the JOHN DANKS Bantam. Readers may be interested to learn that this machine could be considered a genuine "works" Bantam. John until very recently worked in the tool room of the BSA gun operation. If you inspect the machine closely you will observe one or two nice touches, which were doubtless "Home Office" jobs of the time.

On afinal note, what a massive improvement the new club-house is at Cadwell. I cannot recall ever being able to wash my hands in hot water at this circuit, except at the International meetings when Chas Wilkinson used to bring round a bowser full of hot water to the ablutions facility at the end of the day.

It makes one positively look forward to the next Cadwell meeting.

Good luck and good racing,

Jonah.

PUSH START

THE BANTAM RACERS MAGAZINE

summer 88

Here we are again - at last some of you might say. Well the excuses are many and varied, the main one being that Colin and I were too busy getting married to spend all this time typing and writing technical articles. (I know most of you won't believe that in a month of Sundays, but there has to be a good reason for missing Cadwell, doesn't there?)

You will be sad to hear that JS's bit doesn't appear in this edition, and even sadder to hear that Colin's Technical Article does. I'm actually saving the best bits till later, so that I have something already up my sleeve for the next edition, out soon, honest.

Since many of you are obviously reluctant to put pen to paper to give me your views on life, the universe and Bantam racing, you could always just come and talk to me in the paddock, its not too horrible an experience really. I'll then do my best to put it in the mag, and I won't even tell them who said it if you don't want me to.

Remember, I still want to know of any Bantams lurking about out there, they are sorely needed by prospective new riders.

Enough of this waffling, just because I'm married to the man doesn't mean I have to go on like he does.

Keep up the good work,

Elaine.

Editor: Elaine Gillingham 71 Beeston Way, Feltham, Middx TW14 0EU

TESTING THE FINISHED WORK

Introduction

The title is pinched from an old copy of "Tuning for Speed" but the following text isn't.

How often do we go "testing" or practicing and actually manage to carry out a thorough and conclusive evaluation of the parts or machine being tested? I would venture to suggest very rarely.

Let me give you an example. We are on our way home from a race meeting and things haven't gone our way. In fact far from consolidating our lead in the championship we have lost that lead, and are facing the stark realisation that without some sort of improvement/modification to the machine we are not going to be able to redress the balance. What should we do?

a) Nothing

b) Improve the machine

Clearly, opting for a) will probably cost us the championship but involves no effort, whereas opting for b) commits us to a significant amount of effort and expense. However, if b) is opted for, we should ensure that the maximum benefit is obtained for the minimum outlay, and to achieve this we need to know the relative merits of each of the improvements we try, and a repeatable test method is essential in determining this.

Method

Realistically there is only one method available to the average rider and that is to measure the lap times of the motorcycle/rider combination flat out at a representative circuit.

If performed correctly (see later), this is probably a far more relevant method than using a dynamometer, reasons for which I shall reveal later.

Let us assume that during the journey home mentioned in the introduction, we have opted for b) and have come up with 3 modifications which could all be completed in time for the next meeting. For instance:-

i) Improved expansion chamber

ii) Improved rear tyre

iii) Improved reed valve pack

Now, ideally we would like to know what improvement each of the above would make on the existing configuration because if we threw all three mods. on the machine, we would have no way of knowing if the improvement (if any) in lap times was due to each making an equal contribution to this improvement, or as is more likely, a net improvement brought about by one strong plus countered by two small minuses. In this case maximum performance improvement would be achieved by discarding the two mods which gave the minuses and sticking to the strong plus.

Right, all very fine in theory but how to achieve the above in practice. Assemble the retinue at the circuit and set the bike up with the usual gearing and jetting for the conditions. There should be no modified parts fitted. Conduct a few laps to settle rider and machine in, then do ten timed laps flat out. Note average lap time and fastest lap time. This is "<u>baseline performance</u>.

Fit mod. (i) improved expansion chamber. Do a few laps to optimise carburation and ignition timing. When ready, repeat the ten timed laps and record average lap time and fastest lap. This is"<u>mod.(i)" performance</u>.

