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$VT^n$  curves for tools of grade SIP, RD107 and RD110  
when machining EN9



Summary

Tools of SIP, RD107 and RD110 were tested at 300, 420 and 600 fpm cutting speed with .10 in depth of cut and .010 in/rev feed on EN9 to .030 in flankwear in order to find the constants in the expression  $VT^n = C$  for the three grades. The values of 'n' were found to be .51, .53 and .46 and the values of C to be 4550, 4720 and 3620 for SIP, RD107 and RD110 respectively. It was found that at 600 fpm the crater wear of SIP was about a third of the wear of the other two grades.

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Test conditions

The following conditions were used during the tests:-

Work material: EN9  
Depth of cut: .10 in  
Feed: .010 in/rev  
Cutting speeds: 300, 420 and 600 fpm

and the tools used were:-

SIP NT241	RD107 NT217	RD110 NT235
SIP NT242	RD107 NT218	RD110 NT236
SIP NT243	RD107 NT219	RD110 NT237

Test results

The three cutting speeds were selected on a logarithmic scale and the tests were arranged so that the same bars of EN9 were cut by each tip. The flankwear was measured as shown in Figure 1 and the results are recorded in Tables 1 - 9.

From these results the cutting time in minutes to .030 in flankwear can be summarised as follows:-

	SIP	RD107	RD110
300 fpm	216	189	234
420 fpm	103	100	99
600 fpm	56	52	54

and these results are shown graphically in Figure 2 which shows cutting speed against time to .030 in flankwear. Figure 3 shows Figure 2 re-plotted with logarithmic axes in order to obtain the constants in the tool life expression  $VT^n = C$  (where V is the cutting speed in ft/min and T is the time in min to .030 in flankwear). From the figure it can be seen that RD107 was the only grade which obeyed the tool life relationship exactly but mean straight lines have been drawn for the other

two grades. The constants obtained were:-

	SIP	RD107	RD110
n	.51	.53	.46
C	4550	4720	3620

Figures 4, 5 and 6 show the crater wear of the three grades at 300, 420 and 600 fpm respectively. It can be seen that at the lowest speed there was little difference between the three grades but at 600 fpm SIP had by far the greatest resistance to crater wear. RD110 was slightly better than RD107 as regards cratering but both grades suffered deformation at the nose radius.

Figures 7-12 give photographs of the flank and crater wear of the tips at the end of the tests.

### Conclusions

The results showed that over the speed range considered the flank wear of the three grades was not greatly different. The values of 'n' in the expression  $VT^n = C$  were all within 8% of the mean value of .5 and the values of C were within 16% of the mean value 4297.

The results also showed that at 600 fpm the cratering of RD107 and RD110 was much greater than that of SIP. With RD107 and RD110 there was also a certain amount of deformation at the nose radius at 420 and 600 fpm.

TABLE 1

Tool: SIP NI242                      Depth of cut: .10 in  
Speed: 300 fpm                        Material: EN 9  
Feed: .010 in/rev                      Date: 7-7-64

TIME min	FLANK WEAR			DEFORMATION	HARDNESS vpn
	Fa	Fb	Fc		
12	.0045	.0035	.0055		203
24	.0055	.0035	.0055		
36	.0065	.0065	.0065		
48	.0075	.0065	.010		
60	.008	.007	.0115		
72	.009	.008	.012		
84	.010	.009	.0125		
96	.0105	.0105	.013		
108	.012	.0115	.019		215
120	.012	.0115	.0195		
132	.012	.0115	.0205		220
144	.012	.012	.023		
156	.013	.013	.023		
168	.013	.013	.025		
180	.013	.013	.027		
192	.013	.013	.027		
204	.013	.0135	.029		
216	.013	.0135	.030		
228	.013	.0135	.030		
240	.013	.0145	.030		
252	.0135	.0145	.032		

- 4 -  
TABLE 2

Tool:	RD107 NI217	Depth of cut:	.10 in
Speed:	300 fpm	Material:	EN 9
Feed:	.010 in/rev	Date:	29-6-64

