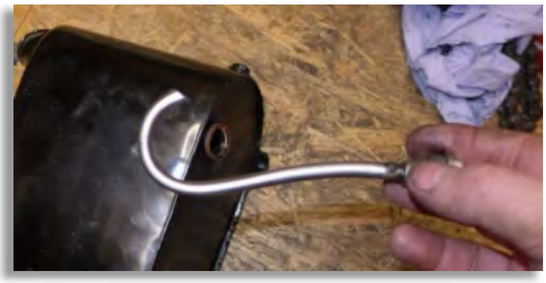


Figure 68: The oil return plug with its pipe.

Figure 69: The tank breather plug with its straight pipe.

Before installing the cylinder magneto unit, one should make use of the simplified access to the oil tank to remove and clean it. For the 1937 Model 9 this is easy and straight forward. Loosen the four tank bolts on the frame and pull the tank out to the side (Fig. 66).

In addition to the filling hole and the drain plug on its side, the oil tank has three ports on the bottom - the feed plug to the engine with a mesh filter (Fig. 67), the return plug with a bent pipe (Fig. 68), and the vent plug with a straight pipe (Fig. 69).

Figure 70: A Neodymium magnet in the oil plug.

Figure 71: Metal chips on the magnet of the oil drain plug.

There are various recommended techniques in the vintage motorcycle community for cleaning the oil tank. That are, e.g., shaking with fuel, lamp oil or paraffin with a handful of screws or a chain inside. Another solution might be a washing machine, such as those that have workshops specializing in engines. The latter, though, includes the risk of damaging the paint surface and we decided to shake the tank with paraffin.

Long before removing the tank, we had attached a small but strong Neodymium magnet to the drain plug to remove metal chips from the oil circuit that inevitably result from engine abrasion (Fig. 70). Shaking the tank with paraffin, old metal chips stuck in the oil mud were now stirred up and held in place by this magnet (Fig. 71). Without a magnet, such metal residues travel unhindered in the oil circuit and lead to increased wear.

Rebuilding Barrel and Piston


Figure 72: A strongly carbonized piston.

The piston is one of the fast moving motor parts and considering our initial problem (spring resonances) the piston should be scrutinized. As a rule, carbonized residues have settled on the upper side of the piston, which can be quite thick (Fig. 72). These residues are removed with a brass brush. The surface is then polished to prevent residues from re-setting quickly. In the present case we found a standard size piston from SPECIALLOID. Either it is the original from 1937 or the cylinder has a cylinder liner to compensate larger bore after successive installation of oversize pistons. However, there was no liner. That means that the engine was still running on its 83-year-old first piston! A clear sign of very low mileage. The piston size was 79.84mm and the bore had 80.07mm. The piston did not show significant wear or scuffing and the bore did not show significant scoring. New piston rings are recommended in any case. The previously used piston rings often no longer sit planarly on the cylinder running surface due to wear, so that their compression effect is reduced. And in our case the oil ring had a gap of 55 thou (1.4 mm) which is far beyond any acceptable limit (see below). It might well be that the rings were not the original ones as the gaps were far too great. After some searching, suitable rings were ordered from Cox & Turner Engineering[5]. Note that Cox & Turner rings have the benefit of being marked 'top' which helped with fitting them correctly during reassembly.

According to the Sunbeam Instruction Book the piston ring require gaps from top to bottom of 8 - 10 thou (0.2 – 0.25 mm), 6 - 8 thou (0.15 – 0.2 mm) and 4 thou (0,1 mm). However, the top rings from

[5] https://www.coxandturner.co.uk

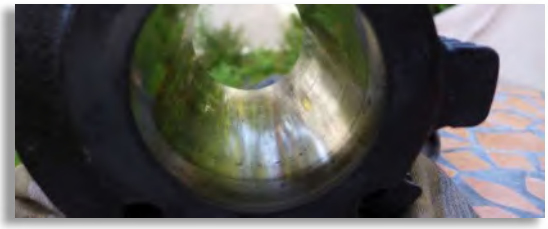


Figure 73: A glazed cylinder.