Refit old expansion chamber and original jetting/timing. Fit improved rear tyre. Aclimatise to new rear tyre with a few flat out laps and then repeat ten timed laps. Record average lap time and fastest lap time. This is "<u>mod.(ii)" performance</u>.

Now refit old rear tyre and fit improved reed valve pack.

Do a few laps to aclimatise and then repeat the ten timed laps. Record average lap time and fastest lap. This is "mod.(iii) performance.

Finally, and this is vital to evaluate any rider drift, refit old reed valve pack and conduct the few laps aclimatisation and the ten timed laps flat out. This gives "Repeat (or Bracket Baseline" performance. This will tell us how much improvement is due to rider improving or conditions changing.

Finally, if two or more modifications indicate an improvement on the average of "Baseline" and "Repeat Baseline" performance, and there is time at the end of the session, fit them and time the combined effect - in my experience a greater improvement than the best of individual mods is generally found.

Results

Set out the results like this. (The examples given are based on Snetterton and on my Bantam, but are from memory and are not therefore guaranteed accurate, although they are realistic.)

Performance	Average lap time	Fastest lap
Baseline	1m 29.3	1m 28.7
Mod.(i)	1m 28.9	1m 28.2
Mod.(ii)	1m 28.8	1m 28.3
Mod.(iii)	1m 28.8	1m 28.1
Repeat Baseline	1m 29.1	1m 28.5
Mods.(i),(ii)&(iii)	1m 28.5	1m 27.9
Average Baseline	1m 29.2	1m 28.6

Discussion of Results

Comparing performance relative to Average Baseline we can see that the new expansion chamber gives 0.3s/lap with 0.4s on fastest lap. However, the improved tyre gives 0.4s/lap with only 0.3s improvement on fastest lap, indicating that a far more consistent and improved cornering performance is available with this tyre. The reed valve pack gave 0.4s/lap with a 0.5s improvement in fastest lap. This could be accounted for by good initial performance in the ten lap test, leading to slight overheating and consequent slowing.

Conclusions

All three modifications gave approximately equal improvements of 0.4s on average lap time and fastest lap, relative to average baseline performance. When combined, average lap time and fastest lap were improved by 0.7s relative to average baseline.

Further Comments

I stated earlier in this article that, in my opinion, this method is more relevant to achieving our objective than dynamometer testing. I make this point for two reasons, one being that our objective of racing is to win and to do this we must cover the course faster than our rivals. Therefore, testing the machine under racing conditions is a direct comparison of the machine/rider combination with lap time, which is directly related to covering the course quickly ie winning. The other is that dynamometer testing is almost always carried out under steady state conditions, and relative to an arbitrary standard (corrected brake horse power). Testing an engine at steady speeds of say 8000, 9000, 10000 rpm will tell you what torque it produces at those steady speeds, but not what you would get if you went through that speed range in a few seconds. (For instance, think how the exhaust gas temperature changes during the transient from 8000 to 10000 rpm - this directly influences the ability of the pipe to scavenge the engine).

Lap Times

Not having the luxury of a stop watch operator when testing I use an alternative method involving a small stereo tape recorder. The tape recorder is placed next to the pit rail, propped up against a jerry can, with one mike pointing back down the circuit and the other in the opposite direction. New batteries are fitted for the day and recordings are taken of all sessions.

On returning home the tape is replayed using stereo headphones. Accurate lap times can be obtained, as can the sound of the engine at peak rpm.

I particularly favour this method as one is not psychologically influenced during the testing, which could affect ones riding and thus the test results.

Written in haste I'm afraid, but I do invite comments.

Peter Tibbitts.

Comments

OK Peter, you asked for it.

Actually, I'm sure this article will be useful to those of you who ride as consistently, though maybe not quite so fast as Pete Tibbitts. But for those of you like me - and I know there aren't many of you out there, I imagine that any improvement from the modifications will be completely swallowed up by the differences in Baseline and Repeat Baseline performance.

Yes, I know what you're going to say. "If you learnt to actually ride the bike instead of spending all your time poncing about, you might get more consistent times".

Next issue Pete will be writing an article on how not to ponce about on a Bantam. In fact, I'd appreciate an article on how and what he records from a race meeting to help in improving performance.