TIME min	FLANK WEAR			DEFORMATION	HARDNESS vpn
	Fa	Fb	Fc		
12	.0035	.0045	.006		
24	.004	.0055	.0055		218
36	.005	.007	.010		
48	.006	.0085	.0135		227
60	.006	.0085	.014		
72	.006	.0095	.014		
84	.0075	.011	.016		
96	.008	.012	.0165		
108	.009	.014	.0185	.0005	215
120	.010	.016	.020	.0005	
132	.010	.016	.0215	.0005	228
144	.011	.016	.024	.0005	
156	.0115	.0165	.025	.0005	
168	.0115	.017	.026	.0005	
180	.013	.019	.029	.001	
192	.014	.019	.0315	.001	



TABLE 4

Tool: SIP MT243                      Depth of cut: .10 in  
Speed: 420 fpm                        Material: EN 9  
Feed: .010 in/rev                      Date: 7-7-64

TIME min	FLANK WEAR			DEFORMATION	HARDNESS vpn
	Fa	Fb	Fc		
9	.0055	.0045	.006	.002	227
18	.007	.006	.009	.002	203
27	.0075	.008	.0115	.003	
36	.009	.011	.015	.004	
45	.0095	.0115	.0165	.0045	
54	.0115	.012	.0185	.0045	
63	.013	.014	.021	.0045	
72	.0135	.015	.022	.0045	
81	.0155	.0155	.0275	.0045	215
90	.017	.0185	.028	.0045	
99	.017	.019	.028	.0055	228
108	.0175	.0195	.033	.0055	

TABLE 5

Tool: RD107 MT219  
Speed: 420 fpm  
Feed: .010 in/rev

Depth of cut: .10 in  
Material: EN 9  
Date: 29.6.64

TIME min	FLANK WEAR			DEFORMATION	HARDNESS vpn
	Fa	Fb	Fc		
9	.003	.003	.0065		
18	.005	.006	.013		
27	.006	.0075	.013		
36	.007	.0075	.016	.0025	
45	.0075	.0085	.016	.003	227
54	.008	.010	.018	.004	
63	.008	.0105	.022	.004	203
72	.011	.012	.024	.004	
81	.011	.0125	.025	.0045	215
90	.0125	.016	.029	.005	
99	.0125	.016	.0305	.0055	228
108	.013	.017	.0345	.006	



TABLE 6

Tool:	RD110 NT237	Depth of cut:	.10 in
Speed:	420 fpm	Material	EN 9
Feed:	.010 in/rev	Date:	29-6-64

TIME min	FLANK WEAR			DEFORMATION	HARDNESS vpn
	Fa	Fb	Fc		
9	.004	.005	.007		
18	.004	.005	.0115	.0025	218
27	.006	.006	.015	.003	
36	.0075	.0075	.0165	.0045	
45	.008	.008	.017	.0045	227
54	.008	.0095	.019	.0045	203
63	.0095	.0105	.0225	.0055	
72	.010	.012	.0235	.0055	
81	.012	.014	.0255	.0055	215
90	.012	.014	.029	.0055	
99	.014	.014	.0295	.0055	228
108	.014	.015	.035	.006	



TABLE 7

Tool: SIP NT241                      Depth of cut: .10 in  
Speed: 600 fpm                        Material: EN 9  
Feed: .010 in/rev                      Date: 7-7-64

TIME min	FLANK WEAR			DEFORMATION	HARDNESS
	Fa	Fb	Fc		
6	.007	.0045	.006	.002	227
12	.0105	.009	.0075	.0035	203
18	.012	.011	.011	.004	
24	.013	.012	.013	.004	
30	.014	.015	.016	.004	
36	.017	.017	.0185	.004	
42	.019	.0175	.021	.0045	
48	.0205	.0205	.0265	.0045	
54	.0235	.0205	.028	.0055	215
60	.0245	.0205	.036	.006	

TABLE 8

Tool: RD107 NI218  
Speed: 600 fpm  
Feed: .010 in/rev

Depth of cut: .10 in  
Material: EN 9  
Date: 29-6-64

TIME min	FLANK WEAR			DEFORMATION	HARDNESS vpn
	Fa	Fb	Fc		
6	.005	.0045	.007	.002	
12	.006	.006	.009	.002	218
18	.008	.010	.012	.003	
24	.0095	.0115	.0175	.0035	
30	.010	.012	.0175	.0035	227
36	.012	.013	.022	.0045	
42	.013	.017	.0235	.0055	203
48	.0145	.0205	.027	.0055	
54	.017	.023	.032	.0065	215

