

## 5.11 GEARBOX continued

Feeds coarser than those shown on the chart can be obtained by placing lever 'N' in the "coarse" position which gives a 4 to 1 coarse pitch ratio. The rear speed selection lever 'F' on the headstock should then be placed in the "Low Gear" position. Refer to section 4.1. These very coarse feeds should always be used with discretion.

Feeds can also be halved by engaging the 4 to 1 coarse pitch ratio and placing the rear speed selection lever 'F' in the "High Gear" position. Thus 9 finer longitudinal feeds from .0008 in. to .00045 in. per rev. may be obtained, on lathes with belt overdrive these feeds are from .0005 to .0003 in. per rev.

A safety spring loaded coupling transmits the feed through the feed shaft to the apron. The slipping load is pre-set, and cannot be adjusted.

The feeds at the higher spindle speeds are limited by the speeds of the feed gearing and the long feed shaft thus:

Up to 1000 R.P.M.	max. feed is .0256 in. (.650 m.m.) per rev.
at 1120 R.P.M.	max. feed is .0216 in. (.549 m.m.) per rev.
at 1400 R.P.M.	max. feed is .016 in. (.406 m.m.) per rev.
at 1600 R.P.M.	max. feed is .0142 in. (.361 m.m.) per rev.
at 2240 R.P.M.	max. feed is .0111 in. (.282 m.m.) per rev.

NOTE: With the lever 'R' set to module, millimetre or inches pitch the feed shaft is still engaged. But in this condition the lathe should not be used for normal turning, the lever must be put over to the right hand "feed" position.

		INDICATOR POSITION										
		1	2	3	4	5	6	7	8	9		
CHANGE GEARS	THREADS PER INCH	4	4 1/2	4 3/4	5	5 1/2	5 3/4	6	6 1/2	7		
		8	9	9 1/2	10	11	11 1/2	12	13	14		
		16	18	19	20	22	23	24	26	28		
		32	36	38	40	44	46	48	52	56		
		64	72	76	80	88	92	96	104	112		
END BOX 30	NORMAL PITCH IN MM.	4	4.5	4.75	5	5.5	5.75	6	6.5	7		
		2	2.25		2.5	2.75		3	3.25	3.5		
		1	1.125		1.25	1.375		1.5		1.75		
INTER STUD 55	LONGI-TUDINAL FEEDS IN THOUS. PER REV.	0.5						0.75		0.875		
		CROSS FEEDS 2/3 x NUMBERS BELOW										
SCREW 60	LONGI-TUDINAL FEEDS IN THOUS. PER REV.	25.6	22.8	21.6	20.5	18.6	17.8	17.1	15.8	14.6		
		12.8	11.4	10.8	10.2	9.30	8.90	8.55	7.90	7.30		
		6.4	5.70	5.40	5.12	4.65	4.45	4.27	3.95	3.65		
		3.2	2.85	2.70	2.56	2.32	2.22	2.13	1.97	1.82		
		1.6	1.42	1.35	1.28	1.16	1.11	1.06	0.98	0.91		

### ELECTRICAL INTERLOCK.

The lathe will not run unless the change gear cover is in position.

### CHANGE GEARS.

These are 12 D.P. 14 1/2° pressure angle.

### LEADSCREW.

This is designed to be reversible, after eventual wear on the flanks of the thread it can be removed by following the instructions (section 11.51), relating to the removal of the leadscrew only.

## 6.1 THREAD CUTTING

When setting the change gears it is important that there should be .005" to .008" backlash between each set of gears. This ensures that the drive to the screw will be smooth and that no undue stress is set up on the change gear stud, which might lead to breakage. No difficulty should be encountered when mounting the change gears if they are set according to the diagrams on the plates.

When cutting pitches other than T.P.I. shown on the screwcutting dial, (Section 6.2) the leadscrew nuts must not be disengaged. The saddle being run back to the starting position by using the main clutch reverse lever.

For cutting T. P. I. shown on the dial, either the above method or the screwcutting dial can be used. The lever 'M' on the headstock (Section 5.1) is used for selecting R.H. or L.H. threads and cannot be used as a reverse during screwcutting operations.

For accurate screwcutting it is essential that all slides should be adjusted properly, without backlash and locked when possible.

When cutting large Helix Angle Screws the tool slide should be locked during each cut to obviate any digging in of the tool.

As the leadscrew thrust is taken on ball thrust bearings there should be no wear, any slackness will be due to the checknut inside the gearbox, easing off, this should be re-tightened.

The leadscrew is 1.3/8 in. diameter, 1/4 in. pitch right hand acme thread.

Change gears for all standard types of threads are shown in the accompanying charts.

The method of finding change gears for threads and pitches not shown on the charts, is to select a thread or pitch near to the one required and modify the change gear ratio given on the chart in proportion to the thread or pitch required.

$$\text{Ratio} = \frac{\text{Gear Ratio On Chart} \times \text{Pitch Required.}}{\text{Pitch Selected.}}$$

$$\text{OR } \frac{\text{Gear Ratio On Chart} \times \text{T.P.I. Selected.}}{\text{T.P.I. Required.}}$$

Example 1. Required 15 T.P.I. Standard Whitworth Thread.

