

The MICROMETER

THE AUCKLAND SOCIETY OF MODEL ENGINEERS INCORPORATED

PO Box 14570, Panmure, Auckland, NEW ZEALAND

Club House Telephone (9) 570 5286

Club Web Site www.asme.org.nz

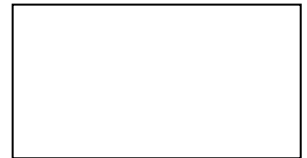
Number 529
October 2008

President Michael Jack 527 8745
E-mail address president@asme.org.nz

Secretary Brian Cotton 820 3381
E-mail address secretary@asme.org.nz

Editor Dave Russell 446 0957
E-mail address editor@asme.org.nz

REGISTERED NEW ZEALAND PUBLICATION



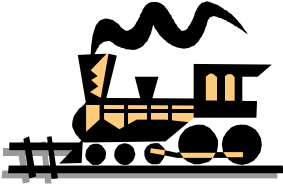
In this Months Edition

John Olsen describes in detail
Differential Dividing

RETURN ADDRESS
ASME
PO BOX 14570
PANMURE



Brand New A1 takes to the rails



Train Roster

| Date | <u>Electric</u> | <u>Electric</u> | <u>Steam</u> | <u>Steam</u> | <u>Station</u> | <u>Station</u> | <u>Station</u> | <u>Extra Guard</u> |
|-----------|-----------------|-----------------------|-------------------------|-------------------------|-------------------|--------------------|------------------|--------------------|
| 5-Oct-08 | T Robinson | D Simons | <u>B Piggott</u> | A Pritchard | E North | J Olsen* | B Parker | |
| 12-Oct-08 | J W-Buys | P Woodford | <u>D Russell</u> | R VanRyn | F Putt* | G Quayle | R Reichardt | |
| 19-Oct-08 | J Yearn | <u>D Black</u> | G Bell | G Anderson | M Richardson | A Roberts | K Ryan* | |
| 26-Oct-08 | D Booth | T Boyd | <u>G Wills</u> | E Burns | A Shirley | R Stratton | R Street* | P Dowdeswell |
| 2-Nov-08 | B Cotton | R Craig | L Farquhar | <u>A Gasteen</u> | T Taylor* | A Watson | A Whillans | |
| 9-Nov-08 | T Crake | <u>P Eaton</u> | B Piggott | A Pritchard | I Ashley* | P Boyes | R Brown | |
| 16-Nov-08 | M Granger | J Harrison | D Russell | R VanRyn | J Burnett* | R Crook | P Cunningham | J Cunningham |
| 23-Nov-08 | D Housley | J McManus | <u>G Wills</u> | G Anderson | G Dickey | G Farquhar* | A Foster | P Dowdeswell |
| 30-Nov-08 | P Moy | T Robinson | <u>G Bell</u> | E Burns | W Green | D Hamp | M Hollis* | |

Bold and Underlined name – is the designated **Train Controller**, i.e. the person in overall control of all operations for the day.

Bold with Asterisked* name – is the designated **Stationmaster**, i.e. the person responsible for activities in the station area for the day. The Stationmaster is also responsible to account for the day's takings.

Club Calendar October 2008

| | |
|--------------------------|--|
| October 7 th | Monthly General Club Meeting, Annual Monster Auction 7.30pm |
| October 11 th | Working Bee at Clubrooms, from about 9.00am |
| October 14 th | Committee Meeting |
| October 21 st | Beginners Night at Graeme Murrays workshop |
| November 4 th | Monthly General Meeting and Annual General Meeting |
| Every Tuesday | Tuesday Club |

Committee Meeting Notes 9th September 2008

The minutes of the previous meeting were read and confirmed as a true record.

Matters Arising:

Discussion held re renewal of Transpower and Auckland City Council leases.

A design for the new badge was presented. This has the Society's name displayed more clearly.

