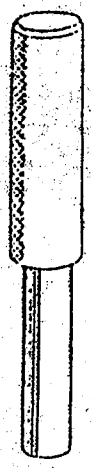
P137-340

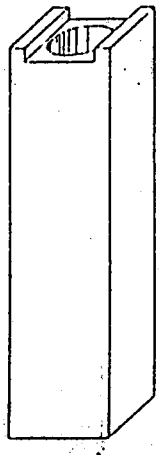
P137-202



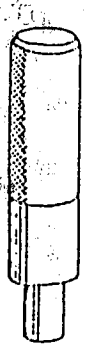
P337-402

P337-404

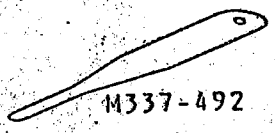
P137-336



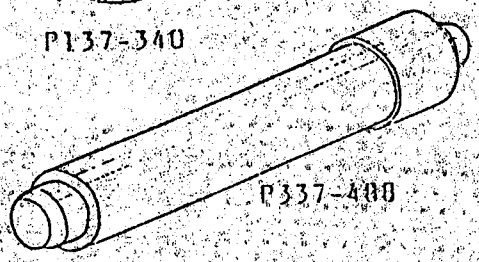
P137-206



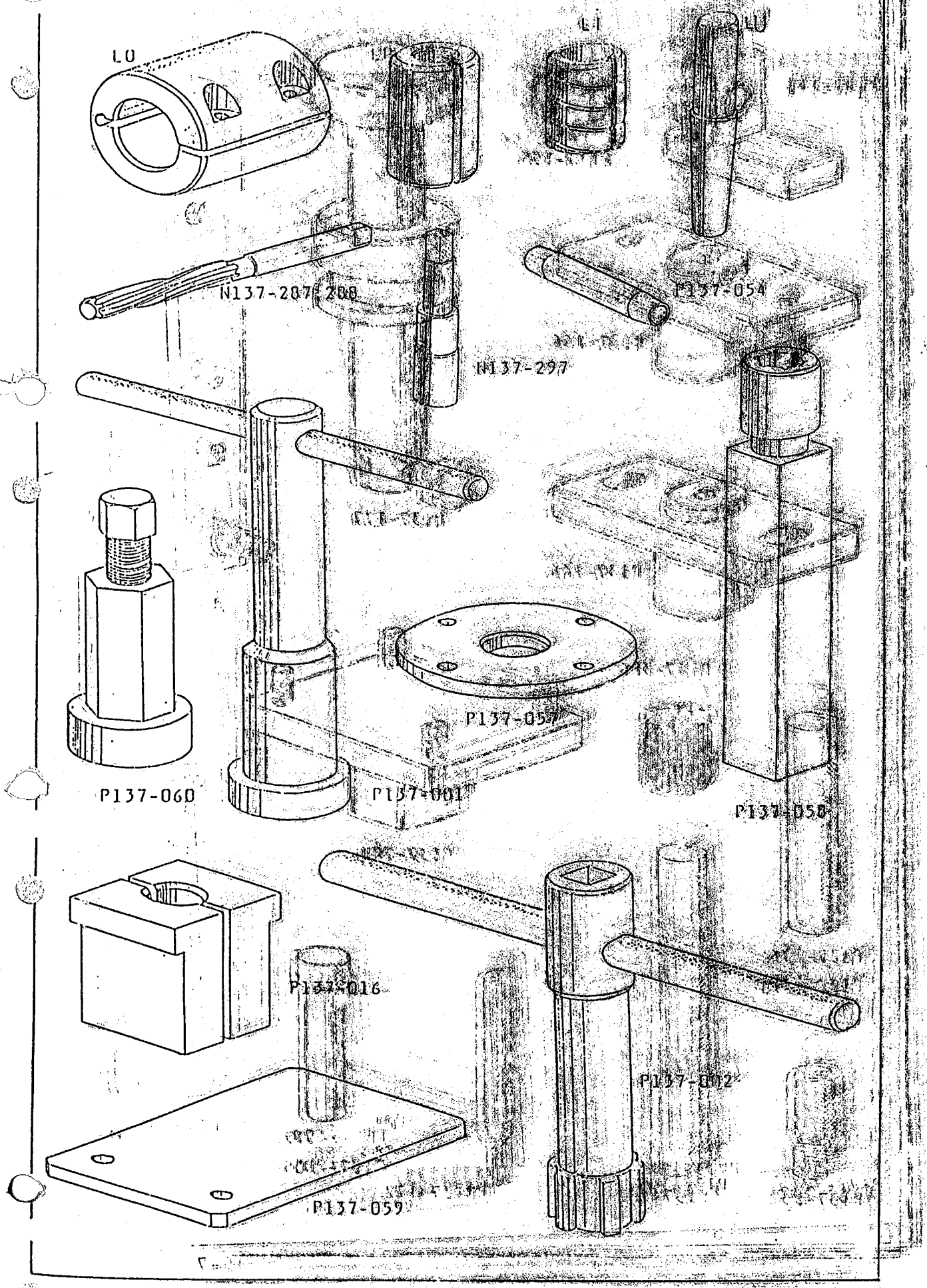
P137-269

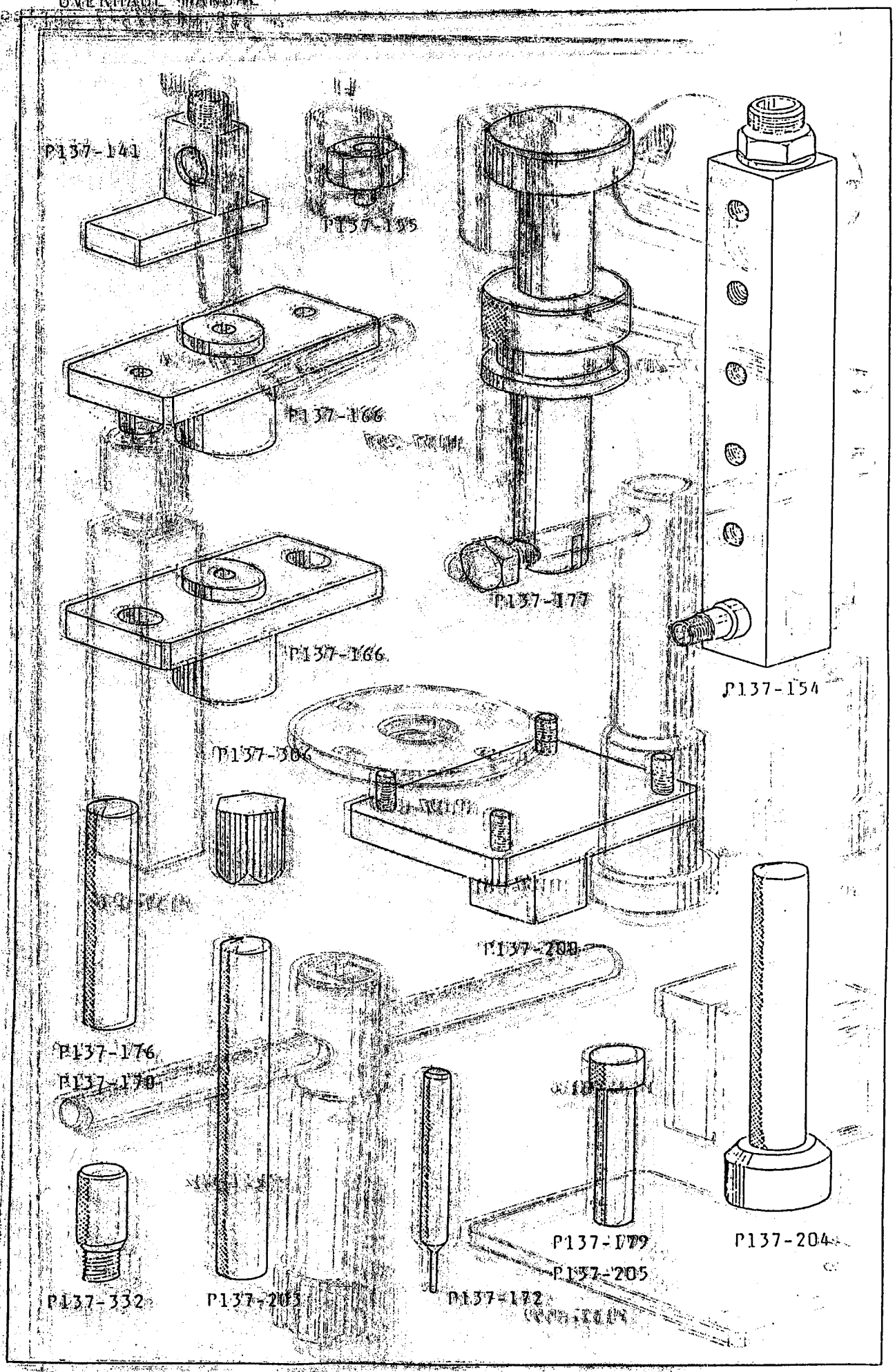


M337-492



P337-400


LO
LI
LI
LU
N137-287, 288
P137-054
N137-297
P137-057
P137-060
P137-001
P137-050
P137-016
P137-012
P137-059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P137-155
P137-166
P137-177
P137-166
P137-154
P137-306
P137-208
P137-176
P137-170
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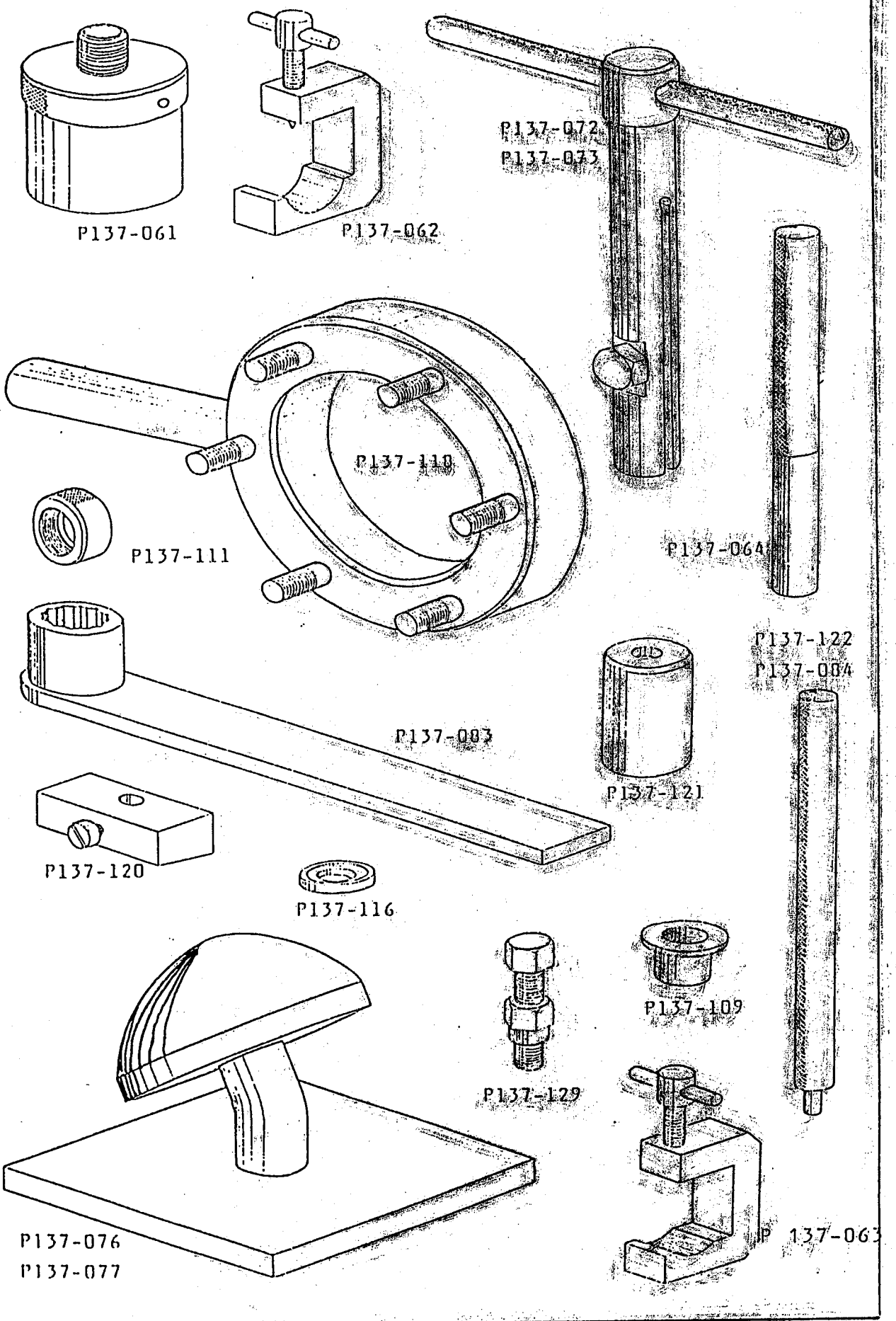
P137-204
P137-205
P137-332
P137-205
P137-172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P137-062
P137-072
P137-073
P137-110
P137-111
P137-064
P137-122
P137-004
P137-083
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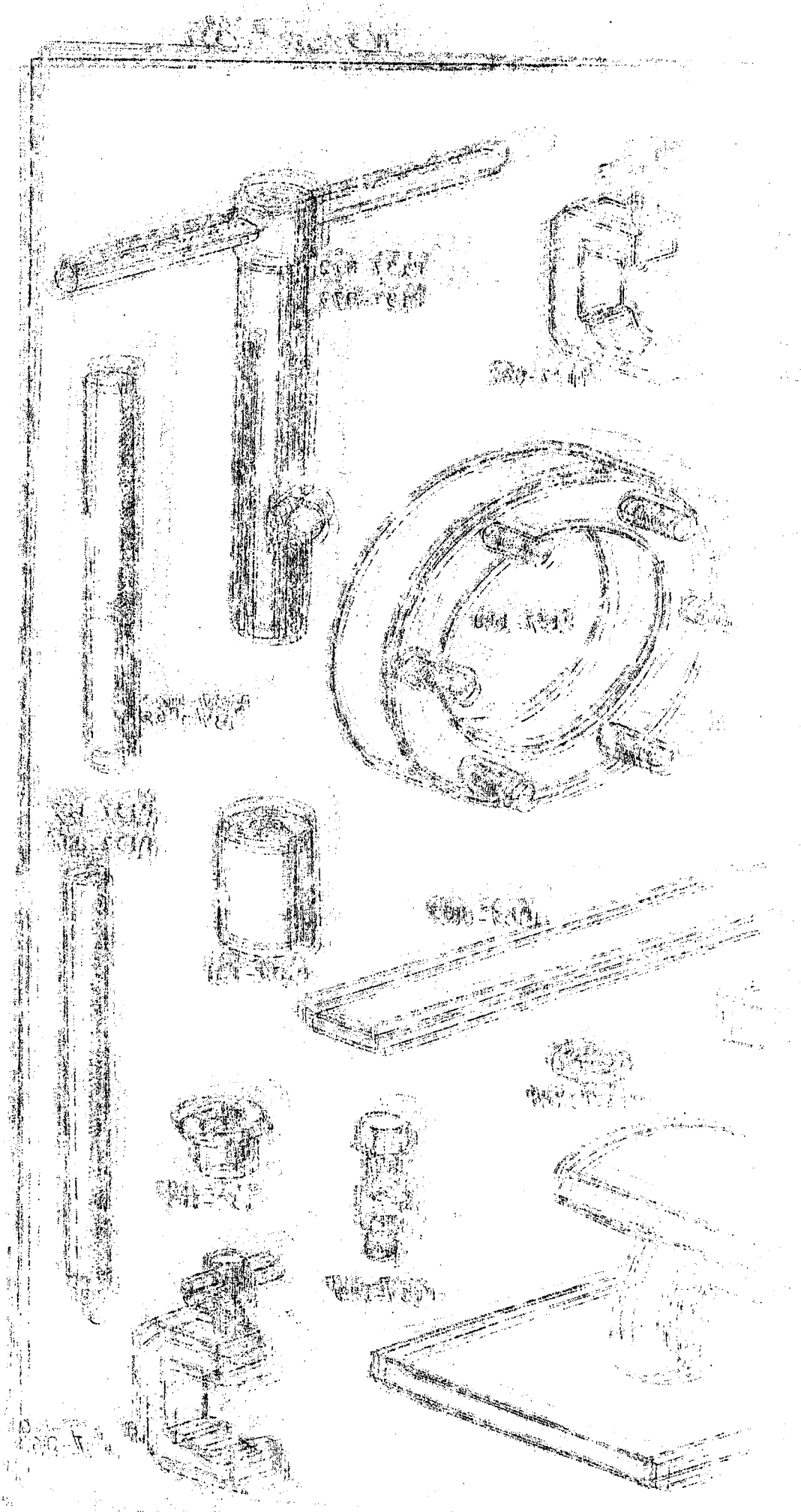
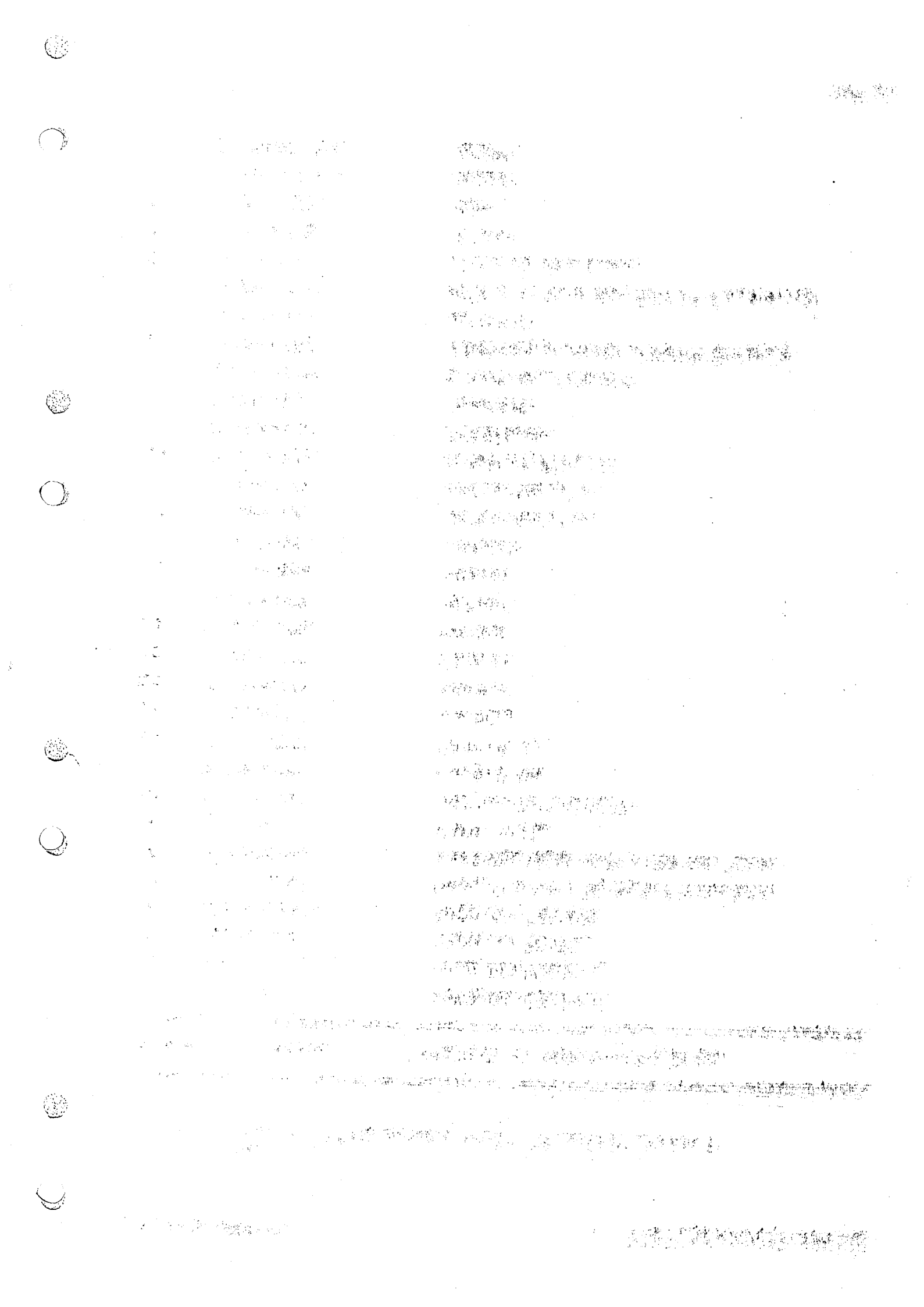
P137-109
P137-129
P137-076
P137-077
P 137-063



19. TABLE of FIXTURES

Ord.no.	Referance	Designation and Description
1	LO ϕ20x30	Lapping Fixture
2	LP ϕ14x30	Lapping Bushing
3	LT ϕ14x30	Lapping Drift
4	LU ϕ14x100	Lapping Driver
5	M 20-0036	Gage,Bearing Insert Measuring
6	M 20-0068	Fixture,Came Strightness Check
7	M 337-92	Card Gage
8	N 20-0023	Adjustable Reamer
9	N 40-0305	Gage,Plug
10	N 40-0316	Gage,Plug
11	N 137-287	Reamer
12	N 137-288	Reamer
13	N 137-293	Reamer
14	N 137-294	Reamer
15	N 137-295	Reamer
16	N 137-296	Reamer
17	N 137-297	Reamer
18	P 10-0055	Extractor,Pin
19	P 10-0055	Extractor,Pin
20	P 10-0058	Giuding Fixture
21	P 10-0139	Dial Gage
22	P 20-0116	Bracket
23	P 20-0256	Mounting Fixture
24	P 20-0267	Fixture,Bearing Insert Reaming
25	P 30-0154	Bracket
26	P 30-0193	Fixture,Bearing Insert Fastening
27	P 30-0268	Fixture,Drilling
28	P 30-0271	Pusher
29	P 30-1953	Plug
30	P 40-4239/1	Drift
	P 40-4240/1	Drift



Group : 101

1	2	3	4	5	6	7	8	9	10
			Ø88.035 Ø88.000	+0.050	-0.020				
269	housing cover	700-0301							
	drive outer toothed rim	700-0201	Ø88.020 Ø87.985		+0.078				
270	housing cover	700-0301	Ø40.039 Ø40.000	0.000					
	electromotor	LUN 2254							
271	countershaft with pinion	700-0203	Ø10.000 Ø9.978						
	motor shaft	LUN 2254							
272									
273									

Group : 101

1	2	3	4	5	6	7	8	9	10
		-	-	-	-	-	-	-	-
263	rear drive planet gear	P320.40-2000.2		+0.002	-0.017				
	planet gear shaft	P320.40-0003.1	Ø8.007 Ø7.998						
264	bevel gears	-	-	+0.090	+0.180				tooth clearance
265	rear drive gears	-	-	+0.095	+0.165				tooth clearance
266	rear drive supp. of planet gears	700-0202	Ø59.940 Ø59.894	+0.060	+0.136				
	cover bushing	P320.50-2002.1	Ø60.030 Ø60.000						
267	housing cover	700-0301	Ø63.030 Ø63.000	-0.020	-0.050				
	cover bushing	P320.50-2002.1	Ø63.050 Ø63.020						
268	starter housing	700-0101	Ø88.035 Ø88.000	+0.050	-0.020				
	drive outer toothed rim	700-0201	Ø88.020 Ø87.985						

Group : **101**

1	2	3	4	5	6	7	8	9	10
257	drive bushing	700-0102	Ø15.018 Ø15.000	+0.032	+0.077				
	drive shaft	700-0001	Ø14.968 Ø14.941						
258	drive shaft	700-0001	-	+0.150	+0.500				ax.clearance
259	plan.gear c'shaft of rear drive	700-0202	-	+0.150	+0.200				ax.clearance
260	starter housing	700-0101	Ø16.018 Ø16.000	0.000	-0.029				
	c'shaft bushing	700-0103	Ø16.029 Ø16.018						
261	c'shaft bushing	700-0103	Ø12.018 Ø12.000	+0.030	+0.077				
	plan.gear supp. w. bevel gear	700-0202	Ø11.968 Ø11.941						
262	plan.gear supp. w.bevel gear	700-0202	Ø8.015 Ø8.000	+0.017	-.007				
	planet gear shaft	P320.40- -0003.1	Ø8.007 Ø7.998						

Group : **101**

1	2	3	4	5	6	7	8	9	10
251	interm.drive planet gear	P320.30-2100.2		+0.002	-0.017				
	planet gear shaft	P320.30-0003.1	Ø8.007 Ø7.998						
252	interm. drive planet gear	P320.30-2100.2		+0.040	+0.084				ax. clearance
253	interm. drive gears	-	-	+0.017	+0.213				tooth clearance
254	starter housing	700-0101	Ø107.035 Ø107.000	0.000	+0.057				
	starter case	700-0401	Ø107.000 Ø106.978						
255	drive shaft	700-0001	Ø11.968 Ø11.941	+0.032	+0.027			+0.091	
	pinion bushing	P320.30-2002.1	Ø12.018 Ø12.000						
256	starter housing	700-0101	Ø19.021 Ø19.000	-0.001	-0.035				
	drive bushing	700-0102	Ø19.035 Ø19.022						

Group : **101**

1	2	3	4	5	6	7	8	9	10
245	c'shaft bushing	P320.20- -2002.1	Ø8.015 Ø8.000	+0.025	+0.055			+0.068	
	engaging shaft	P320.20- -2201.1	Ø7.975 Ø7.960						
246	front drive countershaft	P320.20- -2001.1	Ø10.500 Ø10.382	+0.011	-0.018				
	planet gear shaft	P320.20- -0002.1	Ø10.500 Ø10.489						
247	front drive planet gear	P320.20- -0001.1	-	+0.050	+0.147				ax.clearance
248	front drive gear	-	-	+0.017	+0.213				tooth clearance
249	engaging shaft bushing	107 27 71		+0.025	+0.062				
	engaging shaft	P320.20- -2201.1	Ø7.975 Ø7.960						
250	plan.gear c'shaft of centr.gear	P320.30- -0001.1	Ø8.015 Ø8.000	+0.017	-0.007				
	planet gear shaft	P320.30- -0003.1	Ø8.007 Ø7.998						

Group : **101**

1	2	3	4	5	6	7	8	9	10
	STARTER-complete	P 2131							G-H
240	starter case	700-0401	Ø78.046 Ø78.000	-0.186	-0.262				
	case bushing	P320.10- -2002.1	Ø78.262 Ø78.232						
241	starter case	700-0401	Ø99.035 Ø99.000	+0.022	-0.035				
	exterior toothed rim	P320.10- -2003.1	Ø99.035 Ø99.013						
242	case bushing	P320.10- -2002.1	Ø70.030 Ø70.000	+0.060	+0.120				
	front drive countershaft	P320.20- -2001.1	Ø69.940 Ø69.910						
243	front drive countershaft	P320.20- -2001.1	-	+0.100	+0.175				ax.clearance
	spline adaptor lock	P320.20- -0016.1	-						
244	front drive countershaft	P320.20- -2001.1	Ø65.120 Ø65.000	+0.060	+0.226				
	starter gear	P320.20- -0009.1	Ø64.940 Ø64.994						

Group : 91A

1	2	3	4	5	6	7	8	9	10
223									
224									
225									
219 through 225 for completions									

Group : **91A**

1	2	3	4	5	6	7	8	9	10
218	pinion bushing	Sc 9104	Ø14.127 Ø14.116	+0.016	+0.038			+0.050	sliding bear.is valid for:M337 from 14th ser.. M337A/AK and M332A/AK
	pinion shaft	Sc 9112	Ø14.100 Ø14.089						
219									
220									
221									
222									

Group : **91A**

1	2	3	4	5	6	7	8	9	10
213	base ring	Sc 9119	Ø40.000 Ø39.950	0.000	+0.075				
	drive housing	Sc 9100	Ø40.025 Ø40.000						
214	drive housing	Sc 9100	Ø40.025 Ø40.000			-0.100	-0.150		
	seal ring of protection	Sc 9120	-						
215	pinion-compl.	Sc 0917	-				+0.200	+0.250	tooth clearance
	interm. gear	Sc 9107	-			+0.100			
216	drive housing	Sc 9100	Ø65.030 Ø65.000	+0.030	+0.090				
	LUN 2111 generator	-	Ø64.970 Ø64.940						
217	pinion	Sc 9115	Ø18.133 Ø18.120	+0.040	+0.066	+0.040	+0.070	+0.080	sliding bear.is valid for:M337 from 14th ser., M337A/AK and M332A/AK
	bearing bush	Sc 9104							