Cox & Turner deliver both 16 thou (0.4 mm) and the oil ring 18 thou (0.45 mm). This is significantly larger than recommended by the works but they are in line with recommendations from the Marston Sunbeam Club. We do not know why the works recommend such small values.

Figure 74. A cheap honing tool breakes the glace with its three grinding heads.

In addition, the cylinder running surface is often glazed and oil can no longer wet it well (Fig. 73). For this purpose, the running surface is briefly ground with a low-cost honing tool in a cordless screwdriver (movements up and down to provide a helical pattern) to roughen it again (Fig. 74).

We wanted to re-paint the cylinder with black cylinder paint. Before doing that its surface must be cleaned by getting the old paint and grease off. Interestingly, a bronze surface appeared after using a brass brush to the fins (Fig. 75). That was puzzling and unexpected. A test with a magnet showed that the barrel is out of cast iron.

Figure 75: A bronze cylinder surface appeared after using a brass brush for cleaning the fins.

The best recommended method to clean a cylinder is glass bead blasting and we gave cylinder and head to a specialised machine shop. While blasting the top fin they found that the surface is more a paint and that this paint does not survive blasting.

Instead of continuing blasting we tested an interesting cleaning alternative found in the internet. Dimethyl Sulfoxide (DMSO) is a widely used solvent in laboratories and engineering, nontoxic, relatively cheap and easy to purchase. We mixed one liter with about five liters of warm water (DMSO crystallises at 18.5 °C), about 200g of pure sodium carbonate (washing soda) and plenty of dishwashing liquid and put the cylinder in this liquid for a few hours. The liquid almost completely removed the paint (Fig. 76) and we could finally paint it with cylinder paint.

Figure 76: The cylinder after the bath.

Figure 77: The chrome surface of the front right cylinder stud in poor condition.

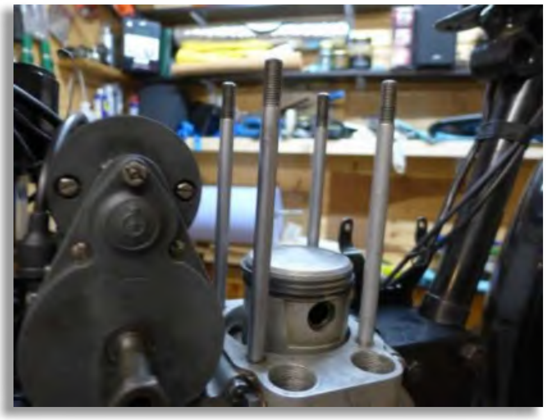


Figure 78: The front right cylinder stud after painting with brake caliper paint.

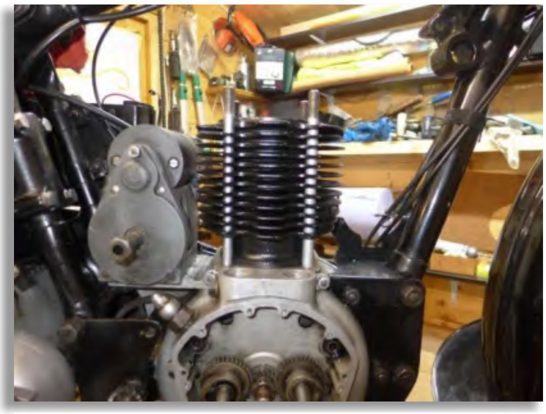


Figure 79: The assembled cylinder.

Now we could install the piston rings to assemble the cylinder together with the piston. The piston ring installation is a delicate affair and much care is needed not to break them – but exactly that happened to us, we broke the oil ring. And because delivery took again some days we had our own break.

One of the front cylinder studs has seen the weather and not had the oily film that maybe protected the others (Fig. 77). From a fellow driver we were told that the studs are satin chromed. Unfortunately, the chrome is one of the most expensive surface application and we got price information of at least 200 GBP for a single bolt. For that reason we opted for 2-component high temperature brake caliper paint in matte silver for a tenth of that price (Fig. 78).

Now with a 0.5mm paper gasket at its base the cylinder can be assembled by carefully sliding it onto the bolts and onto the piston (Fig. 79).