The Good Old Days

After Colin's little fracas with the track at West Raynham last year, when he ripped open the back of his leathers (and a part of his bum as well) he went scrounging for a suit when it became obvious we couldn't worm our way out of attending Lydden. The only person daft enough to agree to such a loan was his brother Terry, who last raced the Bantam in about 1975. By the look of the leathers (not to mention the smell) they hadn't been out since 1975 either, and when Colin had finally cleaned off all the mildew, guess what he found in the pocket? No, not a half eaten Burger from the ladies at Lydden - though Graeme Foden tells a genuine story along those lines - it was the entry acceptance for Snetterton printed below. Note that it was on a Sunday, and that in those days we actually stated times for scrutineering and practice in case people got killed in the crush. You will note though that there was still that ever present plea for Marshals.

BANTAM RACING CLUB SNETTERTON CIRCUIT Sunday 9th. March 1975

The inclusion of extra races at each meeting this year will help to keep costs down but also means that we must work to a much tighter time schedule to complete the programme. Will you please help the Club by listening carefully for announcements and attending promptly for scrutineering, practice and racing. If you could also bring a friend who is willing to be a marshal or help in the Paddock, we should be very grateful.

Scrutineering will start at 8.30 a.m. for Bantams, followed by 125's and 250's; Production and 1,000 cc machines.

NO machines will be scrutineered after 10.00 a.m. unless the rider had a very good reason for being late.

Practice will be in the same order starting at 9.30 a.m.

All racing will be in programme order unless announcements are made to the contrary.

If there are insufficient riders for 4,250 races, the two classes will be run together- see Programme.

Event 7 and 13 will be by electrical or kick start only - all other events by push start.

I hope you have a good days racing.

Mary Styles, Secretary of the Meeting.

Riding Number 19 Events. 1e 9

TECHNICAL ARTICLE

In this edition, some thoughts on the intake system with yet more numbers to wear down your calculator batteries.

The power of our engine is in part limited by the amount of air we can draw into the crankcases in each revolution of the crankshaft. Assuming that the induction port of the engine works in an ideal fashion, our '125' will draw in 0.125 l (one eigth of a litre) in every revolution. So at say 10,000 rpm our engine will consume 0.125 x 10,000 l/min (1250 l/min or 1.25 cubic metres per minute). We can use some of the equations from the last mag to give us a few interesting numbers.

First we'd better put the above into seconds; 1.25 ÷ 60 = approx. 0.021 m^3/s.

Assuming air to 'weigh' 1kg/m^3 our engine will draw in 0.021 kg/s of air. (Its hard to imagine air weighing anything)! Now, petrol will burn at its most efficient if all the hydrogen and carbon atoms that it consists of are oxidised (burnt) with just the right number of oxygen atoms in the air it is mixed with in the engine. This is called the chemically correct air-fuel-ratio which for petrol is around 14.7 to 1. ie for every kg of petrol we need 14.7 kg of air. (Engines tend to give maximum power if run slightly on the rich side.)

So, if our engine draws in 0.021 kg/s of air, we will need to jet the carburettor to give us 0.021 ÷ 14.7 (0.0014 kg/s) of fuel. As we found out last time, 1 kg of petrol will give us 44 MJ of energy, so if we multiply 44,000,000 by 0.014 we find the energy produced by our ideal engine in one second. This gives us the power in watts ie approx. 62,000 W. Again, 1 hp = 0.75 kW so 62 kW is approx. 83 hp and applying our 30% available figure , we have a 125 engine capable of producing 25 hp at 10000 rpm.

However in general it can be stated that the maximum practical amount of air which can be drawn into our engine at a given rpm at wide open throttle is less than we have just worked out. Annand & Roe (ref 1) suggest a rough formula for what we may in reality expect as a maximum:

$$\dot{V} = (0.9\ V_s \times N/60)$$

where $\dot{V}$ = air volume flow in m^3/s

V_s = swept volume in m^3.

N = engine speed in rpm

so for 10,000 rpm we have $\dot{V}$ = 0.019 m^3/s and with air weighing 1 kg/m^3 this is 0.019 kg/s or 90% of the theoretical maximum. So, the maximum power of our engine will be 22 hp. How do we go about achieving this figure?