Group : **91A**

1	2	3	4	5	6	7	8	9	10
208	drive housing	Sc 9100	Ø14.018 Ø14.000	+0.011	-0.018				
	pinion shaft	Sc 9112	Ø14.018 Ø14.007						
209	pinion-compl.	Sc 0917	-			+0.020	+0.040	+0.060	rad.needle bearing up to 13th series of M337
	pinion shaft	Sc 9112	-						
210	pinion	Sc 9115	Ø18.018 Ø18.000	0.000	-0.029				
	plug	Sc 9116	Ø18.029 Ø18.018						
211	base bushing	Sc 9118	Ø22.021 Ø22.000	+0.006	-0.036				
	pinion	Sc 9115	Ø22.036 Ø22.015						
212	base bushing	Sc 9118	-			+0.100	+0.200		ax. clearance
	base ring	Sc 9119	-						

Group : **91A**

1	2	3	4	5	6	7	8	9	10
	GENERATOR DIRECT DRIVE	Sc 0091A							
203	drive housing	Sc 9100	Ø14.018 Ø14.000	+0.011	-0.018				
	interm. gear shaft	Sc 9108	Ø14.018 Ø14.007						
204	shaft bushing	Sc 9109	Ø14.034 Ø14.016	+0.022	-0.004				
	interm. gear shaft	Sc 9108	Ø14.020 Ø14.012						
205	loose bushing	Sc 9110	Ø18.018 Ø18.000	+0.016	+0.052			+0.070	
	shaft bushing	Sc 9109	Ø17.984 Ø17.966						
206	interm. gear	Sc 9107	Ø22.021 Ø22.000	+0.020	+0.062			+0.070	
	shaft bushing	Sc 9110	Ø21.980 Ø21.959						
207	interm. gear	Sc 9107	-			+0.100	+0.200	+0.300	ax.clearance
	-	-	-						

Group : 74AK

1	2	3	4	5	6	7	8	9	10
200									
201									
202									
199 through 202 for completions									

Group : **74BAK**

1	2	3	4	5	6	7	8	9	10
	SHIELDED IGNITION SYSTEM	Sh 0074BAK							
195	crankcase	Sc 1001 Sh 1001(AK)	Ø44.025 Ø44.000	0.000	+0.050				(G-H)
	magneto drive adaptor	Sc 7415	Ø44.000 Ø43.975						
196	magneto drive adaptor	Sc 7415	Ø27.020 Ø26.980	0.000	+0.073				
	magnetos PAL	Sc 7405 Sh 7405	Ø26.980 Ø26.947						
197	magneto bevel gear	Sc 7412	Ø12.435 Ø12.424	+0.002	-0.020	-0.010	-0.015		
	magneto PAL	Sc 7405 Sh 7405	Ø12.444 Ø12.433						
198	magneto bevel gear	Sc 7412	-						tooth clearance
	driving bevel gear	Sc 1541	-			+0.150	+0.200	+0.250	
199									

Group : 63, 66B, 73, 64, 65, 68, 72, 73AZ

1	2	3	4	5	6	7	8	9	10
192									
193									
194									
	192 through 194 for completions								

Group : **63, 66B, 73, 64, 65, 68, 72, 73AZ**

1	2	3	4	5	6	7	8	9	10
	CONTR.CANTILEVER INTAKE MANIFOLD INJECTION SYSTEM	Sh 0063;Sc 0063;Sh 0068 Sh 0066B;Sc 0066;Sh 0064;Sh 0065 Sh 0073;Sc 0070A;Sh 0072;Sh 0073AZ							D-E-F-H;A;G E-F;B;H;G E-F;B;G;H
187	control cantilever	Sc 6700	Ø11.980 Ø11.946	+0.014	-0.038				
	cantilever swivel	Sc 6703	Ø11.984 Ø11.966						
188	lever hubs	Sh0674;Sc0672 Sh 0683	Ø12.018 Ø12.000	+0.016	+0.052			+0.080	hubs ax.clear. shown in 3rd col.-min.0.1
	cantilever swivel	Sc 6703	Ø11.984 Ø11.966						
189	throtlle hous.	Sc 6620 Sh6900;Sh6802	Ø11.015 Ø11.000	-0.004	-0.028				
	throtlle swivel bushing	Sc 6619 Sh 6666	Ø10.028 Ø10.019						
190	throtlle swivel bushing	Sc 6619 Sh 6666	Ø8.015 Ø8.000	+0.013	+0.043			+0.060	
	throtlle shaft	Sc 6622 Sh 6678	Ø8.987 Ø8.972						
191	aux. drive housing	Sc 3301 Sc 3303	Ø48.025 Ø48.000	+0.025	+0.075				D-E-B F-C-G-H
	injection pump	E-F-G-H LUN 5150.01	Ø47.975 Ø47.950						LUN 5152/M337 LUN5152.02/M332A and AK

Group : 59, 60AK

1	2	3	4	5	6	7	8	9	10
186	body mating surface	–	–			+47.9	+48.2		mounting dimension
	driving shaft end								

Group : **59, 60AK**

1	2	3	4	5	6	7	8	9	10
181	RPM indicator fitting	Sc 6044	Ø12.018 Ø12.000	+0.016	+0.052				
	RPM indicator spline	Sc 6047	Ø11.084 Ø11.966						
182	driving shaft	Sc 6062	5.018 5.000	+0.050	+0.088				
	RPM indicator spline	Sc 6047	4.950 4.930						
183	crankcase	Sc 1001 Sh 1001	Ø36.025 Ø36.000	0.000	+0.050				
	pump body	Sc 6000	Ø36.000 Ø35.975						
184	drive gear shaft	Sc 1537	5.018 5.000	+0.050	+0.088				
	driving shaft	Sc 6062	4.950 4.930						
185	intake body	Sc 6000	Ø6.622 Ø6.600	+0.016	-0.015				
	joining bolt	Sc 6063	Ø6.615 Ø6.606						

Group : **50, 60AK**

1	2	3	4	5	6	7	8	9	10
175	intake pressure body	Sc 6000 Sc 6015	Ø39.025 Ø39.000	+0.050	+0.100				
	driving impeller driven impeller	Sc6040;Sc6042 Sc6041;Sc6043	Ø38.950 Ø38.925						
176	toothed wheel	-	-			+0.030	+0.050	+0.090	ax.clearance
177	toothed wheel	-	-			+0.050	+0.100		tooth clearance
178	pressure body	Sc 6015	Ø16.018 Ø16.000	+0.024	-0.012				
	RPM indicator fitting	Sc 6044	Ø16.012 Ø15.954						
179	RPM indicator fitting	Sc 6044	Ø12.018 Ø12.000	+0.006	+0.035	+0.015	+0.025	+0.060	
	driving shaft	Sc 6062	Ø11.994 Ø11.983						
180	RPM indicator fitting	Sc 6044	Ø10.022 Ø10.000	+0.013	+0.050			+0.080	
	RPM indicator spline	Sc 6047	Ø 9.987 Ø 9.972						

Group : **59, 60AK**

1	2	3	4	5	6	7	8	9	10
	OIL PUMP-compl.	Sh 0059 (Sh 0060)							B-E;(D)
		Sh 0060AK (Sc 0060)							C-F-G-H;(A)
170	intake body	Sc 6000	Ø18.018 Ø18.000	-0.010	-0.039				
	bushing	Sc 6005	Ø18.039 Ø18.028						
171	bushing	Sc 6005	Ø14.024 Ø14.006	+0.006	+0.035	+0.015	+0.025	+0.050	
	driving shaft	Sc 6062	Ø14.000 Ø13.989						
172	intake and pressure body	Sc 6000 Sc 6015	Ø14.018 Ø14.000	+0.017	-0.019				
	driven impeller shaft	Sc 6039	Ø14.019 Ø14.001						
173	driving impeller	Sc 6040 Sc 6042	Ø14.011 Ø14.000	0.000	+0.022	+0.010	+0.020	0.030	
	driving shaft	Sc 6062	Ø14.000 Ø13.989						
174	driven impeller	Sc 6041 Sc 6043	Ø14.043 Ø14.025	+0.006	+0.042	+0.020	+0.030	+0.060	
	driven impeller shaft	Sc 6039	Ø14.019 Ø14.001						

Group : 55A-2

1	2	3	4	5	6	7	8	9	10
166									
167									
168									
169									
165 through 169 for completions									

Group : **55A.2**

1	2	3	4	5	6	7	8	9	10
161	worm gear-compl.	Sc 0585	Ø6.012 Ø6.000	-0.003	-0.027				up to 12th ser. (informative)
	pin in engageble gear	Sc 5421	Ø6.009 Ø5.997	+0.015	-0.009				from 13th ser.
162	coil mobil shaft		-			+0.100	+0.200		
	engaging pinion lamella								
163	engine starting ratched gear	Sc 5395	-			+0.600	+0.800	+0.900	to achieve prescribed clear. mount washers Sc 5402
	engageble gear--complete	Sc 0554	-						
164	starter worm	Sc 5417	Ø4.948 Ø4.900	-0.034	-0.100				
	blind plug	Sc 5424							
165									

Group : **55A.2**

1	2	3	4	5	6	7	8	9	10
156	starter housing-compl.	Sc 0583	Ø40.039 Ø40.000	0.000	+0.078				
	starter motor	LUN 2253	Ø40.000 Ø39.961						
157	starter worm	Sc 5417	Ø10.015 Ø10.000	0.000	+0.037			+0.040	
	LUN 2253 motor shaft	–	Ø10.000 Ø 9.978						
158	starter worm	Sc 5417	–			+0.100	+0.200	+0.400	tooth clearance
	worm gear-compl.	Sc 0585	–						
159	engageble gear--compl.	Sc 0554	–			+50.5	+50.6	+50.7	
	starter housing mating surface	–	–						
160	supercharger scroll	Sc 0562	Ø74.030 Ø74.000	+0.042	-0.018				
	starter housing--compl.	Sc 0583	Ø74.018 Ø73.988						

Group : 55A.2

1	2	3	4	5	6	7	8	9	10
151	coil bushing	Sc 5499	–	+0.065	+0.233				
	coil	Sc 0560	–						
152	worm gear hub	Sc 0531	Ø18.018 Ø18.000	+0.050	+0.138			+0.150	
	insert	Sc 5498	Ø17.950 Ø17.880						
153	starter housing--compl.	Sc 0583	Ø30.008 Ø29.995			+0.017	-0.005		
	bearing CSN 02 4636	6200	see CSN						
154	ball bearing	6200	acc. to CSN			-0.001	-0.020		
	starter worm	Sc 5417	Ø10.010 Ø10.001						
155	ball bearing	6200	–			+0.050	+0.100		ax.clearance
	worm housing cover	Sc 5422	–						

Group : **55A.2**

1	2	3	4	5	6	7	8	9	10
	SUPERCHARGER with STARTER	Sc 0055A							
146	supercharger housing	Sc 5440	Ø30.021 Ø30.000	-0.014	-0.056	-0.030	-0.050		
	ball and needles bushing	Sc 5496	Ø30.056 Ø30.035						
147	worm gearing--complete	Sc 0585	Ø18.018 Ø18.000	+0.016	+0.052	+0.030	+0.052	+0.070	
	engageble gear--compl.	Sc 0554	Ø17.984 Ø17.966						
148	worm gearing--complete	Sc 0585	-			+0.100	+0.200	+0.250	ax.clearance
	insert	Sc 5487	-						
149	starter housing-complete	Sc 0583	Ø67.030 Ø67.000	+0.030	+0.090				
	starter housing cover	Sc 5497	Ø66.970 Ø66.940						
150	starter housing cover	Sc 5497	Ø30.021 Ø30.000	-0.001	-0.043				
	coil bushing--complete	Sc 0587	Ø30.043 Ø30.022						

Group : 55A-1

1	2	3	4	5	6	7	8	9	10
142									
143									
144									
145									
141 through 145 for completions									

Group : **55A.1**

1	2	3	4	5	6	7	8	9	10
137	ball bearing	Sc 5389	–	informative new bearing +0.12	+0.15			+0.18	ax.clearance of the bear.itself repeated use acc.to PK4, rad. clear.max.0.03
138	ball bearing	Sc 5389	–			+0.050	+0.100		bearing axial clearance in bushing
	ball bearing bushing	Sc 5339	–						
139	supercharger driving shaft	Sc 0534	Ø21.980 Ø21.967	+0.020	+0.054				
	bushing in bell gear	Sc 5376	Ø22.021 Ø22.000						
140	rear clutch countershaft	Sh 5354	–			+0.100	+0.300		ax.clearance
	bell gear bushing	Si 5314	–						
141									

Group : **55A.1**

1	2	3	4	5	6	7	8	9	10
132	lever swivel	Sc 5374	Ø9.987 Ø9.972	+0.013	+0.043			+0.060	
	supercharger housing bush.	Sc 5309	Ø10.015 Ø10.000						
133	supercharger lever bushing	Sc 5349	Ø9.980 Ø9.960			+0.008	-0.027		
	lever swivel	Sc 5374	Ø9.987 Ø9.972						
134	brake belt pin	Sc 5364	Ø8.015 Ø8.000	+0.013	+0.043				
	brake belt clevis	Sc 5373	Ø8.015 Ø8.000						
135	brake belt adjst. screw	Sc 5367	Ø6.000 Ø5.988	0.000	+0.024	0.000	+0.020		
	supercharger drive housing	Sc 5300	Ø6.012 Ø6.000						
136	supercharger drive housing	Sc 5300	Ø104.780 Ø104.726	0.000	+0.089				
	crankcase-compl.	Sc 0010A;Sh 0010A Sh 0010B	Ø104.815 Ø104.780						

Group : 55A.1

1	2	3	4	5	6	7	8	9	10
127	drive housing cover	Sc 5351	Ø160.040 Ø160.000	+0.071	-0.032				
	supercharger drive housing	Sc 5300	Ø160.032 Ø159.969						
128	drive housing cover	Sc 5351	Ø160.022 Ø159.982	+0.058	-0.022				
	supercharger scroll	Sc 0562	Ø160.040 Ø160.000						
129	starting ratchet gear	Sc 5395	-			+49.9	+50.0	49.7	distance betw. gear and mating surface
	scroll mating surface	-	-						
130	front clutch countershaft	Sh 5351	Ø7.995 Ø7.986	+0.005	+0.029			+0.050	rad. clearance at c'shafts
	crankshaft gear	Sc 2030	Ø8.015 Ø8.000						
131	supercharger drive housing	Sc 5300	Ø13.018 Ø13.000	-0.010	-0.039	-0.020	-0.030		
	supercharger housing bush.	Sc 5309	Ø13.039 Ø13.028						

Group : **55A.1**

1	2	3	4	5	6	7	8	9	10
122	compres.ring (1st type)	gap Sc 5390				+0.350	+0.650		
	compres.ring (2nd type)	gap Sc 5390				0.000	+0.100	0.200	
123	supercharger impeller shaft	Sc 5334	Ø16.839 Ø16.828	-0.010	-0.039	-0.020	-0.030	–	
	supercharger impeller	Sc 5354	Ø16.818 Ø16.800						
124	supercharger impeller	Sc 5354	–			+0.300	+0.500	+0.600	
	drive housing cover	Sc 5351	–						
125	supercharger impeller	Sc 5354	–			+0.300	+0.500		after crimping bearing on the measuring side
	supercharger scroll	Sc 0562	–						
126	supercharger impeller shaft	Sc 5334	Ø 9.975 Ø 9.960	+0.030	+0.054	+0.040	+0.055	+0.070	
	bushing in driving shaft	Sc 5377	Ø10.014 Ø19.005						

Group : **55A.1**

1	2	3	4	5	6	7	8	9	10
117	supercharger impeller shaft	Sc 5334	Ø17.009 Ø17.001	-0.001	-0.019	-0.005	-0.010		
	ball bearing	Sc 5389	Ø17.000 Ø16.990						
118	ball bearing bushing	Sc 5339	Ø40.007 Ø39.982	+0.017	-0.018			+0.020	
	ball bearing	Sc 5389							
119	ball bearing bushing	Sc 5339	Ø40.007 Ø39.982	+0.005	-0.045				
	obturator outer ring	Sc 5324A,B	Ø40.027 Ø40.002						
120	supercharger impeller shaft	Sc 5334	Ø17.009 Ø17.001	+0.002	-0.024				
	obturator base ring	Sc 5321	Ø17.003 Ø16.985						
121	obturator sealing ring	Sc 5390	1.300 1.280	+0.100	+0.170				lateral loose fit of sealing ring between the 2 base rings
	obturator base ring	Sc 5321	1.450 1.400						

Group : **55A.1**

1	2	3	4	5	6	7	8	9	10
112	planet gear	Sc 5331	Ø18.121 Ø18.100	+0.020 group range	+0.071 needles	+0.030	+0.050	0.080 per 0.005 tolerance	rad.fit on needle bearing +0.08 is valid for used needl. sets too
	supercharger driving shaft	Sc 0534	Ø14.080 Ø14.060						
113	planet gear	Sc 5331	–			+0.200	+0.350	0.500	axial fit
	supercharger driving shaft	Sc 0534	–						
114	bell gear-compl.	Sc 0596	–			+0.200	+0.300	+0.350	teeth loose fit
	planet gear	Sc 5331	–						
115	planet gear	Sc 5331	–			+0.200	+0.300	+0.350	teeth loose fit
	supercharger impeller shaft	Sc 5334	–						
116	crankcase cover	Sc 5351	Ø44.025 Ø44.000	+0.008	-0.033				
	ball bearing bushing	Sc 5339	Ø44.033 Ø44.017						

Group : 55A-1

1	2	3	4	5	6	7	8	9	10
	SUPERCHARGER with STARTER	Sc·0055A							
107	supercharger drive housing	Sc 5301	Ø34.155 Ø34.180	+0.018	-0.059	-0.126	-0.054	-	
	bell gear bushing	SL 5314	Ø34.180 Ø34.145						
108	bushing in bell gear	Sc 5376	Ø25.081 Ø25.047	+0.081	+0.035	0.080	-0.010	up to +0.124 seal	dist. between bushing ends 82.5±0.1 assembled to 145.5
	bell gear	Sc 5382	Ø35.101 Ø25.081						
109	bell gear bushing	SL 5314	Ø30.021 Ø30.100	+0.120	+0.044	+0.170			
	bell gear-compl.	Sc 0565	Ø29.981 Ø29.967						
110	supercharger driving shaft	Sc 0594	Ø13.018 Ø13.000	+0.017	-0.043	0.080	-0.010	Ø13.0 +0.081 +0.032	select bush.a. recess for arm. Ø13.0 +0.112 +0.091 no +0.032 +0.012
	A bush.in shaft B	kg Sc 5377 B	Ø13.0 Ø13.0						
111	supercharger driving shaft	Sc 0594		+0.100	+0.080			+0.300	axial fit
	bushing in shaft	Sc 5377	-						

Group: **30,31**									
92	interm. wall	Sc 3320	ϕ10,015 ϕ10,000			-0,009	-0,015		valid for D-E-B
	strainer tube	Sc 3327	-						
93	camshaft	Sc 3200 Sh 3200	-	+0,008	-0,012				
	gear key	Sc 3215	-						
Group: **40,42**									
1	2	3	4	5	6	7	8	9	10
	FRONT COVER	Sh 0040 (Sh 0042)							(G-H)
98	front cover	Sh 4000	ϕ104,054 ϕ104,000	-0,124	-0,200				
	bearing bushing	Sc 4006	ϕ104,200 ϕ104,178						
99	bearing bushing	Sc 4006	ϕ99,963 ϕ99,941	-0,015	-0,052	-0,030	-0,050		Cr according to KsM-M137-PK32
	ball bearing	see catalog	-						
100	pressure bearing cover	Sc 4007 (Sh 4016)	ϕ100,022 ϕ 99,987			+0,037	-0,013		cover Sc 4007 is mount. for test/or. cust.'s wish otherw.distrib. (G-H)
	ball bearing	see catalog	-						
101	crankcase	Sc 1001 Sh 1001(AK)	ϕ180,040 ϕ180,000	+0,037	-0,028				(G-H)
	front cover	Sh 4000	ϕ180,028 ϕ180,003						
102	axial clearance at rad.-ax.bear.	see catalog	-			+0,100	+0,250	+0,39	
103	pressure bearing cover	Sc 4007 (Sh 4016)	-			0,000	-0,040		(G-H) axial, see col.10 from ref. 100
	ball bearing	see catalog	-						

Group: **30,31**

1	2	3	4	5	6	7	8	9	10
81	pump driven impeller	Sc 3755	ϕ10,043 ϕ10,025	+0,009	+0,042			+0,060	
	driven impeller shaft	Sc 3729	ϕ10,016 ϕ10,001						
82	pump driving impeller	Sc 3756	ϕ 9,996 ϕ 9,985	+0,001	+0,030			+0,040	
	shorter vertical shaft	Sc 3757	ϕ 9,984 ϕ 9,966						
83	driving and driven impellers	Sc 3756 Sc 3755	-			+0,070	−0,110	+0,150	tooth clearance
84	bevel gears	Sc 3750 Sc 3757	-			+0,150	−0,200	+0,250	tooth clearance
85	driving and driven impellers	Sc 3756 Sc 3755	-			+0,030	−0,060		axial clearance
86	camsh.gear to flange overhang	-	-			+0,500	−0,800	+1,000	
87	shorter vertical shaft	Sc 3757	-			+0,008	-0,012	+0,020	
	gear key	Sc 3215							
88	aux. drive housing	Sc 3301 Sc 3303	ϕ 7,015 ϕ 7,000	0,000	+0,024				D-E-B F-C-G-H
	centering tube	Sc 3301 Sc 3303	ϕ 7,000 ϕ 6,991						
89	aux. drive housing	Sc 3301 Sh 3303	ϕ38,025 ϕ38,000	+0,030	-0,011				D-E-B F-C-G-H
	interm. wall	Sc 3320 Sh 3311	ϕ38,011 ϕ37,991						
90	gravity valve (stariner)	Sh 0336	ϕ10,022 ϕ10,000	+0,025	+0,062				valid for C-F-G-H
	gravity valve guide tube	Sh 3316	ϕ 9,975 ϕ 9,960						
91	interm. wall	Sh 3311	ϕ10,518 ϕ10,500			-0,020	-0,040		valid for C-F-G-H
	gravity valve guide tube	Sh 3312	ϕ10,536 ϕ10,518						

Group: **30,31**

1	2	3	4	5	6	7	8	9	10
72	camcase	Sc 3000,Sc3006 Sh 3003	ϕ10,301 ϕ10,290	-0,011	-0,033	-0,020	-0,033		KsM-M137-PK38 hole out-of-round max. 0,02
	rocker shaft	Sc 3730	ϕ10,323 ϕ10,312						
73a	rocker	Sc 3721				+0,017	+0,048	+0,060	needle radial clearance
73b	rocker	Sc 3721				+0,100	+0,200	+0,400	axial clearance
74	scav. oil pump interm. wall	Sc 3320 Sh 3311	ϕ22,021 ϕ22,000	-0,014	-0,056				D-E-B F-C-G-H
	vertical shaft bushing	Sc 3326	ϕ22,056 ϕ22,035						
75	vertical shaft bushing	Sc 3326	ϕ18,018 ϕ18,000	+0,016	+0,052			+0,080	
	shorter vertical shaft	Sc 3757	ϕ17,984 ϕ17,966						
76	scav. oil pump cover	Sh 0340 Sh 0339	ϕ34,025 ϕ34,000	+0,016	+0,052			+0,080	D-E-B F-C-G-H
	shorter vertical shaft	Sc 3757	ϕ33,950 ϕ33,925						
77	scav. oil pump cover	Sh 0340 Sh 0339	ϕ24,021 ϕ24,000	+0,050	+0,100				D-E-B F-C-G-H
	oil pump driving impeller	Sc 3756	ϕ23,960 ϕ23,939						
78	scav. oil pump cover	Sh 0340 Sh 0339	ϕ24,021 ϕ24,000	+0,040	+0,082				D-E-B F-C-G-H
	oil pump driven impeller	Sc 3755	ϕ23,960 ϕ23,939						
79	scav. oil pump cover	Sh 0340 Sh 0339	ϕ10,015 ϕ10,000	+0,014	-0,016				D-E-B F-C-G-H Aldurit KsM-M137-PK1
	driven impeller shaft	Sc 3329	ϕ10,016 ϕ10,001						
80	interm. wall	Sh 0332 Sh 0333	ϕ10,015 ϕ10,000	+0,014	-0,016				D-E-B F-C-G-H Aldurit KsM-M137-PK1
	driven impeller shaft	Sc 3329	ϕ10,016 ϕ10,001						

Group: **30,31**

1	2	3	4	5	6	7	8	9	10
	CAMCASE - complete	Sh 0030, Sc 0030A							D-E, B
		Sh 0031, Sc 0031							F-G-H, C
64	camcase	Sc 3000,Sc3006 Sh 3003	ϕ45,025 ϕ45,000			0,000	+0,010	+0,050	
	centering tube	Sc 3710	ϕ45,011 ϕ44,995						
65	centering tube	Sc 3710	ϕ43,025 ϕ43,000			+0,023	-0,018	+0,030	
	camshaft bearing	Sc 0380	ϕ43,011 ϕ42,995						
66	camcase	Sc 3000,Sc3006 Sh 3003	ϕ45,025 ϕ45,000	+0,023	-0,018			+0,030	
	camshaft central bearing	Sc 0381	ϕ45,018 ϕ45,002						
67	front camcase	Sc 3000	ϕ45,025 ϕ45,000	0,000	+0,050				
	front crankcase cover	Sc 3700	ϕ45,000 ϕ44,975						
68	rear camcase	Sc 3006	ϕ45,025 ϕ45,000	+0,023	-0,018			+0,025	
	camshaft rear bearing	Sc 0382	ϕ45,018 ϕ45,002						
69	aux. drive housing	Sc 3301 Sh 3303	ϕ50,025 ϕ50,000	+0,009	+0,050				D-E-B F-C-G-H
	camshaft rear bearing	Sc 0382	ϕ49,991 ϕ49,975						graflak 30 KsM-M137-PK35
70	camshaft bearing	Sc 3700,Sc3780 Sc 3781,Sc3782	ϕ21,021 ϕ21,000	+0,020	+0,062			+0,090	
	camshaft - complete	Sc 0321 Sh 0321	ϕ20,980 ϕ20,959						
71	camshaft	Sc 3200 Sh 3200	ϕ15,018 ϕ15,000	0,000	+0,036			+0,100	spherical surf. of ratchet gear around pin area
	ratchet gear	Sh 3216	ϕ15,000 ϕ14,982						

Group: **28,29**									
1	2	3	4	5	6	7	8	9	10
	CYLINDER and CYLINDER HEAD	Sc 0028 Sh 0029							
56	cylinder head	Sc 2705 Sc 2706	ϕ111,035 ϕ111,000	+0,000	+0,057				
	cylinder	Sc 2606	ϕ111,000 ϕ110,978						
57	cylinder head	Sc 2705 Sc 2706	ϕ52,030 ϕ52,000			-0,180	-0,230		
	intake valve seat	Sc 2710	ϕ52,260 ϕ52,240						
58	cylinder head	Sc 2705 Sc 2706	ϕ50,030 ϕ50,000			-0,185	-0,230		
	exhaust valve seat	Sc 2711	ϕ50,230 ϕ50,210						
59	cylinder head	Sc 2705 Sc 2706	ϕ14,018 ϕ14,000	-0,032	-0,060				
	intake valve guide	Sc 2712	ϕ14,060 ϕ14,050						
60	cylinder head	Sc 2705 Sc 2706	ϕ15,518 ϕ15,500	-0,032	-0,060				
	exhaust valve guide	Sc 2714	ϕ15,560 ϕ15,550						
61	intake valve guide	Sc 2712	ϕ10,022 ϕ10,000	+0,060	+0,092			+0,110	
	intake valve	Sc 2733	ϕ 9,950 ϕ 9,930						
62	exhaust valve guide	Sc 2714	ϕ12,027 ϕ12,000	+0,080	+0,127			+0,150	
	exhaust valve	Sc 0277	ϕ11,920 ϕ11,900						
63	cylinder head	Sc 2705 Sc 2706	thread pitch D ϕ15,026+0,03			-0,031	-0,051		thread press fit (M16x1,5 left)
	spark plug insert	Sc 2713	thread pitch D ϕ15,07+0,1						

