

# MODEL ENGINEER

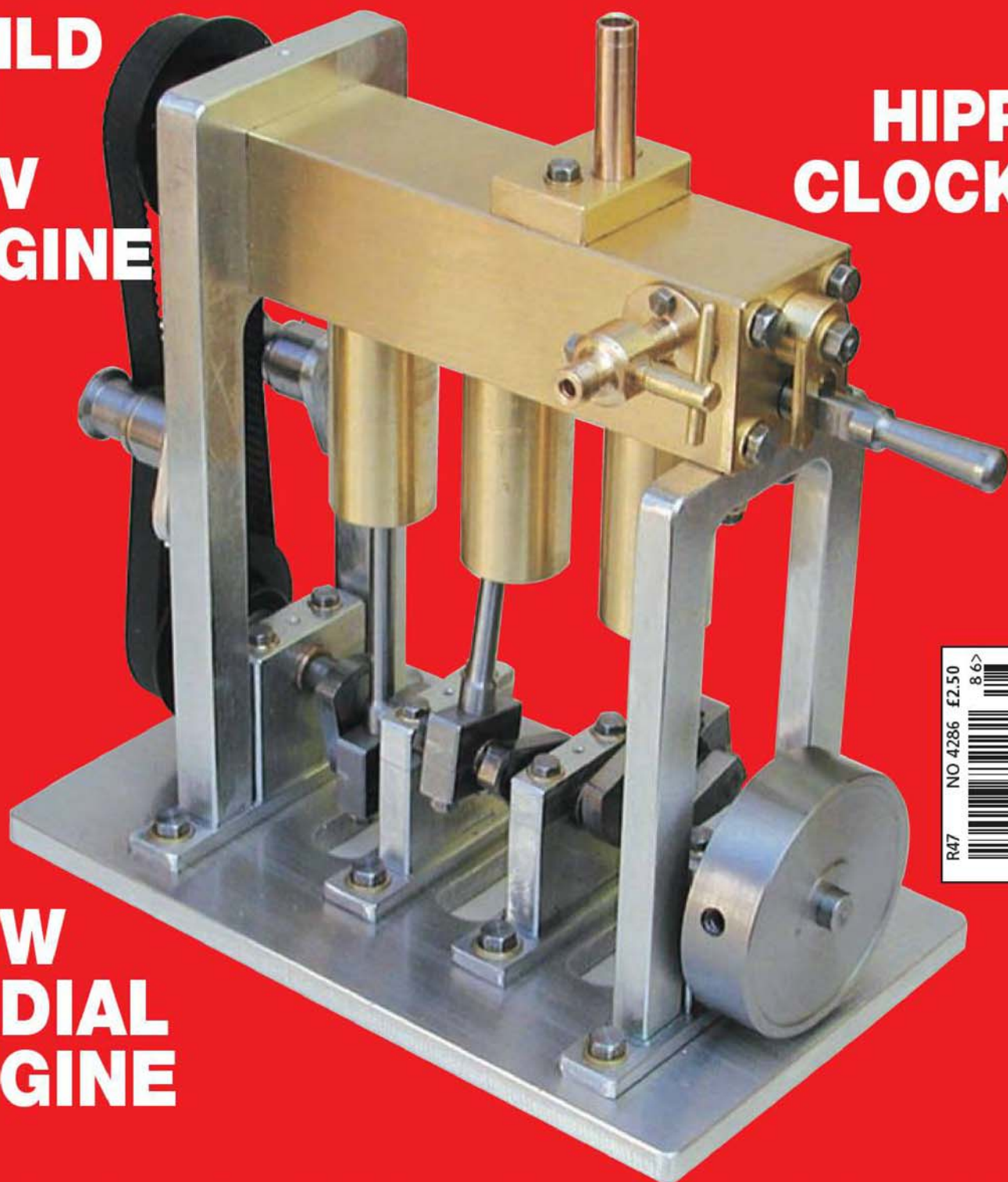
Vol. 197 No. 4286

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10-23 November 2006

**BUILD  
AN  
OHV  
ENGINE**

**HIPP  
CLOCK**



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2006

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29-31 DEC '06 OLYMPIA 2, LONDON

## GREEN GRIT WHEELS & DRESSERS FOR TCT



| CODE  | ITEM            | PRICE         |
|-------|-----------------|---------------|
| XC314 | 6" GREEN WHEEL  | £49.95 £18.00 |
| XC315 | DIAMOND DRESSER | £7.95 £6.95   |
| XC316 | BOTH THE ABOVE  | £27.90 £19.95 |

## DRILL GRINDING BENCH GRINDER-



ATTACHMENT FOR  
CAPACITY 1/8" - 3/4"

| CODE  | PRICE         |
|-------|---------------|
| XC317 | £22.00 £12.95 |

## DRILL STOPS - METRIC OR IMPERIAL



| CODE RANGE                           | PRICE |
|--------------------------------------|-------|
| XC318 3-4-5-6-8-10&12MM              | £4.95 |
| XC319 1/8-3/16-1/4-5/16-3/8-7/16-1/2 | £4.95 |
| XC320 BOTH SETS                      | £8.00 |

## RUST PREVENTION PRODUCTS

| CODE  | SET                   | PRICE |
|-------|-----------------------|-------|
| XC325 | 2 X TINS VCI EMITTERS | £7.50 |

(enough for 6 cubic feet for 2 years)

| CODE  | ITEM                                                         | PRICE |
|-------|--------------------------------------------------------------|-------|
| XC326 | 10 SHEETS RUST<br>INHIBITING PAPER<br>(each sheet 24" x 36") | £5.00 |



## HOME ULTRASONIC CLEANING SYSTEM

Designed with style for home use  
Compact size for desktop use  
(140 x 125 x 200mm; net wt. 780g)  
Wide-diameter transducer for best cleaning results  
Includes:  
Plastic basket  
Watch bracket  
CE Approved  
Specifications:  
Ultrasonic frequency  
42,000Hz  
Tank - stainless steel  
(SUS303) with 600ml  
(1 pint) capacity 3 minute  
timer with auto cut-off  
Power supply 230v, 50Hz



APPLICATIONS  
Jewellery & watches including necklaces, earrings, bracelets, diamond rings, watch straps, and bands and coins  
Eye care including glasses, sunglasses, contact lens accessories  
Daily personal care including dentures, combs, toothbrushes, table-ware, electric shaver heads, razor blades.  
XC321 £55.00 £49.95

## DEBURRING TOOLS



| CODE  | SIZE                   | PRICE |
|-------|------------------------|-------|
| XC327 | 5 X THROWAWAY TYPE     | £7.50 |
| XC328 | DEBURRER WITH 2 BLADES | £4.50 |
| XC329 | 2 X SPARE BLADE        | £1.75 |

## GARRYFLEX ABRASIVE BLOCKS



| CODE  | SHANK          | PRICE  |
|-------|----------------|--------|
| XC330 | EXTRA COARSE   | £4.25  |
| XC331 | COARSE         | £4.25  |
| XC332 | MEDIUM         | £4.25  |
| XC333 | FINE           | £4.25  |
| XC334 | SET OF 4 ABOVE | £15.50 |

## PACK OF 9 BI-METAL HACKSAW BLADES



| CODE  | PRICE         |
|-------|---------------|
| XC337 | £17.90 £12.00 |

## VISION VISOR OPTICAL HEADBAND MAGNIFIERS



| CODE  | TYPE           | PRICE         |
|-------|----------------|---------------|
| XC339 | 1 1/2X         | £16.95 £12.00 |
| XC340 | 2X             | £16.95 £12.00 |
| XC341 | 2 1/2X         | £16.95 £12.00 |
| XC342 | FLIP DOWN LENS | £4.95 £4.50   |

## PROFESSIONAL DIGITAL ULTRASONIC CLEANER

Designed with large tank for professional cleaning  
High power transducer for superior cleaning  
results Isolated-circuit design  
for enhanced safety  
Cooler fan for prolonged use  
Quiet, solid states circuitry  
Includes plastic basket CE  
approved



Specifications:  
Ultrasonic frequency 42,000Hz  
Tank - stainless steel (SUS303) with  
1375ml (2.4pint) Timer: 5 cycles (90s-480s)  
with digital time display.  
Power supply 230v, 50Hz Power output 70W  
Unit size: 230x180x160mm

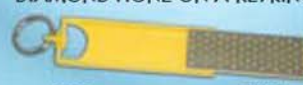
APPLICATIONS  
Jewellery & watches including necklaces, earrings, bracelets, diamond rings, watch straps, and bands and coins  
Eye care including glasses, sunglasses, contact lens accessories  
Daily personal care including dentures, combs, toothbrushes, table-ware, electric shaver heads, razor blades.  
XC322 £105.00 £89.95

## VERTEX FLUORESCENT MAGNIFIER



Superb optical aid!  
Designed with a magnifier lens on a  
luminaire head.  
3x magnification.  
22 watt Daylight Circular Bulb.  
Can be machine mounted with 4 screws  
the optional table clamp is also included!!  
XC338 £105.00 £59.95!

## DIAMOND HONE ON A KEYRING



| CODE  | PRICE |
|-------|-------|
| XC351 | £4.95 |

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### TOS SELF CENTERING CHUCKS

| 3 JAW | CODE  | DIA   | PRICE  |
|-------|-------|-------|--------|
|       | XC101 | 80MM  | £58.95 |
|       | XC102 | 100MM | £64.95 |
|       | XC103 | 125MM | £72.00 |
| 4 JAW | CODE  | DIA   | PRICE  |
|       | XC104 | 80MM  | £69.00 |
|       | XC105 | 100MM | £72.00 |
|       | XC106 | 125MM | £79.00 |



### SET OF 3 OR 4 SOFT JAWS FOR TOS CHUCKS

| CODE  | TO SUIT     | PRICE  |
|-------|-------------|--------|
| XC107 | 80MM 3 JAW  | £23.00 |
| XC108 | 100MM 3 JAW | £24.00 |
| XC109 | 125MM 3 JAW | £26.00 |
| XC110 | 80MM 4 JAW  | £23.50 |
| XC111 | 100MM 4 JAW | £24.50 |
| XC112 | 125MM 4 JAW | £27.50 |

### TOPS QUALITY KEYLESS DRILL CHUCKS 1-13MM

| CODE  | SHANK | PRICE  |
|-------|-------|--------|
| XC123 | 1MT   | £22.00 |
| XC124 | 2MT   | £22.00 |
| XC125 | 3MT   | £22.00 |
| XC126 | R8    | £26.00 |



### TOPS QUALITY HIGH PRECISION KEYLESS CHUCKS WITH INTEGRAL SHANK

| CODE  | SHANK/CAPACITY | PRICE  |
|-------|----------------|--------|
| XC134 | MT2 - 13MM     | £42.95 |
| XC135 | MT3 - 13MM     | £62.95 |
| XC136 | MT3 - 16MM     | £74.95 |
| XC137 | R8 - 13MM      | £72.00 |
| XC138 | R8 - 16MM      | £84.00 |



### ER25 COLLET SYSTEM TO SUIT MYFORD ML7 ETC

| CODE  | ITEM                    | PRICE  |
|-------|-------------------------|--------|
| XC152 | CHUCK & SPANNER         | £87.00 |
| XC153 | SET 15 COLLETS 1 - 16MM | £85.00 |



### TOPS QUALITY KEY DRILL CHUCKS 1 - 13MM

| CODE  | SHANK | PRICE  |
|-------|-------|--------|
| XC127 | 1MT   | £16.00 |
| XC128 | 2MT   | £16.00 |
| XC129 | 3MT   | £16.00 |
| XC130 | R8    | £20.00 |



### 40 PC POLISHING SET

SUITABLE FOR MINICRAFT/  
DREMEL TYPE TOOLS 40  
ASSORTED BUFFS, BOBS,  
WHEELS & STONES

| CODE  | PRICE        |
|-------|--------------|
| XC344 | £68.95 £7.50 |



### ACCESSORIES TO SUIT UNIMAT 3 4 LATHES

| CODE   | TYPE                | PRICE         |
|--------|---------------------|---------------|
| XC3341 | 4 JAW CHUCK         | £68.25 £49.05 |
| XC3342 | TOPSLIDE            | £26.75 £20.75 |
| XC3343 | FIXED STEADY        | £32.55 £28.50 |
| XC3344 | MILLING TABLE       | £44.50 £34.05 |
| XC3345 | MACHINE VICE        | £86.95 £10.05 |
| XC3346 | DRILL CHUCK         | £43.20 £12.00 |
| XC3347 | LIVE CENTRE         | £44.25 £9.00  |
| XC3348 | ER16 COLLET CHUCK   | £35.00 £20.05 |
| XC3349 | SET10 ER 16 COLLETS | £99.00 £85.00 |
| XC3350 | SET OF 6 T NUTS     | £6.00 £5.00   |
| XC3360 | PR DRIVE BELTS      | £5.00 £4.50   |



### 105 PC GENERAL PURPOSE SET

For cleaning, polishing, carving,  
Sanding & Grinding

| CODE  | PRICE       |
|-------|-------------|
| XC343 | £7.95 £6.50 |



### 50 PC DIAMOND DISC & POINT SET

VERY VERSATILE  
EACH ITEM HAS  
A 3MM SHANK

| CODE  | PRICE         |
|-------|---------------|
| XC345 | £45.00 £12.00 |



### SETS OF 3 RADIUS GAUGES

| CODE  | RANGE             | PRICE         |
|-------|-------------------|---------------|
| XC347 | 1MM-25MM METRIC   | £49.50 £15.00 |
| XC348 | 1/32"-1" IMPERIAL | £49.50 £15.00 |



### SET OF THREE DRILL DRIFTS MT1-MT2 & MT3

| CODE  | PRICE |
|-------|-------|
| XC349 | £7.95 |



### CONTOUR GAUGE FOR FINDING AND MEASURING A PROFILE OR EDGE

| CODE  | PRICE |
|-------|-------|
| XC350 | £7.95 |



### HSS SQUARE TOOLSTEEL - PACKS OF FIVE

| CODE   | SIZE                  | PRICE         |
|--------|-----------------------|---------------|
| XC351A | 1/4 SQ X 2 1/2" LONG  | £8.00 £6.00   |
| XC352  | 1/4 SQ X 4" LONG      | £44.75 £6.00  |
| XC353  | 5/16 SQ X 2 1/2" LONG | £8.00 £6.00   |
| XC355  | 3/8 SQ X 2 1/2" LONG  | £8.50 £6.00   |
| XC356  | 3/8 SQ X 4" LONG      | £49.75 £16.00 |



### HSS ROUND TOOLSTEEL - PACKS OF FIVE

| CODE  | SIZE                 | PRICE         |
|-------|----------------------|---------------|
| XC357 | 1/8 RD X 2" LONG     | £3.75 £3.25   |
| XC358 | 1/8 RD X 4" LONG     | £44.75 £11.00 |
| XC359 | 1/4 RD X 2 1/2" LONG | £8.00 £6.00   |
| XC360 | 1/4 RD X 4" LONG     | £9.25 £8.00   |
| XC361 | 5/16 RD X 4" LONG    | £13.00 £11.00 |
| XC362 | 5/16 RD X 3" LONG    | £44.00 £9.00  |



### SET OF 3 DIESTOCKS 13/16"-1"-1 1/16"

| CODE  | PRICE         |
|-------|---------------|
| XC363 | £44.85 £10.00 |



### UNIVERSAL TAP GUIDE - KEEPS TAPS UP TO 1/4" STRAIGHT

| CODE  | PRICE  |
|-------|--------|
| XC364 | £16.00 |



### MODEL ENGINEERS PUBLICATIONS

| CODE  | TITLE                    | PRICE  |
|-------|--------------------------|--------|
| XC365 | MODEL ENGINEERS HANDBOOK | £10.50 |
| XC366 | ZEUSS TABLES             | £6.50  |
| XC367 | BOTH THE ABOVE           | £15.00 |



### OPTICAL CENTREPUNCH

| CODE  | PRICE         |
|-------|---------------|
| XC368 | £87.95 £49.95 |



### SET OF 12 NEEDLE FILES/NEEDLE FILE HANDLE

| CODE  | TYPE                      | PRICE |
|-------|---------------------------|-------|
| XC369 | 12 PC NEEDLE FILE SET     | £4.05 |
| XC370 | WOODEN NEEDLE FILE HANDLE | £4.95 |
| XC371 | BOTH THE ABOVE            | £8.00 |



### ROUND BAR CENTRE FINDER

| CODE  | PRICE        |
|-------|--------------|
| XC372 | £42.95 £8.00 |



### R8 MORSE TAPER CONVERTORS

| CODE  | TYPE   | PRICE         |
|-------|--------|---------------|
| XC373 | R8-MT2 | £15.00 £12.00 |
| XC374 | R8-MT3 | £49.95 £16.00 |



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# MODEL ENGINEER

BUILD  
AN  
OHV  
ENGINE

HIPP  
CLOCK

NEW  
RADIAL  
ENGINE

CHEAP ML7 DIGITAL READOUTS

### On the cover ...

Colin Pape's Step 3 overhead  
valve steam engine is the next  
development in this popular  
series. This new variant is a self-  
starting and reversible engine,  
developed after the earlier  
versions had shown that the OHV  
system was viable. Description of  
this latest version starts in this  
issue, following useful notes on  
building the compound Step 2  
version. The article begins on  
page 578.

(Photograph by Colin Pape)

### DIGITAL VERNIERS FOR THE MYFORD SUPER7 CROSS SLIDE

S. Filipek describes how he fitted a pair of  
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### OVERHEAD VALVE ENGINES

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TURN TO PAGE 584 FOR YOUR MODEL ENGINEER EXHIBITION ENTRY DETAILS





# STUART MODELS

FOUNDED 1906

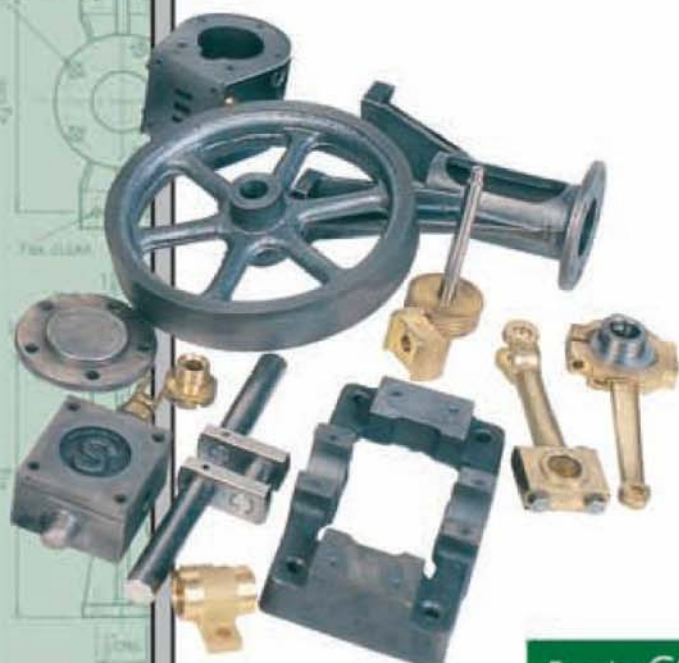
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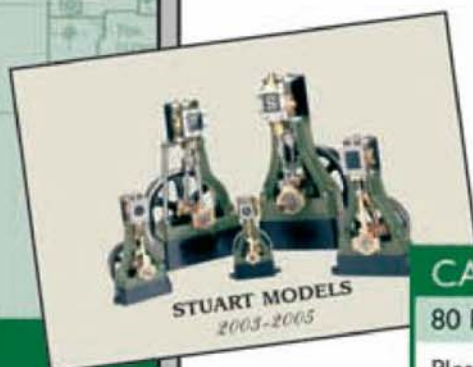
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2. SPECIAL MODEL ENG. SET (2 Taps each size)  $\frac{1}{16}$  x 32,  $\frac{1}{8}$  x 40,  $\frac{1}{4}$  x 40,  $\frac{1}{2}$  x 40,  $\frac{3}{4}$  x 40,  $\frac{1}{2}$  x 32,  $\frac{3}{4}$  x 32,  $\frac{1}{2}$  x 40
3. BA TAP SET (2 Taps each size) & BA DIE SET: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 BA
4. 26 TPI TAP SET (2 Taps each size) & 26 TPI DIE SET (CYCLE ON BRASS THREAD)  $\frac{1}{16}$  x 26,  $\frac{1}{8}$  x 26,  $\frac{1}{4}$  x 26,  $\frac{1}{2}$  x 26,  $\frac{3}{4}$  x 26
5. BSF TAP SET (2 Taps each size) & BSF DIE SET:  $\frac{1}{16}$  x 1",  $\frac{1}{8}$  x 1",  $\frac{1}{4}$  x 1",  $\frac{1}{2}$  x 1",  $\frac{3}{4}$  x 1"
6. BSF TAP SET (2 Taps each size) & BSF DIE SET:  $\frac{1}{16}$  x 1",  $\frac{1}{8}$  x 1",  $\frac{1}{4}$  x 1",  $\frac{1}{2}$  x 1",  $\frac{3}{4}$  x 1"
7. BSW TAP SET (2 Taps each size) & BSW DIES:  $\frac{1}{16}$  x 1",  $\frac{1}{8}$  x 1",  $\frac{1}{4}$  x 1",  $\frac{1}{2}$  x 1",  $\frac{3}{4}$  x 1"
8. BSW TAP SET (2 Taps each size) & BSW DIES:  $\frac{1}{16}$  x 1",  $\frac{1}{8}$  x 1",  $\frac{1}{4}$  x 1",  $\frac{1}{2}$  x 1",  $\frac{3}{4}$  x 1"
9. METRIC COARSE TAP SET (2 Taps each size) & METRIC DIE SET: 2, 3, 4, 5, 6, 7, 8, 9, 10, 12 mm
10. METRIC COARSE TAP SET (2 Taps each size) & METRIC DIE SET: 14, 16, 18, 20, 22, 24 mm
11. UNF OR UNC TAP SET (2 Taps each size) & DIE SET: 0 to 12 UNF or 1-12 UNC
12. UNF OR UNC TAP SET (2 Taps each size) & DIE SET:  $\frac{1}{16}$  x 1",  $\frac{1}{8}$  x 1",  $\frac{1}{4}$  x 1",  $\frac{1}{2}$  x 1",  $\frac{3}{4}$  x 1"
13. UNF OR UNC TAP SET (2 Taps each size) & DIE SET:  $\frac{1}{16}$  x 1",  $\frac{1}{8}$  x 1",  $\frac{1}{4}$  x 1",  $\frac{1}{2}$  x 1",  $\frac{3}{4}$  x 1"
14. GAS (BSP) PIPE SET:  $\frac{1}{16}$  x 1",  $\frac{1}{8}$  x 1",  $\frac{1}{4}$  x 1",  $\frac{1}{2}$  x 1",  $\frac{3}{4}$  x 1" (2 Taps each size)
15. METRIC FINE PITCH SETS (10 sizes from 3 - 12 mm) TAPS & DIES
16. METRIC FINE PITCH SETS (5 sizes from 14 - 24 mm) TAPS & DIES
17. ENDMILL SET (THREADED SHANK)  $\frac{1}{16}$  x 1",  $\frac{1}{8}$  x 1",  $\frac{1}{4}$  x 1",  $\frac{1}{2}$  x 1",  $\frac{3}{4}$  x 1" or (mm) 3, 4, 5, 6, 7, 8, 10, 12 mm
18. SLOT DRILL SET (THREADED SHANK)  $\frac{1}{16}$  x 1",  $\frac{1}{8}$  x 1",  $\frac{1}{4}$  x 1",  $\frac{1}{2}$  x 1",  $\frac{3}{4}$  x 1" or (mm) 3, 4, 5, 6, 7, 8, 10, 12 mm
19. ENDMILL SET  $\frac{1}{16}$  x 1",  $\frac{1}{8}$  x 1",  $\frac{1}{4}$  x 1",  $\frac{1}{2}$  x 1",  $\frac{3}{4}$  x 1" DIA. WITH  $\frac{1}{8}$  THREADED SHANK TO FIT COLLET CHUCK
20. COUNTERBORE SET (FOR SPOTFACING)  $\frac{1}{16}$  x 1",  $\frac{1}{8}$  x 1",  $\frac{1}{4}$  x 1",  $\frac{1}{2}$  x 1",  $\frac{3}{4}$  x 1" OR (mm) 3, 4, 5, 6, 8 mm
21. REAMER SET (STRAIGHT SHANK)  $\frac{1}{16}$  x 1",  $\frac{1}{8}$  x 1",  $\frac{1}{4}$  x 1",  $\frac{1}{2}$  x 1",  $\frac{3}{4}$  x 1" or (mm) 2, 3, 4, 5, 6, 7, 8, 10, 12 mm
22. DRILLS (LONG SERIES) TO VARIOUS SIZES BETWEEN  $\frac{1}{16}$  -  $\frac{1}{2}$  STRAIGHT SHANK
23. MORSE TAPER SOCKET REAMERS (FOR CLEANING MORSE TAPERS)
24. BALL-NOSE MILLING CUTTERS (THREADED SHANK)  $\frac{1}{16}$  x 1",  $\frac{1}{8}$  x 1",  $\frac{1}{4}$  x 1",  $\frac{1}{2}$  x 1",  $\frac{3}{4}$  x 1" DIA
25. D-BIT SET (FOR DRILLING SQUARE BOTTOM HOLES)  $\frac{1}{16}$  x 1",  $\frac{1}{8}$  x 1",  $\frac{1}{4}$  x 1",  $\frac{1}{2}$  x 1",  $\frac{3}{4}$  x 1" DIA
26. SLITTING SAW SET (HS) 3 PIECES, BETWEEN  $\frac{1}{16}$  -  $\frac{1}{2}$  (FINE TEETH)
27. CENTRE DRILL SET (HS)  $\frac{1}{16}$  x 1",  $\frac{1}{8}$  x 1",  $\frac{1}{4}$  x 1",  $\frac{1}{2}$  x 1",  $\frac{3}{4}$  x 1" @ E6 SET
28. TAPER SHANK DRILLS (No. 1 M/T) TO VARIOUS SIZES UP TO  $\frac{1}{2}$  DIA
29. DRILL SETS (HS) GROUND FLUTES, No. 1 - 60 A-2 @ E18,  $\frac{1}{16}$  -  $\frac{1}{2}$  1 - 13mm @ E16, 1 - 60mm x 1mm @ E18, 6 - 10mm @ E25 SET
30. DIAL GAUGES (MM OR IMP) @ E10 EACH
31. INVOLUTE GEAR CUTTERS - ALL SIZES FROM 2 DP - 120 DP, INCL. MODULE & CP. (ALSO STUB, BEVEL & SPROCKET CHAIN)
32. TAPER PIN REAMER SET.  $\frac{1}{16}$  x 1",  $\frac{1}{8}$  x 1",  $\frac{1}{4}$  x 1",  $\frac{1}{2}$  x 1",  $\frac{3}{4}$  x 1" (10 PIECE SET - SHEFFIELD MADE)
33. COLLET CHUCK, TO TAKE THREADED ENDMILLS, UP TO 1" DIA (2mm, 3mm, 4mm, 5mm, 6mm, 7mm, 8mm, 10mm, 12mm) IN STRONG WOODEN BOX
34. LATHE TOOLS (SET OF 8)  $\frac{1}{4}$  SQUARE VARIOUS SHAPES
35. REVOLVING LATHE CENTRES, 1 M/T @ E18; 2 M/T @ E20
36. DRILLS WITH  $\frac{1}{8}$  SHANK  $\frac{1}{16}$  x 1",  $\frac{1}{8}$  x 1",  $\frac{1}{4}$  x 1",  $\frac{1}{2}$  x 1",  $\frac{3}{4}$  x 1" @ E18 SET
37. 3-WAY PRECISION ANGLE VICE, 50 mm JAWS, 180 DEGREE COMPLETE CIRCLE
38. INDEXABLE TOOL HOLDERS (SWISS)  $\frac{1}{16}$  SHANK OR  $\frac{1}{8}$  SHANK
39. PARTING OFF TOOLHOLDERS, COMPLETE WITH COBALT BLADE
40. VARIOUS DRILLS, BELOW  $\frac{1}{16}$  DIA, 10 EACH. STUB, QUICK SPIRAL, SLOW SPIRAL, LEFT HAND, @ E5 EACH TYPE
41. KNURLING TOOLS, 2 WHEEL SIZE @ E5, 6 WHEEL SIZE @ E10 (SPARE KNURLS E2 EACH)
42. ROHM PRECISION DRILL CHUCKS, WITH No. 1 OR No. 2 MORSE TAPER ARBOR

- ALSO AVAILABLE IN WOODEN BOXES
- |                   |                                                                                                               |
|-------------------|---------------------------------------------------------------------------------------------------------------|
| TAPS: E18 SET     | DIES: E18 SET                                                                                                 |
| TAPS E22 SET      | DIES E22 SET                                                                                                  |
| TAPS E18 SET      | DIES E20 SET                                                                                                  |
| TAPS E18 SET      | DIES E18 SET                                                                                                  |
| TAPS E18 SET      | DIES E18 SET                                                                                                  |
| TAPS E18 SET      | DIES E18 SET                                                                                                  |
| TAPS E20 SET      | DIES E20 SET                                                                                                  |
| TAPS E18 SET      | DIES E18 SET                                                                                                  |
| TAPS E20 SET      | DIES E20 SET                                                                                                  |
| TAPS E25 SET      | DIES E25 SET                                                                                                  |
| TAPS E18 SET      | DIES E18 SET                                                                                                  |
| TAPS E18 SET      | DIES E18 SET                                                                                                  |
| TAPS E18 SET      | DIES E18 SET                                                                                                  |
| TAPS E30 SET      | DIES E25 SET                                                                                                  |
| (10) TAPS E18 SET | DIES E25 SET                                                                                                  |
| (8) TAPS E18 SET  | DIES E25 SET                                                                                                  |
|                   | E25 EACH SET                                                                                                  |
|                   | E20 EACH SET                                                                                                  |
|                   | E25 SET OF 4                                                                                                  |
|                   | E30 EACH SET                                                                                                  |
|                   | E6 LOT                                                                                                        |
|                   | E12 SET                                                                                                       |
|                   | E25 SET                                                                                                       |
|                   | 3" DIA @ E6 SET 2" DIA @ E5 SET                                                                               |
|                   | $\frac{1}{2}$ INDEXABLE ENDMILL (THREADED SHANK) @ E10 WITH TIP                                               |
|                   | @ E10                                                                                                         |
|                   | 6 - 10mm @ E25 SET                                                                                            |
|                   | MAGNETIC BASE @ E15 EACH                                                                                      |
|                   | RE-THREADING FILES (IMP OR M/M) @ E6 EACH                                                                     |
|                   | @ E18 EACH                                                                                                    |
|                   | @ E30 SET                                                                                                     |
|                   | @ E70 COMPLETE                                                                                                |
|                   | IN HSS @ E15 SET, OR CARBIDE TIPPED @ E18 SET                                                                 |
|                   | COVENTRY DIEHEAD CHASES - ALL SIZES                                                                           |
|                   | @ E80 + POSTAGE                                                                                               |
|                   | @ E10 EACH, WITH TIP (EXTRA TIPS E2)                                                                          |
|                   | $\frac{1}{16}$ @ E18, $\frac{1}{8}$ @ E13, $\frac{1}{4}$ @ E14, $\frac{1}{2}$ @ E14, $\frac{3}{4}$ @ E16 EACH |
|                   | $\frac{1}{16}$ @ E7, $\frac{1}{8}$ @ E8, $\frac{1}{4}$ @ E10                                                  |

