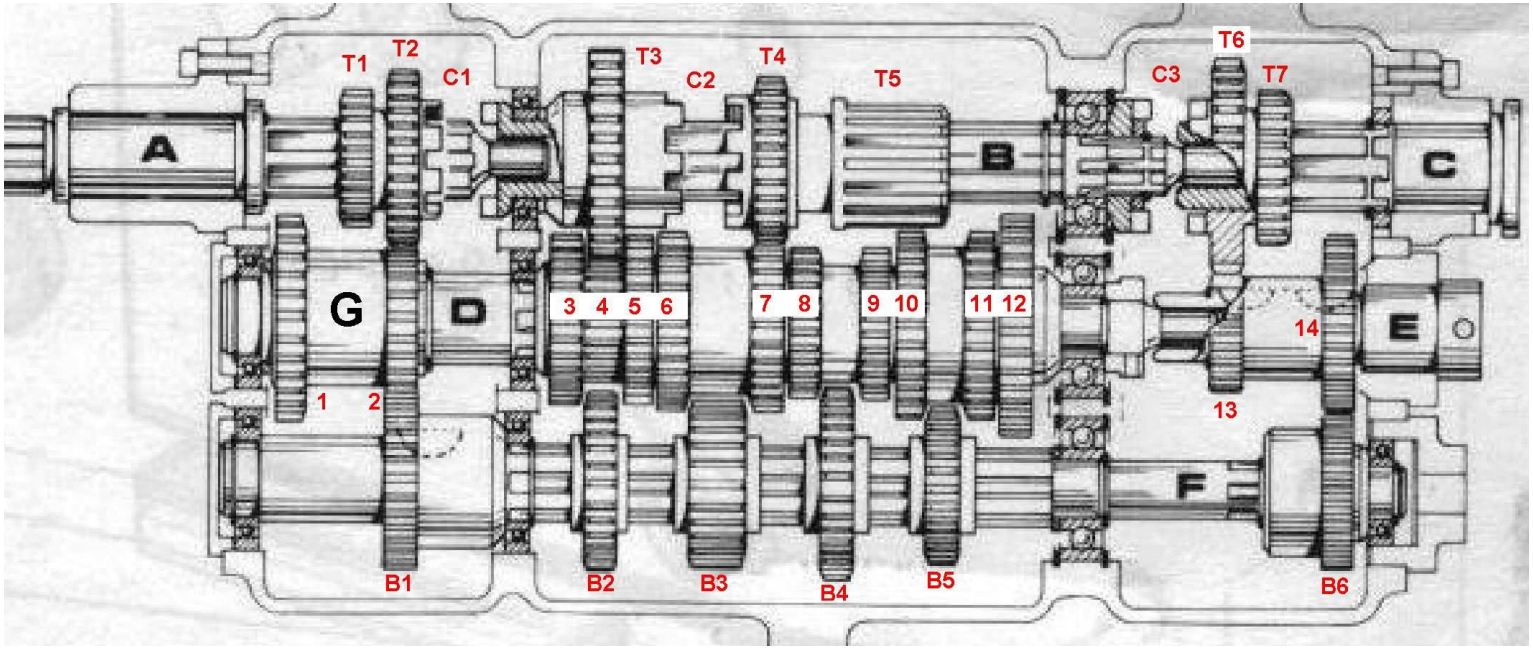
Colchester Triumph 2000 gearbox

Rotary selectors A B C R S T W X Y Z

Input shaft



Leadscrew

Feed shaft

Joystick selector 4--3 6--5 2--1 8--7

Number of teeth on gears														
Gear number on level	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Top level – prefixed T	19	19	32	23	16	35	35							
Middle level – no prefix	30	20	22	16	20	24	23	27	24	28	26	32	18	45
Bottom level – prefixed B	22	22	22	33	22	36								

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Input to the gearbox
The input shaft, A, of the gearbox is driven from an output shaft in the headstock (labelled B in the parts section of the Colchester manual) via gears mounted on the swing frame. That shaft rotates 0.5 revs per main spindle rev with the LR selector in the L position or 2 revs per spindle rev in the H position. It can reversed, for left hand threading, by the control lever immediately below the LR selector.
The standard gears supplied with the lathe for mounting on the swing frame can be configured either for screwcutting and feeds or DP and Mod
The gear arrangements of the metric leadscrew machines differ from those of the imperial model so that the same gearbox can bu used by both.types of leadscrew.