Correspondence: IN – Waipuna, Kapiti Miniature Railway, Glenbrook Vintage Railway, New Plymouth SME, Model Engineer (UK), NZ Engineering Reference.

Correspondence: OUT – Green Bay Auctions, NZ Post, Waipuna

Sub Committees:

Boilers: New hose for test gauge obtained.

Works: Batteries for locos not yet inspected.

Drains at rear of clubrooms re-organized.

Some trolley squeaks isolated and worked on.

Whiteboard now fitted to front cupboard door.

Amplifier cabinet now fitted at front of clubrooms.

Clubrooms and basement cleaned out for Expo.

Gate at bottom of steps painted.

Library: Nil.

Stores: Nil.

Safety: Committee has met.

New Members: Nil

Finance: Statement of accounts, plus payments for approval read and approved.

General Business:

The website now has newsletters added. "Stores" added to "@asme" email addresses.

The stores page on the website to be redesigned.

Some ideas proposed to update the old brochures.

There was another discussion regarding stacking of chairs.

The Glenbrook trip is on 22 November.

Expo Dinner: An email will be sent to all members re attendance.

Murray Lane and Graeme Murray to be expo judges, plus a visitor if possible.

Set up for expo from 0800 on the Saturday. Grant Anderson to provide overnight security on Saturday plus one other member to be arranged.

50th Jubilee: A quote has been received for shelving but the proposal was not thought suitable.

Dave Russell to inquire about hiring more suitable shelving.

Tabled for next month: Kapiti Bereavement Assistance Scheme.

Brian Cotton

Glenbrook Steam & Vintage Country Festival February 2009

Glenbrook Vintage Railway are again running their very successful Steam and Vintage Country Festival weekend. It is to be held on 6th, 7th & 8th February 2009. As with previous years we have been invited to be a part of this festival. Keep these dates free as the whole event is a "must see" and as in the past we would like to contribute a model display to showcase our hobby and the work of our members. This will also be a good chance to hand out some pre Jubilee event fliers etc.

Bits and Pieces Table 2nd September 2008

Conducted by John Olsen

Tonight's first items were a HEINRICI Hot Air engine, believed to have been assembled by Les Fitt, also a vertical 2"x2" engine which has been overhauled by **Murray Lane**. **Photos A & B**

Christopher Ratcliffe showed us a watch base in an early stage of construction.

A Stuart Turner cylinder and flywheel is an ongoing construction by **Graeme Quayle**. **Photo C**

The next item was the coal bunker and tender water tank of **Alan Gasteen's** 2-6-4 tank engine as described in E.I.M. by Doug Hewson. **Photo D**

A 3 cylinder I.C. engine being made by **Murray Granger** was displayed with home made spark plugs and camshaft. Murray made the spark plugs using P.T.F.E. as electrode insulation material. **Photo E**

There was a parcel wrapped item belonging to **Mike Jack** which was revealed as a new leadscrew for a German lathe to replace the original which was damaged. This has been made in America, at a lower cost than the original manufacturer. **Photo F**

John Ohlsen had a curved spoke flywheel which he had carved out of a solid block of steel. John said that he liked the old fashioned look of the curved spokes, he may now make an engine to suit it. **Photo G**

John had a load measuring gauge so he can weigh his boat, based on the area of a cylinder with a seal around the piston and a small quantity of hydraulic oil connected to a pressure gauge. **Photo H**

John has taken an interest into differential indexing and had brought a dividing head and has added auxiliary gears to link up with the milling machine leadscrew. John gave us an insight into its use.