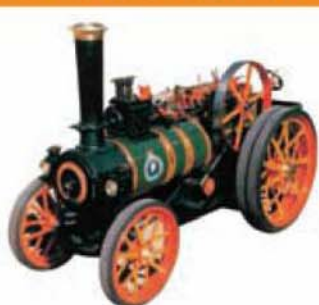
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| Myford VMC Turret Mill, 3 ph                                       | £ 850.00 |  | <b>Lathe Tooling, General</b>                                                           |          |          | Smart & Brown 9" Faceplate for Model A                           | £ 45.00                 |  |
| Warco VMC Type X5015 Turret Mill, 1ph, VGC, 2003 Machine           | £ 950.00 |  | New 2 Morse Taper Live Centre                                                           | £ 20.00  |          | 2 PCM Colets Holders with 1" Shanks & 17 Schaublin Collets       | £ 100.00                |  |
| Tom Senior MI Milling Machine, 3ph, Choice of 3, 3ph               | £ 600.00 |  | New 3 Morse Taper Live Centre                                                           | £ 20.00  |          | 7 Long Series Schaublin Collets, 20mm Shank                      | £ 50.00                 |  |
|                                                                    |          |  | Jones & Shipman No 8144 Knurling Tool                                                   | £ 15.00  |          | 9 x 10mm Pultra Collets                                          | £ 100.00                |  |
| <b>Drilling Machines</b>                                           |          |  | Jones & Shipman No 8142/001 Knurling Tool                                               | £ 14.00  |          | Alexander 2C Engraver Cam Forming Attachment                     | £ 75.00                 |  |
| Starrite Mercury Bench Drill, 3ph, Old                             | £ 85.00  |  | Pultra 10mm Collets, Choice of Sizes                                                    | Each     | £ 15.00  | Jones & Shipman Radius Grinding Attachment                       | £ 225.00                |  |
| Boxford Union Pillar Drill, Table Drilled, Rack Op Table, 3ph      | £ 150.00 |  | Pultra 8mm Collets, 3 for £25.00 or                                                     | Each     | £ 10.00  | Jones & Shipman Radius Grinding Attachment                       | £ 125.00                |  |
| Elliott Progress Pillar Drill, Needs Quill Lock, 3ph               | £ 75.00  |  | Set of 5 Jones & Shipman Lathe Carriers                                                 |          | £ 25.00  | Jones & Shipman Grinding Wheel Balancer                          | £ 350.00                |  |
| Progress 15 Bench Drill, Needs Quill Lock, 3ph                     | £ 75.00  |  | Miller CNC Quickturn Knurling Tool                                                      |          | £ 50.00  | Myford MG12 Wheel Dresser                                        | £ 40.00                 |  |
| Progress 15 Pillar Drill, Needs Quill Lock, Handles & Spring, 3ph  | £ 35.00  |  | Dickson Toolholders For Bantam                                                          | Each     | £ 24.00  | Raglan Lathe 2 Point Steady                                      | £ 55.00                 |  |
| Meddings LFI Pillar Drill, 1/2" capacity, 3ph                      | £ 150.00 |  | Dickson Quick Change Toolpost & 3 Holders, (2 7/8" Square)                              |          | £ 100.00 | Deckel FP3 Horizontal Overarm Support                            | £ 100.00                |  |
| Progress 15 Bench Drill, Needs Spring & Quill Lock, 3ph            | £ 75.00  |  | Arrand 12" Between Centres Boring Bar                                                   |          | £ 55.00  | Deckel FPI or FP2 Overarm for Vertical Head                      | £ 225.00                |  |
| Vicoroy 20mm Pillar Drill, 3ph                                     | £ 60.00  |  | Arrand 2 Morse Taper Saw Arbor                                                          |          | £ 40.00  | Denford Startum 8 Tailstock                                      | £ 100.00                |  |
| Union Pillar Drill, Needs 1 Handle on Starwheel, 3ph               | £ 75.00  |  | Jones & Shipman No 8142/001 Knurling Tool                                               |          | £ 14.00  | Jones & Shipman 12" x 12" Precision Co-ordinate Table            | £ 450.00                |  |
|                                                                    |          |  | Jones & Shipman No 1027 Knurling Tool                                                   |          | £ 30.00  | Tom Senior Vertical Milling Head                                 | £ 550.00                |  |
| <b>Milling Tooling</b>                                             |          |  | Jones & Shipman No 8144 Knurling Tool                                                   |          | £ 15.00  | Vicoroy 5" Lathe Tailstock                                       | £ 125.00                |  |
| Clarkson R8 Autolock & 4 Metric Collets                            | £ 100.00 |  | Jones & Shipman Type 1027 Knurling Tool                                                 |          | £ 25.00  | Vicoroy Topslide & 4 Way Toolpost                                | £ 150.00                |  |
| Clarkson 3MT Autolock Milling Chuck & 3 Collets                    | £ 120.00 |  | 5 Straight Tail Lathe Carriers                                                          |          | £ 25.00  | Set of Vickers Machine Dials, Dual Metric/Imperial, Unused       | £ 35.00                 |  |
| Clarkson 2 MT Autolock Milling Chuck & 4 Imp Collets               | £ 110.00 |  | Soba 3 Morse Taper Tailstock Die Holder                                                 |          | £ 32.00  | Hare SPS Power Press                                             | £ 350.00                |  |
| Clarkson 30 INT Autolock Milling Chuck & 4 Imp Collets             | £ 100.00 |  | Soba 2 Morse Taper Tailstock Die Holder                                                 |          | £ 30.00  | Pinco No 1 Bench Arbor Press                                     | £ 40.00                 |  |
| Clarkson 40 INT Autolock Milling Chuck & 4 Imp Collets             | £ 100.00 |  | 2 Morse Taper Drilling Pad With Plain & V Head                                          |          | £ 15.00  | Denbigh No 3 Fly Press                                           | £ 150.00                |  |
| Clarkson 40 INT Autolock Milling Chuck & 4 Imp Large Collets       | £ 100.00 |  | 5 Off 3 Morse Taper Collets                                                             |          | £ 25.00  | Smart & Brown H3 Toggle Press                                    | £ 185.00                |  |
| Clarkson 30 INT Dedlock 150 Milling Cutter Holder                  | £ 75.00  |  | 3 Off SC Soft Collets                                                                   |          | £ 20.00  | Sweeney & Blockside Large Flypress                               | £ 350.00                |  |
| Clarkson 4MT Autolock Milling Chuck & 4 Imp Collets                | £ 100.00 |  | 5/16" & 3/32" Square SC Collets                                                         |          | £ 20.00  | Alcoa Ceramic Chip Forge                                         | £ 275.00                |  |
| Arrand 2MT Boring Head                                             | £ 75.00  |  | 14 SC Collets                                                                           |          | £ 70.00  | Blacksmiths Leg Vice                                             | £ 45.00                 |  |
| Arrand 2MT Fly Cutter                                              | £ 30.00  |  | 9 Boxed SC Collets                                                                      |          | £ 50.00  | Blacksmiths Leg on Stand                                         | £ 125.00                |  |
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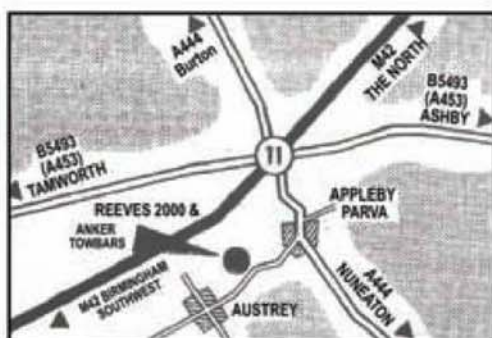
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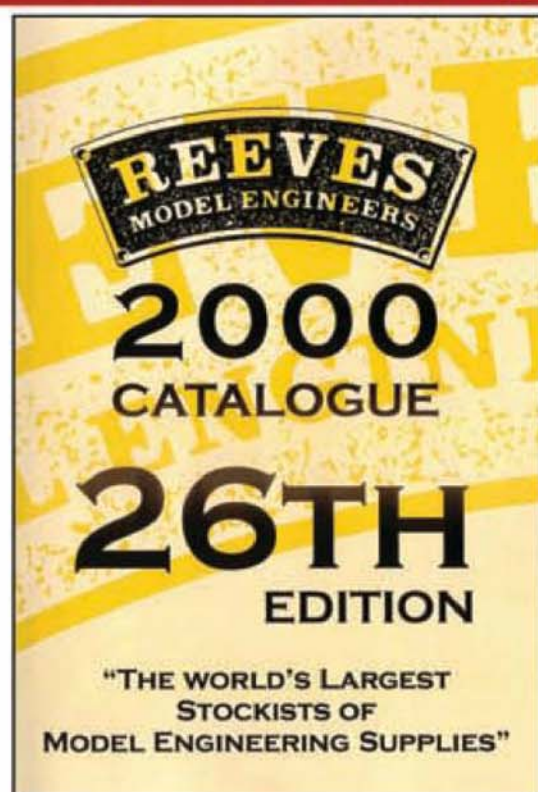
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**SPECIAL OFFER PRICE £32.90 (MRRP = £61.12)**

### USE THE OTHER 2 CORNERS FOR ECONOMY!

Our SCRCR rough turning tool uses the same inserts as the 6, 8 & 10mm sq SCLCR tool above, and the boring bar below. The good news is that it uses the other two corners! These very strong 100° corners are rigid enough for rough or intermittent turning. The insert is mounted at 75 deg to the lathe axis. 10mm sq section only.

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Mr D Hudson of Bromsgrove SME has used these tools since 1995 to profile the special form of tyre treads for his self-steering wheel sets with great consistency. Spare inserts just £4.31 each.

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The SDJCR tool uses a 55° insert, allowing access to small diameter components when using a tailstock centre. It can also profile back-angles.

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### 55° NEUTRAL THREADING and PROFILING TOOL

Our SDNCN tool with neutrally mounted 55° insert allows Whitworth, BSF & BSP threads to be generated, as well as profile turning - both towards and away from the chuck. The 10mm square shank comes as standard with 0.2mm point radius insert. Inserts also available with 0.4mm or 0.8mm radius at the same price of £5.09 each.

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### EXTERNAL THREADCUTTING TOOL

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SEE OUR WEBSITE FOR MORE INFORMATION

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### TURNING/BORING/PARTING TOOLS COME COMPLETE WITH 1 INSERT

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- Electronic variable speed • Gear change set
- Self centering 3 jaw chuck & guard • Power feed



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Full range of accessories available

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- Compound slide with 4 way tool post
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- Clutch for independent mill/drill operation

Shown with optional floor stand & tray  
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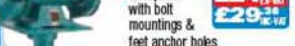
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| CB66RSC     | HD   | 150mm      | <b>£24.99</b> | <b>£29.36</b> |
| CB66RWC     | HD   | 150mm      | <b>£29.99</b> | <b>£35.23</b> |
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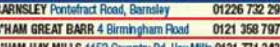
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INCLUDES SINGLE LOCKABLE DRAWER

Shown fitted with optional 3 drawer unit  
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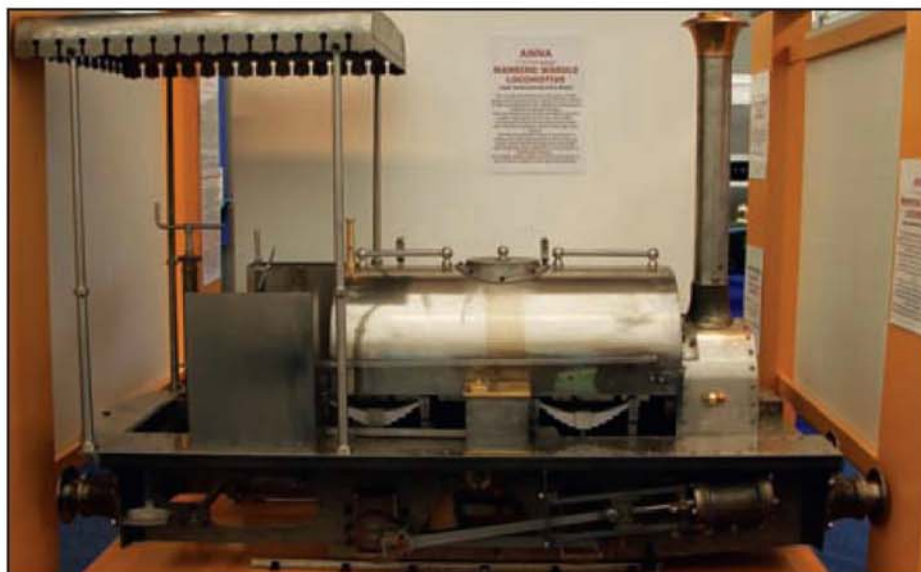


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# SMOKE RINGS

With the Editors



Derek Brown's Anna is now nearing completion, and looked splendid at the recent Midlands Model Engineering Exhibition. Derek reports that there is just the boiler to be done before the locomotive is completed. Many others are building this powerful 7<sup>1</sup>/<sub>4</sub> in gauge engine, and some more details of his build will appear shortly in Model Engineer.

## Maxitrak ready to roll

Maxitrak Owners Club magazine Road'n'Rail reports that the company has taken delivery of the first batch of 1in. scale Burrell traction engines from China. The original design has been updated, and now includes a 100psi boiler, opening smokebox door, and draining cylinders. They sell at £2675, ready to run. Purchasers will need to have them boiler tested.

It also reports from the factory that the big Sentinel lorry seen at the Harrogate exhibition, minus boiler, is to go into production, and customers can choose a copper gas fired boiler, or steel coal fired version.

## Swan upping

Swan Precision Castings had acquired Prop Shop, and will relocate the business from

Malvern to Swan's Banbury works. Swan was founded in 1947 and it is a family owned and managed business centred on its iron foundry. It also has engineering interests in Poland. Prop shop specialises in model propellers, and Swan will now develop its lost wax casting techniques to other model engineering castings. It will also extend the range of alloys to include bronze, aluminium, grey and ductile iron and steel. This, says the company, will allow Swan to offer the model engineering trade a full range of alloys, pattern making and moulding processes. Tel: Keith Shephard on 01295 263134 or see [www.swangroup.co.uk](http://www.swangroup.co.uk) for more information.

## Big stuff

We hear that a new magazine has been launched dealing with miniature railways from 7<sup>1</sup>/<sub>2</sub>in. to

15in. gauge. Appropriately called Miniature Railway, it seems to be published three times a year, and costs £2.50. The second issue contains articles on the sadly failed Oakhill Railway, pioneers Greenly and Haywood, and building a Maxitrak Opal. We wish them well in this venture. See more at [www.miniature-railway.com](http://www.miniature-railway.com)

## In the bag

As you cannot have failed to have notice, Arc Euro Trade's brand new catalogue is 'bagged' with this issue of Model Engineer. A number of new (we think) items caught our eye.

Definitely new is the model C0 Baby Lathe which sells for just £165, including VAT. It has a swing over the bed of 110mm, and the distance between the centres is 125mm. Cross slide travel is 50mm. It is powered by a 150W DC variable speed motor. A range of useful accessories is also available, which are also said to be suitable for other tiny lathes. This machine comes only in factory prepared condition, and so will require cleaning, adjustment and lubrication, before use, unlike many other Arc Euro Trade machines which can be supplied fully prepared.

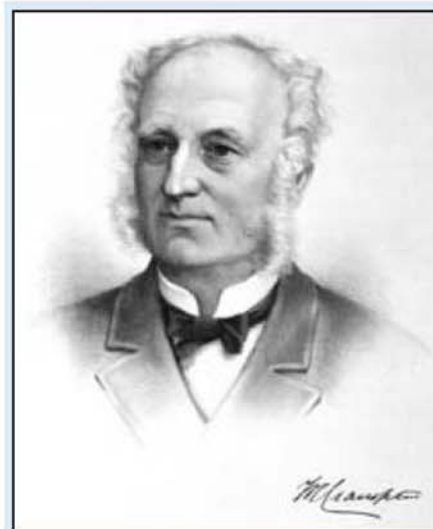
The popular Super X1L milling machine, the one with a 2MT spindle, now has a larger table, measuring 400mm by 145mm, with longitudinal travel of 330mm.

Among the small tools, the expanding mandrel sets in different guises will doubtless prove useful to many, as will a new tapping fixture designed to help use those smaller taps up to 1/4in. dia. A universal radius turning attachment for tool post mounting will find plenty of takers, as will a competitively priced Mini Drill with a host of accessories.

A wide range of ball and roller bearings is listed, and much more. See also the website [www.arceurotrade.co.uk](http://www.arceurotrade.co.uk)



Sir Hugh Ford takes his family for a ride at Guildford after some restoration on his Dean 4-4-0 Armstrong Class. Sir Hugh was apprenticed at Swindon Works, and went on to a top engineering career, including President of the Institution of Mechanical Engineers, and is one of two IMechE presidents to have built a model locomotive. The Dean 4-4-0 was described by J. N. Maskelyne as the most attractive locomotive ever. We aren't going to disagree.



Thomas Russell Crompton (August 6 1816 to April 19 1888) is best known for designing the Crompton locomotive but had many engineering interests including the electric Telegraph and the Channel tunnel for which he designed a boring machine. See our local heroes article on page 581.



# POST BAG

## Easy starting 'mowers

SIRS, - The petrol I used to use in my 17 year-old car was '4 star' and naturally I also used this in the lawnmower. This meant I could tip the remains of the can into the car at the end of the mowing season and begin with fresh petrol again the next year.

Now we are in the 21st century and I have a new car. This uses unleaded petrol so my mower now does too.

The difference in ease of starting the mower is incredible. It used to take at least 2-dozen pulls of the starter cord, but now regularly starts first time.

Can anyone explain this?  
Neil G. Heppenstall, Cheshire.

## Casting and drawing quality

SIRS, - Eric Clark's letter to *Post Bag* (M.E. 4274, 26 May 2006) regarding castings quality certainly provided some interesting comments. I hope readers included my own in this category? However, on re-reading my contribution again I feel I should have written about the 'introduction' of the computer and not the inventor - there was no single person involved.

R. J. Grave's disgust at having a 'solid pulley' and being refused replacement with a correct one (M.E. 4280, 18 August 2006) suggests to me that the supplier has lost the core box having ignorance of the necessity of keeping a tight rein on sending patterns and core boxes to foundries and checking that *all* the various parts are returned. This was one of my tasks in my later years of employment and I really had to be 'on the ball' in this regard so to speak.

John Day comments on being charged a greater amount than an advertised price (M.E. 4280, 18 August 2006). The supply company that I worked for had, in the "Terms of Trading" of their 328-page catalogue the statement "We reserve the right to invoice/charge at prices ruling at date of despatch or collection of order." I assume his supplier operates on the same principle? If John has their catalogue and it does not say something to this effect, then I suggest a legal challenge to the supplier.

John's further comments about "nearly an A4 sheet of mistakes in

the drawings" raised another interesting point of failure in regard to hobby supply. To the best of my knowledge, and I would be happy to be proved wrong, there was only one supplier over the last four decades who employed someone especially to answer customer queries and complaints. That employee was me. I did my best. Occasionally 'ruffled feathers' had to be smoothed down when the reply was not what the customer expected or demanded but on the whole I believe customers' continuing faith in that supplier was justified. I hope Mr. Day's sheet of mistakes were not of one of my designs done while that employee?

In retrospect I should never have done any design at all in the environment of a busy hobby supplier with an almost incessantly ringing telephone plus the dozens of other distinctly separate daily duties required. Design requires total concentration; impossible in such an environment.

Further to this, I was able with the copyright designs of my employer, to make corrections to master tracings, though even that task was fraught with unknown dangers. One professional builder of a 7 1/4in. gauge tank locomotive with outside Walschaerts valve gear brought his chassis to us and demonstrated various major discrepancies in the design as he had constructed it. Unfortunately my company lacked a metrology department; could not actually measure this customer's work, and took it in good faith that he was right. Over a period of months 'corrections' were made, an advertisement put into *Model Engineer* and free replacement drawing sheets supplied to customers who had already purchased drawings provided that they returned the originals so they could be destroyed. Then, one of the company directors built two of these chassis to the original drawings and they assembled almost perfectly!

I was allowed to keep records of who had purchased drawings sets of the two major locomotive designs I wrought and could retrospectively advise them of problems; probably a unique situation in our hobby. Unfortunately the worst drawings suppliers of all in this regard were *Model Engineer* plans services known under various names such as MAP Plans, Argus, Nexus etc.

Prior to Ted Jolliffe taking on as Editor of this magazine, I was interviewed for that post but for several reasons declined the offer of employment. However, during my visit to the then Hemel Hempstead offices my worst fears confirmed that the world's largest suppliers of hobby drawings (many hobbies, not just model engineering) did not have a drawing office. At that time it was possible to have some corrections made by the late Martin Evans' wife who worked at their home. What happens in the 21st century I know not. Again I believe, but will be happy for a correction, that few other suppliers have or have had such a facility either of which would explain Mr. Gay's problems, but not to even acknowledge receipt of his letter and information is, to my mind, insulting and damaging to the future well being of that company.

While writing in response to this same *Post Bag* may I thank John Boothman for completing details of Tangye origins in Illogan, Cornwall, though I did say at the start of my series I did not intend to cover Tangye history in depth. I visited Portreath several times in the 1970s and 1980s noting the spectacularly steep gradient referred to.  
David Piddington, Birmingham.

## Nemett comments;

*As someone who has just entered the realm of engine design and producing drawings, I can only say that with modern CAD produced drawings it is easy to make corrections and, if a record is kept of those who have sets of drawings, equally easy to send out corrections. To those who say that this is a never-ending task, I would counter by saying that once a few examples of any design have been built and assuming the builders do notify the designer of any problems found, any errors soon get put right and then the drawings do not need to change. This situation is obviously more difficult for those suppliers who do not actually produce the drawings, but should still be possible if things are organised properly.*

## IMLEC results - a plea for sanity

SIRS, - I would like to make a plea for some sanity in reporting the IMLEC results sheet (M.E. 4280, 18 August 2006). No calculation can ever be more accurate than the least accurate factor used in that

calculation. To quote the efficiency to ten significant figures when all the key inputs (weight of coal in kg, conversion of kg to lb and distance run) are measured to only four significant figures is nonsensical. If we alter the last figure of any one of these by just one digit only the first three significant figures of the efficiency will remain unaltered.

For example, if we take the last line on the results sheet shown on pages 200/201, by increasing the amount of coal used by just one gram and who's to say that we can weigh coal that accurately, we alter the efficiency from 0.02717647961 to 0.02713889112. In other words it affects the fourth significant digit; the remaining six digits are meaningless. The same argument goes for all the other columns that show the results of a calculation.

Sorry to sound like a grumpy old pedant but with my eyesight I find it very hard to sort the wood for the trees with so many digits on the page.

Roger Curtis, by e-mail.

## 'Ordinary' sleeve valve engines

SIRS, - Referring to Mr. Ted Wale's letter on sleeve valve engine details (M.E. 4277, 7 July 2006). *Strictly I.C. Magazine* ([www.strictlyic.com](http://www.strictlyic.com)) ran a construction article on the Barr and Stroud single-cylinder sleeve valve motorcycle engine by Peter Dekker. The engine is a little over 1cc capacity, six inches tall and does not require castings. The very detailed construction series ran in volume 14, issues 83 and 84. Back issues are available in the UK from Camden Miniature Steam Services (Barrow Farm, Rode, Frome, Somerset BA11 6PS, tel: 01373-830151).

I am pleased to see that Peter King made a point of the difference between aero and 'ordinary' sleeve valve engines, there seems to be very little information on the latter. Is this an indication of such engines not being well disposed to 'ordinary' use?

Sleeve valve aero engines of the time were fed on aviation grade methanol with, I believe, a small percentage of water and were maintained by aircraft industry technical engineers and fitters, 'ordinary' engines would not fare so well.

With the grade of petrol of that period, a de-coke was a regular thing. One would normally remove the head, when studied, this is the



most crucial part of these engines, once bedded in, leave well alone.

For the unwary, removal of the junk head may well equal a junk engine.

Stephen Lockie, Dorset.

### Thanks

SIRS, - In answer to my recent letter on sleeve valve engines (*M.E.* 4277, 7 July 2006) I received a helpful letter from Richard Newport who unfortunately did not include his full postal address so I cannot thank him by return. I therefore hope he sees this.

Ted Wale, by e-mail.

### Romulus valve gear

SIRS, - I am building a pair of *Romulus* 7 $\frac{1}{4}$ in. gauge locomotives. After talking to fellow model engineers I am not very happy about fitting Hackworth valve gear, as shown on the original drawings. I have seen photos of several examples of *Romulus* fitted with Walschaert valve gear, which I am sure, will give a much improved performance as well as looking the part.

Please, are there any model engineers out there with designs for Walschaert valve gear for *Romulus*? This is a somewhat urgent matter as I am now approaching the time when I will need to begin work on the valve gear.

I can be contacted by email on: [vanthahan@hotmail.com](mailto:vanthahan@hotmail.com)  
Harold Pearson, Cambodia.

### Shardlow micrometers

SIRS, - In *M.E.* 4277, 7 July 2006, there is mention of Shardlow micrometers. Readers may be interested in one I obtained for only a few pounds at a car boot sale. It is marked 'GKN Shardlow' and appears to be as new in a fitted wood box. It is an internal micrometer with a range of 5 - 25 mm. The design is one I have not seen anywhere; it is very accurate and is made to a very high standard of precision.

On another matter, in *M.E.* 4278, 21 July 2006, a writer wonders about the demise of the Juneero Company. When I was a young boy a school friend's father worked for Juneero and obtained free kits for his son and me. So if other workers were taking free samples maybe it hit the firm's profits too much!

Jolm Krober, Surrey.

### Old model engineering societies

SIRS, - Following our conversations at the Bristol Exhibition regarding the ages of

Model Engineering Clubs/Societies, may I be permitted to respond to the comment (*M.E.* 4279, 4 August 2006) from the Cape Town Society of Model and Experimental Engineers, and its reaching the age of 100 in 2007.

Per chance, I have been in contact with David Proctor, the Editor of *Australian Model Engineering* on the very same subject since the Sydney Society of Model Engineers is 100 years in 2006. But the question is, who is the oldest Model Engineering Club/Society in the world?

I believe it to be Edinburgh Society of Model Engineers who reached its 100th anniversary in 1994, with SM&EE reaching its in 1998, unless there is somebody out there who knows different?

May I emphasise that I am only referring to model engineering, I am sure there are organisations out there of different disciplines of a similar age.

Brian Thompson, Chairman,  
Southern Federation.

### More on casting quality

SIRS, - I write in response, principally, to David Piddington's letter (*M.E.* 4280, 18 August 2006). Like David, I have in excess of 40 years in the hobby, and can remember when the Midlands abounded in small foundries and workshops. I have over the years, bought castings from a number of our suppliers, and, judging by the comments of others, must have been lucky, because I have encountered very few problems. There were a couple of very hard castings, but they were thin cover plates, exactly the sort of thing which you might expect to have chilled.

We might complain to the suppliers, but most, if not all, of them have no direct control over casting quality, because the castings are 'bought in', and their choice of foundries, like ours, is increasingly limited.

I solved the problem with my hard castings by annealing them in the embers of an open fire overnight, and then taking a light pass over the surface with an angle grinder. Not very scientific, but it seemed to work. Silver steel tool bits, hardened, but not tempered, and very low speeds can be effective on hard spots, but don't let the tool rub, get in under the skin as much as possible.

In reply to David's challenge at the end of his letter, for my current projects (a planing machine and a largish gas engine) I have made patterns, and had castings made by local foundries. The casting sizes range from small flanges weighing a few grams up to 20kg for the planing machine table, and some of the patterns are quite complex (by my standards anyway) with external detail and multiple cores. Both the foundries which I use have a minimum charge per moulding box of around £40, so that six small flanges might cost nearly as much as a 10kg, 14in. dia. flywheel. Without going into too much detail, my experience is that for items such as chuck back plates, angle plate castings, plain wheels, etc., I cannot, by making a pattern and going directly to the foundry, beat the prices which our suppliers charge.

For small items, such as flanges, I now buy a suitable piece of continuously cast iron from one of our suppliers, and cut them from the solid. A bit laborious, I agree, but cheaper, and it certainly overcomes any problems with blowholes and hard spots. With the larger castings, I am usually pleasantly surprised by the reasonableness of the price, given their size, and to date have had no quality issues.

Finding a foundry prepared to make castings from loose wooden patterns is increasingly difficult, and, at one of the foundries which I

use, there is only one moulder, now approaching retirement age, who is entrusted with such work.

In fairness to the foundry trade, both foundries which I use (family owned concerns) have been extremely helpful, and I am sure that the quality of the finished product owes much more to their moulding and casting skills than mine as the pattern maker. At both, the Production Director has given very good advice concerning the arrangement of cores, split lines on patterns etc., for future work, and I am sure that if their time was costed against my castings, they would have made no profit at all out of the work.

Richard Wilson, Staffordshire.

### More on casting quality 2

SIRS, - The letters regarding Casting quality (*M.E.* 4280, 18 August 2006) make sad reading, I was left with the impression that model engineers will just have to expect to pay more, and put up with faults in their castings. I really do not see why we should accept this without looking at alternatives. I fully appreciate the difficulties model engineering suppliers are having in finding foundries in Britain willing to take on small orders. However, foundries do not stop at the English Channel.

A friend of mine in New Zealand gets good quality castings done there at considerably less cost than in this country. Even allowing for carriage costs to the UK they are far cheaper. I feel sure that Eastern Europe, India or China would be lower still. Shipping costs in real terms are very cheap today which is why machine tools made in the Far East are available at reasonable prices. I do hope suppliers who are so necessary in the hobby take a look at this source of supply. Before someone tells me it is not economic and cannot be done, (small orders, customs and excise, etc.) please think about it, because if you do not, some enterprising chap surely will.

There is another way for the model engineer, and that is to go it alone. First of all to see how much can be fabricated. These days I make items like locomotive motion brackets from steel. The first job is to go to a small local steel fabricator and look in his skip. Normally a couple of pounds in the tea moneybox provide enough off cuts to last a long time.

I am not a good MIG welder, but I can tack together a fabrication



Jolm Krober's Shardlow internal micrometer.



with a few spots, and then silver solder it to produce a part at a fraction of the cost of a casting. In the long run the job is often a good deal easier as the machined parts can be made in the lathe, avoiding the difficult chucking procedures with castings, and then added on.

I buy a length (about 10ft.) of continuous cast phosphor bronze generally 1/2in. dia. for fabricating fittings. It is cheaper that way.

There are though, parts that really do need castings unless one is prepared to do a lot of chewing out from the solid. Locomotive wheels, flywheels and cylinders for instance. I was lucky enough to spend a small amount of time, while I was an apprentice, in a brass foundry. However, most of my limited knowledge on casting and indeed all my 'know-how' on cast iron has come from Terry Aspin's articles in the *Model Engineer*, his books, and simply by 'having a go'. I cannot claim to have produced large quantities of castings but at least the system works despite the odd failure, which is returned to the pot. Maybe I've been lucky but hard spots have not been a problem. Whilst casting can be done solo, a bit of help makes things a lot easier. As a club activity it is well worth considering. If the help of a retired moulder is available so much the better. One of the benefits of this approach is the satisfaction of producing your own castings, and having learnt at least something about a different skill. Further you have the freedom to build exactly what you wish. I am not suggesting that it is all easy, it is not, but it is worthwhile.

The great LBSC, who wrote in these pages years ago, always did his best to make the hobby affordable. This encouraged those of limited means to 'have a go'. We should do the same in order to keep costs within the reach of as many as possible.

Mike Casey, Isle of Man.

### Ricardo's engine

SIRS, - In *M.E.* 4281, 1 September 2006, Peter King refers to the *Crecy* engine, the most powerful engine that never flew, as Ricardo's engine. Page 245 of *The Magic of a Name* indicates the *Crecy* engine to be Rolls-Royce Project P1. Only a few engines were built before piston problems and the advent of the gas turbine resulted in cancellation of the engine.

Harry Ricardo, as the foremost authority on piston engine

combustion and cylinder head design at that time, was probably a project consultant on the *Crecy*. For those interested the Rolls-Royce Heritage Trust publish a booklet on the *Crecy* engine in their series on piston engines.

Serious researchers requiring information on past Rolls-Royce engines and the company, should address their enquiries to: Rolls-Royce Heritage Trust, Rolls-Royce Plc., PO Box 31, Derby DE24 8BJ. Peter Neal, Derbyshire.

### Ice cores

SIRS, - Mr. Robinson in his letter (*M.E.* 4279, 4 August 2006) refers to Antarctic ice cores found in 1992 containing 20 times the current amount of carbon dioxide. The amount of CO<sub>2</sub> in today's atmosphere is 380 parts per million, so 20 times that amount represents a concentration of 7600 ppm, enough that is to bring about a catastrophic rise in temperature, kill off all life on Earth and cause the seas to boil away. The cores taken at Vostok Station in the Antarctic reveal that over the past 400,000 years the highest concentration of CO<sub>2</sub> never exceeded 300 ppm.

For further information on the Vostok cores I refer Mr. Robinson to a paper published in *Nature*, June 3 1999 by J. R. Petit *et al.* Neil Macnaughtan, Edinburgh.

### Boat design

SIRS, - If Mr. David Eve (*M.E.* 4279, 4 August 2006) wants to make a start into boat design, he could do no better than to buy a copy of *How to Design a Boat* by John Teal, published by Adlard Coles Nautical. This is really for full sized boats but the principles are the same. Just read inches instead of feet. The book deals with all aspects of boat design including: displacement, buoyancy, lateral areas, stability and even conic projection for hard chine boats.

Another book which might interest him is, *Dampf II* by Udo Mannek published by the Neckar Verlag GmbH, Klosterring 1,

78050 Villingen-Schwenningen, Germany.

The author describes his successful use of 'low-tech' mono-tube boilers in model boats.

I hesitate to call these 'flash boilers' they are not made red hot like those used in tethered hydro planes. They are copper tube boilers run at 'normal' boiler temperatures with steam pressures of around three bar.

Even if he cannot read the German text this book should spark off a whole lot of ideas for his own development.

With regards to Ron Isted's problems with Welsh measurements, surely these are just a result of mistakes being made with the very complicated units being used. Were there 14in. to a foot? Or was it 112 links in a British standard chain? 2240in. in a furlong? Not to mention rods and poles, which did not equate to a whole number of something or other. Sorry, but I couldn't resist a dig back at the 'anti-metrics', for a change.

Len Woods, Germany.

### A Synchronome and Shortt clocks

SIRS, - Being something of a Synchronome addict, I read with interest Patrick Williams' article A Synchronome Clock (*M.E.* 4281, 01 September 2006). I could comment extensively but thought it would be of particular interest to enlarge on just one aspect of the article. Patrick notes that a Mr. Shaw claimed, when writing in an issue of *M.E.* of February 1993, that a Synchronome clock was used for generating Greenwich time pips until the quartz crystal came on the scene. This is only indirectly correct and other clocks were involved, not only the Shortt master clock which I will comment on as follows. Although the Synchronome gravity escapement was a huge step forward, not least for ensuring reliable contact closure, this type of clock still suffered from a number of defects. Firstly, the pendulum has to advance the count wheel which is

subject to variable drag from a change of oil viscosity; secondly, although an invar rod is used for temperature compensation this is far from perfect and, finally, but not least, time keeping is affected by a change of barometric pressure. Although these effects were almost irrelevant, for example, for station clocks, they were far from irrelevant for observatory purposes. A little after the appearance of the Synchronome clock, a Bill Shortt, in conjunction with the Synchronome Company, developed a far freer pendulum than that of the Synchronome clock. It was housed in a vacuum of 18mm of mercury in a temperature controlled environment. But, equally importantly, it did not have to advance a count wheel every second. A Synchronome clock was paired with a Shortt clock, with the former as a slave, in such a way that the half minute impulse from the Synchronome clock was the trigger for releasing the gravity impulse lever in the Shortt clock. When the impulse was complete the Shortt master clock sent a synchronising signal back to the Synchronome slave clock to keep them in step. In brief, this synchronisation was achieved by setting the Synchronome slave pendulum to run about 7 seconds slow per day. The synchronising signal from the Shortt clock then caused the engagement of a very weak leaf spring, about every other thirty seconds, to impede the outward swing of the Synchronome pendulum thus minutely advancing its time. It was the combination of the Shortt and Synchronome clocks, installed at Greenwich and other observatories all over the world, which was responsible for a quantum leap in time keeping accuracy. Such was the accuracy of this combination, that it was possible to observe a change in time rate with a change in the gravity which causes maritime tides!