Figure 80: The bases of the two pushrod tubes. Left with its respective gasket-sealed connector to the crankcase.

Figure 81: Annealing the copper gasket of the pushrod tube.

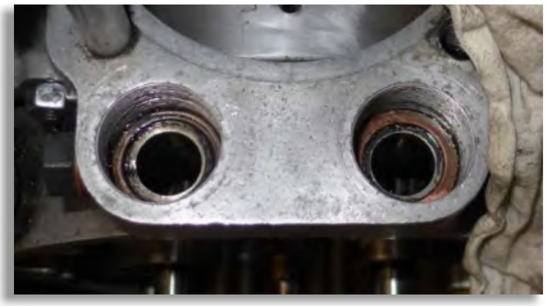


Figure 82: The copper gaskets in the holes for the pushrod tube connectors. They are left untouched because they are pressed firmly into their seats.

Figure 84: The upper rocker box between upper frame tube and cylinder head. Note the two pushrods intruding the box.

We separated the tubes for the pushrods from their flanges to polish them and to be able to remove the upper copper gaskets at their base (Fig. 80). Since they were compressed by their installation, it makes sense to soften them by annealing and quenching, as with any copper gasket before installation (Fig. 81). The lower tube ends both sit on a second copper gasket which again sit in the crankcase (Fig. 82). However, since these were firmly in place and could not be removed without risk of damage, we left them untouched. A little Hylomar ensures sufficient oil tightness.

Since the cylinder head is not yet installed, it is now obvious to adjust the ignition timing at the magneto. With the cylinder open, this measurement is much easier and more accurate than using a feeler through the spark plug hole. The correct ignition timing for the Model 9 is given as 9/16" or 43° before top dead center (BTDC) at lever position at the handlebar for fully advanced ignition[6]. One must now realise that it is impossible to adjust and fix the ignition timing via the position of magneto and timing chain. Since the upper frame tube is in the way, the rocker box can only be moved sideways onto the cylinder head. Since the two pushrods intrude far into the upper rocker box, this is only possible if both pushrods are lowered by removing the lower rocker arms (Fig. 84). As soon as the timing case is opened again to insert the rocker arms, the correct position between piston, timing chain and magneto is lost again.

[6] Data from "The Book of the Sunbeam": Model 10 – 5/16" or 30°, Lion Models – 7/16" or 35°, Model 9 – 9/16" or 43°, Model 90 – 5/8" o 50°.

Figure 85: The timing disc on the crankshaft driving side.

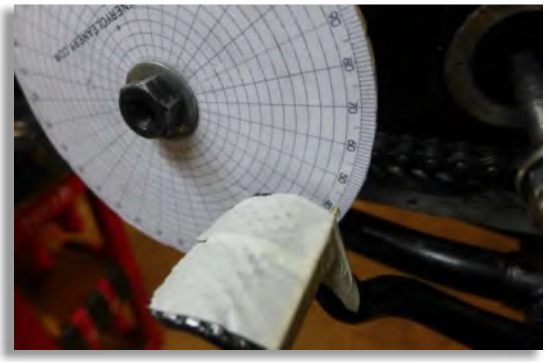


Figure 86: A wooden pointer is taped onto the brake pedal.

Figure 87: 9/16 inch before top dead centre.

Figure 88: Cellophane sheet between the magneto points. As soon as the points open one can pull out the sheet.

To avoid this path, one can fix a timing disc on the crankshaft (Fig. 85). It can be downloaded from the Internet and printed out. Together with a pointer we installed to the brake pedal then "translates" the correct piston position (here 9/16" BTDC[7]) into the desired angle (here 43°) at which the contacts of the magneto must open at fully advanced timing to generate the ignition spark (Fig. 86). The angle of 43° does not have to match exactly to the length of 9/16". In our case it is 41°. With slow carbonization (Fig. 72), the values inevitably change a little. It might well be that the 9/16" was the closest Imperial measurement to the required 43° (Fig. 87). That way a 9/16" spanner could be used to provide the measurement to mark a piece of wire from which the depth could then be set through the hole for the spark plug - no ruler or caliper required8. Note that allocating top dead centre with the respective rotation angle at the crank shaft is somewhat delicate, anyway, since the piston moves by only about half a millimetre within a 10° angle around TDC for a 100mm stroke. This is the reason why one should first adjust the piston position and then setting a timing disc to the desired angle.