Mode	Imperial leadscrew machine			Metric leadscrew machine		
	Swing frame gears	H/L selector	Shaft A:Spindle	Swing frame gears	H/L selector	Shaft A:Spindle
Screwcutting & feeding	(24x56)/(56x57)	H	0.8421:1	(28x55)/(64x54)	H	0.8912:1
		L	0.2105:1		L	0.2228:1
Mod & DP	(24x44)/(56x57)	H	0.6617:1	(22x55)/(64x54)	H	0.7002:1
		L	0.1654:1		L	0.1751:1

There are 6 indepenendent shafts in the gearbox labelled A to F as shown in the diagram.
C is coupled to the leadscrew using a shear pin
E drives the feedshaft

With the following exceptions all gears are splined or keywayed to their shafts.
Exception 1. Gear T3 and left element of clutch C2 is free to run on shaft B.
Exception 2 The cluster comprising Gears 1 & 2 (labelled G) is free to run on shaft D.

Constant mesh gears.
T3 and 4 E = 0.8xF
2 and B1 F = 0.9091xG
B6 and 14 E = 0.8xG
Also see Note 1.

Selector ABC
Slides cluster comprising gears T1 and T2 and left element of clutch C1 on shaft A.
Position A: T1 meshes with 1 G = 0.6333xA F = 0..9091xG so F = 0.5758xA and E = 0.4605xA
Position B: T2 meshes with 2 G = 0.95xA so F = 0.8636xA and E = 0.6909xA
Position C: Clutch C1 engaged B = A

Selector RST
Slides cluster comprising right element of clutch C2 and gears T4 & T5 on shaft B – See note 1.
Position R: C2 engaged D = 2xA
Position S: T4 meshes with 7 D = A
Position T; T5 meshes with 12 D = 0.5xA

Selector WXYZ
Slides cluster comprising right element of clutch C3 and gears T6 & T7 on shaft C.
Position W: C3 engaged. C = B
Position X: T6 meshes with 13 C = 0.5143xE so C = 0.4114xF
Position Y: No engagement (leadscrew is undriven)
Position Z: T7 meshes with 14 C = 1.2587xE so C = 1.2086xF

8 speed joystick (Gate selector)
The mechanism moves one of the splined gears B2, B3, B4 or B5 on shaft F. For odd numbered speed positions the relevant gear is slid to the right and for evens to the left.

Position	Gear on shaft D	Gear on shaft F	Ratio F:D	Ratio relative to position 1
1	9	B4	0.7273	1
2	8	B4	0.8182	1.125
3	5	B2	0.9091	1.250
4	3	B2	1.0000	1.375
5	7	B3	1.0455	1.4375
6	6	B3	1.0909	1.5
7	11	B5	1.1818	1.625
8	10	B5	1.2727	1.75

Leadscrew. Pitch is 0.25" for the Imperial version or 6mm for the metric model.

Feed travels

Saddle travel (sliding) is 0.025" per rev of the feed shaft for the imperial version and, as far as I am aware, that also applies to metric models.
Cross slide travel (surfacing) is half of saddle travel.

Note 1. I have two manuals for the T2000. For both of them the page titled GEARBOX : GEARS is from serial no. 00001 but there is a difference in the arrangement of gears T4 and T5. In the one described above T4 & T5 are a sliding cluster. In the other manual T4 and T5 engage each other with an additional dog clutch and T5 is fixed to the right on shaft B and is in permanent engagement with gear 12. They are functionally identical in terms of gear ratios.

Metric screwcuting and Mod

The path through the gearbox is the same for both: the only difference between them is the arrangement of the gears on the swing frame.

