

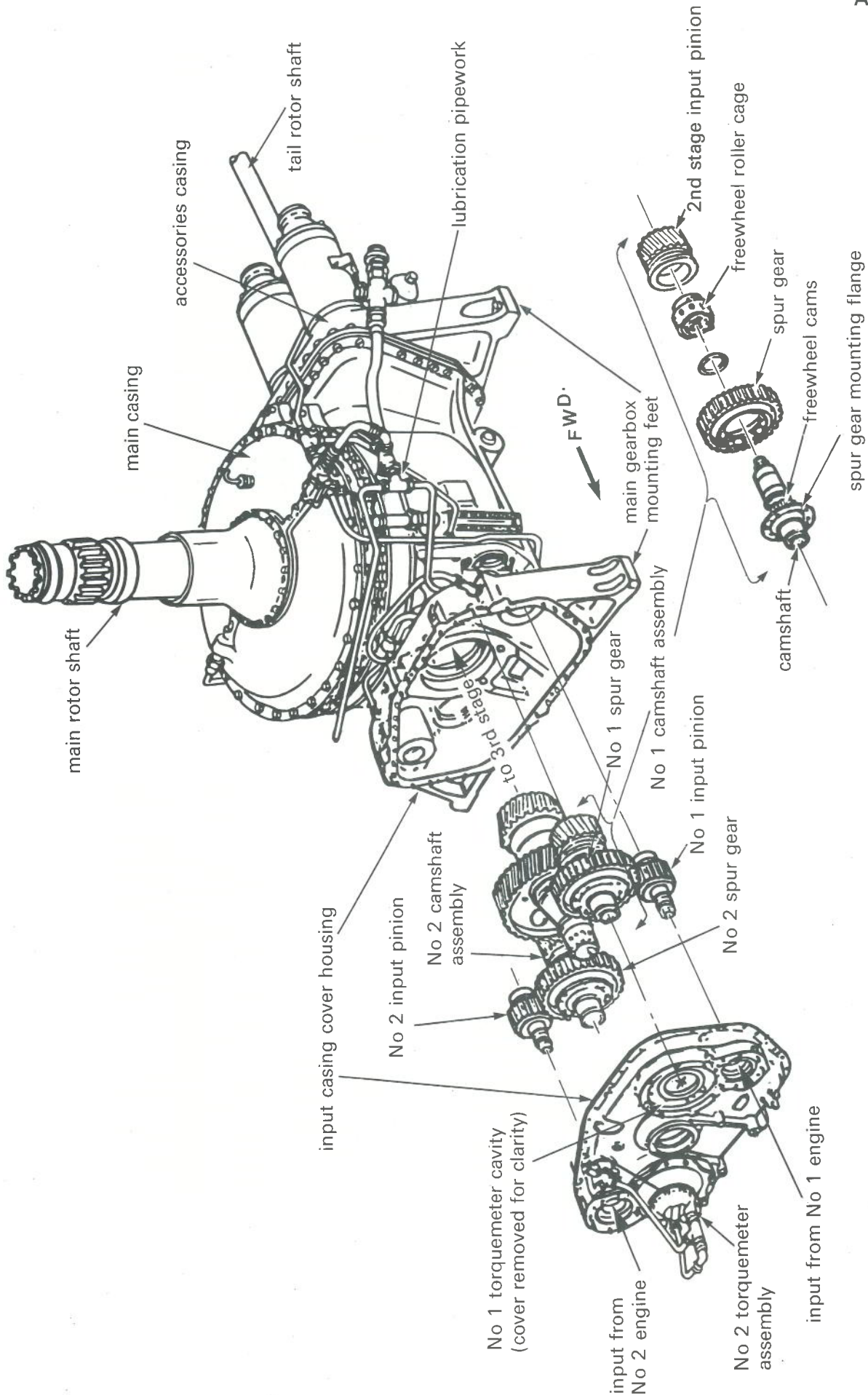


Hole in casing

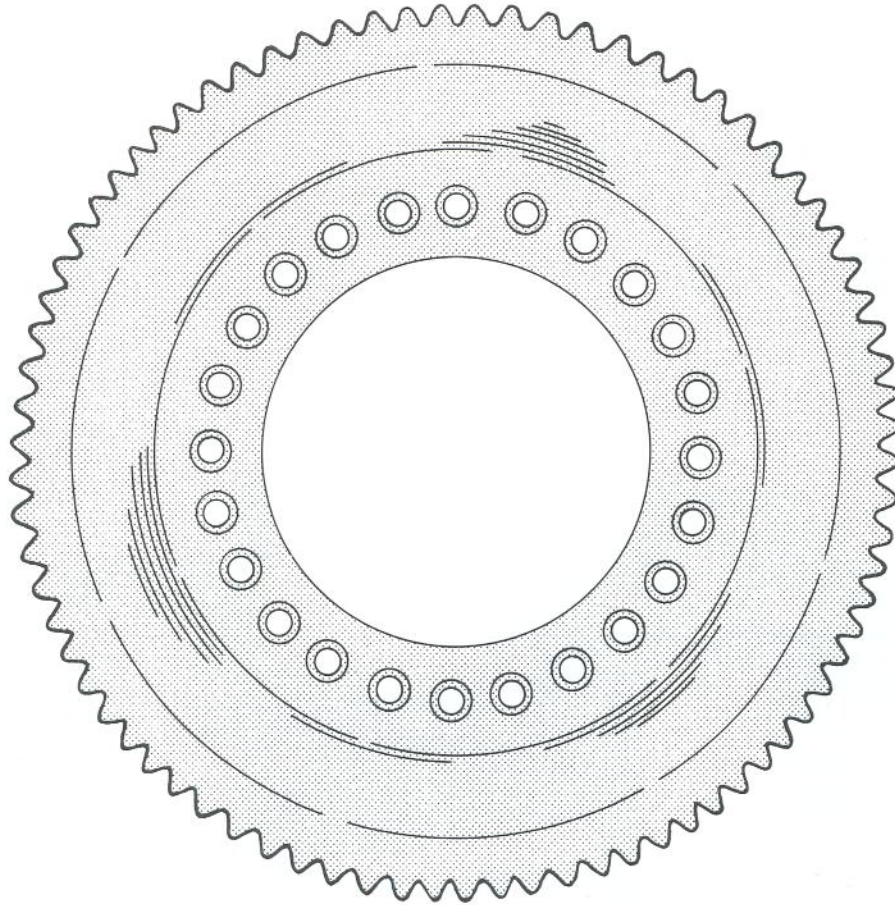