Well first lets make sure that we make the best of what we are drawing into our engine by reducing any losses. Starting at the beginning a well rounded inlet bell to the carburettor (this can be part of the carb body or an add-on) will allow flow with less pressure loss than a sharp edged tube and far better than a flat surface. The bore of the carb and inlet stub should be smooth with no sudden change in section (steps) and no bends. NOTE polishing surfaces of inlets and transfer ports and so on has no value at all!

Can we take advantage of any ram charging by optimising the inlet tract length? And if so, what type of system is it and can we work out an optimum?

The first type of inlet system is based on the 'classic' HELMHOLTZ RESONATOR which in a simple way is a spring-mass system (the spring is the crankcase volume and the mass the column of gas moving down the inlet pipe). However, a few sums will show that a racing Bantam engine cannot run with an inlet tract length based on this method.

However there is another phenomenon which we can use to our advantage, which is based on the wave action that we use to good effect in our expansion chamber.

I will not go into a long explanation of how this works, just to say that in an inlet tract, as the piston opens the inlet port, a negative pressure wave travels back out of the inlet and when it hits the outside world at the carb mouth, it is reflected back towards the piston skirt as a positive pressure wave. It should be noted that this takes no notice of the direction of gas flow in the tract.

So, if we can arrange for this positive wave to arrive at the piston skirt just before closing, we will get some positive forcing into the crankcase. For this we need to work out the inlet opening period, the engine speed at which we wish to maximise the effect of this pulse and the sonic velocity of the air.

So, if we take for an example an inlet opening period of 210 degrees and divide it by 360, we get the fraction of one engine revolution that it is open, which is 210 ÷ 360 = 0.583

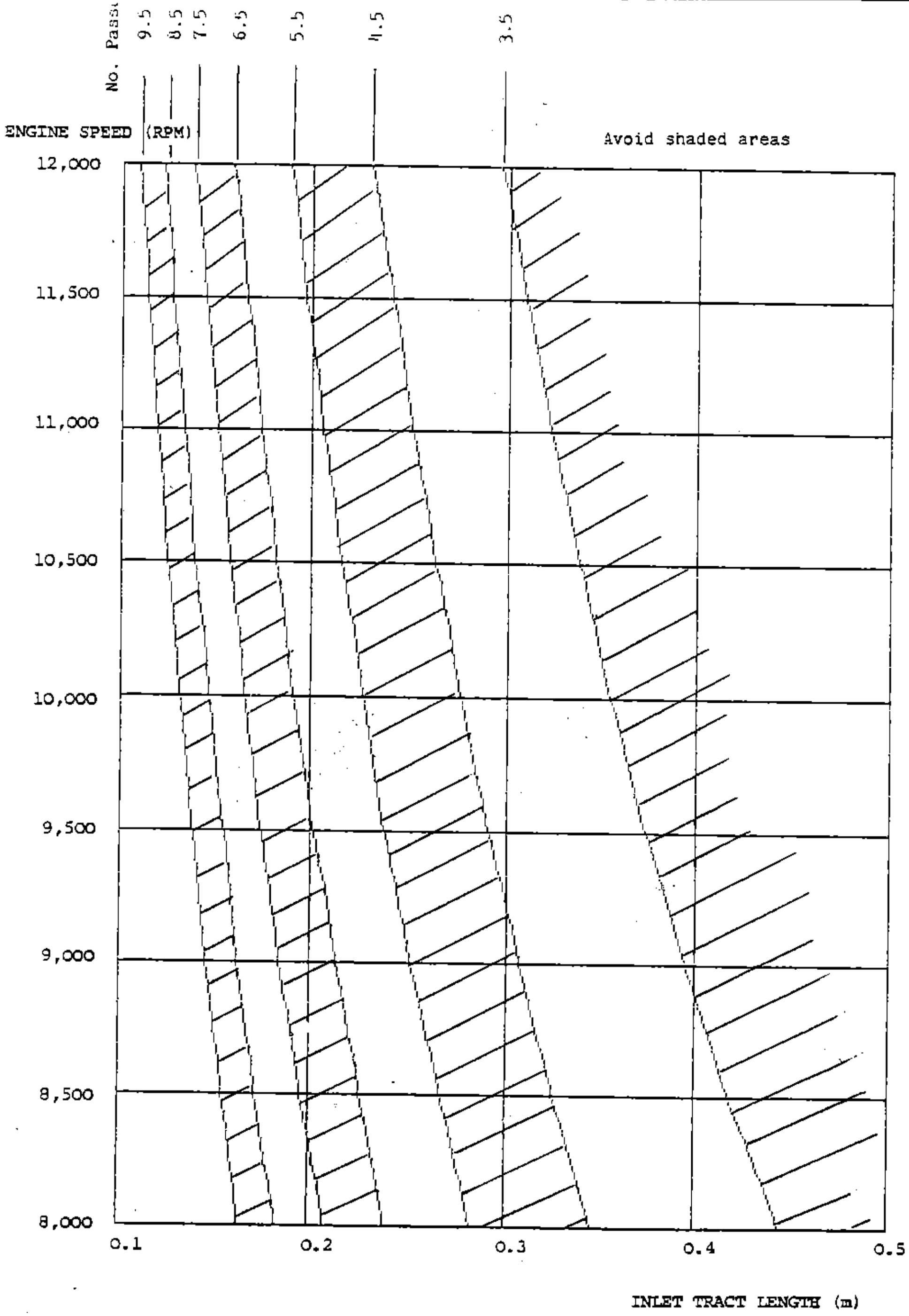
For an engine speed of say 10,000 rpm we divide by 60 to give revs /s which in turn is 0.006 seconds per rev. Together with the fraction of a rev that the inlet is open gives us the total time of opening ie 0.583 x 0.006 = 0.0035 seconds. So with the above conditions, we have all of 3½ thousandths of a second for the entire inlet process to take place. If we now multiply this number by the sonic velocity of air we get the distance travelled by the air pressure wave in that time. The sonic velocity is a function of the inlet temperature which I have assumed to be 40°C - the air is heated by the heat rejection from the engine. This gives a value for sonic velocity of 355 m/s. So,if we multiply this by 0.0035 we get 1.24 m. Now this is the total distance travelled and as we wish the wave to travel out and back again, we divide the above by 2 to give an optimum inlet tract length of 0.62 m.