The evening was getting on and our inventor man **Graeme Murray** wanted to give us some details of things he had been working on. He described the modifications for a microscope by making the stage adjustment knobs larger and having soft sponge rubber around them to enable the operator to rest their hands on the bench, yet make fine adjustments without fatigue. Graeme gave us a historic reminiscence about the design and construction of a small child's feeding chair with only one central leg instead of the usual four legs (this proving more stable than the multi-legged one). I think the most innovative idea that he showed and described was a pillow switch for a patient who was sadly very disabled and relied on the pillow switch to summon aid, yet the pillow switch must not effect nuisance calls to staff. Pressing any portion of the pillow caused a spring, tensioned the length of the pillow to deflect and touch a central bar, hence completing contact and sounding the alarm. **Photos I & J**

Jim Yearn



Understanding Differential Dividing by John Olsen



The simplest approach to dividing is the direct method. This uses a dividing plate, which may be a gear, directly attached to the same shaft as the job. A detent engages with the dividing plate or gear teeth, enabling the job to be rotated by an angle corresponding to the number of divisions available. Thus the job may be divided into the number of divisions on the plate, or by any integer divisor of that number. The limitations of this method are that the number of divisions possible tends to be very limited, and any error in the dividing plate will be reproduced exactly on the actual job. In Model Engineering practice, the simplest form of direct dividing is the use of a block between the lathe bed and a

chuck jaw. This allows division into three, four, or six if the block is used on either the front or back way of the lathe. A more sophisticated approach uses a detent on the back gear bull wheel. Where the number of teeth on the bull wheel does not provide useful numbers, a gear or dividing plate may be mounted on back the end of the spindle.

An improvement over direct dividing is to use a worm reduction gear between the dividing plate and the job. In effect this multiplies the number of holes in the plate by the ratio of the worm, making it possible to divide by a much wider range of numbers. It also divides any error in the dividing plate by the same ratio. The cost of these gains is the need for an accurate worm and wheel, since any errors here will be reproduced exactly on the job.

With a conventional worm dividing head it is reasonably easy to understand what is going on. The job must be positioned correctly for each division, by rotating through a certain angle from the last position. The worm ratio is usually 40:1 so the input shaft must rotate through 40 times the angle required on the output shaft. This requires selecting a division plate with a suitable number of holes and then moving the division pin to the correct hole for each movement. For a simple case, where the division plate has the exact number of holes required, then each move will involve moving the pin to a hole 40 spaces away from the hole just used. Mostly a table is provided, but if the table is missing then for each circle of holes multiply the number of holes by the worm ration and divide by the number of divisions required. Provided the result is an integer (whole number) then that is the number of divisions to step each time. If the result is not an integer then that circle will not divide by the required number of divisions. A typical dividing head, like the Vertex BS0, will be able to do all of the numbers from 1 to some maximum, then some numbers above that. The plates for the BS0 cover every prime in the range from 1 to 50. Primes larger than 50 are not possible with the standard plates. Note that I am not saying that 50 is prime. The largest number it can possibly do is the number of divisions on the largest plate multiplied by 40, which in the case of the Vertex is 40 times 49, or 1960. This is of course somewhat more than is likely to be practically required. A semi-universal head like the Vertex will in fact cover almost all normal requirements.



Where an unusual number is required, there are a number of ways of accomplishing the work with a worm dividing head. The basic idea is to make a dividing plate as accurately as possible, then use it as the master plate to perform the actual job. The errors in the master plate will be divided by the worm ratio. A division of forty means that a reasonably competently made master plate will provide work as accurate as you are likely to need. One simple approach to making such a master plate is to draw it up in a CAD program, then print it, preferably on a laser printer but an ink jet will suffice. Use double sided sellotape to stick it onto a blank, then spot through all the holes and drill them. An older approach was to use the calibrations and the Vernier scale on a rotary table to make the master. Then of course there is the differential dividing method, which we will now explore.

Differential dividing will only be used in cases where there is no available dividing wheel with a suitable number of holes. It follows that it will necessarily be more complex. The method involves setting up a geartrain from the output shaft to drive the division plate by a small amount. We then divide in a similar way to normal, except that each time we move to a new hole, the hole itself has moved to a different position. As a result we don't get the number of divisions that we would if we used that plate in the normal way. This can be a little confusing to get your head around if you think about the input side. We move the pin from one hole to another, which would give us so many degrees of movement at the output. OK, but that movement will be fed back by the gear train to the division plate, so the hole we are aiming for has moved so we move a little further to get there. But that movement itself then causes more

movement of the division plate....Like Zenos arrow, we will never actually reach the turtle with this approach.