Lifting of Helicopter off seabed



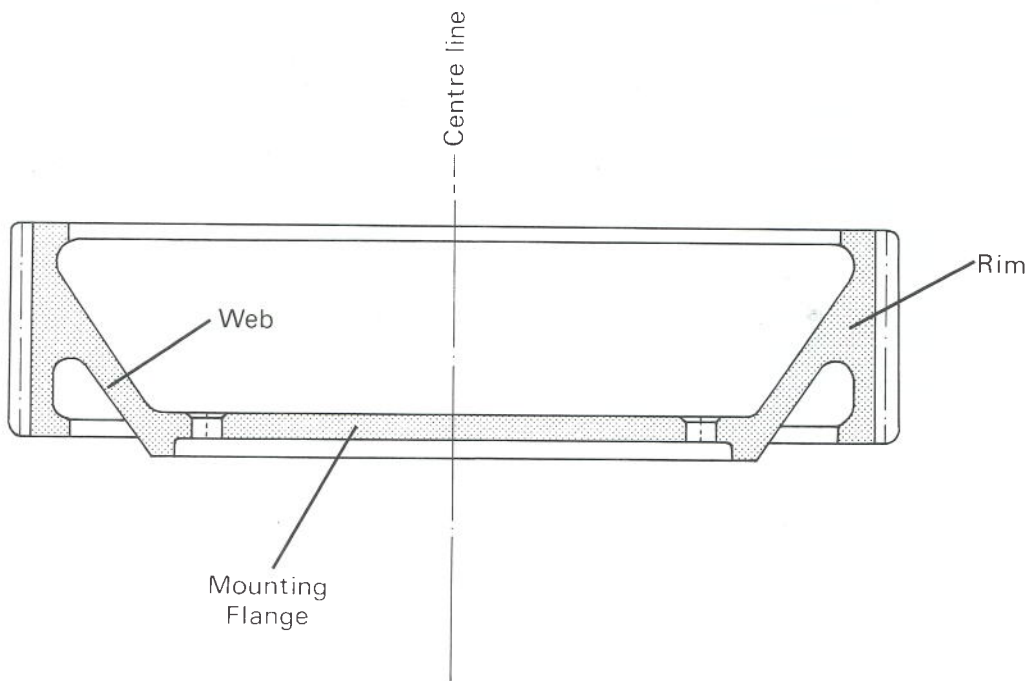
The Helicopter on deck of "SHEARWATER AQUAMARINE"