With this setup one will be able to accurately adjust the timing after assembling the timing cover together with the pushrods and the cylinder head (see next chapter). It is clear that the disc should not be moved again after the correct timing positions are fixed. The exact position when the magneto contacts open can then be adjusted by the upper timing chain sprocket sitting on the conical magneto axis. To get the point where the contacts open one can use a thin piece of Cellophane sheet between the points. As soon as they open one can easily pull out the sheet (Fig. 88).

[7] We recommend to make sure that the piston position is really set BEFORE TDC and not after it.
[8] The value 9/16" can be found in different old manuals. However, this length is translated to 43° in “The Book of the Sunbeam” but to 39.5° in the “Sunbeam Motorcycle Instruction Book”.

Rebuilding Cylinder Head and Valve Gear

Figure 89: Removing the valves with a suitable tool.

As the cylinder head is not easily accessible, it is worthwhile scrutinizing all parts. This means that the valve dimensions and those of the seats and guides should be checked. An appropriate tool for removing the valves is available in the Internet for little money (Fig. 89). **Caution**: The valves are held by two conical collets (Fig. 90), which can easily fall out and get lost when the valve springs are compressed. Since these collets are hard to get, one should take good care of them!

Figure 90: The dismantled valve components. Note the two collets which hold the valve in the spring via the cone dish.

If the valves are too loose in the guides, both must be replaced. New guides can be made by a good specialist workshop (guides for some models are available from the club). The valve seats should be ground in again if necessary. The acquisition of new valves is potentially more time-consuming than expected. With a little luck, standard valves can be procured quickly and inexpensively from the club. In the present case the valve dimensions were year specific and the valves were sent to G&S Valves[9] to have new valves manufactured with the correct dimensions. Interestingly, four valves cost almost as two. We had therefore ordered four at once. Unfortunately, the valves were not delivered until six (!) months after the order was placed[10]. Sometimes extreme patience is required (Fig. 91). Beside this nuisance GS Valves fortunately designed the valve stems a 10th of a millimeter larger in diameter so that only a new guide for the exhaust valve was required (Fig. 95 and 97). The old guide for the inlet valve was slightly widened with a reamer.

Figure 91: The art of waiting.

[9] http://www.gsvalves.co.uk

[10] The valves are custom-made and, hence, took some time to manufacture. After that, the package took one day to get to Germany and then lay in the UPS warehouse for a full two months. UPS never delivered them accompanied by a complete lack of reliable information from their service. The valves were then sent back to GS Valves and FEDEX was chosen. The valves then arrived within one single day.


Figure 92: All inner and outer valve springs.

Ideally the valve springs should be replaced with new ones. However, this is difficult because replacement is no longer available on the market. Here the Sunbeam Club or, as with us, a generous Sunbeam colleague can help. In order to find suitable valve springs, their dimensions such as total length, outer and wire diameter and the distance between the coils are not sufficient (Fig. 92).


Figure 93: Measuring the spring constant with a market weight.

One also needs to know the material or the spring constant. It tells how strongly a spring is compressed by a force acting on it and is given in Newton per meter. This length can be measured by placing a weight on the spring. Without going into the physical details, a spring that is compressed by a weight of one kilogram by one centimeter has a spring constant of about 1.000 Newton per meter (N/m)[11]. We put a 5Kg market weight on the springs and then measured the length that they are compressed (Fig. 93). This resulted in approximately 6,100 N/m and 11,000 N/m for the outer and inner valve springs. For the springs donated by a fellow Sunbeam owner, approximately 8,175 N/m and 11,000 N/m were determined. The one third higher spring constant of the outer spring is not a problem, as this means that the load on the push rods is only 10% higher when the two springs are combined.


Figure 94: A top rocker arm on its axis.