Selector ABC is always in the C position so shaft B rotates with shaft A.
Shaft D is driven from shaft B (and A) by gear pairs T3 & 4, T4 & 7 or T5 &12 as selected by lever RST.
Shaft F is driven from shaft D by one pair of gears selected by the joystick.
Shaft E (and the feed shaft) is driven by shaft F via the constant mesh gears B6 & 14.
Shaft C and the leadscrew are driven from shaft E by gear pair 13 & T6 when the WXYZ selector is in the X position or gear or gear pair 14 & T7 in the Z position.
Cluster G is driven from shaft F but doesn't perform any drive function.

Imperial screwcuting and D.P.

The path through the gearbox is the same for both: the only difference between them is the arrangement of the gears on the swing frame.

Selector WXYZ is always in the W position so shaft C is directly coupled to shaft B by clutch C3.

19TPI & D.P. of 19 are a special case. In this instance selector ABC is in the C position engaging clutch C1 so output shaft C is driven directly by the input shaft: all other elements are idlers.
For all other pitches :-
Cluster G is driven from shaft A by gear pair T1 & 1 when the ABC selector is in the A position or T2 & 2 when in the B position.
Shaft F is driven from cluster G by the constant mesh pair 2 & G1.
Although shaft E (and the feed shaft) is driven by constant mesh pair B6 & 14 it performs no intended function as the gears on it are not engaged with those on shaft C as selector WXYZ is always in the W position.
Shaft D is driven from shaft F by one pair of gears selected by the joystick.
Shaft B, shaft C and the leadscrew are driven from shaft D by gear pairs T3 & 4, T4 & 7 or T5 &12 as selected by lever RST.

Scewcutting tables

The following 2 pages list the screwcutting pitches in mm and TPI for all combinations of the selector settings and the standard gears on the swing frame.
The first character of the setting is ‘N’ for normal, i.e. the normal arrangement of gears on the swing frame for screwcutting and ‘M’ applies to the arrangement normally used when cutting DP or Mod but could be useful when an abnormal pitch is required. e.g. the setting MLCTZ5 giving 44.98 TPI is a reasonable approximation to 45 TPI.
The second character is ‘H’ or ‘L’ is for the position of the H/L selector.
The third is ‘A’, ’B’ or ‘C’, the fourth is ‘R’, ‘S’ or ‘T’ and the fifth is ‘W’, ‘X’, ‘Y’ or ‘Z’ for the respectively marked controls.
The final character is for the position of the joystick.

Standard TPI pitches (i.e. those on the faceplate) are red and standard metric pitches are magenta.

Screwcutting pitch errors

Because of the lack of a 127 tooth gear in the train, there is a constant, but trivial, error in metric pitches on imperial leadscrew machine or imperial pitches on metric models.
Metric pitches on an imperial machine are 0.0027% oversize e.g. an error of 0.004mm on 150mm of screwed length.
Imperial pitches are 0.0027% undersize e.g. an error of 0.00016” on 6” screwed length.