TABLE 9

Tool: RD110 M236                      Depth of cut: .10 in  
Speed: 600 fpm                         Material: EN 9  
Feed: .010 in/rev                        Date: 29-6-64

TIME min	FLANK WEAR			DEFORMATION	HARDNESS vpn
	Fa	Fb	Fc		
6	.0045	.0045	.0075	.002	
12	.006	.006	.010	.0035	218
18	.008	.0095	.0155	.0035	
24	.012	.012	.019	.0035	
30	.012	.012	.0195	.0055	227
36	.014	.014	.021	.0065	
42	.015	.0165	.025	.0075	203
48	.016	.020	.029	.0075	
54	.0175	.0215	.0295	.0085	215
60	.0185	.0275	.037	.0085	

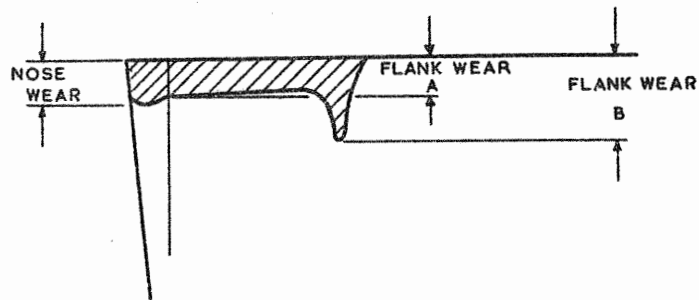


FIG. 1. TOOL WEAR MEASUREMENT.

