Tuning Your ATD – Part 2

In the December 2020 edition of OVR we examined the suitable ignition timing / ATD settings for a Vincent running on modern fuels. We now move on to exploring how the Lucas ATD, fitted as standard to all post war Vincent bikes, can be tuned.

You are going to need a means of measuring the advance range of your ATD; you will need to partially disassemble then reassemble your ATD and you will need to be able to add or remove metal from the two fixed ears/arms of the ATD.

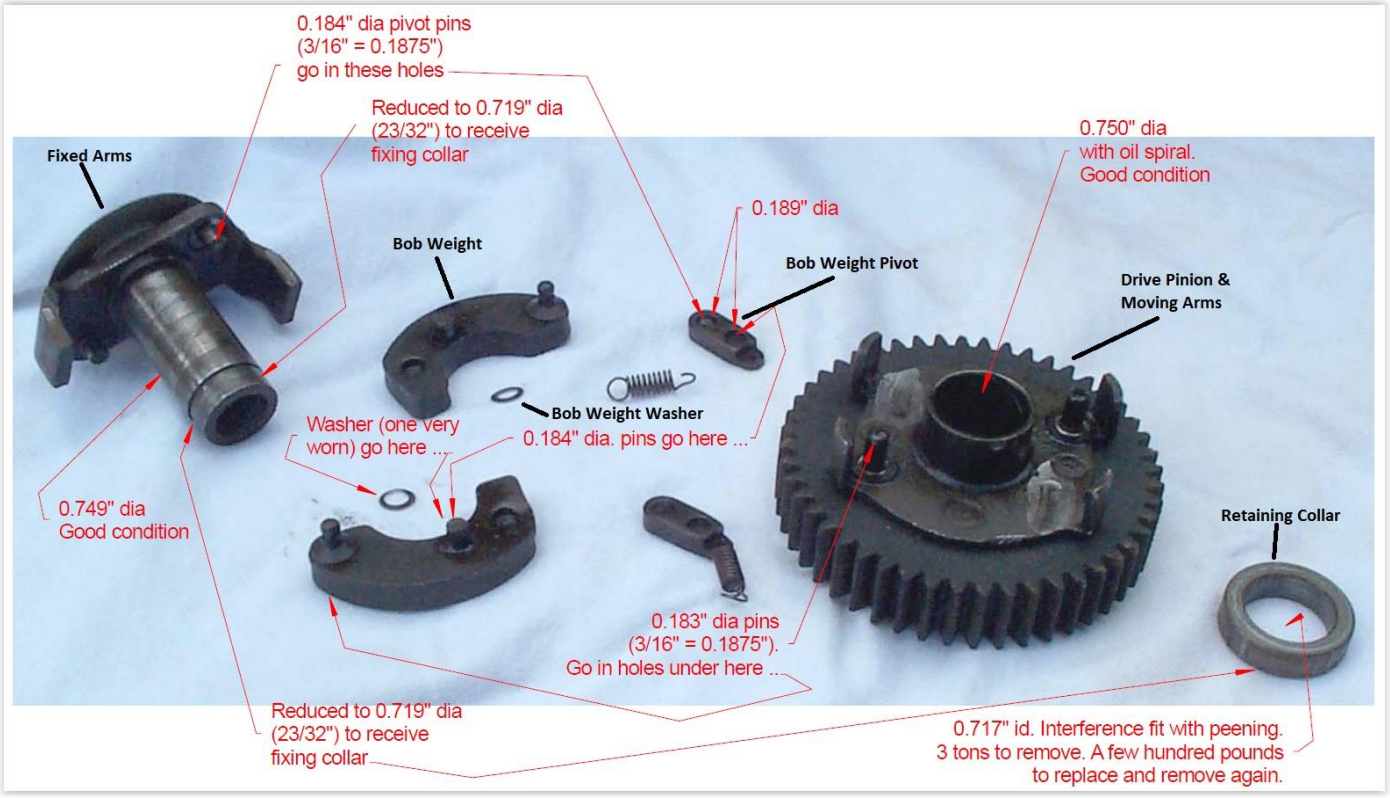
ATD Setup Guide

To find out what your ATD is presently doing you need to accurately measure the amount of advance it provides and it is not hard to do so. Make up a ATD Set Up Guide *Photo left is an example*; To make your own **CLICK HERE** to download a printable image. Print out the image (bigger is better) then glue it to some light plywood or like material, trim it to a convenient size and at the centre point drill a hole to take a snug fitting 3/8" BSF set screw or bolt.