Screwcutting table page 1

TPI	Selectors	mm	TPI	Selectors	mm	TPI	Selectors	mm	TPI	Selectors	mm	TPI	Selectors	Mm
161.6	MLCTX1	0.157	58.54	MLBRW5	0.434	39.08	NLCSX7	0.650	26.94	MLCRX6	0.943	21.00	MHARW4	1.21
143.7	MLCTX2	0.177	57.47	MLCTZ2	0.442	39.00	NLASW7	0.651	26.94	MHCTX6	0.943	20.36	MLBSW1	1.25
129.3	MLCTX3	0.196	56.44	NLCSX2	0.450	38.18	MLASW3	0.665	26.73	MLATW8	0.950	20.32	NLCSZ3	1.25
127.0	NLCTX1	0.200	56.22	MLCSX5	0.452	36.94	NLCTZ4	0.688	26.73	MHARW8	0.950	20.20	MHCSX1	1.26
117.6	MLCTX4	0.216	56.00	MLBRW4	0.454	36.94	MLCTZ8	0.688	26.00	NLBSW7	0.977	20.00	NLBSW3	1.27
112.9	NLCTX2	0.225	56.00	NLBRW8	0.454	36.28	NLCSX8	0.700	25.86	MLCSZ3	0.982	19.89	MLCSZ7	1.28
112.4	MLCTX5	0.226	54.00	NLARW2	0.470	36.00	NLASW6	0.706	25.45	MLBSW3	0.998	19.54	NHCTX7	1.30
107.8	MLCTX6	0.236	53.88	MLCSX6	0.471	36.00	NLBRW2	0.706	25.40	NLCSZ1	1.00	19.54	NLCRX7	1.30
106.9	MLARW8	0.238	53.46	MLASW8	0.475	35.92	MHCTX2	0.707	25.40	NLCRX3	1.00	19.50	NLATW7	1.30
101.6	NLCTX3	0.250	52.00	NLBRW7	0.488	35.92	MLCRX2	0.707	25.40	NHCTX3	1.00	19.50	NHARW7	1.30
99.47	MLCTX7	0.255	51.72	MLCTZ3	0.491	35.64	MLBSW8	0.713	24.87	MHCTX7	1.02	19.09	MLATW3	1.33
99.27	MLARW7	0.256	50.91	MLBRW3	0.499	35.34	NLCTZ5	0.719	24.87	MLCRX7	1.02	19.09	MHARW3	1.33
92.36	NLCTX4	0.275	50.80	NLCTZ1	0.500	34.50	NLASW5	0.736	24.82	MHARW7	1.02	19.00	NLCSW8	1.34
92.36	MLCTX8	0.275	50.80	NLCSX3	0.500	34.36	MLASW2	0.739	24.82	MLATW7	1.02	18.47	MLCSZ8	1.38
91.64	MLARW6	0.277	49.73	MLCSX7	0.511	33.87	NLCTZ6	0.750	24.18	MLCSW8	1.05	18.47	NLCSZ4	1.38
88.34	NLCTX5	0.288	49.64	MLASW7	0.512	33.09	MLBSW7	0.768	24.00	NLBSW6	1.06	18.14	NLCRX8	1.40
87.82	MLARW5	0.289	48.00	NLARW1	0.529	33.00	NLASW4	0.770	24.00	NLASW1	1.06	18.14	NHCTX8	1.40
84.66	NLCTX6	0.300	48.00	NLBRW6	0.529	32.33	MHCTX3	0.786	23.51	MLCSZ4	1.08	18.00	NLATW6	1.41
84.00	NLARW8	0.302	47.02	MLCTZ4	0.540	32.33	MLCRX3	0.786	23.09	NLCRX4	1.10	18.00	NLBSW2	1.41
84.00	MLARW4	0.302	46.18	NLCSX4	0.550	32.33	MLCSZ1	0.786	23.09	MLCRX8	1.10	18.00	NHARW6	1.41
80.82	MLCSX1	0.314	46.18	MLCSX8	0.550	32.00	NLBRW1	0.794	23.09	NHCTX4	1.10	17.96	MHCSX2	1.41
78.15	NLCTX7	0.325	46.00	NLBRW5	0.552	31.75	NHCTX1	0.800	23.09	MHCTX8	1.10	17.82	MLBTW8	1.43
78.00	NLARW7	0.326	45.82	MLASW6	0.554	31.75	NLCRX1	0.800	23.00	NLBSW5	1.10	17.82	MHBRW8	1.43
76.36	MLARW3	0.333	45.82	MLBRW2	0.554	31.26	NLCTZ7	0.813	22.91	MHARW6	1.11	17.67	NLCSZ5	1.44
72.57	NLCTX8	0.350	45.15	NLCTZ2	0.563	30.55	MLBSW6	0.832	22.91	MLBSW2	1.11	17.25	NLATW5	1.47
72.00	NLARW6	0.353	44.98	MLCTZ5	0.565	30.55	MLASW1	0.832	22.91	MLATW6	1.11	17.25	NHARW5	1.47
71.84	MLCSX2	0.354	44.17	NLCSX5	0.575	30.00	NLASW3	0.847	22.58	NLCSZ2	1.13	17.18	MHARW2	1.48
71.27	MLBRW8	0.356	44.00	NLBRW4	0.577	29.39	MHCTX4	0.864	22.49	MLCSZ5	1.13	17.18	MLATW2	1.48
69.00	NLARW5	0.368	43.91	MLASW5	0.578	29.39	MLCRX4	0.864	22.09	NLCRX5	1.15	16.93	NLCSZ6	1.50
68.73	MLARW2	0.370	43.10	MLCTZ6	0.589	29.27	MLBSW5	0.868	22.09	NHCTX5	1.15	16.55	MLBTW7	1.54
66.18	MLBRW7	0.384	42.33	NLCSX6	0.600	29.03	NLCTZ8	0.875	22.00	NLBSW4	1.15	16.55	MHBRW7	1.54
66.00	NLARW4	0.385	42.00	NLASW8	0.605	28.73	MLCSZ2	0.884	21.95	MHARW5	1.16	16.50	NHARW4	1.54
64.65	MLCTZ1	0.393	42.00	MLASW4	0.605	28.22	NHCTX2	0.900	21.95	MLATW5	1.16	16.50	NLATW4	1.54
64.65	MLCSX3	0.393	40.73	MLBRW1	0.624	28.22	NLCRX2	0.900	21.55	MLCSZ6	1.18	16.16	MHCSX3	1.57
63.50	NLCSX1	0.400	40.64	NLCTZ3	0.625	28.11	MLCRX5	0.904	21.17	NLCRX6	1.20	16.16	MLCRZ1	1.57
61.09	MLBRW6	0.416	40.41	MHCTX1	0.629	28.11	MHCTX5	0.904	21.17	NHCTX6	1.20	16.16	MHCTZ1	1.57
61.09	MLARW1	0.416	40.41	MLCRX1	0.629	28.00	NLBSW8	0.907	21.00	NHARW8	1.21	16.00	NLBSW1	1.59
60.00	NLARW3	0.423	40.00	NLBRW3	0.635	28.00	MLBSW4	0.907	21.00	MLATW4	1.21	15.88	NHCSX1	1.60
58.78	MLCSX4	0.432	39.79	MLCTZ7	0.638	27.00	NLASW2	0.941	21.00	NLATW8	1.21	15.63	NLCSZ7	1.63