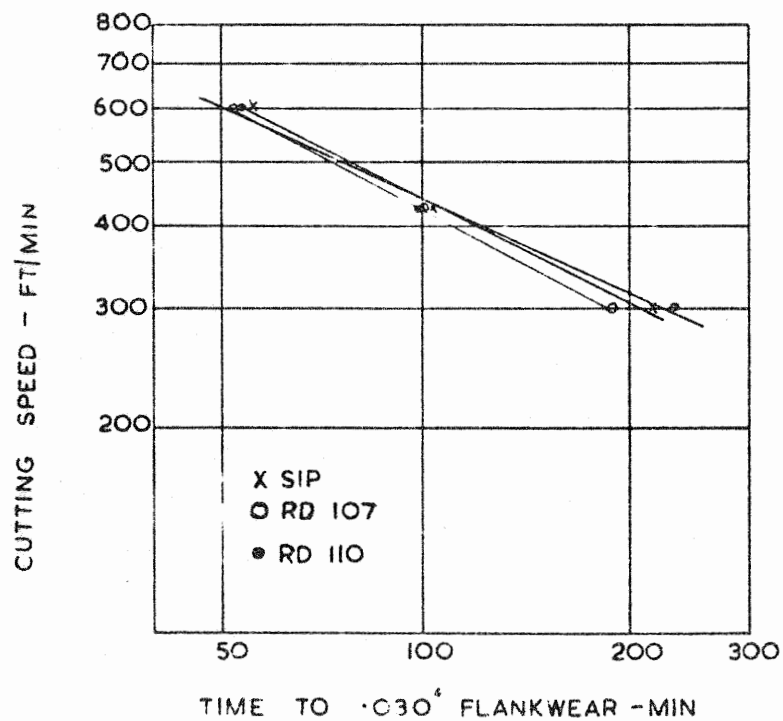


FIG. 3

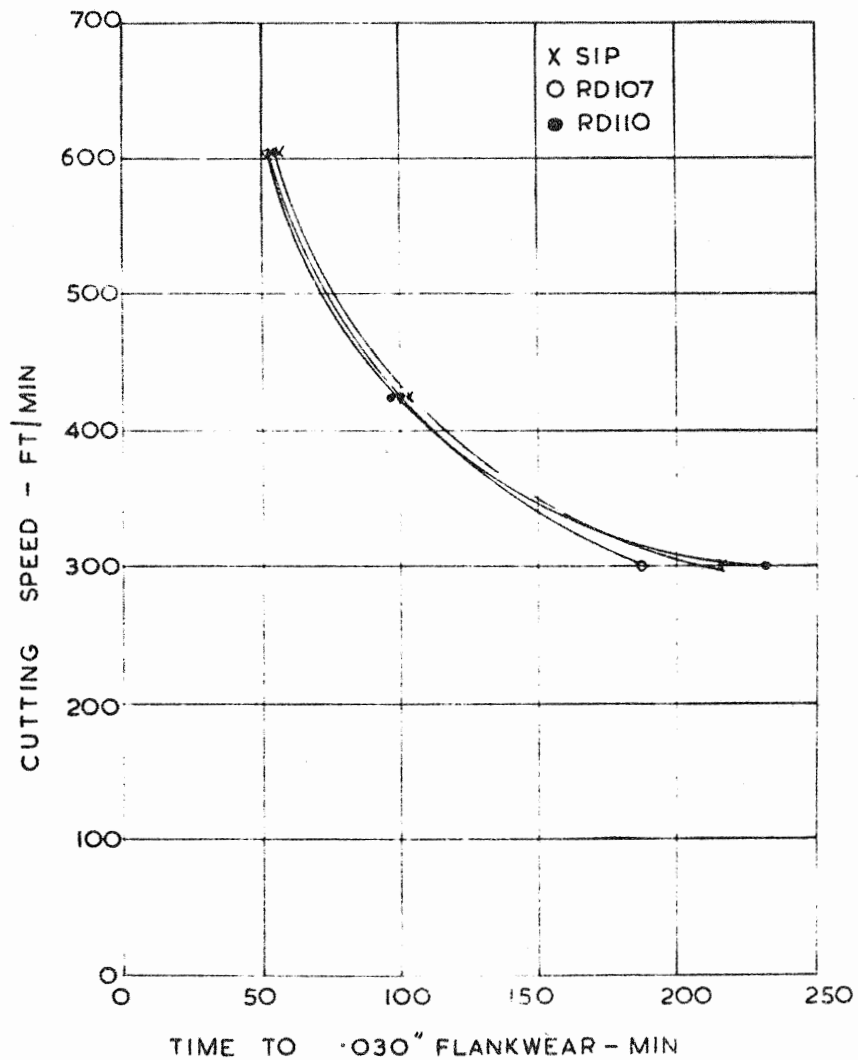
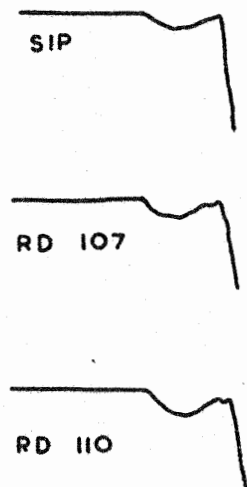


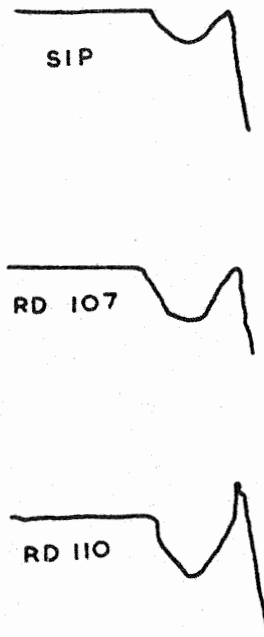
FIG. 2.



$\uparrow$  .005  
 $\rightarrow$  .05°

CRATER WEAR 300 f.p.m.