Also shown in the photo is the pointer made from soft steel wire. One end of the pointer has been hammered to form a flat, thin indicator edge while the other end has been bent so it can be fitted over the pinion of the ATD once the ATD is mounted on the gauge, as depicted in photo right.

Dismantling Your ATD

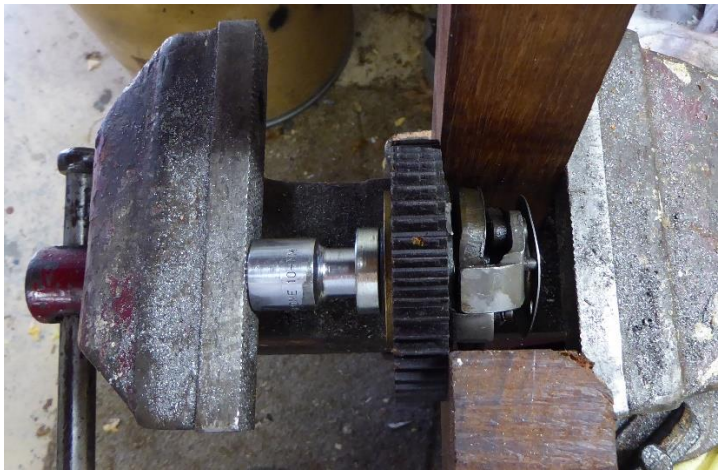
Here are photos of a disassembled ATD *(with thanks to BrightSpark Magnetos, UK)*



The ATD assembly is held together by the Retaining Collar that is an interference fit on the spindle of the fixed arms where it pokes out of the back of the drive pinion. To disassemble the ATD this retaining collar needs to be removed. You DO NOT need to remove the rivets that hold the moving arm plate to the pinion.

One way of doing this is to use a small gear puller provided there is sufficient clearance to allow the edges of the puller to get a grip as shown in the following photos.

The other method is to use a vice. Put two sturdy timber spacers between the drive pinion and one face of the vice jaws and with a suitable drift (I used a 10mm socket) against the other jaw and bearing on the shaft of the Fixed arm, press the retaining ring off.



Taking care not to drop or lose any parts, you can now dissemble the ATD. Be careful with the 2 bob weight washers.

Measure the ATD range

Fit the Fixed Arms into the Drive Pinion & Moving Arm assembly – no other parts! Now using a 3/8 inch BSF set screw into the ATD securing bolt fix the ATD assembly to your newly made ATD Setup Guide. It needs be tight enough to prevent the fixed arms from moving relative to the guide.

If you have not yet done so, now make up a pointer, as described earlier. Fit the pointer onto the Drive Pinion, with the ATD at the limit of its travel and the pointer, pointing to the TDC or zero marker. Now move the driven pinion to the other end of its travel where the pointer will show the number of degrees of movement or range of your ATD. Don't forget that the degrees of movement of the crankshaft is double the ATD reading.

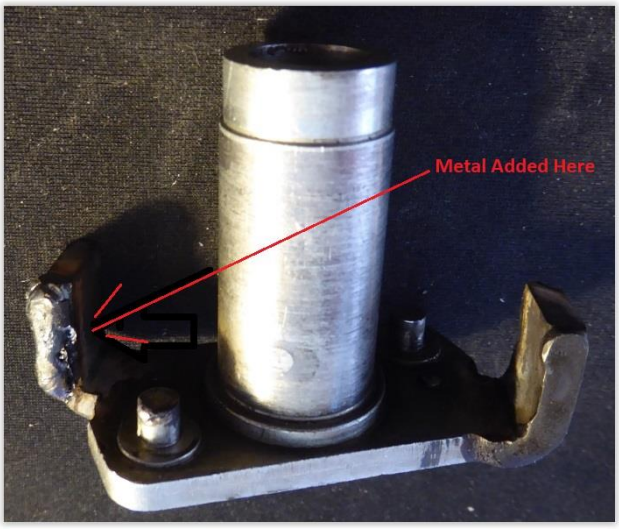
In the example below the ATD has 13 degrees of movement which equals 26 degrees at the crank. So the pictured ATD is set for ignition timing of retarded 4 BTDC and full advance 30 BTDC.