There is a superb description of the detailed working of the Synchronome/Shortt combination, and animation, at [www.electric-clocks.nl](http://www.electric-clocks.nl). Select Shortt's free pendulum at the bottom of the first page, read all about it and then select animation. If Patrick would like to contact me on any aspects of Synchronome clocks, then I would be pleased to hear from him through *M.E.*

Roger Castle-Smith,  
Milton Keynes.

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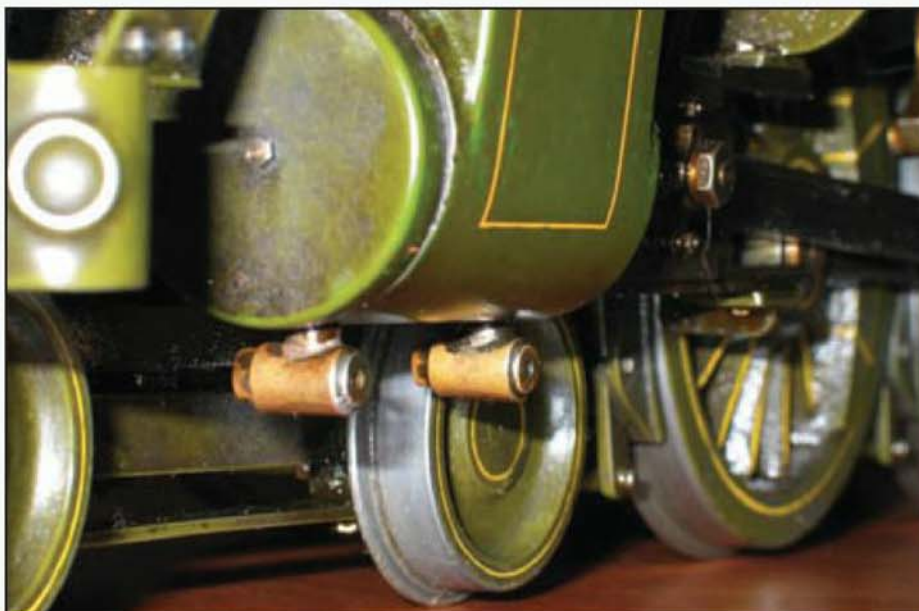
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Bob Thomas' neat automatic drain cocks fitted to his 2 1/2 in. gauge locomotive.

# AUTOMATIC CYLINDER DRAIN COCKS

## Bob Thomas

in the United States gives details of an effective design of drain cocks which operate automatically, and how to make them.

In his letter published in *M.E.* 4252, 22 July 2005, Colin Roberts expressed interest in 'automatic' cylinder drain cocks. My personal experience with these clever devices goes back to 1979, when I fitted them to my 2.5 in. gauge Baltimore and Ohio 4-6-0. The idea was

passed to me by my father, who had successfully used a larger version for many years on his 1 in. scale 4-4-0. The basic concept came to us from Bill Van Brocklin, a prolific New England builder of more than 30 3/4 in. scale locomotives, most of which employed his automatic cylinder cocks.

On his drawing (fig 1), Bill recommended them for engines with cylinders up to 1.5 in. bore, although they have been applied to locomotives with even larger cylinders. Most importantly, Bill cautiously recommended them only for engines with slide valves to avoid a possible disaster with piston valves should the drains fail to be 'automatic' – of which more later.

At first glance, these drain cocks might be expected to perform like snifting valves, simply closing rapidly upon initial application of pressure, preventing free exit of water. In practice, however, when condensate is present there is enough turbulence of steam and water in the valve chamber to bounce the ball around, preventing it from seating permanently until all the water droplets have been cleared. The combination of a small ball in a long, large diameter horizontal chamber, enhances the effect of this turbulence. When starting out for the first time after initially raising steam, it is prudent to open the regulator slowly – just as it is with manually-opened drain cocks – allowing the driving wheels to turn slowly for a few revolutions until all condensation is expelled.

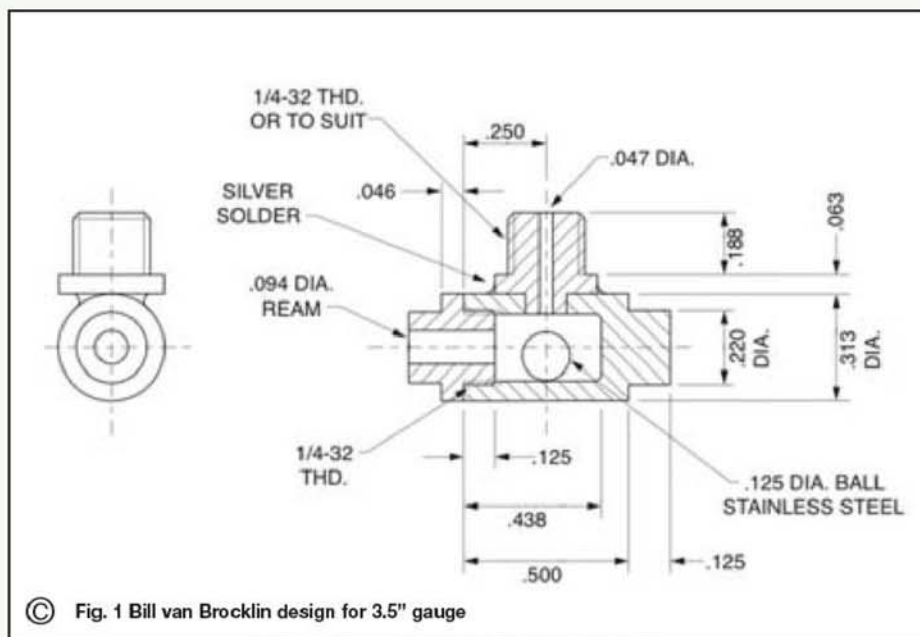
From then on, whenever the regulator is opened after a short stand, the drain cocks can be heard emit a short "pff-fft", and are thereafter silent and tightly closed. Bill's tests indicate the drains will close with approximately 5 lb pressure.

The reference to snifting valves above has some relevance to automatic drain cocks in that they also function to admit air to the cylinders when the engine is drifting with the regulator closed. That might or might not be an advantage because air directly enters the cylinders and cools them somewhat, however, on the positive side, free coasting is enhanced due to the release of cylinder compression.

The smaller version (fig 2) used on my ten-wheeler was described in the National 2 1/2 in. Gauge Association *Newsletter* in 1980. Note that they are 'backward' from Bill's, with a thin ball seat permanently fixed to the outside edge of the body and the rather bulky hexagonal plug screwed-in from the back. That modification makes them less conspicuous on small engines, although somewhat more difficult to construct. For 3/4 in. scale and larger locomotives, the Van Brocklin design, in addition to being more straightforward to manufacture, would be preferable because they are easier to maintain if the balls need to be replaced.

My 2 1/2 in. gauge locomotive is built to typical LBSC dimensions of 1 3/16 in. bore and 1.125 in. stroke with 3/8 in. dia. stainless steel ringless piston valves lapped in drawn bronze liners. Despite my flagrant disregard for Bill's well founded advice, as well as my own reservations about using them with piston valves, the automatic cocks have never failed to drain condensate properly, without a hint of hydraulic lock, nor have they ever opened improperly in 25 years of passenger hauling service. That is not an endorsement for applying them to all piston valve engines, especially large ones, but they have worked flawlessly on my small passenger hauling locomotive.

Fabrication of the two styles of drains is similar. However, assembly of the smaller type is slightly more complicated, so it is the one that will be described. The best approach is to make certain parts one at a time, initially using a full length of stock to facilitate handling. The partially machined part is then cut off the parent length for final machining. The procedure I used is as follows...



© Fig. 1 Bill van Brocklin design for 3.5" gauge



Chuck a length of  $\frac{1}{4}$ in. dia. bronze rod and face the end for the drain cock body.

Remove the rod from the chuck. Drill a  $\frac{1}{8}$ in. dia. hole  $\frac{1}{8}$ in. deep in the side of the rod using a fixture to accurately position the hole. Temporarily leave the rod full length; do not cut off body at this time.

Chuck a length of  $\frac{3}{16}$ in. dia. bronze rod and turn down end for  $\frac{5}{32}$ in. x 40 thread  $\frac{1}{8}$ in. long. Drill a  $\frac{1}{16}$ in. dia. hole  $\frac{3}{8}$ in. deep. Cut off about  $\frac{5}{16}$ in. from end. Hold unthreaded section tightly in a collet chuck and turn  $\frac{1}{8}$ in. dia. spigot, using fine feed, for push fit into body. If a collet chuck is unavailable, make a stub chuck tapped  $\frac{5}{32}$ in. x 40 to hold the short piece for this operation.

Push the spigot of the bush (step 3) into drilled body (step 2) and silver solder.

Once again chuck the length of  $\frac{1}{4}$ in. rod with partially completed body on its end. Drill 0.094in. dia. about  $\frac{1}{2}$ in. deep. Tap six threads in hole with  $\frac{1}{8}$ in. x 40 tap.

Cut off bush assembly  $\frac{1}{2}$ in. (full) from faced end of rod. Reverse in chuck and turn length to 0.343 inch.

Drill body 0.141in. dia. part way then finish hole to 0.234in. depth with a 0.141in. D-bit or a drill with end ground square. Remove from chuck and run  $\frac{1}{8}$ in. x 40 tap through previously-started threads at end of body.

Repeat above for required number of body assemblies. (Ditto Repeat, per LBSC!)

Make a plug from  $\frac{3}{16}$ in. AF hex rod (brass may be used). Thread one end  $\frac{1}{8}$ in. x 40 x 0.109 long, allowing relief at shoulder to permit drawing up plug tightly in body.

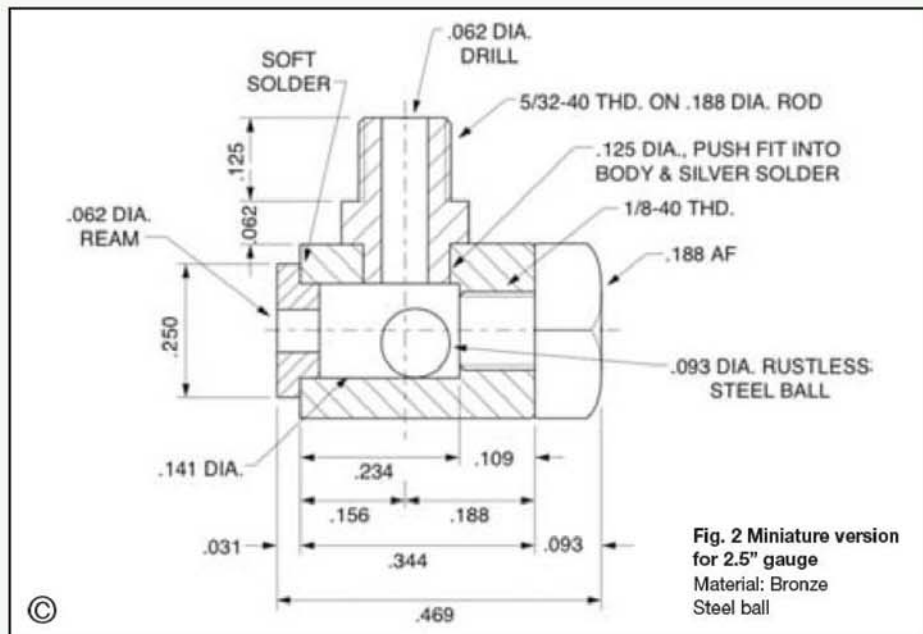


Fig. 2 Miniature version for 2.5" gauge  
Material: Bronze  
Steel ball

Chuck  $\frac{3}{16}$ in. dia. rod. Drill and ream  $\frac{1}{16}$ in. dia. hole about  $\frac{1}{4}$ in. deep. Turn shoulder 0.141 dia. x 0.032in. long. Part off to  $\frac{1}{16}$ in. total length. Biff valve seat with a  $\frac{3}{32}$ in. ball.

Push valve seat (step 10) into body (step 7) and then soft solder. To avoid applying excess solder, first hammer solder to about  $\frac{1}{64}$ in. thickness, then snip off a very small piece (about  $\frac{3}{32}$ in. square) and apply to heated and fluxed body/seat assembly.

Lap seat with a  $\frac{3}{32}$ in. ball, using scouring powder or automotive rubbing compound for abrasive. The lap is made with the ball epoxied to the end of a short length of rod or tube. Twirl the rod between fingers as ball is pressed against the valve seat.

Thoroughly clean body, drop in a new stainless steel ball, then screw-in and tighten the end plug.

Try each drain cock individually in a pre-tapped cylinder hole. If necessary, run a  $\frac{5}{32}$ in. x 40 die over bush to extend threads so that the drain cock screws into cylinder tightly and with desired discharge orientation.

Although the photos show our drain cocks oriented for side-discharge typical of US prototypes; more polite forward-discharge can be easily achieved with appropriate positioning of the outlet hole. In any case, these fittings can be recommended where unobtrusive cylinder drain cocks without mechanical linkage are desired, and where reasonable care in locomotive operation is exercised.

## HIPP CLOCK DEVELOPMENTS

**Frank Taylor**

describes the development work that went into two presents, one for each of his sons.

●Part I

My wife and I have two sons and both are good, innovative engineers in their respective fields. Their much needed skills have made good contributions to society and this gives us much pleasure. In early 1998 I thought it would be nice to make something for each of them to commemorate the Millennium. Items with an engineering flavour would undoubtedly be appreciated especially if they would last for the rest of their lives. The best idea seemed to be a couple of long case clocks.

I was confident about most things, including building nice hardwood cases, but found the prospect of producing a reliable escapement very daunting. With no previous experience this would be inviting trouble and trouble is not what I wanted to give them. It looked like the idea was 'dead in the water'.

I remember the joy when my copy of *Model Engineer* for 11-24 September 1998 (M.E. 4076) arrived. Within it was an article by John Wilding describing the construction of a Hipp clock. This clock was unusual in that the pendulum was powered by electromagnets and the pendulum drove the clock by ratchet and pawl. There was no escapement! My early working days were spent in the old Strowger electromechanical telephone exchanges. Here, almost all of the equipment was electromagnets, ratchets and pawls and straight away I felt 'at home'. It was John's articles that opened the door for me and made it all possible with the help of our favourite magazine. However, delivery was rather late for reasons discussed later. Work started in late 1998.

It is not my intention to add to John's adequate instructions but to concentrate on my add-on bits and pieces, which made the clocks appealing presents. During the construction I came across the problem of the trigger blade catching the tip of the notched blade and causing malfunction. It appears that this problem is endemic with this type of clock. An investigation and a discussion

giving the nature and solution to this problem is offered. It is hoped that this could be useful for people who have made these clocks. It is proposed to look at the differences and extra features of my clocks first and put the investigation and solution part at the end.

**Photograph 1** is a general view of one clock just standing on a stool. The clock is powered by mains electricity and the voltage regulated power unit is housed in the left hand part of the extension at the bottom of the clock. On the right hand side is a small drawer containing everything (I hope) the new owner will ever need. The top of the clock is made to open to provide access for oiling and to allow certain repairs to be done without removal of the mechanism from the case. Also housed within the top is the lighting, which illuminates the dial and the mechanism, with a soft, yellowish light that seems to enhance the look of the brass. There is no visible wiring, which is hidden in channels cut in the backboard. For the curious the two round stick on labels at the bottom of the glass were to play a part in a little lottery to marry a clock to a son.

**Photograph 2** is a closer look. In the lower part of the photograph it can be seen that the trigger blade is mounted on the contact strip in a special fitting which enabled the blade to be placed easily and accurately (detailed later). This was much appreciated during later experiments.

I have a very old clock which belonged to my father. This clock struggles along but its face has





**1**  
A Hipp clock, one of a pair built by the author for his two sons

been spoiled by my finger nail as I push the minute hand round to adjust the time. To avoid this problem with these clocks a turn button is provided on the minute hand shaft. While the eye is on the turn button you will perhaps notice that the gears do not look quite right.

Hanging on a hook in the tool cabinet in my workshop were two home made gear cutters which were made for other work. These were asking to be used. The cutters were 20deg. pressure angle 48DP No.3 and 48DP No.5. These were reasonably close to the cutter that John used and provided separate cutters for pinion and wheel. Small adjustments were made to the outside diameters of the gears to accommodate these cutters. The cutters would not produce a genuine clock gear but I felt that I could get away with it as this clock already had a worm and worm wheel in its train. There would be slightly more friction but the clock would have plenty of torque as it is geared down from the power source as against 'up' for a conventional clock.

While talking of friction in the clock it was lack of it that caused me a small problem which resulted in my fitting a tiny adjustable weight to the pawl which works the count wheel. This is just visible in the picture.

During construction a thought came to mind that somehow I was going to have to deliver the two clocks to separate addresses 80 miles away. I did not want to remove the pendulums or disturb



**2**  
View of the face of one of the clocks and showing, in the lower part of the picture, the specially made trigger blade and contact strip.

the mechanisms in any way. In addition to this my sons would not want to do this when decorating or moving house. The answer to this problem was a pendulum clamp which proved very successful and can be seen in **photo 3**. This photo also shows the little drawer in an open position. This concludes the general changes made to the published design but there is more, which will be in the detail that follows.

### Safety device

When doing things like polishing brass components the brain box is idling and looking for something to think about. I thought about the pendulum suspension spring bending backwards and forwards day and night for years on end. It has a hard life and surely at some time it must give up. The heavy pendulum would drop. The amount of damage would depend on your luck and the position of the pendulum when it happened. I decided that all damage should be prevented and all major adjustments preserved. The outcome from this is shown in **fig 1** and **1A**. I call the device a 'safety fitting'. This was made from a small piece of scrap plate. It consists of three pieces, which were bent to shape and silver soldered together. The joins where the curved top meets the sides were dovetailed. The centre areas of the sides are cut out so that there is access to the top clamp screw, shown by the unlabelled arrow in **fig 1**. The device is fixed by the lower clamp screw to the pendulum hook. The fixing holes in the fitting are slightly elongated to

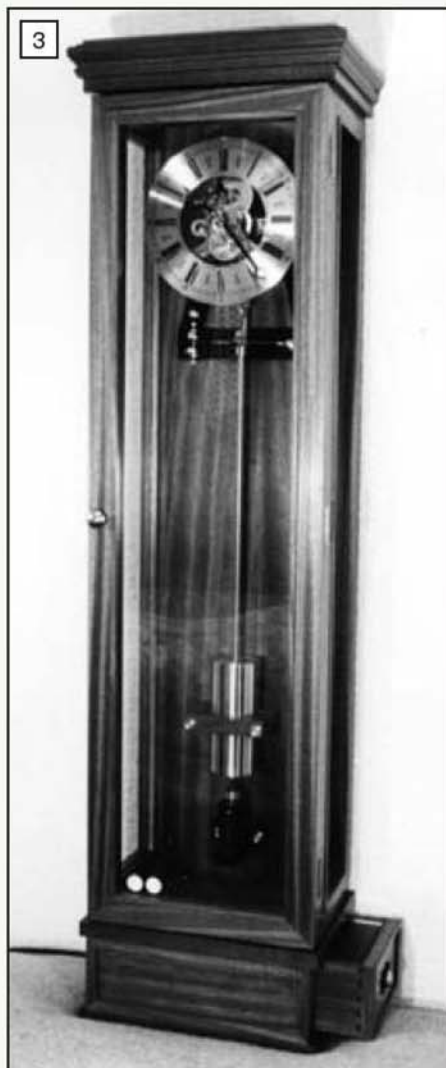
provide adjustment so that the top curved portion is very close but not touching the top of the suspension bracket. When the suspension fails the pendulum is supported by the fitting on the top of the suspension bracket. The device is shown fairly well in **photo 4**. Here the top plate of the clock has been removed and we are looking down into the clock with the fitting in the centre.

**Photograph 5** was taken from a little higher looking straight down through the clock with the lighting switched 'on'. The bulbs look very bright but they are in fact dim with a yellow light. The brightness is due to the time exposure needed to see the rest of the parts. The picture gives another view of the safety fitting from the top where it can be seen how it oscillates over the top of the suspension bracket. The mains wiring for the bulbs comes up in marked and labelled channels within the backboard on the left of the picture whereas the low voltage to the magnets and contacts uses the right hand side keeping them well apart. The wiring also includes the necessary earth for the metal top plate and the brass bulb holders. I am satisfied that the clocks are electrically safe with the enclosures, warnings etc. but using mains for the lighting is not what I would recommend and was not my first preference.

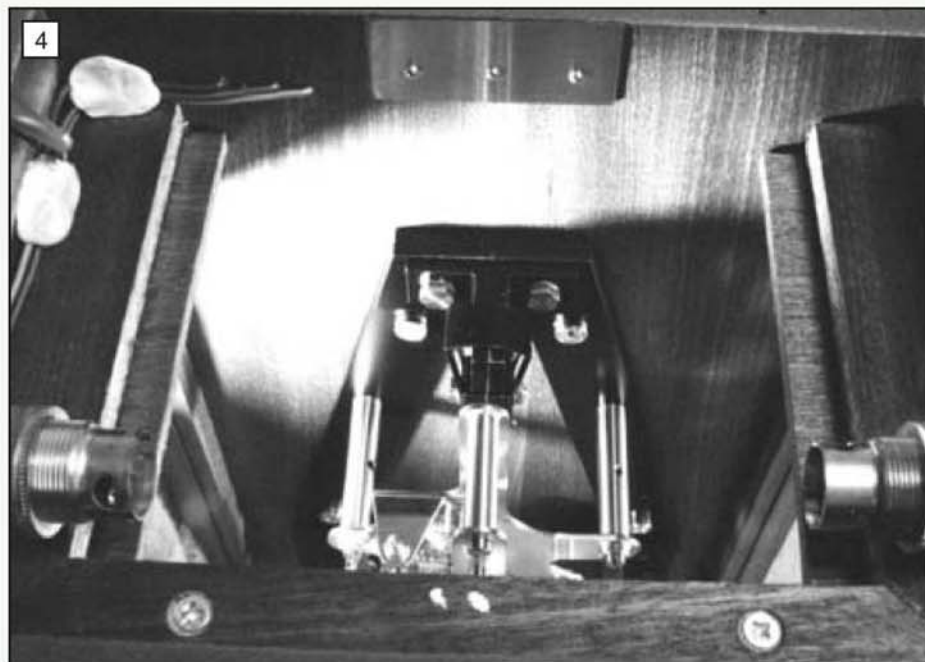
### Lighting

When I first started looking into this I intended to use low voltage lamps run from a transformer but





One of the clocks ready for transport with the pendulum clamp in place.



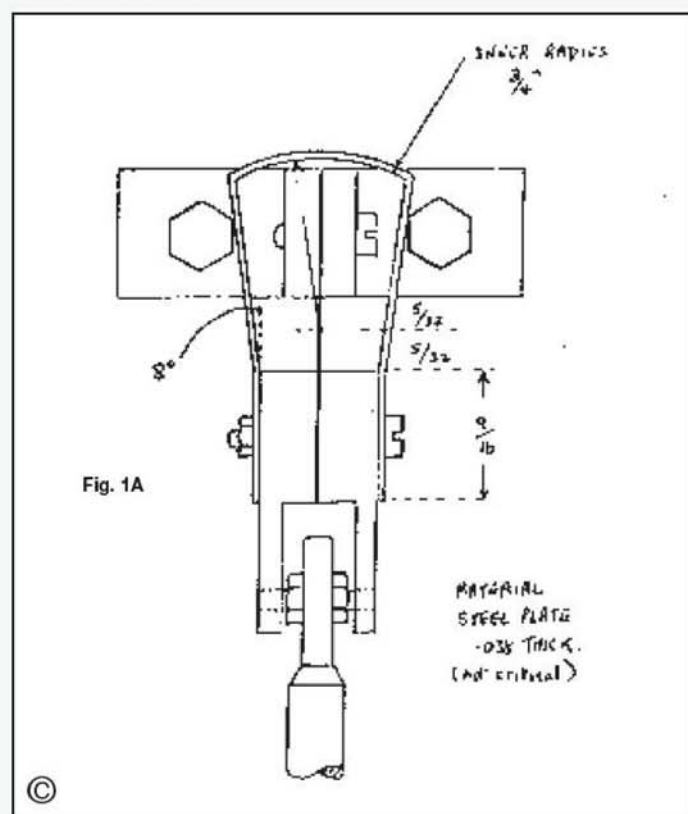
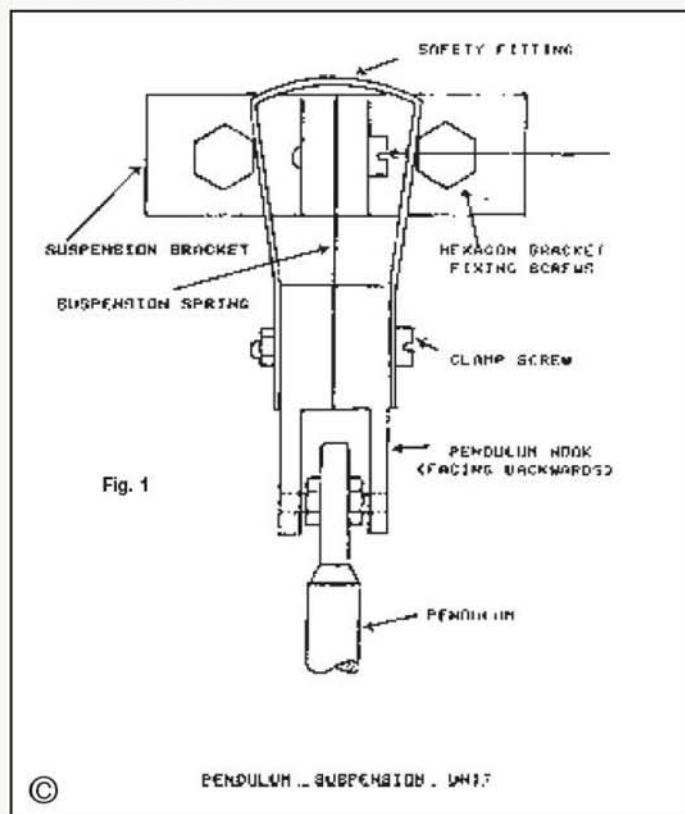
Looking down into the top of the clock mechanism. The pendulum safety device can be seen in the centre of the picture.

when confronted with the life expectancy of around 1000 hours for most catalogued low voltage lamps it was decided to use mains lamps of the Pygmy variety. I was given an additional nudge in this direction because I had a gross (144) of these lamps, which had been lying around waiting to be used. The clocks had to be nearly complete before experiments with the lighting could be carried out. The best light was obtained by placing the two mains lamps in series where they consumed a mere 7 Watts. Run like this they would probably last forever. It was then realised that if I had done this with the low voltage lamps the life expectancy would have been in excess of

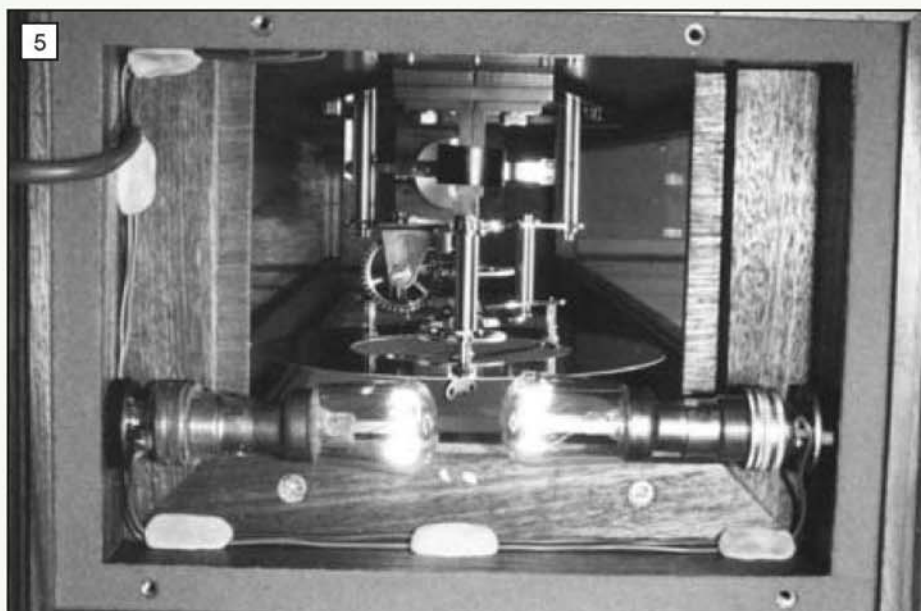
10,000 hours. It was too late to make the change. It is therefore my recommendation that anyone adopting the idea to use a pair of low voltage lamps in series experiments with the voltage to get a nice yellow light. One final point on the lighting. A dissipation of 7 Watts, although very low, will cause a rise in temperature within the case. I made the top plate from  $\frac{1}{4}$ in. thick aluminium alloy checkered plate which took away the heat very nicely.

#### Bottom enclosure and contents

The power unit and the spares drawer are housed in the bottom enclosure and this is shown in







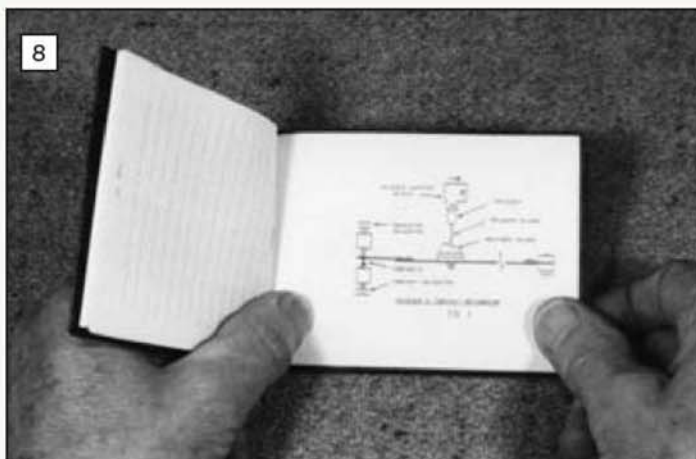
The clocks can be illuminated by soft yellow lights to enhance the appearance of the brass components.



Underside of one of the clock's cabinet. The power unit is to the right whilst the spare drawer fits in the left hand side of the cavity.



The spare drawers contain spares and instructions to help the owners maintain their clocks.



The small instruction booklet presented with each clock and stored in the spare drawer.

**photo 6.** The bottom has been removed and lies to the right of the picture and the view is directly upward from underneath of the clock. The power unit can be seen in the right hand cavity. The unit consists of a transformer and a voltage regulating unit where, within a limited range, the desired Voltage can be selected. The unit keeps this Voltage constant under all conditions. I purchased this as a kit from Maplins after finding it in their catalogue. It was just a case of soldering a few bits in a circuit board. I found that the clocks worked best with a little over 3 Volts so I adjusted the continuously variable control to give 3.5 Volts. In the left hand division the view is of the underside of the spare drawer which is inserted from the left.

### Spare drawer and contents

The drawer is pictured in **photo 7**. A small brass bound book has been produced to fit the drawer and lays on top of the spares. The book contains all the information about the clock, which is best shown by a quote from its contents page:

Contents  
 2: General description  
 3: Fitting the clock  
 3: Starting the pendulum  
 4: Stopping the pendulum  
 4: Setting the time  
 5: Regulating the clock  
 7: The pendulum clamp  
 9/10/11: Circuit and electrics  
 12/13: Clockwork mechanism/ oiling/ removal  
 13/14: Pendulum details  
 15/16/17: Trigger and contact mechanism adjustment  
 18/19/20: Pendulum/ suspension/ spring replacement  
 20/21: Clock case/ glass replacement  
 22: Notes page followed by figs 1 to 4

**Photograph 8** shows the book opened to show one of the figures. The very small print was obtained by using the smallest font on my old computer and two stages of reduction on the photocopier at the local library.

●To be continued.





Doug Willis is seen here instructing Les Henser on John Heslop's LMS 2-6-4 Tank with Lisa De-Vall tentatively taking her first solo trip on Doug Hewson's Y4.

# GILLING DRIVER TRAINING WEEKEND

**Lisa De-Vall**

presents her experiences of this popular event while Doug Hewson provides some photographic highlights.

Gilling East is a quiet and beautiful little village in Yorkshire. When you drive through it, unless you know what you are looking for, you won't find the gem of a 5in. gauge railway there. My husband Derek and I decided, having a big interest in steam railways and model railways, to sign up for a Driver Training course being held at Gilling. We arrived

on the Friday evening so that we could meet Doug Hewson (who was the ring-leader in organising the course) and the other trainee drivers at the Fairfax Arms in Gilling.

It was a long drive from Kent, and we had watched the sky anxiously hoping that it would stop raining for the Saturday when the course was due to start. It was by joining the Ground Level 5 Society that we had found out about the course.

We got to the Fairfax Arms around 8 o'clock, after having dropped all our bits and pieces off at our bed and breakfast in Sproxtton. Doug Hewson gave us a warm welcome and we met the other trainees; Howard from Bedford, Beverly and Leslie, John Clarke, Peter J. Brown, Edward

Deeks from Glasgow and Ingrid and Peter Cole from Herts, and Peter Layfield, one of the instructors. It was interesting to hear about different quirks with the models. Despite being a person with limited knowledge of engineering (very limited) I can relate to some of the terms being used. Derek has obviously been reading and expanding his knowledge. It has to be said that if you are building a kit or building from scratch, a healthy attitude to problem solving is a prerequisite. Derek asks questions and picks other people's brains to get to the bottom of an issue. Whatever you are building it is well worth getting in touch with people of experience. We found that all the instructors and drivers at Gilling to be very open and friendly. After a long evening of food, drink and chatter we retired from the pub to get a good night's sleep and to allow ourselves to get ready for our day of action!

