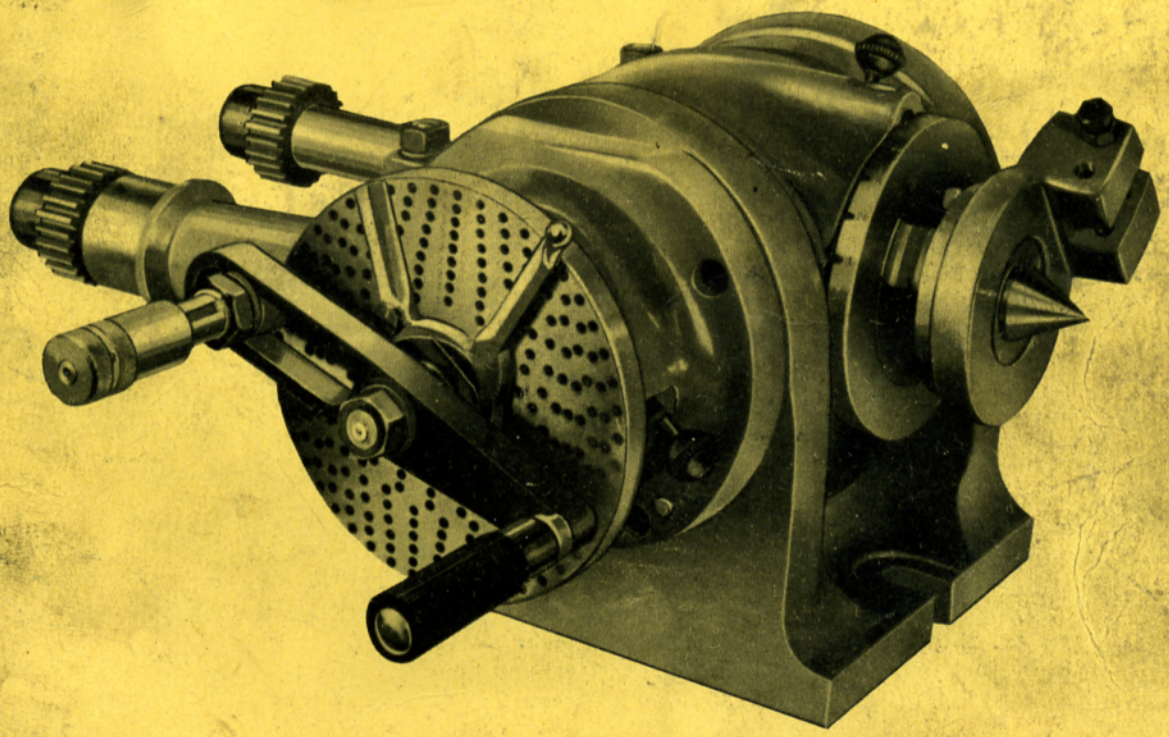
Enco®

UNIVERSAL DIVIDING HEAD

LEAD SCREW
5 TPI



INSTRUCTIONS BOOK

MODEL 84452

NUMBER 08639

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INSTRUCTIONS
FOR THE OPERATING AND MAINTENANCE
OF THE
UNIVERSAL PRECISION DIVIDING HEAD

The versatility of the Dividing Head enables it to be used for :

DIRECT INDEXING

DIVISIONS IN DEGREES AND MINUTES

INDIRECT INDEXING

DIFFERENTIAL INDEXING

SPIRAL MILLING

RACK CUTTING

CONTENTS Page

UNIVERSAL PRECISION DIVIDING HEAD

With the new Universal Dividing Head, any Indexing lead or spiral milling operation can be practically performed with efficiency and accuracy, due to its advanced design and manufacturing.

The wormwheel is of special bronze and is cut on a SYKES Hobbing Machine.

The division worm is of nickel chrome steel case hardened and thread ground to close tolerances of size and surface finish on a MATRIX Thread Grinding Machine and carefully checked on a SIP Measuring Machine.

The swivel block and frame are of high hardeness cast iron and the main spindle and other important parts are of case hardening alloy steel finely ground.

Inspection is rigorously carried out at every stage in the manufacture of the component parts and final testing is performed by means of a CARL ZEISS High Precision Digital Index Tester, being the accuracy of Dividing Heads within DIN/SALMON Standards.

The versatility of the Dividing Head enables it to be used for direct, indirect and differential indexing and spiral milling in any position from the horizontal to the vertical.

SPECIFICATIONS

HEIGHT OF CENTERS	100	115	125	150	175	200	200	250
DIVIDING RATIO	1:40	1:40	1:40	1:40	1:40	1:40	1:40	1:40
HOLE THROUGH SPINDLE	20	20	27	27	38	38	58	58
MORSE TAPER IN SPINDLE	M-3	M-3	M-4	M-4	M-5	M-5	M-6	M-6
MORSE TAPER IN TAILSTOCK	M-1	M-1	M-2	M-2	M-2	M-2	M-3	M-3
HEIGHT IN VERTICAL POSITION	200	215	240	265	310	335	335	385
TOTAL LENGTH WITH CENTRES TOUCHING	360	360	430	430	510	510	620	620
NETT WEIGHT	58	62	78	85	117	127	155	169

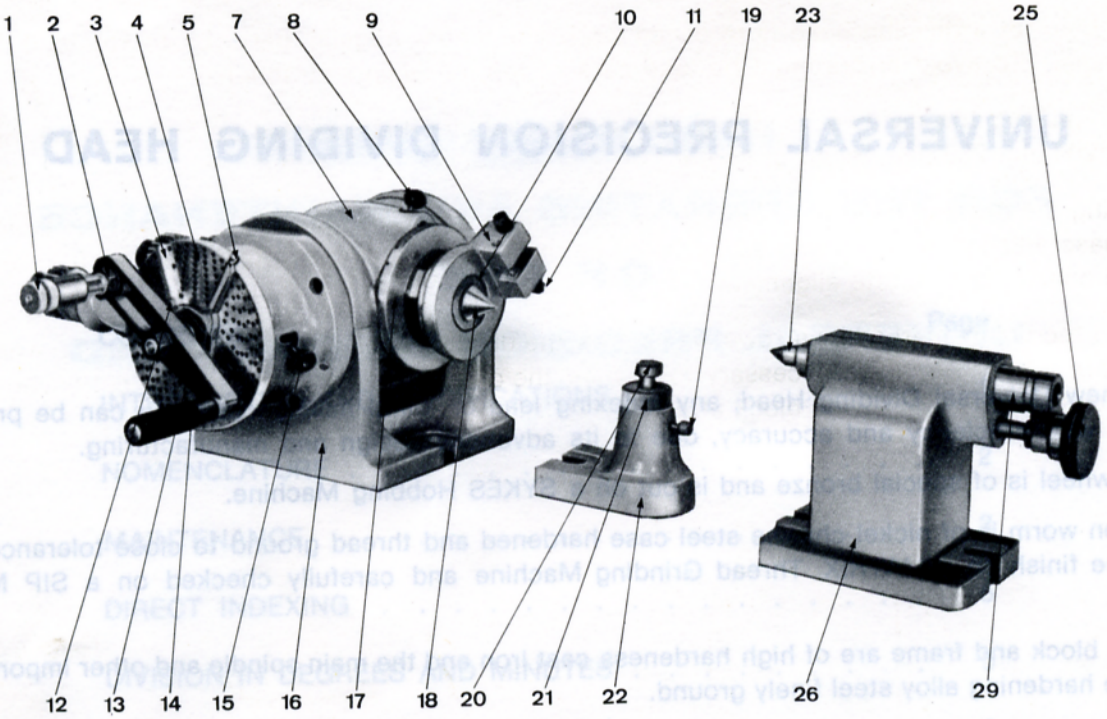
SET OF HOLE PLATES WITH 15, 16, 17, 18, 19, 20, 21, 23, 27, 29, 31, 33, 37, 39, 41, 43, 47, 49 HOLES.

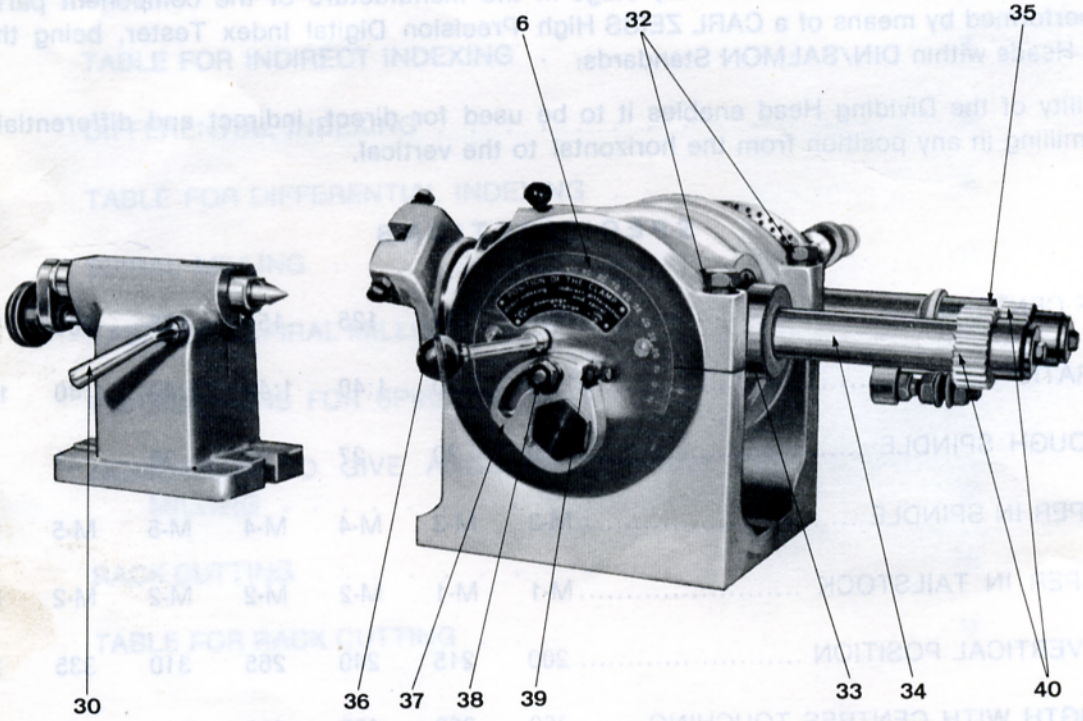
STANDARD EQUIPMENT

Carrier, center, tailstock, adjustable steady, set of 12 gears (24, 24, 28, 32, 40, 44, 48, 56, 64, 72, 86, 100 teeth) and supporting bracket with three pivots, extension spindle for spiral milling, direct indexing 24 stage face plate, 4 clamping bolts, set of spanners and operator's handbook.

Extra Equipment. Swing tailstock, back plates for chucks, universal 3-jaw Chucks, gears with any selected number of teeth, dividing plates and front plates for direct division.