Screwcutting table page 2

TPI	Selectors	mm	TPI	Selectors	mm	TPI	Selectors	mm	TPI	Selectors	mm	TPI	Selectors	mm
15.27	MHBRW6	1.66	11.54	MHCSX8	2.20	9.000	NHASW6	2.82	6.205	MHATW7	4.09	4.041	MHCRZ1	6.29
15.27	MLBTW6	1.66	11.54	NHCSX4	2.20	8.980	MHCRX2	2.83	6.046	MHCSW8	4.20	4.000	NHBSW1	6.35
15.27	MLATW1	1.66	11.50	NHBRW5	2.21	8.909	MHBSW8	2.85	6.000	NHBSW6	4.23	3.908	NHCSZ7	6.50
15.27	MHARW1	1.66	11.50	NLBTW5	2.21	8.835	NLCRZ5	2.87	6.000	NHASW1	4.23	3.818	MHBTW6	6.65
15.00	NHARW3	1.69	11.46	MHBRW2	2.22	8.835	NHCTZ5	2.87	5.878	MHCSZ4	4.32	3.818	MHATW1	6.65
15.00	NLATW3	1.69	11.46	MHASW6	2.22	8.625	NHASW5	2.94	5.773	MHCRX8	4.40	3.750	NHATW3	6.77
14.69	MHCSX4	1.73	11.46	MLBTW2	2.22	8.591	MHASW2	2.96	5.773	NHCRX4	4.40	3.659	MHBTW5	6.94
14.64	MLBTW5	1.74	11.29	NHCTZ2	2.25	8.466	NHCTZ6	3.00	5.750	NHBSW5	4.42	3.628	NHCSZ8	7.00
14.64	MHBRW5	1.74	11.29	NLCRZ2	2.25	8.466	NLCRZ6	3.00	5.727	MHBSW2	4.44	3.592	MHCRZ2	7.07
14.51	NLCSZ8	1.75	11.24	MHCTZ5	2.26	8.273	MHBSW7	3.07	5.727	MHATW6	4.44	3.500	NHBTW8	7.26
14.37	MHCTZ2	1.77	11.24	MLCRZ5	2.26	8.250	NHASW4	3.08	5.644	NHCSZ2	4.50	3.500	MHBTW4	7.26
14.37	MLCRZ2	1.77	11.04	NHCSX5	2.30	8.082	MHCRX3	3.14	5.622	MHCSZ5	4.52	3.375	NHATW2	7.53
14.11	NHCSX2	1.80	11.00	NHBRW4	2.31	8.082	MHCSZ1	3.14	5.522	NHCRX5	4.60	3.250	NHBTW7	7.82
14.05	MHCSX5	1.81	11.00	NLBTW4	2.31	8.000	NHBRW1	3.17	5.500	NHBSW4	4.62	3.233	MHCRZ3	7.86
14.00	MHBRW4	1.81	10.98	MHASW5	2.31	8.000	NLBTW1	3.17	5.489	MHATW5	4.63	3.182	MHBTW3	7.98
14.00	NHBRW8	1.81	10.77	MHCTZ6	2.36	7.937	NHCRX1	3.20	5.388	MHCSZ6	4.71	3.175	NHCRZ1	8.00
14.00	NLBTW8	1.81	10.77	MLCRZ6	2.36	7.815	NLCRZ7	3.25	5.292	NHCRX6	4.80	3.000	NHBTW6	8.47
14.00	MLBTW4	1.81	10.58	NHCSX6	2.40	7.815	NHCTZ7	3.25	5.250	MHATW4	4.84	3.000	NHATW1	8.47
13.50	NHARW2	1.88	10.50	NHASW8	2.42	7.636	MHASW1	3.33	5.250	NHATW8	4.84	2.939	MHCRZ4	8.64