When we arrived at Gilling in the morning it was exactly as I had remembered it from before, when we had visited a main line rally. There is an amazing set-up of signals and track with a fully working signal box complete with lever frame. Kath and Simon Willis were ready with cups of

hot tea (nectar), coffee, and plates of biscuits and we all sat down round the table in the village hall to hear the briefing. We had been sent sets of rules and regulations in an information pack. Doug Hewson explained these to us again. It wasn't a formal briefing, but covered the safety points. He reminded us that we were here to learn but also to have fun. The basic premise was listen to what you are told when you get to drive, pay attention to those who are instructing you and make sure that you perform checks yourself to make sure the locomotive is ready to drive.

We went outside into the cold, and were arranged into two trainees per instructor. Derek and I were with Doug Hewson and a couple of



Doug Willis instructs Beverley Henser, the late Peter Cole and his wife Ingrid on the intricacies of lighting up and oiling round on John Heslop's LMS 2-6-4 Tank.



Derek Waldron now having graduated to Bill Sharp's LNER K1 on the Down Main with Lisa taking a break on the back just going for the ride!





Charles Ledden from the North London Society has his first run with Ballan Baker's Y4 shunting some wagons in the Up Yard.



Enjoying the lunch break with all of the team exchanging views on the morning's proceedings.

people who had come just for the Saturday. Young Jonathan (whose Dad had brought him along) and Lindsey (from down the road) were with us too as there were quite a few subscribers to the day. A number of the Ryedale club members and others had kindly brought their locomotives along for us to use under their watchful eyes! Doug explained the principles of lighting a good fire. He emphasised that you do this after checking that you have a good full tank of water and plenty of coal. I won't explain what was explained to us in detail because I expect the majority of readers are experienced locomotive drivers and I don't want to bore them. I am sure that Doug would be happy to supply people with the details if they are interested.

My initial impression as a complete and utter novice was that there was lots and lots to remember, keeping the water topped up, the boiler in steam, the fire nice and bright, and keeping an eye on the signals as well as other people. I have to say that I was bit confused and a little overwhelmed. Oh, and worried about the driving because I had been warned how dangerous these things can be if you don't operate them correctly—just like the real thing!

Jonathan was first on the locomotive and raring to go. We started on Doug Hewson's Black Y4. Initially the locomotive seemed to be quite juddery and we couldn't work out why. Then Derek asked about the handbrake. Our local model railway society at Maidstone use the brakes supplied on the seat van to stop their locomotives - the idea of having a handbrake on the locomotive was new to both of us. It turned out that the brakes had been applied on Doug's locomotive - though he couldn't work out why! Someone had played with them. Gremlins! I had the chance to drive the locomotive too. It was my first experience of driving and my inclination was to keep the locomotive at quite a low speed. Dave in the signal box later told us that people don't realise how fast they are going, and that people often drive at non-scale speeds equating to 150mph. No shunter ever goes that fast!

Once I had had an opportunity to digest the information about balancing water, fire and steam, things started to become clearer. Doug was happy to let me ride up and down and the fact that he had confidence in me made me feel a lot happier too. Others around us were also in the process of learning and some were obviously more at home than others. We were split into two groups effectively; those on the mainline were using the larger locomotives and

those on the smaller locomotives were in the yard doing shunting and marshalling of trains. The locomotives were of various ages; Doug Willis had a Red Stanier 2-6-4, Colin Carton a Green Y4, Ballan Baker a Black Y4, Peter Layfield a North Eastern Railway T1 class which was originally described in *Model Engineer* by LBSC and called *Netta*, Bill Sharp a LNER K1 (Black 2-6-0) and Barrie Purslow had a completed Winson *Britannia*. All of them were being lovingly cared for by their owners and all were given a good oiling before being run which is essential maintenance for a locomotive.

We spent a happy couple of hours taking turns driving Doug's Y4 and stopped only to have lunch in the village hall. Kath had prepared a hot and cold buffet and we had a wonderfully warming portion of apple bake and custard. After more hot cups of tea and coffee we were back outside. This time Derek and I were assigned to Peter Layfield and his Green 0-8-0. This locomotive was a lot easier to manage; the water tank was larger and once you got it underway it wasn't necessary to top up the water and fire quite so frequently. I drove around the track a couple of times, but found that leaning forward was quite a strain on my neck (which I had hurt earlier that week). Derek was more than happy to take the controls and we went round lots of times with me being his passenger. By this time I grasped the principles of locomotive driving and unfortunately was a bit of a back seat driver! Peter kindly left us to it and we enjoyed the locomotive for quite some time. I began then to appreciate the track layout and the signals as we made full use of Gilling; collecting a marshalled train and driving to signals.

In the late afternoon Derek and I went and joined Dave Myers in the signal box. Gilling has an impressive arrangement in its lever frame, some signals are automated and the track has two level crossings. People were starting to thin out so Doug Hewson decided to go on the mainline with his goods train. We watched him proceed around at the appropriate scale speed. Very slow! Derek had a go at changing the signals and points when people and their locomotives started returning to the goods yard and sidings under Dave's watchful eye.

Although we were aware of the weather and the brooding dark clouds overhead, it did not spoil our enjoyment of the day. This wind of

opportunity doesn't come along too often - to be surrounded by friendly, helpful people who were willing to share their knowledge and entrust us with their locomotives - made for a great day. As with full-size locomotives it is hard to believe that these machines are not alive in some way as they are all quirky and individualistic. Each one was a character; very much like their owners! I would recommend this course to anyone who doesn't mind getting stuck in and getting dirty and loves locomotives.

We rounded the evening off with a meal at the Fairfax Arms. We had had a really good day and what's more the weekend didn't end there, because we went back for more practice on the Sunday before driving home to Kent with big smiles on our faces!

I am looking forward to the day when we can go back to Gilling with a 5in. gauge '9F'. We have now joined the Ryedale Society as well as the Maidstone Model Engineering Club and with the help of the skilled and experienced members of both, Derek hopes to one day be able to drive his own locomotive on the track at Gilling.



Peter Layfield gives Simon Ledden final instructions before he leaves the Up Yard for his first trip on the Main Line with a 20 wagon Mineral Train.





**Tony Griffiths**

Looks at later versions of the Student, Master, and Triumph models.

# LATER COLCHESTER LATHES

## Student 1800 and Master 2500

Constructed in the style of the established and very successful 7.5in. centre height Triumph 2000 and 8.5in. Mascot 1600 models, the 6.5in. (165mm) centre height Student 1800 (together with its close cousin the Master 2500), continued Colchester's traditional use of two names that had long been synonymous with lathes ideal for both training and professional workshops. As with older Students and Masters the two lathes shared the vast majority of their components and had only small but nevertheless significant differences in their specifications - all of which centred on the robustness of the headstock and drive system.

The model number of each lathe referred to its top speed that, in the case of the Student 1800, was reached with a 2.2kw (3hp) motor and a direct drive by twin V-belts into an all-gear, splash-lubricated headstock.

The 9.5in. (230mm) wide bed, induction hardened and ground-finished as standard, was of the usual Colchester 'V and flat' type with separate pairs of ways for the carriage and tailstock. It was available in two lengths that gave either 25 or 40in. (635mm and 1000mm) between centres and both could be had with or without a detachable gap piece that allowed material up to 19in. (480mm) in diameter and 4.5in. (115mm) thick to be swung on the (optional-extra) 12 or 18in. (300 and 460mm) faceplates.

The headstock casting could be adjusted laterally on the bed (although before altering the settings the owner was strongly cautioned to consult the owner's manual) with the gears lubricated by splash with the same oil directed, unfiltered, to the Gamet Super Precision, pre-loaded and self-adjusting taper roller bearings. The 1.625in. (40mm) bore, 4in. D1 Camlock nose spindle was especially rigid and had been designed in conjunction with the British Machine Tool Industry Research Association.

Not all the gears in the headstock were hardened, only those under the greatest strain, but all were ground finished on Reishauer machines. Sixteen spindle speeds were available that spanned 30 to 1800 rpm with selection by a pair of concentrically mounted paddle levers working through an ingenious and compact mechanism, with (for a machine tool) an almost foolproof system of colour coding to indicate the settings. Once the motor had been switched on, by a headstock-mounted push-button starter, electrical control of stop, forward and reverse was by a single lever pivoted from the right-hand apron wall and working through a 'third shaft' parallel and below the feed shaft and leadscrew. The control rod was connected by links to a cross shaft that passed through the bed, just in front of



## Specification

|                              |                   |                                  |                         |
|------------------------------|-------------------|----------------------------------|-------------------------|
| Height of centres            | 8 1/2 in (185mm)  | Width of bedways                 | 9 1/2 in (230mm)        |
| Swing over bed               | 12 1/2 in (325mm) | Total travel of cross slide      | 8 1/2 in (210mm)        |
| Swing over cross slide       | 8 1/2 in (210mm)  | Total travel of top slide        | 3 1/2 in (95mm)         |
| GAP BED MODELS               |                   | Total travel of tailstock barrel | 5 1/2 in (145mm)        |
| Swing in gap                 | 18 in (480mm)     | Number of spindle speeds         | 16                      |
| Width in front of faceplate  | 4 1/2 in (115mm)  | Range of spindle speeds          | 22 - 1800 r.p.m.        |
| Spindle bore (max. bar dia.) | 1 1/2 in (40mm)   | Overall width of machine         | 35 in (890mm)           |
| Spindle nose mounting        | 4 in D. 1 Camlock | Overall height of machine        | 47 in (1195mm)          |
| Taper in spindle nose bush   | No. 3 Morse       | Drive                            | 2 'A' Section Vee Belts |
| Taper in tailstock barrel    | No. 3 Morse       | Motor                            | 3 h.p.                  |
| Threads:                     |                   | Number of Module pitches         | 18                      |
| Number of Whitworth threads  | 45                | Range of Module pitches          | 0.3 - 3.5               |
| Range of Whitworth threads   | 2 - 72 t.p.i.     | Feeds:                           |                         |
| Number of Diametral pitches  | 21                | Range of sliding feeds           | 0.001 in - 0.040 in     |
| Range of Diametral pitches   | 8 - 44            | per rev. of spindle              | (0.03mm - 1.0mm)        |
| Number of Metric pitches     | 39                | Range of surfacing feeds         | 0.0005 in - 0.020 in    |
| Range of Metric pitches      | 0.2mm - 14.0mm    | per rev. of spindle              | (0.015mm - 0.5mm)       |

### Standard Equipment (unless otherwise specified):

Slotted toolblock. Driving plate. Centre bush. Two No. 3 Morse Taper centres. Thread indicator. Electrical equipment for standard 3 phase 50 cycle a.c. supply 110 volt control. End guard limit switch. Set of spanners and keys. Instruction and spare parts manual. Accuracy chart. Apron dial (English or Metric). Emergency Stop button. Lockable motor switch. Foot actuated spindle brake. Electric coolant pump, tank and fittings. Splash guard. Chuck guard. 200mm 3 jaw chuck.

## Colchester Student 1800

the headstock, before coupling with the electrical switchgear at the back. The lathe was also fitted with a headstock-mounted emergency stop button that operated through the obligatory 'no-volt' release (to prevent the motor restarting after a power cut) and a motor-run warning light to alert the hard-of-hearing, or those working in a noisy environment, that things were 'active' and the controls not to be played with casually.

While the Student was a perfectly capable machine, and ideal for instructional use, the Master 2500 was intended for more serious work and the drive system beefed up with a 3.75kw (5 hp) motor driving through 2 V-belts to an instant-acting forward and reverse wet-type multi-plate clutches (made by either Matrix in England or Ortlinghaus in Germany) mounted inside the headstock on the rearmost layshaft. While the





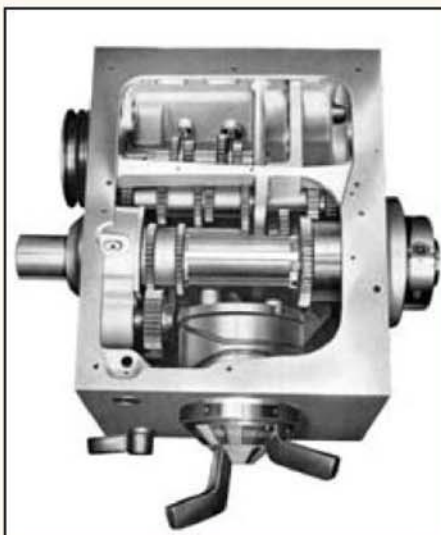
Student 1800 saddle.

spindle speeds were selected in an identical way to those on the Student – with the same type of apron-mounted lever used for electrical control – on the Master 2500 the headstock-mounted clutches allowed the motor to continue running and the change from forward to reverse becoming almost instantaneous. The lubrication system of the Master's headstock was also improved with an impeller-type pump (driven from an extension to the main-motor spindle) mounted on an oil tank fitted inside the headstock-end plinth. From the tank the oil was taken to a 'distributor block', fastened beneath the headstock's top cover, and from there by pipes to the required locations. To check that all was in order a flow-indicator sight-glass was fitted to the front headstock face.

With the Master capable of rotating heavy jobs at high speed a powerful and easily operated spindle brake was essential and the mechanism used on previous models – where a combined stop/start/brake lever of limited leverage was fitted to the front face of the headstock – was judged inadequate. The company's first attempt at a redesign was hardly an improvement, an automatic 'spring-applied' brake that brought the spindle to a halt when the apron-mounted control was returned to neutral. The second attempt was far better and employed powerful automotive-type expanding brake, controlled by a full-length foot pedal (interconnected with the headstock clutches) that was able to bring the heaviest job to a rapid stop.

Like the Student, 16 spindle speeds were available but with a top speed of 2500 rpm – high enough for the makers to warn against the use of other than the dynamically balanced, ductile-iron chucks with hardened scrolls that had been specially commissioned from Burnerd. As a note of caution, should a new chuck be fitted it would be unwise to use anything other than one recommended by a reputable Western manufacturer.

The drive to the oil-bath dual Metric/English screwcutting gearbox (common to Master and Student) was by splined 1.5 MOD 20PA metric gears. The box was totally enclosed, fitted with hardened and ground gears throughout and operated by three conventional levers plus one that moved through an unusual, 8-position vertical gate. A wide range of pitches and feeds was provided for without the need to alter any of the changewheels – the threading range comprising: 39 Metric from 0.2mm to 14.0mm;



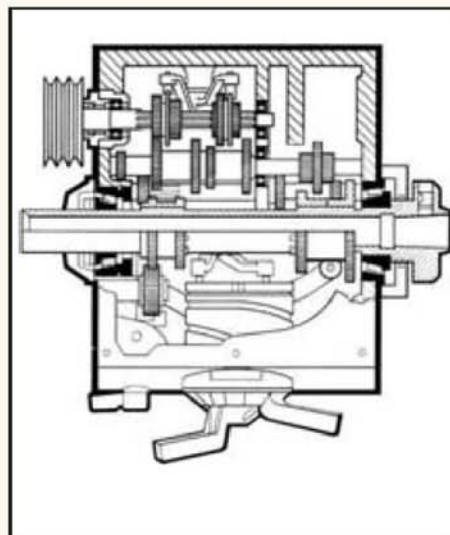
Student 1800 headstock - top removed.

18 Module from 0.3 to 3.5m; 45 English from 2 to 72 t.p.i. and 21 Diametral from 8 to 44 D.P. Sliding power feeds varied from 0.001in. to 0.040in. (0.03mm to 1.0mm) and surfacing feeds (at half the sliding rate) from 0.0005in. to 0.020in. (0.015mm to 0.5mm) – all per revolution of the spindle. Special shear pins, the specification of which was outlined in the manual with strict instructions not to vary the material used, protected both the leadscrew and the powershaft.

The apron was doubled-walled, with all shafts supported on bearings at both ends and the base closed off to form an oil bath. Although not listed as standard, or even on the options' list, some Student 1800s have been found with the apron-mounted, hand-plunger-operated pump (that fed lubricant to the bed, cross-slide and cross-slide feed screw) that was listed as a standard only on the Master.

The power feeds were selected by a push/pull button and positively engaged by a flick-up-and-down lever that allowed the drive to be stopped instantly regardless of how heavy a cut was being taken. A thread-dial indicator, mounted on the right-hand face of the apron, was fitted as standard. The carriage traverse handwheel could be pulled out to disengage it when power feeds were being used – though it is unclear if this provision was standard during the whole of the production run.

The compound slide rest was ground all over and fitted with taper gib strips that allowed a very precise fit to be obtained – while giving far superior support in comparison with the cheaper 'loose-strip' type. The 8.25in. travel cross-slide was especially wide and fitted with a cross-feed nut that could be adjusted to reduce backlash. Although the slide was devoid of T-slots and tapped holes – and hence appeared to be incapable of mounting any accessories – the edges of the slide were machined



Drawing of Student 1800 headstock gearing.

so that neat 'slide-on' T-slotted and plain blocks could be fitted to hold a variety of items including hydraulic profiling units and parting-off and other special tools. While the top slide could be rotated through 360 degrees its standard tool post was, unfortunately, a very simple and barely-adequate slotted block able to hold just one tool.

The set-over tailstock had a No. 3 Morse taper barrel engraved with metric and inch graduations and, happily, a large-diameter zeroing micrometer dial on the handwheel.

The stand was constructed around two cast-iron plinths with a slide-out chip tray between. A minor but irritating point – and one that left the

**COLCHESTER LATHES**



**COLCHESTER**  
**MASTER2500**

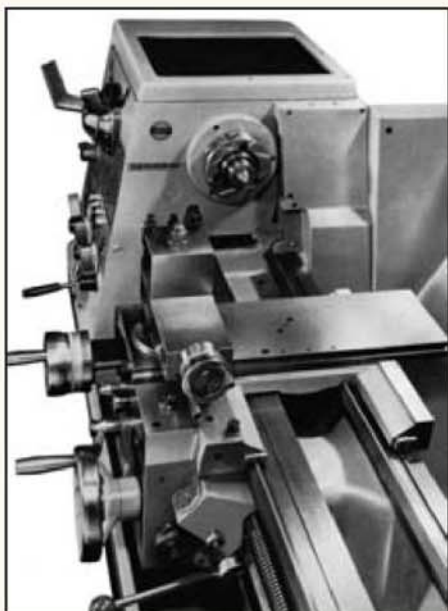
6" x 25 or 40in centre lathe



**600**

Master 2500 catalogue.





Master 2500 saddle.

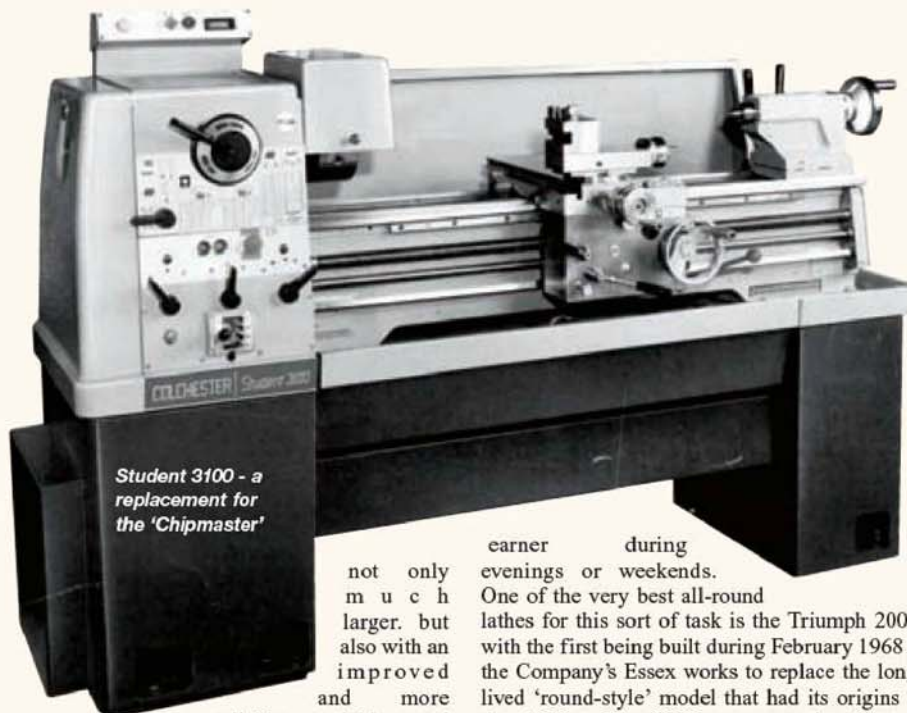


Master 2500 gearbox and diagram.

operator with nowhere convenient to store tools and small jobs in progress - was the lack of any storage in the stand, even though it would have been simple to engineer. The 25in. Capacity Student 1800 weighed approximately 790kg (Master 2500 840 kg) and the long-bed 40in. version around 840kg (Master 2500 890 kg).

### Student 3100

Using the same bed, carriage and screwcutting gearbox as the Student 1800 and Master 2500 the expensive (and hence rare) Student 3100 was intended to fill the niche vacated by the popular, long-serving 3000 rpm variable-speed 'Chipmaster' - a lathe that continued in production until 1983, long after the demise of its 1950s contemporaries. Unfortunately, the appeal of the tough little Chipmaster had always been always restricted by its limited capacity: a centre height of 5.5 inches and 20 inches between centres making it suitable for only smaller tasks in a commercial workshop. Designed to overcome these limitations the Student 3100 was



not only much larger, but also with an improved and more reliable variable-speed drive system that employed three 'geared' speed ranges. The provision of fixed-ratio ranges allowed seamless bands of speeds to be selected between 20 to 120 rpm, 90 to 540 rpm and 500 to 3100 rpm - and also ensured that a good proportion of the motor's power was available at slower revolutions. Claimed by the makers to be 'maintenance-free' the variable-speed section of the drive used a pair of 'expanding-and-contracting' pulleys that were moved further apart, or closer together, by threaded rods turned by limit-switch protected electric motors. Electrical control of the operation was by push buttons with a digital read-out on the headstock. The fixed speed ranges were provided by a simple gear set within the headstock.

Once the motor had been switched on by a headstock-mounted push-button starter, and the speed set by the push-buttons, the starting and stopping of the spindle was by a single lever pivoted from the right-hand apron wall and working through a third shaft parallel to and below the feed shaft and leadscrew.

Although the lathe was capable of rotating heavy jobs at high speed it was not possible, because of the variable-speed drive system, to fit the same sort of powerful spindle brake that was used on conventionally driven Colchesters. An automatic 'fail safe' brake, with a manual release button, was used instead. Also included was the usual kind of 'no-volt' release starter and a motor-run warning light to alert the hard-of-hearing, or those working in a noisy environment, that things were 'active'. The lathe was available in two bed lengths that gave either 25 or 40 in. (635mm and 1000mm) between centres but it could not (wisely, because of its size and very high top speed), be ordered with a gap.

### Colchester Triumph 2000

Although lathes larger than the Colchester Student and Master might be considered too massive for many model-engineering operations there is still a place for them, especially for those undertaking a larger project or have other interests 'on the side' where some extra machining capacity might prove a useful little

earner during evenings or weekends. One of the very best all-round lathes for this sort of task is the Triumph 2000, with the first being built during February 1968 at the Company's Essex works to replace the long-lived 'round-style' model that had its origins in the 1930s. The 2000 was not the first of Colchester's new-style lathes - that was the very much bigger and heavier Mascot 1600, manufactured from November 1965 - but it shared with that model a revolution in styling and specification that, with distinctive lines, ergonomically designed controls and bright finishes made competitors suddenly look distinctly dowdy and old-fashioned. However, the Triumph 2000 was much more than a mere styling exercise for this was a tough, well-made machine with a combination of capacity, high spindle speeds and ease of use that made it ideal both as a both general-purpose lathe for industry and, because of its modest price, affordable by smaller machine shops who needed a good all-round workhorse.

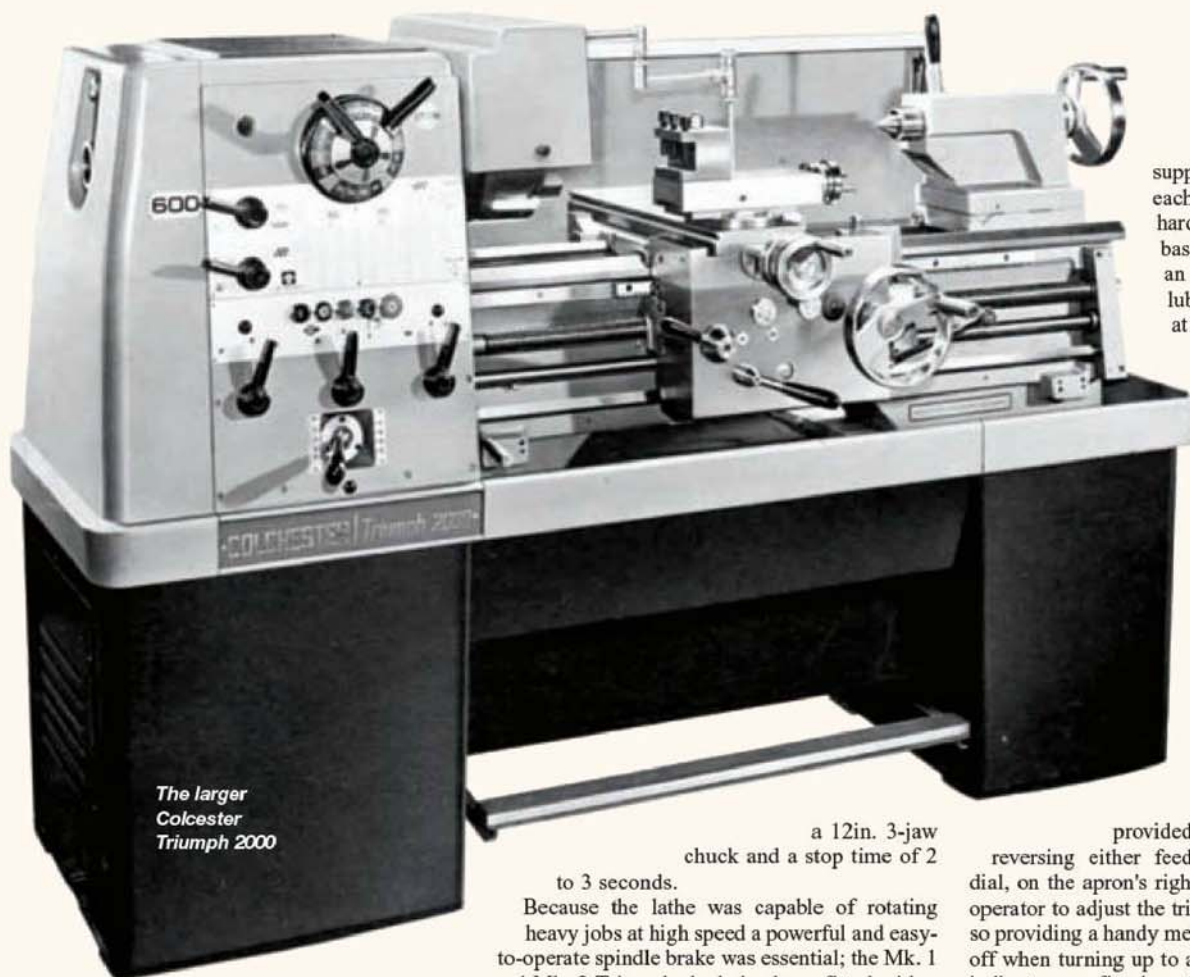
Despite the model's novel appearance it lacked mechanical novelty (no bad thing in many peoples' opinion) and was a strong reminder that even prosaic machine tools are subject to the vagaries and whims of fashion.

Needless to say, with its modern looks and high speeds, so successful did the model become that, for some time after its introduction, demand outstripped supply and used examples were so difficult to find that good ones fetched almost list price.

The bed was 11in. (280mm) wide, induction hardened and ground-finished as standard; it was of the usual Colchester 'V and flat' type, with separate pairs of ways for the carriage and tailstock, and available in two lengths that gave either 30 or 50 inches (760mm and 1270mm) between centres. Both beds could be had either with or without a detachable gap piece that allowed material up to 23in. (580mm) in diameter and 6.125in. (155mm) thick to be swung on the (optional-extra) 14 and 21in. (355mm or 535mm) diameter faceplates.

The lathe was powered by a 5.6kw (7.5 hp) base-mounted motor that drove through 4 V-belts to quick-action forward-and-reverse 'wet' multi-plate clutches of Matrix manufacture mounted inside the headstock on the rearmost layshaft. The headstock casting could be adjusted laterally on the bed although, as with all lathes so fitted, reference to the manual is essential before making any changes. The





The larger  
Colchester  
Triumph 2000

**Lubrication** arrangements for the headstock reflected the harder work that the lathe was expected to perform and employed exactly the same system as the Master 2500 described previously where oil was lifted from a tank within to a 'distributor block' beneath the headstock's top cover and from there by pipes to the various bearings and gears with a flow-indicator sight-glass on the headstock's front face.

The 2.1875in. (55.5mm) bore spindle, with a hardened 6-in D1 Camlock nose, was especially rigid (another collaboration exercise with the British Machine Tool Industry Research Association) and all the gears in the headstock, and not just those responsible for the main drive as on less heavily stressed Colchesters, were hardened and finish ground on Reishauer machines. 16 speeds were available, from 25 to 2000 rpm and again, because of these high revolutions, only dynamically balanced chucks of the right material should be fitted as replacements.

Concentrically mounted paddle levers on the front face of the headstock selected the spindle speeds and worked through an ingenious and compact mechanism, with the (by then) standard Colchester method of colour coded speed ranges. On the Triumph two spindle-speed control levers were fitted, one in the normal place on the right-hand face of the apron and another by the screwcutting gearbox. This easily operated and safe system allowed the operator to control the spindle from either the vicinity of the tool post, or the headstock. The up-to-speed times for the spindle was impressive for the era - the makers quoting a figure of 4 to 5 seconds to reach 2000 rpm with

a 12in. 3-jaw chuck and a stop time of 2 to 3 seconds.

Because the lathe was capable of rotating heavy jobs at high speed a powerful and easy-to-operate spindle brake was essential; the Mk. 1 and Mk. 2 Triumphs had also been fitted with a brake that, like those on the Student and Master, relied on a shared control with the electrical stop/start lever. On the 2000 the problem was fully addressed by mounting a more powerful brake, interconnected with the control for the spindle-clutch, and activated by a full-length foot-operated bar hinged along the front of the stand.

The dual Metric/English screwcutting gearbox was totally enclosed, lubricated from an oil bath and fitted with hardened and ground gears running on ball-race supported shafts. Three conventional levers, and a 6-position joystick that moved, with a rather uncertain action, into locations around a circle, swapped the ratios. The box was able to generate a usefully wide range of pitches without dismantling or changing any of the changewheels; the range of threads comprised: 39 Metric from 0.2mm to 14.0mm; 18 Module from 0.3 to 3.5m; 45 English from 2 to 72 t.p.i. and 21 Diametral from 8 to 44 D.P. The range of sliding feeds varied from 0.001in. to 0.040in. (0.03mm to 1.0mm) and surfacing feeds at half those rates (and thus) from 0.0005in. to 0.020in. (0.015 mm to 0.5mm) - all per revolution of the spindle.

The apron was doubled walled, with its shafts

supported on ball bearing at each end and with all gears hardened and ground; the base was closed off to form an oil bath to splash lubricate the internals and at the top of the front face,

just to the right of cross-feed screw, was a push-rod operated plunger pump that fed lubricant to the bed, cross-slide ways and cross-feed nut. While the power feed selection and engagement mechanisms were the usual well-tried Colchester 'safety-apron' type (as previously described on Student and Master) a second push/pull button

provided a means of instantly reversing either feed while a knurled-edge dial, on the apron's right-hand face, allowed the operator to adjust the trip-disengagement force - so providing a handy means of knocking the feed off when turning up to a shoulder. A thread-dial indicator was fitted as standard.

When power feeds were being used the carriage traverse handwheel could be pulled out to disengage it - though its use on the earliest models is doubtful.

Like the Student 1800 and Master 2500 the compound slide rest was ground all over,

fitted with taper gib strips and could accept, courtesy of its machined sides, 'slide-on' T-slotted and plain blocks to hold various kinds of tooling.

The set-over tailstock had a hardened No. 4 Morse taper barrel engraved with metric and inch graduations, and a large-diameter zeroing micrometer dial on the feed handwheel.

All but the most perverse would have been happy with the combination of feed and leadscrew combinations offered by the maker for the lathe was available with an English-pitch leadscrew with feed-screw micrometer dial graduations in inches or millimetres, or with a Metric leadscrew and millimetre dial graduations.

The 30in. Capacity Triumph 2000 weighed approximately 1170kg and the long-bed 50in. version around 1280kg.

Find out more about Colchester lathes at [www.lathes.co.uk](http://www.lathes.co.uk)



Rigid spindle developed in conjunction with the Machine Tool Industry Research Association.







**Peter Spenlove-Spenlove** describes what bifurcated rivets are and how to fit them without drama, before discussing the use of leather aprons.

**W**hen leather items break with use they often give way at a rivetted joint. Leather is often joined with a rivet having a split shank; in effect two legs under a thin, domed head. Rivets of this type are known as bifurcated rivets and they are often sold in a box of assorted sizes for the home user. Bifurcated rivets made of steel are usually copper or nickel-plated but, despite this, they tend to rust in time and cause the leather in contact with them to weaken. One can buy copper bifurcated rivets but these are weaker than the steel type.

When two pieces of leather have to be joined most of us would use a leather punch to make a close fitting hole for the rivets in each piece of leather. If for some reason it is not possible to punch such holes then it is permissible to hammer the rivet through the leather provided a soft wooden backing is placed behind the work to prevent damage and tearing. However, if your rivets are short this is not an easy procedure. If you are unlucky like me the rivets will simply go flying across the workshop and hide in inaccessible corners! You quickly realise that you need a device to hold the rivet upright while it is struck with the hammer.

The last time I saw such a device was in the 1930s. A little tin I acquired contained a collection of 50 assorted rivets plus the wire rivet holder seen in the photographs. This rivet holder is made of hard, 16swg (1/16in. dia.) steel wire and has proven to be indispensable over the years. I have never seen such a tool in any of the rivet packs bought since World War II and must assume that today's users of these rivets just have to put up with bashing their fingers whilst trying to fit them. Such a gadget may also be useful for holding small screws or panel pins when lining them up to screw, or drive them, into a piece of work.