A better way to look at this is to consider everything from the perspective of the output side. In dividing our peculiar number of divisions, whatever it is, the output shaft must start in one position and then rotate through one complete turn, dividing the angular space into "n" divisions. To create an artificially simple example, suppose we have only one division plate, which has forty divisions, and suppose our worm is 1:1. That would only permit us to divide numbers which are exact divisors of 40, eg 2, 4, 5, 8, 10, 20 and 40. For some reason we need to divide a circle into 41 divisions. We will use the 40 hole plate as if we were dividing into 40, but will use the gear train to adjust the motion. Now, our output shaft will still have to turn through a total of 360 degrees, but we will need a total of 41 stopping places instead of 40. That means the angle the output shaft must turn through is $360/41$ degrees instead of $360/40$ for each division. Since we made our worm 1:1, the same applies to the input. So, using our 40 hole plate, we must rotate the division plate by a small amount in the opposite direction. How much? Well, the output shaft has done 1 whole rotation when we get back to the starting point. Hence in our situation, the input shaft must also have done one whole rotation. But we must have passed over 41 spaces instead of 40 on the division plate, so the division plate must have done $1/40$ of a rotation in the opposite direction. So we need a gear train that has a ratio of 40:1 and reverses the rotation.

Now, making things a little more realistic, we try another example but with a 40:1 worm as per normal. We could now do forty divisions by using the same hole (on any plate) forty times. To get 41 divisions, we will do the same thing, but gear the division plate to rotate in the opposite direction. Now, the input shaft will have to rotate through forty turns, but will have to drop into the same hole of the division plate 41 times in the process. For this to happen, the division plate will have to rotate 1 full turn in the opposite direction to the input shaft. Thus the gearing will be 1 to 1, which should not be too hard to organise.

If we follow a similar argument for getting 39 divisions from a forty division plate, we will find that we must again use a 1:1 gear ratio, but this time we must rotate the division plate in the same direction as the input shaft.

Now, forty is an artificially easy number, because it matches the worm ratio. Suppose we have a plate that can do 72 divisions but we want 71. From our earlier examples, we can see that it will need the division plate to be rotated in the same direction as the input shaft. But by how much? The output shaft must still do a full turn, and the input shaft must also do 40 turns. But instead of doing this in 72 steps we must do this in 71 steps. Typically for 72 divisions we will use an 18 division plate and take steps of 10 divisions each time, but when we have done this 71 times the dividing pin must be back to the starting location. (ie the input shaft must have done exactly 40 full turns) Relative to the dividing plate it will still be 10 divisions short of the starting hole, so to be back to the starting location the dividing plate itself must have moved 10 holes worth in the same direction. So for 1 full turn of the output shaft the division plate must move $10/18$ of a turn in the same direction. Looking through our changewheels, we find that we have a 25 and a 45 which give the same ratio, so we put the 25 on the main shaft and the 45 on the shaft driving the dividing plate. Any convenient size of idler may be used between. Compound trains could of course also be used if necessary.

Note that this will require us to have a suitable pair of gears to give this ratio, but at least these are more reasonable looking numbers than trying to find a 71 hole plate or gear. In fact this is a merit of the method. The gears we need are related to the ratio of the worm, the division wheel we wish to use, and the difference between the wanted number of divisions and the available number, not to the awkward number we wish to divide. This means that if we do not happen to have the exact wheels needed, they are at least something we could make without already having them.

I now find myself looking at what I have written and wondering if it is sufficiently clear. The danger is that by writing more I will simply make the verbiage more dense and confusing. So I will set out the process of choosing a ratio in a step by step fashion. This assumes you have a table for normal dividing but not for differential dividing.