NOMENCLATURE





1. Index knob
2. Index knob clamp unit
3. Left finger
4. Index plate
5. Right finger
6. Scale of degrees
7. Swivelling body
8. Direct index lever
9. Work driver
10. Main shaft
11. Adjusting screw
12. Clamp screw
13. Index Arm
14. Index Arm handle
15. Index plate locking lever
16. Base
17. Direct index plate
18. Centre
19. Locking screw
20. Adjustable rest
21. Adjustable rest nut
22. Adjustable rest body
23. Tailstock centre
25. Tailstock adjusting screw
26. Tailstock
29. Tailstock sleeve
30. Tailstock sleeve clamp
32. Dividing head clamp screw
33. Extension collar
34. Extension shaft
35. Index plate gear shaft
36. Main shaft locking lever
37. Worm adjusting clamp
38. Clamp nut
39. Clamp stop
40. Change gears

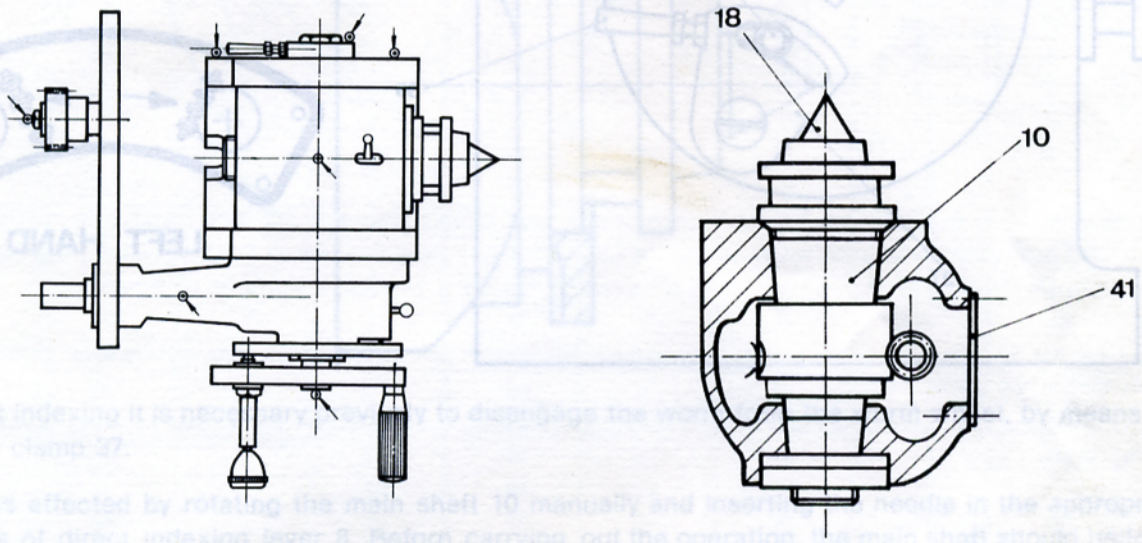
MAINTENANCE OF THE DIVIDING HEAD

The main object of a dividing head is to divide work into equal angular parts or to rotate it through a required angle. To avoid errors must be take care of the following instructions.

1) When removing the dividing head use always the eyebolt. It is provided for this purpose, in models of 175, 200 and 250 mm height of center.

2) In placing the dividing head on the machine table take care of the perfect cleaness of the table, dividing head base and tailstock, as well as the slots of the table and tongues, that must be free of hurt and burr to enable an accurate alignment.

3) Daily oil the points marked by arrows, as long as the dividing head is in constant use. The worm and its wheel are in oil bath. It is necessary to change the oil at last once a year, taking out cover 41 placed in the lower part of the swivel block after putting it in a vertical position.



Vertical position of the dividing head

4) The clamp 36 at the back of the dividing head serves to lock the main spindle after indexing and it should be used whenever cutting is performed with the work spindle stationery. The most of damages in dividing head are due to the little care taken in this operation.

5) When the work is placed between centers, adjust the back lash with knob 25, clamping then the tailstock sleeve 29 with clamp 30.

6) When the head is to be used with the spindle axis inclined, it is necessary to take off the extension 34, releasing nut 33, till the extension is through out.

7) To place the dividing head inclined release both nuts 33, clamping then again when is reached the desired position.

When it is necessary to tilt the dividing head without changing the position of the workpiece, in order not to vary the position, proceed as follow before tilting the head.

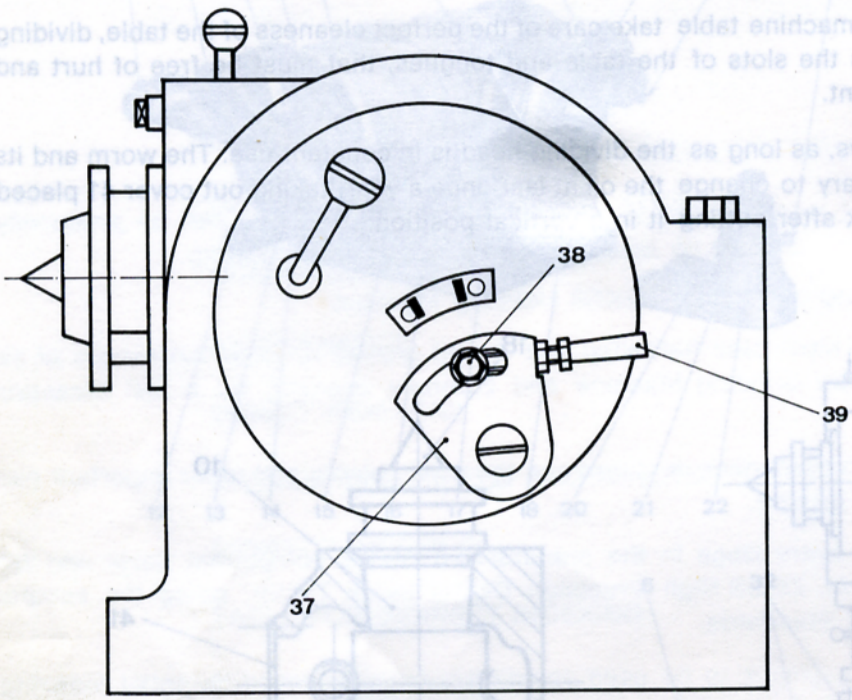
1) The index plate —figure 4— must be clamped by means of the locking lever 15 and the index knob 1 without changing the hole in the indexing plate.

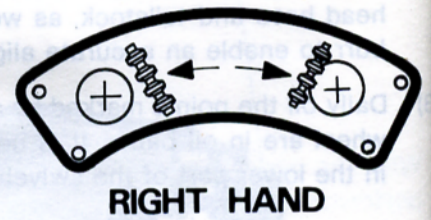
2) Slacken the nut and screw which clamp index arm 13 to enable the spindle to turn freely.

3) Slacken the two screws 32 and tilt the head to the required position and re-tighten the screws.

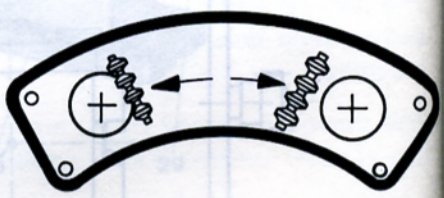
4) Re-tighten the nut and screw which clamp index arm 13.

The worm adjusting clamp 37 engages and disengages the worm and worm wheel. To do this slacken clamp fixing nut 38 and re-tighten it after engaging or disengaging.





RIGHT HAND



LEFT HAND

IMPORTANT

Maximum attention and care is required in engaging the worm in the worm wheel. The worm must engage freely in the worm wheel, avoiding sharp impact between both. Whilst carrying out this operation, at the same time as the worm gear is being engaged by means of worm adjusting clamp 37 it is necessary to assist the engagement by means of slight movements of index arm 13. With the object of achieving the highest precision in dividing and at the same time reducing to the minimum vibrations in the work, it is necessary to eliminate play between the worm and worm wheel. The adjustment of this play is achieved by means of clamp stop 39 in the following way.

1) Slacken clamp fixing nut 38.
2) Slacken slightly clamp stop 39, take up play with worm adjusting clamp 37 and re-tighten clamp fixing nut 38 and fix clamp stop by means of the lock-nut.

Play has been eliminated when no radial movement can be observed when main shaft 10 is rotated manually.

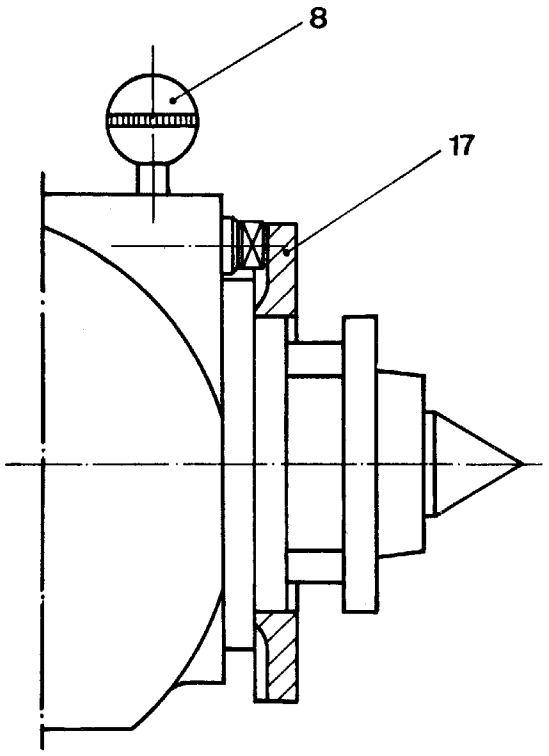
IMPORTANT

The worm should not be engaged too tightly in the worm wheel as this could cause the main shaft to rotate under excessive load and would damage the teeth in the worm wheel.

DIRECT INDEXING

Direct indexing is useful and practical for achieving 2, 3, 4, 6, 8, 12 or 24 divisions by means of direct indexing plate 17 which is supplied with the dividing heads.

Any other number of divisions can be obtained by means of special direct indexing plates.



For direct indexing it is necessary previusly to disengage the worm from the worm wheel, by means of work adjusting clamp 37.

Division is effected by rotating the main shaft 10 manually and inserting the needle in the appropriate slot by means of direct indexing lever 8. Before carrying out the operation, the main shaft should be locked by means of main shaft locking lever 36.

Direct indexing can be efected at any tilt angle of the dividing head from —10° to + 100° from the horizontal of the main shaft.

DIVISION IN DEGREES AND MINUTES

IN DEGREES. The worm gear drive with a ratio of 40:1 between the index arm and the dividing head spindle permits indexing in degrees in connection with the index plate. It is obvious that as 40 revolutions of the crank give one complete revolution of the spindle, one turn of the crank will give

$\frac{360}{40} = 9°$ and 1/9 of a turn (2 holes in a 18-holes plate $= 1°$.

Example. — Index 43°. $\frac{43}{9} = 4\frac{7}{9} = 4\frac{14}{18}$ i. e., four complete turns of crank and 14 holes in a 18-hole circle giving 7.°

IN MINUTES. One turn of the arm $= 9° \times 60 = 540$ minutes. On hole in a 18-holes circle $= \frac{540}{18} = 30$ minutes. One hole in 27-holes circle $= \frac{540}{27} = 20$ minutes.

For division in degrees and minutes index plate 4 should be locked without play by means of index plate locking lever 15 and the worm engaged in the worm wheel.

Division in degrees and minutes can be effected at any angle of the dividing head between —10° and + 100° from the horizontal of the main shaft.

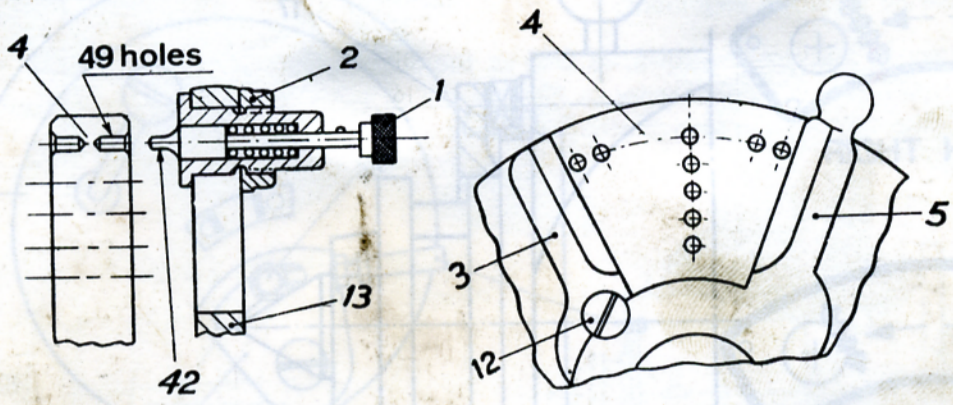
INDIRECT INDEXING

If the work piece is to be divided into N parts, the indexing movement V in revolutions of arm is: $V = \frac{40}{N}$

Example. — 28 divisions are required. Revolution of arm will be:

$$V = \frac{40}{N} = \frac{40}{28} = 1\frac{12}{28} = 1\frac{3}{7} = 1\frac{21}{49}$$

I.e., using the 49-hole circle the arm is to be moved one complete turn and 21 holes further, as shown on page 5 of this booklet.