Group: 25

1	2	3	4	5	6	7	8	9	10
	PISTON	Sh 0025							
50	cylinder	Sc 2606	ϕ105,035 ϕ105,000	+0,950	+1,085				Cr 100 see M137-P00-07 and KsM-M137-PK25
	piston top	Sh 2503	ϕ104,050 ϕ103,950						
	above 1st ring		ϕ104,220 ϕ104,180	+0,780	+0,895				
	above 3rd ring		ϕ104,370 ϕ104,330	+0,630	+0,705				
	other skirt area		ϕ104,600 ϕ104,580	+0,400	+0,455			+0,700	no graphite taper pointed to piston top
			ϕ104,650 ϕ104,630	+0,350	+0,405			+0,650	
51	piston	Sh 2503	ϕ24,010 ϕ24,000	+0,007	+0,030		-0,010	+0,030	
	piston pin	Sc 2510	ϕ23.993 ϕ23,980						
52	piston	Sh 2503	2,214 2,200	+0,200	+0,227			+0,300	
	piston ring	Sc 2520	2,000 1,987						
53	piston	Sh 2503	4,138 4,120	+0,120	+0,164			+0,225	
	scrap. ring - upper - lower	Sc 2525 Sc 2526	2,000 1,987						
54	piston ring gap	Sc 2520 Sc 2525 Sc 2526	-			+0,400	-0,600	+1,200	
55	crankcase	Sc 1001 Sh 1001(AK)	ϕ111,100 ϕ111,050	+0,030	+0,110			+0,200	(G-H)
	cylinder	Sc 2606	ϕ111,020 ϕ110,990						

Group : 24									
1	2	3	4	5	6	7	8	9	10
	CONNECTING ROD	Sh 0024							
42	connecting rod	Sh 2302	ø55,019 ø55,000			-0,040	-0,050		
	bearing insert	Sc 2315	ø55,060 ø55,041						Cd 30, M137-P00-07
43	connecting rod	Sh 2302	ø10,015 ø10,000	+0,014	-0,010				reconditioning KsM-M337-PK7
	connecting rod bolt	Sc 2330	ø10,010 ø10,001						
44	connecting rod	Sh 2302	ø 6H7 ø 6H7			-0,020	-0,030		reconditioning M137-P00-07
	lock pin	Sc 2322 Sc 2323	ø 6u7 ø 6u7						
45	connecting rod complete	Sh 0232	ø50,020 ø50,010	+0,030	+0,050			+0,080	Pb 35 at connecting. rod overhaul Pb 5-7 at new rods (G-H)
	crankshaft	Sc 2000 Sh 2000(AK)							
46	connecting rod complete	Sh 0232	-						rad. clearance (G-H)
	crankshaft	Sc 2000 Sh 2000(AK)	-						
47	connecting rod	Sh 2302	ø24,013 ø24,000	+0,007	+0,033	+0,015	+0,026	+0,040	
	piston pin	Sc 2510	ø23,993 ø23,980						
48									
49									

30									

Group : **20, 20AK**

1	2	3	4	5	6	7	8	9	10
	CRANKSHAFT - complet	Sh 0020(AK) Sc 0020							for D-E-F (G-H) for A-B-C
34	crankshaft	Sh 2000(AK)	ϕ30,033 ϕ30,000	-0,067	-0,150	-0,100	-0,150		for D-E-F (G-H)
	plug	Sh 2013	ϕ30,100 ϕ30,150						
35	crankshaft	Sc 2000 Sh 2000(AK)	ϕ40,016 ϕ40,000	-0,044	-0,070	-0,050	-0,070		(G-H)
	geared wheel	(Sh 2031) Sc 2030	ϕ40,070 ϕ40,060						
36	main bear.insert later.and centr.	Sc 1015 Sc 1016	ϕ55,030 ϕ55,020	+0,040	+0,060			+0,090	Pb 50 at orig. 10-15, max. 50 at new parts (G-H)
	crankcase	Sc 2000 Sh 2000(AK)	ϕ54,980 ϕ54,970						
37	ball bearing	see catalog	-			+0,007	-0,027		Cu 30 (ID)
	crankshaft	Sc 2000 Sh 2000(AK)	ϕ55,015 ϕ55,002						(G-H)
38	crankshaft	Sc 2000 Sh 2000(AK)	8,022 8,000	+0,016	-0,021				Cu 8, KsM-M137-PK16 key width (G-H)
	propeller flange key	Sc 2014	8,021 8,006						
39	crankshaft run-out M337A,AK (M137A,AZ)	a) 2 4 6 max. 0,08 b) 1 4 7 max. 0.15 c) 2 1 6 max. 0,15							Journals : support. area measur. area
	M332	1 3 5 max. 0,08 2 3 4 max. 0,05 2 1 4 max. 0,08							
40	crankshaft	Sc 2000	o32,039 o32,000			-0,100	-0,150		A-B-C
	plug	Sc 2011	o32,150 o32,100						

Group : **10A, 10B, 10AK**

1	2	3	4	5	6	7	8	9	10
19	bearing insert (in crankcase)	Sc 1015 Sc 1016	ϕ 5,018 ϕ 5,000	+0,027	-0,009				
	low.bearing insert lock pin	Sc 1025	ϕ 5,009 ϕ 4,991						
20	bearing insert (in cover)	Sc 1015 Sc 1016	4,030 4,000	+0,039	-0,009				
	up. bearing insert lock pin	Sc 1026	4,009 3,991						
21									
22									

Group : **14**

1	2	3	4	5	6	7	8	9	10
	OIL SUMP	Sh 0014							
26	sump	Sh 1403	ϕ22,021 ϕ22,000	-0,014	-0,056				
	vertical shaft bushing	Sc 1405	ϕ22,056 ϕ22,035						
27	vertical shaft bushing	Sc 1405	ϕ18,018 ϕ18,000	+0,016	+0,052			+0,080	
	vertical shaft	Sh 0148	ϕ17,984 ϕ17,966						
28	crankcase	Sc 1001 Sh 1001 (AK)	ϕ58,030 ϕ58,000	+0,037	-0,012				(G-H)
	sump	Sh 1403(AK)	ϕ57,912 ϕ57,993						
29	sump	Sh 1403(AK)	ϕ 6,022 ϕ 6,010	+0,014	-0,006				(G-H)
	pin	Sc 1013	ϕ 6,016 ϕ 6,008						

Groupe : **10A, 10B, 10AK**

1	2	3	4	5	6	7	8	9	10
9	bevel gear	Sc 1534	ϕ26,021 ϕ26,000	+0,019	-0,015				
	central gear	Sc 1533	ϕ26,015 ϕ26,002						
10	crankcase	Sc 1001 Sh 1001 (AK)	ϕ24,021 ϕ24,000	-0,014	-0,056				(G-H)
	countershaft bushing	Sc 1047	ϕ24,056 ϕ24,035						
11	crankcase countersh.bushing	Sh 1001 (AK) Sc1047,Sc 1001	ϕ20,021 ϕ20,000	+0,020	+0,062			+0,080	Cr 50 on new shaft, KsM-M137-PK 49 (G-H)
	countershaft pin	(Sh 1590) Sc 1537	ϕ19,980 ϕ19,959						
12	drive bevel gear	Sc 1541	5,013 5,001	+0,017	-0,013				
	drive gear	Sc 1539	5,018 5,000						
13	drive gear	Sc 1539	ϕ18,027 ϕ18,000	0,000	+0,045				
	countershaft pin	(Sh 1590) Sc 1537	ϕ18,000 ϕ17,982						(G-H)
14	crankcase cover	Sc 1300A Sh 1300	ϕ30,033 ϕ30,000	+0,005	-0,041	-0,020	-0,030		
	breather tube	Sc 0132	ϕ30,041 ϕ30,028						
15	cylinder gears teeth clearance	-	-			+0,100	+0,200	+0,250	
16	bevel gears teeth clearance	-	-			+0,150	+0,200	+0,250	
17	crankcase	Sc 1001 Sh 1001 (AK)	ϕ 6,018 ϕ 6,000	-0,005	-0,035				from 13th series D and E-F (G-H)
	low.bearing insert lock pin	Sc 1025	ϕ 6,035 ϕ 6,023	+0,006	-0,024				up to 12th series
18	main bear.cover later.and centr.	Sc 1005 Sc 1006	ϕ 6,012 ϕ 6,000	-0,011	-0,035				from 13th series D and E-F (G-H)
	up. bear. insert lock pin	Sc 1026	ϕ 6,035 ϕ 6,023	0,000	-0,024				up to 12th series

Groupe : **10A, 10B, 10AK**

1	2	3	4	5	6	7	8	9	10
	CRANKCASE - complet	Sh 0010A, Sc 0010A, Sh 1001AK							E, B, G-H
		Sh 0010B, Sc 0010 B							F, C
1	crankcase	Sc 1001 Sh 1001 (AK)	102,035 102,000	+0,050	-0,020				(G-H)
	main bear. cover later.and cent.	Sc 1005 Sc 1006	102,020 101,985						Cu 30, M137-P00-07
2	crankcase	Sc 1001 Sh 1001 (AK)	ø62,019 ø62,000			-0,030	-0,040		(G-H)
	main bear.cover later.and centr.	Sc 1015 Sc 1016	ø62,051 ø62,032						Cd 30, M137-P00-07
3	crankcase	Sc 1001 Sh 1001 (AK)	ø17,018 ø17,000	0,000	-0,29				(G-H)
	central gear shaft bushing	Sc 1046	ø17,029 ø17,018						Cr 20 clean, M137-P00-07
4	crankcase	Sc 1001 Sh 1001 (AK)	ø14,018 ø14,000	+0,011	-0,018				(G-H)
	central gear shaft	Sc 1530	ø14,018 ø14,007						
5	central gear shaft bushing	Sc 1046	ø14,017 ø14,006	+0,010	-0,012				
	central gear shaft	Sc 1530	ø14,018 ø14,007						
6	distance bushing	Sc 1531	ø14,043 ø14,016	+0,036	-0,002				
	central gear shaft	Sc 1530	ø14,018 ø14,007						
7	bearing bushing	Sc 1532	ø17,018 ø17,000	+0,016	+0,052			+0,080	
	distance bushing	Sc 1531	ø16,984 ø16,966						
8	central gear	Sc 1533	ø20,021 ø20,000	+0,007	+0,041			+0,050	
	bearing bushing	Sc 1532	ø19,993 ø19,980						

Symbol	Engine model
A	M 332
B	M 332 A
C	M 332 AK
D	M 337
E	M 337 A
F	M 337 AK
G	M 137 AZ
H	M 137 AK

NOTE:

The illustrations shown are typical for references of the recommended tolerances and fit, but in no instance, can be considered to represent a specific part or engine model.

are applicable. A list of symbols and engine models to which they refer is presented below.
Referances to work stations, where there are not applied usual procedures or gages, are made in this column.
In this column there are shown other data, that are not directly listed in the table. If the repair procedures requires, indications about deviations from shape and position may be set forth.
"O" indicates out-of-round
"K" indicates taper.
Special symbols are used to indicate plating. They represent the chemical symbol of the element and a figure indicating the max. admitted layer thickness expressed in µm after finish.
E.g.:
Cr 100 - chrome plating 0.1 mm thickness.
In case the plating is 100% performed, there are indicated the limits: Pb 30-50 - lead plating 0.03-0.05 mm thickness. All galvanic platings are considered when calculating the fit, otherwise it is indicated "fit without layer". This indication can be accompanied by the referance no. of the document ordering the peculiar repair procedure, while this number may refer to engine M137A/AZ,considering the experience gained overhauling this model an further applied when overhauling models M337, M337A/AK, M332 and M332A/AK.

At positions, where the modification of the part involves modification of the dimension or tolerances, the comparison between data and table is not permitted. It is prohibited to perform deductions in case of modifications.

Fit (5th,6th,7th, 8th column)

In these columns there is set forth the fit between parts as manufactured.The character of the fit is indicated by signs:
+ means loose fit
- means shrink (pressure) fit
Dimensions in col.5 and 6 are minimum, in col. 7 and 8 are maximum for a newly manufactured part.

Calculated fit (5th,6th column)

The fit is calculated considering the part manufacture tolerances. If no recommended fit is indicated (7th,8th col.) or the service fit can not be applied for the two matching parts, then observe these values.

Recommended fit (7th,8th column)

It is necessary to observe this fit through a convenient selection of parts anywhere the manufacture tolerances enables an extended fit range or anytime the fit is not dependable upon the manufacture dimensions.
When mounting new parts or matching a new part with an old one, the recommended fit has priority before the calculated one, while the service fit should not be applied.

Service max. (9th column)

In case of reusing original parts, it is possible to apply service fit, if one is indicated. If no one indicated, then the recommended fit has priority before the calculated one.
The service fit as well as other repair values indicated in this section may not be applied at engine manufacturing.

Notes (10th col.)

The symbols, in the head line of groups or farther in different lines, introduce the engine model to which the specified values

18. TOLERANCES and FITS

These tables of tolerances and fits are intended to present data to all service and maintenance personnel involved in repairs and overhauls of LOM-built engines.

Data in these table may be affected by changes, so that if one has doubts concerning the existing and the recommended values or when interpreting the shown data, immediately address an inquiry to LOM factory for clarification.

The material herein contained is organized into 10 columns, as explained below:

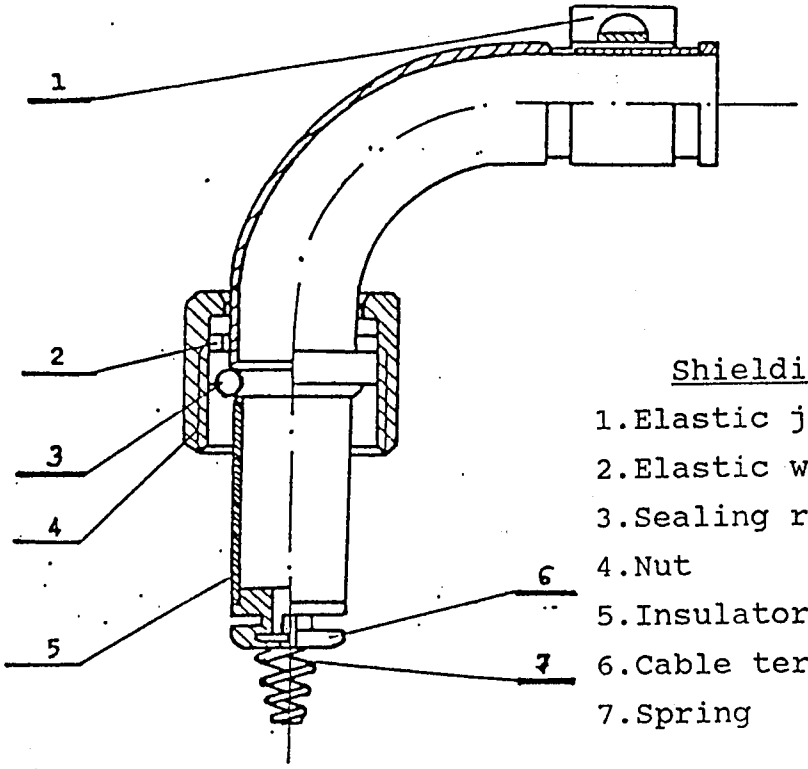
EXPLANATIONS:

Ref.(1st col.) — Nos. in this column are shown as a reference no. to locate the area described in the "Nomenclature"column.This no.will be found in the diagram on the adjacent page,indicating a typical part,where the limits are applicable.

Nomenclature (2nd column) — In this column there is introduced the abbreviated or complete denomination of the parts as specified in the Spare Parts Catalog of each model engine indicated by the number after the designation "Group",to which the clearance is refered and that are illustrated in figures at the corresponding page.

Drawing no. (3rd column) — This column introduces the drawing no. of the part or assembly,as they are referenced to in the Spare Parts Catalog or in the Engine Drawing Documentation.

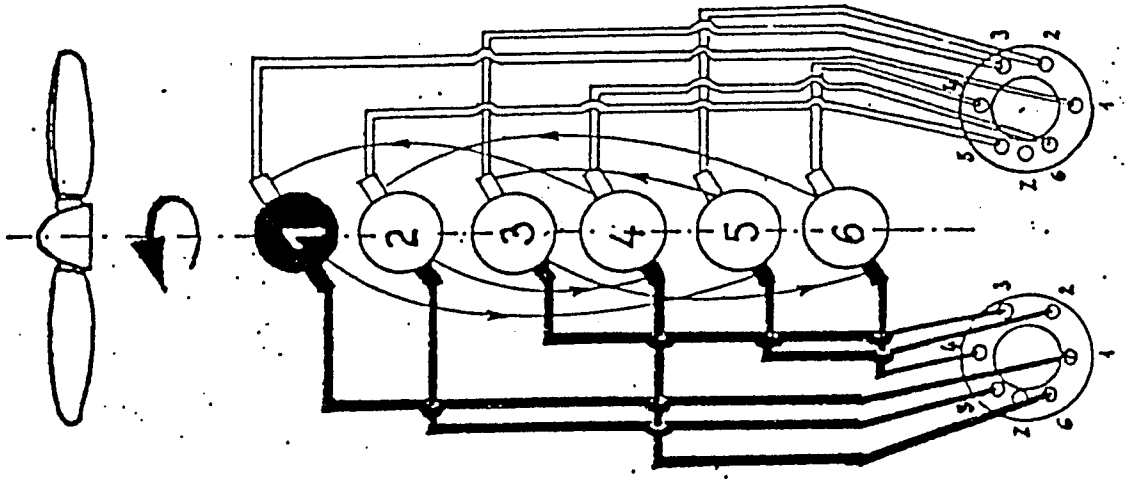
Design dimension (4th column) — This represents the drawing dimension of the considered parts, tolerances included.



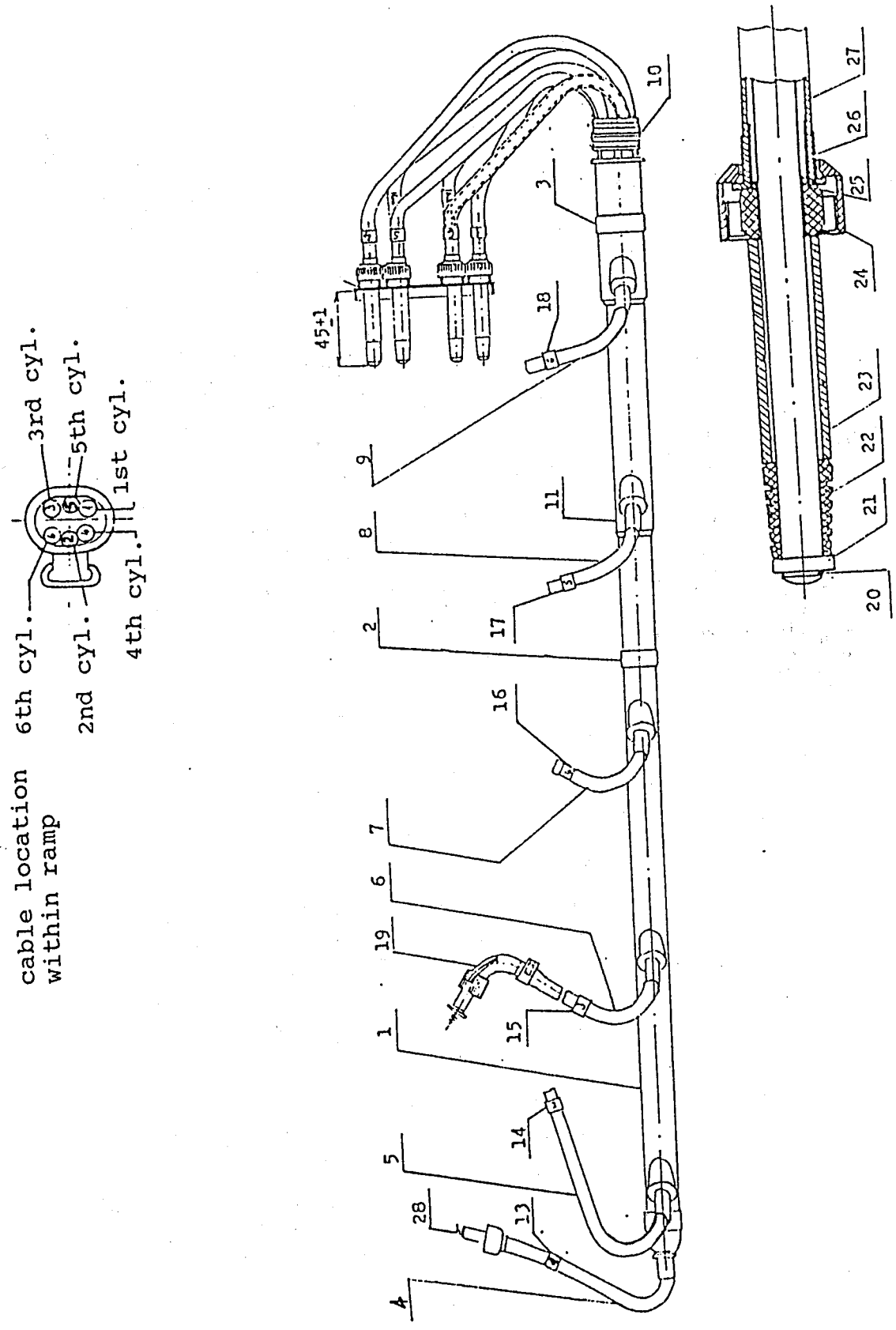
Shielding Elbow Sc 0748/1

1.Elastic joint	415-5610.03	1 pc.
2.Elastic washer	415-0979.02	1 pc.
3.Sealing ring	415-7070.01	1 pc.
4.Nut	415-6630.05	1 pc.
5.Insulator	415-5400.01	1 pc.
6.Cable terminal	415-5400.01	1 pc.
7.Spring	415-5911.02	1 pc.

Fig. 17.3

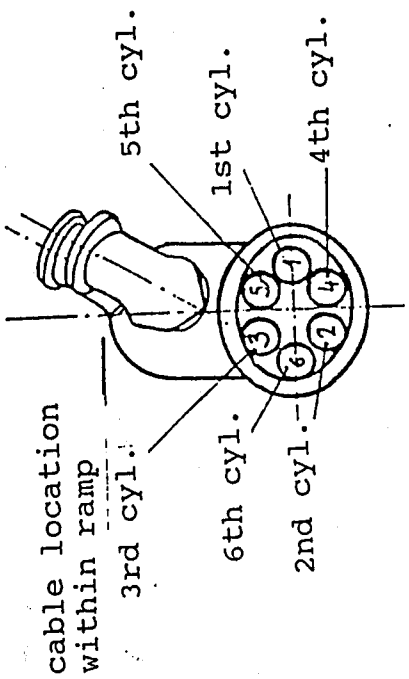


Ignition cables connection and firing order
(viewing cylinder heads)
Fig. 17.4



LEFT IGNITION RAMP-COMPLETE p/n Sh 0755 AK

Fig. 17.2



RIGHT IGNITION RAMP-COMPLETE p/n Sh 0754

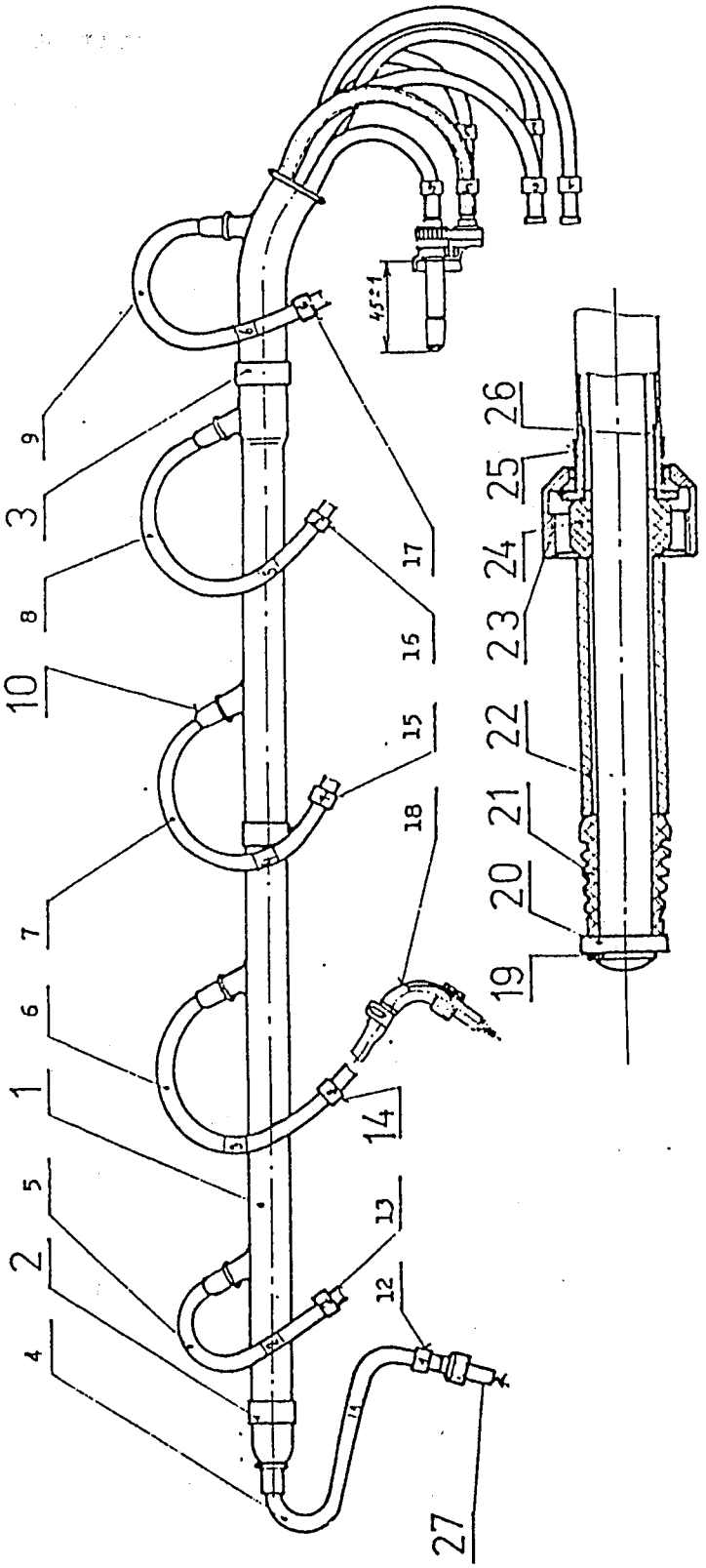


Fig. 17.1

6	1021151	inner shielding bushing	6
7	1021081	outer shielding bushing	6

17.7.4. Insert the cables according to fig. and table. Dress the cable sleeves to cables and outlets.

17.7.5. Install the ignition ramp on the testing fixture. Check the ramp for insulation breackdown at a voltage of 15kV for 1 min. Replace damaged components and repeat the test. The testing fixture: Z00-0061, plugs P 137-332.

17.7.6. Ramp Reassembly Completion.

Install the nut with elastic washer, the sealing ring, the insulator and the elastic clip to the shielding elbow.

Remove shielding on 85 mm and strip the cable at spark plug end on 25 mm. Mount the shielding elbows with above mentioned components to the ignition cables. Mount the terminal without the spring to the cable end. Insert the insulated strands throughout the terminal, divide into two parts,bend them and conduct them along the lateral grooves for 180°C.Install the spring and bend the two wire bundles over the spring lower winding into the lateral groove and then conduct them to the center of the cable terminal.

At the opposite end mount the nut and the outer bushing,fit the shielding and mount the inner shielding bushing. Swage bushings in the P 137-103 fixture, clean shielding and bushing.

Install the shielding pad, the insulator, the plug and the two washers, flare the wires and braze.

Screw in the cable terminal to the magneto shielding protection. Check cables for continuity by lighting. Check joints for electrical resistance.

9	PAL 502-0904.27	washer	6
20	PAL 502-7211.82	washer	6
1	Sc 7433	plug	6
2	Sc 7432	insulator	6
3	PAL 402-0760.36	nut	6
4	PAL 502-4200.74	sealing pad	6
5	1021151	inner shielding bushing	6
6	1021081	outer shielding bushing	6

17.7.3.Layout of Left Ignition Ramp.

ref.no.	p/n ref.	designation	qty
1	Sh 0743	cable tube, left-complete	1
2	Sh 7465	tube holder,left	2
3	Sh 7466	tube holder,aft left	1
4	Sh 7451 B	left 1st cyl.ignition lead,shielded	1
5	Sh 7452 B	left 2nd cyl.ignition lead,shielded	1
6	Sh 7453 B	left 3rd cyl.ignition lead,shielded	1
7	Sh 7454 B	left 4th cyl.ignition lead,shielded	1
8	Sh 7455 B	left 5th cyl.ignition lead,shielded	1
9	Sh 7456 B	left 6th cyl.ignition lead,shielded	1
10	Sh 7425	cable sleeve	1
1	Sc 7426	cable sleeve in ramp.	6
3	1031611	model tag no.1	2
4	1031621	model tag no.2	2
5	1031631	model tag no.3	2
6	1031641	model tag no.4	2
7	1060811	model tag no.5	2
8	1060821	model tag no.6	2
9	Sc 0748/1	RK-14 shielding elbow with contacts	6
20	PAL 502-0904.27	washer	6
1	PAL 502-7211.82	washer	6
2	Sc 7433	plug	6
3	Sc 7432	insulator	6
4	PAL 402-0760.36	nut	6
5	PAL 502-4200.74	sealing pad	6

102 1081	Inner shielding bushing	12 pcs cadm.&chrome plated
102 1151	Outer shielding bushing	12 pcs cadm.&chrome plated
415-6630.05	Nut	12 pcs zinc &chrome plated
415-8351.05	Elbow body	12 pcs zinc &chrome plated

17.6. COMPONENT REPAIR

Dress out mechanically indentations and minor deformations from both cable tubes and then chemically clean.Check tubes for material thickness after cleaning. Dress out gallings and damages from tube holders,ignition ramp elbows,nuts and shielding bushings. Recondition the surface protection. Clean components in gasoline

17.7. IGNITION RAMP REASSEMBLY

17.7.1.Cut Cables to Length: see table 17.7.1.