- 1/ Examine the tables to determine if the number required can be divided in the conventional manner.
- 2/ If not, choose an easy to divide number that is a small amount larger or smaller than the number you require.
- 3/ Set up the dividing plate and the arms as if you are going to divide by that number.
- 4/ Note the difference between the number of divisions you want and the number you have set up for. For instance, $72-71 = 1$ or $72-73 = -1$. (Sign is important.

5/ Divide the number of divisions for each step (as set up in 3) by the number of divisions on the plate being used. For instance for 72 we have 10 divided by 18. (you can leave this expressed as a simple fraction.)

6/ Multiply the number from 5 by the number from 4. So for 71 we get 1 times 10/18 while for 73 we get -1 times 10/18.

7/ This result is the amount the division plate must rotate by when the main shaft rotates by one full turn. A negative number means that the division plate goes in the opposite direction to the input shaft, while a positive number means that it goes in the same direction.

8/ So the actual ratio needed is 1: 10/18. That is the velocity ratio of the gears, the ratio of the number of teeth on each gear is the inverse of this, or 1:18/10. This can be multiplied and divided by suitable factors to find a set of gears that we actually have. For instance multiply both sides by 10. That would give 10 to 18. A ten tooth gear is too small. Multiplying both sides by 2 would give 20 to 36. This is workable except we may not have a 36 in a standard set of changewheels. So multiply by five instead, giving 50 to 90. Sounds OK, but 90 bigger than we have. So divide them both by two and we have 25 to 45, which are both part of the standard Myford set.

9/ Depending on the spacing of the two shafts and the direction needed, we may need one or two idler gears. The number of teeth on these does not matter.

10/ If this is the first time you have done this, divide around the whole job just making marks with a scribing block. Count the marks when you reach the start. If the number is wrong, or if the first mark does not line up with the scriber after going around, then you have got something wrong.

If you prefer, you can instead just consult a set of tables for a similar dividing head and use whatever they say.

Having provided ourselves with the means to gear the output shaft of the dividing head to the division plate, we may as well do a little extra work and provide a few more interesting possibilities.

1/ Gear the output shaft of the dividing head to the milling table feed. This will allow cutting a helix, the pitch of which may be varied by changing the gear ratio. A 1:1 ratio will give a helix pitch equal to the table leadscrew. This lends itself to milling screwthreads.

2/ Gear the division plate to the table leadscrew. This will also allow cutting helices, but of a much longer pitch. Here a 1:1 ratio together with the 40:1 ratio of a typical dividing head will give a pitch forty times as long as the table leadscrew. In addition the dividing plate and selector pin are in the path, making it easy to cut a multistart helix. This can be used for cutting helical gears of any tooth number, provided the changewheels available can provide the correct helix angle.

3/ Gear the division plate to the leadscrew and use the division plate to perform linear dividing. This is potentially useful where a length must be divided into equal divisions that are not easy to measure using handwheels or even a digital scale. For instance, cutting racks will often require odd division numbers since π is included in the pitch calculation. This can be done with an offset table. Using a table of offsets like this is difficult with just a calibrated handwheel. A set of digital scales makes it easier, but even so errors are possible. The geared arrangement will reduce the possibility of errors. The downside is that such arrangements will generally need a division by π , and any geartrain will only provide an approximation to π . Fortunately the approximation can quite readily be as good as we are likely to need. For general work, the standard π approximation 22/7 will give an error of under half a thou per inch. If a higher standard is needed then there are other approximations such as 355/113, which will provide a very low error while still being able to be constructed with reasonably practical gears. When I say practical, you may need to use the differential dividing facility to make yourself a set. Rather than making a rather large 355 tooth gear, a 71 tooth gear should be made, and the 5:1 ratio can be incorporated in the rest of the train. ($355/5=71$) Other possible ratios include:

| | | | | | | | | | | | | | | |
|---|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| 3 | 13 | 16 | 19 | 22 | 179 | 201 | 223 | 245 | 267 | 289 | 311 | 333 | 355 | 52163 |
| 1 | 4 | 5 | 6 | 7 | 57 | 64 | 71 | 78 | 85 | 92 | 99 | 106 | 113 | 16604 |

Note also that the gearing to the table leadscrew may be via the 40:1 worm of the dividing head, if this suits. This is more likely to be the case for small divisions than for large.