Thread selected from chart, 20 T.P.I.

$$\text{Ratio} = \frac{30}{55} \times \frac{55}{60} \times \frac{20}{15} = \frac{30}{60} \times \frac{20}{15} = \frac{2}{3} = \frac{30}{45}$$

Change gears. N = 30T. Inter. 55T. S = 45T.

Set the gearbox to give 20 T.P.I. and arrange the change gears as indicated.

Example 2. Required 15/16 inches pitch.

Pitch selected from chart, 5/8 inches pitch.

$$\text{Ratio} = \frac{30}{55} \times \frac{55}{60} \times \frac{15/16}{5/8} = \frac{30}{60} \times \frac{15}{10} = \frac{30}{40}$$

Change gears. N = 30T. Inter. 55T. S = 40T.

Set the gearbox to give 5/8 inches pitch and arrange the change gears as indicated.

It is possible by varying T. P. I. or pitch selected to use change gears which may be a stock item. The numbers of teeth may be noted from the gears shown on the charts. (Section 6.11 & 6.12).

## 6.11 THREAD CUTTING continued

### INCH AND MM. PITCHES

Lever 'N' on the headstock should be set to the "Normal" or "Coarse" pitch as required.

Set levers 'R' and 'S' on the gear-box to the required type of pitch, and levers 'P' and 'U' to the positions shown on the chart.

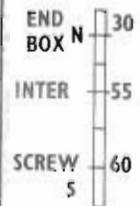
The indicator 'T' should be set to the column number in which the required pitch appears on the chart.

For 32 to 56 MM. pitches, set to "Coarse" pitch on the headstock and reverse the change gears, i.e. N=60T, 55T, Inter, S. = 30T.

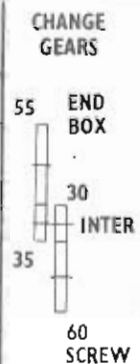
### DIAMETRAL AND MODULE PITCHES

Arrange the change gears as shown and operate as above.

INDICATOR	1	2	3	4	5	6	7	8	9	FOR 32 TO 56 M.M. SET TO COARSE AND REVERSE CHANGE GEARS	
SCREW PITCHES IN MILLIMETRES											CHANGE GEARS
LEVERS											
E	B	32	36	38	40	44	46	48	52	56	COARSE
E	B	8	9	9.5	10	11	11.5	12	13	14	
E	A	4	4.5	4.75	5	5.5	5.75	6	6.5	7	NORMAL
E	B	2	2.25		2.5	2.75		3	3.25	3.5	
D	A	1			1.25			1.5		1.75	NORMAL
D	B	0.5						0.75			
SCREW PITCHES IN INCHES											
E	A	1	1 1/8	1 1/4	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/4	COARSE
E	B	1/2	9/16	5/8	11/16	3/4	13/16	7/8			
E	A	1/4	9/32		5/16	11/32		3/8	13/32	7/16	NORMAL
E	B	1/8			5/32			3/16		7/32	



INDICATOR	1	2	3	4	5	6	7	8	9	CHANGE GEARS	
DIAMETRAL PITCHES											CHANGE GEARS
LEVERS											
D	A	2	2.25	2.375	2.5	2.75	2.875	3	3.25	3.5	COARSE
D	B	4	4.5	4.75	5	5.5	5.75	6	6.5	7	
D	A	8	9	9.5	10	11	11.5	12	13	14	NORMAL
D	B	16	18	19	20	22	23	24	26	28	
E	A	32	36	38	40	44	46	48	52	56	NORMAL
E	B	64	72	76	80	88	92	96	104	112	
E	C	128	144	152	160	176	184	192	208	224	
MODULE PITCHES											
E	A	8	9	9.5	10	11	11.5	12	13	14	COARSE
E	B	4	4.5	4.75	5	5.5	5.75	6	6.5	7	
E	A	2	2.25		2.5	2.75		3	3.25	3.5	NORMAL
E	B	1			1.25			1.5		1.75	
E	C	0.5						0.75			

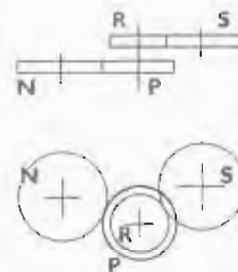


### B. A. AND OTHER THREADS.

Arrange the change gears to suit the chart.

Set to the T.P.I. shown on the chart and operate the other levers in the ordinary way.