To place needle 42 in front of the desired circle leave nut 2 and move it till the needle is introduced in the hole. The hole plate 4 is able to remove and has different hole circles in both faces. Fingers 3 and 5 are adjustable by means of the screw 12 and serve to locate a constant number of holes.

NOTE. For indirect division index plate 4 should be locked without play by means of index plate locking lever 15 and the worm engaged in the worm wheel.

Indirect division can be effected at any angle of the dividing head betwenn —10° and + 100° from the horizontal of the main shaft.

UNIVERSAL DIVIDING HEAD

TABLE OF INDIRECT INDEXING

Divisions	Hole circle	Turns	Holes
2		20	
3	39	13	13
4		10	
5		8	
6	39	6	26
7	49	5	35
8		5	
9	27	4	12
10		4	
11	33	3	21
12	39	3	13
13	39	3	3
14	49	2	42
15	39	2	26
16	20	2	10
17	17	2	6
18	27	2	6
19	19	2	2
20		2	
21	21	1	19
22	33	1	27
23	23	1	17
24	39	1	26
25	20	1	12
26	39	1	21
27	27	1	13
28	49	1	21
29	29	1	11
30	39	1	13
31	31	1	9
32	20	1	5
33	33	1	7
34	17	1	3
35	49	1	7
36	27	1	3
37	37	1	3
38	19	1	1
39	39	1	1
40		1	
41	41		40
42	21		20
43	43		40
44	33		30
45	27		24
46	23		20
47	47		40
48	18		15
49	49		40
50	20		16
52	39		30
54	27		20

Divisions	Hole circle	Holes
55	33	24
56	49	35
58	29	20
60	39	26
62	31	20
64	16	10
65	39	24
66	33	20
68	17	10
70	49	28
72	27	15
74	37	20
75	15	8
76	19	10
78	39	20
80	20	10
82	41	20
84	21	10
85	17	8
86	43	20
88	33	15
90	27	12
92	23	10
94	47	20
95	19	8
98	49	20
100	20	8
104	39	15
105	21	8
108	27	10
110	33	12
115	23	8
116	29	10
120	39	13
124	31	10
128	16	5
130	39	12
132	33	10
135	27	8
136	17	5
140	49	14
144	18	5
145	29	8
148	37	10
150	15	4
152	19	5
155	31	8
156	39	10
160	20	5
164	41	10
165	33	8

Divisions	Hole circle	Holes
168	21	5
170	17	4
172	43	10
180	18	4
184	23	5
185	37	8
188	47	10
190	19	4
195	39	8
196	49	10
200	20	4
205	41	8
210	21	4
215	43	8
216	27	5
220	33	6
230	23	4
232	29	5
235	47	8
240	18	3
245	49	8
248	31	5
260	39	6
264	33	5
270	27	4
280	49	7
290	29	4
296	37	5
300	15	2
310	31	4
312	39	5
320	16	2
328	41	5
330	33	4
340	17	2
344	43	5
360	18	2
370	37	4
376	47	5
380	19	2
390	39	4
392	49	5
400	20	2
410	41	4
420	21	2
430	43	4
440	33	3
460	23	2
470	47	4
490	49	4

DIFFERENTIAL INDEXING

As the method of simple of indirect indexing cannot be applied for all numbers, the differential indexing method is to be used.

For differential indexing the spindle and the hole plate are connected by change gears and the fixing screw 15 behind the hole plate is disengaged. The spindle is provided with an extension 34 thus allowing change gears to connect the spindle with the hole plate through the gear shaft 35.

When the index arm is turned, the spindle is rotated through the worm and wormwheel and the plate moves either in the same or opposite direction to that of the arm. At every indexing the total movement of the index arm is therefore equal to its movement relative to plate plus the movement of the plate when it revolves in the same direction as the arm, or minus the movement of the plate when it revolves in the opposite direction of the arm.

Our booklet shows numerous divisions on pages, 9, 10 and 11. If a component part has to be made, the division of which is not included in our booklet, the following example, may indicate how to deal with it. If generally the number N is to be indexed, an approximate number D either greater or less than N is selected and the ratio of change gears is;

$$R = N\,\frac{40}{D} - 40 = 40\left(\frac{N}{D} - 1\right) = 40\left(\frac{N-D}{D}\right) \quad \text{If D is less than N}$$

and $$R = 40\left(\frac{D-N}{D}\right) \quad \text{if D is greater than N.}$$

Example. — To index the nomber N=103 we choose from our booklet D=100 (moving 8 holes in a 20-hole circle), and the ratio R, as D is greater than N, is.

$$R = 40\left(\frac{103-100}{100}\right) = 40\,\frac{3}{100} = \frac{6}{5} = \frac{48}{40} = \frac{A}{D}$$

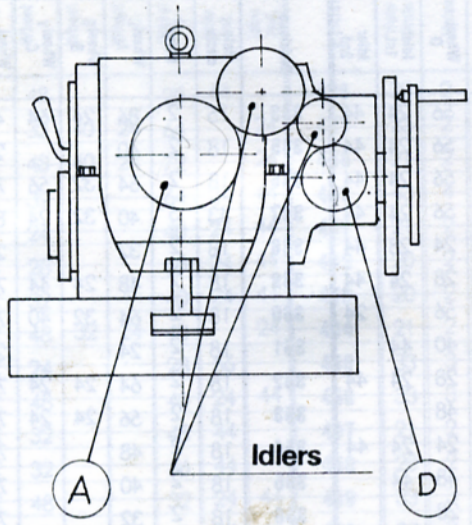
Place gear A of 48 teeth in the extension 34 and gear D of 40 teeth in the gear shaft 35 which moves hole plate 4. Use any gears as idlers to make up center distances where necessary.

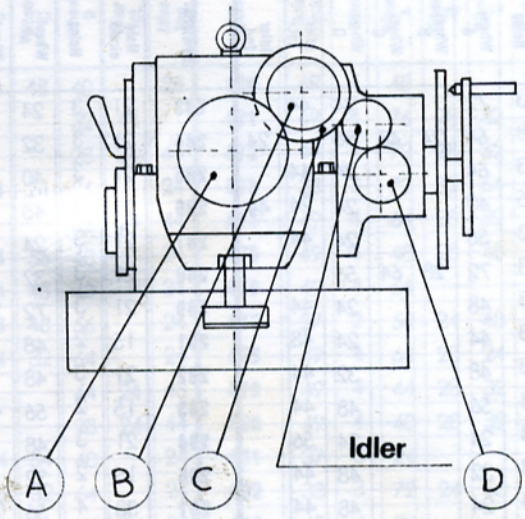
Use one idler if selected number is greater than N and two if the number is less.

If it is necessary to use a compound train of four gears use respectively none or one idler if the number selected is greater or less than the number to be obtained.

UNIVERSAL DIVIDING HEAD

TABLE OF DIFFERENTIAL INDEXING





Divisions	Hole circle	Holes	Wheel A	Wheel B	Wheel C	Wheel D	Idler 1st.	Idler 2nd.
51	17	14	48			24	24	44
53	49	35	72	24	40	56		
57	21	15	40			56	24	44
59	39	26	32			48	44	
61	39	26	32			48	24	44
63	39	26	48			24	24	44
67	21	12	48			28	44	
69	20	12	56			40	24	44
71	18	10	40			72	24	
73	21	12	48			28	24	44
77	20	10	48			32	44	
79	20	10	24			48	44	
81	20	10	24			48	24	44
83	20	10	48			32	24	44
87	15	7	24			40	24	44
89	18	8	32			72	44	
91	39	18	48			24	24	44
93	18	8	32			24	24	44
96	21	9	32			28	24	44
97	20	8	48			40	44	
99	20	8	32	40	28	56		
101	20	8	48	40	24	72		24
102	20	8	32			40	24	44
103	20	8	48			40	24	44
106	43	16	48	24	24	86		
107	20	8	64	32	56	40		24
109	16	6	28			32	24	44
111	39	13	72			24	32	
112	39	13	64			24	44	
113	39	13	56			24	44	
114	39	13	48			24	44	
117	39	13	24			24	56	
118	39	13	32			48	44	
119	39	13	24			72	44	

Divisions	Hole circle	Holes	Wheel A	Wheel B	Wheel C	Wheel D	Idler 1st.	Idler 2nd.
121	39	13	24			72	24	44
122	39	13	32			48	24	44
123	39	13	24			24	32	44
125	39	13	40			24	24	44
126	39	13	48			24	24	44
127	39	13	56			24	24	44
129	39	13	72			24	24	44
131	20	6	28			40	44	
133	21	6	48			24	44	
134	21	6	48			28	44	
137	21	6	24			28	56	
138	21	6	32			56	44	
139	21	6	24	48	32	56		
141	18	5	40			48	44	
142	21	6	32			56	24	44
143	21	6	24			28	24	44
146	21	6	48			28	24	44
147	21	6	48			24	24	44
149	21	6	72			28	24	44
151	20	5	72			32	44	
153	20	5	56			32	44	
154	20	5	48			32	44	
157	20	5	24			32	56	
158	20	5	24			48	44	
159	20	5	28	56	32	64		
161	20	5	82	56	32	64		24
162	20	5	24			48	24	44
163	20	5	24			32	24	44
166	20	5	48			32	24	44
167	20	5	56			32	24	44
169	20	5	72			32	24	44
171	21	5	40			56	24	44
173	18	4	64	32	56	72		
174	18	4	32			24	56	

Divisions	Hole circle	Holes	Wheel A	Wheel B	Wheel C	Wheel D	Idler 1st.	Idler 2nd.
175	18	4	64	32	40	72		
176	18	4	64	24	24	72		
177	18	4	48			72	24	
178	18	4	32			72	44	
179	18	4	32	48	24	72		
181	18	4	32	48	24	72		24
182	18	4	32			72	24	44
183	18	4	32			48	24	44
186	18	4	64			48	24	44
187	18	4	56	24	48	72		24
189	18	4	64			32	24	44
191	20	4	72			40	24	
192	20	4	64			40	44	
193	20	4	56			40	44	
194	20	4	48			40	44	
197	20	4	24			40	56	
198	20	4	32	40	28	56		
199	20	4	32	64	40	100		
201	20	4	24	40	24	72		24
202	20	4	48	40	24	72		24
203	20	4	24			40	24	44
204	20	4	32			40	24	44
206	20	4	48			40	24	44
207	20	4	56			40	24	44
208	20	4	64			40	24	44
209	20	4	72			40	24	44
211	16	3	28			64	44	
212	43	8	48	24	24	86		
213	27	5	40			72	44	
214	20	4	64	32	56	40		24
217	21	4	64			48	24	44
218	16	3	56			64	24	44
219	21	4	48			28	24	44
221	17	3	24			24	56	

