8.9 Speedometers

THE HEART OF A BONNIKSEN

The basic principles behind those whirling hands

Nick Sloan

Once upon a time one of my Isochronous Bonniksen speedometers, the one on my 1928 Three Speed Super, started doing things it ought not to. I searched for an able watchmaker or similar to rectify the malfunctions but was usually met with gaping mouths and blank looks.

One firm did offer to do the job but their "We'll have a go at it mate" did not instil confidence. The only solution, I decided, was to discover the principle of working myself and from there decide which part of this principle the head was ignoring. Staring at the exposed internals of a Bonniksen, whilst twiddling the input shaft, makes a welcome change from the telly; and after a long, long while it dawned on me what was, or rather should have been, going on. From there I won't say it was easy, but it was possible to deduce the reason for the fault. Being rather pleased with myself at having re-discovered the principles of working I could hardly wait to bore you with my findings. To those who don't have Bonniksens on their Scotts, I am sorry for using the space; for those who do the *basic* principle seems to be as follows. Please excuse the lack of correct technical terms for the various parts involved, but I just do not know them and so have made up my own from 'logic'. Incidently, there have been several types of Bonniksens in the past, all working on basically the same principle, but some were just speed meters. Some had two small trip dials and the ultimate type with the tenths and mile trip shown on one small dial by means of two hands; the other small dial a clock with which average speeds could be calculated. The one I am going to attempt to describe is the second type, which although having the two small trip dials still has the earliest layout of the major dial, with the figures aligning with the actual circumference of the dial rather than horizontal to the ground as in later Bonniksens and modern practice.

The true heart of a Bonniksen, which is also the unit embodying the principle of working, is the main shaft gearclutch cluster 'A' which I shall deal with a little later. Leading up to this shaft are the drive gears coming from the cable input, and away from it the gears between it and the almost normal clock-type escapement which controls the absolute accuracy of the instrument.

Firstly the input gears. On the other end of the shaft to which the drive cable is attached is a small brass gear, stamped upon its face with the number of the teeth it has. Mating with it, and attached in a like manner by tapered brass pin to its shaft which protrudes from the actual mechanism, is a gear of similar size also stamped with the number of teeth.

It is these two gears which determine the internal ratio of the head to suit various wheel sizes and drive gear boxes, and vary in all the examples I have studied from between 65 and 75 teeth each. The drive gear boxes on early examples are rather clumsy tubular affairs marked 'oil and grease', with an internal ratio of 3:1 produced by bevel gears with incredibly small teeth rather prone to rapid wear. On later models, however, skew gears were used and an additional ratio of 4⅔:1 introduced with gears of much more practical proportions, although even these I have seen worn to a knife edge though this was possibly due to owners neglecting to screw down the grease cup. This lower gearing would have been impractical to achieve with bevel gears as the driving pinion would have been just too small. The driven gear of the pair in the back of the head and stamped with the number of teeth transmit the drive into the mechanism proper, and from one end of its shaft drives the main odometer through bevel gears; from the other through spur gears and an idler (1) to the main shaft 'A'. The main odometer shaft protruding from the opposite end of the odometer unit, whence it is driven, is reduced in ratio by worm and spur gears three separate times before driving the 1 mile divisions dial on the right hand side of the main dial. The ratio is then reduced once more and raised for the last time before driving the spindle of the final odometer, that showing 10 mile divisions on the left hand side of the dial. This last train of gears is interesting in that it occupies the exceedingly narrow space behind the speedometer face and the main works upper plate. The centre gear cluster in this train straddles the main speed indicator spindles by means of a large boss surrounding them, the periphery of which acts as the bearing for the centre gear cluster.

The shaft 'A' is the only part illustrated as the gear trains are very simple to trace in this instrument, which can easily be dismantled sufficiently for inspection. The two sketches accompanying this article show this vital shaft in assembled and component forms in the hope that all will be made clear. Referring first to the breakdown sketch it will be seen, starting at the top, that the main spindle of this assembly (2) pivots normally between to and bottom plates of this clock-like assembly. It is of 0.065" diameter, has a left-hand threaded portion at the end nearest the speedometer back, and permanently fixed to the opposite end is the gear (3) which receives the drive through gears and cable from the front wheel. (Rear wheel in the case of some—particularly American—machines).