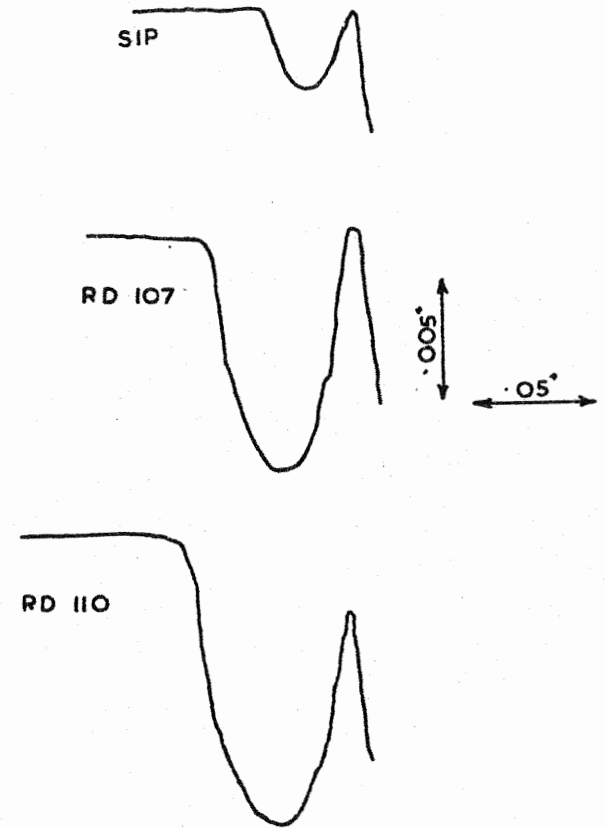
FIG. 4



$\uparrow$  .005  
 $\rightarrow$  .05°

CRATER WEAR 420 f.p.m.

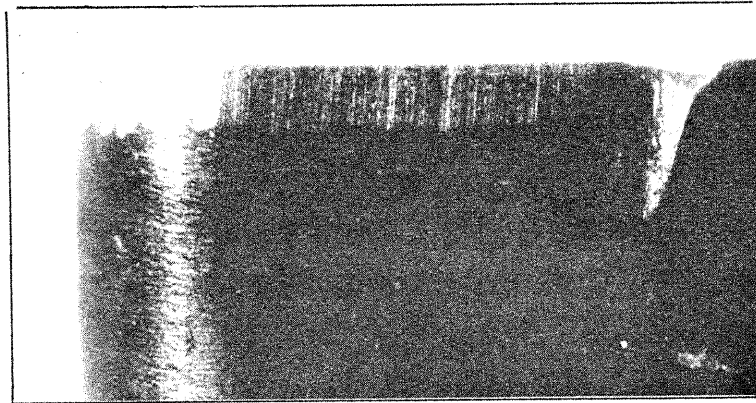
FIG. 5



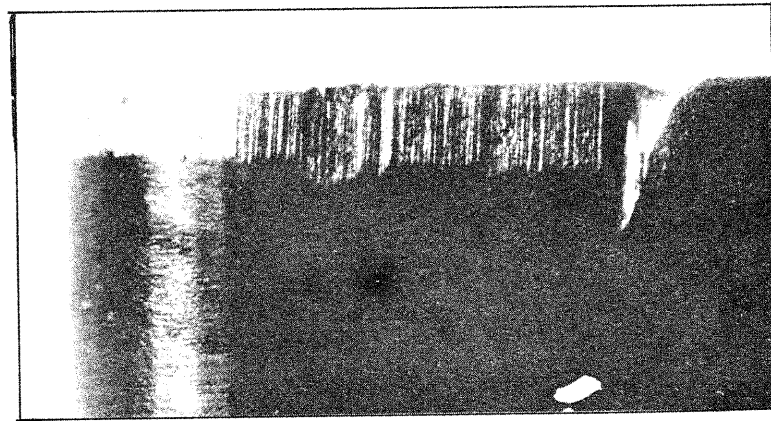
$\uparrow$  .005  
 $\rightarrow$  .05°

CRATER WEAR - 600 f.p.m.