We felt that the upper rocker arms were moving a bit hard in their box and considered removing them (Fig. 94). They have a Thackeray washer that allows some end-float but this also introduces a degree of resistance as they are operating axially. The arms fit on a taper on the spindle and need a shock to dislodge it. The two keys can be tight fitting as well. We had no suitable puller and the castings may have been brittle as they have been through many heat cycles. So, we wanted to avoid a shock even with a soft hammer. There was a possibility that the

[11] That are about 1 Kg per centimeter or 5½ pound per inch.

Figure 95: The 7/16 inch bolts are carefully tightened crosswise with a torque wrench.

rocker arm shaft is fixed to the rocker arm and is not designed to come loose. Hence, we only washed them thoroughly with paraffin which was enough to make them easy again. Finally, we painted the head as we did for the cylinder, assembled the valves and install it again (Fig. 95). For the 7/16"head bolts we give 37 lb·ft (48 Nm) as required according to figure 58.

For installing the upper rockerbox the pushrods need to be slid into their tubes. The rocker arms are not installed so that the pushrods are low and do not hinder the upper rockerbox to be slid in from the side. Then the pushrods can be lifted and the rocker arms installed. For the 3/8" rockerbox bolts we give 25 lb·ft (32 Nm) as required according to figure 58 again.

After pre-lubricating the conrod by injecting oil with a syringe into the hollow shaft on the control side, the cover of the lower rocker box (the timing chest) can now be closed. The magneto chain and its sprockets can now be installed, the chain tightened via the magneto bolts (3/8" lateral slack) and the timing can now be adjusted according to the previous chapter.

Because we still have easy access to the valve rockers we can now set the valve clearance. That are 4thou for the inlet valve and 6thou for the exhaust valve.