13.50	NLATW2	1.88	10.50	MHASW4	2.42	7.636	MHBSW6	3.33	5.091	MHBSW1	4.99	2.875	NHBTW5	8.83
13.47	MHCSX6	1.89	10.18	MLBTW1	2.49	7.500	NHASW3	3.39	5.080	NHCSZ3	5.00	2.864	MHBTW2	8.87
13.36	MHASW8	1.90	10.18	MHBRW1	2.49	7.347	MHCRX4	3.46	5.000	NHBSW3	5.08	2.822	NHCRZ2	9.00
13.00	NHBRW7	1.95	10.16	NHCTZ3	2.50	7.318	MHBSW5	3.47	4.973	MHCSZ7	5.11	2.811	MHCRZ5	9.04
13.00	NLBTW7	1.95	10.16	NLCRZ3	2.50	7.257	NHCTZ8	3.50	4.884	NHCRX7	5.20	2.750	NHBTW4	9.24
12.93	MHCTZ3	1.96	10.10	MHCRX1	2.51	7.257	NLCRZ8	3.50	4.875	NHATW7	5.21	2.694	MHCRZ6	9.43
12.93	MLCRZ3	1.96	10.00	NLBTW3	2.54	7.184	MHCSZ2	3.54	4.773	MHATW3	5.32	2.545	MHBTW1	9.98
12.73	MHBRW3	2.00	10.00	NHBRW3	2.54	7.055	NHCRX2	3.60	4.750	NHCSW8	5.35	2.540	NHCRZ3	10.0
12.73	MLBTW3	2.00	9.947	MHCTZ7	2.55	7.027	MHCRX5	3.61	4.618	NHCSZ4	5.50	2.500	NHBTW3	10.2
12.70	NLCRZ1	2.00	9.947	MLCRZ7	2.55	7.000	MHBSW4	3.63	4.618	MHCSZ8	5.50	2.487	MHCRZ7	10.2
12.70	NHCTZ1	2.00	9.769	NHCSX7	2.60	7.000	NHBSW8	3.63	4.536	NHCRX8	5.60	2.309	MHCRZ8	11.0
12.70	NHCSX3	2.00	9.750	NHASW7	2.61	6.750	NHASW2	3.76	4.500	NHBSW2	5.64	2.309	NHCRZ4	11.0
12.43	MHCSX7	2.04	9.545	MHASW3	2.66	6.735	MHCRX6	3.77	4.500	NHATW6	5.64	2.250	NHBTW2	11.3
12.41	MHASW7	2.05	9.236	NLCRZ4	2.75	6.682	MHATW8	3.80	4.455	MHBTW8	5.70	2.209	NHCRZ5	11.5
12.00	NHBRW6	2.12	9.236	MHCTZ8	2.75	6.500	NHBSW7	3.91	4.417	NHCSZ5	5.75	2.117	NHCRZ6	12.0
12.00	NLBTW6	2.12	9.236	MLCRZ8	2.75	6.465	MHCSZ3	3.93	4.312	NHATW5	5.89	2.000	NHBTW1	12.7
12.00	NHARW1	2.12	9.236	NHCTZ4	2.75	6.364	MHBSW3	3.99	4.295	MHATW2	5.91	1.954	NHCRZ7	13.0
12.00	NLATW1	2.12	9.071	NHCSX8	2.80	6.350	NHCSZ1	4.00	4.233	NHCSZ6	6.00	1.814	NHCRZ8	14.0
11.76	MHCTZ4	2.16	9.000	NHBRW2	2.82	6.350	NHCRX3	4.00	4.136	MHBTW7	6.14			
11.76	MLCRZ4	2.16	9.000	NLBTW2	2.82	6.217	MHCRX7	4.09	4.125	NHATW4	6.16			