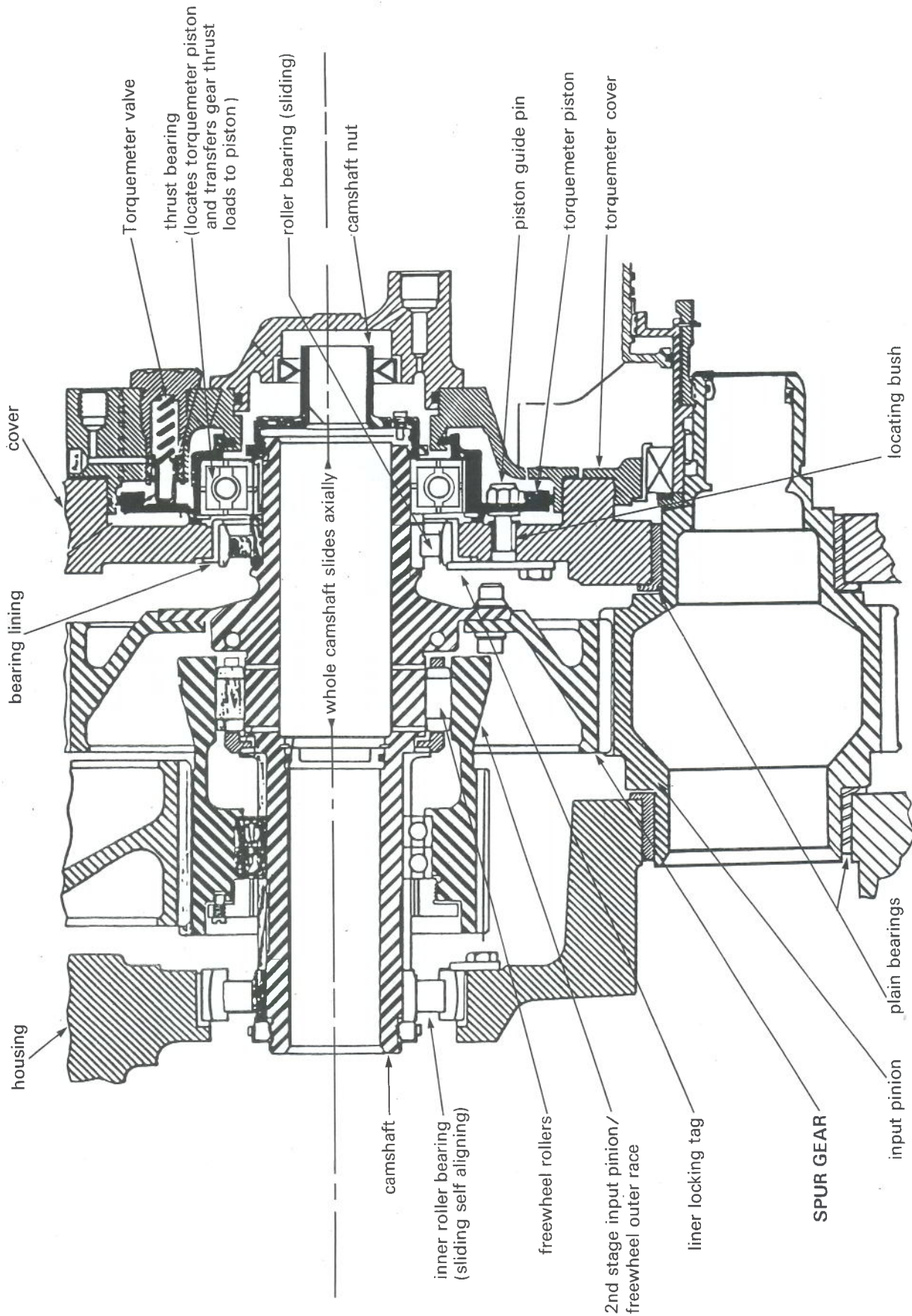
Sikorsky S61 Main gearbox — arrangement of the input stages