Changing Your ATD Range

Having now measured the movement range of your ATD, if you want MORE movement then you need to remove metal from the contact face of the 'ears' by an equal amount on both the fixed arms. If you want LESS range then you need to ADD metal to the contact face of the 'ears' by an equal amount on both the fixed arms.

Metal **removal** is accomplished by the gently use of a file, working little by little checking the movement range as detailed above as you go.

Metal **addition**, to restrict the range is achieved by adding metal to the contact face of the 'ears' by an equal amount on both the fixed arms. The easiest way to do this is by welding.

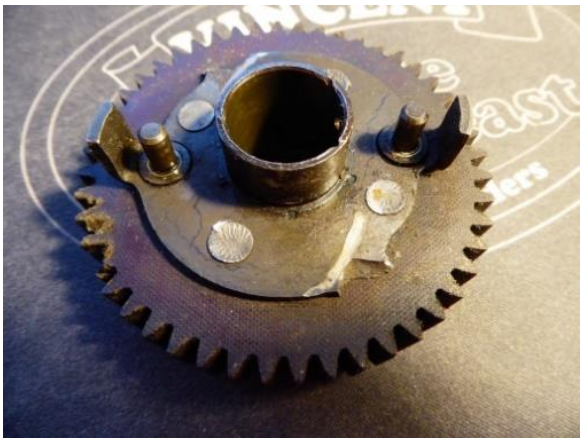


The photo, left, shows a fixed arm where metal has been added to the ears by welding. When doing this be sure to take precautions to avoid damaging the bob weight pivot pins. In retrospect it may have been better to add the metal to the faces of the 2 ears furthest from those pins.

Metal is to be added to the same face on both ears.

Once the initial metal has been added to both 'ears' then check the movement range. Also check that BOTH ears make contact with the ears on the fixed plate at the same time; you will need to file some metal from the ear that makes contact first till you achieve this.

Now measure the movement range of the modified ATD. If it is less than you wanted (and it most likely will be) you need to remove metal from both ears by the gently use of a file, working little by little checking the movement range as detailed above as you go to you achieve your target movement range.



Some folks will tell you that the ATD range may by altered (or tuned) by BENDING the 'ears' on the ATD and while this is true it will create stress inside those bends that could lead to the ATD ears breaking off when in use. The ATD 'base' shown in Photo left had both its limit ears fail in use as a result of bending them when attempting to change the ATD range.

Quick Overview of ATD Action

Think of the ATD as a component that works in three stages....

1. the fixed pinion picks up drive from the engine then.....
2. the drive is passed on to a flexible connection made of springs and bob weights, then...
3. the drive is collected from the moving mechanism by a nut fixed onto the magneto armature shaft.

Remember that the gear is fixed because it is meshed to the timing gear, so the springs are trying to pull the magneto armature back to the 'at rest' position whilst one end of each spring is attached to the gear and the other end of each spring is attached to the armature shaft.

Now here's the critical bit.... (and the reason why the ATD doesn't always flick back when stationary) ... the magneto armature is not free-floating because there is friction and magnetism in the magneto which prevents the armature responding fully to the pull of the springs. The friction/resistance is caused by the pickup brushes, earth brush, heel of the points, drag in the bearings and the attraction of the magnets.

As the engine is turned over very slowly the friction is reduced because the parts are moving - sliding over each other, and the springs are then able to pull the mechanism to its 'at rest' position. You can test this by turning the bike over slowly on the kick start and watching the ATD return to its fully retarded position - Hey Presto!

Bob Weight Springs

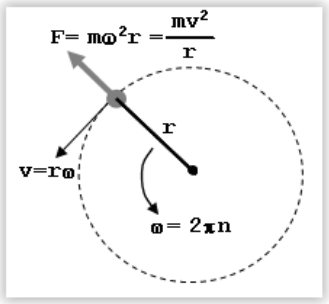
The bob weight springs MUST have sufficient tension or preload so that they are able to pull the ATD back towards the retarded position as the engine revs fall towards idle speed. In the photo you can see a pair of bob weighs with the bob weight pivot and spring installed. The one at the top has sufficient preload to do its job, but not the one at the bottom – it's spring is useless!