*Two bifurcated rivets shown with the pre-World War II rivet holder referred to in the text.*

# ON BIFURCATED RIVETS AND LEATHER APRONS

Once through the leather the bifurcated rivets need to have their two legs spread sideways and flush with the work. This can be assisted by resting the head of the rivet on the same soft wooden backing used whilst driving it home. Sometimes it is appropriate to place a close fitting washer over the legs before spreading them. However, the use of a washer can make the legs stand rather proud and lead to the scratching of parts in contact with the leather/ washer assembly so be prepared to glue a thin leather or canvas patch over the area to avoid this.

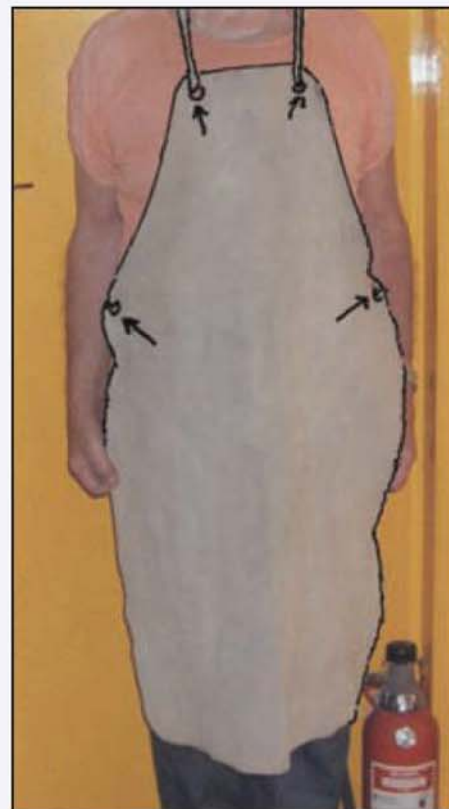
## Leather aprons

I have in the past recommended the use of protective gloves and goggles when carrying out operations where there is risk to the hands or eyes. Always buy reputable protective gear marked with the appropriate standard for the country you live in. Goggles need to be made of a material which cannot shatter.

When you are required to work at a forge for any length of time your tummy can become very hot. Sparks can burn holes in clothing or even a piece of you. Foundry work, and also some soldering and welding operations, can expose you to the risk of burns from sparks or molten metal.

If you do such work regularly look out for a leather apron. These are usually supplied with four brass eyelets as shown in the photograph. Two in the upper chest position allow a tape to go round the neck. Two further eyelets in the hip position carry a tape which ties at the rear of the wearer. In this way there is nothing in front to get caught up in machinery such as a rotary wire brush or mop.

The leather resists hot sparks and molten metal splashes. However, most are not long enough to protect the ankles or feet. A local brass foundry near to me provides its employees with high ankle boots and leather gaiters. Welders who work in tricky environments where there is a risk of sparks falling on their heads are often issued with a protective leather skull cap.



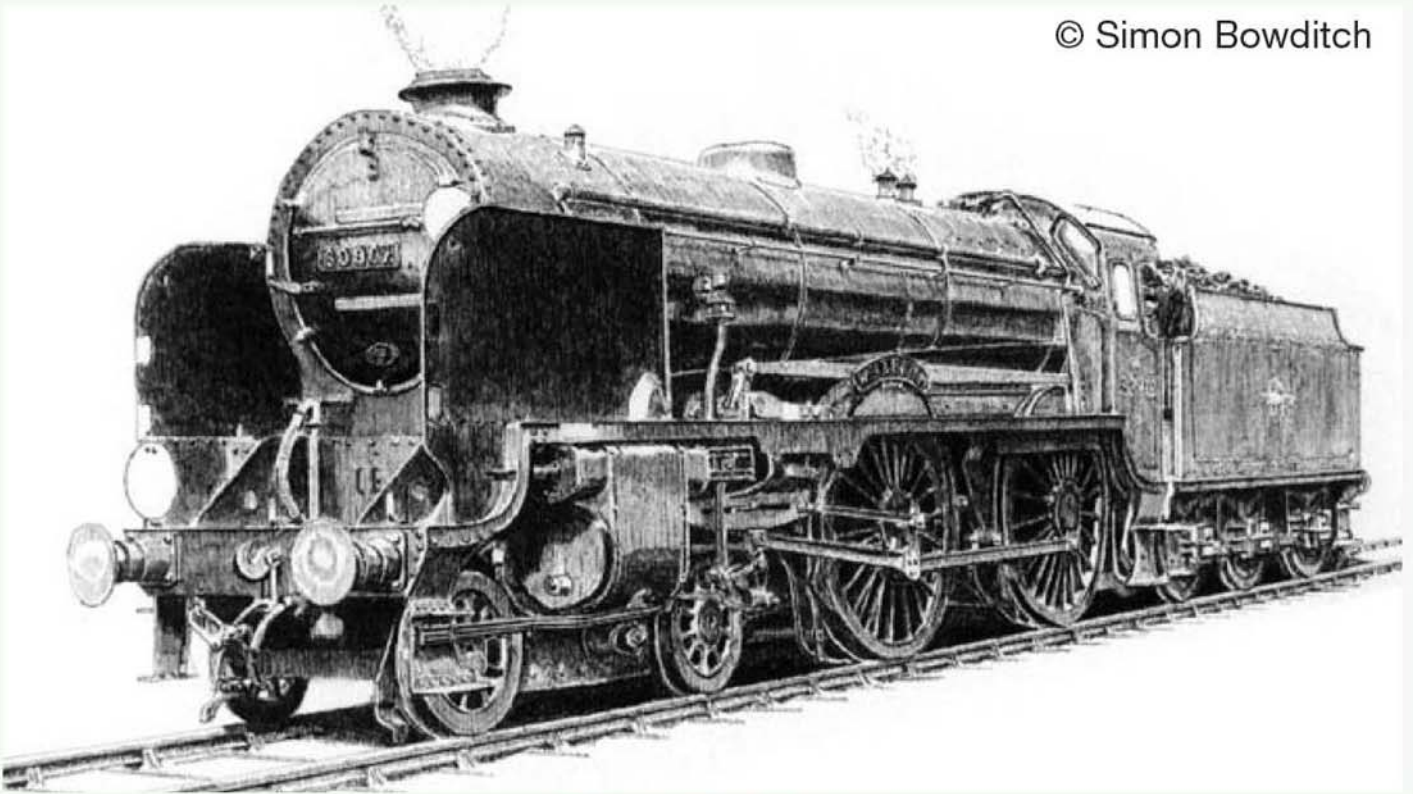
*A well made leather apron is a valuable safety aid when working with hot or molten metal.*

The leather apron is not really suitable for machine tool operations. It will easily absorb lubricating and cutting oils, which could become rancid and smelly over time. Proper machine tool protective gear which can be washed regularly, like well-made overalls, should be used when machining work is being undertaken. 



*The loop of spring wire enables the rivets to be gripped firmly when it is necessary to drive them in with a hammer.*





## STOWE SOUTHERN RAILWAY 'SCHOOLS' CLASS LOCOMOTIVE

**Neville Evans**

now discusses the inside cylinders and associated parts for this attractive locomotive.

●Part VI continued from page 448  
(M.E. 4284, 13 October 2006)

A point must be made concerning the main frame width and material measurements. The important thing is that the outside of the frame is spaced at 4.375 inches. Not too difficult in the days when the

Empire ruled, but nowadays when it has become harder to source steel in imperial sizes, one may have to use metric and make allowance for correct size in the finished job. A prime example is, of course, width over the inside cylinder assembly. Allowance has to be made for four lots of plate and the thickness thereof. If we use  $\frac{1}{8}$ in. thick plate for both frames and the outside cylinder back plates, then there is no problem, we can machine the inside cylinder castings to 1.125in. width and things will work out fine. If we are using 3mm plate however, which should be 0.118in. thick plate

throughout, then to achieve a final width over frames, the casting has to measure 4.139in. in total width. I have just 'miked' up the steel to be assembled into my 'Loch' tender, and some of it is in fact 0.115in. thick. A long way off 3mm and even further from  $\frac{1}{8}$  inch. As it happens it doesn't really matter in a tender, but if it were used for the main frames by mistake instead of  $\frac{1}{8}$ in. plate, it would throw the outside cylinder width quite a way out. The point of this blurb is that it is essential to measure the material used and to make appropriate allowances for same. Sermon over.



The three types of wheel pattern needed for this model.



Computer simulation of the driving wheel pattern.

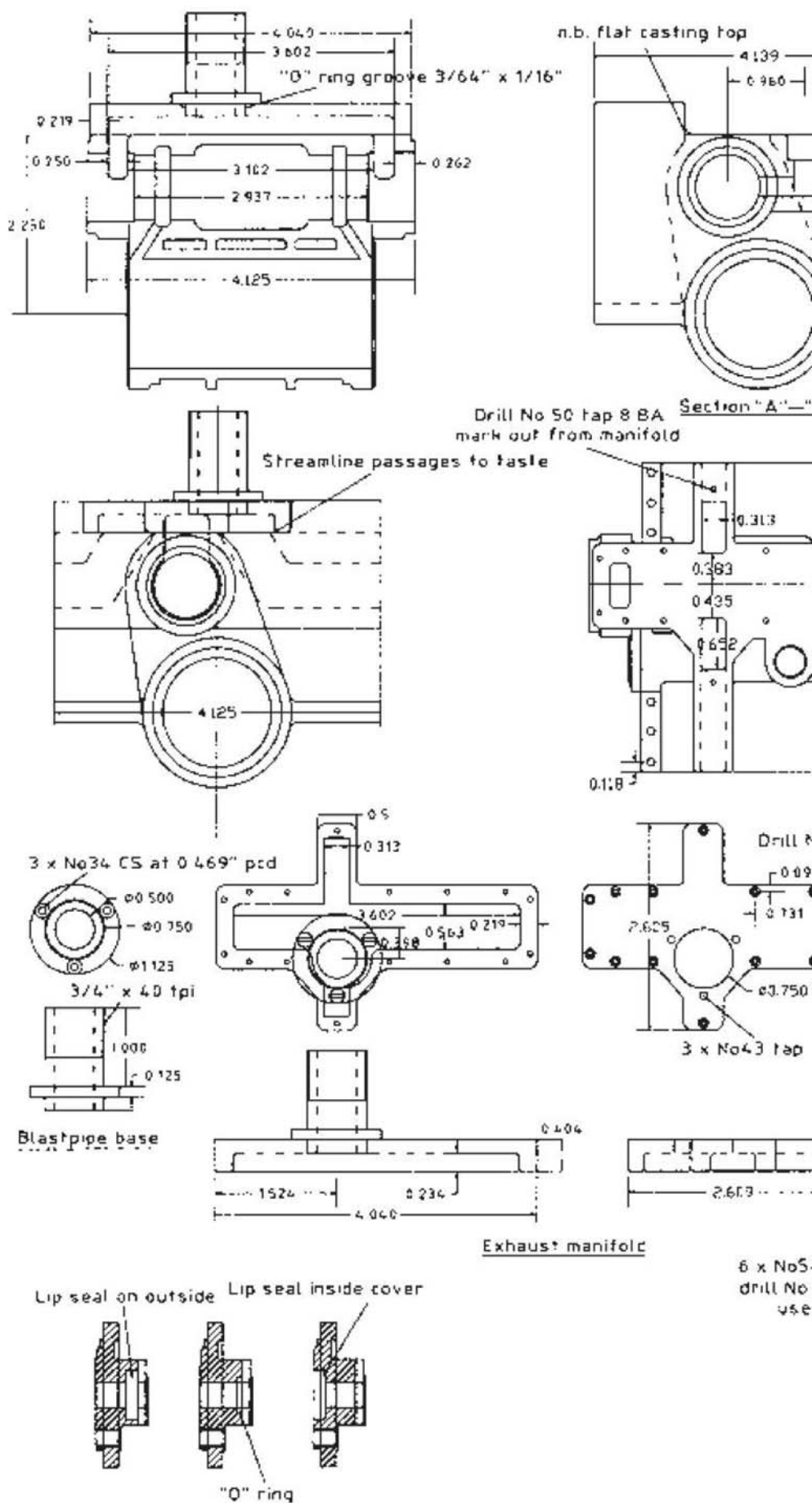


## Cylinder covers

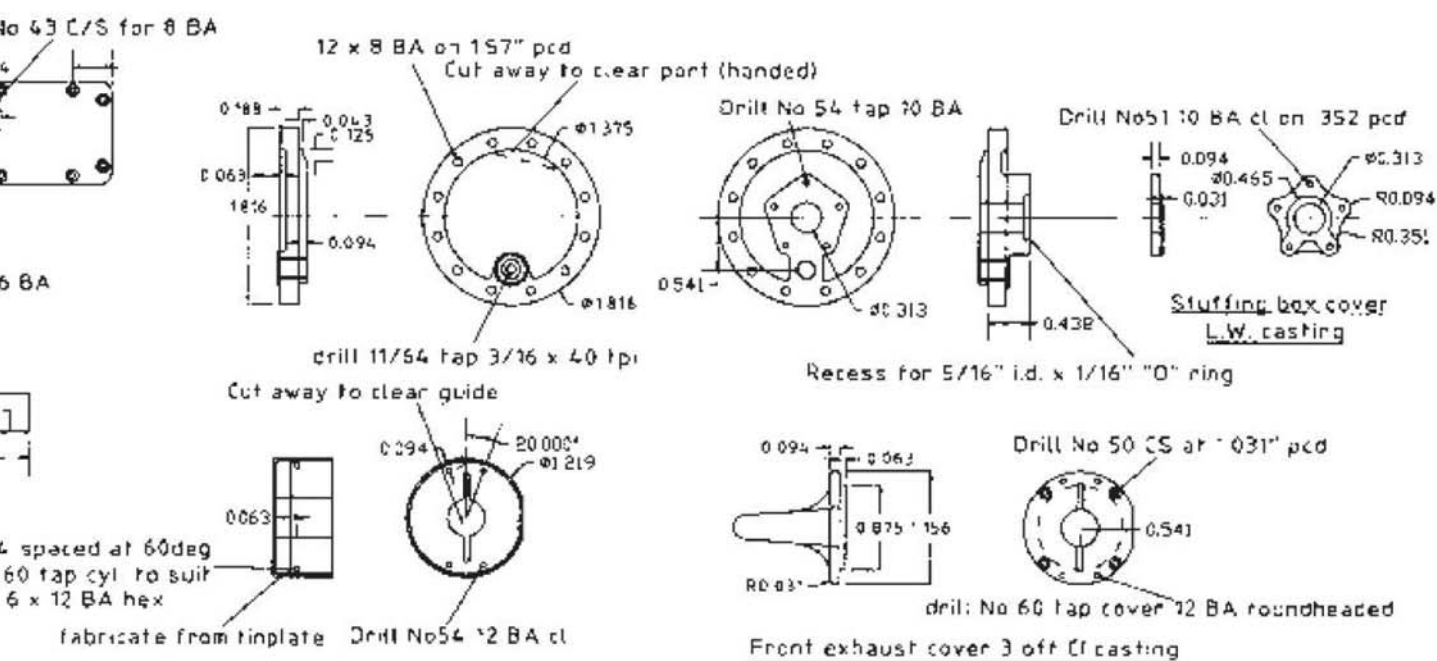
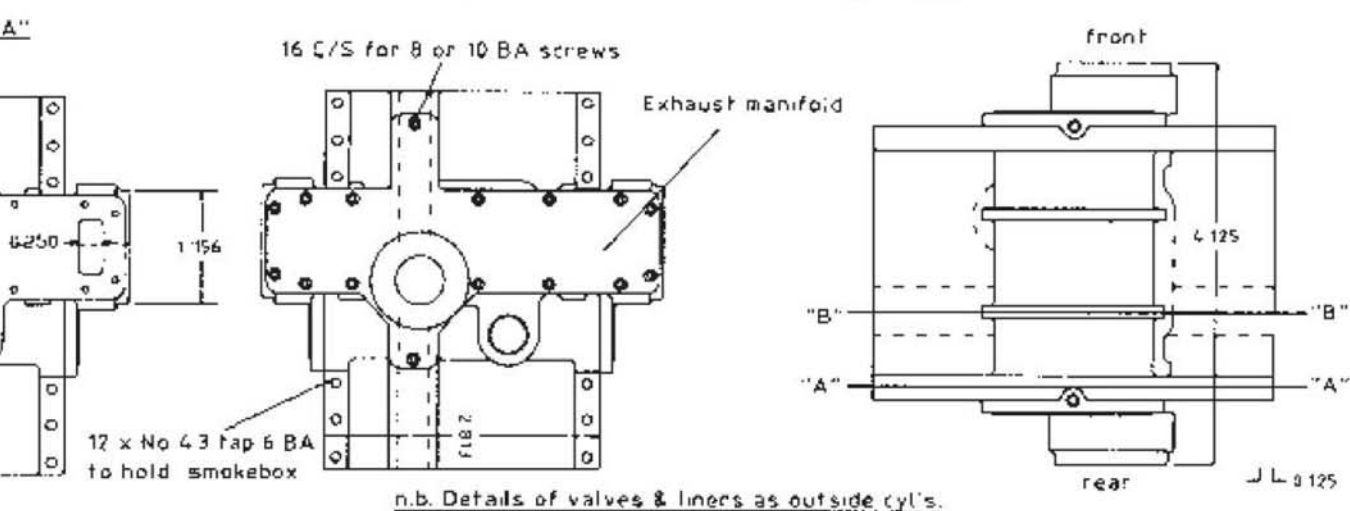
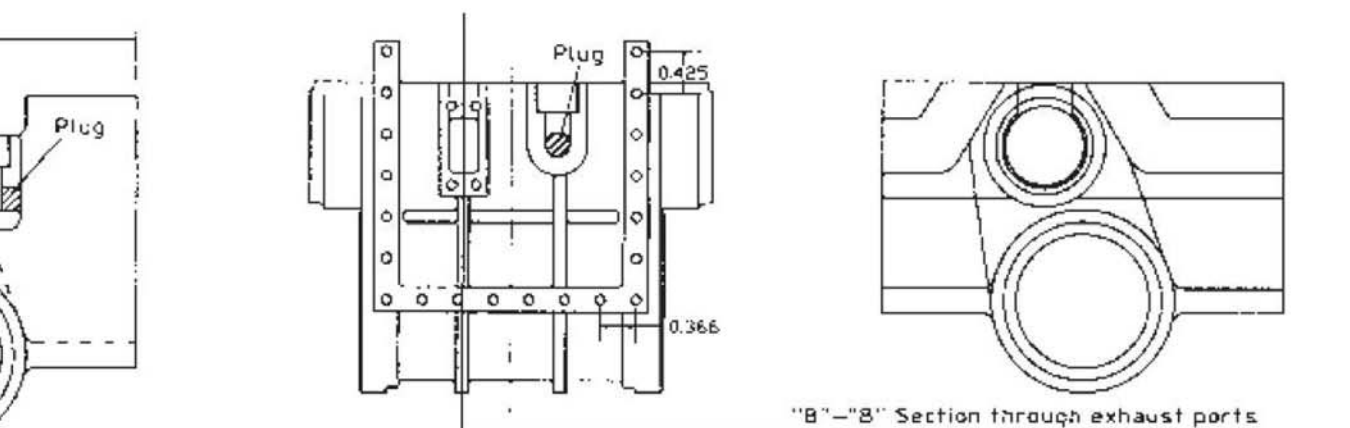
The front covers require no description. The operations that are necessary for both ends include the positioning of the stud holes and fairing in the top of the spigot to allow free passage of steam. Note that both covers are handed by the bolt holes. When turning the spigot I make a practice of making a small groove with a very fine knife edge tool at the appropriate radius and marking out the stud holes from the inside. I say stud holes because studs are the correct practice. However, as our little cylinders won't have the covers taken off and replaced as frequently as in full size, most people find it easier to use hexagon headed or even countersunk screws in this application. You can't see them because they are hidden under the end cover cleading.

What I do is drill the holes in the cover the correct tapping size for 6BA which is No. 43, place the cover on to the cylinder in its correct position, and drill through one of the holes with the No. 43 drill to a depth of  $\frac{5}{16}$ in. or so. I then remove the cover and, using a cordless drill set to the lowest speed and with the most sensitive setting, put in a 6BA taper tap followed by a bottoming tap. I next open up the corresponding hole in the cover to clearance size, that is No. 34, and fit one locating screw to hold the cover in place, the rest of the holes in the block are drilled No. 43 and tapped as before. I remove the cover and open up the holes with a No. 34 bit to clearance size. Using this method I find that I can put 48 holes in two sets of covers in a quarter of an hour or so without breaking taps or having sore fingers.

The back cover carries a gland as well as the hole for the piston rod. Make sure that said hole is drilled and reamed  $\frac{5}{16}$ in. without disturbing the cover in the chuck to ensure that the hole is concentric with the flange. The full size Southern glands contained metallic labyrinth seals, and so were bolted up flush as can be seen from the photographs. This means that a squeezed up gland containing steam packing is inappropriate. We can either use an O-ring, as detailed, in Viton, Silicone or Nitrile rubber. I would choose Viton for this application. We could also employ my favourite method, which is to use a lip seal as detailed in diagram No. 2. These seals are available from your friendly local bearing suppliers and are now stocked by Bruce Engineering. I haven't given an exact measurement for the press fit, as the seals, which have a steel case, may vary slightly in dimensions. Just give them 0.001in. interference fit and squeeze them gently in. Don't fit them the wrong way round as you'll find it rather counter productive. The obvious snag is that to fit lip seals, you have to take off the piston or the cross head. The up side is that they last an awfully long time, they certainly shouldn't need looking at between ring examinations. O-rings, of course, can be renewed by cutting them in half, discarding and reassembling with new ones cut with a razor blade and stuck back together when assembled with superglue. To avoid embarrassment, lightly smear some oil on the piston rod first, otherwise the O-ring might stick to said rod. The third drawing of the cover may be







## 'STOWE' INSIDE CYLINDERS





The centre motion stay.



The bogie hornblock pattern.



The inside connection rod assembly.



The inside and outside rods.

of interest as it details a lipped seal on the inside of the cover. This idea came from the late Eddie Cooke who was a professional builder of O-gauge locomotives. His engines were very close to scale and were marvels of efficiency. I would say that it would be extremely difficult to pick one up nowadays as they are treasured like the masterpieces they are. Eddie's idea was that you placed the O-ring on the inside of the cover as you could then use a scale stuffing box. I have tried it on an Atlantic tank chassis and find that it works wonderfully well. I wouldn't even consider using any other method in a smaller scale.

Both front and rear covers are lagged and housed in a sheet metal fairing, for want of a better word. In the smaller sizes this covering can usually be made from aluminium alloy bar, which can be machined to the required thickness with no problem. In this case however, there is the flat part on the outside to deal with, which means fabrication from tinplate. Note that the pieces are held on by means of small screws, which may be of either hexagon or slotted shape. The screws holding the main cylinder lagging are always hexagonal and will be detailed at the proverbial later date. These screw heads are pretty minute in 5in. gauge, and I will be interested to find out exactly how small they are when I next see a 'Schools'.

### Inside cylinder block

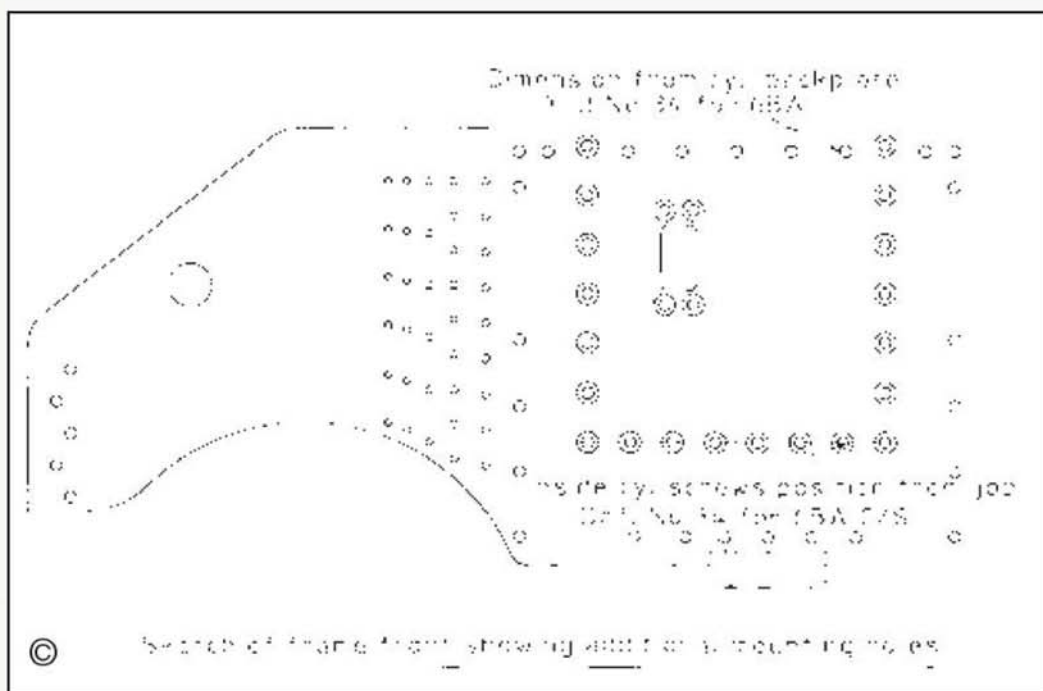
The innards of the inside cylinder are similar to those of the outside, except that the exhaust ports are situated on top of the valve chest instead of at the side. The exhaust system is similar to that of the full size locomotive but, for ease of pattern making and of manufacture, I have made the final collection of exhaust steam by means of a detachable manifold. This

artefact is held onto the flat top of the block by sixteen 8BA countersunk screws and carries the blast pipe, which is held onto the top by means of three 6BA countersunk screws. The manifold top is also flat and is level with the top of the cylinder block mounting flanges. The bottom of the smokebox is held onto these flanges by twelve 6BA screws and the blast pipe and inside cylinder steam pipe go through into the smokebox by means of two large holes in its bottom. They are secured and the smokebox floor sealed by O-rings and appropriately sized nuts. Note that the blast pipe base and the nozzle will have to be screw cut 40 threads per inch. All should be made clear by a brief perusal of the accompanying artwork.

Due to the complicated nature of these

cylinders, they have taken far longer to think out and draw than I anticipated. I shall have to leave such essentials as the cross heads, valve guides, slide bars and outside motion brackets until the next gripping instalment. The valve gear has also taken far longer than anticipated, in fact such luminaries as Charlie Dockstetter in America and, of course, Simon Bowditch have been wrestling with problems such as outside motion with weigh bar in the normal position above the eccentric rod, and inside motion with weigh bar underneath coupled to the outside by a system of cranks and levers. All has now been made plain however and the results of our work will shortly be displayed for your inspection and, I hope, approval.

●To be continued.





# ROAD STEAM

## The late Stan Nipper and Martin Wallis

complete the description of the valve gear for the Savage Universal Carrier.

●Part XXVI continued from page 452 (M.E. 4284, 13 October 2006)

The sliding eccentric is the last part of the valve gear, and indeed the last part of the engine, leaving just the gears and differential before the 'box of tricks' under the chassis is complete.

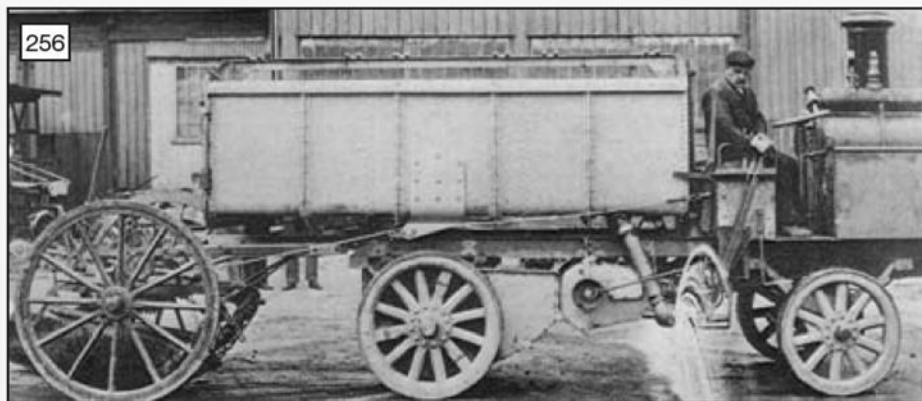
The sliding mechanism that moves the eccentric will probably need a little thought before the way it operates becomes apparent; it certainly took me more than a few minutes with the works drawings before I had figured it all out. However, I believe photos 257 and 258 plus Stan's excellent colour arrangement drawing will do the trick.

### Slippers and eccentric

When complete the eccentric sheave, with its attendant slippers, must be a close sliding fit on the 0.656in. square on the crankshaft. If the eccentric is a loose fit it will move around in service resulting in unnecessary wear and loss of valve travel. If tight it is likely that it will bind and it will be difficult for the pin to do its deed in the diagonal slot.

First of all source a piece of 0.188in. thick gauge plate. Gauge plate is high carbon steel so it can be hardened and tempered. If a suitable piece of gauge plate is not readily available slices of phosphor bronze or even gunmetal may be substituted. Likewise there is no reason why case hardened mild steel should not be used, remembering to case harden the faces of the slot as well as the flat face that bears on the crankshaft.

Cut two rectangles out and polish the sides on a piece of smooth wet and dry paper on a surface plate. Gauge plate will be ground on both sides so certainly ought to be of uniform thickness but if bronze or gunmetal are the choice check for uniform thickness very carefully with a micrometer.



Savage's combined Steam Sanitary wagon. The body or tank could hold either 1,000 gallons of water or 4 tons of refuse, a simple tipping arrangement facilitating unloading. Taken from The Implement and Machinery Review, 2 September 1903 - see the article on page 572.

## SAVAGE'S UNIVERSAL CARRIER

The two slippers are identical and, at this stage, they are not handed until the 0.156in. x 45deg. chamfers are added. The 31deg. angle for the slot has a degree of tolerance but must be the same on both slippers. Either take a sheet of A4 paper and, working across the whole width, cut a 31deg. angle and use the paper as a template, or use an adjustable protractor if one is to hand, to fix a substantial length of bright mild steel to the milling machine table. Set two further smaller pieces of bar to the table adjacent to the steel strip so that the slipper may be just dropped into place without wobble or slack. Thus the slipper is held at 31deg. to the axis of the table and, if both the slippers are identical, one may then be substituted for the other easily enough. The first slot may then be machined and the table travel stops set to the extent of the travel, the second

slipper may then be substituted in the knowledge that the angle and length of slot will be identical.

If the slipper is gauge plate put a slither of brass sheet under it. If the slipper is bronze or gunmetal put a slither of steel under it; that way once full depth of slot has been achieved you will know as the material will change colour.

### Eccentric sheave

Turning the eccentric should be routine. The eccentric strap, since it is in two halves, may be offered up and used as a gauge both for the diameter and the width of the slot. A small centre drilling in the middle of one of the faces is worth adding. It will be needed in establishing the middle of the sheave in the next operation.

Next place the two slippers one on each side of the slotted crankshaft flats and carefully measure across the assembly. This is the reference dimension for the width of the slot in the eccentric sheave. Once the 1.031in. dimension for the hole has been checked a start may be made on making the square hole in the eccentric.

The set up Stan used is shown in photo 261. The eccentric sheave is first mounted axially on a rotary table and using a centre in a collet or a wobblers the quill is set axially above it. If the milling machine table is then moved exactly 0.64in. to one side the centre of the 1.031in. square is established at 0.064in. offset from the



The sliding eccentric valve gear, note the pin in the diagonal slot (photo: Stan Nipper).



The pin, now hidden at the other end of the slot, has moved the eccentric from forward gear to full backwards (photo: Stan Nipper).



The right hand bearing housing with the sliding eccentric operating gear (see end view in photo 269) on the crankshaft (photo: Stan Nipper).



The last operations on the slippers are the 45deg. chamfers. These should be machined on for maximum accuracy, but if you are a dab hand with a file that would of course be fine. It is unwise to harden the slippers until the mechanism has been proven, but when ready the gauge plate is heated to red and quenched, then tempered to straw. Tempering to straw will leave it a fraction harder than tempering to blue.

The eccentric collar is machined and parted off from a piece of bar, the hole needs to be a close fit on the crankshaft. A light push fit is best. This probably means boring rather than reaming, but that depends on the exact diameter of the crankshaft. The collar is then pushed onto the crankshaft until it is against the slippers. It may then be drilled the

tapping size for the 5BA grub screw, allowing the drill to just run through and form a shallow dimple on the crankshaft. It is then removed and threaded. When back together again the grub screw should locate in the dimple and, when tightened up, should not throw one of those annoying burrs that can cause so much inconvenience when disassembling at some later stage.

The machining of the reversing bobbin is illustrated in **photos 263 and 264** and is retained on the end of the eccentric operating rod by a 0.25in. BSF thread or M6 if preferred. Once beyond 2BA (3/16in.) I find the metric threads very satisfactory; BSW (British Standard Whitworth) is a bit too coarse and chunky, conversely BSF (British Standard Fine) is







**260**  
The retaining hole on the slipper being threaded (photo: Stan Nipper).

rather fine. Since the metric threads look the part I tend to use them, and of course  $\frac{5}{16}$ in. and 8mm are dimensionally much the same.

The 4BA thread in the far end of the eccentric operating rod is for a grub screw which may be tightened with an Allen key. The screw is accessed through the 0.094in. hole in the centre of the crank web especially drilled for the purpose.

### Eccentric pin

The eccentric pin is not a very exciting piece to make. It needs to be a close sliding fit in the slipper slots, and likewise the slots in the crankshaft. To get a rolling rather than rubbing action between the pin and slot, and thus minimise the effort needed to push the pin, a sleeve that can be dropped over the pin was considered; but there is very little room to fit a sleeve and a method to prevent it coming out was needed so it was rejected. Stan and I both suspected that the Savage designers probably considered a rolling sleeve arrangement, or perhaps a square block to fit the slot with a hole in it for the pin, but like us, found it difficult to fit into the space available. However, since the full size engine worked perfectly well with just a pin it was not pursued on the model.