Plan view of spur gear



Sectional view of spur gear



Sikorsky S61 Main gearbox — arrangement of the input stages

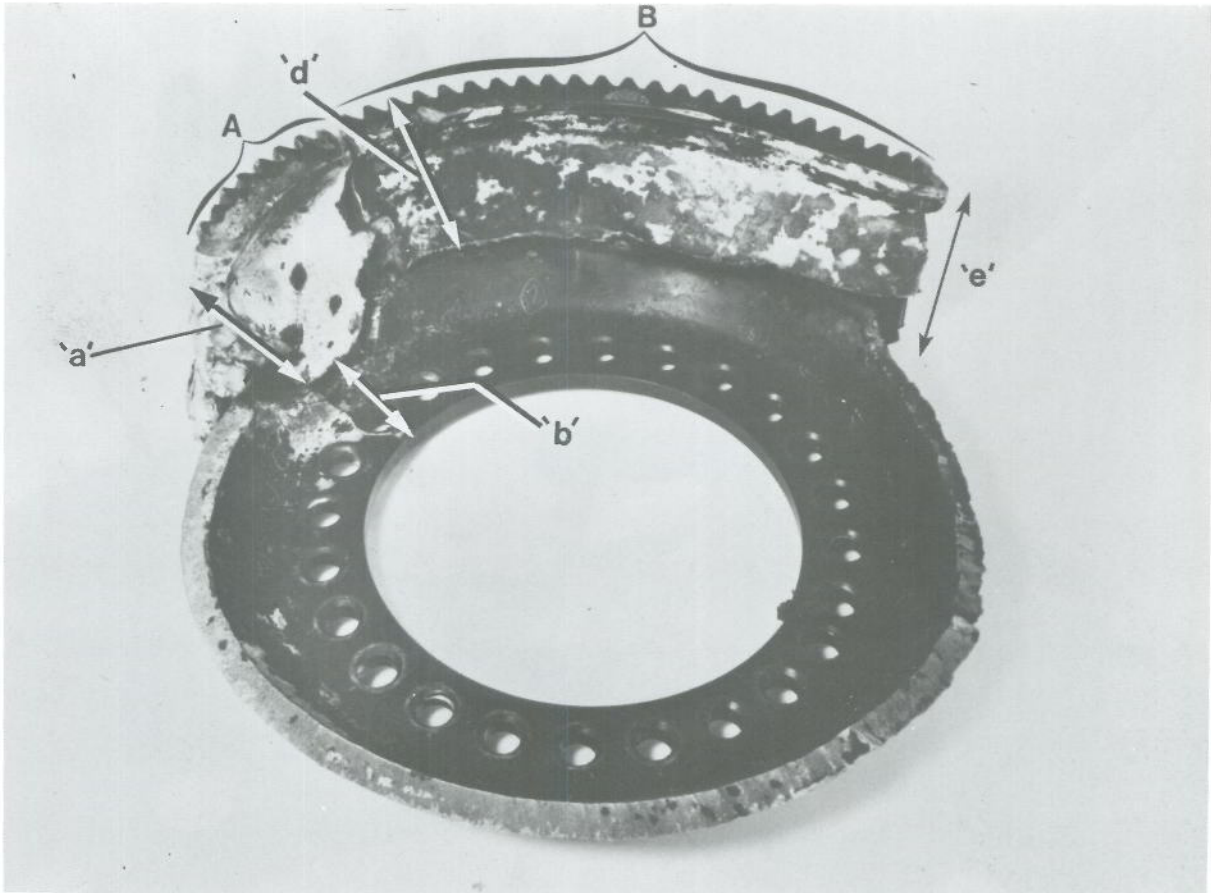