UNIVERSAL DIVIDING HEAD

TABLE OF DIFFERENTIAL INDEXING

Divisions	Hole circle	Holes	Wheel A	Wheel B	Wheel C	Wheel D	Idler 1st.	Idler 2nd.
222	18	3	72			24	44	
223	43	8	64	24	48	86		24
224	18	3	64			24	44	
225	27	5	40			24	24	44
226	18	3	56			24	44	
227	49	8	72	28	64	56		
228	18	3	48			24	44	
229	18	3	44			24	48	
231	18	3	48			32	44	
233	18	3	56			48	44	
234	18	3	24			24	56	
236	18	3	32			48	44	
237	18	3	24			48	44	
238	18	3	24			72	44	
239	18	3	32	64	24	72		
241	18	3	32	64	24	72		24
242	18	3	24			72	24	44
243	18	3	32			64	24	44
244	18	3	32			48	24	44
246	18	3	24			24	28	44
247	18	3	56			48	24	44
249	18	3	48			32	24	44
250	18	3	40			24	24	44
251	18	3	64	32	44	48		24
252	18	3	48			24	24	44
253	33	5	40			24	56	
254	18	3	56			24	24	44
255	18	3	64	24	40	48		24
256	18	3	72			24	24	44
257	49	8	72	28	48	56		24
258	43	7	72			32	24	44
259	21	3	64			24	44	
261	29	4	64	24	64	48		
262	20	3	28			40	44	
263	49	8	72	28	64	56		24
265	21	3	72	24	40	56		
266	21	3	64			32	44	
267	27	4	32			72	44	
268	21	3	48			28	44	
269	20	3	28	40	32	64		24
271	21	3	72	24	24	56		
272	21	3	64			56	42	
273	21	3	24			24	56	
274	21	3	48			56	44	
275	21	3	40			56	44	
276	21	3	32			56	44	
277	21	3	24			56	44	
278	21	3	24	48	32	56		
279	27	4	32			24	24	44
281	21	3	24	56	24	72		24
282	43	6	56	24	24	86		
283	21	3	24			56	24	44
284	21	3	32			56	24	44
285	21	3	40			56	24	44
286	21	3	48			56	24	44
287	21	3	24			24	28	44
288	21	3	32			28	24	44
289	21	3	72	24	24	56		24
291	15	2	48			40	44	
292	21	3	48			28	24	44
293	15	2	56	40	32	48		
294	21	3	48			24	24	44
295	15	2	32			48	44	
297	33	4	56	24	48	28		
298	21	3	72			28	24	44
299	23	3	24			24	56	
301	34	6	48			24	24	44
302	16	2	72			32	24	
303	15	2	48	40	24	72		24
304	16	2	48			24	44	
305	15	2	32			48	24	44
306	15	2	32			40	24	44
307	15	2	56	40	48	72		24
308	16	2	48			32	44	
309	15	2	48			40	24	44
311	16	2	72	24	24	64		
313	16	2	28			32	56	
314	16	2	24			32	56	
315	16	2	40			64	24	
316	16	2	32			64	44	
317	16	2	24			64	44	
318	16	2	24	48	28	56		
319	29	4	72	24	64	48		24
321	16	2	24	64	24	72		24
322	23	3	64			32	24	44
323	16	2	24			64	24	44
324	16	2	32			64	24	44
325	16	2	40			64	24	44
326	16	2	24			32	24	44
327	16	2	28			32	24	44
329	16	2	72	24	24	64		28
331	16	2	48	24	44	64		24
332	16	2	48			32	24	44
333	18	2	72			24	44	
334	16	2	56			32	24	44
335	33	4	40	44	48	72		24
336	16	2	64			32	24	44
337	43	5	56	32	40	86		
338	16	2	72			32	24	44
339	18	2	56			24	44	
341	43	5	40	32	24	86		
342	18	2	64			32	44	
343	15	2	86	24	64	40		24
345	18	2	40			24	56	
346	18	2	64	32	56	72		
347	43	5	40	32	24	86		24
348	18	2	32			24	56	
349	18	2	48	24	44	72		
350	18	2	64	32	40	72		
351	18	2	24			24	56	
352	18	2	64	24	24	72		
353	18	2	56	24	24	72		
354	18	2	48			72	24	
355	18	2	40			72	24	
356	18	2	32			72	24	
357	18	2	24			72	44	
358	18	2	24	48	32	72		
359	43	5	100	32	48	86		24
361	19	2	64			32	44	
362	18	2	32	56	28	72		24
363	18	2	24			72	24	44
364	18	2	32			72	24	44
365	20	2	56	24	48	32		
366	18	2	32			48	24	44
367	18	2	56			72	24	24
368	18	2	64	24	24	72		28
369	41	4	64	28	56	32		
371	21	2	64	24	56	32		
372	18	2	64			48	24	44
373	20	2	72	32	48	40		
374	18	2	56	32	64	72		24
375	18	2	40			24	24	44
377	29	3	24			24	56	
378	18	2	64			32	24	44
379	20	2	72	40	56	48		
381	18	2	56			24	24	44
382	20	2	72			40	24	
383	20	2	68			40	44	
384	20	2	64			40	44	
385	20	2	48			32	44	
386	20	2	56			40	44	
387	43	4	64	28	56	32		
388	20	2	48			40	44	
389	20	2	44			40	56	
391	20	2	72	40	24	48		
393	20	2	28			40	44	
394	20	2	24			40	56	
395	20	2	32			64	44	
396	20	2	32	40	28	56		
397	20	2	32	40	24	64		
398	20	2	32	64	40	100		
399	21	2	64			32	44	
401	21	2	76	24	32	56		

UNIVERSAL DIVIDING HEAD

TABLE OF DIFFERENTIAL INDEXING

Divisions	Hole circle	Holes	Wheel A	Wheel B	Wheel C	Wheel D	Idler 1st.	Idler 2nd.
402	21	2	48			28	44	
403	20	2	32	40	24	64		24
404	20	2	48	40	24	72		24
405	20	2	32			64	24	44
406	20	2	24			40	24	44
407	20	2	28			40	24	44
408	20	2	32			40	24	44
409	20	2	48	32	24	40		24
411	21	2	24			28	56	
412	20	2	48			40	24	44
413	21	2	32			48	44	
414	21	2	32			56	44	
415	20	2	48			32	24	44
416	20	2	64			40	24	44
417	21	2	24	48	32	56		
418	20	2	72			40	24	44
419	33	3	72	24	28	44		
421	20	2	72	40	56	48		24
422	20	2	64	32	44	40		24
423	21	2	48	56	24	72		24
424	43	4	48	24	24	86		
425	21	2	40	56	48	72		24
426	21	2	32			56	24	44
427	20	2	72	32	48	40		24
428	20	2	64	32	56	40		24
429	21	2	24			28	24	44
431	21	2	48	28	44	72		24
432	20	2	64	28	56	40		24
433	20	2	72	24	44	40		24
434	21	2	64			48	24	44
435	21	2	40			28	24	44
436	20	2	72	24	48	40		24
437	23	2	64			32	44	
438	21	2	48			28	24	44
439	43	4	72	24	24	86		24
441	21	2	64			32	24	44
442	20	2	72	24	56	40		24
443	20	2	86	24	48	40		24
444	21	2	64	24	48	56		24
445	33	3	40	44	32	64		24
446	33	3	24			44	24	48
447	21	2	72			28	24	44
448	20	2	72	24	64	40		24
449	33	3	72	44	32	64		24
450	33	3	40			44	24	32
451	33	3	24			24	28	44
452	33	3	48			44	24	40
453	33	3	52			44	24	40
454	49	4	72	28	64	56		
455	49	4	64	32	40	28		
456	21	2	72	24	64	56		24
457	33	3	68			44	24	40
458	33	3	72			44	24	24
459	27	2	72	24	48	24		
461	33	3	72	24	28	44		24
462	33	3	64			32	24	44
463	21	2	86	24	64	56		24
464	33	3	56	28	48	44		24
465	33	3	100	24	24	44		24
466	49	4	64	28	48	56		
467	33	3	72	32	48	44		24
468	39	3	56	24	48	28		
469	49	4	48			28	44	
471	49	4	76	28	32	56		
472	49	4	72	28	32	56		
473	33	3	72	32	64	48		24
474	49	4	64	28	32	56		
475	49	4	48	28	40	56		
476	49	4	64			56	24	
477	27	2	56	24	48	24		
478	49	4	64	28	24	56		
479	49	4	44	28	32	56		
480	49	4	40	28	32	56		
481	37	3	24			24	56	
482	33	3	72	24	56	44		24
483	49	4	32			56	44	
484	49	4	32	28	24	56		
485	23	2	100	24	24	46		24
486	27	2	64	28	56	32		
487	39	3	44	52	72	24		
488	33	3	72	24	64	44		24
489	23	2	64	32	58	46		24
491	33	3	72	24	68	44		24
492	41	3	56	24	48	28		
493	29	2	72	24	64	32		
494	39	3	64			32	44	
495	27	2	64	24	40	32		
496	49	4	32	28	24	56		24
497	49	4	32			56	24	44
498	27	2	64	24	56	48		
499	49	4	48	28	24	56		24
500	49	4	40	28	32	56		24

SPIRAL MILLING

The dividing head is positively connected with feed mechanism of the milling machine as shown on page 13 of our booklet. The ratio of the change gears may be called.

$$R = \frac{\text{Driving gears}}{\text{Driven gears}}$$

The worm gear drive of the dividing head causes a reduction of 1:40. Therefore forty revolutions of the lead screw of milling machine effect one complete revolution of the spindle of the diviping head. If the pitch of the lead screw of the milling machine is 5 mm the longitudinal movement of the table in relation to the milling cutter is therefore.

$$Lm = 5 \times 40 = 200 \text{ mm.}$$

which is the lead of spiral obtained with change gears ratio 1:1 and is called Lm=lead of the machine.

Example. — To mill spiral of L=180 mm with lead of machine Lm=200 mm, the gear ratio will be

$$R = \frac{\text{lead of machine}}{\text{lead of spiral of work piece}} = \frac{Lm}{L}$$

$$R = \frac{200}{180} = \frac{40}{24} \times \frac{32}{48} = \frac{A}{B} \times \frac{C}{D}$$ (as shown on page 14)

The formula for determining the lead of work piece is

$$L = \frac{\text{Circum. of work piece} \times \pi}{\text{Tan of spiral angle}} = \frac{D \times \pi}{\text{Tan}\,\alpha}$$

Example. — Diameter of work piece d = 100 mm (cutting gears take pitch diameter)

Spiral diameter = 27° 30' Tan. α = 0,52056.

$$\text{Lead of work piece } L = \frac{100 \times 3{,}1416}{0{,}52056} = 603{,}5 \text{ mm.}$$

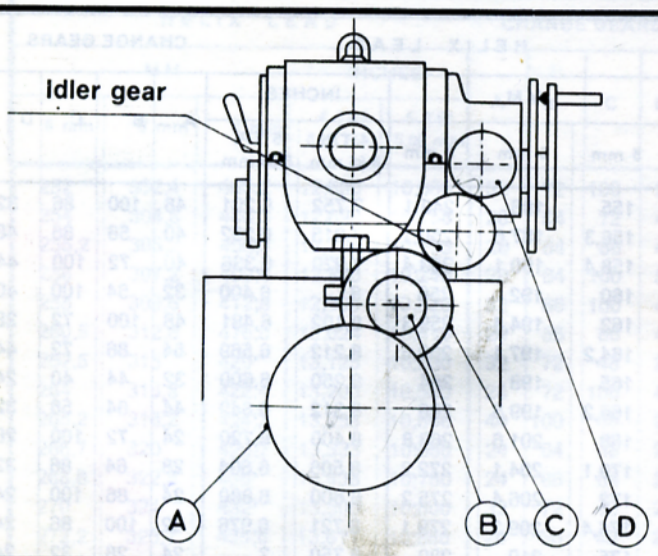
The Nomograph in page 18 shows the rotation of the above example.

To bring the table in line with the spiral to be cut, the spiral angle must be known and can be calculate according to the above as:

$$\text{Tan setting angle (spiral angle)} = \frac{\text{Circum. of work}}{\text{Lead}} = \frac{D \times \pi}{L}$$

UNIVERSAL DIVIDING HEAD

TABLE FOR SPIRAL MILLING



Worm gear ratio. 1 : 40

Change gears: 24, 24, 28, 32, 40, 44, 48, 56, 64, 72, 86, 100.