**263**  
A rear parting off tool was used to put the groove in the reversing bobbin (photo: Stan Nipper).



**261**  
The square hole being milled in the eccentric (photo: Stan Nipper).

### Reversing fork and lever

The reversing fork and lever are both silver soldered fabrications in steel. The clever CAD worked out that if the centres on the top and bottom arms of the reversing fork are drilled at 1.178in. centres then, once bent, they will be 1.125in. as called for on the drawing.

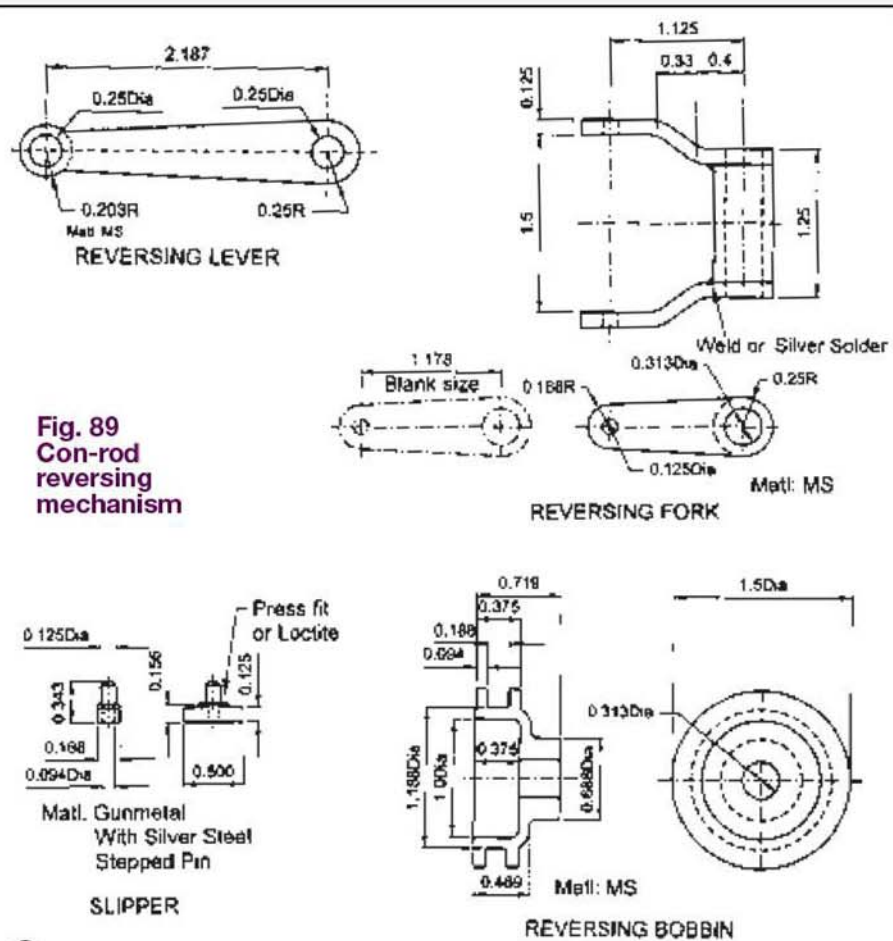
There are very limited clearances for the fork and bobbin in its housing on the full size



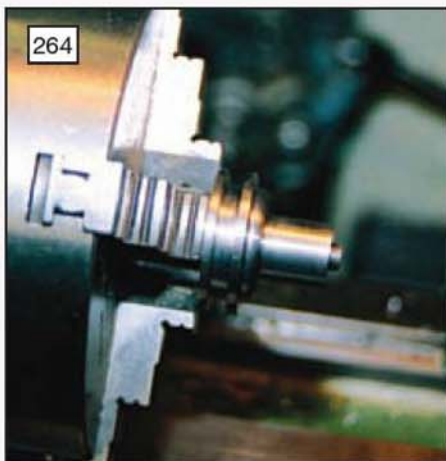
**262**  
The fixing hole being drilled in the eccentric and through into the slipper (photo: Stan Nipper).

drawings, and once scaled the clearances will, of course, be even smaller. It is therefore highly likely that on assembly a little extra clearance will be required in some area or another so the bearing housing may need to be returned to the milling machine or lathe for an extra skim.

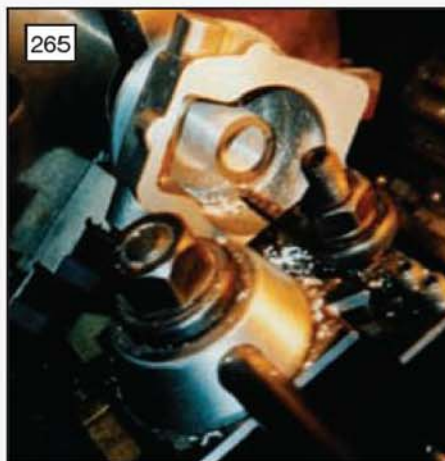
A pair of bronze slippers completes the job. They are the sort of little part that seem easy to make, which they are, but do take much more







**264**  
The bobbin was mounted on a stub mandrel to complete the boss (photo: Stan Nipper).



**265**  
The bearing housing may need re-visiting to gain the required clearances (photo: John Thompson).



**266**  
The reversing lever was drilled prior to reaming (photo: Stan Nipper).



**267**  
A completed and ready to fit reversing lever (photo: Stan Nipper).

time than might have been anticipated. The reversing lever is cut from a piece of 3mm or 0.125in. plate and silver-soldered to a length of 0.25in. bar, see photos 266 and 267. The reversing fork, slippers and the bobbin may then be coaxied into the bearing housing and the reversing lever dropped through. Initially a grub screw may be used to fix the reversing rod to the reversing fork but a taper pin or small roll pin should be added for additional security. Do not use a pin much over 0.062in. in diameter as it will unduly weaken the 0.25in. dia. rod.

After assembly a turn of the reversing lever should move the eccentric sheave across the square on the crankshaft. Check there are no undue tight spots. Investigate as necessary and, if there are not, engage full gear and with any luck a little compressed air will set the engine spinning. Since there is no flywheel do not expect it to turn over smoothly at slow revs, the more so as compressed air does not have the expansive properties of steam.

The gears, differential and two sprockets are the only parts of the engine unit left to make. A start will be made on them next time.

●To be continued.



**268**  
The reversing fork, slippers, and bobbin (photo: Stan Nipper).



**269**  
The assembled reversing mechanism mounted in the crankcase (photo: Stan Nipper).

## 1903 Review of Wagon

If our worthy editors deem there is space a review of our wagon, in the *The Implement and Machinery Review* published on 2 September 1903 has recently been brought to my attention. It is largely based on a speech given at a dinner for 'Borough Engineers' in Kings Lynn, their correspondent being, presumably, one of the invited guests. A number of interesting figures and other assorted pieces of information have come to light; it seems the wagon burnt 'gas coke' rather than coal, which accounts for the absence of smoke in all the photos I have. The cost of the wagon was £575 in 1903, and the engine was rated at 30bhp at 450rpm.

The document recounts what was undoubtedly a marketing exercise by Messrs. Savage Bros Ltd. A common use of our wagon was for 'Steam Sanitary' purposes (road cleaning), such uses being extensively detailed in Mr. F. W. Savage's speech. The Borough Engineers were repeatedly reminded of the great economy to be had by changing their street cleaning arrangements from horse to steam. Quoting from part of his speech:

"Steam is certainly a more up-to-date method of locomotion, and one cannot get away from the fact that it is certainly more safe, reliable, and cleanly method of locomotion than horse power. Horses are largely used in the cleaning of our streets, but they contribute in no small way to their uncleanness. We claim for our wagon that in point of safety and cleanliness it is a great advantage over horse locomotion; it will do the work of four scavengers or four water carts; it will make in one journey that which requires four journeys by horses, thus saving time, and wear and tear of road. Three men (driver and two attendants) will collect as much refuse as four horses, four carts and eight men."

Mr. Savage then gives some financial details. I am neither an economist or a mathematician but to attempt a present day context the site <http://www.parliament.uk/commons/lib/research/rp99/rp99-020.pdf> translates the purchasing power of £1 in 1913 to no less than £65 today. The following figures taken from *The Implement and Machinery Review* in 1903 are reproduced, and present day values are added in brackets (1903 figures multiplied by 65).

### Cost of equipment, Horses:

|                             |                |
|-----------------------------|----------------|
| Five horses each            | £60 (£3,900)   |
| Four water carts each       | £70 (£4,550)   |
| Four scavenging carts each  | £40 (£2,600)   |
| Five sets of harnesses each | £8 (£520)      |
| One machine brush           | £35 (£2,275)   |
| Total                       | £815 (£52,975) |

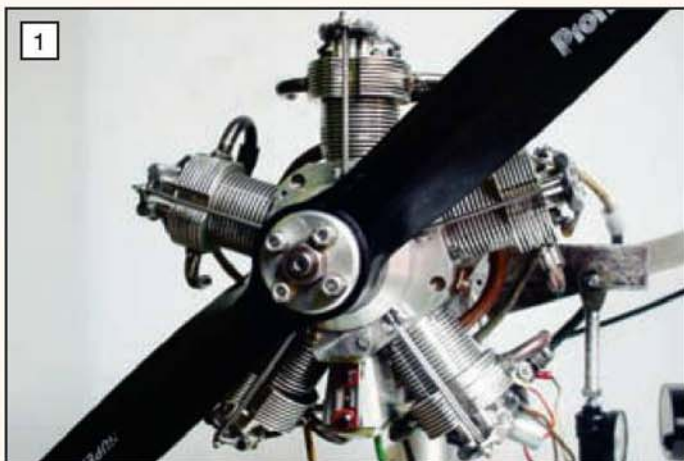
### Cost of equipment, Steam:

|                   |                |
|-------------------|----------------|
| Savage's Wagon    | £575 (£37,375) |
| One machine brush | £35 (£2,275)   |
| Total             | £610 (£39,650) |

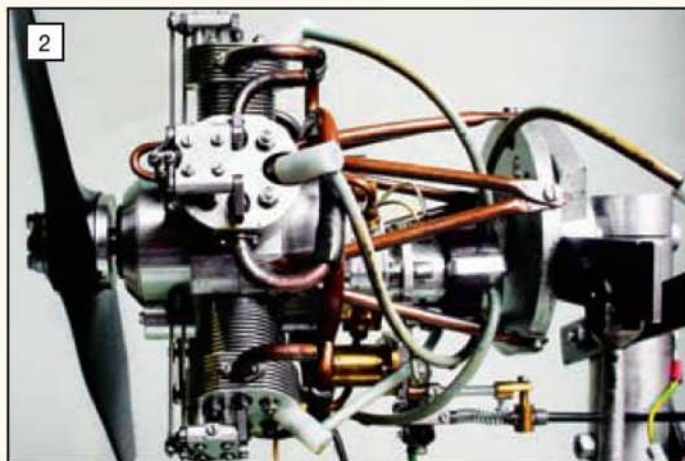
As far as labour charges were concerned horsemen in 1903 were paid £1 a week (£65 a week or £3,380 per annum) and an engine man £1 10s (£97.50 a week or £5,070 per annum) which are both very low figures in present day terms, and presumably indicates the extent to which earnings have risen ahead of prices.

In summary Mr Savage concluded that each sanitary wagon would save £9-12s-11d a week in capital costs, materials and labour - or per annum very nearly its own cost!





Front view of the author's five-cylinder radial aero engine, which has a capacity of 5cc per cylinder.



Side view of the engine revealing some of the complexity behind the working parts of the engine.

# A FREELANCE RADIAL AERO ENGINE

**Dr. Michael Ackerman** gives an account of his latest engine and explains how it all started.

●Part I

Internal combustion engines seem to be becoming ever more popular as the subject of model engineering projects, and some marvellous examples of model engines have been featured recently in *Model Engineer*. Having recently been engaged myself on the development of a miniature radial engine, I have produced this article in the hope that some of the design issues, and the vicissitudes of test and development, may be of interest and encouragement to other readers.

Some two years or so ago I wrote an article (*M.E.* 4214, 6 February 2004) on the testing of a single cylinder engine which had been built to test and refine some design features and construction methods for a 25cc free-lance five-cylinder radial engine. At the time of publication the radial had been built and I was working my way through a number of problems towards achieving the design performance. Since then that goal has been achieved and I have learned a good deal about model engines and of radial engines in general. This article will review some of the design issues and lessons learned.

## Outline design

The inspiration for the engine came from classic air-cooled radial poppet valve engines, such as the Bristol *Pegasus* and *Mercury* engines of the 1930s. Being a relative newcomer to model engineering however, I did not consider it feasible to embark on a true scale model of one of those engines. I decided rather to design an engine that would be relatively simple and straightforward of construction, but in the spirit of the classics. This led me to a design for a five-cylinder poppet valve radial, air-cooled and spark ignition of course, driving a large air screw at modest rpm. Five cylinders seemed the minimum for a real radial whilst avoiding too

much repetition work. In order to avoid having to make any very miniature components I decided arbitrarily on a swept volume of about 25cc; 5cc per cylinder.

Choosing the design speed was the first hurdle. I have never been able to decide whether the engine is just an engine for its own sake, or whether it is actually a power plant for a model aircraft yet to come. A speed of say 2,500rpm would sound right, but would not allow much power to be developed. Model aircraft engines tend to be run at 10,000-20,000rpm to develop power, but such a screaming would be most un-radial-like, so I compromised on a design speed of 6,000rpm. From the tests on the single, I knew I could expect a specific power in the region of 40bhp per litre at that speed, so the design power became 1hp; a nice round number. This in turn allowed me to specify a suitable air screw since from some previous work I knew that an air screw of 18in. diameter and 10in. pitch would absorb about that amount of power at 6,000 rpm. At the time I did not know that the Bristol Aircraft Company had in fact made a five-cylinder radial, an early model called the *Titan*. I later discovered that the main dimensions of bore and stroke of my design made it close to a one-eighth scale *Titan*, but that is about where the resemblance ends. Following the Bristol tradition though, one of these days I intend to brush up on my mythology and find a suitable offspring of a *Titan* to name my engine after.

The issue of engine speed is an interesting one, for the scaling laws show that a model engine built to a scale of 1 : 'x' to a prototype should develop the same inertial stresses as the prototype if it runs 'x' times faster. If the model runs slower than this 'scale speed', and most miniature engines do by a large margin, then the inertial stresses are much reduced. The model engine should then have a large margin of strength without recourse to the stronger alloys of steel and aluminium, which are often used in full size engines. The valve train loadings are similarly affected, and other things being equal, allow the use of lighter-than-scale valve springs in the model, which I presume is how many model engines run happily without valve seat

inserts in alloy heads, which is unheard of in full size practice.

This is not the whole story; for instance stresses due to cylinder pressures are not speed dependent. The inertial stresses are however very significant, and I believe that if the proportions of a miniature engine are designed by eye to resemble those of full size practice, then at the usual running speeds a very robust design automatically emerges. Likewise bearing loadings will tend to be low and the selection of bearing materials less critical. To put some numbers into this assertion, if my engine was an accurate 1:8 scale model of a *Titan*, its scale speed would be 16,000 rpm. At the design speed of 6,000 rpm, since inertial stresses depend on the square of the speed, they would amount to about one seventh of those in the full size engine.

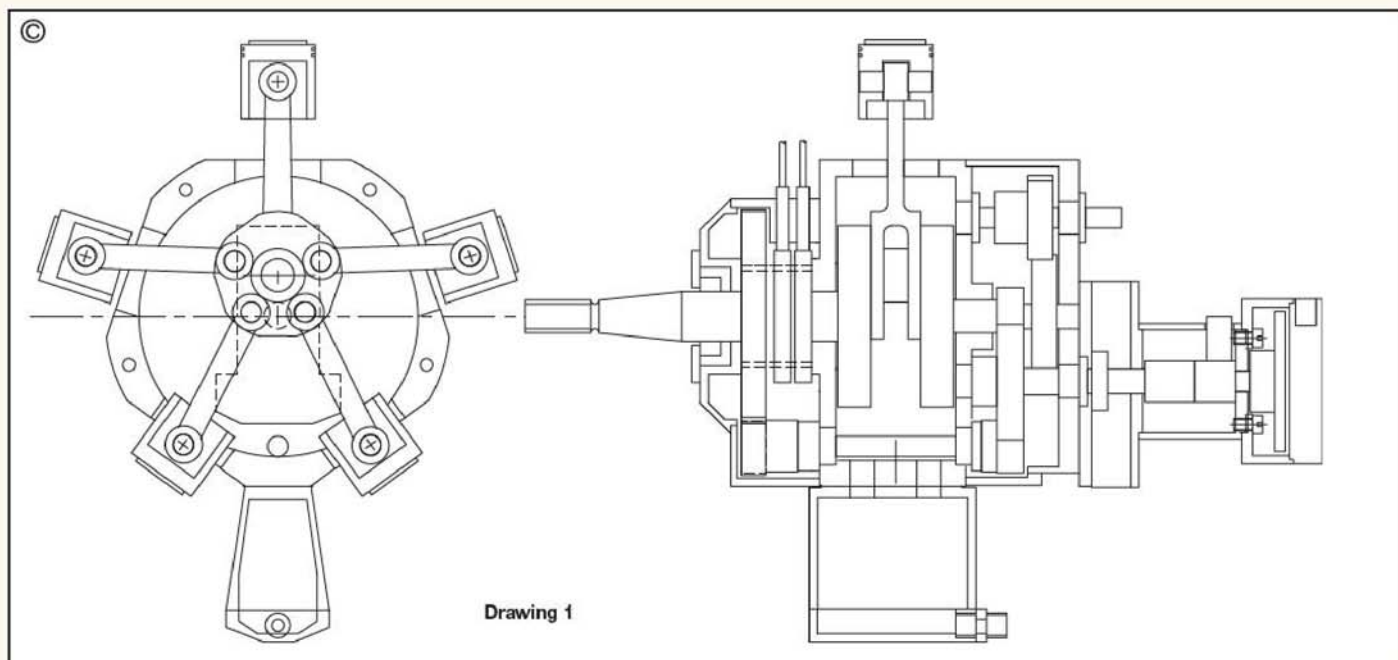
## Description of the radial engine

The engine follows orthodox radial practice by and large. I had a few guiding principles. Notwithstanding the previous comments on stresses in model engines, I was extremely nervous about the possibility of mainshaft failure. Crankshaft failure by torsional fatigue was, I believe, a problem of the radial (and other types), and so I wanted a generously sized, plain and simple mainshaft with few stress-raisers. Although the single cylinder test engine was splash lubricated and ran without trouble, I thought that the radial ought to have an oil pump because it would be developing about five times the power on about the same bearing areas.

A small oil tank fits between the lower two cylinders, containing enough oil for a few minutes running. For extended runs, a larger separate tank can be easily plumbed in leaving the engine tank to act as a sump. For good measure the base of the tank was fitted with a gauze strainer and a chunk of magnet to mop up steel debris. The idea was not to provide high-pressure supply to the bearings, but to merely ensure a positive supply to the critical points; big end, mains and cam sleeve.

I knew that excessive oil supply might cause problems; this is often I believe a difficulty with small engines, and was also a difficulty with





early radials, the Bristol engines amongst them. In the early 1920s the development of a 7-cylinder Bristol radial, presumably the *Neptune*, was held up by the need to limit the oil supply to the big end in order to avoid over-oiling of the cylinders. A new crankshaft and big end assembly was designed by Ricardo, which was capable of running with a less copious supply of oil, allowing the engine to run at higher speed (ref. 1). One of the fascinating aspects of the project has been the sense of travelling parts of the same road as the designers of the full size engines. I have gradually come to know rather more about the full size engines, and have found that many of my difficulties were met with and solved (mostly) in the 1920s.

For instance, once the big end bearing on the aforementioned engine had been improved, it was then found that thermal expansion effects in the valve mechanism limited the performance of the engine. Exactly the same thing happened in my single cylinder development engine, leading to a measurable power drop at sustained full throttle running. In the Bristol engines the problem was overcome by using the push rod tunnels to locate the front of the rocker boxes relative to the timing case. In the case of the model radial engine I chose not to add that complication at first, but it is designed so that it would be a fairly straightforward modification.

The crankshaft is split, with mainshaft, front web and crank pin in one lump. The mainshaft was silver-soldered into the front crank web, but the crank pin was secured by one of the strongest grades of Loctite. This later proved to be an error of judgement, as will be mentioned later. The rear web and timing/auxiliary shaft is attached firmly to the crank pin by a split bore and pinch bolt following Bristol practice. Swinging on the crank pin is the first characteristic radial component, the master con-rod with slave con-rods articulated from it. One of the first serious design issues was the balancing of the crankshaft assembly. The crankshaft balance masses are calculated according to the standard 'half balance' approach, being sized to balance the sum of the rotating masses plus half the sum of the reciprocating masses. This calls for some careful weighing of the con-rod and piston assemblies and some careful machining of the

bob-weights. It is important to get this as near right as reasonably possible, because the residual vibrational forces will then be only a small fourth-order component, and in lay terms the engine should run sweet as a nut.

A pinion on the rear shaft drives a gear on the half-time shaft, which extends to the rear to drive the gear type oil pump, five-lobed contact breaker cam and distributor. The oil pump unit also incorporates an adjustable pressure relief valve. The half-time gear then drives a cross-over shaft at crankshaft speed to take the drive to the cam gear. This sits at the front of the engine running concentric to the crankshaft, driving the two-lobed cam rings revolving counter to the crankshaft at one-fourth engine speed. Traditionally, the cam ring of a radial would be driven by gearing in the front cover from a pinion on the main shaft, but I could not find a tidy layout using readily available and inexpensive gears. At that time, I did not realise that the cam rings could also run at one-sixth engine speed in the same direction as the crankshaft (but with three lobes instead of two) which might have made life easier. A departure from custom is that the cam rings were not hardened, partly for fear of distortion and partly to save time because I was intending to test at least a couple of alternative cam timings. Cylindrical tappets with radiused ends slide radially in the cam casing. These were hardened, and the combination seems to have worked well enough as a temporary arrangement, with no significant wear after about thirty hours running, mostly at high power. The push rods are simple lengths of 1.6 mm diameter silver steel.

A further gear wheel was fitted on the rear shaft to accommodate a starter drive and to allow for the possibility of fitting a magneto at a later date. The main shaft runs in a long plain bearing bush which is an extension of the aluminium alloy front crankcase half, on the outside of which runs the cam ring and gear. **Drawing 1** shows a part-cutaway assembly of the bottom end.

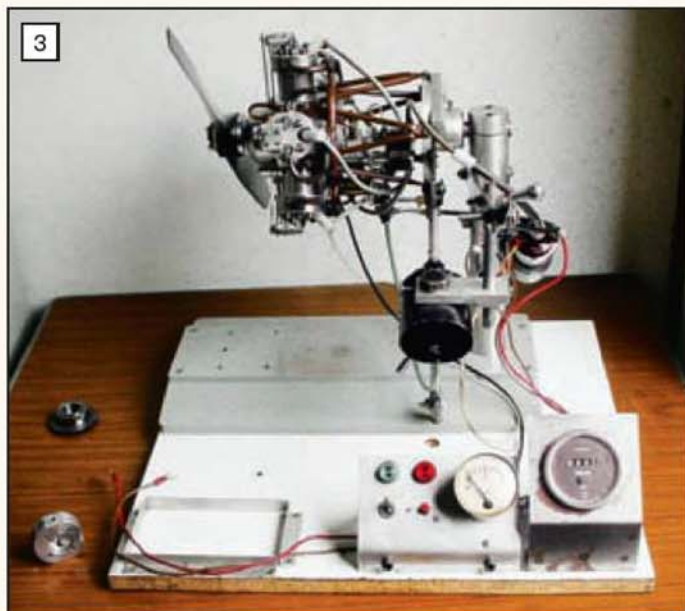
The cylinders consist of cast iron liners lapped to a good finish, which are a light push fit inside light alloy finned sleeves. The liners extend below the sleeves to locate the cylinders in the crankcase. Slots at the bottom of the liners are necessary to clear the con-rods on the slave cylinders, but not

on the master, because the geometry of the articulated slave rods causes them to swing by larger angles about the gudgeon pins.

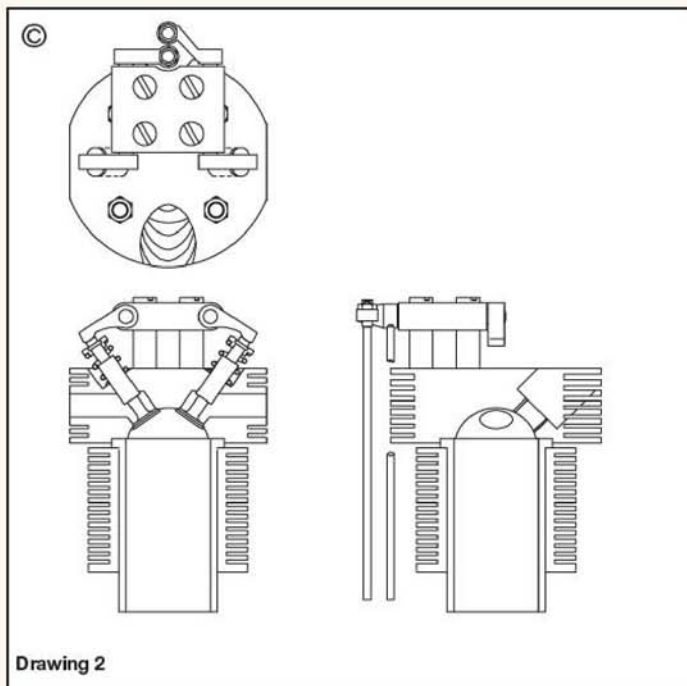
The cylinder heads are made from light alloy, provide a nearly hemispheric combustion chamber, and are held down by long studs extending through the barrel to the crankcase. The use of these long holding-down studs is I think a departure from common aero engine practice, but very much simplifies the design and construction. Because these steel studs are holding down an aluminium alloy assembly however, very significant stresses are set up when the engine warms up. Some simple calculations indicated that these thermal stresses could in fact be in the region of the yield stress for mild steels. The studs were made with a waisted centre section to make sure that the highest stresses would be developed there rather than in the threaded ends and mating components.

The pistons were machined from the solid in light alloy, and have two cast iron compression rings each. Another peculiarity of the radial engine has a bearing on the detail design of the pistons. Because the slave con-rods are articulated from the master rod, the swing of the master rod introduces a small deviation from the notional top dead centre positions of the slave pistons. In order to have as near as possible the same compression ratio in each cylinder, the height of the piston crowns above the gudgeon pins had to be adjusted to suit for the slave cylinders. A spreadsheet was developed to simulate and display the geometry of the crank and con-rod assembly in order to calculate the necessary adjustments. For the geometry of this particular engine, this subtlety is just about worth taking into account, since it would amount to a variation of about 10% in compression ratio between cylinders. The articulation also causes deviations of  $\pm$  two to three degrees from the notional crank angles at which each top dead centre occurs. Magnetos for radial engines often had the contact breaker cams ground asymmetrically to correct for this phenomenon. That refinement was not deliberately incorporated on the model engine, but it was found that manufacturing tolerances on the cam were significant. Trial assemblies were needed to





The engine on its test bench shown with some of the instrumentation needed to measure its performance.



Drawing 2

find the best position of the cam on the shaft, which minimised the timing errors. Even so, it proved very difficult to reduce the cylinder to cylinder variations below about  $\pm 6$  degrees.

Stainless steel valves seat directly in the heads and run in bronze guides, with an included angle of 70deg. between them. The valve springs were sized to provide a closing force of about 15 Newton (1.5kgf or a little more than 3lbf). This figure was based on custom and practice on other similar sized engines, and is well on the safe side above what a back-of-the-envelope calculation suggests would be needed to avoid valve float. The valves are operated by steel rocker arms carried in alloy bearing blocks mounted to the cylinder heads. The valves and rocker gear are not enclosed, in keeping with Bristol practice and because it is nice to watch it all working. There are oil galleries in the bearing blocks which are charged from an oil can before a run, which with a drop of oil on each valve guide seems to keep everything well enough lubricated. At some future date it would be nice to arrange a proper feed from the oil pump. Drawing 2 illustrates some of the details of the engine top ends.

Coil ignition was used, with commercial  $1/4$ in. x 32 tpi spark plugs. The contact breaker points were adapted from a small commercial unit, as had been done successfully on the single. The ignition timing was made manually variable over a range of about 5 - 45deg. before top dead centre. An oil pressure switch was arranged to cut the ignition upon loss of oil pressure, with a manual override for starting.

A number of different carburettors and inlet manifold arrangements were tried which will be detailed later. Photographs 1 and 2 give front and side views of the engine.

The general design challenge was to fit everything in without allowing the overall dimensions of the engine to grow to an ungainly extent, so as to preserve the right overall proportions. This was clearly not helped by the desire to have plenty of accessories at the rear of the engine, and many hours were spent trying alternative arrangements. Here again history was being repeated; it was a relief to find that radial engines always had tended to stick out to a surprising extent behind the crankcase. Toward the

end of the golden age of the piston aero engine, there was a wry saying in the industry to the effect that "one has to weigh up the excessive length of the radial engine against the inconvenient frontal area of the in-line designs". In fact at that time one could say that the two types of engine were converging, in the sense that huge four-bank radials were beginning to look much like the competing multi-crank 'H' and 'double-V' designs; cylinders sticking out all over the place.

### Construction

A good deal of time was spent considering the design from a manufacturing point of view, since the usual issues of family, work and workshop time management applied. No castings were used. This was partly because I have never produced any castings, partly in order to have that characteristic Bristol 'all machined' look to all the finned bits, and partly because I have plenty of HE30 in the scrap bin. Almost all the shafts and pins were of unhardened silver steel (used for its close tolerance to size) running in aluminium alloy or bronze bushes.

### Outline specification

|                    |                                                                                                                                                                                                |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bore and Stroke:   | 18mm x 20mm                                                                                                                                                                                    |
| Valve lift:        | 2mm                                                                                                                                                                                            |
| Valve head dia.:   | 7mm                                                                                                                                                                                            |
| Port Diameter:     | 5mm                                                                                                                                                                                            |
| Carburettor:       | various.                                                                                                                                                                                       |
| Ignition Timing:   | 5 - 45deg. before top dead centre                                                                                                                                                              |
| Firing order:      | 1-3-5-2-4                                                                                                                                                                                      |
| Compression Ratio: | about 8:1.                                                                                                                                                                                     |
| Valve Timing:      | Inlet opens 20deg. before top dead centre.<br>Inlet closes 60deg. after bottom dead centre.<br>Exhaust opens 60deg. before bottom dead centre.<br>Exhaust closes 25deg. after top dead centre. |

Construction started with a set of jigs and fixtures to facilitate rapid setting up for some of the repetition work, such as the production of valve ports and spark plug holes in the cylinder heads. As the work proceeded it became clearer that even for a five-cylinder engine, it is well worth making up jigs and fixtures for almost all the repetition work. All the work was to be done on a very well-used Colchester Bantam (with the aid of a home-made drilling and milling spindle and a cheap bench drill press) which encouraged a straightforward approach.

There were a few false starts. At one point an article in an old journal, describing a special machine with (I think) 52 cutting tools for cutting the fins in *Mercury* cylinders, inspired some similar efforts which ended in an ignominious shower of HSS shrapnel. Out of curiosity I kept a log of workshop time and found that the manufacture and construction occupied about 400 hours in total - not counting the design work. Being a newcomer to engine building I do not know whether this counts as a lot or a little, but it seemed quite a good rate of production at the time.

### Test rig

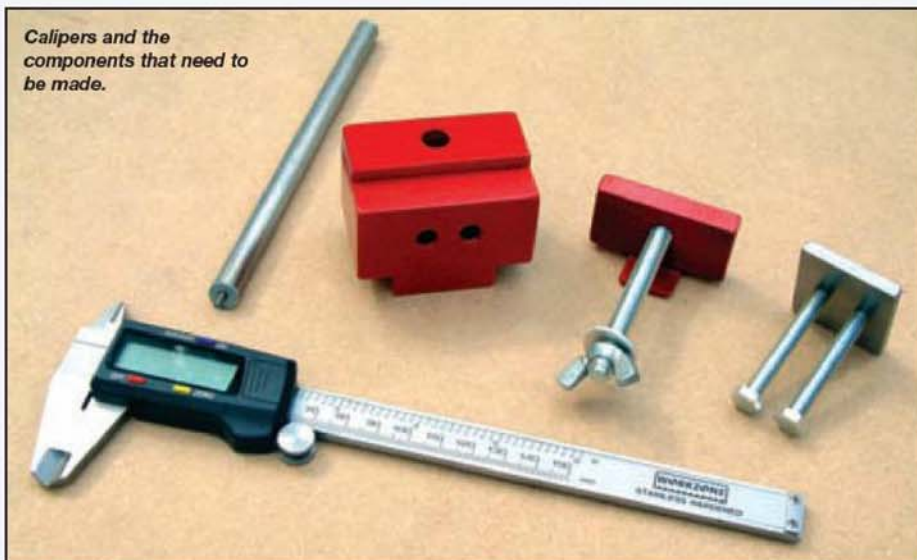
A simple test bench, shown in photo 3 was constructed to mount the engine and accessories, with a small control panel to carry switches and an oil pressure gauge. An 'hours run' indicator was also fitted to give an air of professionalism. The engine was attached by a girder frame to a mounting plate supported on bearings, so that the torque of the engine could be measured by a spring balance and torque arm. Engine speed was measured initially by cautious application of the traditional Smith's hand-held mechanical tachometer, and later by an electronic tachometer sensing the contact breaker points. A substantial weld-mesh cage was provided around the air screw since it is all too easy to absent-mindedly reach through an air screw when it is running, though this item is not shown on the photographs.

### References

- 1: Ricardo, H. R., 'Memories and Machines', Constable & Co. 1968, p 213 et seq. ●To be continued.



Calipers and the components that need to be made.