B.A. No.	PITCH M.M.	SET TO T.P.I.	CHANGE GEARS			
			N	P	R	S
0	1	64	63	40	50	
1	0.9	80	63	40	45	50
2	0.81	64	50	35	45	63
3	0.73	64	65	45	35	55
4	0.66	104	45	50	60	40
5	0.59	80	65	35	30	60
6	0.53	88	63	40	35	60
7	0.48	104	45	55	60	50
8	0.43	112	45	38	40	50
9	0.39	112	63	55	45	60
10	0.35	92	38	55	60	



CHANGE GEARS

OTHER THREADS		
THREAD REQUIRED	THREAD SET FOR	CHANGE GEARS N INTER S
13 1/2 T.P.I.	18 T.P.I.	40 55 60
27 T.P.I.	36 T.P.I.	40 55 60
33 1/2 T.P.I.	40 T.P.I.	30 35 50
42 T.P.I.	40 T.P.I.	30 35 63
60 T.P.I.	80 T.P.I.	40 35 60
2" PITCH	1/2" PITCH	60 55 30

## 6.12 THREAD CUTTING continued

DIRECT DRIVE FOR T. P. I. MODULE, METRIC, INCH AND DIAMETRAL PITCHES.

Arrange the change gears to suit the chart.

Set lever 'N' on headstock to "Normal" or "Coarse" pitch as required.

NOTE: Lever 'R' and 'S' on the gearbox MUST be set to the "Direct Drive" position, and lever 'P' to the position shown on the chart.

Lever 'U' should be placed in the neutral position.

T.P.I. WITH DIRECT DRIVE									
SET LEVERS TO DIRECT DRIVE									
T.P.I. OBTAINED					CHANGE GEARS				
COARSE		NORMAL							
A	B	A	B	C	N	P	R	S	
1	2	4	8	16	40	50	40		
		4 <sup>1</sup> / <sub>2</sub>	9	18	40	50	45		
		4 <sup>3</sup> / <sub>4</sub>	9 <sup>1</sup> / <sub>2</sub>	19	44	38	40	55	
	2 <sup>1</sup> / <sub>2</sub>	5	10	20	40	45	50		
	2 <sup>5</sup> / <sub>8</sub>	5 <sup>1</sup> / <sub>2</sub>	10 <sup>1</sup> / <sub>2</sub>	21	60	50	40	63	
		5 <sup>1</sup> / <sub>2</sub>	11	22	40	45	55		
		5 <sup>3</sup> / <sub>4</sub>	11 <sup>1</sup> / <sub>2</sub>	23	40	50	40	46	
	3	6	12	24	40	45	60		
		6 <sup>1</sup> / <sub>2</sub>	13	26	40	45	63		
		6 <sup>3</sup> / <sub>4</sub>	13 <sup>1</sup> / <sub>2</sub>	27	40	45	40	60	
	3 <sup>1</sup> / <sub>2</sub>	7	14	28	45	50	40	63	
		7 <sup>1</sup> / <sub>2</sub>	15	30	40	50	40	60	
		8	16	32	30	55	60		
				36	40	45	30	60	
				40	40	50	30	60	

MODULE PITCHES WITH DIRECT DRIVE									
SET LEVERS TO DIRECT DRIVE									
MODULE PITCH OBTAINED					CHANGE GEARS				
COARSE		NORMAL							
A	B	A	B	C	N	P	R	S	
16	8	4	2	1	63	35	55	50	
15	7.5	3.75			66	40	45	40	
14	7	3.5	1.75		63	40	55	50	
13	6.5	3.25			55	35	45	44	
12	6	3	1.5	0.75	66	40	45	50	
11	5.5	2.75			60	35	50	63	
10	5	2.5	1.25		55	40	45	50	
9	4.5	2.25			65	35	30	50	

DIRECT DRIVE FOR B.A. THREADS

Arrange the change gears to suit the chart.

Set lever 'N' on the headstock to "Normal" pitch. Set levers 'R' and 'S' on the gearbox to the "Direct Drive" position, and lever 'P' to the central position. (C)

Place lever 'U' in the neutral position.

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METRIC PITCHES WITH DIRECT DRIVE									
SET LEVERS TO DIRECT DRIVE									
METRIC PITCHES OBTAINED					CHANGE GEARS				
COARSE		NORMAL							
A	B	A	B	C	N	P	R	S	
52	26	13	6.5	3.25	65	50	63	40	
50	25	12.5	6.25		63	40	50	40	
48	24	12	6	3	63	40	60	50	
44	22	11	5.5	2.75	63	40	55	50	
40	20	10	5	2.5	63	50	40	40	
36	18	9	4.5	2.25	63	40	45	50	
32	16	8	4	2	63	40	50	50	
30	15	7.5	3.75		63	40	45	60	
28	14	7	3.5	1.75	63	40	35	50	
24	12	6	3	1.5	63	40	30	50	
20	10	5	2.5	1.25	63	40	30	60	
16	8	4	2	1	63	50	30	60	
B	4	2	1	0.5	30	65	45	66	