Fig 1 Spur gear flange and remaining sections of rim

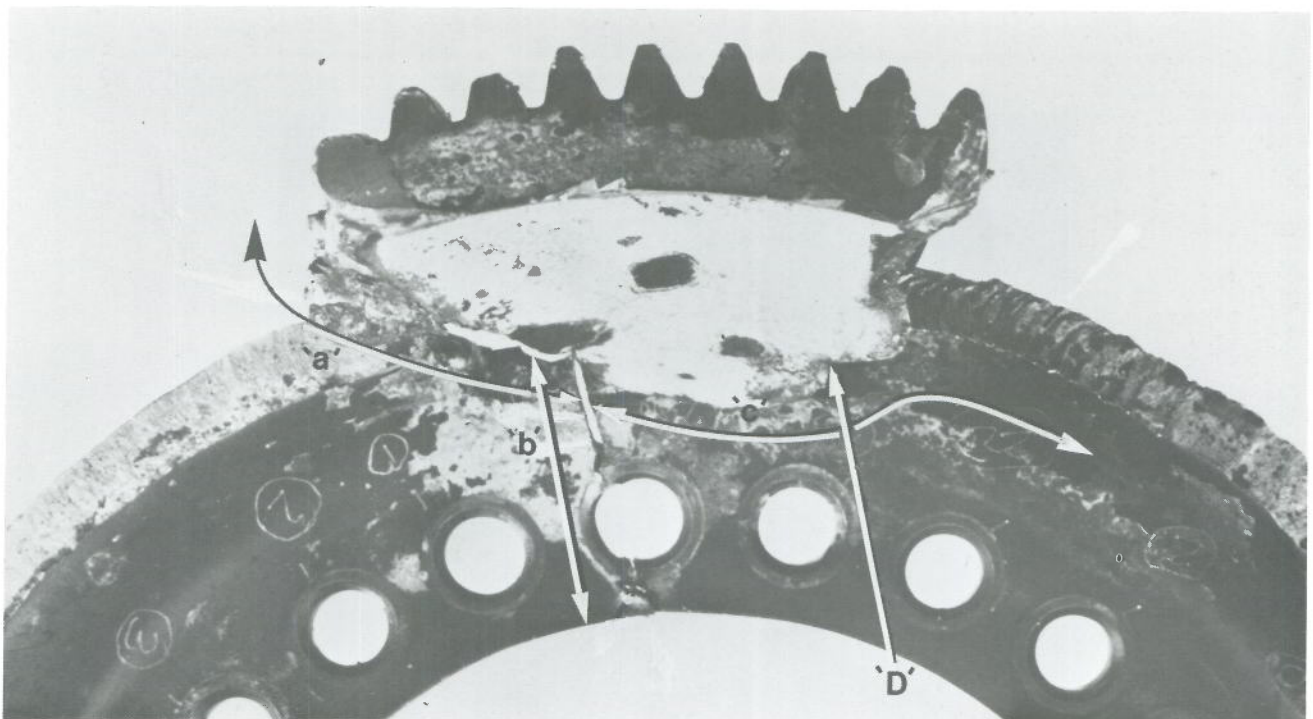


Fig 2 Showing difference in crack path through rim and flange