## A CHEAP DIGITAL READOUT FOR THE MYFORD SUPER 7 CROSS-SLIDE

**S. Filipek**

describes how a pair of cheap digital calipers became a useful digital readout.

After buying a cheap pair of digital verniers (£8.99) from my local Aldi store, I began to wonder if I could use the display and slide, on a Myford Super 7 lathe, as a digital readout on the cross slide. The lathe in question is fairly elderly, from about 1969.

After giving it some thought, I came up with this idea, which does seem to work. Although it does have its limitations, for instance the travel of the carriage assembly on the lathe bed is a bit

restricted with the vernier block in place, and as the verniers are probably not waterproof, so the use of any coolant may be a problem.

The first thing to sort out was a method of moving the display along with the cross slide. This I did by using a 160mm long by 9.5mm ( $\frac{3}{8}$ in.) dia. rod. This rod needs to be a good sliding fit in the T slot of the lathe cross slide.

I drilled one end of the rod 6mm dia. (This was to be a tight press fit, over the body of the vernier slide locking screw). I then removed the screw from the vernier and pressed its body into the hole in the rod. On the other end of the rod I turned a slight chamfer. With a washer on the thread, it was screwed back into the verniers. The washer prevents the screw from going in too deep, and locking the vernier display in position.

The next problem was how to hold the vernier,

while the cross-slide movement moves the display. This was solved quite easily by the use of a machined block and clamping plate. The machined block sits in the slot in the lathe bed and is clamped in position by a T-bolt. The T-bolt that I made used an M8 bolt with 80mm of thread, a washer and an 8mm wing nut to clamp it in position.

Two M6 bolts with 50mm of thread were used through the body of the block into the clamping plate.

Very few of the dimensions are critical. The height from the lathe bed to the underside of the clamped verniers was 30mm, and needed to be right, to ensure that the verniers were level when clamped and with the rod located in the cross-slide T bolt slot.

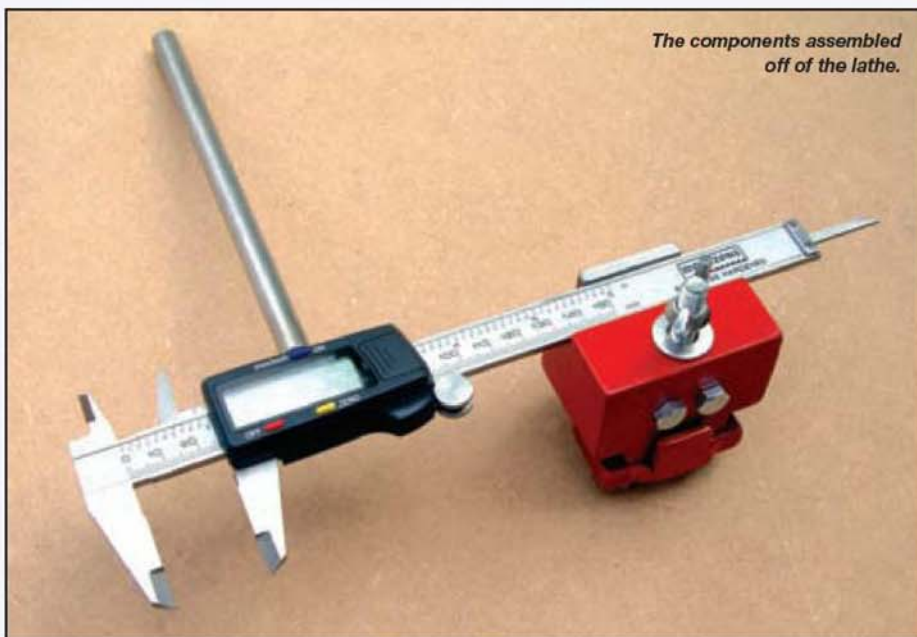
The vernier slide measured 16mm wide. So the top of the block was machined back by 15.5mm, so the clamping plate would clamp the verniers in place. The only other critical size was the machining of the bottom of the block so that it was a good sliding fit into the bed of the lathe. Of course the top machining and the bottom machining of the block need to be parallel to one another.

For my first attempt at making the block, I used a piece of square bar (35 x 35 x 40mm long) that fitted nicely into the slot in the bed of the lathe. I then welded on two side bars (making sure the top of the block sat 30mm above the lathe bed). Then I welded a piece of bar on the top (15.5mm from the edge). When made this way, it does work, and needed no machining, other than the drilling of the bolt holes, but it did not look quite so tidy as the machined block, that I opted for after all.

Using the vernier this way, they measure the movement of the cross-slide, rather than having to read the index dials and allowing for any backlash in the screw thread. Also the vernier can be toggled between imperial and metric, and also zeroed at any point.

The whole thing can quickly be removed from the lathe, and the vernier can still be used for measuring as intended.

The components assembled off of the lathe.





One minus point is the auto off function of the vernier (After about 5 minutes). This can be overcome by making sure that the cross-slide is moved at least once before the vernier switches off automatically.

When mounting the assembly on the lathe, it is best to first position the block and clamp it, then fit the verniers and clamp them. There is no need to over tighten, but obviously they must be secure enough so that they don't slip.

Care must be taken that the power feed of the lathe (as used when screwcutting) is not used when the block is fixed in the lathe bed, or damage may occur if the carriage hits the clamped block. Also when manually turning, be aware of the limits of travel.

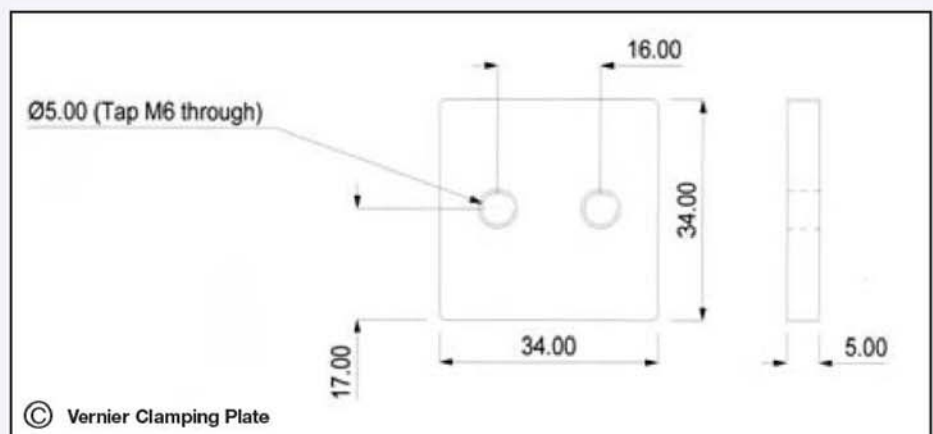
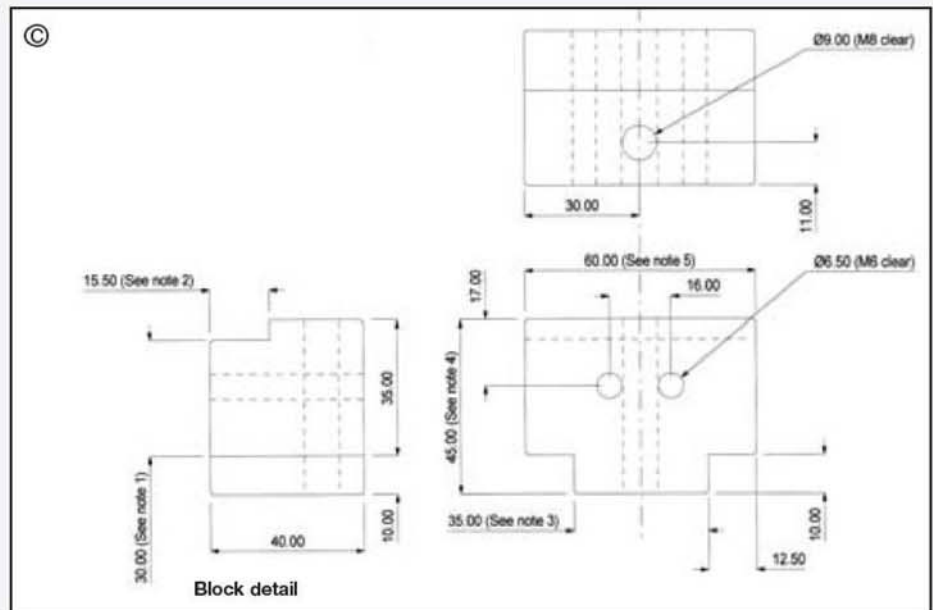
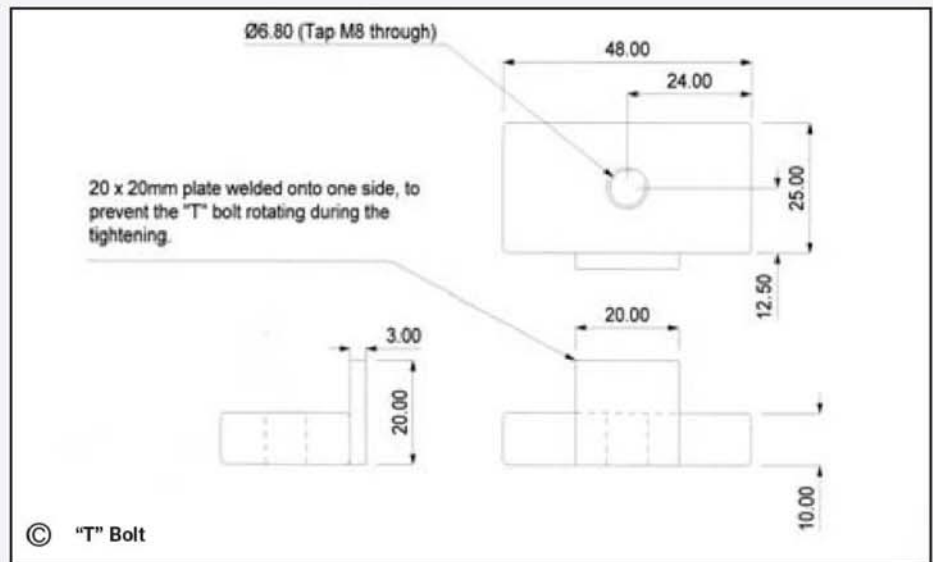


#### NOTES FOR FIGURES

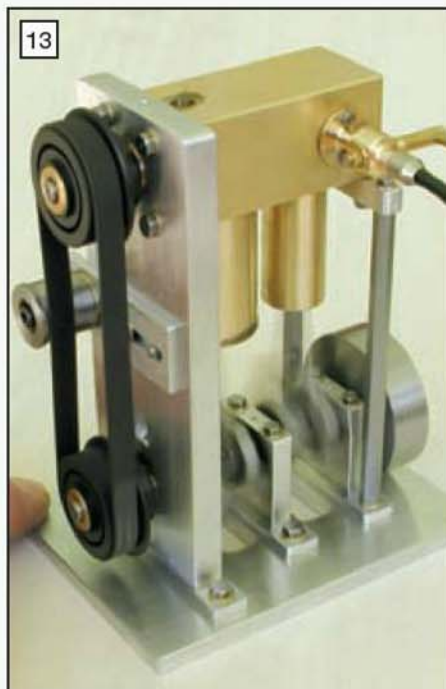
1. The 30mm height is a critical dimension. This is from the lathe bed to the underside of the clamped vernier, and needs to be right, for the vernier to be level.
2. The 15.5mm dimension is 0.5mm smaller than the width of the vernier, to allow for clamping action.
3. The 35mm dimension is a critical size, this fits into the bed of the lathe.
4. The overall height of 45mm is not critical, but it is best not to make it much higher, or the tailstock may not pass over the top, with the block in place.
5. The 60mm width can be bigger, but check that it will fit onto the lathe bed.
6. The 9.5mm dia. of the rod, is to be a good sliding fit in the cross slide T-bolt slot.
7. The hole in the end of the drive pin, should be a tight press fit over the vernier slide locking screw.
8. All other sizes can be to suit available materials.
9. Material: All mild steel. The guide/drive pin could be harder material (stainless for instance).
10. Break all sharp corners.
11. Third Angle Projection.
12. All dimensions in millimetres.



The assembly mounted on the lathe.







The Step 2 simple compound engine being put through its paces.

**Colin Pape**

of France presents his description of the Step 2 engine before going on to look at the Step 3 type.

●Part IV continued from page 441  
(M.E. 4284, 13 October 2006)

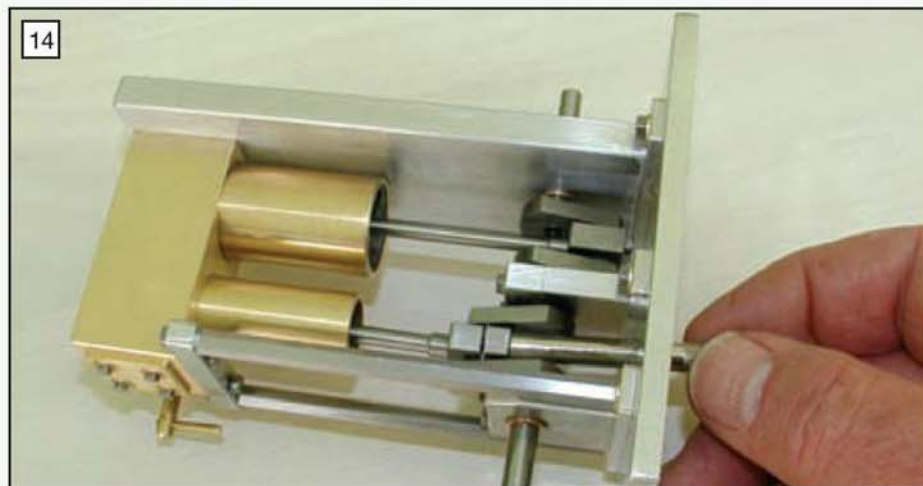
The objective of the Step 2 was to take a first step into compounding. As far as possible this engine would be an extension of the Step 1 engine. In fact, from the front it is hard to tell which engine is which. It is a simple compound engine without a receiver. It has one high-pressure cylinder that exhausts directly into one low-pressure cylinder. The two cranks are 180deg. apart. The ultimate engine in the series will use three of these engines.

The stroke of the low-pressure cylinder of the Step 2 engine is the same as for the high-pressure cylinder. The bore of the low-pressure cylinder was increased to the maximum I could go to with my available material and was calculated to provide about equal power to the high-pressure cylinder at an average setting with some allowance for leaks and other losses. The cylinder head is of course longer and I provided a support for the rear end of the cylinder block in the form of a crutch.

The valve shaft was lengthened to provide control of the inlet and outlet flows of both the high and the low-pressure cylinders. This sort of valve does not provide variable cut-off so, as a starting point, the same 50% cut-off was used for the high-pressure cylinder as in the Step 1 engine and it is fixed.

The air transfer between the high-pressure cylinder and the low-pressure cylinder is made inside the rotor; there is no external plumbing on this engine, which is shown running in photo 13 whilst assembly is seen proceeding in photo 14.

There is no cut-off for the low-pressure cylinder. In my studies about compound engines I have seen criticism of some engines in that there was no cut-off to the low-pressure stage. I have trouble understanding the criticism. I do not see any point in controlling the steam admission



Step 2 engine seen here being assembled.

## OVERHEAD VALVE ENGINES

to the low-pressure stage unless there is useful alternative work for the high-pressure exhaust steam to do. If there is no such use then the steam that does not enter the low-pressure stage can only be thrown away.

As the throttle is opened there is more and more energy left in the gas at the end of the high-pressure piston stroke so the power from the low-pressure side increases. The basic dimensions of this engine are as follows:

Bore of high-pressure cylinder: 13mm

Bore of low-pressure cylinder: 20mm

Stroke of both cylinders: 22mm

Cut-off of high-pressure input: 50%

I had not sorted out a good reversing system when I designed this engine so it rotates only in one direction and this is clockwise when viewed

from the timing belt end. This was my first attempt at building a compound engine and it runs very well. It has a good speed range, more torque than its predecessor and an entirely different exhaust note.

### Notes on building this engine

#### General

The Step 2 engine has the same type of front frame, overhead valve drive, belt tensioner and bearings as the Step 1b engine. The belt and pulleys have the same part numbers as in Step 1.

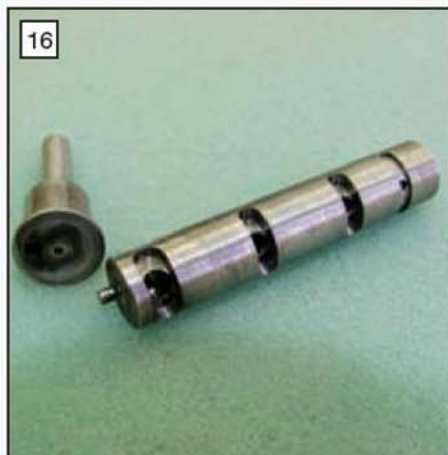
I have included the drawings for the parts of this engine in Figures 2-1 to 2-6 and some photos of the main components. Photograph 15 shows all the parts in the Step 2 engine.

A belt tensioner/guide similar to that used in Step 1b was included in this engine from the



All the parts for the Step 2 engine





Step 2 engine rotor and its accompanying drive shaft.

beginning. Although not required for the belt length adjustment it has proved useful in maintaining the belt in a good central position on the pulleys.

### Cylinder head

Each cylinder has two ports. When I was boring out the recesses for the cylinders I found that it was not easy to get a flat bottom to the recess. More experienced people probably know that it is much easier to get a flat bottom to the hole if you have a central pilot hole. In subsequent engines I always arranged for one port to be in the centre of the cylinder and if I built this engine again I would arrange for the exhaust port to be in the centre of the cylinder end.

### Valve rotor

This part is shown in photo 16. It controls the input and exhaust to the two cylinders. The path from the high-pressure cylinder to the low-pressure cylinder is entirely within the rotor. I plugged the open end of this passageway after making sure that all the debris was cleaned out. This rotor has two balance slots. There is one for the input to the high-pressure cylinder and this is the right hand slot in photo 16. There is another bigger one for the input to the low-pressure cylinder. This larger slot is on the non-visible side in photo 16 but can just be seen in photo 15. My indexing notations have 180deg. (6 o'clock) at the point nearest the crankshaft and 90deg. is at 3 o'clock with the engine turning clockwise as seen from the timing belt end.

### Assembling the engine

There is no special procedure to follow but I found it useful to do the following to ensure good alignment of the engine.

For the frame and bottom end it could be a good idea to leave the bearings slightly undersize until the last minute. A 6mm hand reamer will just reach through all the crankshaft bearings as seen in photo 17.

Then, for the rotor and drive shaft, if the drive shaft bearing and the hole for the rotor have been left slightly undersize they may be reamed to final size and aligned at the same time by passing a 10mm hand reamer through the mounted cylinder then on through the bearing.

### Step 3 - a self-starting and reversible engine

The previous engines had shown me that the overhead valve system was usable. I had also

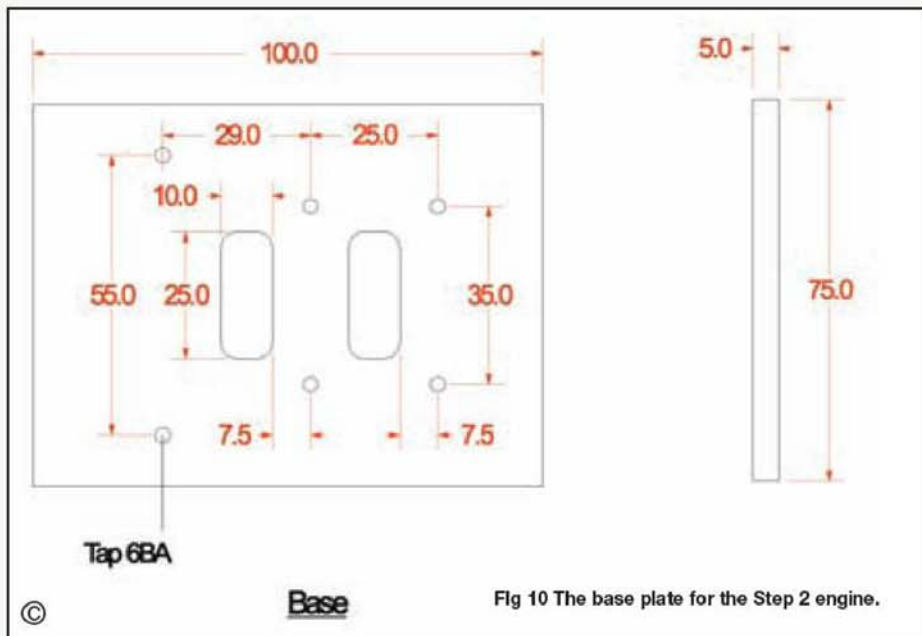


Fig 10 The base plate for the Step 2 engine.

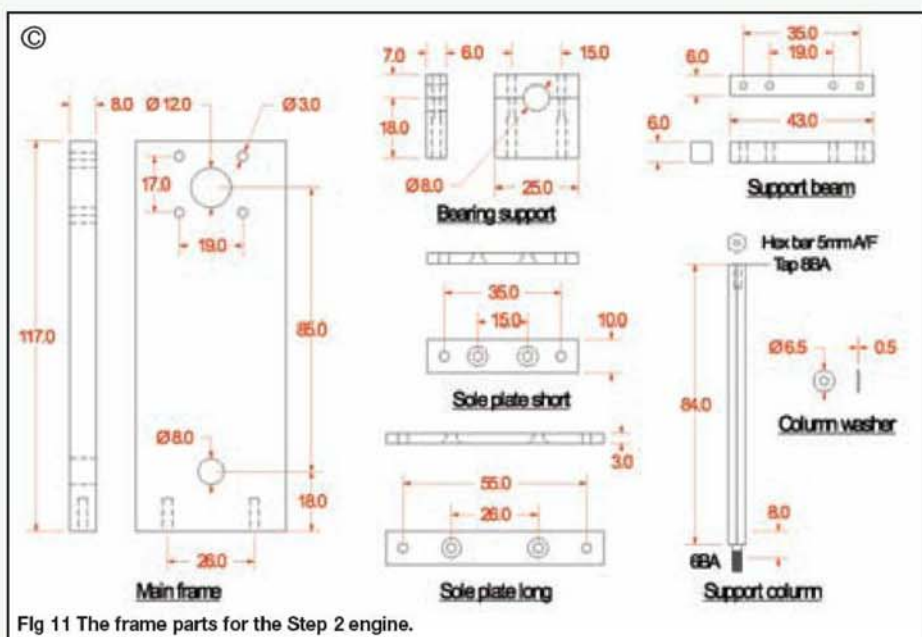


Fig 11 The frame parts for the Step 2 engine.

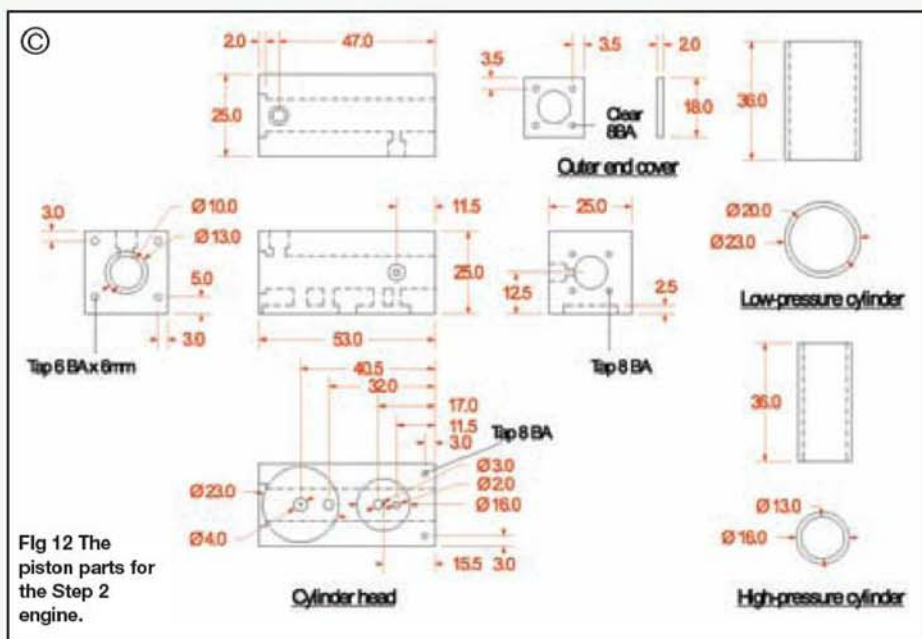
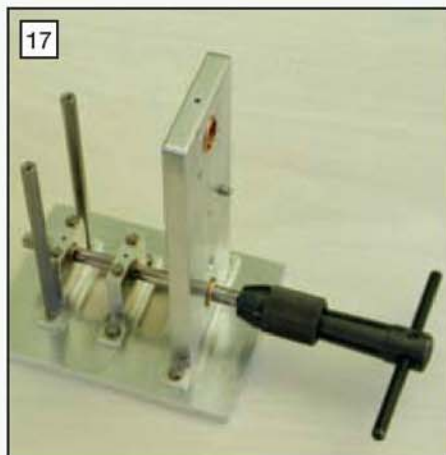


Fig 12 The piston parts for the Step 2 engine.





Reaming to achieve final alignment of the crankshaft bearings.

been able to determine a good centre-to-centre distance for the belts but I had decided to adopt a belt tensioner for alignment reasons. The attempt at compounding had worked so what remained was to define an approach for self-starting and reversing.

I started out on Step 3 without a viable reversing system but fortunately inspiration arrived in time. Because of the materials that I had available and the parts that I had already bought, any reversing system had to avoid any change on the centre-to-centre distance of the crankshaft to rotor

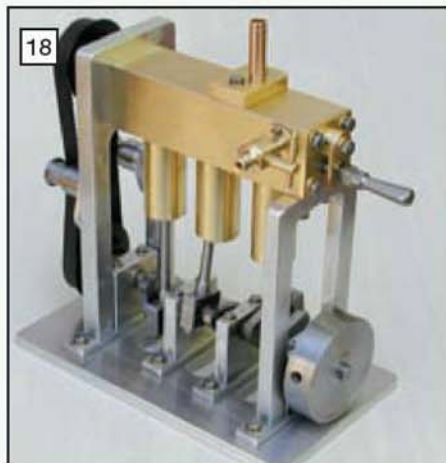
### Reversing system

The reversing system consists of extra slots cut in the valve rotor and a switch between the rotor slots and the cylinders.

The basic dimensions for all the engines had been decided in the beginning and, in particular, the distance between the crankshaft and the valve had been fixed when I bought the timing belts so the reversing gear had to be designed so as to have no impact on the basic dimensions.

I managed to do this by putting the reverser system inside the cylinder head. In the previous engines the rotor had been in the centre of the cylinder head, in this one the rotor has been moved up and the depth of the cylinder seats has been slightly decreased to make room for the reverser. The cylinders have been moved down, closer to the crankshaft. To maintain the crankshaft to rotor shaft distance the connecting rods have been shortened by 5 millimetres.

● To be continued.



The Step 3 engine. Three cylinders, self-starting and reversible.

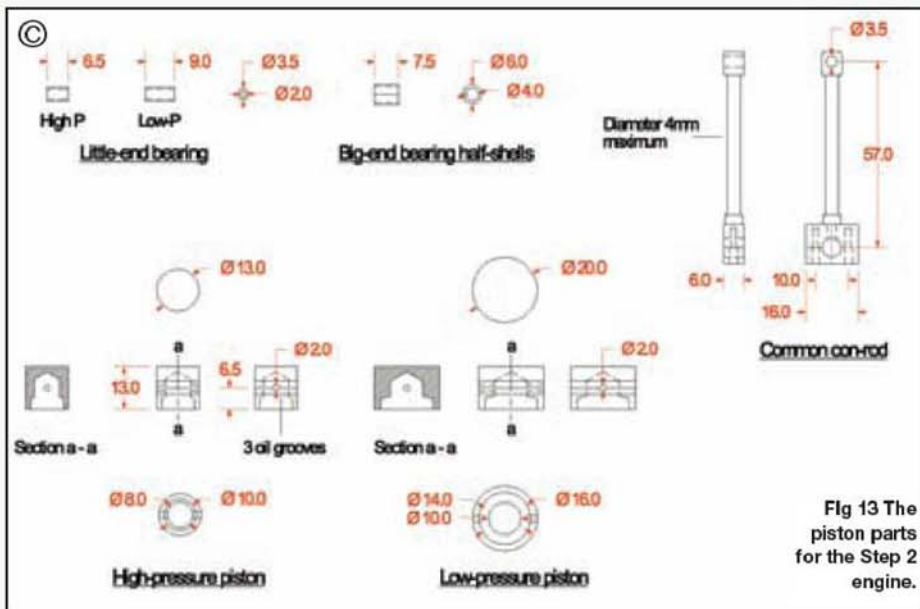


Fig 13 The piston parts for the Step 2 engine.

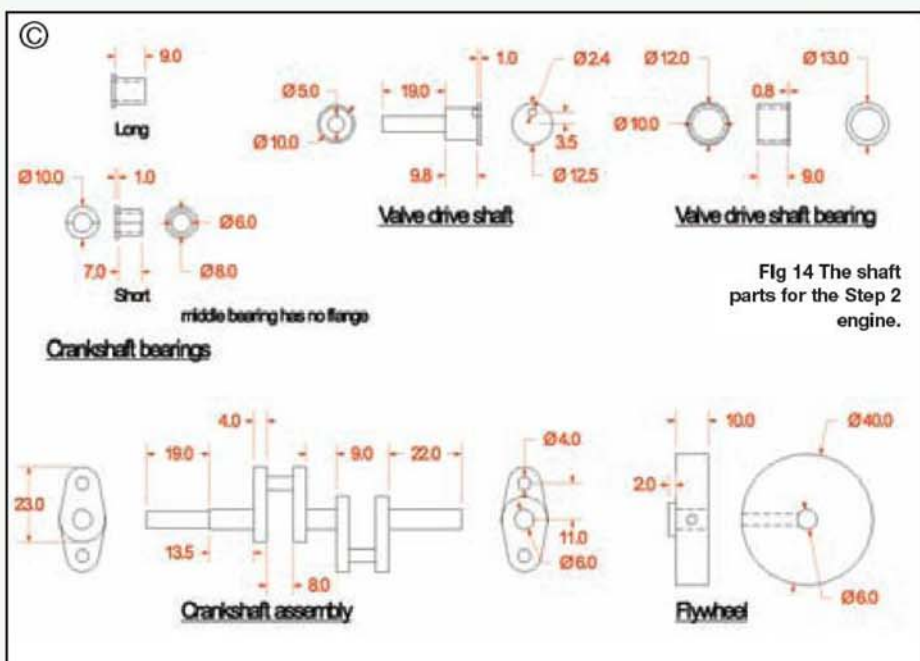


Fig 14 The shaft parts for the Step 2 engine.

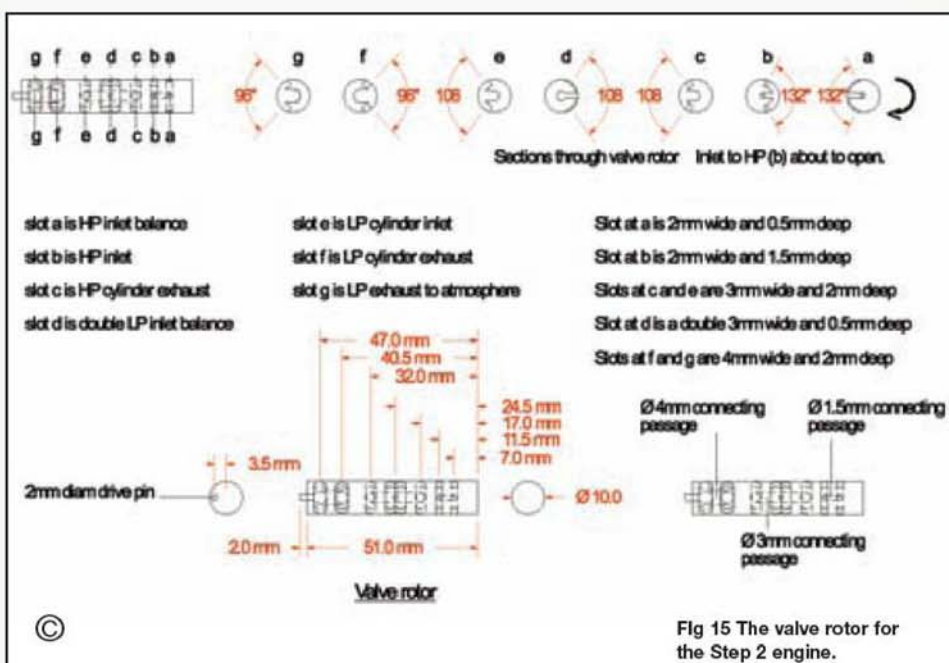


Fig 15 The valve rotor for the Step 2 engine.





At top, the distinctive Broadstairs home of Thomas Crampton.



Crampton 4-2-0 locomotive built by John Wilks at the 2002 M.E. Exhibition.

## ENGINEERING'S LOCAL HEROES

### Thomas Russell Crampton of Broadstairs

**Roger Backhouse** describes the 'Brunel of Broadstairs' whose achievements were many and wide-ranging.

The Kent resort of Broadstairs is best known for the beach, narrow streets and the Charles Dickens industry that brings thousands to see his seaside house overlooking the harbour. Far fewer will look at the museum largely devoted to the memory of the remarkable Broadstairs born engineer, Thomas Russell Crampton.

Crampton was a versatile engineer in a way almost impossible to imagine today. He built successful locomotives, engineered railways, designed machinery to dig a Channel Tunnel and laid the first submarine cable to France. He found time to marry an opera singer and have eight children, design a church tower and build a new bridge in Broadstairs. His wide-ranging abilities matched those of Isambard Kingdom Brunel even if his works are not so spectacular nor so well-known in this country.

He was born in Broadstairs in 1816 the son of John Crampton who owned the local baths. After local education he was apprenticed to the engineer John Hague of London showing early promise by designing a steam-powered rolling machine at the age of just 16. From 1839 to 1844 he assisted Marc Brunel, then worked with Daniel Gooch when he created the Great Western's celebrated *Firefly* locomotive.