HELIX HAND

Right hand: With no or two idler gears

Left hand: With one idler gear

HELIX LEAD					CHANGE GEARS			
MM			INCHES		A	B	C	D
5 mm	6 mm	8 mm	4 TPI 6,35 mm	5 TPI 5,08 mm				
13,4	16,1	21,4	0,670	0,536	86	24	100	24
15,6	18,7	25	0,781	0,624	86	24	100	28
16	19,2	25,6	0,800	0,640	72	24	100	24
17,9	21,4	28,6	0,893	0,714	86	24	100	32
18,6	22,3	29,8	0,930	0,744	72	24	86	24
21	25,2	33,6	1,050	0,840	64	24	100	28
22,3	26,8	35,7	1.116	0,892	86	24	100	40
24	28,8	38,4	1,200	0,960	48	24	100	24
25	30	40	1,250	1	64	24	72	24
26	31,2	41,7	1,302	1,041	86	28	100	40
27,4	32,9	43,9	1,371	1,096	56	24	100	32
28	33,6	44,8	1,400	1,120	48	24	100	28
29,2	35	46,7	1,458	1,166	64	24	72	28
30	36	48	1,500	1,200	64	24	100	40
31	37,2	49,6	1,550	1,240	72	24	86	40
32	38,4	51,2	1,600	1,280	48	24	100	32
33	39,6	52,8	1,650	1,320	64	24	100	44
34,1	40,9	54,6	1,706	1,364	72	24	86	44
35	42	56	1,750	1,400	64	28	100	40
36	43,2	57,6	1,800	1,440	64	24	100	48
37,2	44,6	59,5	1,860	1,488	56	28	86	32
38,1	45,7	61	1,905	1,524	56	24	72	32
39,1	46,9	62,5	1,954	1,563	40	24	86	28
40	48	64	2	1,600	40	24	72	24
41,1	49,4	65,8	2,057	1,645	28	24	100	24
42	50,4	67,2	2,100	1,680	64	24	100	56
43,4	52,1	69,5	2,171	1,736	72	24	86	56
44	52,8	70,4	2,200	1,760	48	24	100	44
45	54	72	2,250	1,800	40	24	64	24
46,5	55,8	74,4	2,326	1,860	64	32	86	40
47,4	56,8	75,8	2,368	1,894	44	28	86	32
48	57,6	76,8	2,400	1,920	56	28	100	48
49	58,8	78,4	2,450	1,960	64	28	100	56
50	60	80	2,500	2	48	24	56	28
51,2	61.4	81,9	2,558	2,046	64	32	86	44
52,1	62,5	83,4	2,605	2,084	40	28	86	32
53,2	63,8	85,1	2,658	2,126	56	32	86	40
54	64,8	86,4	2,700	2,160	64	24	100	72

HELIX LEAD					CHANGE GEARS			
MM			INCHES		A	B	C	D
5 mm	6 mm	8 mm	4 TPI 6,35 mm	5 TPI 5,08 mm				
55	66	88	2,750	2,200	64	40	100	44
56	67,2	89,6	2,800	2,240	24	24	100	28
57	68,4	91,2	2,849	2,279	64	28	86	56
58,2	69,8	93,1	2,909	2,327	44	32	100	40
59,2	71	94,7	2,960	2,368	44	28	86	40
60	72	96	3	2,400	40	24	56	28
61,1	73,3	97,8	3,055	2,444	44	28	100	48
62	74,4	99,2	3,101	2,480	72	40	86	48
63	75,6	100,8	3,150	2,520	100	28	64	72
64	76,8	102,4	3,200	2,560	100	28	56	64
65,1	78,1	104,2	3,256	2,604	24	24	86	28
66	79,2	105,6	3,300	2,640	64	44	100	48
67	80,4	107,2	3,349	2,679	86	40	100	72
68,1	81,7	108,9	3,403	2,722	64	28	72	56
68,8	82,5	110	3,438	2,750	48	24	64	44
70	84	112	3,500	2,800	64	40	100	56
71	85,2	113,7	3,552	2,841	44	56	86	24
72	86,4	115,2	3,600	2,880	48	72	100	24
73,1	87,8	117	3,657	2,925	56	64	100	32
74,1	88,9	118,5	3,704	2,963	48	32	72	40
75	90	120	3,750	3	32	24	48	24
76	91,2	121,6	3,799	3,039	48	56	86	28
77	92,4	123,2	3,850	3,080	64	44	100	56
78,2	93,9	125,2	3,911	3,128	72	44	100	64
79,5	95,4	127,3	3,977	3,181	44	28	64	40
80	96	128	4	3,200	40	24	48	32
81,2	97,4	129,9	4,060	3,248	44	64	86	24
82,3	98,7	131,6	4,114	3,291	28	48	100	24
82,9	99,5	132,6	4,144	3,315	44	56	86	28
84	100,8	134,4	4,200	3,360	64	48	100	56
85,1	102,1	136,1	4,253	3,402	56	64	86	32
86	103,2	137,6	4,300	3,440	56	86	100	28
87,2	104,7	139,6	4,361	3,488	64	100	86	24
88	105,6	140,8	4,400	3,520	24	24	100	44
89,3	107,2	142,9	4,466	3,572	40	48	86	32
90	108	144	4,500	3,600	64	72	100	40
91	109,2	145,5	4,548	3,638	72	44	86	64
93	111,6	148,8	4,651	3,720	24	40	86	24

UNIVERSAL DIVIDING HEAD

TABLE FOR SPIRAL MILLING

HELIX LEAD					CHANGE GEARS				HELIX LEAD					CHANGE GEARS			
MM			INCHES		A	B	C	D	MM			INCHES		A	B	C	D
5 mm	6 mm	8 mm	4 TPI 6,35 mm	5 TPI 5,08 mm					5 mm	6 mm	8 mm	4 TPI 6,35 mm	5 TPI 5,08 mm				
94,3	113,1	150,8	4,714	3,771	40	44	56	24	155	186	248,1	7,752	6,201	48	100	86	32
95,2	114,3	152,4	4,762	3,809	28	40	72	24	156,3	187,6	250,1	7,815	6,252	40	56	86	48
96	115,2	153,6	4,800	3,840	24	48	100	24	158,4	190,1	253,4	7,920	6,336	40	72	100	44
97	116,4	155,2	4,849	3,879	44	32	72	48	160	192	256	8	6,400	32	64	100	40
98	117,6	156,8	4,900	3,920	32	56	100	28	162	194,4	259,3	8,102	6,481	48	100	72	28
99	118,8	158,4	4,950	3,960	44	56	72	28	164,2	197,1	262,6	8,212	6,569	64	86	72	44
100	120	160	5	4	24	24	56	28	165	198	264	8,250	6,600	32	44	40	24
102,1	122,5	163,4	5,105	4,084	48	28	64	56	166,2	199,5	266	8,312	6,649	44	64	56	32
103,1	123,8	165	5,156	4,124	32	44	64	24	168	201,6	268,8	8,400	6,720	24	72	100	28
104,2	125	166,7	5,210	4,168	40	64	86	28	170,1	204,1	272,2	8,506	6,804	28	64	86	32
105	126	168	5,250	4,200	32	24	40	28	172	206,4	275,2	8,600	6,880	24	86	100	24
106,1	127,3	169,7	5,303	4,242	44	28	48	40	174,4	209,3	279,1	8,721	6,976	32	100	86	24
107	128,4	171,1	5,348	4,278	32	44	72	28	175	210	280	8,750	7	24	28	32	24
108	129,6	172,8	5,400	4,320	32	72	100	24	176	211,2	281,6	8,800	7,040	24	48	100	44
109,1	130,9	174,6	5,455	4,364	44	48	56	28	178,2	213,8	285,1	8,909	7,127	40	56	44	28
110	132	176	5,500	4,400	40	44	48	24	180	216	288	9	7,200	32	48	40	24
111,1	133,3	177,8	5,556	4,444	24	40	72	24	182,3	218,8	291,7	9,115	7,292	48	100	64	28
112	134,4	179,2	5,600	4,480	24	56	100	24	184,2	221	294,7	9,210	7,368	40	72	86	44
113,1	135,8	181	5,657	4,525	44	56	72	32	185,2	222,2	296,3	9,260	7,408	48	100	72	32
114	136,8	182,3	5,698	4,558	32	56	86	28	186	223,2	297,7	9,302	7,441	24	48	86	40
115,2	138,2	184,3	5,760	4,608	40	72	100	32	188,1	225,7	301	9,406	7,524	40	86	64	28
116,4	139,6	186,2	5,818	4,654	44	64	100	40	190,5	228,6	304,8	9,524	7,619	28	40	48	32
117	140,4	187,1	5,848	4,678	28	44	86	32	192	230,4	307,1	9,598	7,678	56	86	64	40
118,2	141,9	189,2	5,912	4,729	64	86	100	44	195,4	234,4	312,6	9,768	7,814	48	72	86	56
119	142,8	190,5	5,952	4,761	56	100	72	24	196,4	235,7	314,3	9,822	7,857	32	44	56	40
120	144	192	6	4,800	40	48	56	28	198	237,6	316,8	9,900	7,920	32	72	100	44
121,2	145,5	194	6,061	4,848	44	40	48	32	200	240	320	10	8	28	56	48	24
122,2	146,7	195,6	6,112	4,889	24	24	72	44	202	242,4	323,2	10,101	8,080	44	100	72	32
123,2	147,8	197,1	6,160	4,928	40	56	100	44	204,2	245	326,7	10,209	8,167	24	56	64	28
124	148,8	198,5	6,202	4,961	24	40	86	32	205,3	246,4	328,5	10,267	8,213	24	56	100	44
125	150	200	6,250	5	24	24	64	40	206,2	247,5	330	10,312	8,249	32	48	64	44
126	151,2	201,6	6,300	5,040	32	72	100	28	208,3	250	333,3	10,417	8,333	32	100	72	24
127,3	152,7	203,6	6,364	5,091	44	56	48	24	210	252	336	10,500	8,400	32	56	40	24
128	153,6	204,8	6,400	5,120	24	64	100	24	212,1	254,5	339,4	10,606	8,484	44	56	48	40
129	154,8	206,4	6,450	5,160	64	86	100	48	214,3	257,1	342,8	10,714	8,571	32	48	56	40
130,2	156,3	208,4	6,512	5,209	24	56	86	24	215	258	344	10,750	8,600	40	86	48	24
131	157,2	209,5	6,548	5,238	48	44	56	40	216	259,2	345,6	10,800	8,640	32	72	100	48
132	158,4	211,2	6,600	5,280	32	48	100	44	218,3	261,9	349,2	10,913	8,730	56	100	72	44
133,3	160	213,3	6,667	5,333	48	64	56	28	220	264	352	11	8,800	24	44	40	24
134	160,8	214,3	6,698	5,358	40	72	86	32	222,2	266,7	355,6	11,111	8,888	24	40	48	32
135	162	216	6,750	5,400	40	72	64	24	224	268,8	358,4	11,200	8,960	24	56	100	48
136,1	163,3	217,8	6,806	5,444	32	56	72	28	225	270	360	11,250	9	24	72	64	24
137,1	164,6	219,4	6,857	5,485	28	32	40	24	226,3	271,5	362	11,313	9,050	44	64	72	56
138,9	166,7	222,2	6,944	5,555	48	100	72	24	228	273,6	364,8	11,401	9,120	44	86	48	28
140	168	224	7	5,600	24	28	40	24	230,4	276,5	368,7	11,520	9,216	40	72	100	64
141,4	169,7	226,3	7,071	5,656	44	56	72	40	232,6	279,1	372,1	11,629	9,303	24	100	86	24
142,2	170,7	227,6	7,111	5,688	40	64	72	32	234,4	281,3	375,1	11,721	9,376	40	72	86	56
143,2	171,8	229,1	7,159	5,727	44	72	64	28	235,1	282,2	376,2	11,757	9,405	32	86	64	28
144	172,8	230,4	7,200	5,760	24	72	100	24	236,5	283,8	378,4	11,825	9,460	32	86	100	44
145,4	174,4	232,6	7,268	5,814	64	100	86	40	238,1	285,7	381	11,905	9,524	28	100	72	24
146,2	175,4	233,9	7,310	5,848	28	44	86	40	240	288	384	12	9,600	24	48	40	24
147,4	176,9	235,9	7,372	5,897	28	86	100	24	242,4	290,9	387,9	12,121	9,696	24	40	44	32
148	177,6	236,8	7,400	5,920	44	100	86	28	244,4	293,3	391,1	12,222	9,777	24	44	48	32
149,3	179,2	238,9	7,465	5,972	64	86	72	40	245	294	392	12,250	9,800	32	56	40	28
150	180	240	7,500	6	24	48	64	24	246,4	295,6	394,2	12,318	9,854	48	86	64	44
152	182,4	243,2	7,601	6,080	44	86	72	28	248,1	297,7	396,9	12,403	9,922	24	64	86	40
154	184,8	246,4	7,700	6,160	32	56	100	44	250	300	400	12,500	10	24	40	32	24