17.7.2.Layout of Right Ignition Ramp.

ref.no.	p/n ref.	designation	qty
1	Sh 0742	cable tube,right-complete	1
2	Sh 2732	tube holder	2
3	Sh 7427	tube holder,aft right	1
4	Sh 7457 B	right 1st cyl.ignition lead,shielded	1
5	Sh 7458 B	right 2nd cyl.ignition lead,shielded	1
6	Sh 7459 B	right 3rd cyl.ignition lead,shielded	1
7	Sh 7460 B	right 4th cyl.ignition lead,shielded	1
8	Sh 7461 B	right 5th cyl.ignition lead,shielded	1
9	Sh 7462 B	right 6th cyl.ignition lead,shielded	1
10	Sc 7426	cable sleeve in ramp	6
2	1031611	model tag no.1	2
3	1031621	model tag no.2	2
4	1031631	model tag no.3	2
5	1031641	model tag no.4	2
6	1060811	model tag no.5	2
7	1060821	model tag no.6	2
8	Sc 0748/1	RK-14 shielding elbow with contacts	6

tection.

17.4. DISCARD the following components:

Sc 7433	Plug	12 pcs
Sh 7425	Cable sleeve	1 pcs
502-4200.74	Sealing pad	12 pcs
Sc 7426	Cable sleeve	12 pcs
Sh 7451÷ 56B	Ignition cable	6 pcs
1031611	Model tag	2 pcs
1031621	Model tag	2 pcs
1031631	Model tag	2 pcs
1031641	Model tag	2 pcs
1060811	Model tag	2 pcs
1060821	Model tag	2 pcs
415-7070.01	Sealing ring	12 pcs
415-0979.02	Elastic washer	12 pcs
Sc 7466	Spring	12 pcs
Sc 7465	Cable terminal	12 pcs
Sh 7457÷ 62B	Ignition cable	6 pcs
Sh 7451÷ 56B	Ignition cable	6 pcs
502-0904.27	Washer	12 pcs
502-7211.82	Washer	12 pcs
Sc 0748/1	RK-14 shielding elbow with contacts	12 pcs

17.5. TABLE of COMPONENTS WITH SURFACE PROTECTION

Sh 0743	Left cable tube	1 pcs	chemical clean.
Sh 0742	Right cable tube	1 pcs	chemical clean.
Sc 2732	Tube holder	2 pcs	zinc&chrome plated
Sh 7427	Right tube holder	1 pcs	zinc&chrome plated
Sh 7465	Tube holder	2 pcs	zinc&chrome plated
Sh 7466	Left tube holder	1 pcs	zinc&chrome plated
402-0760.36	Nut	12 pcs	copper plated 3÷5 nm,matly nickel plated 2÷3 nm

17. IGNITION HARNESS

The engine ignition system is shielded, double, reciprocally independent. The magnetos have a right-hand sense of rotation and are provided with automatic firing advance adjustment. They turn twice less than the crankshaft. The right magneto fires the spark plugs on the intake side, the left one on the exhaust side. The magnetos are equipped with shielding caps fixed to the distributor block. The terminal of the main grounding lead is also provided with a shielding cap. Both magnetos have terminals for the shortcircuit wires.

Each cylinder head is equipped with two spark plugs type PAL L22.62 with M12x1.25 mm reach thread. The cables are shielded by a hose-like metal braid. The ends to spark plugs are provided with end pieces and M14x1 mm socketnuts to join to spark plugs.

17.1. IGNITION RAMP DISMOUNT

Remove tags, shielding elbow with contacts and cable sleeve. From the opposite end braze off the end piece and remove the washer, the plug, the insulator, the sealing pad, the nut and the bushings of the inner and outer shielding.
Extract cable sleeves out of the ramp tubes and then the ignition wires and dismount the clamps.
Loose the socketnuts from the outlet terminal and remove.

17.2. CLEAN components in gasoline.

17.3. INSPECTION

Cable tube - dress out minor damages and deformations, strighten deeper indententions. Reject in case of indententions deeper than 5 mm and cracks longer than 30 mm. Weld shorter cracks.
Cable holders - cracked and nicks - reject.
Insulators - reject if damaged.
Nut, inner and outer shielding bushing.
Dress out galling, recondition threads, remake surface pro-

excessive oil. Connect oil feeding to the top cover breather. Remove the plug in the camcase corresponding to the first cylinder and fill the crankcase. The oil should not attain the level of the magneto flanges in order to avoid flooding of the magnetos. Last 2 min with oil filled crankcase. Disconnect the hose and let oil flow out. Mount back the plug to the camcase. Spray the cylinder heads exhaust canals with K 101 oil.

16.4. ENGINE EXTERNAL PRESERVATION

Wrap the generator, the starter motor, the adjusting air bleed hoses and the ignition harness shielding with paraffin paper. Apply a fine film of "Konkor" preservative oil on the engine's exterior surface by means of a sprayer.

16.5. ENGINE PACKING

Uniformely place 17 silicagel bags over the engine,each bag weighing 300 g. Mount dehydrator plugs with blue indicator of moisture into the spark plug holes. Insert Grosfield indicating paper with color scale into the plastic sleeves. Wrap the engine with two layers of paraffin paper and bind with cord. Dress the engine in the plastic cover provided with orifices for bracket bolts. Stiffen the cover around the orifices. Install the engine on the shipment mount.Iron the cover and surge the air. Bind with cord. Enclose in separate packing the starter, the relay and the starting vibrator and the preserved spark plugs. Place the engine into the shipping case together with engine log-book.

16.6. MARK with colors the Overhaul No., preservation date and CH if chrome plated cylinders were mounted.

16.1.5. Engine Plugging-M137.

Oil strainer chamber-threaded plug 0191401,eye-type fitting 20 ČSN 313821.31, ring seals 26x32 mm, rubber cap N 959.
Protection nut of the RPM indicator drive at the oil pump - 022 9512.
Breather plug of the top cover - Sc 8501.
Oil pressure indicator connection - Sc 8519.
Oil outlet - M16x1.5 mm ČSN 02 1923.
Air pressure indicator on the manifold and the eye-type connection on the front manifold section - Sc 8519.
Exhaust obturators - Sc 7815, exhaust gaskets Sc 7807, washers 6.1 mm and nuts Sc 2728.
RPM indicator drive - obturator Sc 9075,gasket Sc 9076,nuts Sc 0151, washers 0177851.

16.1.6. Engine Plugging - M332, M337.

Breather plug - Sc 8501.
Supercharger air entrance protection - Sc 8504.
RPM indicator drive protection nut - 0229512.
Crankshaft front end protection - Sc 8507.
Correction nozzle plug - N 1186 II-20-15.
Oil outlet plug - 57058.
Exhaust obturators - Sc 7815.
Oil inlet plug - N 959 27x40 mm.

16.2. ENGINE CLEANING

The engine must be plugged during cleaning :manifold inlet, adjusting valve and the P 137-111 grounding plugs mounted on magnetos.
Do not wash: the magnetos, the starter, the generator, the ignition wire terminals and the rubber hoses. Protect the magnetos and the generator with paraffin paper.
Wash engine with gasoline to remove dirt and then wipe by means of a clean cloth.

16.3. ENGINE INTERNAL PRESERVATION

Revolve the engine cylinders up.
Preserve cylinders with oil K1.Crank the engine to eliminate

16. ENGINE SHIPMENT

Remove engine from the transport stand and install it on the reassembly stand 21-01501-00 using the brackets P 30-0154, P 20-0116, the Sc 8825 aluminium shims and the M8x20 mm bolts. Torque bolts to 10-12 Nm.

16.1. DISMOUNT the technological air scoop and exhaust stacks. Remove spark plugs and rockers plugs.

16.1.1. Finally torque cylinder heads to 24.5 Nm using the P 137-045 wrench. When carrying on torquing, first of all loose the nut 90° and then torque to the prescribed moment.
Perform the valve clearance adjustment, when the piston is at TDC. Tighten the camacase and lock the nuts.
Rotate the Z2-00172-00 dial indicator and place the 1st cylinder piston at TDC on compression stroke. Adjust the valve clearance: 0.25 mm for the intake and 0.4 mm for the exhaust valve using the P 137-108 wrench.One dial on wrench corresponds to 0.01 mm. Adjust valve clearance in the following order 1,5,3,6,2,4 or 1,3,4,2.
Reinstall the rocker plugs.

16.1.2. Mount the complete air scoop to engine.

Air scoop ref.	Sh 0796	- M137 A
	Sh 0781	- M137 AZ,M337 A,AK
	L-201.6000-01	- M337
	Sc 0076	- M332 (L-40)
	Sc 0077	- M332 (Ae-145)

16.1.3. Lock the adjusting elements from oil and fuel system and from the barometric capsule by ϕ0.8 mm wire and lead seals. Secure all pipes and rubber hose fittings with ϕ0.8 mm wire. Check levers, rods and pins (swivels) and secure by cotter pins.
Visually inspect the ceramic cable terminals - reject defective ones. Tighten loose circlips from the ignition ramp.

16.1.4. Extract the oil screen out of the oil pump, clean it with gasoline, reassemble and secure.

Table no.1 - cont.

ENGINE RATINGS

Rating	RPM	Perform. [kW]±2.5%	Manif.pres. [MPa]±0.002	Fuel Cons. [g/kWxh]	Oil Cons. [g/kWx]
M337 : The correction is set at - 2 increments at all ratings.					
Take-off^{xx}	2750±50^{x}	154	0.121-0.118	$367^{+27}/_{-14}$	-
Nominal^{xxx}	2600±3%	125	0.1±0.002	$292^{+14}/_{-7}$	1.4-11
Cruis.^{xxx} at ground	2400±3%	103	0.092±0.002	$278^{+14}/_{-7}$	1.4-8.2
Idle^{xxx}	500-600	-	-	-	-
M337A,M337AK :					
Take-off^{xx}	2750±50^{x}	154	0.121-0.118	$388^{+27}/_{-14}$	-
Nominal^{xxx}	2600±3%	125	0.1±0.002	313±14	1.4-11
Cruis.^{xxx} at ground	2400±3%	103	0.092±0.002	292±7	1.4-8.2
Idle^{xxx}	500-600	-	-	-	-

Explanations :

x) Tolerances when using a flight propeller ±30 RPM

xx) Engaged supercharger

xxx) Disengaged supercharger

Table no.1

ENGINE RATINGS

Rating	RPM	Perform. [kW]±2.5%	Manif.pres. [MPa]±0.002	Fuel Cons. [g/kWxh]	Oil Cons. [g/kWx]
M332,M332A,M332AK : The correction is set at lean stop (-) at all ratings.					
Take-off^{xx}	2700±50^{x}	103.0	0.118	$367^{+27}/_{-14}$	-
Nominal^{xxx}	2550±3%	84.6	0.100	$292^{+14}/_{-7}$	1.4-6.8
Cruis.^{xxx} at ground	2400±3%	73.5-5%	0.090	$278^{+14}/_{-7}$	-
Idle^{xxx}	500-600	-	-	-	-
M137A,M137AZ:					
Take-off	2750±3%	132	0.1	$333^{+14}/_{-7}$	1
Nominal	2680±3%	118	0.0946	$313^{+14}/_{-7}$	1.35 max
Cruising	2580±3%	103	0.0874	299±7	0.6
% nominal 75	2480±3%	88	0.0804± 0.001		
70	2440±3%	82	0.078		
65	2390±3%	77	0.0755		
60	2340±3%	71	0.0721		
55	2230±3%	59	0.0667		
Idle	500	-	-	-	-

The normal duration of the acceptance test is established as follows:

engine after teardown	2 hrs. and 20 min.
engine without teardown	1 hr. and 15 min.

After completion of the acceptance test, wash and rinse oil and fuel systems. Connect to the wash tank and wash the engine at 900-1000 RPM for 10 min.

Install the short-circuit plugs to magnetos or ground by means of the short-circuit cables before the engine leaves the test bench.

Assuming, that the engine will not be preserved imediately after test operations, it is necessary to spray the inside of each cylinder through the spark plug hole with preservative oil OK-1 or an other equivalent as it is indicated in Operator's Manual.

- engine RPM
- manifold pressure
- oil pressure
- fuel pressure
- oil inlet pressure
- oil outlet pressure
- cylinder head temperature under spark plug
- fuel consumption
- oil consumption
- air temperature at manifold inlet
- RPM drop at one magneto operating

The underlined parameters in §15.10. are curently recorded in the test record form.
Farther there are recorded all performed procedures including supercharger engaging and disengaging as well as the achieved values of control parameters during check procedures.

15.11. TEST CONDUCTING

After starting engine, perform engine warming up to operation values. Prolongue warming up engine as long as necessary. Normal duration of the engine run-in is 4 hours and 10 minutes. Following run-in completion, the engine is remo-removed from test bench and send to teardown and reassembly All new engines are submitted to teardown. If the engine is not going to be submitted to teardown, then visually inspect and check the engine, check oil strainers, remove defects and seepages, improve adjustment.
After the engine has been inspected and defects, conduct the acceptance test.

CAUTION:

If defects or damages are evidenced during tests (possibly during engine inspection after run-in), which can not be removed in the test bench station, then send the engine to teardown in order to remove those defects and damages.

Only strictly necessary data for engine test are set forth. Other data are set forth in Technical Requirements for Manufacturing or Overhaul, at which pertinent references are made in the text. The engine test after overhaul consists of the Run-In and the Acceptance Test.

15.6. PERFORMANCES

The performance data of each model engine are contained in:

- TP-M 332-00 for M 332
- TP-M 332-01 for M 332A,AK
- TP-M 137-00 for M 137A,AZ
- TP-M 337-00 for M 337A,AK

The basic performance data are set forth in table no.1.
Permitted values o the monitored data are shown in table no.2
A list of power settings during the run-in and acceptance test is shown in table no.3.

15.7. ENGINE AND BRAKE PROPELLER

The engine test is conducted on a club test bench. The engine is braked by a club test.

15.8. THE GENERATOR is loaded during the run-in test up to 0.9 of its nominal output (19.3 A at 28 V).
During the acceptance test load the generator turned once at 2550 RPM and 0.9 of its output.

15.9. OPERATING SUBSTANCES

For the mentioned engine there is prescribed the LBZ 78 grade fuel in compliance with the standard ČSN 65 6510 or equivalents indicated in the Operator's Manual.
The MS-20 grade oil in compliace with GOST 21743-76 or equivalents indicated in the Operator's Manual is prescribed to use with these engines.

15.10. MONITORED AND RECORDED PARAMETERS

All below mentioned parameters are to be monitored during tests:

15.3.3.Oil Pump Adjustment.

Oil pressure is adjusted form the right side of the pump. Loose the nut of the Sc 6053 adjusting screw. Tighten the screw of valve Sh 6014 to increase pressure. Tighten the nut and lock.

15.3.4.Injection Pump.

The mixture is leaned by inserting max. 3 shims under the barometric capsules. Remove the 4 screws from the pump rear cover.Extract the barometric capsules and insert the shims. Max. two shims between two capsules. Reassemble,tighten and lock.

Fuel pressure adjustment is performed from the right side of the injection pump. Remove the plug, loose the setnut and adjust the pressure from adjusting screw to the desired valve. Tighten the setnut,mount the plug and lock.

15.3.5.Replace one nozzle by a nozzle of similar parameters.

15.4. CONDUCT the run tests no.1 and no.2 for model engines M137, M337,M332 according to table schedules.Accessories loadings included.

15.4.1.After the engine test run has been completed, rinse the oil and fuel system with a mixture of fuel B 78+15% oil MS-20 at RPM=900-1000.

Stop engine. Remove the oil strainer and check for dirt and particles.Drain the oil from injection pump aneroid chamber by screwing off the plug at the bottom.

15.4.2.Dismount the propeller. Disconnect control rods, shafts, feeding cables and magneto short-circuit wires.

Disconnect the fuel and oil lines, pressure gages and thermometers.

Remove the air intake adapter.

Plug all outlets. Install the P 137-111 short circuit plugs. Dismount and remove the engine from the test bench.

15.5. GENERAL

The above mentioned instructions are ment for testing the mentioned model engines after overhaul.

15. ENGINE TEST

15.1. ENGINE INSTALLATION ON TEST BENCH

Remove engine from transport stand. Clean test bench mounting brackets. Install the engine and torque the bolts to 16-18 Nm.

15.2. CONNECT the test bench lines to oil inlet and outlet including thermometer and pressure gage at both front and rear side.

Connect cylinder heads temperature sensors on the right side.

Connect intake air thermometer.

Connect fuel lines to the injection pump and to the fuel pressure gage. Connect air pressure transmitter to the intake manifold (PK) and pressure transmitters (PK') to the injection pump and to the fuel supply adjusting valve.

15.2.1. Connect and adjust the rods to throtlle and correction levers. Connect wires to magneto terminals, to starter and generator. Mount the Z00-1136 special air intake adapter on M 137AZ.

15.2.2. Mount the propeller in compliance with each model engine. Check the engine for proper installation on test bench,open fuel and oil flow to engine, check connections for leaks. Heat oil in test bench tank to 50°C.

15.3. ENGINE TEST RUN

15.3.1. Control the following parameters during test run:

RPM, manifold pressure, fuel and oil pressure, inlet and outlet oil temperature, cylinder head temperature under spark plug,fuel and oil consumption,RPM drop when switching to one magneto.

15.3.2. Fuel Supply Valve Adjustment.

Loose the two screws, disassemble the valve. The pressure increases, when the nut with spring is screwed off and decreases, when the nut is screwed on.Lock the nut 705-1103 after adjusting. Assemble the valve and secure.

hub according to each model engine.

14.21.1. Plug and obturate the air manifold, oil and fuel inlets, air intakes.

14.22. REMOVE the engine from the overhaul stand and install it onto the transport stand.Fasten the engine by means of the brackets and aluminium pads using M8x20 bolts to the framework. Torque bolts to 10-12 Nm.
The bracket thickness must be 10 mm and of the pads 2 mm.
Deliver engine for test.

measured to limit the tooth clearance of the gear. Tighten the gear. Mount the generator and tighten. Align holder to generator and tighten. Stretch the fixing belts of the generator and secure by ϕ0.8 mm securing wire. Mount the RPM indicator drive to the right side of the the cranckcase. When mounting the drive, put gaskets measured to limit the tooth clearance of the drive.

14.19. IGNITION SYSTEM MOUNTING

Visually check both cable ramps for proper condition of shielding and insulators.Mount the clamps to the right and left ramp. Remove the lateral screws from cylinder heads no. 2,4,6 from both sides, insert the screws and tighten. Introduce the ignition leads terminals into the holes of the distributor block according to ordinal numbers and hand tighten. Mount spark plugs to cylinder heads. Connect the wires. Spark plug wrench: P 137-106.

14.20. AIR SCOOP MOUNTING

Mount the P 137-276 dummy exhaust stacks to the exhaust holes at cylinder heads past gaskets.
Mount the upper and lower part of the air scoop to engine. On the test bench, use the P 137-142 summer technological scoop, or the P 137-143 winter one for 6-cylinder engines. Bolt the scoop by M4x12 mm screws with washers. Joint the lower part to cylinder heads by means of the long needle and lock.

14.21 ENGINE REASSEMBLY COMPLETION

Remove the dial from cranckshaft and the pointer for valve timing from the front cover. Tighten nuts past washers and secure. Install the key to the cranckshaft beveled end. Mount the propeller hub, previously ground to shaft. Tighten the Sh 0401 propeller hub by means of the V 506-0001 nut past the V 410-2103 washer and torque to 300-350 Nm. Use the P 137-110 and P 137-118 fixtures. Lock the nut by the V 506-0002 securing item. Perform Sh 0401 propeller

14.16. AIR CONDUITS MOUNTING

14.16.1. Connect the pump cooling hose to the injection pipes and attach it to the rear wall of the air scoop.
Connect the breathing hose to the injection pump.
Connect the hoses from the injection pump to the fuel adjustment valve and to the throttle.
On some model engines,the control cantilever with the fuel adjustment valve is mounted firstly.
Tighten hoses by means of PVC 55221 strip and Sc 5489 buttons.

14.17. CONTROL CANTILEVER MOUNTING

Mount the complete control cantilever on the oil sump using M6 nuts and washers.
Mount the fuel adjustment valve to the control cantilever- according to each model.

14.17.1. Connect the rod from the intake manifold to the cantilever clevis. Lubricate the clevis pin and introduce to rod, joint and tighhten the nut past the washer. Check rod for axial clearance with respect to clevis, L_{ax}=0.1-0.2 mm. Secure by 1x10 mm cotter pin.

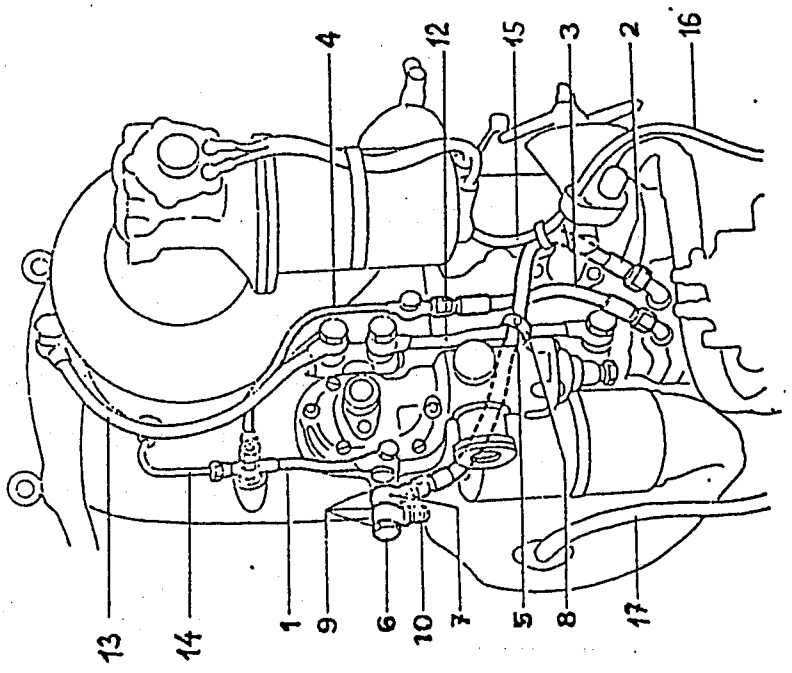
14.17.2. Loose the plug of the ball joint from the rod to the injection pump.
Set main control lever to open the throtlle and the correction lever to stop toward engine. Adjust rod length so that the lever on the injection pump dial be located at the step N-2. Following adjustment, lock both ball joint plugs by 1x15 mm cotter pins. Tighten the M5 securing nut. This is valid for engine models M137,M337.
Lubricate cantilever by means of a hand grease pump with LN-2 grease.
At model engine M332, adjust rod so that levers move from stop to stop.

14.18. DRIVE MOUNTING

Mount the generator support to the left side of cranckcase.
Mount the generator drive to cranckcase putting gasket

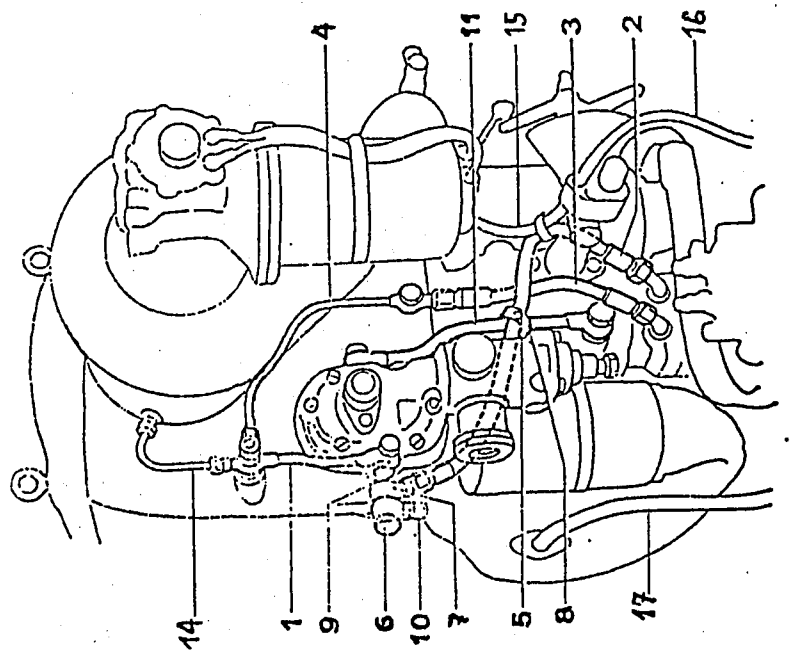
15. Sh 7039
16. Sh 7038
17. Si 7753

M337AK



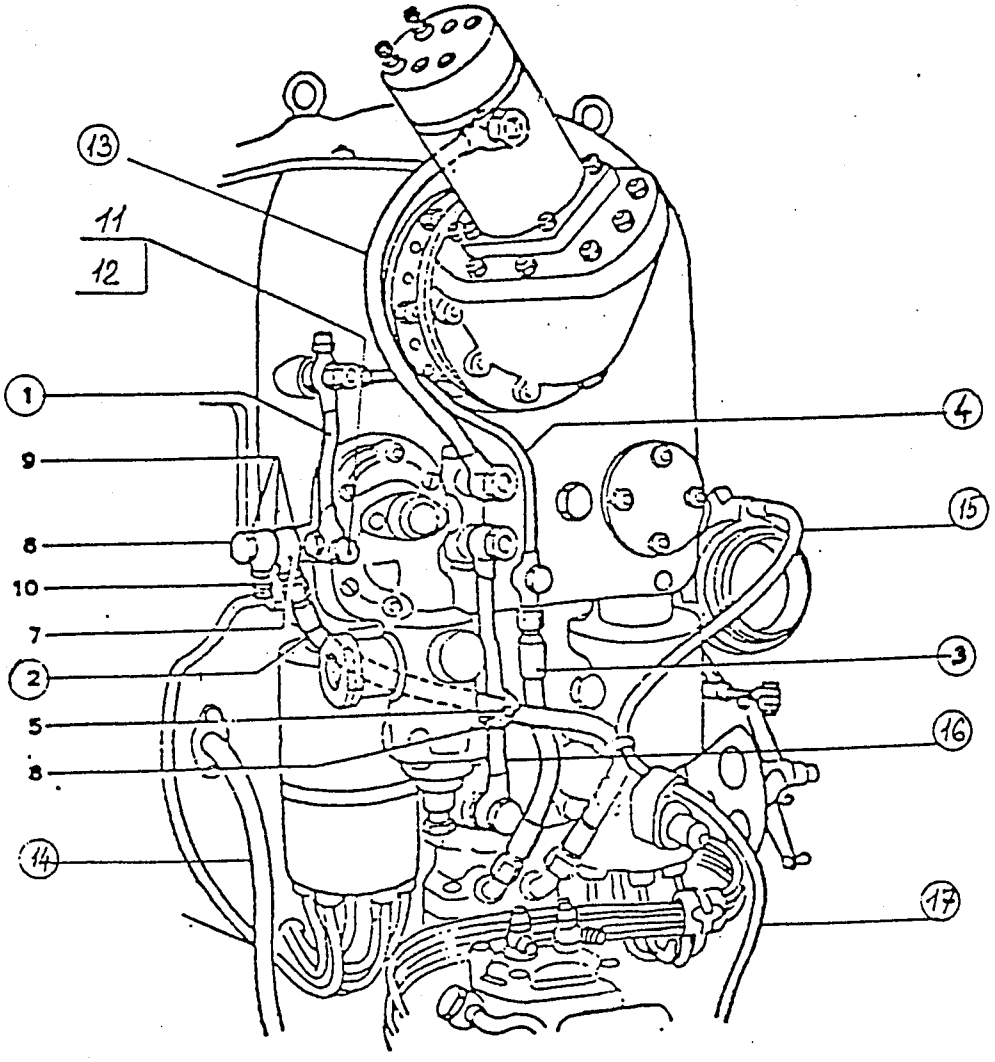
11. Sc 0621
12. Sh 0971
13. Sh 0973
14. Sc 0538

M337A



1. Sh 0622
2. Sh 0624
3. Sc 0625
4. Sc 0626

Fig. 14-5



1. Sh 0622 AK
2. Sh 0624
3. Sc 0625
4. Sh 0630
13. Sh 0972
14. Si 7753.
15. Sh 7037
16. Sh 0971
17. Sh 7038

Fig. 14-4

supercharged engines, mount the Sc 0538 line between pressure line and supercharger.