x1.25

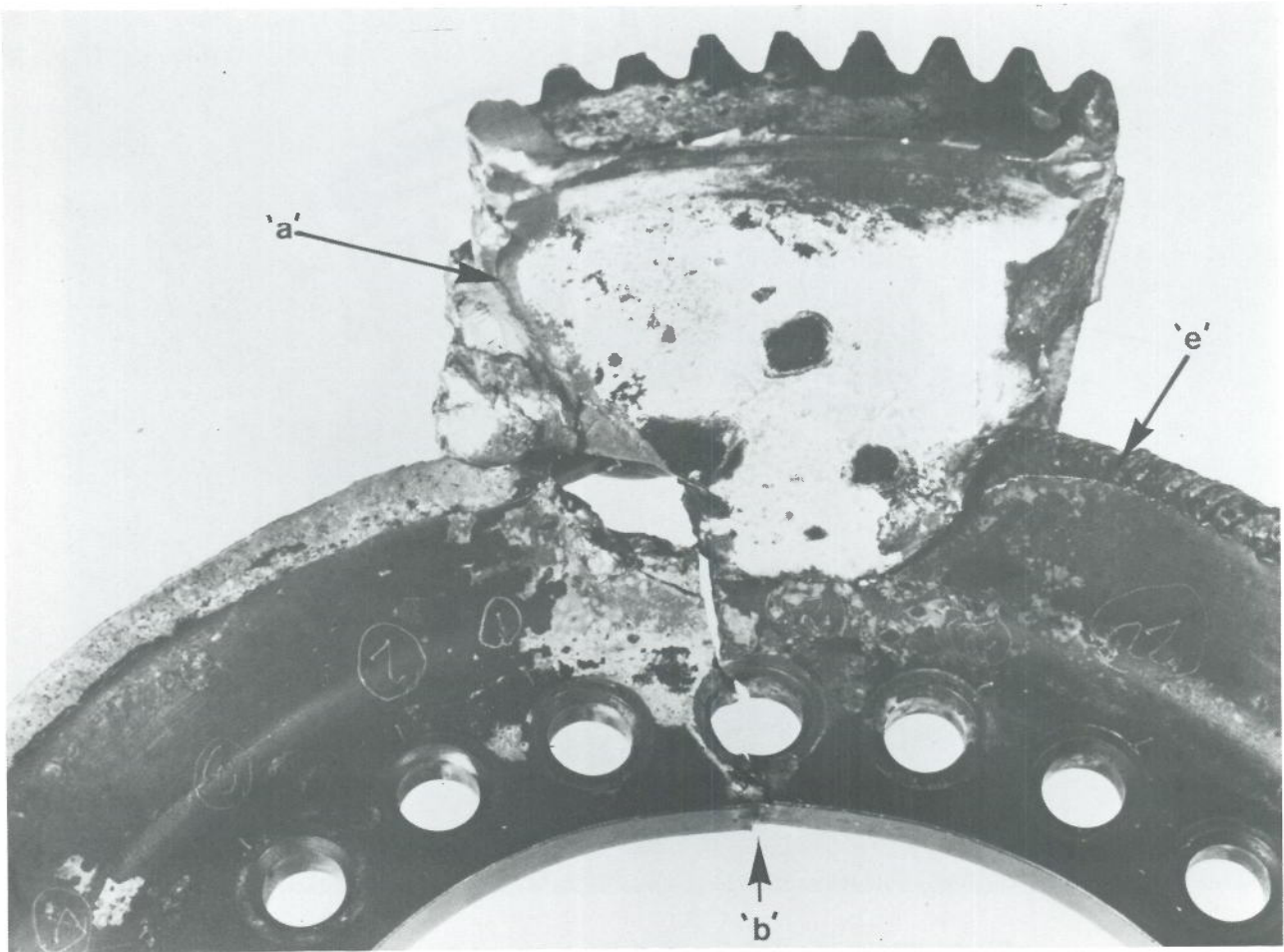


Fig 3 Showing position of fatigue evidence, 'a' and 'e', and crack through flange, 'b'