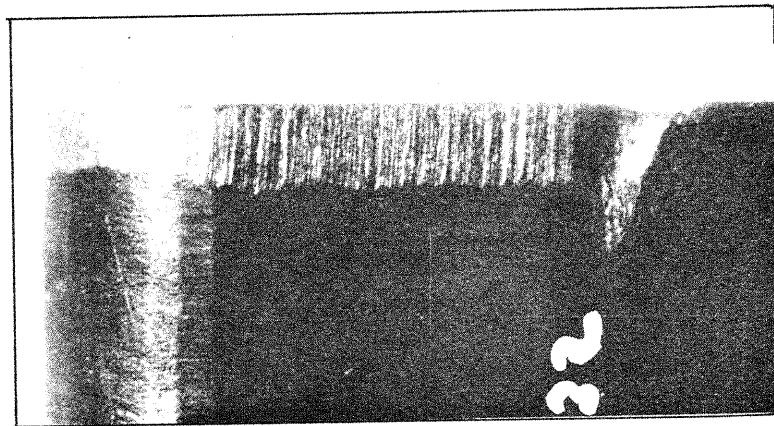
FIG. 6



S1P

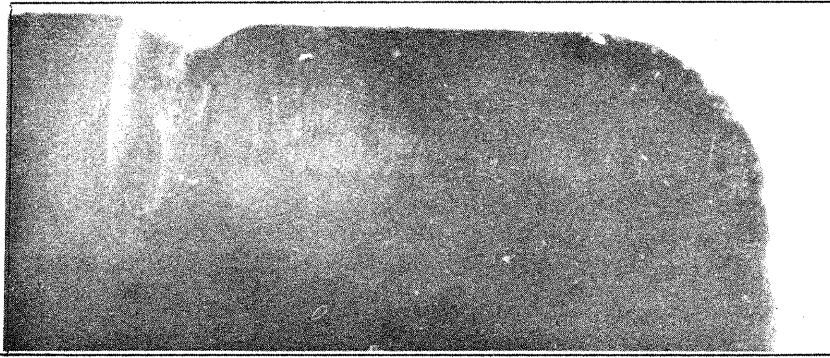


RD 107

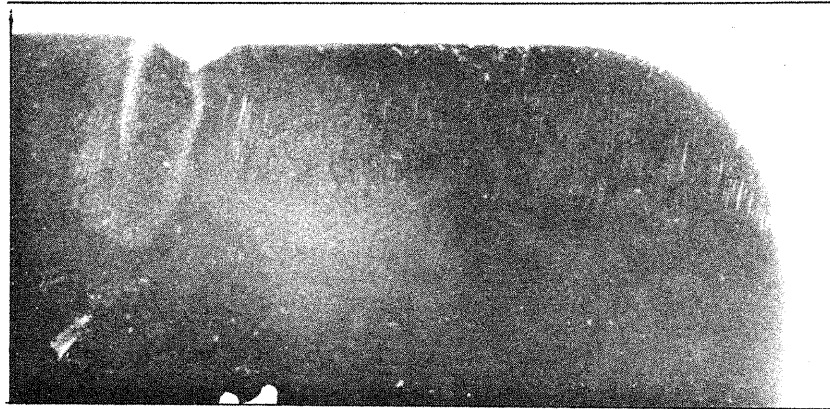


RD 110

FIG. 7 FLANKWEAR AT 300 fpm



S1P



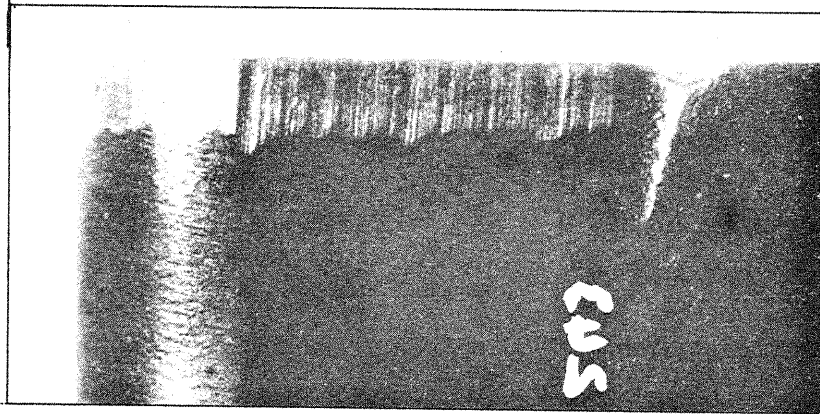
RD 107



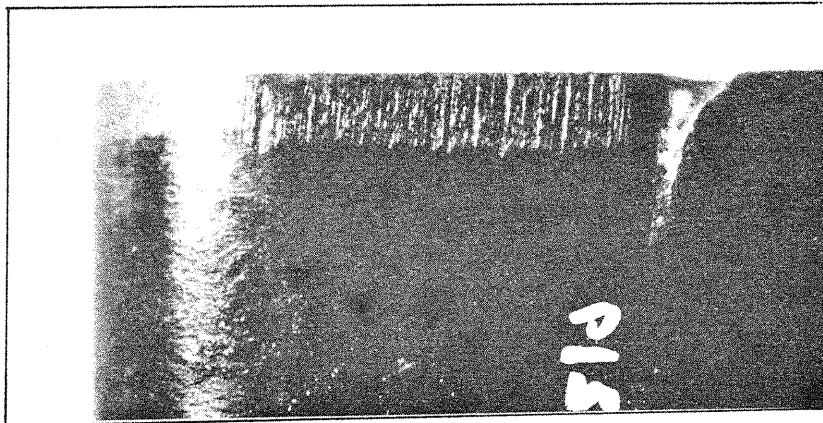