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TABLE FOR SPIRAL MILLING

HELIX LEAD					CHANGE GEARS			
MM			INCHES		A	B	C	D
5 mm	6 mm	8 mm	4 TPI 6,35 mm	5 TPI 5,08 mm				
252	302,4	403,2	12,600	10,080	32	72	100	56
254	304,8	406,3	12,698	10,158	28	64	72	40
255,2	306,2	408,3	12,758	10,206	28	64	86	48
256	307,2	409,6	12,800	10,240	28	64	100	56
258	309,6	412,8	12,900	10,320	32	86	100	48
260,5	312,6	416,8	13,024	10,419	24	56	86	48
262,5	315	420	13,125	10,500	32	72	48	28
264	316,8	422,4	13,200	10,560	24	72	100	44
265,2	318,2	424,3	13,258	10,606	44	100	48	28
266,7	320	426,7	13,333	10,666	24	64	48	24
268,8	322,5	430	13,438	10,750	24	86	64	24
270	324	432	13,500	10,800	32	72	40	24
272,2	326,7	435,6	13,611	10,888	24	56	48	28
274,3	329,1	438,8	13,713	10,970	40	64	56	48
275	330	440	13,750	11	24	44	32	24
277,8	333,3	444,4	13,889	11,111	24	100	72	24
280	336	448	14	11,200	24	56	40	24
282,9	339,4	452,5	14,142	11,313	40	72	56	44
284,1	340,9	454,5	14,204	11,363	44	100	64	40
285,2	342,2	456,3	14,260	11,408	24	56	72	44
286,4	343,7	458,3	14,322	11,457	48	100	64	44
288	345,6	460,8	14,400	11,520	24	72	100	48
294,9	353,8	471,8	14,743	11,794	28	86	100	48
296	355,2	473,6	14,800	11,840	44	100	86	56
300	360	480	15	12	24	48	32	24
303	363,6	484,8	15,150	12,120	44	100	48	32
304	364,8	486,5	15,202	12,161	44	86	72	56
305,4	366,5	488,7	15,272	12,217	40	56	44	48
306,1	367,3	489,8	15,306	12,244	28	100	56	24
308,6	370,3	493,7	15,429	12,343	40	72	56	48
310,1	372,1	496,1	15,504	12,403	48	100	86	64
312,5	375	500	15,625	12,500	24	100	64	24
314,3	377,1	502,8	15,714	12,571	24	44	28	24
315	378	504	15,750	12,600	32	72	40	28
320	384	512	16	12,800	24	64	40	24
322,5	387	516	16,125	12,900	32	86	40	24
324,1	388,9	518,5	16,204	12,963	24	100	72	28
325,6	390,7	521	16,280	13,024	40	100	86	56
326,5	391,8	522,5	16,327	13,061	28	64	56	40
328,5	394,2	525,5	16,423	13,138	32	86	72	44
330	396	528	16,500	13,200	40	72	48	44
332,2	398,7	531,6	16,612	13,289	28	100	86	40
334,4	401,3	535,1	16,722	13,377	40	86	72	56
335	402	536,1	16,752	13,401	44	86	56	48
336	403,2	537,6	16,800	13,440	24	72	100	56
338,3	405,9	541,2	16,914	13,531	44	100	86	64
340,9	409,1	545,4	17,045	13,636	32	100	44	24
342	410,4	547,3	17,102	13,681	32	86	44	28
344	412,8	550,4	17,200	13,760	32	86	100	64
345,5	414,6	552,8	17,275	13,820	56	86	64	72
348,8	418,6	558,1	17,442	13,953	32	100	86	48
350	420	560	17,500	14	24	56	32	24
355,6	426,7	568,9	17,778	14,222	24	64	48	32
358,4	430	573,4	17,918	14,334	24	86	48	24
360	432	576	18	14,400	24	72	40	24
363,6	436,3	581,8	18,181	14,544	28	56	44	40
364,6	437,5	583,3	18,229	14,583	32	100	48	28

HELIX LEAD					CHANGE GEARS			
MM			INCHES		A	B	C	D
5 mm	6 mm	8 mm	4 TPI 6,35 mm	5 TPI 5,08 mm				
365,5	438,6	584,7	18,273	14618	28	100	86	44
366,7	440	586,7	18,333	14,666	28	56	48	44
368,6	442,3	589,7	18,428	14,742	28	86	40	24
370,4	444,5	592,6	18,519	14,815	24	100	72	32
372,1	446,5	595,4	18,605	14,884	40	100	86	64
374	448,8	598,4	18,700	14,960	44	72	56	64
375	450	600	18,750	15	32	100	40	24
376,2	451,5	602	18,812	15,049	32	86	40	28
378,8	454,5	606	18,939	15,151	44	100	48	40
380,6	456,7	608,9	19,029	15,223	44	100	86	72
382,2	458,7	611,6	19,111	15,288	40	86	72	64
384	460,8	614,4	19,200	15,360	24	72	100	64
385	462	616	19,250	15,400	32	56	40	44
388,9	466,7	622,2	19,444	15,555	24	40	24	28
390,6	468,7	625	19,531	15,624	32	100	64	40
392,7	471,2	628,3	19,635	15,708	40	72	44	48
394,2	473	630,7	19,710	15,768	40	86	48	44
396,8	476,2	634,9	19,840	15,872	28	100	72	40
398,2	477,8	637,1	19,908	15,926	24	86	72	40
400	480	640	20	16	24	72	48	32
404	484,8	646,4	20,200	16,160	44	100	72	64
408,2	489,8	653,1	20,410	16,328	28	100	56	32
412,6	495,1	660,2	20,630	16,504	32	72	48	44
414,8	497,8	663,7	20,740	16,592	24	64	72	56
415,6	498,7	665	20,780	16,624	28	64	44	40
416,6	499,9	666,6	20,830	16,664	32	100	72	48
418	501,6	668,8	20,900	16,720	32	86	72	56
420	504	672	21	16,800	32	56	40	48
422,4	506,9	675,8	21,120	16,896	32	86	56	44
426,4	511,7	682,2	21,320	17,056	24	100	86	44
428,6	514 3	685,8	21,430	17,144	40	100	56	48
430	516	688	21,500	17,200	24	86	40	24
436,4	523,7	698,2	21,820	17,456	44	72	48	64
438	525,6	700,8	21,900	17,520	24	86	72	44
440	528	704	22	17,600	32	64	40	44
442,2	530,6	707,5	22,110	17,688	28	86	100	72
444,4	533,3	711	22,220	17,776	40	100	72	64
446,8	536,2	714,9	22,340	17,872	44	86	56	64
448	537,6	716,8	22,400	17,920	32	86	48	40
450	540	720	22,500	18	24	72	64	48
454,6	545 5	727,4	22,730	18,184	24	100	44	24
456	547,2	729,6	22,800	18,240	48	86	44	56
458,4	550,1	733,4	22,920	18,336	40	100	48	44
460,8	553	737,3	23,040	18,432	56	86	48	72
462,8	555,4	740,5	23,140	18,512	24	100	72	40
465,2	558,2	744,3	23,260	18,608	32	100	86	64
466,6	559,9	746,6	23,330	18,664	32	64	48	56
470,4	564,5	752,6	23,520	18,816	32	86	64	56
476,2	571,4	761,9	23,810	19,048	48	100	56	64
480	576	768	24	19,200	40	64	48	72
482,6	579,1	772,2	24,130	19 304	28	86	56	44
484,8	581,8	775,7	24,240	19,392	24	64	44	40
486,2	583,4	777,9	24,310	19,448	32	100	72	56
488 8	586,6	782,1	24,440	19,552	24	44	24	32
490,8	589	785,3	24,540	19,632	32	72	44	48
492,8	591,4	788,5	24,640	19,712	24	86	64	44
495	594	792	24,750	19,800	32	72	40	44

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TABLE FOR SPIRAL MILLING

HELIX LEAD					CHANGE GEARS			
MM			INCHES		A	B	C	D
5 mm	6 mm	8 mm	4 TPI 6,35 mm	5 TPI 5,08 mm				
498,6	598,3	797,8	24,930	19,944	28	64	44	48
500	600	800	25	20	24	72	48	40
502,8	603,4	804,5	25,140	20,112	28	64	40	44
510,2	612,2	816,3	25,510	20,408	28	100	56	40
512	614,4	819,2	25,600	20,480	28	86	48	40
514,2	617	822,7	25,710	20,568	24	72	56	48
516	619,2	825,6	25,800	20,640	24	86	100	72
520,8	625	833,3	26,040	20,832	32	100	48	40
525	630	840	26,250	21	32	72	48	56
526,6	631,9	842,6	26,330	21,064	28	86	56	48
530,4	636,5	848,6	26,520	21,216	44	100	48	56
535,8	643	857,3	26,790	21,432	48	100	56	72
540	648	864	27	21,600	32	72	40	48
542,6	651,1	868,2	27,130	21,704	24	100	86	56
544,4	653,3	871	27,220	21,776	24	56	24	28
545,4	654,5	872,6	27,270	21,816	40	100	44	48
546	655,2	873,6	27,300	21,840	28	86	72	64
548,6	658,3	877,8	27,430	21,944	28	64	40	48
550	660	880	27,500	22	32	56	28	44
552,8	663,4	884,5	27,640	22,112	40	86	56	72
555,6	666,7	889	27,780	22,224	32	100	72	64
558,4	670,1	893,4	27,920	22,336	28	86	44	40
560	672	896	28	22,400	64	100	48	86
562,6	675,1	900,2	28,130	22,504	40	100	64	72
565,8	679	905,3	28,290	22,632	28	72	40	44
568,2	681,8	909,1	28,410	22,728	32	100	44	40
581,8	698,2	930,9	29,090	23,272	24	64	44	48
584,4	701,3	935	29,220	23,376	56	100	44	72
586,4	703,7	938,2	29,320	23,456	48	86	44	72
587,8	705,4	940,5	29,390	23,512	28	72	56	64
591,2	709,4	945,9	29,560	23,648	32	86	40	44
595,2	714,2	952,3	29,760	23,808	28	100	48	40
598	717,6	956,8	29,900	23,920	28	100	86	72
600	720	960	30	24	28	56	32	48
604,6	725,5	967,4	30,230	24,184	32	86	64	72
606	727,2	969,6	30,300	24,240	48	100	44	64
610,8	733	977,3	30,540	24,432	44	100	64	86
612,2	734,6	979,5	30,610	24,488	28	100	56	48
614,2	737	982,7	30,710	24,568	24	86	56	48
620,2	744,2	992,3	31,010	24,808	24	100	86	64
622,2	746,6	995 5	31,110	24,888	24	64	48	56
625	750	1000	31,250	25	28	100	64	56
628,6	754,3	1005,8	31,430	25,144	28	64	32	44
630	756	1008	31,500	25,200	32	72	40	56
635	762	1016	31,750	25,400	72	100	28	64
636,4	763,7	1018,2	31,820	25,456	44	100	40	56
640	768	1024	32	25,600	28	64	40	56
641,8	770,2	1026,9	32,090	25,672	24	56	32	44
645	774	1032	32,250	25,800	48	86	40	72
648,2	777,8	1037,1	32,410	25,928	24	100	72	56
651,6	781,9	1042,6	32,580	26,064	24	86	44	40
654,6	785,5	1047,4	32,730	26,184	32	72	44	64
660	792	1056	33	26,400	24	72	40	44
666,6	799,9	1066,6	33,330	26,664	24	100	40	32
670,2	804,2	1072,3	33,510	26,808	28	86	44	48
675,8	811	1081,3	33,790	27,032	28	86	40	44
678,8	814,6	1086,1	33,940	27,152	24	64	44	56