However, we are fortunate in that our wave will bounce back and forth within the inlet tract. So if we halve our fundamental inlet length giving 0.31 m, we will have a wave that will pass out, in, out and in again and still give a positive pressure wave at inlet closing. We can carry on doing this for some time, but due to a number of factors the strength of the wave will reduce with more passes.

How to make the best use of this? It is easier to see what the best inlet tract length is(and also the worst) by plotting a map of the engine speed range that you wish your power band to be against inlet tract lengths.(You will have to do this for every change you make to inlet timing.) If we look at the map reproduced here we can see engine speed plotted against inlet length. Unlike the single point we have just worked out the curves are for what looks like a strange number of wave passes. What I have done is to work out the curves so that when the piston is closing the inlet, the wave is halfway down the tract. This means that the wave at the skirt is neither positive nor negative. The right hand curve shows a wave which has travelled 3½ times along the tract and if we move to the left where the wave has moved 4½ times we will move through a point where the wave has travelled exactly 4 times. At this point we get our maximum effect. If we travel further left, towards the 5½ curve we get into an area where we get a negative wave which is working against us.

So, what we can say from this map is that the areas incorporating the even numbers are good and the uneven numbers bad!

For our example of inlet timing with say an inlet tract length of 0.2 m, we can see from the map that from below 8,000 to about 8,300 rpm we are in a positive wave area at 8 passes. From 8,300 to 9,500 rpm we move into a bad out of phase band with 7 wave passes. But from 9,500 to 11,400 rpm (6 passes) we could



have a power band of almost 2,000 rpm with positive pressure wave reaching its maximum effect at around 10,500 rpm. It should be noted that we could try a 4 pass length with an even wider power band and a stronger pressure wave. Perhaps the best way to use the map is to mark horizontally across the limits of your existing power band , find an even numbered area that takes your fancy and run down vertically to find the ideal inlet tract length.

Don't forget that the map I've given is for 210 degrees inlet timing only. Also, this method only works on piston-ported or disc valve engines. You can't use it on reed valve engines unless you can determine the opening period of the reed pack.