14.15.2. Mount a pressure line between return valve and hose ref. Sc 0625. Attach the line by means of the Sc 1517 hollow screw past the ϕ8x12 seal ring. Connect the hose to the pipe and then connect to the oil scavenge pump.

14.15.3. Mount the oil scavenge pipe with oil strainer past the ϕ8x12 mm seal to the top cover. Connect the pipe to the gravity valve by means of the screw ref. Sc 1554 and the ϕ18x22 mm seal. By means of the screw ref. Sc 1554 and of the ϕ18x22 mm seal, mount to the gravity valve and then mount the line with oil strainer past the ϕ16x20 mm seal to the oil sump.

NOTE:

At pumps without gravity valves there is no pipe between the oil pump and the top cover. Secure all fittings and nuts by ϕ 0.8 mm securing wire.

14.15.4. Mount the outlet hose between scavenge pump and oil pump. Attach it from the left to the first fitting of the oil pump.

Table (Hose Mount); Table (Pipe Mount)-fig. 14-3,14-4, 14-4a. Table 14-01. Table 14-02.

charger, connect the throttle control rod to the control cantilever and check the throttle for free movement over entire range. Connect the supercharger air inlet to the intake manifold. Reciprocally center the inlet tubes and tighten the nuts and the fixing strips. Mount the Yc 070 injection nozzle together with the Yc 0707 fuel eye-like fitting and washer to the inlet tube.

14.14. INJECTION SYSTEM MOUNTING

Mount the LUN 5150 or LUN 5150.1 pump to model engine M 137A,AZ and M 337A,AK.

Mount the pump 5152 to model engine M 337.

Mount the LUN 5151 pump to model engine M 332 and the LUN 5151.02 to M 332A.

Mount the Sc 3770 gasket manufactured from paranit type 5091.

14.14.1. Mount the Sc 3770 gasket (keep free the oil conduit) and the corresponding pump with drive spline to the driving gear of the camshaft. Mount the M6 nuts with locking.

14.14.2. Mount the nozzle to the fuel line terminal and than screw on to the intake elbow no.1. Connect the other terminal of the fuel line to pump by means of the socket nut. Mount nozzle no.2 with fuel line, attach the line sleeve with insertion.

Mount progressively other nozzles with lines and sleeves with insertions. Fasten the sleeves to holders by means of the M4x12 mm screws and the M4 nuts with washers.

Strighten lines so that the distance between different lines be 1-2 mm.

14.15. OIL SYSTEM MOUNTING

14.15.1. Mount the pressure line past the seal ring ref. 106 0271 using the joint nut M14x1.5 to the overpressure valve. The nut should be min.13 mm high. Connect the line to the oil pump by means of the hollow screw ref. Sc 6060 and of the ϕ14x18 mm seal.

At model engine M 137 plug the upper line fitting. At

elbow threads with oil and mount the manifold. Tighten the socket-nuts using the P 137-104 and P 137-105 wrenches. Mount the drain fitting to elbows, to them the connecting hoses and then the drain valves.

14.10. OIL PUMP MOUNTING

Mount the Sc 1516 gasket and the oil pump to the cranckcase. Oil conduit must be free, oil pump shaft must match the grooves of the drive gear. Bolt the pump by 4 M6x55 mm bolts with washers. Measure the clearance between the pump shaft and the drive swivel. L=0.5-1.25 mm. Achieve prescribed clearance adding gaskets.

14.11. HYDRAULIC PUMP FLANGE

Dress the Sc 1526 gasket and then mount the cover Sh 1586, washers and M6 nuts.

14.12. STARTER MOUNTING (M137)

Dress the Sc 1507 starter gasket on the studs of cranckcase. Measure the distance between the flange front including the gasket and ratchet gear of the cranckshaft. Measure the distance between the starter ratchet gear and starter flange front.Make a substraction between these two dimensions. The result gives the clearance between the ratchet gears. The prescribed clearance is L=1.6-2 mm. Mount the starter, tighten the nuts Sc 0152 past washers.

NOTE:

Coat the gasket prior to mount with Hyllomar compound.

14.13. SUPERCHARGER MOUNTING (M 332,M 337)

Measure the distance between the tooth top of the supercharger clutch and the toothing recess of the cranckshaft. Sum the thickness of the gasket. Prescribed clearance is L=0.5-1.8 mm.

Coat the gasket prior to mount with Hyllomar compound. Tighten the Sc 0152 nuts with washers.

14.13.1.Prior to attaching the air inlet manifold to the super-

E.g.:

Simmetric timing	*Timing setting 6° in advance*
IV opens: 20° IV closes: 60°	*IV opens: 26° IV closes: 54°*
EV opens: 60° EV closes: 20°	*EV opens: 66° EV closes: 14°*

14.7.4. Adjust progressively the clearance from all the valves by means of the adjusting screws.For IV V=0.25 mm,EV V=0.4 mm. Use the P 137-120 fixture and the P 137-108 wrench.Tighten firmly the setnuts. Lock the bolts of the camcase.

14.8. MAGNETO MOUNTING

Turn the cranckshaft to 12° BTC read on dial on the compression stroke. Install the gasket of the Sc 7419 adapter to the Sh 0744 magneto marked "P" and mount the magneto to the cranckcase. Perform mounting so that the short circuit terminal forms an angle of 30° in the exterior of the engine's longitudinal axis.

14.8.1. The magneto gear must match the driving gear while the distributor pointer must be positioned at the mark of the cylinder no.1.

14.8.2. Loose the Sc 7445 magneto adjusting screw through the hole in cranckcase. Attach one lead of the magneto control timing device to magneto ground and the second lead to the spring of the mobile contact of the breaker. Turn magneto to the breaking moment-the lights comes on. Tighten the adjusting screw. Tighten the magneto fixing belt screw. Verify the moment of breaking. Turn the cranckshaft to 10° BTC and simmilarly mount the left magneto.

14.8.3. Check the tooth clearance between magneto gear and driving gear. L_{tooth}=0.2-0.3 mm.
Measure clearance in three locations.
Mount the 8x12 mm seal rings and plugs to the holes for adjusting screw.

14.8.4. Pour 0.2 l of oil engine to each rocker. Mount the rocker plugs past seals and tighten using the P 137-082 fixture.

14.9. INTAKE MANIFOLD MOUNTING

Mount the air intake elbows to cylinder heads. Lubricate

with joints to the oil sump and couple it to the upper shaft.Mount the rubber collar together with the circlip to the oil sump neck.

14.7.2. Turn camshaft so that the key of the beveled gears be directed to the cylinder heads. Screw on the P 137-066 pilot bolt to cyliner heads. Mount the camcase to the cylinder heads and meanwhile couple the vertical shaft to the joint. Mount two flanges with seals to the scavange oil tube. Mount the tube to the front cover of the camcase. When mounting the camcase, the tube must have already been mounted to the camcase cover. Tighten uniformely the camcase to cylinder heads by means of the P 137-066 fixture. Fasten the scavenge oil tube flange to cranckcase using bolts M4x16 mm and to camcase using M4 nuts with washers. Tighten the Sc 3778 bolts with lockings,which are fastening the camcase. Tighten the circlip from the rubber collar.

14.7.3. Valve Mechanism Check.
Mount the Z3-00260-00 TDC indicator to the first cylinder. Mount the Z2-00172-00 pointer on the front cover and the P 10-0139 dial to the cranckshaft. Set the pointer to "0" according to TDC of the piston.
Adjust the clearance of both valves from cyl. no.1 to 0.25 mm by means of the P 137-108 fixture. Check the valve mechanism for correct timing using the P 137-004 indicator. The intake valve opens 25° BTC and closes 65° ABC. The exhaust valve opens 65° BTC and closes 25° ABC. It is important when checking the valve timing to adjust the the mechanism,so that the times be simmetrical with respect to the DC within the limit of max. 5° difference.
Remove the indicator.

NOTE:

The basic valve timing is achieved when the marks (the 6th tooth of the cylindrical gear and the 4th tooth of the beveled gear) match the tooth intervals from cranckshaft and from vertical shaft gear. The simmetry of timing can be better checked, when the valve clearance is set to 1 mm.

Mount the other pistons and cylinders. Use the driver Z2-00172-00.

14.6. PLACE the cylinder heads and verify to have the engine number. Select the gaskets of the cylinder heads so that the difference in thickness is not greater than 0.02 mm and install to heads.
Mount heads to cylinders. Check the surface for camcase basing for strightness using a rule set. Max.interstice is 0.06 mm. Replace head gasket if greater interstice.
Mount the P 137-007 rule set to the exhaust studs and align the heads. Torque heads to 30 Nm using the torque wrench with prolonger P 137-049.
Check the surface for camcase basing for straightness.

NOTE:

Use gaskets with thickness step difference of 0.3 mm to make the surface straight.

Fasten the gaskets to heads. Remove the rule set and obturate the exhaust flanges using the Sc 7815 plugs.
Introduce the shim Sc 2729 into the gasket notch from both sides of the head and bolt it.

14.6.1. Mount the intake side spark plugs using the P 137-106 wrench.

14.6.2. Mount the inter-cylinder baffles and fasten the stirrups to them, install the slots and secure them by means of the Sh 7692 cotter pin. Introduce the Si 7693 inter-cylinder deflectors from the exhaust side and mount the Sh 0790 baffle to the first cylinder.

14.7. CAMCASE REASSEMBLY
Put piston no.1 in TDC. Screw off the rocker adjusting screws from cranckcase.

14.7.1. Insert the Sc 3772 securing elements to the two joints of the shafts.Mount joints on the grooves to both ends of the Sh 1421 vertical shaft. Mount the joints with longer grooves to the Sh 1421 shaft. Mount the shafts together

Install the splashing ring and the nut on the cranckshaft front journal. Tighten using the P 137-002 wrench and lock the nut.

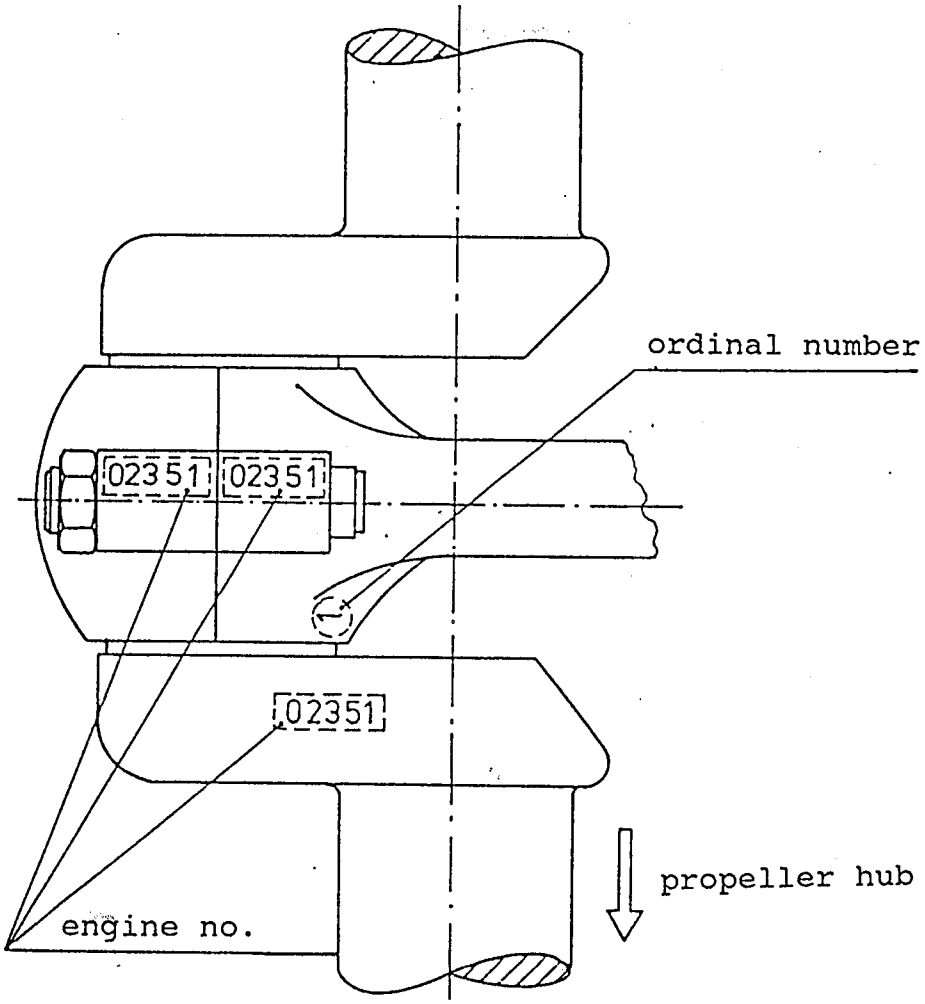
14.3.2. If the cover Sh 4016 of the pressure bearing is mounted to the front cover, it is necessary to measure how much the the ball bearing overhings the plane of the front cover mating surface and of the recess in bearing cover. Select the thickness of the Sc 4008 gasket so that a pressure fit P=0.00-0.04 mm be achieved.
Mount the gasket and the cover of the pressure bearing with the 62x90x13 oil seal to the front cover. Tighten the M6 nuts past washers.

14.4. REVOLVE the engine the upper cover down.
Fasten the rear cylinder baffle to the rear wall of the air scoop.
Fasten the two hinges to the baffle of the first cylinder. Mount the airscoop rear wall to the oil sump. Fasten the two holders of the rear wall to cranckcase and mount the rear wall.

14.5. PREPARE pistons, piston pins and cylinders on a clear beanch.Install one piston pin retainer ring to each piston using the Z3-00170-00 fixture. Verify parts to bear the engine number. Place the gaskets on the cylinder base flange. Coat gaskets with Hyllomar. Coat the sliding surfaces of cylinders and connecting rods with oil. Heat the piston to 70°C. Shrink the piston pin and assemble the piston with the last connecting rod. Mount the second piston pin retainer. Rotate rings to have the gaps at 90° intervals, press the rings using the 3068-Z fixture. Mount the cylinder.

NOTE:

Mount the pistons and the cylinders to have the number toward the front cover.



cotter pin locking

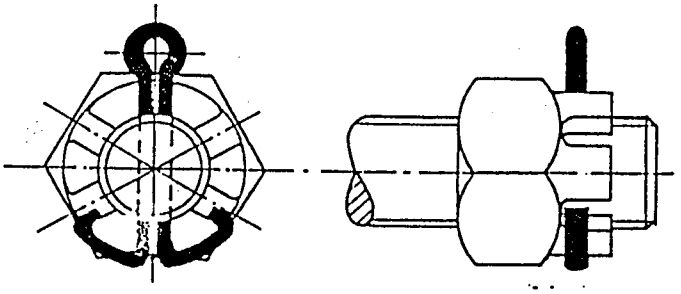


Fig. 14-3

14.2.1. Turn the central gear with the marked tooth toward the bearing insert concavity. Set the cranckcase into the insert, so that the two marked teeth of the shaft gear match the similar marked tooth of the central gear. Mount the bearing caps with the other inserts and tap to position. Install the nuts with washers and slightly tighten.

NOTE:

Prior to mounting, coat both bearing inserts and cranckshaft journals with engine oil. Tighten alternatively the nuts of the bearing caps beginning from the middle of the line on the right side as viewing in the direction of flight.

Progressively torque the bearing cap nuts to 34 Nm and meanwhile make the holes for cotter pin correspond. Check the cranckshaft for free rotation. Secure the nuts with 2.5x20 mm cotter pins.

See Fig. 14-3

14.2.2. Mount the 14 transversal bolts with washers and selflocking M7 nuts. Torque the bolts to 9.2 Nm. Check cranckcase for free rotation.

14.2.3. Coat the gaskets of the lateral covers with Hermosal and then mount them together with the covers to the cranckcase. Mount M5 nuts past washers and tighten.

14.3. CLEAN the mating surface of the upper cover. Place the gasket and the cover on the cranckcase. Install plain and elastic washers, the M6 and M8 nuts and tighten. Cut off overhang gasket.

14.3.1. Heat the front cover with bearing to 80°C.Coat the bearing with oil and shrink the cover past the gasket onto the cranckshaft by means of the P 137-402 fixture.

NOTE:

With decrease of clearance,stick the bearing using Loctite.

Mount the Sh 3322 washers and the Sh 3323 nuts to the studs and torque to 7 Nm. Fasten the front cover to the upper cover using M8x22 screws with washers.

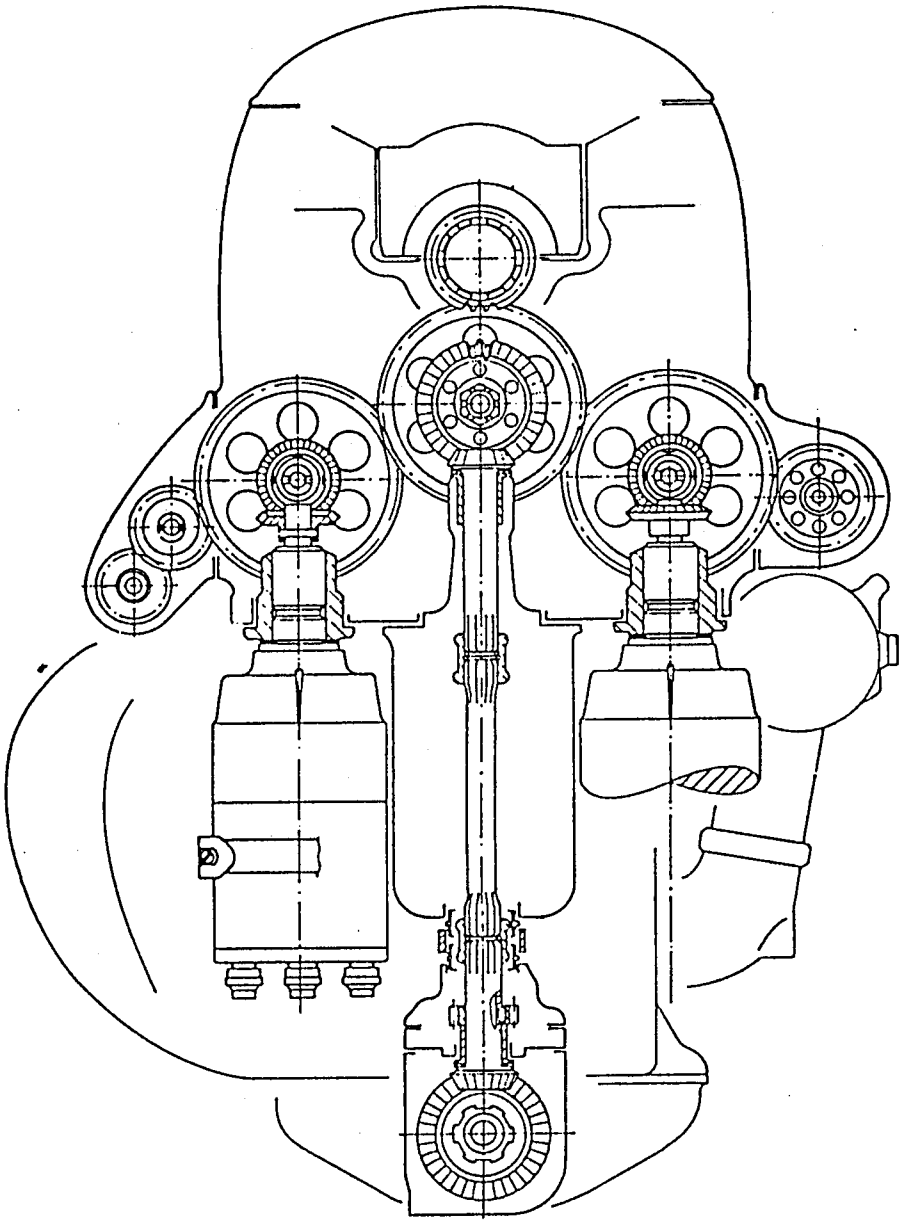


Fig. 14-2

Mount back the countershaft with gear to the housing. Repeat measurement.

14.1.5. Mount the Sc 1410 adapter to the Sh 0148 vertical shaft and insert into the bushing of the oil sump. Mount the sump with gasket and shaft to the crankcase and tighten. Check beveled gears for clearance of toothing: L_{tooth}=0.15-0.20 mm (0.25 mm max.). Measure the clearance at three locations; limit clearance by suitable Sc 1055 or Sc 1410 shims. Dismount the sump.

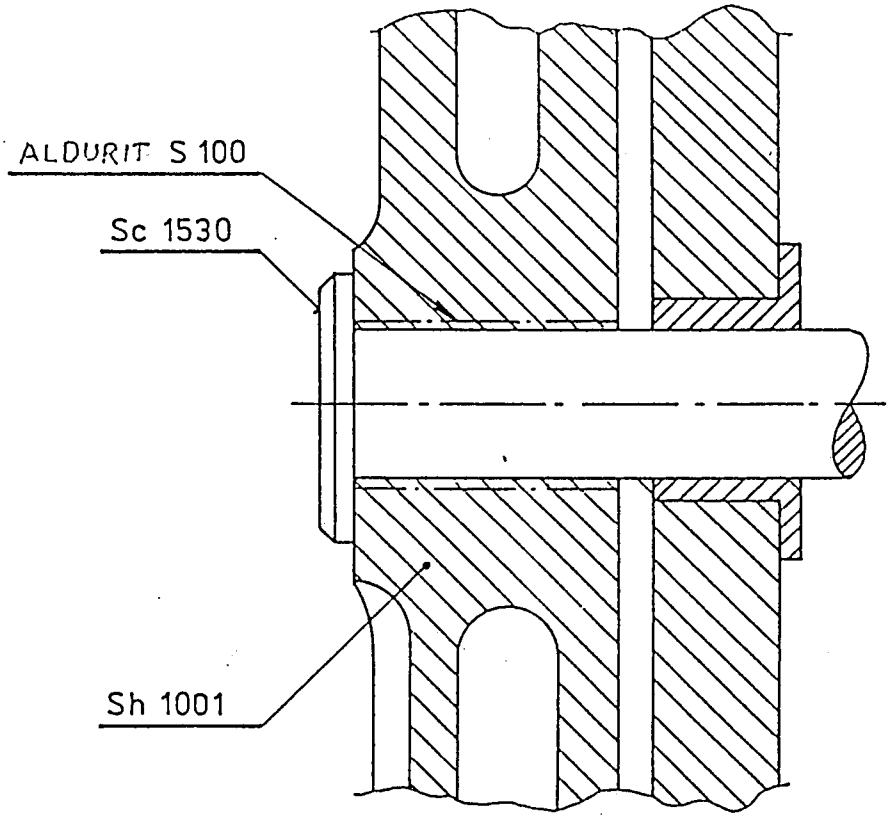
14.1.6. Mount the generator drive. Measure the tooth clearance between the countershaft gear and the drive:L_{tooth}=0.1-0.2 mm (max. 0.25 mm). Adjust clearance by mounting a suitable Sc 9027 or Sc 9073 gasket. Mount the RPM indicator drive. Measure the teeth clearance between the countershaft gear and the drive: L_{tooth}=0.1-0.2 mm (max. 0.25 mm). Adjust clearance by mounting a suitable Sc 9072 or Sc 9073 shim.

14.1.7. Remove the technological bushing with th Sc 1055 shim from the central gear. Mount the Sc 1046 bushing with shim. Press bushing with the longitudinal groove directed to the bearing insert.Use the P 137-121 and the P 137-122 fixtures. Mount the Sc 1531 bushing, the Sc 1532 bushing with the recess directed to the crankcase and the gear to the shaft. Tighten the nut and lock by means of a 3.2x25 mm cotter pin. Lock the wheel nuts from the countershafts.

14.1.8. Mount the oil sump with gasket, the adapter and the shaft. Tighten. Check the tooth clearance.

14.2. CRANKSHAFT MOUNT

Place the cranckshaft on the Z3-01395-00.Wipe the journals and the main bearing inserts with leather.Mount the bottom bearing inserts to the cranckcase. Place the bearing insert no.1 in the first bearing with the number on the right side viewing in the direction of flight.
Mount the remaning inserts observing their numbering.



Stick countershaft after teeth clearance check
Fig. 14-1

14.1.2. Mount the left magneto with gasket,tighten and measure the tooth clearance from the Sc 1541 beveled gear. L_{tooth}=0.15-0.2 mm (max. 0.25). Achieve the prescribed clearance by replacing the Sc 1538 shim.

14.1.3. Mount the right countershaft and repeat the procedure from 14.1.1. and 14.1.2.

14.1.4. If the locking orifices in countershaft and nut are not corresponding after torquing to the prescribed moment, dismount the nut and the wheel using the P 137-087 fixture, remove the shaft and torque the assembled sub-assembly - shaft, shim, wheel and nut - to 60-65 Nm in the P 137-016 fixture. Remove from fixture and drill together with respect to the nut up to the half of the ϕ1.3 mm pin in the P 137-005 fixture.

NOTE:

The thickness of the material between the old and new holes should be at least 3 mm. Chamfer sharp edges.

14. ENGINE REASSEMBLY

MOUNT 4 brackets ref. P 30-0154, P 20-0116 corresponding to engine model to the cranckcase. Place aluminium shims Sc 8825 between brackets and cranckcase. Brackets wall thickness must be 10 mm. Fasten each bracket by means of 4 bolts M8x20. Torque the bolts to 10-12 Nm. Install the case on the Z1-01501-00 mounting stand and fasten it.

NOTE:

Before mounting each part, coat their sliding surfaces with engine oil.

14.1. REASSEMBLY OF THE GEARS OF THE VALVE OPERATING MECHANISM

Check the gears Sc 0103 and Sh 0148 to bear the same assembly number. These gears must be reciprocally runin. Mount the Sc 1530 countershaft of the central gear.

NOTE:

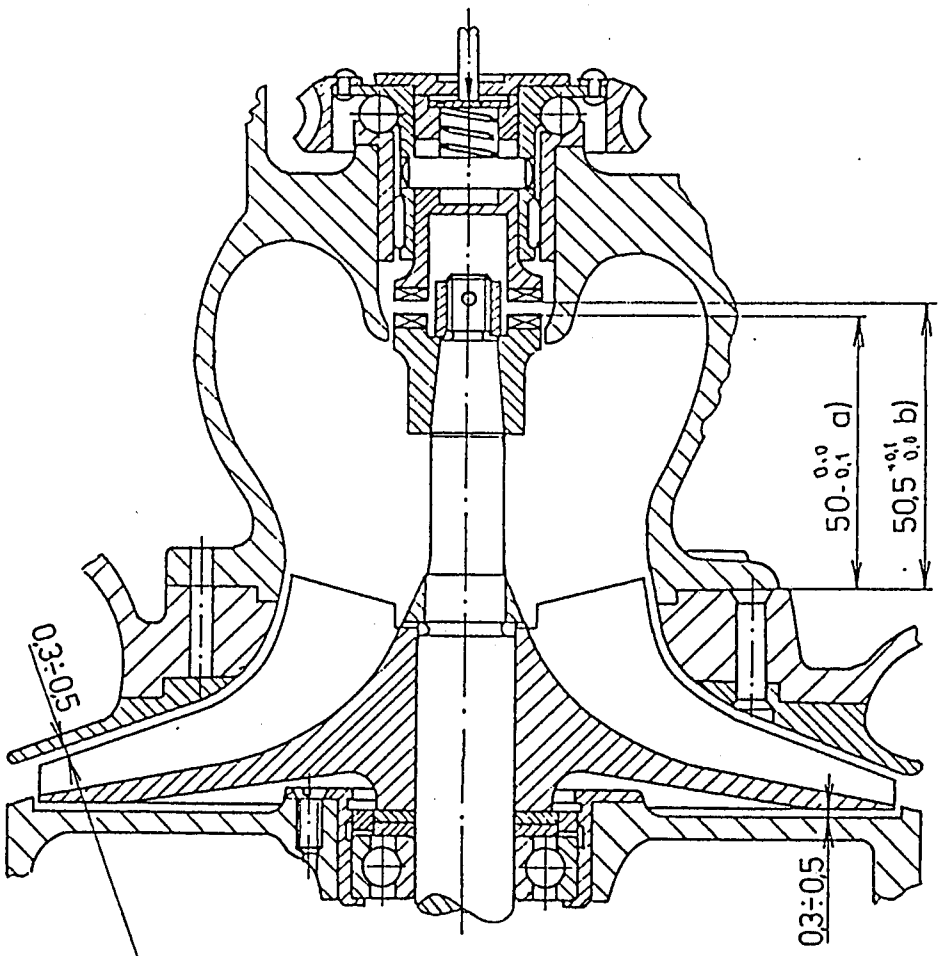
If the pertinent diameter in the cranckcase exceeds $14^{+0.018}$, stick the countershaft using the compound ALDURIT S100 or Loctite, provided that the clearance does not exceed max. 0.08 mm.