INCHES PITCH WITH DIRECT DRIVE									
SET LEVERS TO DIRECT DRIVE									
INCHES PITCH OBTAINED					CHANGE GEARS				
COARSE		NORMAL							
A	B	A	B	C	N	P	R	S	
2	1	1/2	1/4	1/8	60	55	30		
1 7/8	15/16	13/32			60	40	50	40	
1 7/16	7/8	7/16	3/32		63	40	50	45	
1 5/8	13/16	13/32			65	45	40		
1 1/2	3/4	3/8	3/16	3/32	60	45	40		
1 3/8	11/16	11/32			55	50	40		
1 1/4	3/4	3/16	3/32		50	55	40		
1 1/8	9/16	9/32			45	50	40		

DIAMETRAL PITCHES (DIRECT DRIVE)									
SET LEVERS TO DIRECT DRIVE									
DIAM. PITCHES OBTAINED					CHANGE GEARS				
COARSE		NORMAL							
A	B	A	B	C	N	P	R	S	
2	4	8	16	32	55	45	35		
2.25	4.5	9	18	36	55	35	40	45	
2.5	5	10	20	40	55	35	40	50	
2.75	5.5	11	22	44	40	50	35		
3	6	12	24	48	55	35	40	60	
3.25	6.5	13	26	52	55	35	40	65	
3.5	7	14	28	56	44	35	45	63	

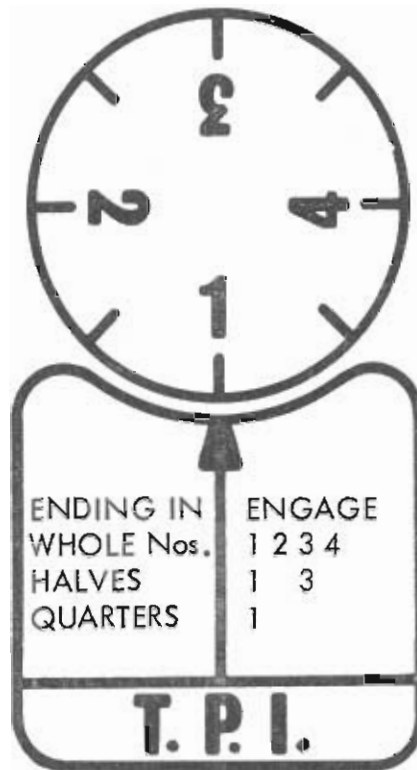
B.A. THDS. (Dir. Drive)				
SET LEVERS TO DIRECT DRIVE, C & NORMAL				
B.A. No.	CHANGE GEARS			
	N	P	R	S
0	63	50	30	60
1	63	50	27	60
2	45	42	30	63
3	39	45	35	66
4	30	50	45	65
5	39	50	30	63
6	28	55	42	64
7	27	65	40	55
8	28	64	39	63
9	27	55	30	60
10	27	65	35	66

CHANGE GEARS

TYPE 13-1 & 16 SB.

## 6.2 SCREWCUTTING DIAL



### USE OF SCREWCUTTING DIAL

This is a most useful aid to screwcutting although its use is limited to certain threads and pitches. Where applicable it enables the nuts to be engaged without cross threading. The dial may be used when cutting any pitch which is contained a whole number of times in a length of 4 in. From this it will be seen that the whole numbers of threads per inch can be cut, also threads per inch ending in quarters and halves, viz.  $2\frac{1}{4}$ ,  $2\frac{1}{2}$ , t.p.i.