RD 110

FIG. 8 CRATER WEAR AT 300 fpm

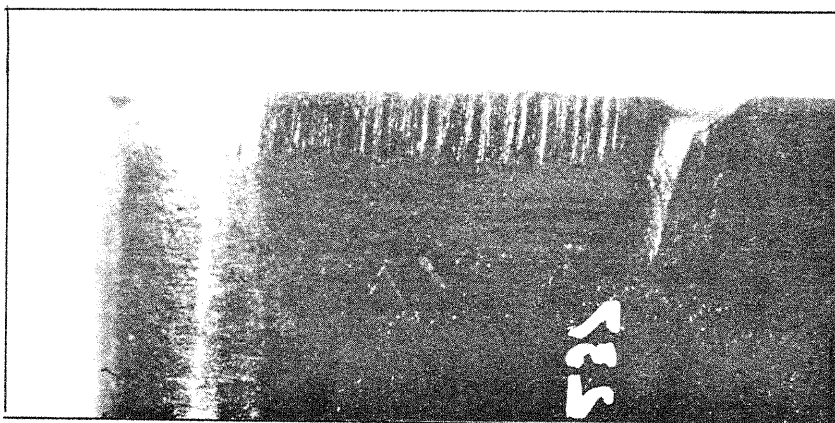




S1P



RD 107



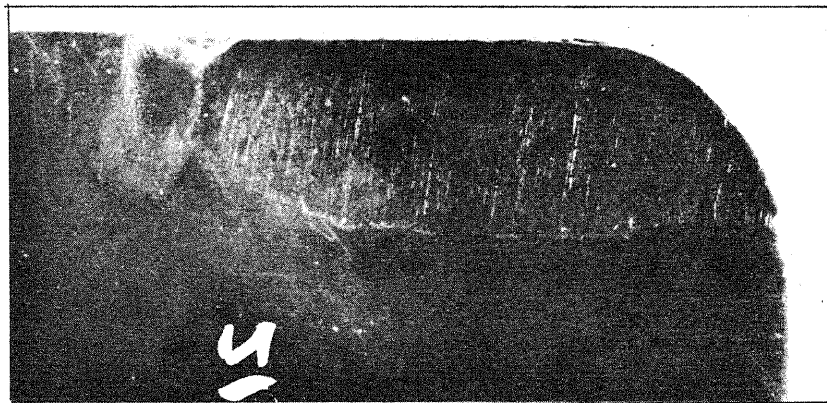
RD 110

FIG. 9 FLANKWEAR AT 420 Fpm





S1P

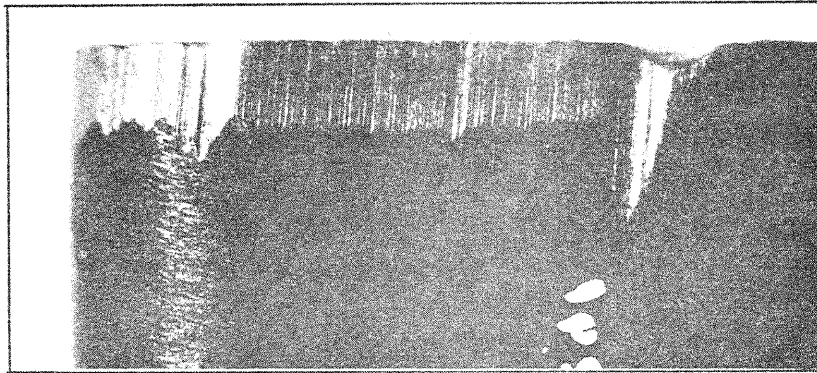


RD 107

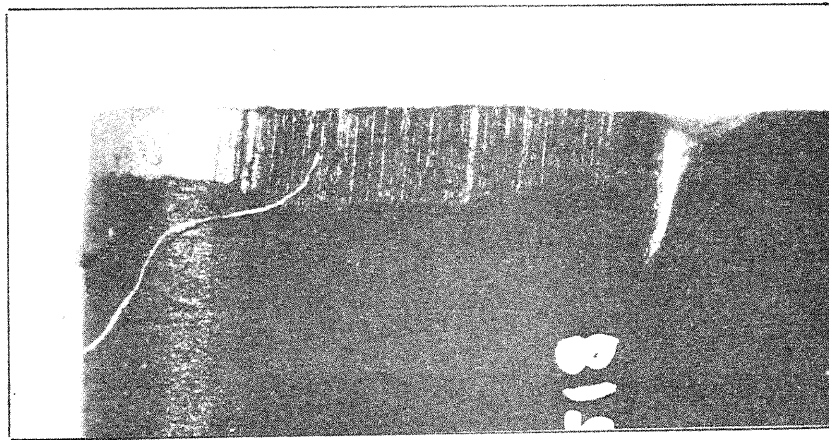