See *Fig. 14-1*

Mount the distance shim to the P 139-109 technological bushing and then mount to the Sc 1530 countershaft pressed in cranckcase.Mount the washer and the nut to the gear and tighten by means of the P 137-083 wrench.

14.1.1. Mount the left Sc 1537 countershaft. Mount the Sc 1538 distance shim, the cylindric gear and the beveled gear. Use the P 137-116 fixture for secure tightening. Torque the Sc 1542 nut to 60-65 Nm using a left acting torque wrench and the P 137-116 prolonger, so that the orifices for locking correspond. The nut is left threaded. Install the dial gage fixture and measure the tooth clearance.L_{tooth}=0.1-0.2 mm (max. 0.25 mm) - measure the clearance at four locations.

for free operation for 10 sec.



a) From supercharger flange
b) From starter flange

Fig. 13-3

13.9.4. Adjust the displacement of the core of coil at $40^{+0.2}/_{-0.1}$ mm by means of nut from the coil stem. Solder nut after adjustment.
Extract the adapter. Place the cover on starter case and tighten. Verify the clearance, L=0.1-0.3 mm between the engageble ratchet gear and the coil core, while displacing the core. Remove the cover. In order to achieve the prescribed clearance, file off the soldering area of the nut or free the nut, adjust displacement and solder again.

13.9.5. Insert new insulating grommets to the cover passage holes for bolts. Mount screws,insulating washers and nuts to the cover. Connect the coil terminal and secure by nut and washer. Install the adaptor to the case.

13.9.6. Install the cover to the starter case and tighten the screws. Check worm gearing for free movement.
Measure the distance between the tooth top of the engageble ratchet gear to the mating surface of the starter case, l=50.7 mm max.

13.9.7. Unscrew the bolts from the upper and rear cover,remove the rear cover. Pour 200 ml of oil mixture, BTS with MS-20 , mixing ratio 2:1. The worm wheel and the adaptor should be immersed. Set the cover and tighten the bolts. Mount the protection to the rear cover.

13.9.8. Connecting Wire Mounting.
Cut connecting wires to 260 mm and 230 mm long. Strip ends for 5-5.5 mm. Cut 4 pieces of insulating hoses 40 mm long. Pass the insulating hoses past wire terminal and solder the terminal lugs. Apply a film of varnish C 1005. Pass all wires together through an insulating tube, 170 mm long. Mount insulating caps to lugs and rubber protection to the terminals.

13.9.9. Install the electromotor with gasket to the case flange and tighten the nuts past the washers. Connect the lugs of the wires to the terminals of the cover and of the electromotor by means of nuts and washers.

13.9.10. Put a 27.5 V voltage to the electromotor and and check it for free operation for 10 sec.

mating surfaces, recondition damaged surface protection.
Coil with bushing - dress out scores, dents, corrosion.
Connecting wires - replace deformed terminal lugs.
Replace damaged and hardened insulation.

13.9. STARTER CASE REASSEMBLY

Insert the plug with the collar inside into case by the side of the electromotor and tap till stop.Insert the plug adaptor and secure by means of the a locking ring.

13.9.1. Measure the distance from the basing surface for the rear cover up to the upper edge of the race bushing for balls and needles;l=15.5 mm. Press an other race using the P 137-438 drift if this dimension is not realised.
Insert the spring into the engageble ratchet gear and press it to bottom.Insert ratchet gaer into the worm wheel hub and lock by pin. The spring must be located between ratchet bottom and pin. Check the ratch for free movement. Coat the groove and the hub base with grease Tziatim 201. Place the 36 needles into the grooves and 16 balls on the hub base. Insert the worm wheel into the starter case to stop.

NOTE:

Prior to insert the worm wheel,coat needles and balls with grease. Coat with grease bushing recesses and holes too. Fill with grease the worm bearing.

13.9.2 Mount the splashing ring to the worm shaft, press the bearing and secure by an elastic washer. Mount the worm to stop. Verify the clearance between the worm and worm wheel toothing. L_{ax}=0.05-0.1 mm. Install the cover with gasket to the worm gear housing and tighten the screws.

13.9.3 Mount the oil control plug gage together with the sealing ring to the starter case. Install the adapter to the worm wheel. Measure the dimension between the case basing surface for the rear cover and the upper surface of the adaptor. Place the gasket on the cover. Measure the dimension between the coil bushing front and the cover mating surface.The dimension between coil and cover should

Galling of the coil core, seizing - reject.
Deformation, bad damages - discard. Damaged terminal - discard.
Scoring, corrosion, peening - dress out.
Starter case cover, $\phi 30^{+0.021}$ P=0.001 - 0.043 mm
Coil with bushing, $\phi 30^{+0.043}/_{+0.022}$
Adapter.
Scores, light cuts - dress out.
Spring.
Free length 9.5±0.8 mm - otherwise discard.
Engageble ratchet gear.
Light nicks - dress put. Loose rolling - reject. Wear, chipping, peening, corrosion - reject.
Check for cracks applying the magnetic method.
Starter case and worm housing cover.
Cuts and damages on surface up to 0.5 mm deep - dress out.
Mating surface - dress out. Chafing of bolt holes up to 0.5 mm - dress out.
Plug shim.
Deformation, mutilated thread, corrosion - discard.
Connecting wires.
Cuts, badly damaged conductors - discard.
Deformed terminal lugs - replace. Damaged insulation - replace.

13.8.3 Repair

Starter case - dress out mating surfaces, scores, cuts, deformations. Calibrate damaged threads using M4,M5,M6 taps. Recondition the surface protection.
Starter worm - dress out light damages.
Worm wheel - dress out light scoring and peening of the teeth.
Loose rivets - drive by means of a rivet snap.
Chamfer sharp edges of teeth.
Engageble ratchet gear - dress out light scuffing and peening of the teeth.
Starter case and housing cover - dress out damages on the mating surfaces, recondition damaged surface protection.

curing ring and extract the bearing with splashing ring using the P 20-1216 fixture.Extract the worm wheel by means of the P 337-482 fixture together with the ratchet gear, balls and needles.Tap out the pin, remove the ratchet gear and the spring.

Take out the shaft obturator from the starter case using the P 337-488 drift and unscrew the oil contol plug together with the sealing rings.

13.8.1. Clean all parts in gasoline.

Wip only the coil and the cover with a cloth dipped in gasoline. Clean the connecting wires with spirit and dry.

13.8.2. Inspections.

Starter case.

Cuts and bad damages on the surface up to 0.5 mm deep - dress out.

Damages on mating surfaces - dress out.

Damaged threads - repair, replace.

Case, $\phi 30^{+0.008}/_{-0.005}$ P=0.005 - L=0.017 mm

Bearing, $\phi 30$

Check for cracks applying the fluorescent method.

Starter worm.

Light scores, peening - dress out.

Evidence of galling, staining, wear, chipping, corrosion - reject.

Worm, $\phi 10^{+0.01}/_{0.001}$ P=0.001 - 0.020 mm

Bearing, $\phi 10$

Check for cracks applying the magnetic method.

Worm wheel.

Evidence of galling, staining,chipping, corrosion - reject.

Light scores and peening- dress out.Loose rivets - repair.

Gear, $\phi 18^{+0.018}$ L=0.03 - 0.052 mm max. 0.07 mm

Ratchet gear,$\phi 18^{-0.016}/_{-0.034}$

Gear, $\phi 18^{+0.018}$ L=0.05 - 0.138 mm max. 0.150 mm

Adapter,$\phi 18^{-0.05}/_{-0.12}$

Check for cracks applying the fluorescent method.

Coil with bushing.

Winding resistance out of limits $14^{+1}/_{-0.8}$ (measure by an

tures 8-95-Sc 0053/8, 8-95-Sc 0053/7, 8-95-Sc 0053/9, 6-94-Sc 0053/15 and a securing drift.

13.7.3. Mount the ratchet gear to the shaft. Check the dimension $50^{+0.5}/_{-0.1}$ mm between the mating surface and the ratchet gear front. Check the pin for runout,max.0.05 mm. Dismount the ratchet gear.
Clean, degrease and remount the Sc 5395 ratchet gear and tighten the Sc 5396 nut. Check ratchet gear and flange to be coaxial. Admitted runout is 0.15 mm. Lock the nut using 2.3x12 mm flexible pins. Flare both ends.

13.7.4. Install the cover and the scroll past the Sc 5386 gasket on the assembled gear housing. The shaft teeth must match the planet gears teeth. Equip the 10 studs and the 2 bolts in the housing with plain and elastic washers and tighten the M5 nuts in turns.

13.7.5. Put the Sc 5402 starter gasket (A=0.2 mm,B=0.3 mm) over the studs of the scroll to achieve the prescribed loose fit between the ratchet gears of the compressor and of the starter,L=0.6-0.9 mm.The distance between ratchet gear and supercharger flange is l=50-0.1 mm and between ratchet gear and starter flange is l=50.5+0.1 mm.

13.7.6. Mount the starter and the plain and elastic washers and the M5 nuts. Tighten nuts. Mount the Sc 5397 oil inlet fitting including the 10x14 gasket and plug it.

13.7.7. Check the supercharger and starter for proper operation.

13.8. STARTER

Disconnect the cables from the electromotor.Screw off nuts with washers ans remove the electromotor. Unscrew the screws and and remove the cover of the starter case together with the gasket. Remove the protection from case cover,unscrew the bolts and nuts and extract the insulating bushing (leave the coil in cover).
Unscrew bolts and remove the cover of the worm gear housing including the gasket, the securing ring and the pad of the protection. Pull out the worm with bearing. Remove the securing ring and extract the bearing with splashing ring

cover L_{ax}=0.05-0.1 mm. Assure the prescribed clearance selecting a suitable outer ring of the protection.

13.6.5. Supercharger Impeller Measuring and Mounting.

Place the housing cover on the blocks on a tracing plate. Install the impeller in the cover. Insert the P 40-0532 auxilliary measuring gage into the impeller. Place two sealing ring supports (2;2.1;2.2 mm thick rings) under the impeller. Measure the fit using a dial gage, loose fit L_{ax}= 0.5-0.55 mm.

Compute the measured fit and adjust if necessary by replacing the supports. Introduce the P 40-0532 drift into the impeller and the cover of the gear housing. Check mating surfaces for reconditioning, assemble the cover and the supercharger scroll by tightening the 4 nuts.

Place the assembled housing on blocks. Releasing the drift, measure the axial clearance, L_{ax}=0.5-0.55 mm. Limit this loose fit using suitable distance shims. Disassemble all.

13.7. FINAL SUPERCHARGER REASSEMBLE

13.7.1. Install the adapter with the flange facing the shaft toothing onto impeller shaft in the direction from threading and press the assembled housing cover by means of the 6-94-Sc 0053/15.

NOTE:

Press the cover using the ϕ20 mm tube, putting the pressure on the inner race of the bearing. Check the ball bearing for proper contact with the splashing ring.

Prior to mount, check the bearing for axial loose fit: 0.12- 0.16 mm and radial 0.018-0.03 mm.

13.7.2. Mount the support ring of the sealing ring with the plain side facing the bearing, then insert the sealing ring and the second collar and tap for proper mounting. Check for free rotation.

Heat the impeller at 120°C-140°C and shrink it onto the shaft and tighten by means of a tube wrench with thread. (Prescribed shrink fit impeller to shaft is 0.02-0.039 mm). Following cooling, mount the Sc 5399 locking item, the

Flatten the braking belt with respect to the bell gear, insert the braking belt end piece into the clevis and secure by the pin.
Install a distance shim to the plug.Meanwhile fit the flat end of the pin to match the groove in the plug and then tighten the plug.

NOTE:

The groove in the plug should be parallel to the brake lever pin. This can be achieved by selecting a suitable distance shim.

Secure the braking lever using the screw with washer and both using ϕ0.8 mm lock wire.
Insert the sealing ring, the adjusting screw and screw it on to the belt pin.
Pull out the lever till stop in the opposite direction of the clutch and mount the spring with the longer end winding at the lever pin and the shorter one at the housing pin.
Coat the bushing in the supercharger housing with oil.
Install the bell gear and check for free rotation.
Coat the bushing in the bell gear with oil, install the driving shaft with the planet gears and check for free movement.
Check toothing for clearance; L=0.2-0.3 mm, max. 0.35 mm.
Fasten the driving shaft onto the P 30-0268, mount the clutch, the shim and the nut and tighten by means of the UN-72-1144 wrench.Limit the axial clearance to L_{ax}=0.1-0.5 mm, check for free rotation, secure the nut by a 3x22 mm cotter pin.

13.6.4. Sc 0582 Housing Cover Mounting.
Insert the oil inlet ring into the bushing of the housing.
Place the cover on a special pad and press the ball bearing by means of the P 30-0271 drift.
Insert the protection outer ring with grooves facing the bearing into the bushing and secure by a locking ring.After the bearing has reached the outer ring of the protection, measure the axial clearance of the bearing against the cover L_{ax}=0.05-0.1 mm. Assure the prescribed clearance

Fig. 13-2

Measure a 0.2 mm clearance between the collar of the rear mount and the bore of the front mount using a card gauge. Secure the lockings.

13.6.2. Sc 0595 Driving Shaft Mounting.

Wipe the components of the driving shaft using leather. Fix the shaft in a vice with soft chucks.

NOTE:

Verify the top tooth diameters of the bell gear, planet gear and of the supercharger impeller shaft.

	New Design	Old Design
Impeller shaft	top tooth ϕ = 25 mm	top tooth ϕ = 24 mm
Planet gear	- " - = 57 mm	- " - = 58 mm
Bell gear	- " - =123 mm	- " - =124 mm

Different parts are interchangeable only with respect to the design.

Coat shaft swivel with soluble grease. Install corresponding planet gears onto pertinent swivels. Mount 25 needles to each planet gear (max. needle diameter difference at the same planet gear is 0.005 mm). Mount the shim with nut. Measure the axial clearance of the planet gear.

L_{ax}=0.15-0.35 mm,max. 0.5 mm.

Required planet gear radial clearance is L_{rad}=0.03-0.05, max. 0.08 mm. Mount the second planet gear.

Lock the shaft nut by means of a 3x16 mm elastic pin or a 3x20 mm cotter pin. Check for clearance after locking.

13.6.3. Sc 0531 Gear Housing Mounting.

Insert the brake lever equipped with the pin and the washer. Pull out the lever till stop in the opposite direction of the clutch and screw on the belt clevis, so that a 1 mm gap remain (between the clevis face and the edge of the securing screw notch). Check for axial clearance between the supercharger control lever and the bushing inside the supercharger body, in mounted condition, while the braking belt

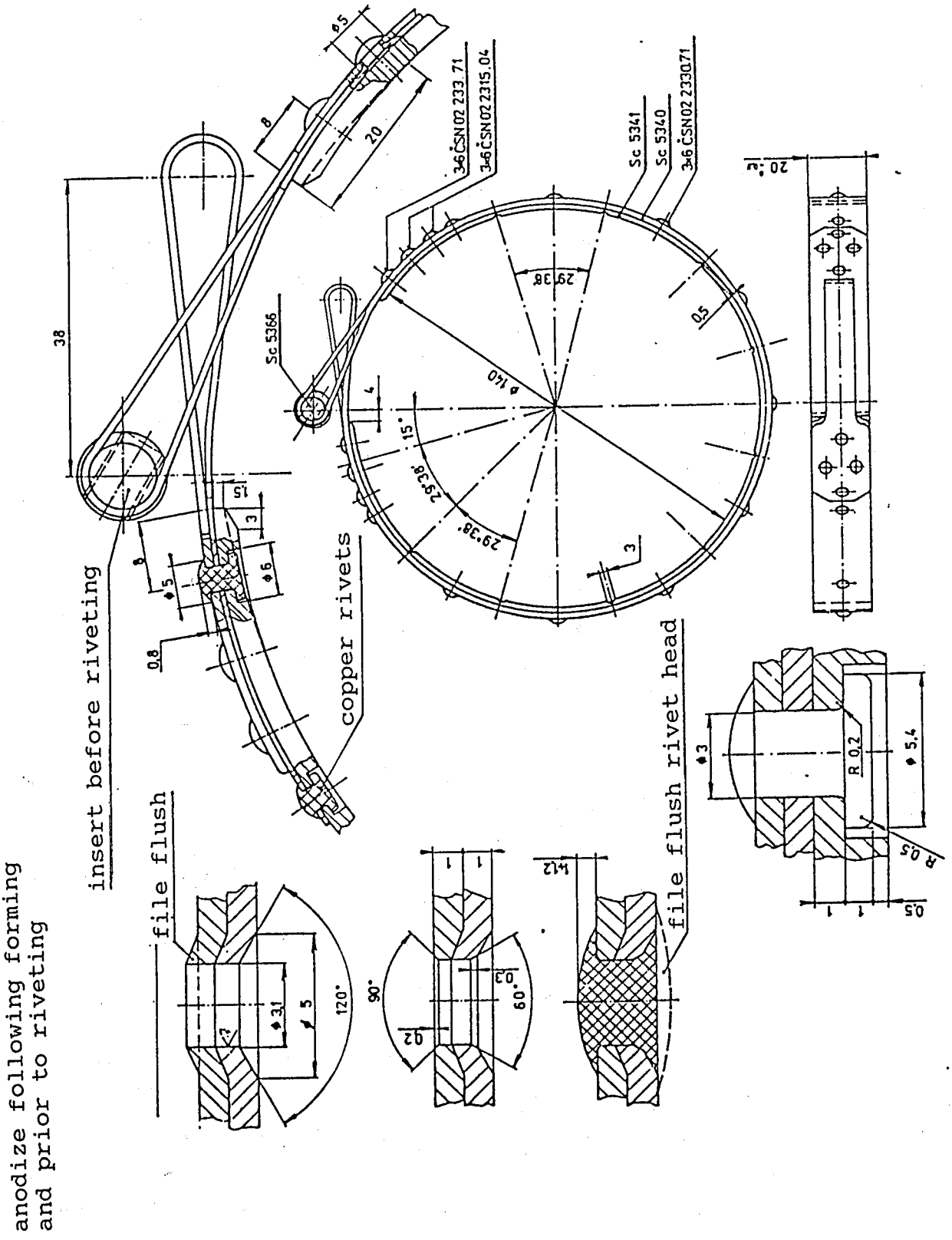

anodize following forming
and prior to riveting
insert before riveting
file flush
copper rivets
file flush rivet head
Sc 5365
Sc 5341
Sc 5340
3+6 ČSN 02 233 71
3+6 ČSN 02 2315.04
3+6 ČSN 02 2330.71
38
20
29°38'
15°
90°
60°
120°
R 0.2
R 0.5

Fig. 13-2

Install the Sc 5394 and check its mating surface for run-out with respect to the thread - max. runout 0.5 mm. Polish the ϕ16.8 mm, ϕ17 and ϕ10 mm using lapping paper. Measure the top tooth diameter, $\phi 25_{-0.1}$ mm. If the top tooth diam. is $24_{-0.1}$ mm,discard the sub-assembly composed from even dimension gearing.Mount always odd diameter parts.

13.5.10.Sc 5343 Brake Lever.

If the Sc 5374 lever swivel is damaged, dismount both pin and swivel. Measure the ϕ10 bushing and swivel. Fit,loose L= 0.008 to pressure P=0.027 mm. Heat the lever and shrink the swivel.Fasten the lever in the P 30-0268,drill a ϕ3.9 mm hole and ream to $\phi 4^{+0.012}$ mm. Deburr,tap a 4x25 mm elastic pin and secure by flaring the ends.

13.5.11.Sc 0536 Braking Belt.

Braking pads replacement - drill out rivets and remove pads. Grit blast corroded belt and oxidize. Round the pads and work flat with the braking belt. Drill together pads and rivet using 3x6 mm rivets. Remove burrs and adjust pad length to 20 mm. Machine 9 grooves along circumference $0.5^{+0.1}$ mm deep.

13.5.12.Sc 5357 Shock Absorber Flange.

Dress out nicks,scores, scuffing. Calibrate the M5 thread.

13.5.13.Clutch Mount.

Dress out light damages at the mating surface and torn areas of the grooves.Recondition the surface protection if necessary.

13.6. SUPERCHARGER REASSEBLY

13.6.1. Clutch Reassembly.

Set up shock absorbers so that the max. thickness difference is 0.2 mm.Progressively install the shock absorbers into the holes of the front mount and tighten the screw over the securing and the thin washer.

Install this sub-assembly onto the 6-94-Sc 0053/14 fixture.Place the rear mount and tighten the screws over washers.

ellbow tube nut by means of a M68x2 tap. Dress out scores and nicks up to 0.4 mm from the scroll surface showing smooth passage to the surrounding material. Pasivate the surface following reconditioning.

13.5.5. Driving Shaft.

Dress out light damages, check the swivels for planet gear needles and the sliding gear, dress out damages and buff. Damaged Sc 5377 bushing.Remove locking,extract the bushing using an extractor.Select a new bushing,so that a pressure fit P=0.00-0.01 mm result against the ϕ13 hole and a loose fit L=0.04-0.05 mm result against the supercharger impeller shaft. Press the bushing and lock it.

13.5.6. Planet Gears.

Dress out light damages and peening of the teeth. Recondition the $\phi 18^{+0.121}/_{+0.100}$ mm using lapping paper. Swivel-planet gear radial fit L=0.03-0.08 mm. Classify the needles within a tolerance range of 0.005 mm.

13.5.7. Bell Gear.

Clean grooves located on the ϕ140 mm area, chamfer sharp edges and lap.Recondition the bushings and polish. Measure the distance between bushing ends $l=62^{-0.1}/_{0.2}$ mm. Bushing fit with respect to the ϕ25 mm: P=0.00-0.01 mm. Stick bushing in case of loose fit up to 0.025 mm. Replace the Sc 5376 bushing if the length decrease exceeds 0.3 mm. Check the lubricating orifices for free passage. Measure the tooth top diameter=$\phi 123^{+0.1}$ mm. The original design is $\phi 124^{+0.1}$ mm. The parts are not interchangeable. Always set up a sub-assembly of odd dimension parts.

13.5.8. Recondition and straighten on a straightening plate the mating surfaces of the rings,protections and washers using lapping paper. Maintain parts dimensions according to the dimensional inspection.

13.5.9. Supercharger Impeller Shaft.

Dress out peening of the teeth,light damages.Calibrate the M15x1 mm and M8 threads.Lap reciprocally the taper and the corresponding ratchet gear using lapping compound 600. Install the Sc 5394 and check its mating surface for

13.5.2. The Sc 5309 Bushing Replacement.

Dismount the defective bushing including the pin. Drill a $\phi 13^{+0.018}$ mm hole. Mount the bushing observing a pressure fit of P= 0.02-0.03 mm.Stick the bushing by Loctite if the loose fit is up to L=0.05 mm. Heat the housing at 80^{o}C and shrink the bushing.Drill a common $\phi 2$ mm and $10^{+0.2}$ mm long hole for pin through the housing and the bushing. Drill through at an angle of 45^{o} or 180^{o} with respect to the initial hole.Lock by means of a pin and lathe to $\phi 10^{+0.015}$ mm. The shaft to bushing loose fit L=0.013-0.06 mm.

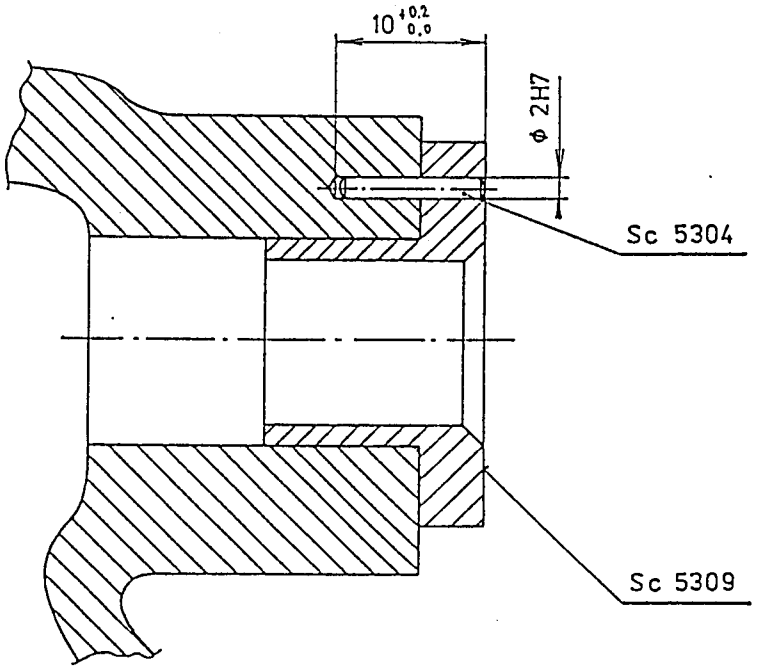


Fig. 13-1

13.5.3. Housing Cover.

Recondition and repair mating surfaces. Replace damaged bushing, remove loose screws, replace by new ones and stick. Repaint.

13.5.4. Supercharger Scroll.

Repair and recondition mating surfaces. Replace damaged

Check for cracks applying the magnetic method.

13.4.23. The Sc 5389 Bearing.
Check for axial and radial clearance according to "Tolerances and Fits".

13.4.24. Planet gear needle 2x16-ϕ2 mm - the incremental factor of planet gear set of the ϕ2 mm class is max. 0.005 mm.

13.4.25. The Sc 5351, Sc 5354 Clutch Spline.
Damaged surface protection - remake.
Mating surface scuffing up to 0.5 mm deep - dress out.
Damages on other surfaces up to 0.1 mm - dress out.
Check for cracks apllying the magnetic method.

13.4.26. The Sc 5383 Nut.
Badly damaged M12x1.5 mm - reject.

13.4.27. The Sc 5321 Sealing Ring Support.
Ring thickness 1.8-2 mm - dress out .

13.4.28. The Sc 5384 Washer.
Thickness 1.5 mm - dress out scoring.

13.4.29. The Sc 5374 Brake Lever Axle.
Cuts, damaged grooves - discard.
The M10 special left thread with 10 helixes - if badly damaged, discard; dress out light damages.
$\phi 10^{-0.013}/_{-0.028}$ mm - dress out light damages; the fit: L=0.008 - P=0.027 mm.

13.4.30. The Sc 5373 Brake Clevis.
Damaged M10 thread - discard.
Cracked - discard.

13.5. SUPERCHARGER REPAIR

13.5.1. Supercharger Gear Housing.
Dress out all scores, nicks, sharp edges from the matings surfaces. Calibrate stud threads, or replace damaged studs. Replace defective seals under fittings. Dress out light damages in the bores of busings using lapping paper.
If the Sc 5309 bushing shows nicks, indentations,increased out-of-roundness,replace it.Pasivate the reconditioned and repaired areas of the housing. Repaint.

Damaged spherical pin, galling above 0.2 mm - replace.
The Sc 5347 lever pin: loose, badly damaged - replace.
The Sc 5347 lever pin $\phi 10^{-0.013}/_{-0.028}$ mm - recondition, observe the fit L=0.013-0.06 mm against the Sc 5309 bushing.
Check for cracks applying the magnetic control.

13.4.16. The Sc 0536 Brake Belt.
If braking pads thickness is less than 2 mm - replace.
Loose rivets - replace.
Badly corroded belt - discard.
Mutilated thread of the pin - replace the pin.
Visually check for cracks and scoring.

13.4.17. The Sc 5357 and Sc 0546 Shock Absorbers.
Damaged M5 thread - reject.
Light surface damages - dress out.
Rubber surface and rubber to metal joint must be free of cracks - discard.Check each absorber on the 6-94-Sc 0546/1 fixture for shear,where the deformation is 9 mm.

13.4.18. The Sc 5369, Sc 5372 Spring End Windings.
Chafing and upsetting of the eyes at the ϕ8.5 mm - discard.
Damaged M8x2 mm - reject.

13.4.19. The Sc 5367 Adjusting Screw of the Brake Belt.
Cracked scrrew and mutilated thread - discard.
Damaged head and grooves - discard.

13.4.20. The Sc 5394 Nut.
Mutilated thread and damaged grooves for wrench - discard.

13.4.21. The Sc 5324 Protection Outer Ring.
Fine scratches, scores on the surface - lap out.
Ring thickness $3.8^{+0.05}$ mm; $3.95^{+0.05}$ mm.
$\phi 40^{+0.027}/_{+0.002}$ mm - observe this dimension.
Check for cracks applying the magnetic method.

13.4.22. The Sc 5395 Ratchet Gear.
Badly deformated teeth - reject.
Light surface damages - dress out.
Damaged taper - regrind in concordance with the impeller shaft.
Top tooth edges and fillets with radius R=0.2-0.5 mm -

Thooth top diameter=$123^{+0.1}$ mm, original design $\phi 124^{+0.1}$ mm. If one component discarded, replace the whole sub-assembly.

Check for cracks apllying the magnetic method.

13.4.11. The Sc 5328 Distance Washer.

Dimension:1.7±0.05 - lap, discard if severe damages.