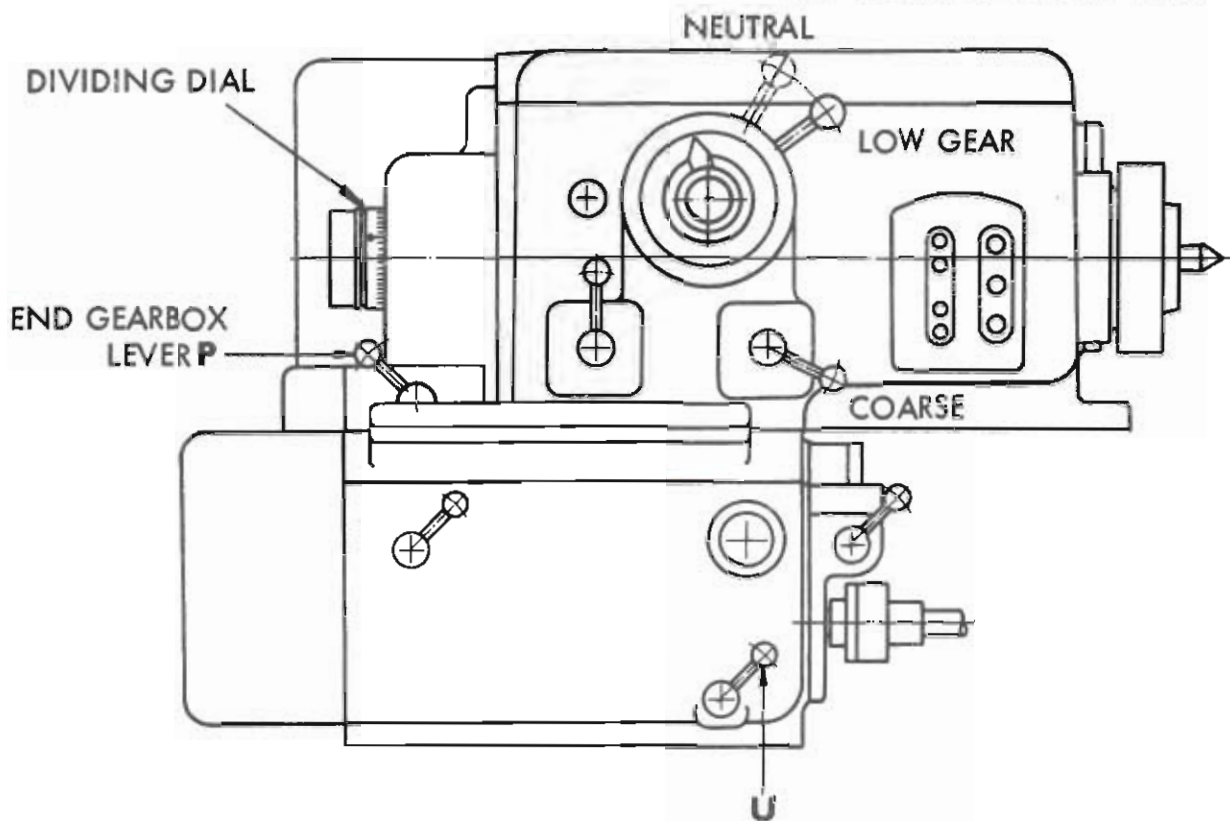
The dial makes one revolution for 16 turns of the leadscrew, and as the screw is  $\frac{1}{4}$  in. pitch this is equivalent to 4 in. length of thread on the screw. As the dial is divided into 8 divisions, the alternate ones being numbered 1 to 4, then from one numbered division to the next is  $\frac{1}{2}$  of a revolution and is equivalent to 1 in. of screw thread. It will be seen therefore that when cutting a screw having a whole number of threads per inch the spindle will make a whole number of revolutions in one inch length, and as the leadscrew likewise makes a whole number of revolutions in the same distance the leadscrew nuts can be engaged at any numbered division on the dial. From this it follows that if the threads per inch on the screw to be cut is an even number a whole number of threads is contained in  $\frac{1}{2}$  in. and the nuts may be engaged at any of the 8 divisions on the dial.

Similarly odd numbers of t.p.i. can only be engaged at any numbered division, threads ending in halves engaged at every half revolution and threads ending in quarters at every revolution. For linear inch pitches, convert the pitch to an equivalent number of threads per inch (viz.  $\frac{1}{3}$  inch pitch = 3 t.p.i.) and follow the above rules.

If the number of threads per inch is neither a whole number or does not end in  $\frac{1}{2}$  or  $\frac{1}{4}$  then the dial cannot be used, in which case the screw must be cut completely without disengaging the nuts and by using the main clutch reverse lever to run the saddle back with the nuts engaged.

(Information or advice on any particular application of the dial, will be supplied by our technical department on request.)

## 6.3 MULTIPLE START THREADS



For all multiple start threads where the number of starts will divide into 72, engage the coarse pitch ratio and use the following method of dividing.

When the first start of the thread has been cut, take up all the backlash with the work and the leadscrew turning in the direction of the cut. Set the dividing dial at the rear end of the spindle to zero. Move the rear speed selection lever on the headstock from the low gear position to the neutral position, i.e. Move lever 'F' from position 1 to position 2, see section 4.11. Rotate the spindle by hand in the direction of the cut to the next appropriate number on the dial and re-engage low gear. This procedure is repeated on completion of each subsequent start. Care should be taken not to disturb any other motion whilst this is being done.

The rear speed selection lever on the headstock controls the 18T pinion 'G' (section 4.11) which meshes with the 72T front wheel on the spindle. Thus any number of starts which will divide into 72 can be cut in this way.

5 start worms can be cut using either the normal or coarse pitch ratio and the following method of dividing.

When the first start of the thread has been cut, take up all the backlash with the work and the leadscrew turning in the direction of the cut. Set the dividing dial at the rear end of the spindle to zero. Move the lever 'P' on the end gearbox into an adjacent neutral position, and set lever operating speed cone to a neutral position and then rotate the spindle by hand in the direction of the cut to the next appropriate number on the dial, and re-engage the lever 'P'.

Repeat the procedure for each start.

## 6.31 MULTIPLE START THREADS continued

For leads shown on the charts in the normal ranges set all levers to the positions indicated, excepting lever 'U' on the gearbox which should be placed in the 'D' position instead of 'E' and engage the 4 to 1 coarse pitch ratio on the headstock. The changing of lever 'U' from 'D' to 'E' position gives a 4 to 1 ratio, thus cancelling out the coarse pitch ratio. When using the coarse pitch ratio for multiple start screws designated in T.P.I. i.e. 12 T.P.I. 3 starts, the gearbox levers should be set to the T.P.I. on the chart which is found in the following manner:-

$$\text{T.P.I. On chart} = \frac{\text{T.P.I. of work} \times 4}{\text{Number of starts}}$$

Example 1. To cut 12 T.P.I. 3 starts.

$$\text{T.P.I. on chart} = \frac{12 \times 4}{3} = 16 \text{ T.P.I.}$$

Therefore set the levers to 16 T.P.I. and coarse pitch.