At approximately one third from the lower end of this shaft, which remember is only 0.065" in diameter, is a tapped hole with a second hole a similar distance from the top of the shaft. Into these holes are screwed two short pins (4) of 0.023" diameter, and not the sort of part to drop on the sheepskin rug in the drawing room, as I found.

The first item which we will place on this shaft, in imagination, is the first floating gear cluster (5), which at the moment will run free on the shaft. It has been produced from one piece of metal and consists of two concentric gears, one a simple spur gear (6) which meshes with the gear attached to the lower end of one of the main indicator hands shafts, and the other a similar spur gear (7) but with one tooth (8) protruding above the rest, the point of which we will see in just a moment. Next on the shaft is the first clutch disc (9) which is merely an accurately ground disc, with a hole in the centre a running clearance on the central shaft, and a slot from this hole to the outside edge which engages with the lower pin, which as I described is screwed into the shaft. Placing the next component on the shaft we arrive at the approximate centre point with the Central Cam gear (10) which also rotates freely at the moment. This is once more a plain spur gear, and meshes through gears (11) with a conventional balance wheelhelical hairspring type clock escapement, the balance wheel itself protruding slightly through matching 'T' shaped apertures in the mechanism main plates.

Although as I have said this escapement set-up appeared conventional to myself, with little of horology, it has been pointed out by a friend that it is unusual in that the capstan wheel has straight pins rather than the sloping pins that are evidently normal.

This, then, is the absolute heart of the machine, for this central gear when driven by the necessarily slipping clutches revolves at constant speed governed by the escapement, and so will provide a means whereby the speed of the motorcycle may be gauged by using this constant-speed gear as a standard. The last two main items on the shaft are identical to the first two described, that is another clutch disc driven by the shaft through the second minute pin, and a second floating gear cluster with protruding tooth on the gear closest to the central cam gear. Axial pressure is put on the whole assembly by a small coil spring (12) which is the penultimate part of this assembly. The amount of compression put on this spring is governed by the last item, a left-hand threaded nut (13) with tightening slots either side of the main spindle. As you can now see this assembly will revolve as a whole, as long as no outside influence is put upon it, by the friction between clutch discs and gears. The rotational speed the shaft is driven at varies, of course, with the speed of the machine, but the speed of the central gear is constant by courtesy of the escapement. Another relevant feature of this central gear is that it has incorporated in it, and protruding from either face, a banana shaped cam (14) with a kickup heel (15) on one end shown in the sketch. Engaging with these two cams are, in effect, followers (16) attached to the ends of spring steel strips (17) with sideways extensions (18) on the followers, aligning with the protruding teeth gears on either side of the main central cam gear.

Description enough about the working parts has now, I think, been given to enable the working principle to be explained. Imagine the machine to be at rest, and concentrate on one side only of the cam gear. The indicating hand attached to this gear will be pointing at whatever speed the machine had been doing a few seconds before coming to rest. The motorcycle commences, and the Bonniksen gear trains grind into motion.

The central shaft and the two clutches pinned to it being, as it were, permanently engaged with the wheel of the motorcycle, revolve at a speed directly proportional to the machine. The central gear cam cluster also revolves, but being driven through the clutch discs, and controlled by the escapement, its speed remains constant, the clutches slipping more as the speed of the machine rises. The gear cluster with protruding tooth on which our attention is directed is at rest, for although a similar turning effort is being placed on it through one of the driven clutch discs, it is positively restrained by the pawl on the end of the spring strip being engaged in one of the lower teeth, that is not the protruding tooth. However, rapidly approaching the sideways extension of this pawl is the banana cam which, if you remember, is incorporated in the governed central gear. When the cam reaches the follower, the pawl attached to it is lifted out of the gear allowing it to turn driven by the clutch disc. The gear can only turn a limited amount with the pawl lifted to this height, and stops when the raised gear tooth comes up against the pawl. At this position the indicator hand connected by gears to this gear is at zero on the dial.