Check for cracks applying the magnetic method.

13.4.12. The Sc 5334 Shaft of the Supercharger Impeller.

Toothing: chipping, cuts, pitting - discard.

Damages at non-machined surfaces not deeper than 0.1 mm - dress out.

1:5 taper: damaged, galling - regrind in concordance with the Sc 5395 ratchet gear.

Damaged, mutilated M15x1 thread - discard.

$\phi 16.8^{+0.039}/_{+0.028}$ mm - diameter decrease not permitted, dress out light indentation.

$\phi 17^{+0.009}/_{+0.001}$ mm - diameter decrease not permitted,dress out light indentation.

$\phi 10^{-0.025}/_{-0.04}$ mm - observe clearance L=0.04-0.07 mm, if increased clearance, replace the Sc 5377 bushing.

Tooth top diameter=$25_{-0.1}$ mm, original design $\phi 24_{-0.1}$ mm.

When discarding, replace the entire sub-assembly.

Check for cracks applying the magnetic method.

13.4.13. The Sc 5329 Oil Inlet Ring.

Damaged surface protection - cadmium plate.

Dimension 1.6±0.1 mm - discard if bent or deformed.

Visually check for scoring and cracks - discard.

13.4.14. The Sc 5370 Lever Spring.

Cracked, damaged, corroded surface protection - discard.

Winding shape - the windings should be closely in contact, the length l=±0.5 mm; reject if longer.

13.4.15. The Sc 5343 Brake Lever.

Damaged, deep nicks - discard.

Dress out light damages.

Indententions of the $\phi 5$ mm bore for the Sc 5344 spherical pin - discard.

Damaged spherical pin, galling above 0.2 mm - replace.

The $\phi 22^{-0.02}/_{-0.033}$ mm: damages, indentations - dress out observing the fit L=0.02÷0.054 mm.
Damaged $\phi 14.1^{-0.02}/_{-0.04}$ mm swivels - maintain dimension, discard if decreased.
The Sc 5377 bushing $\phi 10^{+0.014}/_{+0.005}$ mm - discard bushing if the fit L=0.07 mm against the shaft is increased.
Check for cracks applying the magnetic method.

13.4.9. The Sc 5331 Planet Gear.
Damaged tooths,pitting-discard.
The planet gear width 15.8±0.05 mm - dress out scratches within tolerated dimension.
The $\phi 18.1^{+0.021}$mm:swivel to planet gear radial clearance= 0.03÷max. 0.08 mm - observe the fit.
Tooth top diameter= $\phi 57_{-0.1}$mm;original design top diameter= $\phi 58_{-0.1}$mm. When discarding one of the matching gear from the gearing sub - assembly, allways use the same sub-assembly. Discard the previous sub-assembly.

Sc 0534 shaft	ϕ $57_{-0.1}$ mm	ϕ $58_{-0.1}$ mm
Sc 0596 gear	$\phi 123^{+0.1}$ mm	$\phi 124^{+0.1}$ mm
Sc 5334 shaft	ϕ $25_{-0.1}$ mm	ϕ $24_{-0.1}$ mm

Check for cracks applying the magnetic method.

13.4.10. The Sc 0596 Bell Gear.
Interior toothing: chipping, pitting, tooth profile, deformation - discard.
ϕ 140 mm grooves: heat staining, galling, chipping (hardness 750 Vc) - discard; dress out scratches, cuts, indentations.
Damaged mating surface on the ϕ38 mm area - dress out, possibly regrind.
The Sc 5376 bushing length $l=62^{-0.1}/_{-0.2}$ mm - if decrease is greater than 0.3 mm, replace bushing.
$\phi 30^{-0.02}/_{-0.033}$ mm - dress out damages or regrind up to ϕ29.95 mm and replace the Si 5314 bushing. Clearance L=0.02-0.07 mm.
$\phi 25^{+0.023}/_{+0.002}$ mm from the Sc 5376 bushing - recondition, clearance L=0.00 - P=0.01 mm.Up to a loose fit of 0.025 mm, stick the bushings with Loctite compound.

13.4.4. The Sc 5309 Bushing: enlarged $\phi 10^{+0.015}$ mm, loose bushing - replace.
Check the housing visually with a magnifier for cracks - discard.

13.4.5. The Sc 5351 Housing Cover.
Mating surfaces: scoring, indentations - dress out.
Damaged surface protection - remake.
The $\phi 40^{+0.007}/_{-0.018}$ mm:scuffed and enlarged to 40.04 mm - grind bushing and chrome plate the bearing to maintain the fit.If the enlargement exceeds ϕ40.04 mm - discard bushing.
Check for cracks applying the flourescent method.

13.4.6. Impeller
Damages on the trailing edge of the blades not deeper than 0.5 mm - dress out.
Damages on the lateral side of the blades not deeper than 0.3 mm - dress out.
Damaged surface protection - grit blast, anodize.
Damaged front mating surfaces at ϕ16.8 mm - dress out.
$\phi 16^{+0.018}$mm - observe fit in compliance with the table.
Check for cracks applying the flourescent method.

13.4.7. Supercharger Scroll.
Damaged studs - replace.
Mating surfaces: scoring, cuts, galling - dres out.
Chipping at the inlet manifold bevel not greater than 0.5 mm - dress out, otherwise discard.
Loose rivets at the supercharger joint - discard.
Chafing at the wall profile up to 0.2 mm - dress out.
Check for cracks applying the fluorescent method.

13.4.8. The Sc 0534 Driving Shaft.
Serration: cracked teeth - discard.
Toothing:chipping, cuts, pitting, tooth profile deformation - discard.
Light damages on the beveled surface up to 0.1 mm deep - dress out.
Damaged M12x1.5 mm,M10x1 mm - calibrate the first thread winding, discard if severe damages.
The $\phi 22^{-0.02}/_{-0.033}$ mm: damages, indentations - dress out

nut using the UN-72-1144 wrench. Extract the rear spline using a drift, disassemble the clutch and the absorber using the 6-94-Sc 0053/14 fixture.
Using a puncher, mark the first pin of the crank of the Sc 0534 shaft and the corresponding satellite gear.

13.2.7. Remove cottered pins 3x16, the nut and the satellite gears.

NOTE:

Put the needles into a bag and measure them.Mount back the washer and the nut to the shaft.

13.2.8. Dismount the screw of the brake belt, the drum wheel, the plug,the brake control lever,the clevis and the brake belt.

13.3. CLEANING

Clean parts in decarbonizer and in synalod,remove the rests of dirt and sealing compound.
Wash parts in gasoline.

13.4. INSPECTIONS

13.4.1. Supercharger Drive Housing

Damaged, scored, scuffed mating surfaces - dress out.
Deep cuts, chipping - reject the part.
Damaged surface protection - remake.
Damaged pressure oil fitting and the M10x1 thread -replace.
Damaged M5x30 studs - replace.
Housing plug: damaged or loose thread M16x1.5 mm - replace.
The Sc 5310 housing bolt-bent, mutilated thread - replace.
Wirely locking item: corroded, damaged - replace.
The Sc 5308 spring drift:broken, loose, indentations of the ϕ5 mm area - replace.
Check the marking of the sub-assembly number or engine number for condition; recondition the marking.

13.4.2. The Si 5314 Bushing:loose,broken pin retainer,deep scoring - replace.
Bushing ϕ30:if enlargement exceeds 30.05, replace the bushing.

13.4.3. Damaged, deformated pilot diameter $\phi 160^{+0.032}/_{-0.031}$ mm - dress out light damages, discard if deformated or more

13. SUPERCHARGER

13.1. THE SUPERCHARGER of the engine fulfils two aims. It encreases engine performances during take off and at different flight ratings on one hand and the engine starting succeds over it on the other hand.
The supercharger consists of the impeller itsself and of the steady mounted electric starter provided with a worm gear and a ratchet gear pinion engaging the engine crankshaft. The pinion slides fore and aft and its actuation is accomplished by a solenoid, concomitently energized with the starter. An other reduction gear, after the worm gear of the starter, is represented by the epicyclic gear of the supercharger impeller, which must be actuated in order to add its reduction ratio to the global reduction ratio of the starter.

13.2. DISASSEMBLY
The dismount from the engine occurs during the Engine.
Supercharger's proper disassembly.

13.2.1. Remove starter case from the supercharger scroll case.

13.2.2. Remove the Sc 5351 cover and the Sc 5319 scroll from gear case. Unlock the nut and tap out the elastic pin. Use the P 30-0268 fixture and the narrow drift.

13.2.3. Loose nut from the Sc 5396 shaft (left-hand thread) using the 8-95-Sc 0053/9 wrench and press out the Sc 5395 ratchet pinion by means of the 6-95-Sc 0053/15 fixture.

13.2.4. Unlock the Sc 5399 lockwasher and screw off the Sc 5394 nut by means of the 8-95-Sc 0053/8.

13.2.5. Heat the shaft and the impelle at 170°C, fasten on the P 20-0256 fixture and remove the shaft.
Remove the retaining ring and extract the Sc 5389 bearing using the P 30-0271 drift.

13.2.6. Install the case onto the P 30-0268 fixture, dismount the spline of the front clutch and unlock and loose the Sc 5383 nut using the UN-72-1144 wrench. Extract the rear spline

Reassemble.

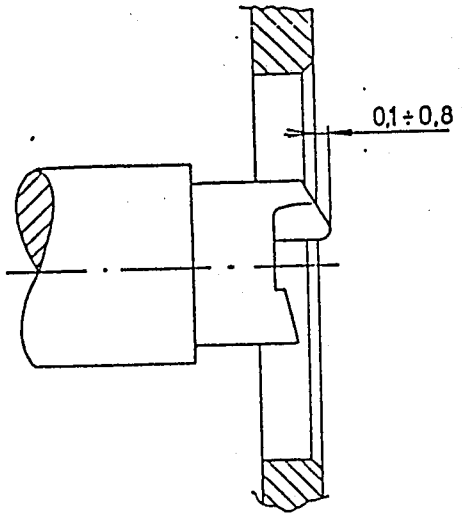
After the prescribed teeth clearance and gear matching have been achieved, secure the nut of the bevel gear by bending the Sc 3752 lock washer.

NOTE:

Coat the Sc 3767 and the Sc 3771 (Sc 3319) gaskets with Hyllomar at the final mounting.

12.21.14. Mount the scavenge oil pipe with the flange and the sealing onto the frontal cover of the camcase and tighten. Check the axial clearance of the rockers, the securing of the shafts and of the locking items and the mounting of the cap-nuts with washers to the three adjusting screws.

Prior to mount the pump, verify if orifices of the Sh 3319 gasket are not obturated and the mounting of the Sc 1410 pad on the vertical shaft.



Remark:
The hole in centering tube should meet the hole in camshaft

Fig.12-5

12.21.11. Fasten the P 137-058 fixture in a vice. Insert the camshaft and torque the Sc 3751 nut to 40 Nm + 10 Nm (4+1 kgm). Check the teeth clearance between the bevel gear and the vertical shaft using the P 137-059 fixture equipped with dail gage.

L_{tooth}=0.15÷0.20 mm - max. 0.25 mm.

12.21.12. Check the teeth for proper matching using test colour.

NOTE:

Adjust improper clearance or matching by replacing the Sc 1410 washer with an other one from class A,B,D,E or by turning the front of the rear bearing.

12.21.13. Use the P 137-060 fixture, when removing the bevel gear.

shaft. Install the rubber sealing ring with garter spring onto the centuring tube, mount the front camcase section. Make the holes in the camcase, centering tube and bearing correspond.

NOTE:

Coat the vulcanized camcase tappered end and the rubber sealing ring with a film of adhesive KR-5-18 before completion of mounting.

12.21.6. Install the front section, tap in proper position, check holes for alignment and screw on the screws.
Install seals to the front section, the front cover and tighten the nuts. Check the crankshaft for free movement.

12.21.7. Install the rubber sealing ring with garter spring onto the crankshaft. Mount the bearing for the rear camcase section to the cranckshaft and tighten.Coat the vulcanized camcase tappered end and the rubber sealing ring with a film of adhesive KR-5-18. Install the front section,tap in position,align holes and screw on the lock screws.Mount the rear bearing and tighten.Mount the drive housing with the Sc 3750 bevel gear to the camshaft.

NOTE:

The Sc 3750 gear and the Sc 3757 vertical shaft are mounted as the run-in Sc 0165 sub-assembly.

12.21.8. Press the key into the groove, mount the bevel gear, tap the drive housing in position and tighten nuts. Screw on the Sc 3751 nut and tighten by means of the P 137-001 wrench.

12.21.9. Measure the extention of the spur gear beyond the plane of the drive housing flange by means of the P 137-057 fixture equipped with a dial gage. The spur gear should extend for 0.1÷0.8 mm. Assure the extention of the spur gear by turning the bearing front.

See Fig. 12-5

12.21.10. Mount the gasket Sh 3319 and the assembled scavenge oil pump onto the studs of the drive housing and tighten the nuts.

NOTE:

For rocker shaft reassembly see table at "INSPECTIONS" paragraph.

12.21.2. Coat the rocker bores with soluble grease AV-2 and settle the 19 needles to each rocker, then install the distance ring and the two pads. Reassemble rockers to the case and insert the technological drift P 137-054. Measure the axial clearance of the rockers L_{ax}=0.1÷0.2 mm-max. 0.4 mm. Use the Sc 3732 distance ring in the R1,R2 or R3 class to limit the clearance.
The distance ring p/n reference completed with letter A measures $10^{-0.10}/_{-0.15}$ mm, the letter B measures $10^{+0.0}/_{+0.15}$ mm. The rocker marking "L" signifies left-hand, "P"-right hand. After the shaft was measured and numbered, install a lock at one end.

12.21.3. Heat the camcase together with the rockers in an electrical furnace at 80°÷100° C,take out and mount the Sc 3730 rocker shaft by means of the P 137-056 drift.
Following cooling, check rockers for free movement and axial clearance. Install the second lock. Mount the P 137-095 technological springs to rockers.

12.21.4. For models M 137 and M 337, mount the sliding bearings to camshaft at points corresponding to the central camcase. Thoroughly align the bearing and tighten screws. Introduce the camshaft throughout the central camcase section. Complete bearing positioning by tapping using a drift and align it so that the screw hole in the case points to the bearing. Screw on the adjusting screw.Mount slide bearings according to the ordinal number at both sides of the central case and tighten screws. Mount the centering tube on them, make the holes in bearings,centering tube and camcase correspond.

NOTE:

Following reassembly of each component of the camcase, check the camshaft for free rotation. The bearings are to be mounted with the ordinal number facing the front of the engine.

12.21.5. Mount the bearing of the front section of the case to the

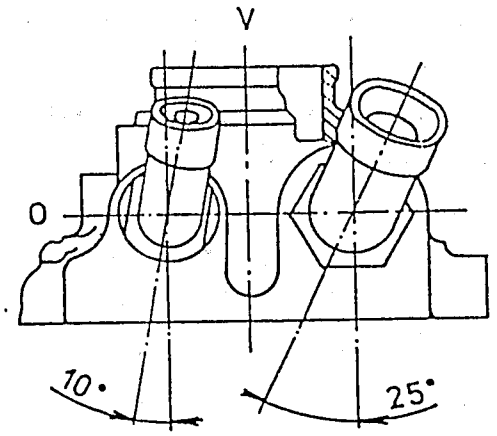


Fig. 12-4

12.20.3. *NOTE:*

In case of an enlarged hole in the midwall and in the cap of the driven impeller shaft, considering ϕ10.019 through ϕ10.040 mm, stick the shaft using Loctite.

12.20.4. Install seals and the pump cover on studs.Tighten the nuts.

12.20.5. Mount the gravity valve or the oil strainer,in compliance with the version design. Check the shaft for free and continous mouvement.

NOTE:

Coat the gasket between case and cover with Graflak prior to reassembling.

12.21. CAMSHAFT REASSEMBLY

12.21.1. Place cleaned parts on a clean bench. Compare the part ordinal number with the engine series no. Measure each part and record the fits. For dimensions and clearances see Tolerances and Fits.

Replace damaged studs. If the press in the threaded area gets loose, stick these screws using Loctite.If screws for the injection pump mounting are found torn out, install threaded inserts.

12.19.2. Lap the recess bottom for impellers located in the pump cover using the P 137-239 and the P 137-240 fixtures and ST-1 or ST-320 lapping compound.
Lap the impeller flank and bores with ST-1 lapping compound using the LT ϕ10x50, LT ϕ18x50, LU ϕ10x100 and LU ϕ18x100 fixtures.

12.19.3. Check impellers for axial clearance L_{ax}=0.034-0.058 mm (max. 0.07 mm). Check the driving impeller for radial clearance L=0.04÷0.082 mm. Carry on measurements by means of the P 137-229 and P 137-228 plug gages.

12.19.4. Measure impeller tooth clearance.
L_{tooth}=0.15÷0.20 mm (max. 0.25 mm); use the P 137-222 fixture.

12.19.5. Finish the outer surface of the vertical shaft and the hole of the gravity valve with lapping cloth no.400.
Replace damaged sieve by soldering.
Clean each part prior to assembling with gasoline.

12.20. REASSEMBY
Check parts for completion with a view to reassembly.

12.20.1. Insert the Sc 3757 vertical shaft into the pump midwall. Mount sealing and the midwall on the drive housing studs.

12.20.2. Mount the oil outlet and inlet fittings and the connection fitting to the pump cover.

NOTE:

At Model M 137 up to series no.724263, install the Sc 3765 outlet fitting in the direction of the axis "O". From series no.724264, install the fitting at an angle of 25° with respect to the axis "V". Adjust the proper positioning by means of the Sc 3785A,B and Sc 3784A,B gasket washers.

12.18.4. Dress out damages of the centering tube with lapping cloth and number it using an electric pencil.

12.18.5. Grind the Sc 3750 bevel gear to match the camshaft bevel.

12.18.6. Lap the sliding swivels of camshaft,strighten the surface of each cam lobe using a fine stone.
Install the camshaft on the fixture and using technological tappets and color prints, check the cam lobes for planeness The cam lobe surface must be plane for min. 85%.
Use the P 137-304, P 137-305, M20-0068 fixtures.Verify if the cams are provided with oil inserts.Replace the loosen ones.The inserts must be sunk beneath the sliding surface for 0.1 trough 0.4 mm and mounted shrunk.

12.18.7. If the camshaft run-out is 0.04 trough 0.1 mm, strighten it in a press and mark with the referance PK-24. Reject bent shafts after overhaul bearing the PK-24 marking.

12.18.8. Rinse the camshaft with engine oil at 60-80^{o}C. Use the P 137-061, P 137-062, P 137-063 fixtures.

12.18.9. Strighten the rocker inner diameter of the needle race using lapping paper no. 400.Inspect the adjusting screws, reject damaged screws together with nuts. Crimp loose end pieces of the screws showing increased clearance using the fixture P 137-064 or discard.

12.18.10. Strighten and finish the rocker slide surface using a fine stone and lapping paper no.400. Check the entire area for chrome layer integrity. Carry on the check using blue solution. If there are evidenced spots where the chrome layer is missing, then chrome plate and grind.
Chrome layer thickness: 0.06±0.01 mm.

12.18.11. Recondition the camshaft gearn in accordance with Fig.12-3 if scuffing at fillet of the injection pump key is evidenced.Check for condition after repair applying the magnetic method.

12.19. SCAVENGE OIL PUMP REPAIR

12.19.1. Dress out galling and indentation, remove corrosion, strighten mating surfaces on the lapping plate.
Calibrate threads from drive housing and pump cover.

Wear (scores, scratches) of the impeller front surface - lap out while observing the fit.
Damaged surface protection - repaint.

12.14.1. Check for cracks applying the fluorescent method.

12.15. SCAVENGE OIL PUMP IMPELLERS
Galling, scuffing on the lateral sides - lap out.
Damaged teeth - pitting - reject.
Impeller to shaft grooves increased clearance - reject.

12.15.1. Check for cracks apllying the magnetic method.

12.16. Sc 3735 VERTCAL SHAFT
Pitting and galling at teeth - reject.
When replacing the rejected shaft, allways use a run - in Sc 0165 gearing (Sc 3750 + Sc 3757).
Check for cracks apllying the magnetic method.
Damaged swivel - dress out damages observing clearance L= 0.016-0.052 mm.

12.17. GRAVITY VALVE (M 137A,AZ; M 337AK)
Oil strainer (M 332, M 337A).
Damaged, torn sieves - reject or replace sieves.

12.18. CAMCASE AND PARTS REPAIR

12.18.1. Clean and straighten all mating surfaces, replace mutilated studs and threaded inserts. Remake pilot diameters for bearings. Chamfer sharp edges of cases, remake fillets to the flange for the injection pump. Clean the case with gasoline and repaint.

12.18.2. Turn the damaged tappered surfaces of the case about 0.1 mm. Vulcanize tappered surfaces. Degrease with acetone, scuff with abrazive paper no.240, degrease. Apply a film of KR-5-18 adhesive, let air dry for 30-40 min. and then coke in a furnace at 140^{o}C for 30 min. Stick the sealing rings while mounting the cams.

12.18.3. Grind the new bearing inserts to match the pertinent camshaft swivel, provide the paint touch check and number.

Fig. 12-3

12.11. CENTERING PIPE

Holes indenting caused by screws, surface deformation - reject.

Scores, damaged chrome layer - reject.

Inside diameter worn to ϕ44.98 mm - dress out, if greater reject.

12.11.1. Check for cracks applying the mgnetic method.

12.12. CAMSHAFT BEARING

Damaged M15 thread - reject.

Damaged mounting pilot holes - reject in case of excessive damage.

While measuring the $\phi 21^{+0.021}$ mm inside diameter, the bearing blocks must be tightened and aligned to the camshaft pin.

12.13. ACCESSORY DRIVE HOUSING

Light damages on the mating surfaces - dress out.

Scores and cuts not deeper than 0.1 mm on the mating surfaces - grind.

Loose or torn out studs for the injection pump - install threaded inserts.

Enlarged ϕ50 mm hole in the housing - it is permited to apply a max. 0.03 mm graphite layer on bearing inserts.

Damaged surface protection - repaint.

12.13.1. Check for cracks applying the fluorescent method.

12.14. SCAVENGE OIL PUMP

Midwall and pump lid.

Scores, cuts on the mating surfaces - grind.

Damaged (scuffed) max. ϕ14.02 mm at case and max. ϕ14.035 mm at the Sc 9190 bushing for impellers shafts - observe fit between the intermediate gear shaft and case L=0.011-S=0.02 mm; between the intermediate gear and the Sc 9190 bushing L=0.025-S=0.005 mm, discard if fit is greater.

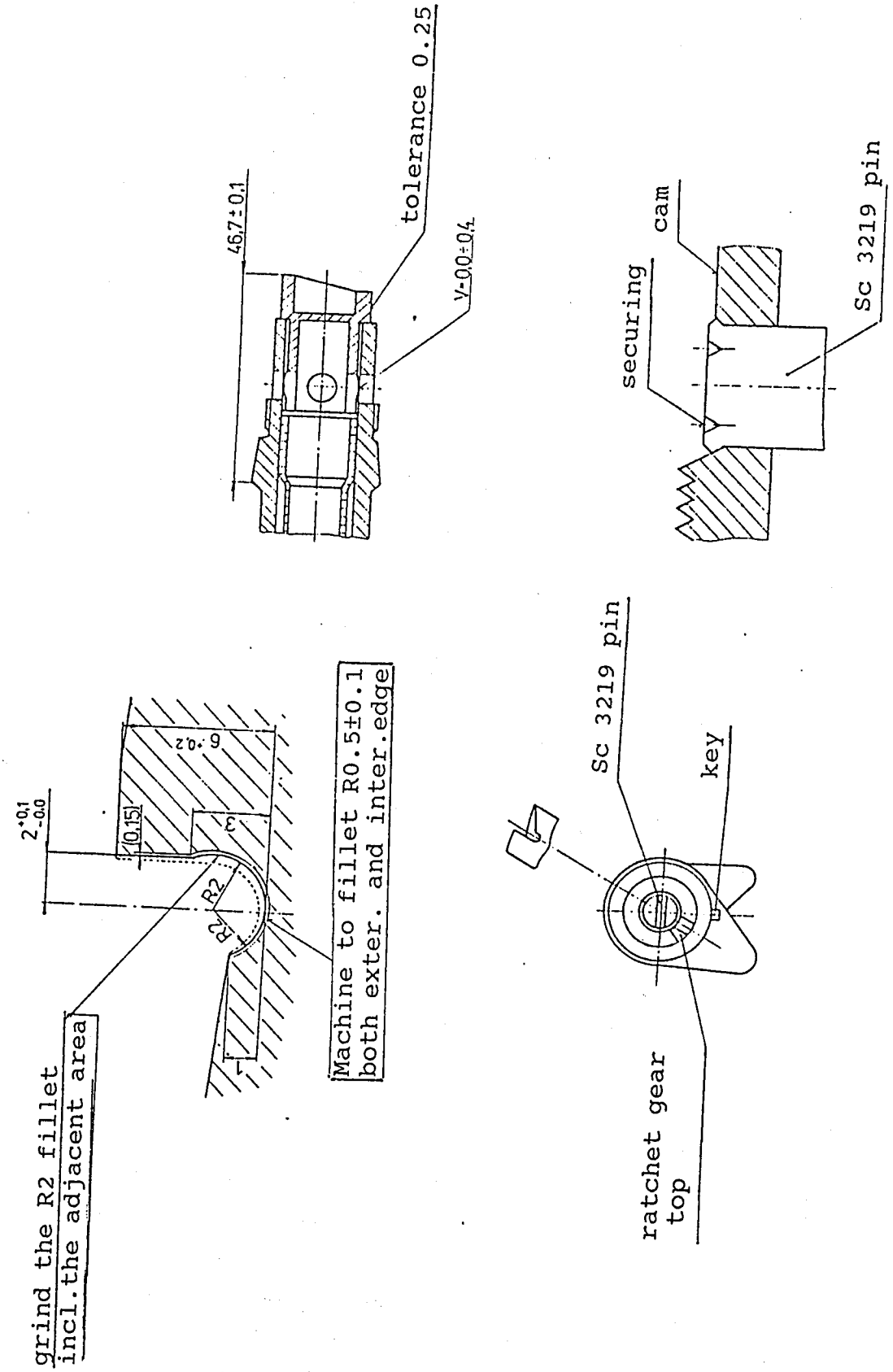

tolerance 0.25
46.7±0.1
V-0.0±0.4
securing
cam
Sc 3219 pin
Sc 3219 pin
key
ratchet gear
top
Machine to fillet R0.5±0.1
both exter. and inter.edge
grind the R2 fillet
incl.the adjacent area
2+0.1 -0.0
0.15
6 -0.2
3
R2
R2

Fig. 12-3

Fig. 12-2

12.6. ROCKER

Light surface damages - dress out.
Sliding surface wear, scores, damaged chrome layer - grind, chrome plate.
Enlarged ϕ14.3 mm hole- lap to ϕ14,36 mm max., if greater reject.

12.6.1. Check for cracks applying the magnetic method.

12.7. CAMSHAFT

Chipping on the lobe surface - reject.
Loose camshaft plug tube - reject.
Bearing shaft wear exceeding permited fit - discard.
Shaft bending up to 0.045 mm - acceptable.
Shaft bending up to 0.1 mm - strighten.
Greater bending - discard.
Check for cracks applying the magnetic method. Discard if evidence of cracks.

12.8. CAMSHAFT GEAR

Wear of the surface and fillet area, gallings - dress out in compliance with Fig.12-3.
Check for cracks applying the magnetic method.

12.9. CAMCASE FRONT COVER

Studs with damaged threads - replace.
Damaged surface protection - repaint.
Enlarged $\phi 21^{+0.021}$ mm hole for cam pin - dress out respecting the loose fit L=0.02-0.062 mm. Max. L=0.09 mm.
Replace cover if fit is greater.

12.9.1. Check for cracks apllying the fluorescent method.

12.10. OIL SCAVENGE PIPE

Dress out scoring and indents not deeper than 0.3 mm, straighten. Discard in case of more severe wear.
Damaged surface - anodize.