Feeds

Selector WXYZ is always in the Y position so there is no engagement between shaft C and any other shaft. i.e. the leadscrew is undriven.
Selector ABC is always in the C position engaging clutch C1 coupling shaft B to shaft A.
Shaft D is driven from shaft B (and A) by gear pairs T3 & 4, T4 & 7 or T5 &12 as selected by lever RST.
Shaft F is driven from shaft D by one pair of gears selected by the joystick.
Shaft E and the feed shaft are driven by shaft F via the constant mesh gears B6 & 14.

The following table shows all the available feed rates when the swing frame is fitted with the normal gear arrangement. Feeds will be reduced by about 21% of tabulated values when the swing frame is set up for DP/MOD.

The greyed out settings, with the H/L control set to H, should not be used as the H position should not be used when the spindle speed is greater than 625 rpm.

Feed table for imperial models					
mm	Y	Ins	mm	Y	ins
0.039	LCT1	0.0015	0.156	HCT1	0.0061
0.044	LCT2	0.0017	0.175	HCT2	0.0069
0.049	LCT3	0.0019	0.194	HCT3	0.0077
0.053	LCT4	0.0021	0.214	HCT4	0.0084
0.056	LCT5	0.0022	0.224	HCT5	0.0088
0.058	LCT6	0.0023	0.233	HCT6	0.0092
0.063	LCT7	0.0025	0.253	HCT7	0.0100
0.068	LCT8	0.0027	0.272	HCT8	0.0107
0.078	LCS1	0.0031	0.311	HCS1	0.0122
0.087	LCS2	0.0034	0.350	HCS2	0.0138
0.097	LCS3	0.0038	0.389	HCS3	0.0153
0.107	LCS4	0.0042	0.428	HCS4	0.0168
0.112	LCS5	0.0044	0.447	HCS5	0.0176
0.117	LCS6	0.0046	0.467	HCS6	0.0184
0.126	LCS7	0.0050	0.506	HCS7	0.0199
0.136	LCS8	0.0054	0.544	HCS8	0.0214
0.156	LCR1	0.0061	0.622	HCR1	0.0245
0.175	LCR2	0.0069	0.700	HCR2	0.0276
0.194	LCR3	0.0077	0.778	HCR3	0.0306
0.214	LCR4	0.0084	0.856	HCR4	0.0337
0.224	LCR5	0.0088	0.895	HCR5	0.0352
0.233	LCR6	0.0092	0.933	HCR6	0.0367
0.253	LCR7	0.0100	1.011	HCR7	0.0398
0.272	LCR8	0.0107	1.089	HCR8	0.0429

It is probable that feeds for metric models are about 5% greater than those shown above.