HELIX LEAD					CHANGE GEARS			
MM			INCHES		A	B	C	D
5 mm	6 mm	8 mm	4 TPI 6,35 mm	5 TPI 5,08 mm				
684	820,8	1094,4	34,200	27,360	44	86	32	56
685,8	823	1097,3	34,290	27,432	48	72	28	64
691	829,2	1105,6	34,550	27,640	32	86	56	72
694,4	833,3	1111	34,720	27,776	24	100	48	40
698	837,6	1116,8	34,900	27,920	56	100	44	86
700	840	1120	35	28	24	72	48	56
702	842,4	1123,2	35,100	28,080	28	86	56	64
711,2	853,4	1137,9	35,560	28,448	24	64	24	32
714,2	857	1142,7	35,710	28,568	32	100	56	64
720	864	1152	36	28,800	32	72	40	64
727,2	872,6	1163,5	36,360	29,088	44	100	40	64
733,4	880,1	1173,4	36,670	29,336	24	48	24	44
737,2	884,6	1179,5	36,860	29,488	28	86	40	48
740,8	889	1185,3	37,040	29,632	24	100	72	64
746,6	895,9	1194,6	37,330	29,864	32	100	72	86
748	897,6	1196,8	37,400	29,920	28	72	44	64
750	900	1200	37,500	30	48	100	40	72
752,6	903,1	1204,2	37,630	30,104	32	86	40	56
757,6	909,1	1212,2	37,880	30,304	24	100	44	40
762	914,4	1219,2	38,100	30,480	24	64	28	40
764	916,8	1222,4	38,200	30,560	24	100	48	44
767,8	921,4	1228,5	38,390	30,712	40	100	56	86
771,4	925,7	1234,2	38,570	30,856	28	72	32	48
777,8	933,4	1244,5	38,890	31,112	24	56	24	40
779,2	935	1246,7	38,960	31,168	28	100	44	48
785,8	943	1257,3	39,290	31,432	28	100	40	44
788,4	946,1	1261,4	39,420	31,536	24	86	40	44
789,8	947,8	1263,7	39,490	31,592	28	86	56	72
795,4	954,5	1272,6	39,770	31,816	32	100	44	56
800	960	1280	40	32	24	72	48	64
803,6	964,3	1285,8	40,180	32,144	32	100	56	72
806,2	967,4	1289,9	40,310	32,248	32	86	48	72
816,4	979,7	1306,2	40,820	32,656	28	100	56	64
818,2	981,8	1309,1	40,910	32,728	40	100	44	72
822,8	987,4	1316,5	41,140	32,912	28	72	40	64
825	990	1320	41,250	33	24	72	32	44
833,4	1000,1	1333,4	41,670	33,336	32	100	48	64
836,2	1003,4	1337,9	41,810	33,448	24	86	48	56
838,2	1005,8	1341,1	41,910	33,528	24	64	28	44
840	1008	1344	42	33,600	24	72	40	56
844,6	1013,5	1351,4	42,230	33,784	28	86	32	44
855,6	1026,7	1369	42,780	34,224	24	56	24	44
860	1032	1376	43	34,400	32	86	40	64
872,8	1047,4	1396,5	43,640	34,912	24	72	44	64
875	1050	1400	43,750	35	32	100	40	56
879,6	1055,5	1407,4	43,980	35,184	32	86	44	72
888,8	1066 6	1422,1	44,440	35,552	24	64	24	40
892,8	1071,4	1428,5	44,640	35,712	28	100	32	40
895,8	1075	1433,3	44,790	35,832	40	100	48	86
900	1080	1440	45	36	28	72	32	56
909	1090,8	1454,4	45,450	36,360	32	100	44	64
912,2	1094,6	1459,5	45,610	36,488	24	86	44	56
918 4	1102,1	1469,4	45,920	36,736	28	100	56	72
921,4	1105,7	1474,2	46,070	36,856	28	86	48	72
933,4	1120,1	1493,4	46,670	37,336	24	64	32	56
937,6	1125,1	1500,2	46,880	37,504	32	100	48	72
943	1131,6	1508,8	47,150	37,720	24	72	28	44

UNIVERSAL DIVIDING HEAD

TABLE FOR SPIRAL MILLING

HELIX LEAD					CHANGE GEARS				HELIX LEAD					CHANGE GEARS			
MM			INCHES		A	B	C	D	MM			INCHES		A	B	C	D
5 mm	6 mm	8 mm	4 TPI 6,35 mm	5 TPI 5,08 mm					5 mm	6 mm	8 mm	4 TPI 6,35 mm	5 TPI 5,08 mm				
952,4	1142,9	1523,8	47,620	38,096	28	100	48	64	1612,5	1935	2580	80,625	64,500	32	86	28	84
955,6	1146,7	1529	47,780	38,224	24	86	48	64	1680	2016	2688	84	67,200	40	96	24	84
960	1152	1536	48	38,400	24	72	40	64	1720	2064	2732	86	68,800	40	96	24	86
967,6	1161,1	1548,2	48,380	38,704	32	86	40	72	1750	2100	2800	87,500	70	40	100	24	84
972,2	1166,6	1555,5	48,610	38,888	24	100	48	56	1777	2133	2844	88,850	71,080	24	80	24	64
977,2	1172,6	1563,5	48,860	39,088	40	100	44	86	1791	2150	2866	89,550	71,640	40	100	24	86
982,2	1178,6	1571,5	49,110	39,288	28	100	32	44	1800	2160	2880	90	72	28	84	24	72
985,4	1182,5	1576,6	49,270	39,416	24	86	32	44	1828	2194	2925	91,400	73,120	28	96	24	64
995,4	1194,5	1592,6	49,770	39,816	24	100	72	86	1842	2211	2948	92,100	73,680	32	96	28	86
1000	1200	1600	50	40	28	100	40	56	1866	2240	2986	93,300	74,640	24	84	24	64
1005,2	1206,2	1608,3	50,260	40,208	28	86	44	72	1875	2250	3000	93,750	75	32	100	28	84
1022,8	1227,4	1636,5	51,140	40,912	32	100	44	72	1904	2285	3047	95,200	76,160	28	100	24	64
1028,6	1234,3	1645,8	51,430	41,144	28	72	32	64	1919	2303	3071	95,950	76,760	32	100	28	86
1042,4	1250,9	1667,8	52,120	41,696	24	86	44	64	1944	2333	3111	97,200	77,760	24	100	24	56
1050	1260	1680	52,500	42	24	72	32	56	2000	2400	3200	100	80	28	84	24	80
1060,6	1272,7	1697	53,030	42,424	24	100	44	56	2047	2457	3276	102,350	81,880	28	86	24	80
1066,6	1279,9	1706,6	53,330	42,664	24	64	28	56	2057	2468	3291	102,850	82,280	28	96	24	72
1075	1290	1720	53,750	43	24	86	32	48	2083	2500	3333	104,150	83,320	32	100	24	80
1100	1320	1760	55	44	24	72	24	44	2100	2520	3360	105	84	24	84	24	72
1105,6	1326,7	1769	55,280	44,224	28	86	40	72	2133	2560	3413	106,650	85,320	24	96	24	64
1111,2	1333,4	1777,9	55,560	44,448	24	100	24	32	2142	2571	3428	107,100	85,680	32	100	28	96
1119,8	1343,8	1791,7	55,990	44,792	24	100	64	86	2150	2580	3440	107,500	86	28	86	24	84
1125	1350	1800	56,250	45	32	100	40	72	2187	2625	3500	109,350	87,480	32	100	24	84
1142,8	1371,4	1828,5	57,140	45,712	28	100	40	64	2222	2666	3555	111,100	88,880	24	100	24	64
1146	1375,2	1833,6	57,300	45,840	24	100	32	44	2239	2687	3583	111,950	89,560	32	100	24	86
1166,6	1399,9	1866,6	58,330	46,664	24	100	40	56	2285	2742	3657	114,250	91,400	28	96	24	80
1172,8	1407,4	1876,5	58,640	46,912	24	86	44	72	2333	2800	3733	116,650	93,320	24	84	24	80
1190,6	1428,7	1905	59,530	47,624	24	100	28	40	2380	2857	3809	119	95,200	28	100	24	80
1200	1440	1920	60	48	24	72	32	64	2388	2866	3822	119,400	95,520	24	86	24	80
1225	1470	1960	61,250	49	32	84	24	56	2400	2880	3840	120	96	28	96	24	84
1250	1500	2000	62,500	50	40	100	32	80	2457	2948	3931	122,850	98,280	28	96	24	86
1280	1536	2048	64	51,200	40	96	24	64	2500	3000	4000	125	100	28	100	24	84
1290	1548	2064	64,500	51,600	40	86	28	84	2508	3010	4013	125,400	100,320	24	96	24	84
1312,5	1575	2100	65,625	52,500	40	100	32	84	2559	3071	4095	127,950	102,360	28	100	24	86
1350	1620	2160	67,500	54	32	84	28	72	2666	3200	4266	133,300	106,640	24	96	24	80
1371,43	1645,71	2194,29	68,571	54,857	40	96	28	80	2800	3360	4480	140	112	24	96	24	84
1400	1680	2240	70	56	40	84	24	80	2857	3428	4571	142,850	114,280	28	100	24	96
1440	1728	2304	72	57,600	40	96	28	84	2866	3440	4586	143,300	114,640	24	96	24	86
1500	1800	2400	75	60	40	100	28	84	2916	3500	4666	145,800	116,640	24	100	24	84
1575	1890	2520	78,750	63	32	84	24	72	2986	3583	4777	149,300	119,440	24	100	24	86
1600	1920	2560	80	64	40	96	24	80	3333	4000	5333	166,650	133,320	24	100	24	96

NOTES. Spiral milling loose fixing screw 15 and introduces needle 42 in plate 4, so that movement may be drived to the main spindle.

For spiral leads greater than 50 mm the feed of the table must be automatically produced.

For spiral leads less than 50 mm, the automatic movement must be aid by the handle 13.