If the T.P.I. thus found is not on the chart, convert to an equivalent inch pitch.

Example 2. To cut 10 T.P.I. 3 starts.

$$\text{T.P.I. on chart} = \frac{10 \times 4}{3} = \frac{40 \text{ T.P.I.}}{3} = \frac{3 \text{ ins. pitch.}}{40}$$

If the pitch is not on the chart for screw pitches, the change gears may be found from:-

$$\frac{N}{S} \text{ or } \frac{N}{P} \times \frac{R}{S} = \frac{\text{Pitch required} \times \text{T.P.I. set for}}{2}$$

Example 2. Change gears required for  $\frac{3}{40}$  ins. pitch.  
(Continued)

$$\text{Change gears} = \frac{3 \times (10 \text{ T.P.I. set for})}{40 \times 2}$$

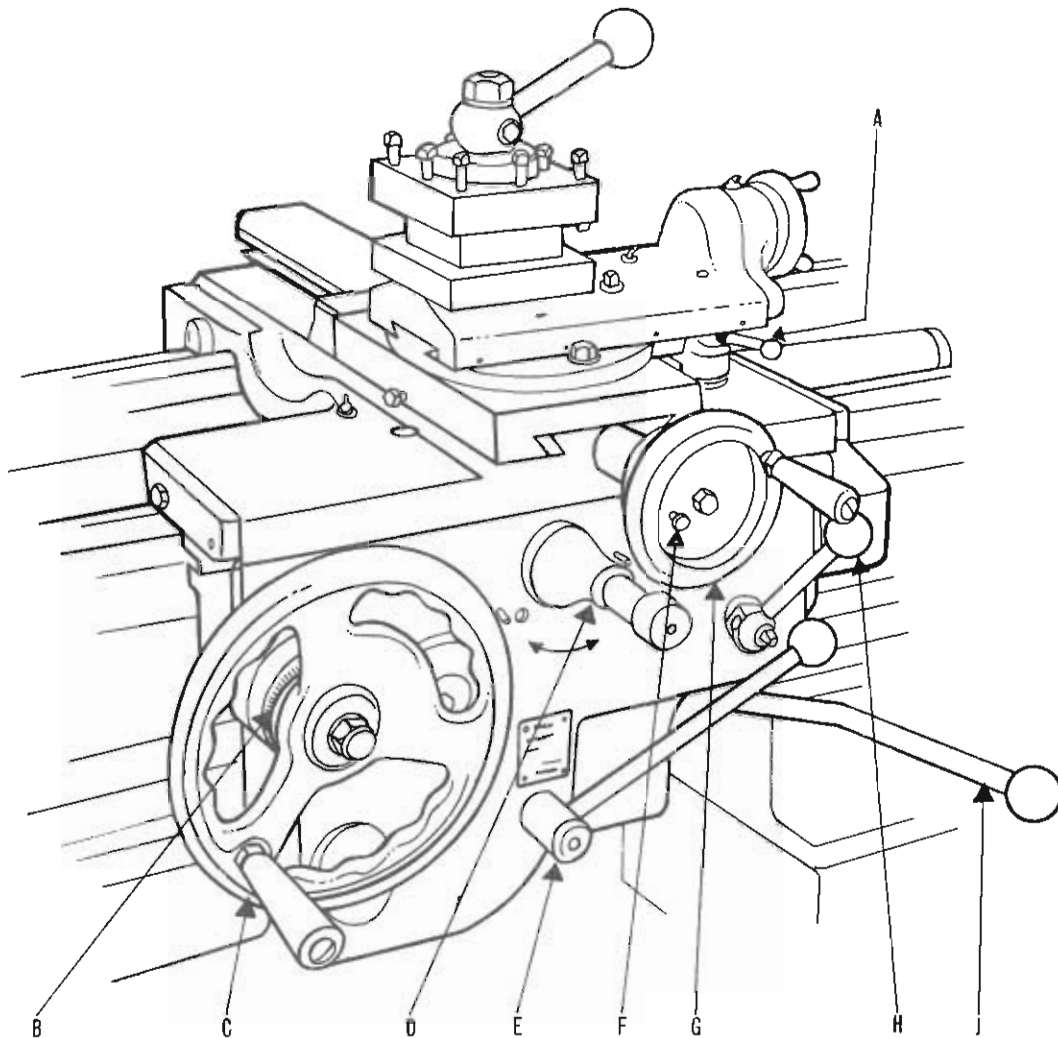
$$\text{Change gears} = \frac{3}{8} = \frac{45}{60} \times \frac{30}{60}$$

Therefore set the gearbox to give 10 T.P.I. and set to coarse pitch. Use change gears,

$$\frac{N}{P} \times \frac{R}{S} = \frac{45}{60} \times \frac{30}{60}$$

Information on any particular case will be supplied on request by our technical department.