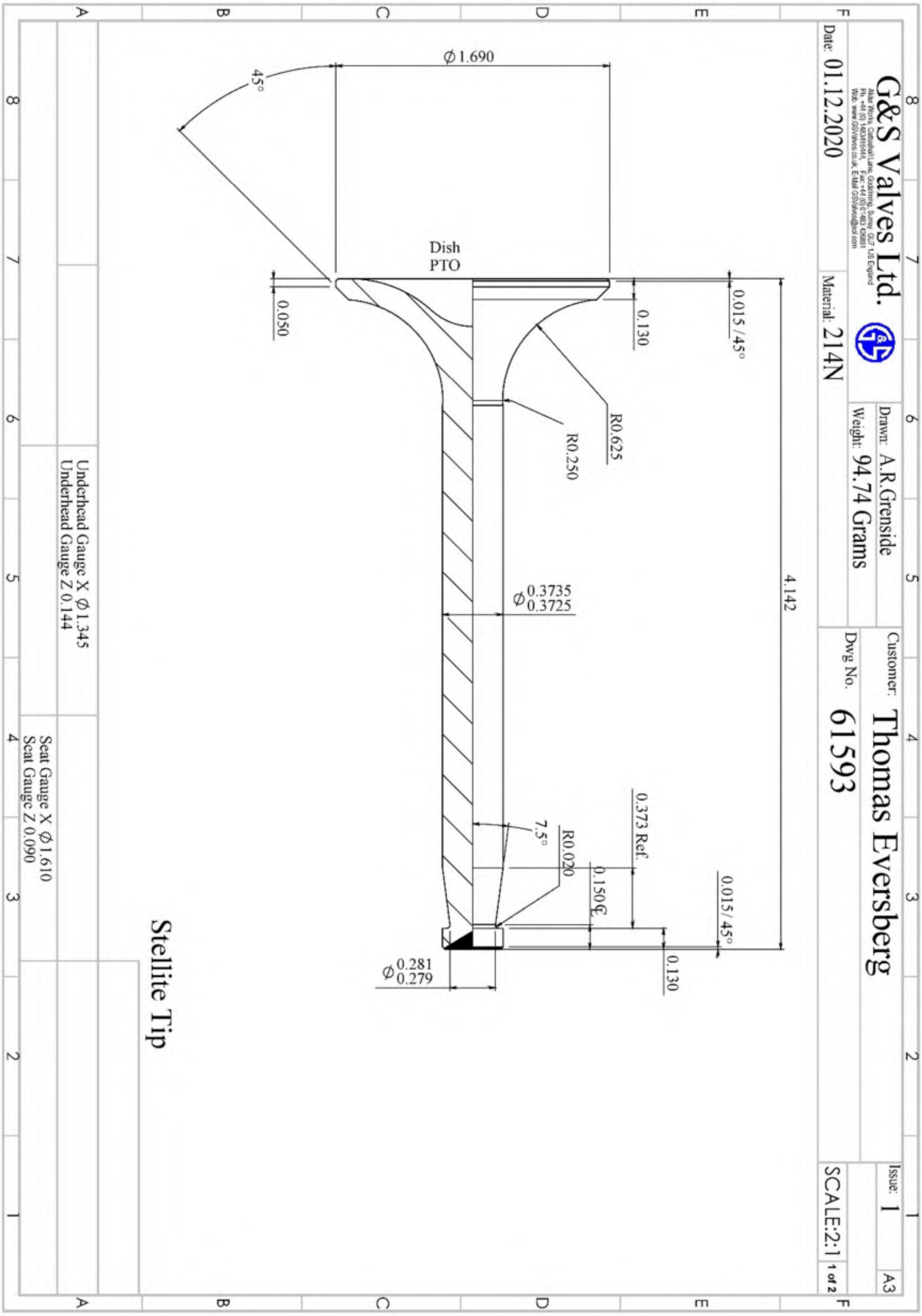


Figure 96: Valve drawing.