So once more we have the condition where although the central shaft and clutch disc are rotating at a speed in unison with the machine, and the central cam gear is rotating governed by the escapement, the gear cluster with which we are concerned is stationary, restrained now by the protruding tooth at zero rather than one of the lower teeth an at indicated speed.

We come now, with the heel of the cam rapidly approaching, to the act of speed indication, for as the heel lifts the follower a fraction higher than the banana cam, the pawl clears the protruding tooth and in a short space of time (⅔ second I believe) the pawl is held at this height by the heel. The indicating hand concerned turns, driven by the clutch disc, and shows the *mean speed* the machine is doing the time the pawl has been lifted completely clear of the gear teeth. And that's all there is to it.

Through time limitations I have been unable to research thoroughly the production history of the Bonniksen, but believe that it began production some while before the first war produced by Mr Bonniksen, a Watchmaker. It was certainly offered in the 1914 Scott spares list in my possession, which illustrates what I think is the earliest type of milled edge bezel turned from the solid and figures aligning with the circumference of the dial. This is marked only "Bonniksen" so presumably it was made by them.

The earliest one examined for this article is of this type, but with additionally the two trip dials, and has the serial number 1340. The next head examined was the first Bonniksen I purchased, and was fitted to a forward counter-shaft twin Zenith of 192021 from new, so the serial number of 2950 is presumably 1920. This head also has the solid milled bezel, but by now the figures on the major dial are horizontal.

The next two in my collection have the serial numbers A911 and A4514 and have been cheapened rather by the use of pressed bezels rather than the far more aesthetically pleasing solid varieties.

The last head examined has the serial number B9823, and is marked from 0 to 100 m.p.h. rather than 0 to 50, as on all the previous heads. It is also one of the more sophisticated versions, having two trip hands on the left dial doing the job normally done by the two dials, leaving the right hand dial space free for a normal clock, normal hat is except that it only runs when the machine is in motion, allowing average *running* speeds to be calculated.

This head also indicates the speeds at intervals of 2⅔ secs. rather than the standard 5 secs., a more sporty or racing one I suppose.

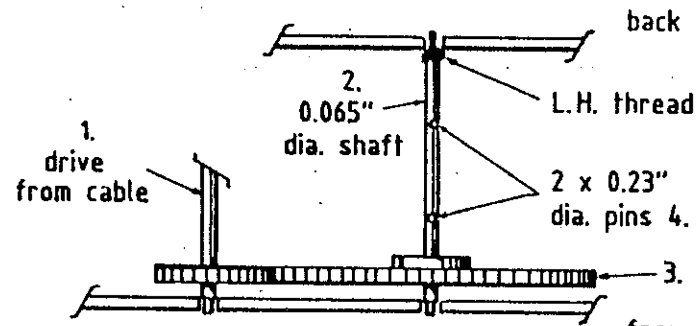
So the only date I can be relatively certain of is the 192021 head serial no. 2950.

The last head *type* (time/speed meter) was I know introduced in 1922, but how soon after that this one was produced I have no idea.

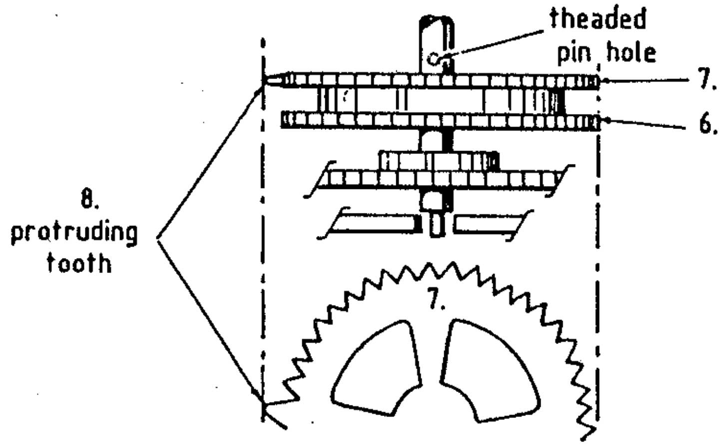
Quite early in the life of these speed meters, production was taken over by Rotherams of Coventry, directly after the first war, or at least till the late 'thirties, when they were still appearing in the Rotherams catologue calibrated in miles, kilometers or versts*, the latter being for the Russian enthusiast.