If you don't have a computer to work out the curves for you I might plot one for you if you're very nice to me.

I shall now stop at this point and say that in my next planned piece I will be looking at something far more interesting 'How to gas flow a 2-stroke barrel'.

Regards,

Colin.

Ref 1 Annand & Roe: Gas flow in the internal combustion engine.
Published by GT Foulis, Somerset. ISBN 0 85429 1601

<u>From Our Own Correspondent</u>

This season id almost over and the racing Bantam has not been out of the garage - well not in any complete form. Mainly through a lack of time, but also with long delays over the Xmas period from platers and painters. Everyone here takes their 2-4 week summer holiday after Xmas so everywhere is shut down. I have been attempting to rebuild the bike in concourse pre-'63 style having made up a dôuble-sided SLS front hub to fit C15 forks, modified a D1 tank and built a Walsh style seat. But the wheel rims were held up being chromed, the zinc platers ruined one set of spokes (irreplaceable) and the painter dropped my tank after 4 weeks work. I was beginning to think my Mother-in-law had put a curse on me. So I was not able to get the bike ready in time for the big annual Classic Racing Register meeting at Pukekoe.

I am organising our local Classic Club 'fun day', (Not allowed to call them races as we don't have ACU permit) early March so I might get some practice and run it in before the "Modern" Club race day on the Sunday. Then Easter at Taupo (scenic central North Island next to big lake and geothermal areas) for the next Register meet where I have been challenged by a 71 year old who races a methanol fuelled D7.

Maybe the short stroke engine will have to wait till next winter.

John Sendall

OUT AND ABOUT ON THE BANTAM FRONT

BRIAN WHITE appears to be reaching the end of his "cold stuff" test programme, when at Cadwell the new engine lasted two laps before being prevented from further rotation by means other than piston/bore adhesion.

ADRIAN & KARL ANDREW (otherwise known as the Andrews sisters) have experienced mixed fortunes in recent meetings. Adrian's machine, whilst not exactly fast, has attained a degree of reliability enabling good finishes, particularly at Lydden. The same cannot be said of Karl's machine however, as carburation seems a little too generous with the petroil. Additionally, it is to be hoped that this team provide themselves with a tool kit exceeding the sophistication of a bed spanner.

Chasing carburation gremlins at Lydden was DAVE OUTRED. I don't recall Dave obtaining any finishes despite Messrs. Hall Barnsley and Tibbitts acquainting themselves with the internals of Mark I concentric carburettors.

Cadwell marked the return to the trade, following a globe-trotting tour by JOHN SAWER. Despite extensive scrutiny of far east offerings, John's performance showed no noticeable improvement.

Following approx. 10 years development of the back to front engine, during which plug wetting seems to have been the main obstacle to reliable running, COLIN HALL has still to overcome this unwanted feature of the design. A dismal Cadwell performance bears witness to this shortcoming.

MICK POTTER was heard to be building a machine, but further investigations revealed it to be an MZ. Traitor.

Still regularly reminding us of his nickname JOHN MARKS is currently going well when he stays on. The same can be said of STEPHEN HALL, that hoarder of Bantam clutch plates.

MIKE BARN SLEY was unable to attend Cadwell, his excuse was that he had to control a few ships that weekend. However, we're not so easily fooled, but I'm sure there are easier ways of getting your new racer from Japan when the NUS are on strike.

Cake development engineer ELAINE GILLINGHAM could do with a cooking motor. The fast performing "clone" engine broke an expansion chamber at Lydden and a primary chain at Cadwell.

PETER TIBBITTS was trying out a new wide rim on the rear of his machine at Cadwell. The object was to use the last 3/16" of tread on the edge of the tyre for maximum economy. The lengths some people will go to.

Seen to be trying before his motor went "pop" in the Championship race at Cadwell was MICHAEL POWELL. A post race inspection apparently failed to reveal the cause of this mysterious stoppage.

DEREK BETTS has made a welcome return to the fold. His machine now sports a reed valve and a seemingly ineffective "cantilever" rear suspension, and he the customary red boots.

Doing battle with Derek at Cadwell was DEREK CRADDOCK riding