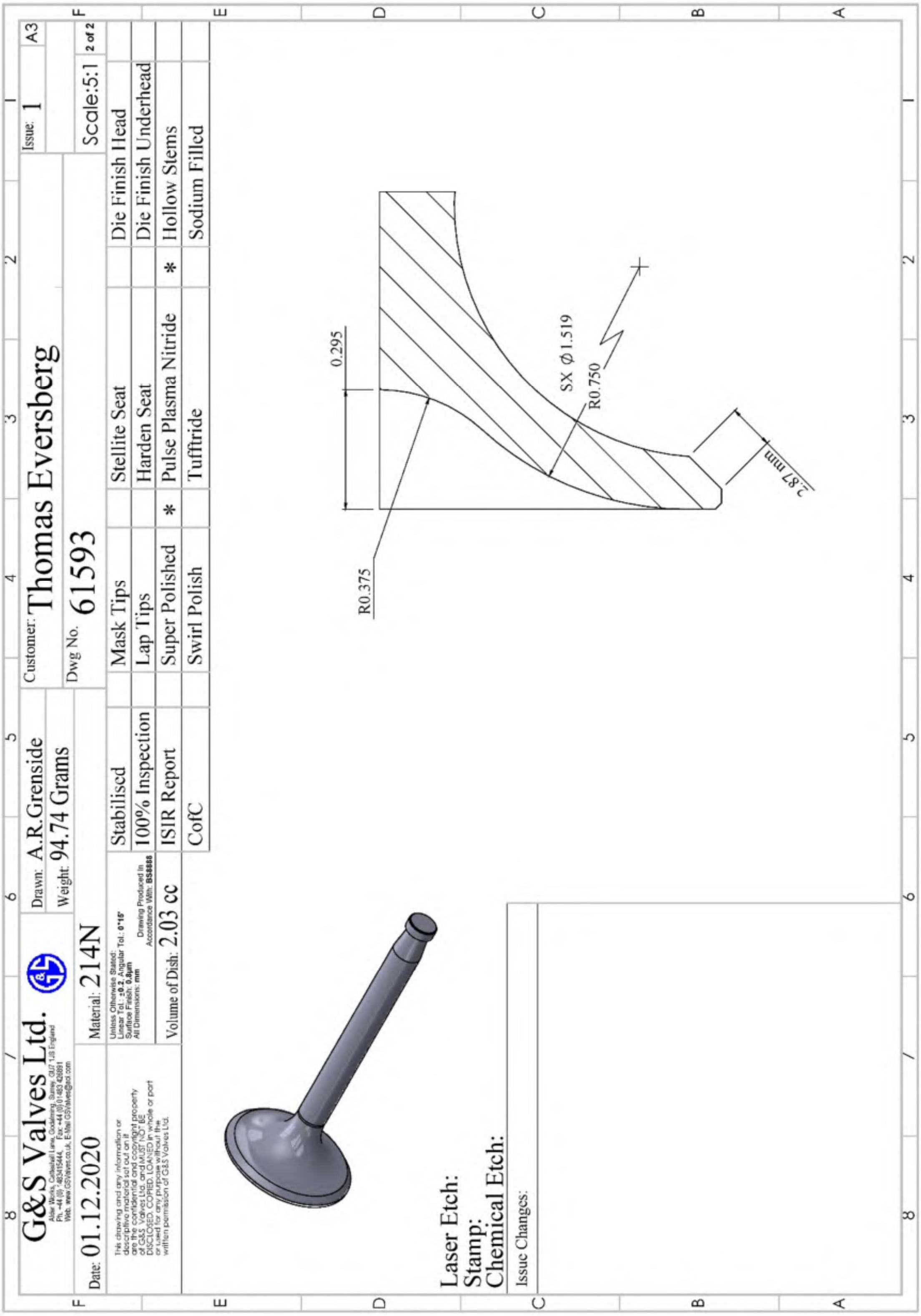


Figure 97: Valve drawing.

Final assembly

From this point on the final assembly is straightforward and there are no unknown difficulties. After the cush drive nut is secured with a new cotter pin, the primary chain case can be closed. The hollow crankshaft and the rockers should be thoroughly lubricated to then close both the upper and lower rocker box as well as the timing chain cover.

Figure 98: The cush drive is secured with a new cotter pin.

The horn can be assembled again as can the carburettor. Because of easier access it is recommended to re-connect the clutch cable to the gear box lever before attaching the oil pipes. When assembling the primary chain case again do not forget to secure the cush drive with a new cotter pin (Fig. 98). Finally, the tank and the saddle can be assembled. After filling the oil and fuel tanks as well as the primary chain case and after connecting wiring we recommend to kick the motor over for some dozen kicks to pre-oil the internal lubrication points.

The machine is now ready to be fired. When the motor runs for the first time again, one should immediately check the return oil flow in the oil tank. If everything is in order, the first test drive can be performed. The new piston rings need to be run in carefully - at least 100 miles of light running with regular checks, as the barrel could well get very hot. Followed by a check of all fasteners, then progressive increase in load and speed - treat the engine as 'all new' before taking it up to higher speeds and loads. Then some great rides out are waiting.

Postscriptum

Figure 99: The screw and spring of the ball valve.

Figure 100: All parts of the ball valve.

When the engine was restarted for the first time (first kick) a lot of smoke came out of the exhaust. It looked like wet sumping, where residual oil in the crankcase is burned. That would not have been a problem if it had not returned after a few hours. Especially since this problem did not occur prior to the rebuild. And sure enough, about a pint (0.5 liter) of oil collected in the sump overnight. In addition, a drop of oil dripped from the open oil drain plug every ten seconds thereafter - in other words, way too much.

Such a large amount of oil can only come directly from the oil tank. Since we had left the oil pump untouched, the ball valve was suspect. It ensures that oil only enters the system at a certain pressure, thus preventing unwanted oil flow into the crankcase. The valve is located in the lower valve cover in the direction of travel (on earlier models, the tell tale was located here, which had been abandoned in favor of the oil pressure gauge – Fig. 99). It consists of the screw, which carries a spring. The spring in turn presses a ball of 9.02mm diameter (23/64 thou?) against the opening of the oil supply from the oil tank. The assembly is encased in a brass mesh oil filter[12] (Fig. 100).

Some oil sludge had accumulated in the filter and this had probably prevented the ball from completely closing the opening at rest. Probably the magnet in the oil drain plug (Fig. 71) had not caught all the chips, or the material had been moved when the pump assembly was flushed in-situ. After a thorough cleaning, the unwanted oil flow was stopped.