x1.25

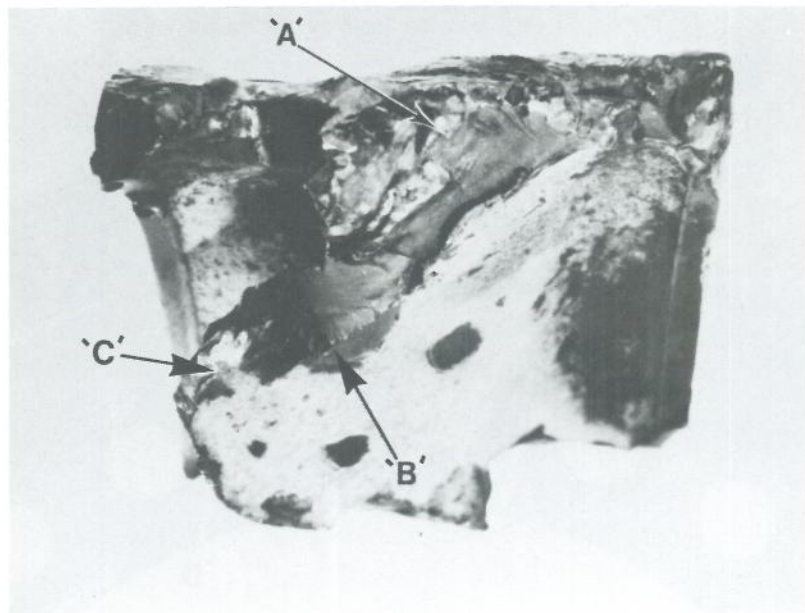
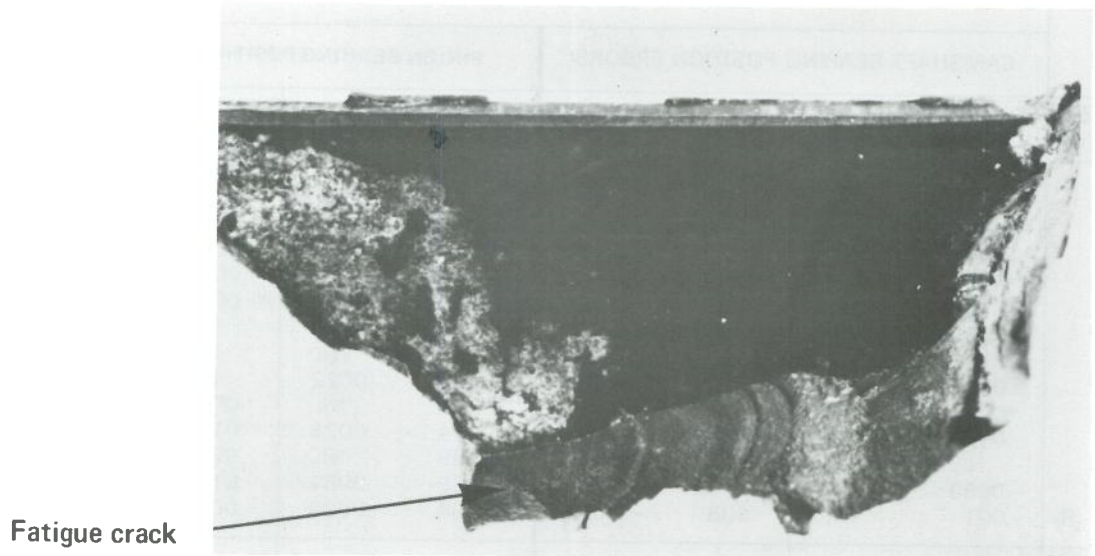


Fig 4 Fatigue damage on rim section



Fatigue crack

Fig 5a Fragment of tooth recovered from gearbox x6

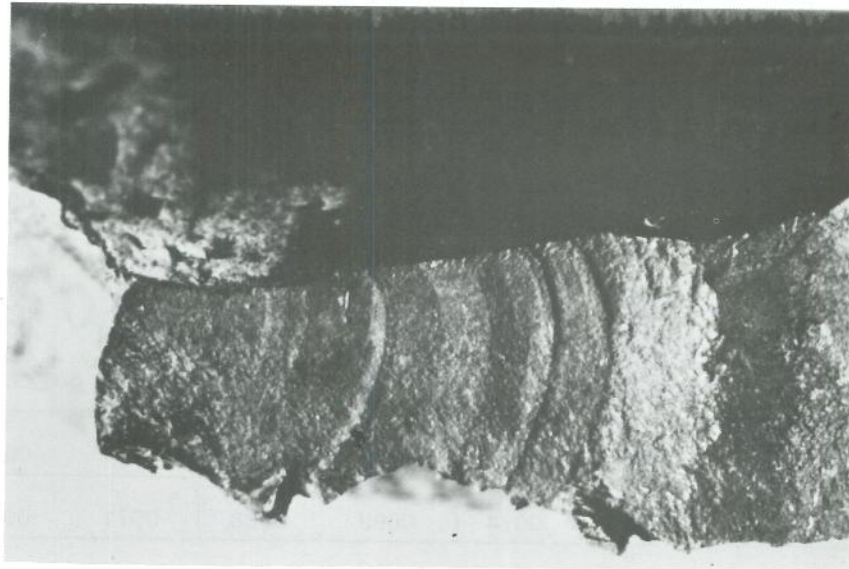


Fig 5b Fatigue evidence exhibited by fragment shown in Fig 5a

**SUMMARY OF BEARING LOCATION ERRORS AND RESULTING
INCREASE IN TOOTH STRESS (CALCULATED)**
(SAMPLE OF INPUT CASINGS FROM "SERVICEABLE" S61 MAIN GEAR BOXES)