In conclusion, if the main aim is to do divisions that the normal plates cannot do, it might be better to go for one of the electronic conversions with a stepper motor. However, the ability to use changewheels with the dividing head offers other possibilities that the electronic arrangement does not provide. In addition, I have more confidence that the mechanical arrangement can be made to work again after spending a few years under the bench between jobs.

Around the Clubs, reviewed by Alan Emerson

Engine Booster, Los Angeles, Aug 08 Interesting article on treating chip fat to run steamers on. Pictures of their small scale track and locos. Pot luck dinners and evening runs seem very popular.

Thames Small Gauge Railway, July 08

More on tunnels and an article on the Rimutaka Incline.

Expansion Link, Hamilton, Aug 08

Story of a loco lost then recovered in quicksand. Article for the computer buffs. Invitation to CSME 75th Anniversary at Halswell on the 14-16 November.

Mailship, Aug 08

History of Ariel, some very large models and a trip to Taupo.

Boilers, Rotorua, Aug 08

Trip to A&G Price at Thames, list of Magazines for Metalworkers, life on the railway at Kakahi.

Wheels and Floats, Tauranga, Aug 08

Club is trying a reverse osmosis system to remove silica from the boiler water. Rail type wedding vows. Idea for drilling holes in round bar. Phantom boiler under construction. "F" class overhaul.

Southern Rail, Aug/Sept 08

The story of a Russian tank recovered from a lake after some 56 years. Seems the engine was still able to run. Lot of interesting Club news.

Model Torque, Hawke's Bay, July 08

A successful, dry though cold, Open Weekend with plenty of hot food to keep the troops going.

Blast Pipe, Sept 08

A number of good photos. A list of Machinery dealers. More on gear cutting.

The Generator, Palmerston North, July and August 08

Letters from Stan Compton in the UK, always interesting. References to trains carrying molten metal from the smelter to the foundry, some 63 miles in one case. Article on the Parliamentary Special with a photo of MOTAT's L class. Couple of photos of locos that ended up where they shouldn't have been.

Mixed Traffic, Wanganui, Aug-Oct 08

Club News and a write up on the Parliamentary Special. Problems with falling membership and the possibility of lease difficulties with the Council.

Swarf, New Plymouth, July 08

Story and photo of a massive steam engine used up `til 1980 to pump water into London. Train rides for the Rainbow Care children. Learn to drive a steam train on the Loughborough Line.

Conrod, Otago, August 08

AGM time again and other Club news. Photo of massive digger for an open cast coal mine in Germany.. Northern Views, Whangarei, August 08. Track running affected by rain. Detailing a model Dash 9 loco.

Upcoming Model Engineering & Associated Events

| | |
|------------------|--|
| 4-5 Oct 2008 | Melbourne Society of Model Engineers, Model Engineering Exhibition |
| 22 Nov 2008 | Glenbrook Vintage Railway, Open day for enthusiast clubs. Be there by 1.00pm. Train rides and workshop visit payment by donation. |
| 13-14 Dec 2008 | Rotorua Model Engineers Club, Open Weekend |
| 6-8 Feb 2009 | Glenbrook Steam & Vintage Country Festival |
| 15 Feb 2009 | Panmure Basin Festival |
| 14-15 March 2009 | Wanganui Model Railway and Engineering Society, Model Train Show |
| 2-4 October 2009 | A.S.M.E. 50th Jubilee Exhibition |
| 5-11 Jan 2010 | Nelson M.E., Steam and Cinders 2010 International Live Steam Convention |