One of the key concerns of that time was having a low centre of gravity for stability. With the large driving wheels then in use boilers had to be high and small. Crampton overcame these problems with his locomotive *Liverpool* of 1844 for the London and North Western Railway. In the style later named after Crampton it had a large, low boiler with giant driving wheels set behind the firebox. In front were four other wheels, never a bogie.

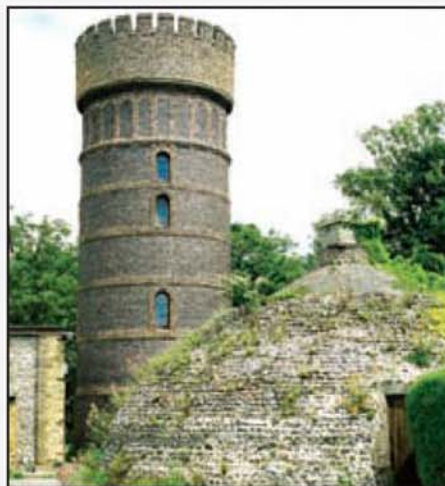
The Crampton was not popular in Britain. Only 25 were built here though one forms the subject of the first locomotive photograph taken at the Great Exhibition of 1851. However, more than 300 were built in France, Belgium and the Germany. In France some lasted in service until the 20th century when rising train weights finally

made them unfeasible. Their large direct steam pipes, big boilers and larger driving wheels made them record breakers. In 1889 a 4-2-0 Crampton of the French Northern Railway reached 89.5mph (144kph) a world record which stood for some years. Such was their success that "prendre le Crampton" became a French expression for going by train.

Fortunately one is preserved in the French National Railway Museum at Mulhouse. It is in running order apart from a damaged tyre. The only British survivor is an oddity – the 4ft. gauge *Fire Queen* of the Padarn Railway, now in Penryn Castle Museum.

Crampton was involved early on in railway engineering. He helped promote the East Kent line from Strood to Canterbury that later became part of the London, Chatham & Dover Railway. He expanded his engineering interests to work on railway projects on the continent and Turkey, receiving honours from several countries but not the UK Government. With a partner he helped develop the Berlin waterworks.

He was involved in telegraph development early and was responsible for the first successful submarine cable between Dover and Calais inaugurated in 1851. His design for this demanding application was used for cables for many years after.



Crampton Tower together with covered reservoir.

Soon after he became interested in cross-channel links of a different kind. He designed and automatic hydraulic tunnel boring machine for the projected Channel Tunnel, a forerunner of modern tunneling machines. With business interests in brick and cement works he designed an early rotary kiln.

Despite his many commitments aboard Thomas Crampton devoted much time to his hometown. He subscribed much of the money for the Broadstairs Gasworks set up in 1851 but his greatest contribution was the creation of the Broadstairs Water Company. Previously the supply from private wells had been poor but Crampton designed a water tower and covered reservoir to supply the town. Both still stand near the station. This system lasted for 50 years until the sea entered the water bearing strata which meant other wells had to be dug further inland.

Other contributions to the town were his design of the wrought iron lattice 'Louisa Gap' bridge to replace a rickety wooden structure and his design and building of a new tower for Holy Trinity Church. Unfortunately the tower was lost in drastic re-modelling of the church in the 1920s.

If Thomas Crampton lacks the fame of Brunel and other contemporaries he was highly successful as a locomotive engineer. He also worked in areas like telegraphy and water supply which the great Isambard never attempted.

Thomas Crampton died at his London home in 1888 after a period of failing health. He was highly regarded by his many friends, including Charles Dickens, but he never had the recognition here he received abroad, even if a local pub now carries his name.

#### Details

The volunteer-run Crampton Tower Museum commemorates his work as well as carrying other information on Broadstairs history. It is open from Easter to October from 2-5pm daily. There is a small admission charge. Details on 01843-864446 or website [www.cramptontower.co.uk](http://www.cramptontower.co.uk) Ramsgate and District Model Engineering Club meets next door on Friday evenings.

For those wishing to know more of Crampton's locomotives I suggest: *The Crampton Locomotive* by M. Sharman published by Oakwood Press, 1983. ISBN-0-950-906700.





# CLUB CHAT

With Malcolm Stride

## UK News

Some good news from Cardiff MES is that it has been granted planning permission to extend its track to provide an additional ride through woodland adjacent to the current site. The proposed development, for the most part, will be a 2 metre wide ribbon of track bounded by a fence and suitable hedging plants maintained in a relatively wild state. It will be dual gauge (5in and 7<sup>1</sup>/<sub>4</sub>in.) consisting of a spiral and loop adding some extra 1500ft. to the existing ground level track and providing some underground storage sidings. The extension will be a sympathetic addition to the current facility enjoyed by the many visitors to the railway from Cardiff, other parts of the country and overseas who will be able to enjoy a miniature train ride through a small part of the woodland of Heath Park. The extra ride in the woods will provide visitors, especially children; with a journey where they can get see the woodland with the educational advantages of seeing wildlife in a natural habitat in complete safety.

Crawley Model Engineers has suffered the attentions of the local vandals on two occasions recently with the hut walls being decorated with graffiti. This was painted over by some of the members. Fifteen members of the local Crawley Model Railway Society visited the club in August and were kept busy driving the trains. The society reports that on some occasions work in the ticket office can be "a bit of a laugh". On one occasion a large family asked for a quantity discount and two young ladies asked if the club did cheap tickets for students. Other similar

tales will be welcome.

Fylde SME was host to the National 2<sup>1</sup>/<sub>2</sub>in. gauge Association Northern Rally in August and in spite of the generally bad weather nationally, had a reasonably dry day. Seventeen visitors attended with six locomotives in steam. Some excitement occurred when a visitor (no names, no pack drill) dropped something red hot into his toolbox. The resulting fire was dealt with by Ron Strachan who, it is reported, received plenty of instruction from the amused onlookers. The club suffered a break in at the hut during the night of Sunday 27 August and two battery-powered Class 08 0-6-0 shunting locomotives were stolen. One is painted green with the number LMS 3810 and the other is a standard black Charlton. The Charlton is minus its key and the other locomotive is without its plug in control box. We would urge readers to be on the lookout for these two locomotives.

Members of the Lindsey Model Society enjoyed a good July running session with good weather and fully working signal boxes. The session was followed by a barbecue which went on well into the evening in the good weather.

We have received the sad news that Littlebrook MES has been asked to vacate its site at the

Littlebrook Power Station after 22 years in residence. They are now looking for a new track site in the Dartford area. The Club will continue to meet at the Glentworth Ex-Serviceman's Club (Dartford) on the 1st and 3rd Tuesdays of each month at 8pm. We wish the society good luck in its search for new premises. I am sure that they will be pleased to hear from anyone in the area who knows of any potential sites.

Following the closure of the workshops at Marjons, Plymouth Miniature Steam members are attempting to find a new venue for their workshop evenings, but without success at present. The society will no doubt be pleased to hear from any readers with knowledge of suitable facilities within reach of Plymouth. On a happier note, the society reports that the exhibition in July was "one of the best we have held".

It seems to be an issue for fiery tales this time. A member of Stamford MES had organised the barbecue for the visit by members of Peterborough SME. At the end of the event he let everything cool down before placing the barbecue in his van. At this point one of the legs came off resulting in the (still hot) contents being deposited onto the van floor. The smouldering floor was extinguished with some thawed out ice cube bags which happened to be available. All these things do provide endless amusement at club meetings for years to come.

Rochdale SMEE has a thriving junior section and this was demonstrated when in early April Matthew Hainsworth (aged 15) suggested that a Diesel Traction Weekend be run in August. Maybe Matthew was unaware that those who propose such things usually get to do most of the work. However in the week prior to the event he was down at the track ensuring that everything was

ready for the visitors. Unfortunately the weekend was washed out by the rain which started on Friday night and continued until the sun shone again on Sunday evening. Nevertheless several hardy souls brought locos from Bolton, Leyland and Wigan as well as visitors from Sale and Southport plus a long-distance traveller from Eastbourne. Rochdale provided cooked breakfasts and non stop tea and coffee on both days, but the advertised Barbecue was a last minute cancellation due to the weather. I think Mathew is to be congratulated on his efforts and his attitude is to be encouraged.

I think it is time for some more workshop definitions from the Sutton MEC:

*Oxy-acetylene torch* – Used almost entirely for lighting various flammable objects in your workshop. Also handy for igniting the grease inside the wheel hub you want the bearing out of.

*EZ Out bolt and stud extractor* – A tool ten times harder than any known drill that snaps off in bolt holes you could not use anyway.

*1/2in. by 16in. Screwdriver* – A large pry bar that inexplicably has an accurately machined screw driver tip on the end opposite the handle.

More again soon!

Work at the Creech track site of Taunton Model Engineers has concentrated on tidying up loose ends and dealing with any snags that have arisen during operation. Some re-aligning and adjustment of rail joints has been needed after the hot weather in July. A different welding technique is to be tried on the track to minimise the initial distortion. The portable track was taken to Forde House, Newton Abbott to take part in the Brunel 200th Anniversary celebrations organised by Teignbridge District Council. Among the many visitors having a ride on the train was a



Alan Priddey's Amtrak diesel nicknamed 'The Beast' hauls a long train of visitors and members at Rochdale's Diesel Traction Weekend.



Tree felling at Wigan DMES provides entertainment for the members.



## In Memoriam

It is with the deepest regret that we record the passing of the following members of model engineering societies. The sympathy of staff at *Model Engineer* is extended to the family and friends they leave behind.

Jim Bowler  
John Chesworth  
Harold Hope  
Phil Johnson  
Manfred Knupfer  
Roy Young

Taunton Model Engineers  
Wigan DSME  
Tyneside SMEE  
Tyneside SMEE  
Germany  
Taunton Model Engineers

large black Labrador. The track was situated next to a model of Brunel's atmospheric railway which led to much discussion on the merits of the system.

Work on the new track at Tyneside SMEE is starting in earnest with a mini-digger booked to excavate the track bed. The digger will do one quarter of the track at each visit with members laying cables and drains before infilling with gravel ready for the next digger visit.

Wigan DMES has been subjected to the attentions of a group of forestry contractors who have dealt with some dangerous trees at the track site. One horse chestnut tree was deemed so dangerous that the contractors refused to climb it. The tree was felled in one piece after the fence was lowered. All of this provided lots of entertainment for the members. One length of a tall

beech tree bounced close to the track but did not cause any damage. Returning to more traditional club activities, the society hosted a visit by members of the **Butterley Park Miniature Railway Society** at the end of July. The visitors brought three locomotives and enjoyed a good running session in the hot weather.

## World News

### Canada

Items shown and discussed at the recent meeting of the Toronto SME included Bill Huxhold's Sulzer poppet valve twin-cylinder engine and Joe Foster's clamping device

made to free up the valves in the Ford Flat Head Engine in his recently acquired (full size) World War Two Bren Gun Carrier. An item for the I/C enthusiasts was provided by Dave Bowes who described how his EVIC (electronic valve internal combustion) engine self destructed while running at approximately 13,000rpm while at the Hamilton Museum during the OMLET meet. He believes that the E ring came off the intake valve stem, which then caused the valve to drop into the cylinder. The cylinder head was severely damaged as a result. David was able to salvage the head with some TLC and adding a valve insert

for the intake valve with a slightly increased bore to improve performance. Dave has a website at <http://rbowes1.11net.com/dbowes/index.htm> which gives details of his engines.

## South Africa

The club activities at **Centurion MES** have started to pick up with an increasing number of locomotives being steamed up at the club Sundays. Work on the tunnel and other projects has progressed nicely and the tunnel should be finished soon. The society is considering building an extra store/workshop at the dead end of the two storage tunnels. This will provide additional space in the clubhouse, as well as the possibility of enlarging the library/committee room.

The society has bought a new printer/scanner/copier so that members will be able to get copies of articles at the library.

# CLUB DIARY

A minimum of 6 weeks notice is required for diary entries. Clubs and Societies are asked to include a telephone number for the assistance of would-be visitors.

## November

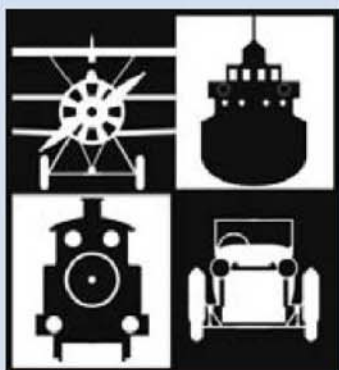
- 10 **Brighton & Hove SMLE.** *Stuart Potter: Unmanned Satellites.* Contact Mick Funnell: 01323-892042.
- 11 **Glasgow & S.W. Rly Ass'n.** *Ian Lothian: North American Adventure.* Contact Bruce Steven: 0141-810-3871.
- 11/12 **Hutt Valley MES.** *Tauranga Open Weekend.* Contact Gavin McCabe: 567-4487.
- 11 **SM&EE.** *Training Seminar.* Contact David Boote: 01202-745862.
- 12 **York City & DSME.** *Running Day.* Contact Pat Martindale: 01262-676291.
- 13 **Bedford MES.** *A 5in. gauge gas turbine locomotive.* Contact Ted Jolliffe: 01234-327791.
- 13 **Erewash Valley MES.** *AGM.* Contact Jim Matthews: 01332-705259.
- 13 **Melton Mowbray DMES.** *Mary Matts: Foxton Incline Plane.* Contact Phil Tansley: 0116-2673646.
- 14 **Dockland & E. London MES.** *Meeting.* Contact P. M. Jonas: 01708-228510.
- 15 **Bournemouth DSME.** *Ladies Night.* Contact Dave Fynn: 01202-474599.
- 15 **Bristol SMEE.** *Patrick Hassell: Bristol Aero Engines.* Contact Trevor Chambers: 0145-441-5085.
- 15 **Chingford DMEC.** *Gordon Rowley: A clock evening.* Contact Ron Manning: 020-8360-6144.
- 15 **Leeds SMEE.** *Meeting.* Contact Colin Abrey: 01132-649630.
- 15 **MELSA.** *Meeting.* Contact Graham Chadbone: 07-4121-4341.
- 16 **Cardiff MES.** *Cyril Chandler: Cyril's Film Night.* Contact Don Norman: 01656-784530.
- 16 **Frimley & Ascot LC.** *AGM.* Contact Bob Dowman: 01252-835042.
- 16 **Isle of Wight MES.** *AGM & Annual Auction.* Contact Malcolm Hollyman: 01983-564568.
- 17 **Canvey R&MEC.** *J. Whybrow: Paddle Steamer Preservation.* Contact Brian Baker: 01702-512752.
- 17 **Rochdale SMEE.** *Auction Night.* Contact Mike Foster: 01706-360849.
- 17 **Romford MEC.** *Photo Talk.* Contact Colin Hunt: 01708-709302.
- 18 **Canvey R&MEC.** *Members' Running Day.* Contact Brian Baker: 01702-512752.
- 18 **SM&EE.** *Rummage Sale.* Contact David Boote: 01202-745862.
- 18 **York City & DSME.** *Frank Dean: Steam Scene film/video presentation.* Contact Pat Martindale: 01262-676291.
- 19 **Frimley & Ascot LC.** *Club Running.* Contact Bob Dowman: 01252-835042.
- 20 **Model Steam Road Vehicle Soc.** *Modellers' Question Time.* Contact Geoff Miles: 01869-247602.
- 20 **Peterborough SME.** *Roy Mosley: Cinema Organs.* Contact Ted Smith: 01775-640719.
- 20 **Steam LS of Victoria.** *Working Bee & Barbecue Lunch.* Contact Graham Plaskett: (03) 9750-5022.
- 21 **Basingstoke DMES.** *Bring & Buy Evening.* Contact Guy Harding: 01256-844861.
- 21 **Chesterfield MES.** *Ken Horan: Visit to China.* Contact Mike Rhodes: 01623-648676.
- 21 **Nottingham SMEE.** *Rolls-Royce staff: Gas Turbine Development.* Contact Graham Davenport: 0115-8496703.
- 21 **Taunton ME.** *Auction Night.* Contact Don Martin: 01460-83162.
- 22 **Chingford DMEC.** *Dave Whiting: A Christmas Auction.* Contact Ron Manning: 020-8360-6144.

- 22 **Hull DSME.** *Chairman's Evening.* Contact Tony Finn: 01482-898434.
- 22 **Staines SME.** *Work in Progress.* Contact Stan Bishop: 01784-241891.
- 23 **Cardiff MES.** *Bits & Pieces.* Contact Don Norman: 01656-784530.
- 23 **Leyland SME.** *Quiz Night.* Contact A. P. Bibby: 01254-812049.
- 23 **Reading SME.** *Winter Talk.* Contact Brian Joslyn: 01491-873393.
- 23 **Worthing DSME.** *Andrew Ballantyne: An amazing precision.* Contact Bob Phillips: 01903-243018.
- 24 **Malden DSME.** *Rummage Sale.* Contact John Mottram: 01483-473786.
- 25 **Chesterfield MES.** *Public Running Day.* Contact Mike Rhodes: 01623-648676.
- 25 **Oxford (City of) SME.** *AGM.* Contact Chris Kelland: 01235-770836.
- 25/26 **South Lakeland MES.** *Ulverston Dickensian Festival (Portable Track).* Contact Adrian Dixon: 01229-869915.
- 26 **MELSA.** *Sunday in the Park.* Contact Graham Chadbone: 07-4121-4341.
- 26 **Westland & Yeovil DMES.** *Track Running Day.* Contact Gerald Martyn: 01935-434126.
- 27 **Bedford MES.** *Tool and wear care.* Contact Ted Jolliffe: 01234-327791.
- 27 **Canterbury DMES (UK).** *Bits & Pieces.* Contact Mrs P. Barker: 01227-273357.
- 28 **Chelmsford SME.** *Club Auction.* Contact D. Blake: 01376-324205.
- 29 **Chingford DMEC.** *Noel Shelley: The small scale Foundry.* Contact Ron Manning: 020-8360-6144.
- 30 **Cardiff MES.** *Club Chat.* Contact Don Norman: 01656-784530.

## December

- 1 **Canvey R&MEC.** *AGM.* Contact Brian Baker: 01702-512752.
- 1 **Maidstone MES (UK).** *Members' Old Slides Show.* Contact Martin Parham: 01622-630298.
- 1 **North London SME.** *A Pre-Christmas Social Evening.* Contact David Harris: 01707-326518.
- 1 **Portsmouth MES.** *Any Questions.* Contact John Warren: 023-9259-5354.
- 1 **Rochdale SMEE.** *Work in Progress.* Contact Mike Foster: 01706-360849.
- 1 **Romford MEC.** *Competition Night & Millennium & Rusty Titford Cup.* Contact Colin Hunt: 01708-709302.
- 2 **Bradford MES.** *BMES Annual Competition & Display.* Contact John Mills: 01943-467844.
- 2 **Canvey R&MEC.** *Members' Running Day.* Contact Brian Baker: 01702-512752.
- 2 **Ickenham DSME.** *Public Running.* Contact David Sexton: 01895-630125.
- 2 **New Jersey Live Steamers, Inc.** *Work Day.* Contact Karl Pickles: 718-494-7263.
- 2 **SM&EE.** *Competition Day.* Contact David Boote: 01202-745862.
- 2 **Sunderland (City of) MES.** *Meeting.* Contact Albert Stephenson: 01429-299649.
- 2 **York City & DSME.** *Paul Butler: Four Decades on NYMR.* Contact Pat Martindale: 01262-676291.
- 3 **Basingstoke DMES.** *Public Running.* Contact Guy Harding: 01256-844861.
- 3 **Bristol SMEE.** *Santa Special.* Contact Trevor Chambers: 0145-441-5085.
- 3 **Cardiff MES.** *Santa Special Day.* Contact Don Norman: 01656-784530.
- 3 **Ellenroad Engine House.** *Christmas Fair.* Enquiries: 01706-881952.
- 4 **Peterborough SME.** *Bits & Pieces.* Contact Ted Smith: 01775-640719.





# THE MODEL ENGINEER EXHIBITION

Please return completed form to:  
Model Engineer Competition,  
9 Tranmore Lane, Eggborough,  
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ENTRY NO.



OFFICE USE ONLY

|       |           |
|-------|-----------|
|       |           |
|       |           |
| CLASS | ENTRY NO. |

## ENTRY FORM - COMPETITION & LOAN MODELS

### PERSONAL DETAILS (Please print)

Surname \_\_\_\_\_ Forename(s) \_\_\_\_\_ Age: \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ Post Code: \_\_\_\_\_

Home Tel No \_\_\_\_\_ Daytime Tel No \_\_\_\_\_

Model Club or Association \_\_\_\_\_

Have you entered before? (Y/N) \_\_\_\_\_

Do you purchase or subscribe to an Encanta Media Ltd magazine? (Y/N) \_\_\_\_\_

How many years have you been a modeller? \_\_\_\_\_

Mail Order Protection - please tick this box if you would prefer not to receive mail from other companies which may be of interest to you ☐

### MODEL DETAILS – PLEASE TICK BOX IF MODEL IS FOR LOAN ☐

Entry Class (competition entries only) \_\_\_\_\_

Model Title (to be used for catalogue and display card) \_\_\_\_\_

Model Description \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Model Scale \_\_\_\_\_ Length \_\_\_\_\_ Width \_\_\_\_\_ Height \_\_\_\_\_ Weight \_\_\_\_\_

Type of construction \_\_\_\_\_

\_\_\_\_\_

Parts not made by you and commercial items \_\_\_\_\_

\_\_\_\_\_

Have you supplied a photograph? (Y/N) \_\_\_\_\_

Are you supplying Judges Notes? (Y/N) \_\_\_\_\_

Value of Model (Encanta Media Ltd will not insure the model unless a value is entered) £ \_\_\_\_\_

Name and address of your local newspaper \_\_\_\_\_

\_\_\_\_\_



# TO HELP YOU GET THE BEST FROM THE MODEL ENGINEER EXHIBITION

These notes are written purely for guidance. Full information is contained in the Competitors' Information booklet which is sent to every entrant as part of the information package. If you have an item and are unsure as to the Class into which it should be entered, leave that section blank and we will take care of it. The Judges have the right to move any competition exhibit into another class if they feel that by doing so its chances of gaining higher marks or a more appropriate award are improved.

If the item is offered as a Loan exhibit please indicate this by writing Loan on the form in the box identifying the Class. Loan models are not judged but carry all other privileges associated with competition entries.

Part built models are particularly welcome in the Loan Section; visitors like to see work in progress, and entry does not preclude the item being entered in competition when completed.

The classes listed below are those associated with mainstream model engineering.

## Club exhibits

Where a club is exhibiting, each model should be entered on a separate entry form and clearly identified as a club exhibit by entering Loan/Club in the class section box. This ensures that we have a full record of all models on display during the show and facilitates matters of administration and insurance.

## Additional forms

If you do not wish to deface your copy of the magazine we are happy to receive photocopies of the entry form, one for each model. We will be pleased to send out extra forms if required, so if you know of a modeller who is not a reader of one of our magazines but who you think may wish to participate, please advise them to contact our Exhibitions Office, or simply photocopy the entry form for them.

The success of the show depends largely on the number of models on display. Your work could well be the stimulus which inspires someone else to start in the hobby. There can be no doubt that this event is our showcase on the world of modelling in all its aspects. Every modelling discipline needs more and more participants, and it is by displaying not only the crème-de-la-crème, but also examples of work of a more achievable standard, that people are encouraged to join into the wonderful world of modelling, in whatever aspect.

We look forward to seeing a sample of your work at the show!

## Engineering Section

- A1 Hot air engines.
- A2 General engineering models (including stationary and marine engines).
- A3 Internal combustion engines.
- A4 Mechanical propelled road vehicles (including tractors).
- A5 Tools and workshop appliances.
- A6 Horological, scientific and optical apparatus.
- A7 General engineering exhibits – not covered by the above

## Railway Section

- B1 Working steam locomotives 1" scale and over.
- B2 Working steam locomotives under 1" scale.
- B3 Locomotives of any scale, experimental, freelance or based on any published design and not necessarily replicas of full size prototypes, intended for track duties.
- B4 Scratchbuilt model locomotives of any scale, not covered by classes B1, B2, B3, including working models of non-steam, electrically or clockwork powered steam prototypes.
- B5 Scratchbuilt model locomotives gauge 1 (10mm scale) and under.
- B6 Kitbuilt model locomotives gauge 1 (10mm scale) and under.
- B7 Scratchbuilt rolling stock, gauge 1 (10mm scale) and under.
- B8 Kitbuilt rolling stock, gauge 1 (10mm scale) and under.
- B9 Passenger or goods rolling stock, above 1" scale.
- B10 Passenger or goods rolling stock, under 1" scale.
- B11 Railway buildings and lineside accessories to any recognised model railway scale.
- B12 Tramway vehicles.

## Marine Models

- C1 Working scale models of powered vessels (from any period). Scale 1:1 to 1:48
- C2 Working scale models of powered vessels (from any period). Scale 1:49 to 1:384

- C3 Non-working scale models (from any period). Scale 1:1 to 1:48
- C4 Non-working scale models (from any period). Scale 1:49 to 1:384
- C5 Sailing ships and oared vessels of any period – working.
- C6 Sailing ships and oared vessels of any period – non-working.
- C7 Non-scale powered functional models including hydroplanes.
- C8 Miniatures. Length of hull not to exceed, 15in for 1:32 scale, 12in for 1:25 scale, 10in for 1:16 scale, 9in for 1:8 scale. No limit for smaller scales.
- C9 For any model boat built from a commercial kit. Before acceptance in this class the kit must have been readily available for at least 3 months prior to the opening date of the exhibition and at least 20 kits must have been sold either by mail order or through the retail trade.

## Scale Aircraft Section

- D1 Scale radio control flying models
- D2 Scale flying control-line and free flight
- D3 Scale non-flying models, including kit and scratch-built
- D4 Scale flying radio controlled helicopters

## Model Horse Drawn Vehicle Section

- G1 Carriages & other sprung vehicles. (Omnibuses, trade vans etc.) Wagons, carts and farm implements. Caravans.

## Junior Section

- J1 For any type of model, mechanical or engineering work, by an under 14 year old.
- J2 For any type of model, mechanical or engineering work, by an under 16 year old.
- J3 For any type of model, mechanical or engineering work, by an under 18 year old.

All entries will be judged for standard of craftsmanship, regardless of the modelling discipline, i.e. a boat will not be competing against a military figure. Providing a model attains sufficient marks it will be awarded a gold, silver or bronze medal.

## Model Vehicle Section

- K1 Non-working cars, including small commercial vehicles (e.g. Ford Transit) all scales down to 1/42.
- K2 Non-working trucks, articulated tractor and trailer units, plus other large commercial vehicles based on truck-type chassis, all scales down to 1/42.
- K3 Non-working motor bikes, including push bikes, all scales down to 1/42.
- K4 Non-working emergency vehicles, fire, police and ambulance, all scales down to 1/42.
- K5 Non-working vehicles including small commercial vehicles (e.g. Ford Transit) scale from 1/43 or smaller.
- K6 Any available body shells including Concours, in any scale or material, to be judged on appearance only.
- K7 Functional model cars/vehicles which must be able to move under its own power of any type. Can be either free-running, tethered radio controlled or slot car, but must represent a reasonable full size replica.

## DUKE OF EDINBURGH CHALLENGE TROPHY Rules and Particulars

- 1. The Duke of Edinburgh Challenge Trophy is awarded to the winner of the Championship Award at the Model Engineer Exhibition.
- 2. The trophy remains at all times the property of ENCANTA MEDIA LTD.
- 3. The name of the winner and the date of the year in which the award is made will be engraved on the trophy, which may remain, at the discretion of ENCANTA MEDIA LTD, in his/her possession until required for renovation and display at the following Model Engineer Exhibition.

- 4. Any piece of model engineering work will be eligible for this Championship Award after it has been awarded, at The Model Engineer Exhibition, a Gold or Silver medal by ENCANTA MEDIA LTD
- 5. No model may be entered more than once.
- 6. Entry shall be free. Competitors must state on the entry form:
  - (a) That exhibits are their own bona-fide work.
  - (b) Any parts or kits which were purchased or were not the outcome of their own work.
  - (c) That the model has not been structurally altered since winning the qualifying award.
- 7. ENCANTA MEDIA LTD may at their sole discretion vary the conditions of entry without notice.

## COMPETITION RULES

- 1. Each entry shall be made separately on the official form and every question must be answered.
- 2. Competition Application Forms must be received by the stated closing date. LATE ENTRIES WILL ONLY BE ACCEPTED AT THE DISCRETION OF THE ORGANISERS.
- 3. Competitors must state on their form the following:
  - (a) Insured value of their model.
  - (b) The exhibit is their own work and property.
  - (c) Parts or kits purchased.
  - (d) Parts not the outcome of their own work.
  - (e) The origin of the design, in the case of a model that has been made by more than one person.

NOTE: Entry in the competition can only be made by one of the parties and only their work will be eligible for judging.

- 4. Models will be insured for the period during which they are in the custody of ENCANTA MEDIA LTD
- 5. A junior shall mean a person under 18 years of age on December 31st in the year of entry.
- 6. Past Gold and Silver medal award winners at any of the exhibitions promoted by ENCANTA MEDIA LTD are eligible to re-enter their model for the 'Duke of Edinburgh Challenge Trophy'.

Past winners at any of the exhibitions promoted by ENCANTA MEDIA LTD will not be eligible for re-entry into the competition unless it has been substantially altered in any way.

- 7. ENCANTA MEDIA LTD reserve the right to:
  - (a) Transfer an entry to a more appropriate class.
  - (b) Describe and photograph any models entered for competition or display and to make use of any such photographs and descriptions in any way they may think fit.
  - (c) Refuse any entry or model on arrival at the exhibition and shall not be required to furnish a reason for doing so.
- 8. Entry into the competition sections is not permitted by:
  - (a) Professional model makers.
  - (b) Anyone who has a financial interest in the direct supply of materials and designs to the public.

NOTE: If unsure, please contact the Competition organisers prior to the show.

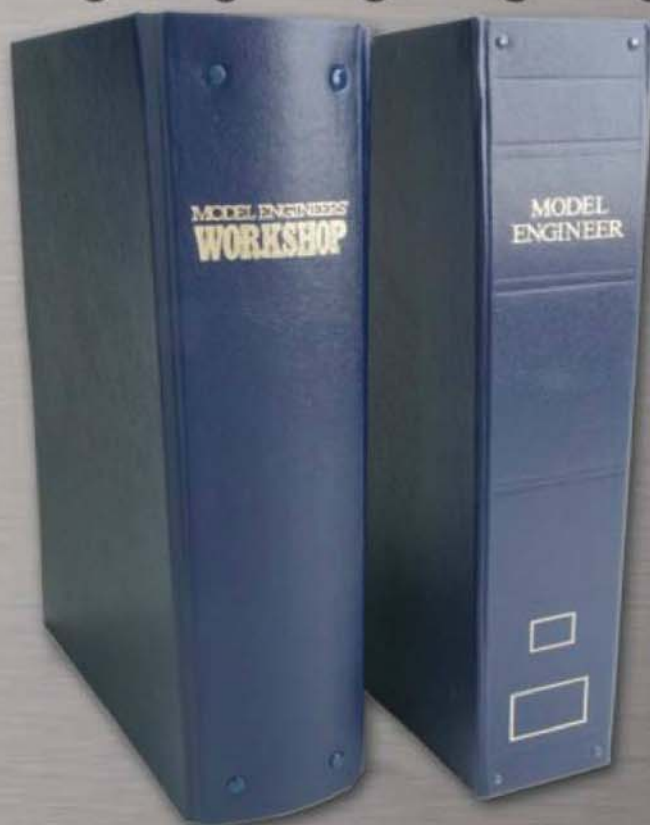
- 9. The judges' decision is final. All awards are at the discretion of the judges and no correspondence regarding the awards will be entered into.
- 10. Exhibitors must present their model receipt for all models collected at the end of the exhibition and sign as retrieved.
- 11. The signed release for each model must be presented to security staff when leaving the exhibition complex with display model(s) after the close of the exhibition.

**IMPORTANT NOTE: PLEASE MAKE COPIES, INCLUDING PHOTOGRAPHS, OF ALL INFORMATION RELATING TO YOUR MODEL, AS ENCANTA MEDIA LTD WILL NOT ACCEPT LIABILITY FOR ANY LOSS.**

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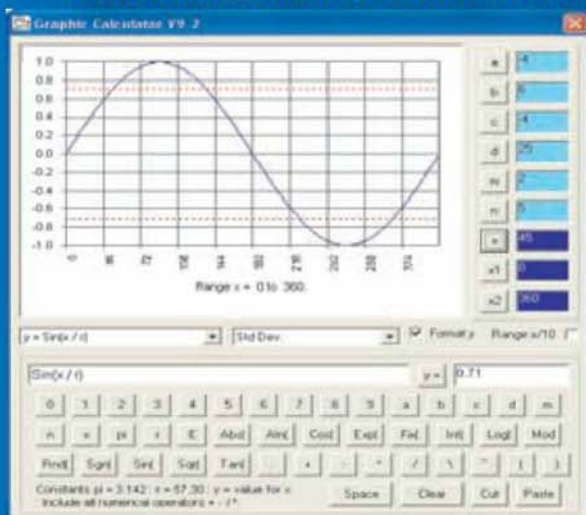
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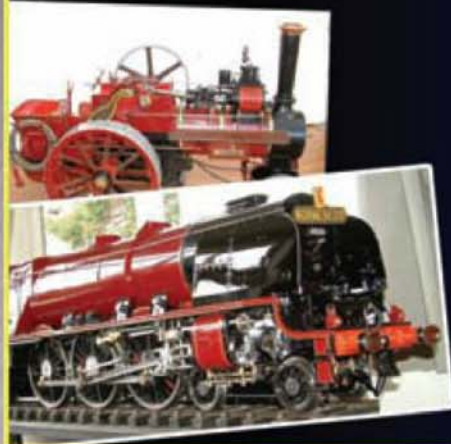
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