[12] A total of three filters in the oil circuit (tank, ball valve and sump) testify to the quality that the manufacturer has aimed for.

Some Tips

Figure 101: Heating a bolt for blueing it.

Figure 102: blued bolts

Figure 103: The old damaged sump oil filter.

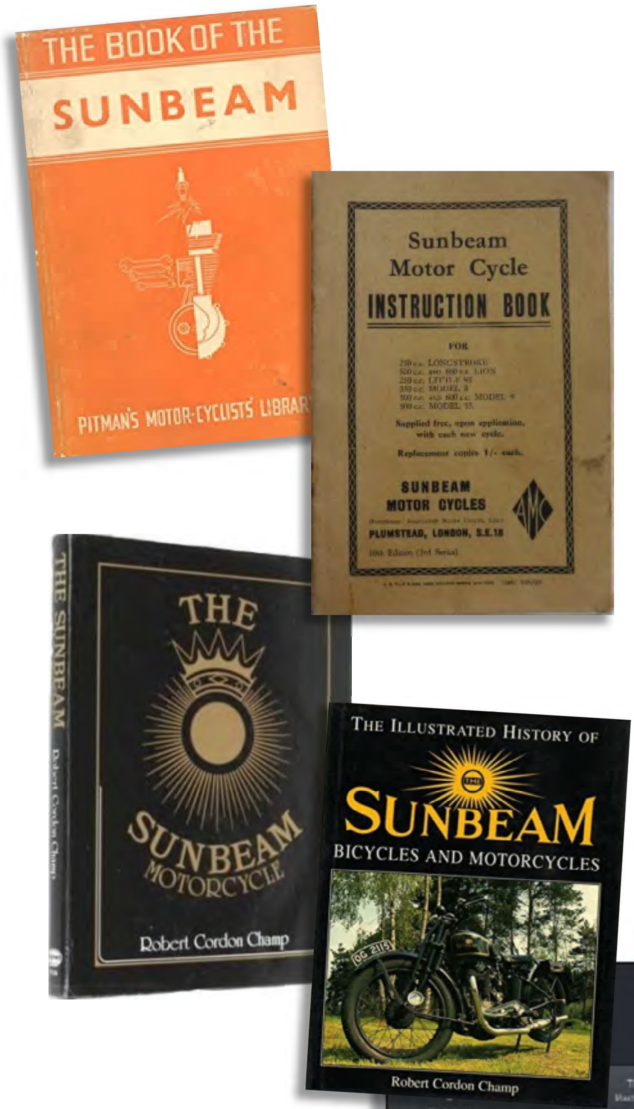
- **Screws and bolts** are usually primed and painted black. When bolts are worn, they then look accordingly. Instead of repainting them, they can be blued. To do this, the metal is heated (Fig. 101) and then quenched with linseed oil. The result is a clean matt black surface (Fig. 102).

- **A 'big' dismantling job** spread over time contains the risk that one fits bolts and nuts and then forgets to tighten fully or that need something attached or needs Loctite. For that one can use coloured chalk or other markers (e.g. tape) to mark up those bolts/nuts - once tightened or torqued the chalk can then be wiped off. One should also check that everything than can move still does so when each part is fitted, rather than put everything together and then find something, somewhere is jamming.

- **The oil sump filter** out of brass should be washed out regularly with fuel every time the oil is changed. In our case, it was damaged (Fig. 103) and therefore had to be replaced. We changed the mesh with a size of about 1mm to one of 0.5mm and soldered it to the oil drain plug (Fig. 104).

Figure 104: The soldered brass filter with a smaller mesh width.

Further Readings



- **"The Book of the Sunbeam 1928-1939" by Leslie K. Heathcote**
- **"Sunbeam Motor Cycle Instruction Book" by Sunbeam Motorcycles Ltd.**
- **"The Sunbeam Motorcycle" by Robert Cordon Champ**
- **"The Illustrated History of Sunbeam Bicycles and Motorcycles" by Robert Cordon Champ**
- **Website and Online Forum of the "*Marston Sunbeam Club & Register*"**

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