If any reader would like to correct or add to the foregoing I would be delighted to see their contribution in *Yowl.*

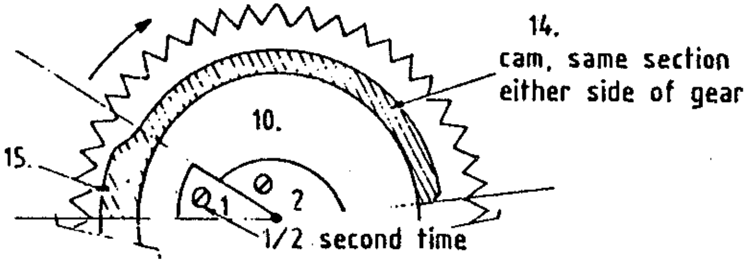
This voss for recording short versts of speed-Ed. I recall that some long articles about Bonniksens appeared in the V.M.C.C. magazine many years ago. Those with big collections and complete indices could no doubt turn them up.



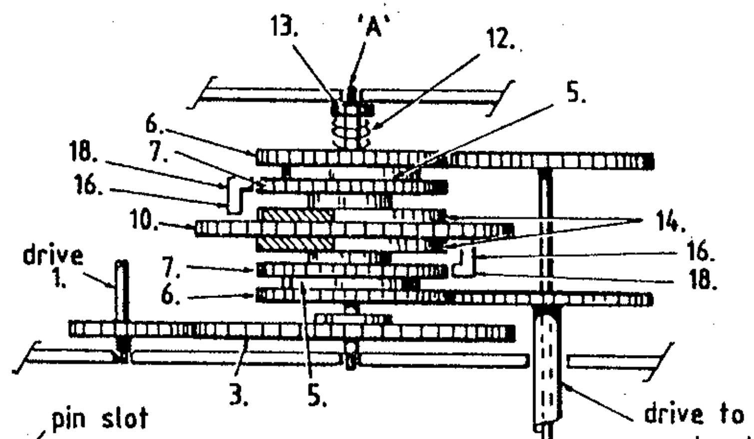
Main Shaft & Gear 'A'

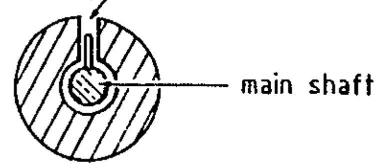


First Floating Gear Cluster
5.

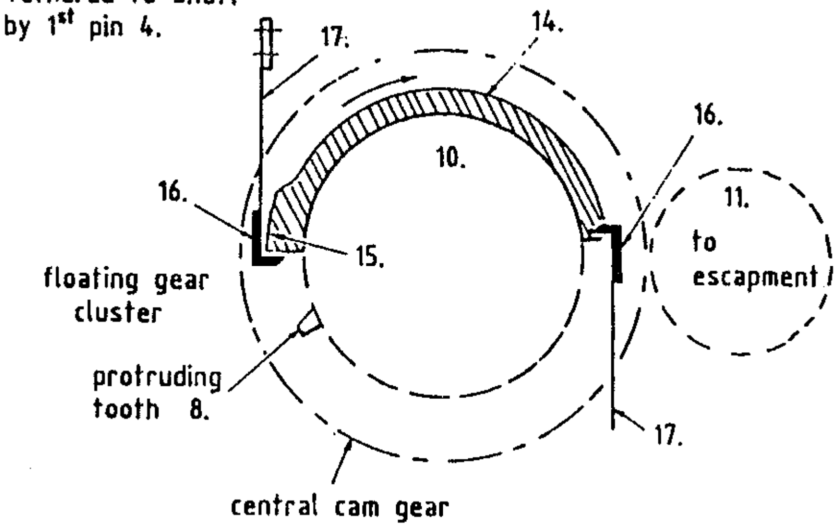


Central Cam Gear (fully floating)





First Clutch Disc 9.
tethered to shaft
by 1st pin 4.



Inside a Bonniksen Isochronous Speedometer

redrawn for S.O.C. by A.R.Griff'ths.