## 7.1 APRON



Do not operate the apron before reading the lubricating instructions. Section 3.

For selection of feeds from the gearbox see section 5.

Manual movement of the apron along the bed is by means of the handwheel 'C'. Ensure that the trip lever 'E' is in the trip position and the leadscrew nut operating lever 'H' is in the dis-engaged position as shown.

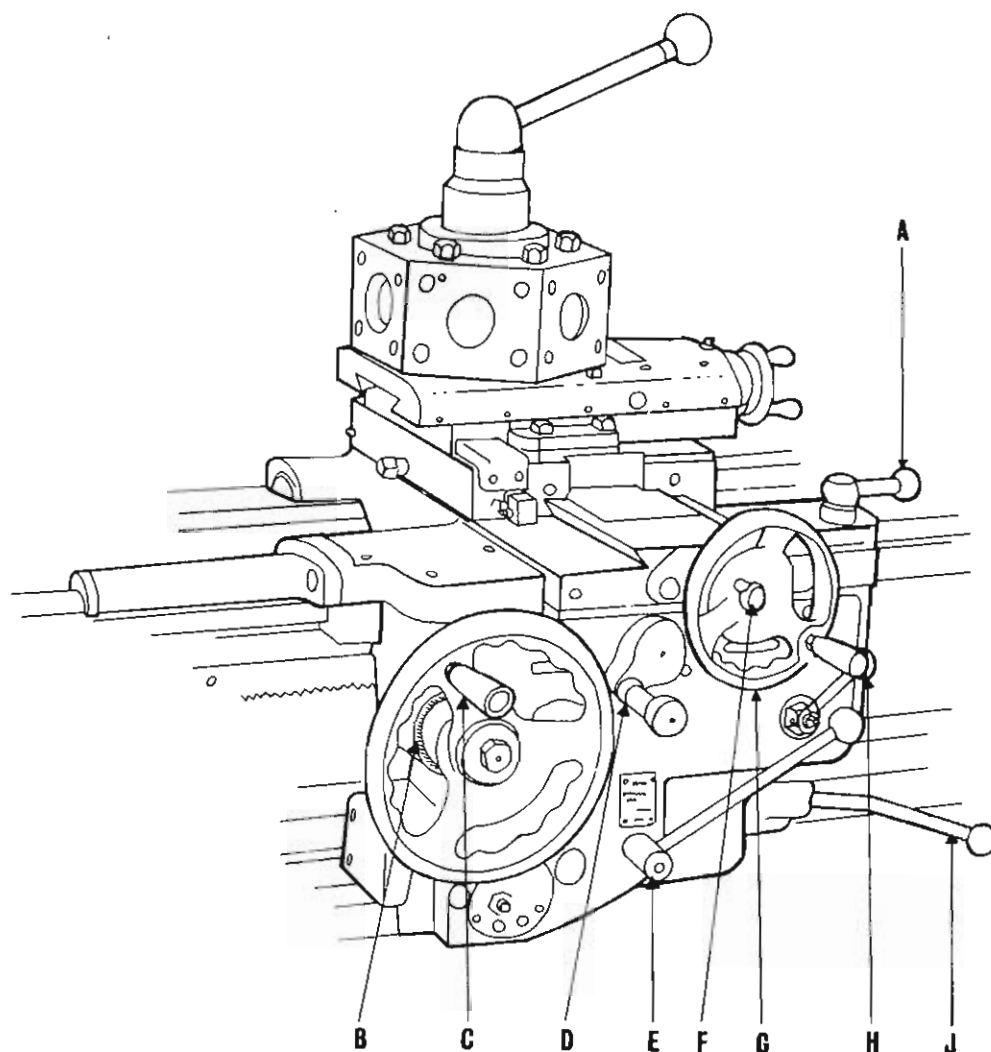
For length measurement the dial 'B' may be set to zero, it is graduated 64 divisions each division representing  $1/64$ " , thus one revolution of the handwheel gives one inch of travel. The cross slide is traversed by the handwheel 'G'. The cross feed dial may be set to zero by releasing the screw 'F'. The dial is graduated 200 divisions each division representing  $.001$ " movement of the tool or  $.002$ " alteration in the diameter of the workpiece.

Longitudinal or cross feed selection is made by lever 'D'. To operate, pull the lever out to disengage the locating plunger. When the cross feed is engaged the saddle should be clamped to the bed by lever 'A'.

The feed engage and trip lever 'E' is interlocked with the leadscrew nut operating lever 'H'. Clutch engagement lever 'J' travels with the apron and is additional to lever 'B' Section 4.1.