NO 1 (LEFT SIDE)									
Sample No	CAMSHAFT BEARING POSITION ERRORS				PINION BEARING POSITION ERRORS :				% Tooth Stress Increase
	HOUSING		COVER		HOUSING		COVER		
	X ERR	Y ERR	X ERR	Y ERR	X ERR	Y ERR	X ERR	Y ERR	
1 #	NIL	NIL	-.001	-.0098	.0106	.0014	.0066	.0094	23.9
2	.0018	-.0025	NIL	NIL	.007	.0031	NIL	NIL	39.1
3	.0031	-.0046	NIL	-.0014	.0022	.004	NIL	.0046	12.1
4	NIL	NIL	.0036	.0018	.0074	.0014	.0058	.0007	34.2
5	.0004	.0007	.0096	-.0018	.0096	.0025	.0098	.0029	28.1
6	NIL	NIL	NIL	NIL	-.0002	NIL	-.0004	-.0005	-5.4
7	.0005	-.0021	NIL	NIL	.0003	.0019	NIL	.0002	0.0
*	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	31.2
8	.0016	-.0025	NIL	-.0024	.0028	.0022	NIL	.0027	18.2
9	.0002	NIL	.0026	-.0002	.005	NIL	.0041	NIL	14.7
10	.0021	-.0012	.0096	-.0019	.0114	.0028	.013	.0019	17.5
11	NIL	-.0003	.007	-.0041	.0069	NIL	.0043	.0077	64.7
12	.0039	-.0057	.0152	-.0056	.0065	.0064	.0125	.0058	23.2
5 (R)	.001	NIL	.008	-.0016	.0094	.0026	.0077	NIL	24.6
ABSOLUTE AVERAGE	.0011	.0015	.0043	.0023	.0061	.0021	.0049	.0028	23.5
ABSOLUTE MAX	.0039	.0039	.0152	.0098	.0114	.0106	.013	.0094	64.7

NO 2 (RIGHT SIDE)									
Sample No	CAMSHAFT BEARING POSITION ERRORS				PINION BEARING POSITION ERRORS				% Tooth Stress Increase
	HOUSING		COVER		HOUSING		COVER		
	X ERR	Y ERR	X ERR	Y ERR	X ERR	Y ERR	X ERR	Y ERR	
1 #	.0023	.0011	NIL	.0073	.0068	.0014	NIL	.0082	35.8
2	.0022	.0008	.0006	NIL	.0069	.0011	.0011	NIL	38.8
3	.0039	-.0006	.0069	.0023	.0099	-.0007	.0032	.0045	43.1
4	NIL	.0017	NIL	.0018	-.0024	.0014	NIL	.0001	-2.8
5	NIL	NIL	-.0046	.0029	.0017	.0025	-.0071	.0072	41.6
6	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	-3.7
7	NIL	.0009	NIL	.0004	.001	.0006	.0011	.0007	-0.7
*	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	31.7
8	.0001	NIL	NIL	NIL	.0022	NIL	NIL	.001	5.4
9	.0013	NIL	.0009	.0025	.0043	NIL	-.002	.0025	50.4
10	-.0008	.0027	-.005	.004	NIL	.0028	NIL	.0024	-11.4
11	.0031	.0062	.0016	.0032	.0023	NIL	NIL	.0026	3.1
12	.0009	.0039	-.0112	.0074	.0017	.0064	-.0002	.0048	-21.7
5 (R)	.0005	NIL	-.003	.002	.0018	.0026	-.0058	.0059	37.0
ABSOLUTE AVERAGE	.0011	.0013	.0025	.0026	.0031	.0015	.0015	.0030	22.7
ABSOLUTE MAX	.0039	.0009	.0112	.0074	.0099	.0068	.0071	.0082	50.4

Notes: * Theoretical stress increase with 'in limits' input casing but tolerances stacked adversely
 (R) Repeat measurement
 # G – ASNL

SIGN CONVENTION: + ve stress increase results from contact pressure biased towards 'cover' end of teeth