RD 110

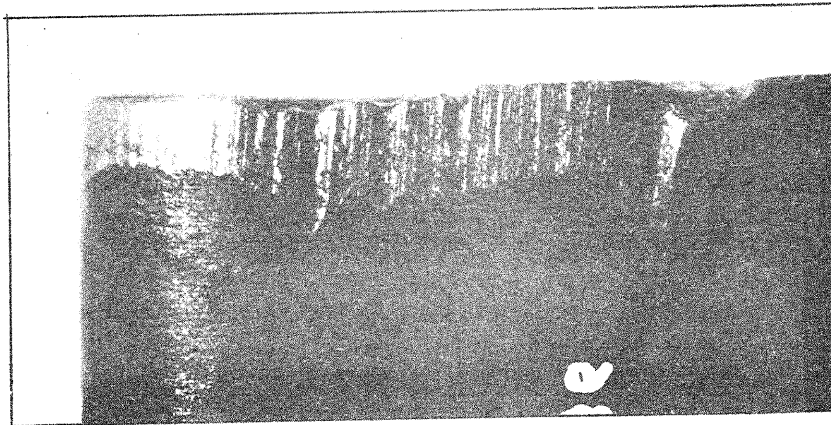
FIG. 10 CRATER WEAR AT 420 fpm



S1P



RD 107



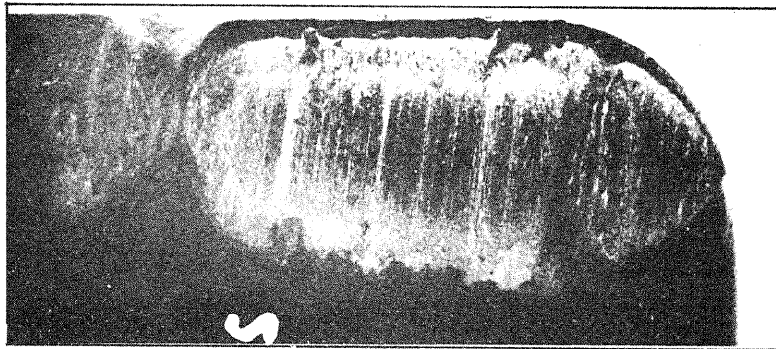
RD 110

FIG. 11 FLANKWEAR AT 600 rpm

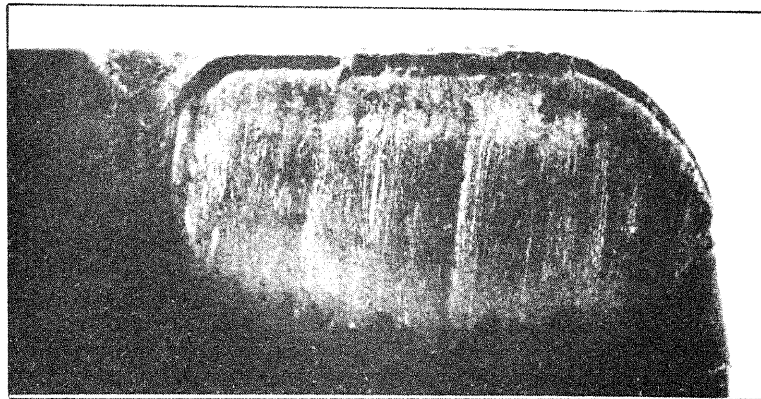




S1P



RD 107



RD 110

FIG. 12 CRATER WEAR AT 600 fpm