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For length measurement the dial 'B' may be set to zero, it is graduated 64 divisions each division representing  $1/64$ " , thus one revolution of the handwheel gives one inch of travel. The cross slide is traversed by the handwheel 'G'. The cross feed dial may be set to zero by releasing the screw 'F'. The dial is graduated 200 divisions each division representing .001" movement of the tool or .002" alteration in the diameter of the workpiece.

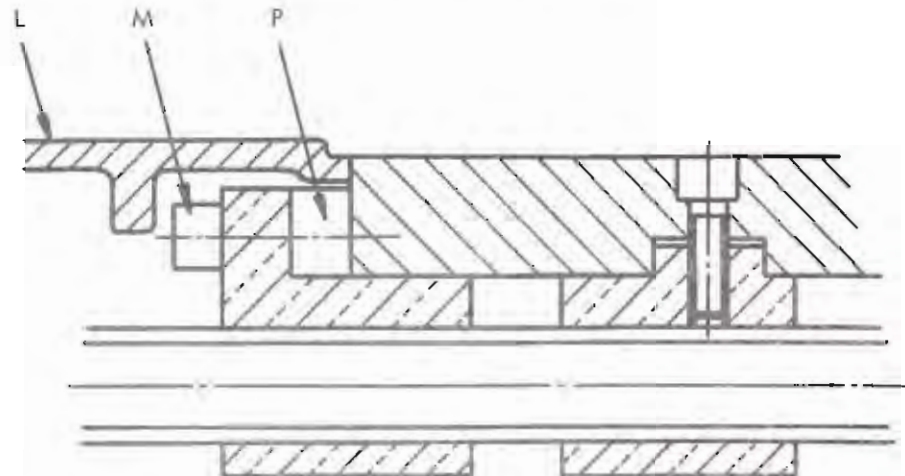
Longitudinal or cross feed selection is made by lever 'D'. To operate, pull the lever out to disengage the locating plunger. When the cross feed is engaged the saddle should be clamped to the bed by lever 'A'.

The feed engage and trip lever 'E' is interlocked with the leadscrew nut operating lever 'H'. Clutch engagement lever 'J' travels with the apron and is additional to lever 'B' Section 4.1.

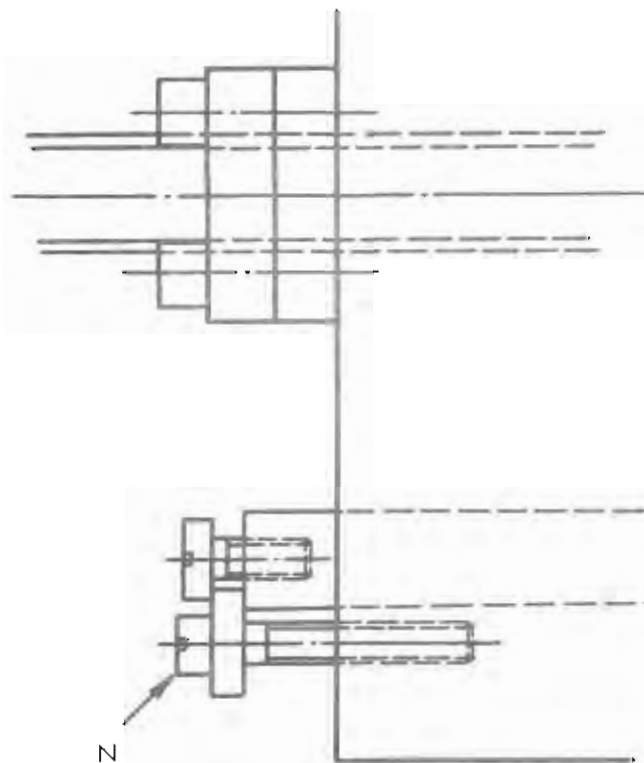
## 7.2 SADDLE

The saddle should not be moved before reading the lubricating instructions. Section 3. Wipers are fitted on the end of the saddle wings and on the cover at the rear of the cross slide, it is advisable to remove these periodically to clean them. To re-assemble, use a light pressure to force the springing edge of the wiper down onto the bed or slideway, simultaneously tightening the retaining screws.

The wipers should be checked regularly and renewed when necessary.



SECTION THROUGH CROSS SLIDE SCREW NUTS.



PLAN VIEW OF CROSS SLIDE.

Two saddle screw nuts are fitted and provision made for adjustment to minimise the backlash. This adjustment being carried out as follows:-

Measure the backlash by means of the cross slide dial.

Remove the cover 'L' at the rear of the cross slide. Release the two Allen fixing screws 'M' and lift off the slotted plate 'P'. Grind the plate to give the required adjustment and replace.

When a taper turning attachment is fitted, the backlash between the key and keyway of the telescopic joint must be taken into account.

On lathes supplied with a Hydraulic Copying unit, only one nut is fitted and the above procedure does not apply.

A taper slip is provided for the adjustment of the cross slide guides.

The slip is adjusted by screw 'N' which is held in position by a locking screw. The screw being situated under cover 'L'.