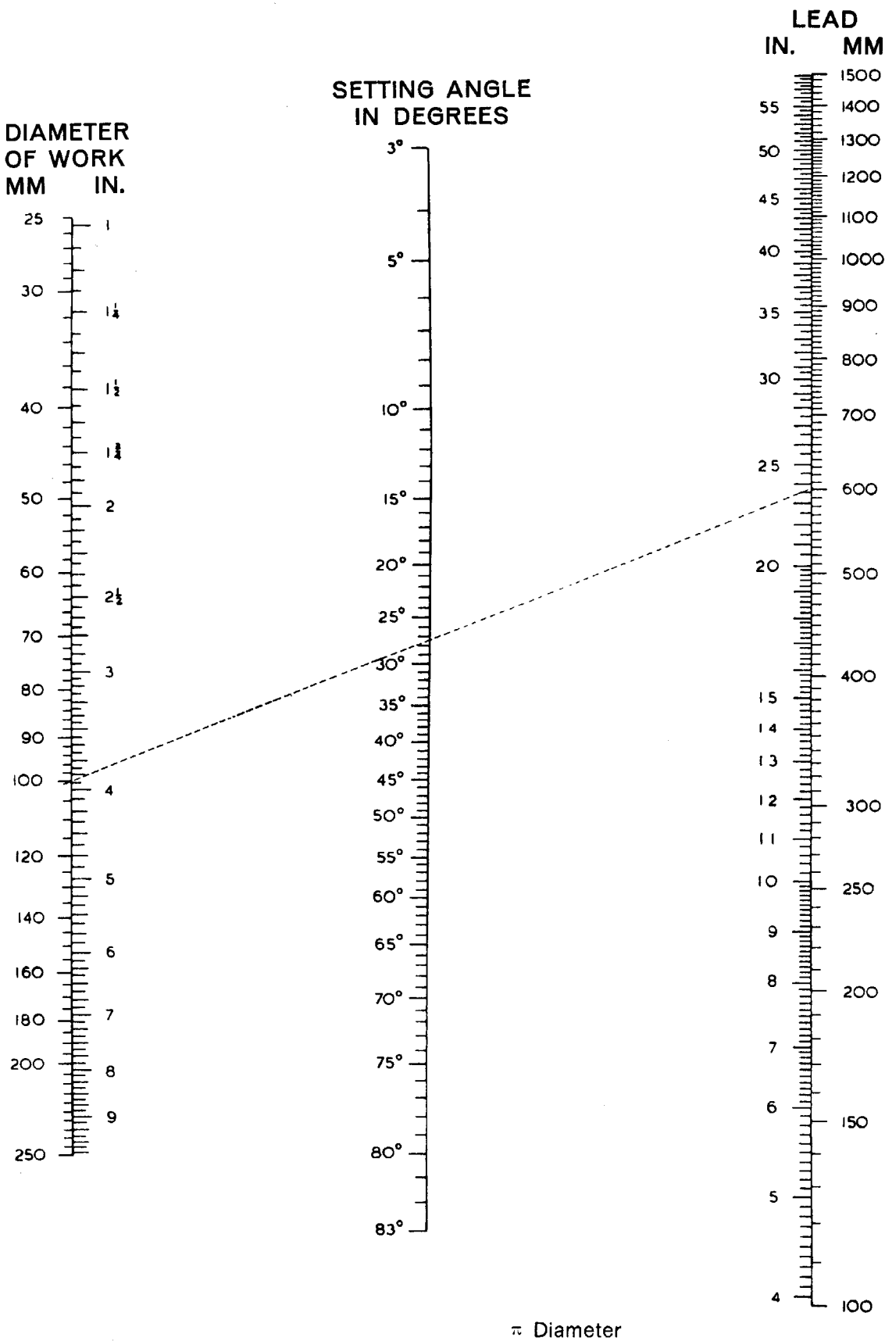
When the desired lead is too much short, driving may be direct between the table and the main spindle of the dividing head, disengaging clamp 37 to avoid any surplus effort in the gears.

Calculation will be

$$R = \frac{\text{Lead of the lead screw}}{\text{Lead of helix}} = \frac{\text{Driving gears}}{\text{Driven gears}}$$

Example: Lead of 4 mm in a milling machine with lead screw of 5 mm.

$$R = \frac{5}{4} = \frac{40}{32}$$ gearing these wheels with idlers.



$$\text{TANGENT OF THE ANGULAR POSITION} = \frac{\pi \text{ Diameter}}{\text{Lead}}$$

Example: — Diameter of work piece 100 mm. Spiral lead 603,5 mm.

Taking these values on the table and tracing a line between both data, give us 27° 30' which will be its setting angle.

It also serves to calculate the spiral lead knowing the diameter of work piece and its setting angle.

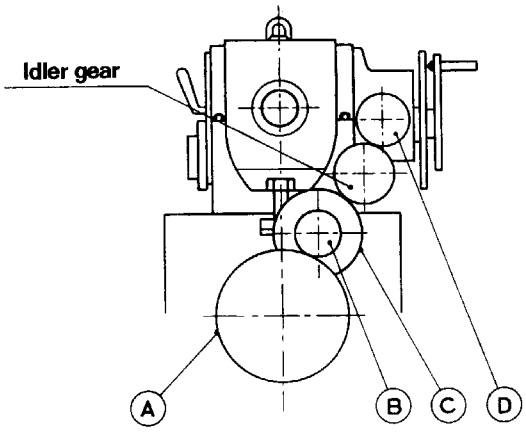
NOMOGRAM TO GIVE ANGULAR SETTINGS OF MACHINE TABLE FOR SPIRAL MILLING

RACK CUTTING

By means of a specific train of gears it is possible to obtain for each revolution of index arm 13 a feed of 1 mm on the lead screw.

The ratios for a few pitches are as follows:

Pitch of lead screw.	Gears			
	A	B	C	D
5	72	24	40	24
6	72	24	48	24
8	72	24	64	24
4 TPI (6,35 mm.)	127	40	48	24
5 TPI (5,08 mm.)	127	40	64	40



NOTE: For rack cutting the worm must engaged by means of worm adjusting clamp 37 in order to avoid forcing the worm wheel.

Example: It is required to cut a rack M=2 mm, P=6.2832 mm, on a milling machine having a lead screw of 5 mm pitch.

The gear compound according to the table above will be=72-24-40-24.

Revolution of index arm 13 for P=6.2832 mm.

6 complete revolutions=6 mm.

Taking the 49 hole circle, for each hole the lead screw will feed

$\frac{1}{49}$ = 0.024 mm. there fore in oraer to feed 0.2832 mm the index arm 13 must rotate $\frac{0.2832}{0.0204}$ = 14 spaces in the 49 hole circle.

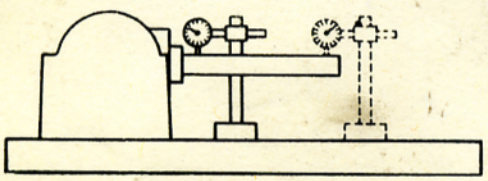
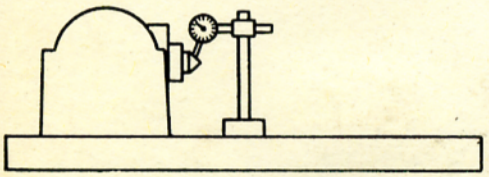
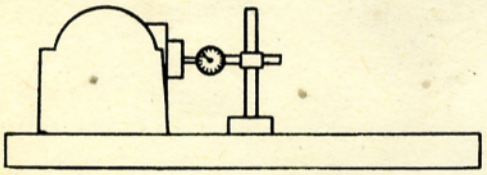
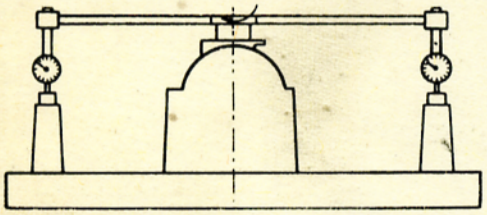
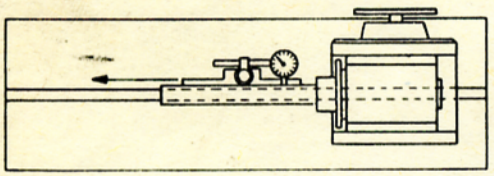
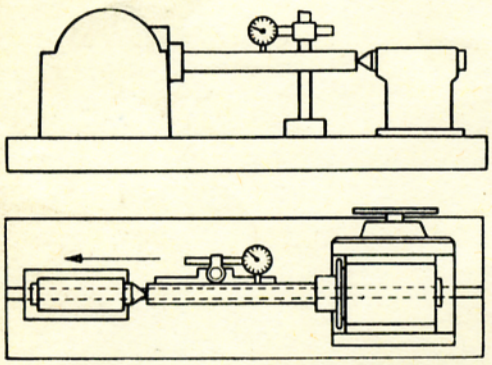
Check for error:

6 revolutions of index arm = 6 mm of feed
14 holes at 0.0204 mm per hole = 0.2856 mm of feed
6.2856 mm of feed effected
6.2832 mm of feed required
0.0024 mm of error obtained

TABLE FOR RACK CUTTING

	mm.	Turns	Hole circle	Holes
1	3,1416	3	49	7
1,25	3,9270	3	43	40
1,50	4,7124	4	31	22
1,75	5,4978	5	23	12
2	6,2832	6	49	14
2,5	7,8540	7	49	42
3	9,4248	9	33	14
3,5	10,9956	11	49	—
4	12,5664	12	37	21
4,5	14,1372	14	29	4
5	15,7080	15	31	22
6	18,8496	18	41	35
7	21,9912	22	49	—
8	25,1322	25	37	5
9	28,2744	28	47	13
10	31,4160	31	43	18

TEST CARD FOLLOWING DIN/SALMON STANDARDS

	SCHEME	Purpose	Error in mm. Allowed	Error in mm. Checked.
1		Concentricity of internal taper of spindle: a) At the outlet. b) At a distance of 300 mm.	0,01 0,02	0,003 0,018
2		Concentricity of center.	0,01	0,004
3		Back lash, under constant pressure of spindle on its seat.	0,005	0,003
4		Perpendiculary of the main spindle with the table.	0,02 on 300 mm.	0,015
5		Parallelism between the slot of the table and the internal taper of the diving head placed in horizontal position. a) Horizontal plane. b) Vertical plane.	0,02 0,02 per metre	0,010 0,008
6	See diagram	Indexing accuracy: a) Error between two different divisions. b) Max. total indexing error.		18" ±30"
7		Parallelism between the center line and the slot. a) Horizontal plane. b) Vertical plane.	0,02 0,02	0,011 0,013

Model 84452 Number D 8639

3-6-80

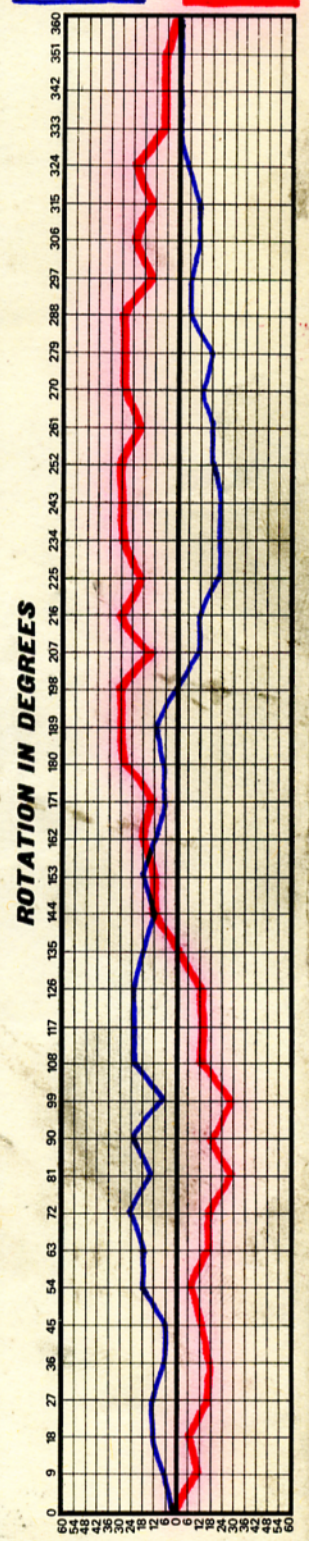
Controller

Chief controller

DIAGRAM OF TESTING WITH A "CARL ZEISS" HIG PRECISION DIGITAL INDEX TEXTER.

ROTATION

To the right To the left



MAXIMUN TOTAL ERROR

To the rigth 48" To the left 1'