Your ATD springs are most likely well past their use by date. Do yourself a favour and fit new ones – readily available from the VOC Spares Co. Part No. PR22A/D

ATD Rate of Movement

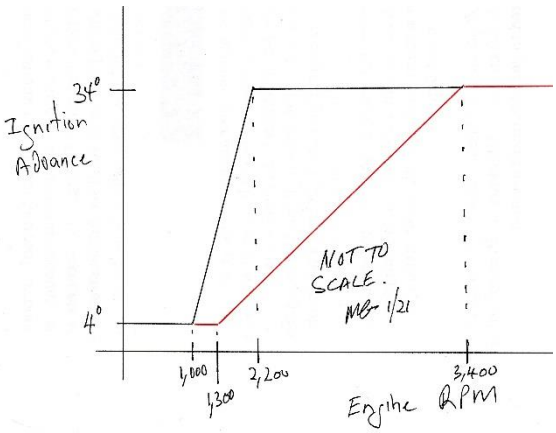
The stock standard ATD in good condition with good standard springs will start to move at around 750 ATD RPM (1500 at the crank) and will reach the limit of its movement around 1,100 ATD RPM (2,200 at the crank) and this change is rapid, almost like an on-off switch.

When a body of mass (the bob weighs) rotates about an axis it exerts an outward radial force called centrifugal force upon the axis or any arm or cord from the axis that restrains it from moving in a straight (tangential) line.



If you want to change the engine rev range over which the ATD operates, you need to consider that what we are working with is the centrifugal force that works against the bob weight springs, allowing the bob weights to move out and thus move the ignition timing.

And the heavier the bob weights are the narrower the rev range from retarded to advanced and the lower the revs where that force commences to overcome the ATD springs. Lighter bob weights have the opposite effect, flattening the slope of the advance line and extending the rev range over which the ignition advance happens. The not-to-scale graph illustrates this.



The black line represents the advance performance with standard bob weights while the red line depicts the effect on ignition advance of reducing the weight of the bob weights. With lighter bob weights the ignition advance starts increasing at slightly higher RMP and maximum advance is not reached to higher RPM – in this example the lighter bob weight has extended the RPM advance range from a total of 1,200 rpm (2,200 less 1,000) to a total of 1,700 rpm (3,000 less 1,300) . This widening of the rev range over which the ATD operates helps minimise the chance of engine 'knock' when under load engine revs start to fall.

Bob Weight, Weight Reduction

I wanted to increase the rev range over which my ATD operated so with my bench grinder I removed some metal from the outboard end of my two bob weights. Not having any equipment available to empirically measure the effect it was a bit of a trial-and-error process – I should add I did have a spare set of bob weights just in case I went too far.

The photo shows, left an unmodified bob weight and on the right, one that I did modify.

Having reassembled my ATD with the modified bob weights, new springs, and reduced advance range in line with part 1 of this article, I am exceedingly happy with the improved on-road performance of my Comet.

Reassemble the ATD

Once you are happy with the changes (if any) that you have made to the ATD you can reassemble it, a reverse of the disassembly procedure, taking care to put the bob weight washers in place under the bob weights. These washers are not readily available as spare parts so if you need to replace them (as I did) seek out the thinnest brass washers you can find that will fit over the bob weight pivot pins. The ones I sourced had a bigger OD than was needed so with very careful file work I reduced the OD till they fitted.

It's a smart move to fit new ATD springs as well.

The final step in reassembly is to press the retaining collar back onto the fixed shaft. BE CAREFUL - Don't press the retaining collar all the way home as this will prevent the mechanism turning freely on the centre sleeve. Leave a few thou end float (0.005" / 0.010") in the shaft.

In Conclusion

All that remains is for the ATD to be refitted onto the magneto and the ignition timing set as outlined in part 1 of this article. If you want to make you own timing disk CLICK HERE to download a printable image. Print out the image (bigger is better) then glue it to some light plywood or like material.

Additional Information

For more information on making your own timing disk see OVR edition 43, October 2017

For information on setting your ignition timing, see the Workshop Wisdom item in OVR edition 9, October 2014

All back issues of OVR are in the OVR Archives which CAN BE FOUND HERE