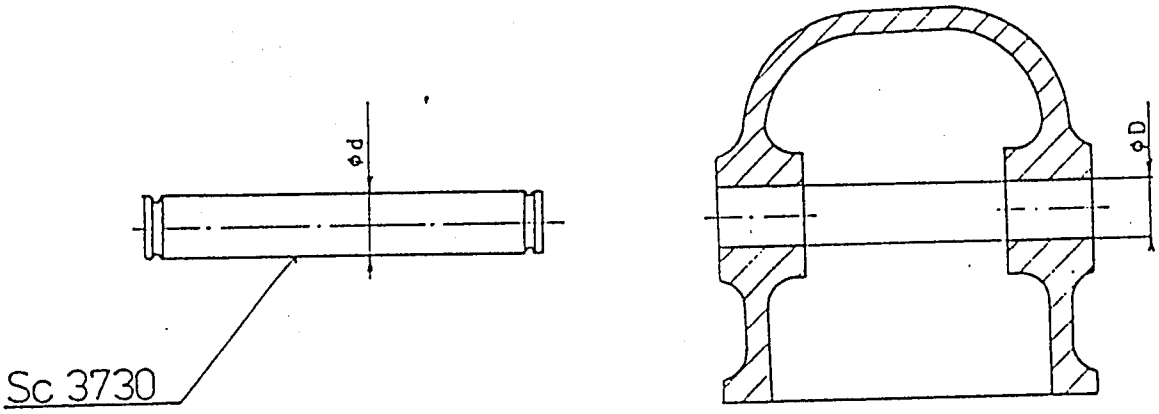
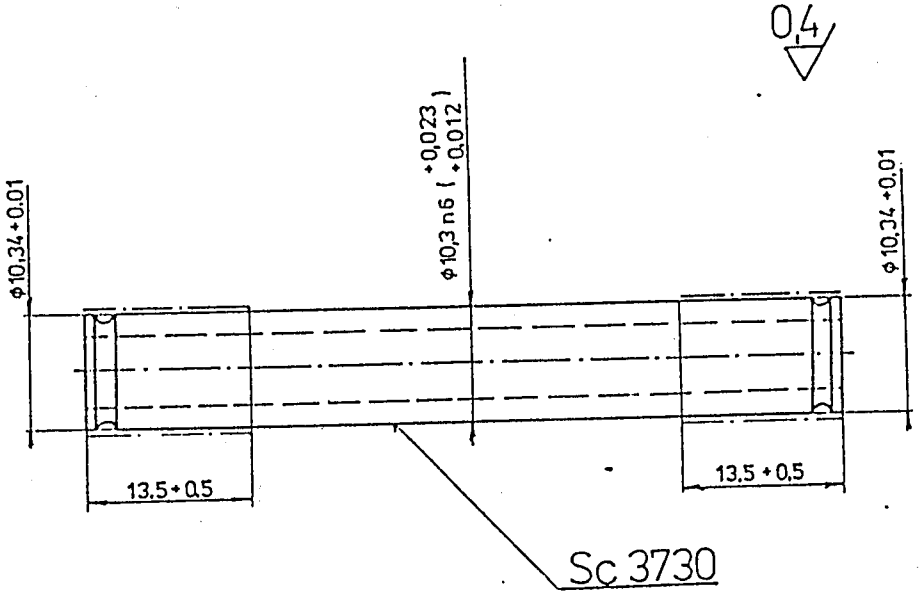


Fig. 12-1



—·—·— chrome plated including the grooves and polished

Fig. 12-2

Rocker Shaft Fit Table

Bore dia. (mm)	Reassembly Dia.(mm)	shaft P/N	Computed fit
max. 10.301	10.323	Sc 3730	S 0.033 x)
min. 10.290	10.312		S 0.011
max. 10.335	10.323	Sc 3730	S 0.013 xx)
	10.312		L 0.023
min. 10.310	10.350	OM-Sc 3730 RE	S 0.040
	10.340		S 0.005 xxx)
max. 10.360	10.350	OM-Sc 3730 RE	S 0.010
min. 10.340	10.340		S 0.020 xxx)

Remarks: x) "A",variant 1
xx) seal clearance to 0.025 according to "B",variant 2
xxx) ensure "A" by choice,variant 3
xxxx) seal clearance to 0.020 mm according to "B",variant 4

"A"- newly remachined fit prescribed-shrink fit 0.011-0.033 mm

"B"- eventually seal using LOCTITE or ALDURIT S-100

Fits at both shaft ends must comply with the same variant.
Combination between variants 1 and 4 is possible at camcase.
The OM-Sc 3730 R1 rocker shaftcan be used instead of the OM-Sc 3730RE - they are interchangeble.

12.4.2. Check for cracks applying the magnetic method.

See Fig. 12-1, 12-2

Fig. 12-1

12.5. ADJUSTING SCREW

Badly damaged screw, cracked, very loose end piece - discard.

12.2. PART CLEANING

Clean parts in decarbonizer and gasoline.

12.3. INSPECTIONS

12.3.1. Camcases.

Damaged paint - repaint.

Light damages on mating surfaces - dress out.

Sharp edges at the injection pump flange - chamfer, dress out.

Light thread damages - recalibrate.

Severe thread damages at screws and inserts - replace.

Mutilated thread at the rocker plug hole - discard camacas

Excessive damages at the rocker plug mating surface - strighten surface.

Galling, wear on the camcase taperred mating surfaces - dress out.

More severe damages on the camcase tappered mating surfaces - turn about 0.1 mm and mark camcase "0".

Unstraight surfaces mating the cylinder heads-0.1 mm max. permissible.

Wear of the ϕ47 mm dia.for the centering tube and bearing - dress out warping and scoring up to 0.08 mm deep.

Scoring and enlargement of the rocker shaft bores up to ϕ10,3 mm - dress out, polish.

12.3.2. Cracks - carry out a fluorescent check.

12.4. ROCKER SHAFTS

Worn needle race area and corrosion - dress out unless exceeding ϕ10.3 mm, otherwise discard shaft.

12.4.1. Shaft ends evidencing cuts and out-of round - grind and chrome plate ends up to $\phi 10.34^{+0.01}$ mm through 13.5 mm length.

Finish $\overset{0.4}{\checkmark}$. Remove rust and brown. Use the fixture P 137-412 for chrome plating.

Match shafts according to the table below.

12. CAMCASE

It is part of the OHC type valve operating mechanism. It consists of 2 or 3 sections depending upon engine type. The individual sections are joined together by means of centering tubes and sealing rubber sleeves provided with garter springs. The camcase supports the camshaft on seven/five electron alloy slide bearings.Each camcase section is common for two cylinders. Rockers for each valve are supported in the camcase too. The camshaft is driven by the crankshaft over the bevel and central gear. The camshaft drives directly the injection pump located on the rear wall of the accessory drive housing.

12.1. CAMSHAFT DISASSEMBLY

12.1.1. Install camcase onto the P 137-058 fixture.Remove securing and loose nut of the bevel gear using the P 137-001 wrench. Extract the gear using the P 137-060 fixture.

12.1.2. Dismount the scavenge oil pump and the small drive housing, the oil strainer included. Secure rockers by means of the P 137-095 dummy springs. Remove rear bearing.
Remove the front lid of the camcase, dismount the nut and the adjusting screw from the front camcase section, extract bearing by light tapping. Remove lock screw from the centering tube, dismount front camcase section.Repeat for the rear section.

NOTE:

Reassemble together the different bearing halves after disassembly and number them.

12.1.3. When dismounting the central section, remove the lock screw and the adjusting dowel from the centering tube. Dismount the tube and the bearing. Remove the central bearing from camcase, dismount the camshaft.

12.1.4. Dismount the scavenge pump,tie the Sh 3757 vertical shaft together with the Sc 3750 bevel gear and mark them with the engine number.

PUMP PERFORMANCES

Rating	RPM	t min.	oil temp °C	scavenge sec.		pres.sec.	
				otl pres	flow l/hr	otl pres	flow l/hr
1.	300	5		-	min. 175	red.va.at stop	min. 130
2.	500	3		-	min. 300	"	min. 205
3.	1000	3		-	min. 600	"	min. 400
4.	1300	5		-	min. 72	"	min. 515
5.	1300	5		0.1 MPa 1 kp/cm^2	min. 450	0,3 MPa 3 kp/cm^2	min. 450
6.	1300	5		-	-	adj.red.valve 0.48-0.5 MPa 4.8-5 kp/cm^2	min. 260
7.	300	4		-	-	min. 0.18 MPa 1.8 kp/cm^2	min. 115

11.8. RUNNING-IN PUMP

11.8.1. Mount pump on the test bench. Connect the oil inlet and outlet. The sense of rotation is to the right while facing the driving shaft.

11.8.2. Perform run-in in accordance to the following ratings:

Ref.	RPM	Time [min]	Oil flow [lit./hr.] scavenge sec.	press.sec.
1.	500	3	-	-
2.	600	10	135	90
3.	800	10	270	180
4.	1000	10	-	-
5.	1200	10	360	240
6.	1400	5	450	300
7.	500	2	-	-

11.8.3. Pump Tear Down. Do not dismount the return and gravity valve. Inspect all parts and the mating surfaces. Dress out light scoring. Reassemble.

11.8.4. Mount pump on the test bench. Check the pump for performances. See below the pump performances table.
Check the suction capacity of the scavenge section during test rating ref.4 by obturating inlet.
During test rating ref. 6, check the reduction valve for operation by turning the adjusting screw.

11.8.5. Perform the adjustment of the reduction valve at 1300 RPM, oil temp. 60-65°C and min. flow 260 lit./hr. at 0.37-0.39 MPa pressure.
Check the pressure section for outlet pressure at 300 RPM, min. flow 115 lit./hr. and reduction valve adjusted at 0.37-0.39 MPa. Min. outlet pressure should be 0.17 MPa.
Check the pump for leaks.
Remove pump from test bench, plug holes, secure with wire adjusting elements and filter protection.

indicator spline. Mount the RPM indicator adapter and tighten the two screws past washers. Press in the seal using the P 137-269 and the P 137-336 fixtures.Install the oil pump shaft with key into the scavenge pump housing. Mount then the impellers at the scavenge pump. Verify the teeth clearance L_{tooth}=0.05-0.1 mm by means of the P 137-262 fixture. Extract impellers, shaft with key and impeller pin out of the housing.

11.7.2. Install key with driving impeller to the driving shaft,the driven impeller on pin and mount both to the pump pressure section. Verify the teeth clearance L_{tooth}=0.05-0.10 mm. Extract impellers, pin, shaft out of the housing.

11.7.3. Install the driving shaft with key and impeller. Mount pin with driven impeller. Install gasket, shim, second gasket, key with pressure section impeller onto the scavenge section housing.Mount driven impeller on pin and reassemble the pressure section housing. Fasten the housings by two studs past washers and tighten nuts. Check for easy and free operation.

11.7.4. Insert the reduction valve and the spring to the pressure pump and screw on the adjusting screw with washer and setnut.Mount the second screw with seal to the second hole.

NOTE:

Modify pumps with old design return valve to incorporate new design conformly to par. 11.4.8.

11.7.5. Mount gravity valve body with seal, to the scavenge pump housing. Insert the ball and the needle and screw on the plug with seal.

11.7.6. Insert the strainer screen into the pressure pump housing, install the filter protection with seal and mount the screws with washers. Mount the extension fitting with seal to the filter protection. Mount the plug with seal to the fitting.

Mount the return valve to the lateral fitting of the filter case.

NOTE:

The return valve is to be mounted on customer's wish.

Finish shaft bores using lapping paper. Lap the flanges and shim mating surfaces using M5 abrasive compound with min. material removal. Use the P 137-268, fixture and the P 137-263 cutter.

11.6.2. Lap the front and the bore of impellers from both scavenge and pressure section. The impeller widths i.e. 18 mm and 12 mm may decrease after lapping with 0.01- 0.015 mm. Min. impeller width is 17.93 mm and 11.93 mm.
Use the LT ϕ14x30,LU ϕ14x100, LP ϕ14x30 mm, LO ϕ20x30 mm lap stones; the P 137-265, P 137-266, P 137-267 drifts.
Repair the threads of the oil filter protection and of the RPM indicator adapter. Use the P 137-388 fixture.
Strighten deformated protection using the P 137-340 drifts.

11.6.3. Check Sc 0090 return valve for tighteness using gasoline. Max.leak rate : 1 drop per minute. If greater leak, disassemble valve.
Press pin out of the valve body by means of the P 137-172 drift. Remove stan brazed locking and extract the elastic ring. Screw out the valve seat. Extract the return valve, the insert, the securing valve and the valve shaft.Extract the seal. Replace the Sc 9057 insert, the Sc 9059 elastic ring, the 2x10 mm pin and the seal.
Reassemble valve and remake the tighteness check.

11.6.4. Check gravity valve ball for tighteness. Max.leak rate: 1 drop per minute. If greater leak, lap mating surfaces with M10 compound and by means of the P 137-212 fixture. Check mating surface of the ball for continuity by the color print method. The print must be without a break along all mating contour.

11.7. PUMP REASSEMBLE

11.7.1. Press in the driven impeller pin to the scavenge section by means of the P 137-264 fixture.

NOTE:

In case of excessive clearance up to L=0.055 mm, stick the pin using ALDURIT N 100 or Loctite compound.

Mount the seal to the RPM indicator adapter and the RPM

	New Design	Old Design
Reduction valve	Sh 6061	Sc 6050
Adjusting screw	Sh 6016	Sh 6014
Valve spring	Sc 6066	Sc 6066
Nut,adjust.screw	Sc 6053	Sc 6053
Seal,adjust.screw	Sc 6054	Sc 6054
Guiding pad	-	Sh 6013
Valve guide	-	Sc 6048

11.4.9. Oil Filter Protection.
Damaged mating surfaces, threads, paint - repair.
Evidence of cracks - discard.

11.4.10. RPM Indicator Adapter.
Dress out galling and scoring.
RPM Indicator Adaptor $\phi 12^{+0.018}$ mm L=0.016-0.052 mm.
RPM indicator spline $\phi 12$.
RPM Indicator Adapter $\phi 10^{+0.027}$ mm L=0.013-0.050 mm.
RPM indicator spline $\phi 10$ mm.
Evidence of cracks - discard.

11.4.11. Filter Screen.
Strighten deformations, reject if badly damaged.
Clean with ultrasonic beams.

11.4.12. Gravity Valve.
Reject if cracks or sever wear of the ball seat are evidenced.
Reject damaged needle and corroded ball.

11.5. RETURN VALVE
Dress out light damage. Reject if evidence of cracks,rigid operation or leaks.
Valve Spring.
Reject if corroded. Spring diameter = $\phi 7.2$ mm, free length l=39±0.5 mm.

11.6. PUMP REPAIR

11.6.1. Dress out galling and light damages on the pump housing, strighten mating surfaces, remove corrosion.Repair threads.

11.4.5. Scavenge Section Impellers- wear,pitting,scores ranging to 0.2 mm on matching surfaces-lap matching surfaces, otherwise reject part or if impeller width decreases beneath 17.93 mm .

Pressure section impellers- wear,pitting,scores ranging to 0.2 mm at matching surfaces - lap matching surfaces, otherwise reject part or if impeller width decreases beneath 11.93 mm .

Driving impellers $\phi 14^{+0.014}$ mm L=0.00-0.022 mm.

Oil pump shaft $\phi 14$ mm.

Driven impellers shaft $\phi 14,025^{+0,018}$ mm L=0.006-0.042 mm, max. 0.05 mm.

Driven impellers shaft $\phi 14$ mm.

Verify teeth clearance at both scavenge and pressure section using the P137-262 fixture and the P137-265 drift. L=0.05-0.1 mm.

Verify impeller radial clearance at both sections using the P 137-266 dowel. L=0.05- 0.1 mm.

Verify impeller axial clearance at both sections using the P 137-267 drift and the feeler gage. L=0.05- 0.07 mm.

Measure axial clearance past the shim gasket. Substract 0.01- 0.02 mm due to shim gasket collapse at reassembly and tightening.

Check impellers for cracks applying the magnetic method.

11.4.6. Oil Pump Shaft.

Dress out light damages, reject for scoring deeper than 0.1 mm.

Check for cracks applying the magnetic method.

11.4.7. Driven Impeller Pin.

Dress out light damages, reject for scoring deeper than 0.1 mm.

Check for cracks applying the magnetic method.

11.4.8. Reduction Valve.

Dress out light damages, reject if cracks evidenced.

The previous design reduction valve was manufacturated until the 31st of Dec. 1979.

The new design Sh 0060AK was introduced the 1stof Jan.1980.

Remove the plug and the protection of the oil filter, extract filter. Remove the plug and the return valve.
Remove the 2 nuts of the pump joining screws and press out the screws using the P 40-4239/1 drift.Extract the pressure section housing and the impellers.
Remove the key from shaft. Remove the shim from the scavenge section housing and extract the impellers. Remove the second key from shaft and extract the pump shaft. By means of the P 40-4240/1 drift, depress the pin of the impellers from the scavenge section.
Remove 2 screws fastening the RPM indicator adaptor, extract it and then the spline. By means of the P 137-270 fixture, extract the seal from the adaptor.

11.4.2. Clean all components with gasoline and dry by air blasting.

11.4.3. Inspections.
If severe damage or cracks are evidenced, reject the scavenge section of the pump together with the pressure section housing. Lap light damages on the mating surfaces. Repair threads.
Scavenge pump housing $\phi 14^{+0.018}$ mm, clearance L=0.017-S=0.019 mm. Driven impeller pins ϕ14 mm. If increased clearance ranging to L=0.055 mm, seal applying the ALDURIT N 100 or Loctite sealant.
The Sc 6005 bushing from housing- if the loose fit against the shaft exceeds 0.05 mm, reject part.
If severe damage or cracks are evidenced, reject the pressure section of the pump together with the scavenge section housing. Lap light damages on the mating surfaces. Repair threads, or replace bushing.
Pressure pump housing $\phi 14^{=0.018}$ mm. L=0.015-0.050 mm.
Oil pump shaft ϕ14 mm, if increased clearance- reject.
Pressure pump housing $\phi 14^{+0.018}$ mm, L=0.017-S=0.019 mm.
Driven impeller pin ϕ14 mm. If increased clearance ranging to L=0.055 mm, seal applying the ALDURIT N 100 or Loctite sealant.

11.4.4. Pump Shim- reject if cracks or scores deeper than 0.2 mm; lap surfaces if necessary.

11. OIL SYSTEM

The oil system is composed from the main oil pump, the pipes, the camcase scavenge pump, the oil sump and the high pressure valve. The oil pump of the aerobatic version is provided with a gravity valve.

11.1. CLEANING

Perform cleaning with technical gasoline.

11.2. INSPECTION

Piping.

Damages at piping not deeper than 0.3mm - dress out.

Galling, cuts on the pipe sealing surface - reject.

Indentations - reject.

Shape distortion - reject; bending not allowed.

All rubber hoses - replace.

11.3. REPAIR

Remake the mating surfaces of pipe eye-type connections.

Dress out light damages not deeper than 0.3 mm.

Remake the surface protection by repaint.

Wash the pipe interior with gasoline. On the test bench, check pipes for pression at 0.6 MPa for 5 min using oil at 80°C. Check joints for leaks. Wash pipe with gasoline and plug them.

11.3.1. Mounting oil pipes and hoses is carried on at the engine general reassembly.

11.4. OIL PUMP

11.4.1. Dismount the gravity valve from oil pump housing, remove plugs and extract the ball and the needle.

Remove the joining screws, the flange, the gasket and the drive shaft from the housing of the pressure section.

Screw off the adjusting screw with set-nut, extract spring and valve. At previous designs, extract also the distancer and the rod.

Check drain valve for underpression operation. The valve must both side close at a pression of 0.05 atm.
Reject if damaged.

10.5.ENGINE PIPING

Engine Piping-Injected Fuel Conduit						
P/N	M137A	M137AZ	M337	M337A	M337AK	M332
Sh 0701	x	x	x	x	x	
Sh 0702	x	x	x	x	x	
Sh 0703	x	x	x	x	x	
Sh 0704	x	x	x	x	x	
Sh 0705	x	x	x	x	x	
Sh 0706	x	x	x	x	x	
Sc 0701					x	
Sc 0702					x	
Sc 0703					x	
Sc 0704					x	

10. FUEL SYSTEM

The fuel system is composed from the injection pump,the fuel lines and injection nozzles of each cylinder. It is completed by an independent fuel supply circuit with nozzle supplying fuel to the intake manifold for cold engine starting. The excess fuel is drained by the drain valves from the intake elbows.
The injection pump is located on the oil scavenge pump of the camcase. It is driven by the camshaft.

10.1.CLEANING

Wash and clean every component of the fuel system with gasoline.

10.2.INSPECTIONS

Injection nozzles showing surface damages - discard.
Dents on fuel lines - dress out unless deeper than 0.2 mm, otherwise reject.
Damaged sealing taper of fuel line end piece - reject lines.
Damaged fuel line surface protection - zinc plate.
Damaged supports - repair, remake surface protection.
Hoses - arbitrary replace.

10.3.PIPING REPAIR

Dress out light damages on piping and end pieces, lap the taper of the end pieces for nozzles. Verify the tube conduit in accordance with the templet.
Check piping for pression at 10 atm using oil.
Check brased joints for seepage and cracks.
Use the P 137-154, P 137-155 plugs.
Rinse piping with oil at 80^{o}C for 5 min.

10.4.DRAIN VALVES

Clean valves with gasoline.
Check fittings if loose, the body for integrity and the lem forming for condition.

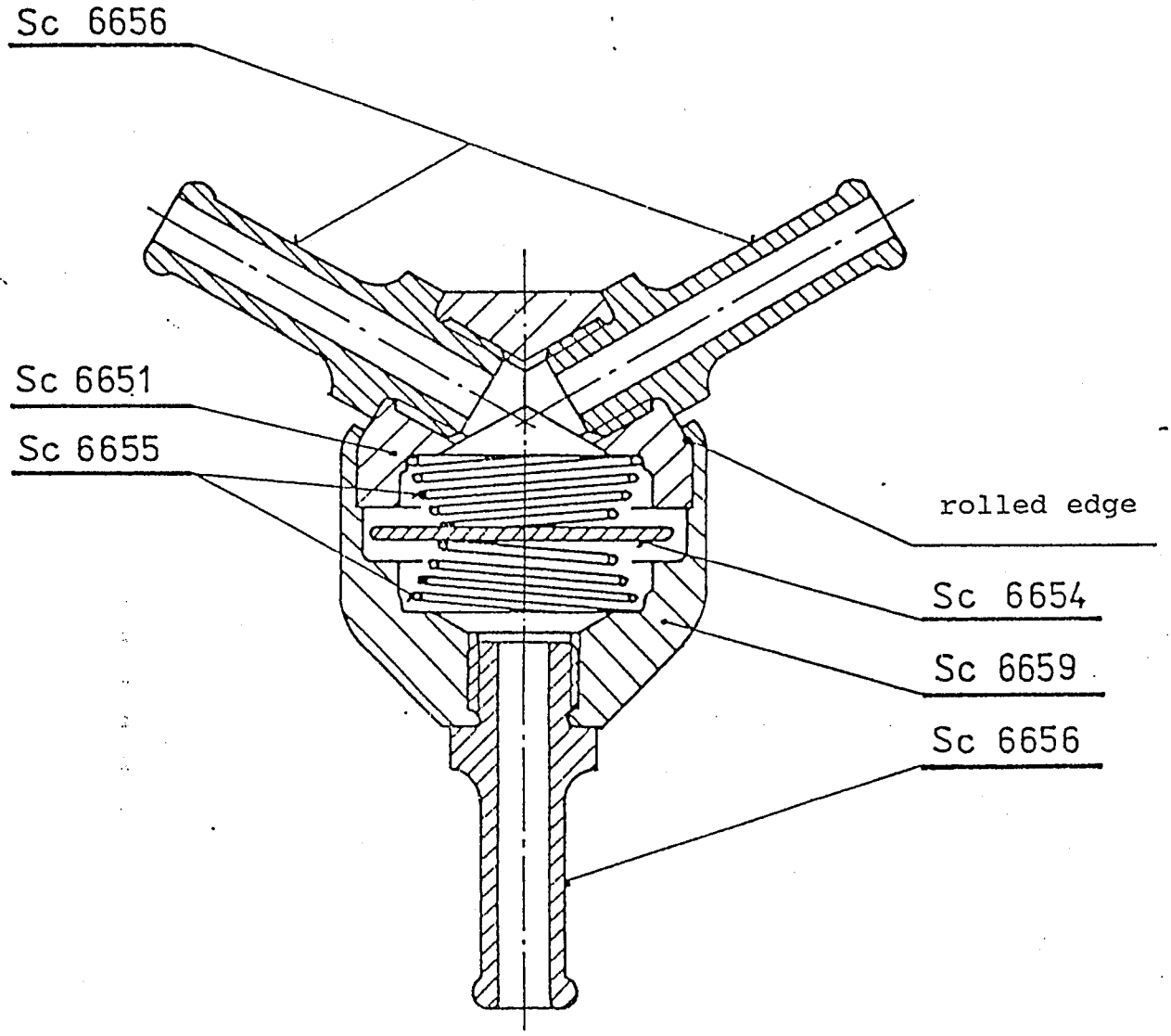
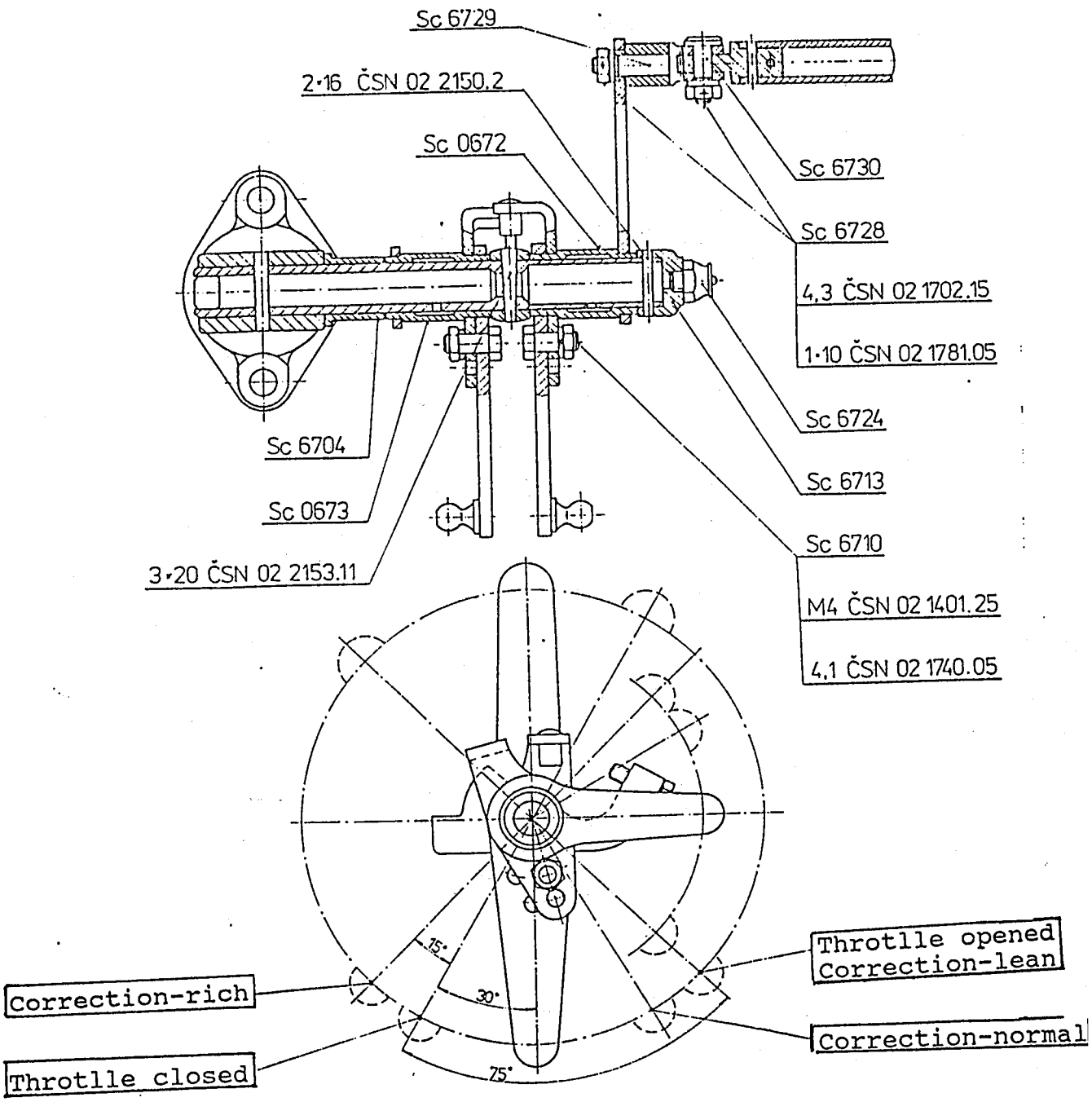


Fig. 9-8


Sc 6729
2·16 ČSN 02 2150.2
Sc 0672
Sc 6730
Sc 6728
4,3 ČSN 02 1702.15
1·10 ČSN 02 1781.05
Sc 6724
Sc 6713
Sc 6710
M4 ČSN 02 1401.25
4.1 ČSN 02 1740.05
Sc 6704
Sc 0673
3·20 ČSN 02 2153.11
15°
30°
75°
Throtlle opened
Correction-lean
Correction-rich
Correction-normal
Throtlle closed

M 332

Fig. 9-7

M 137 AZ
M 337 A,AK

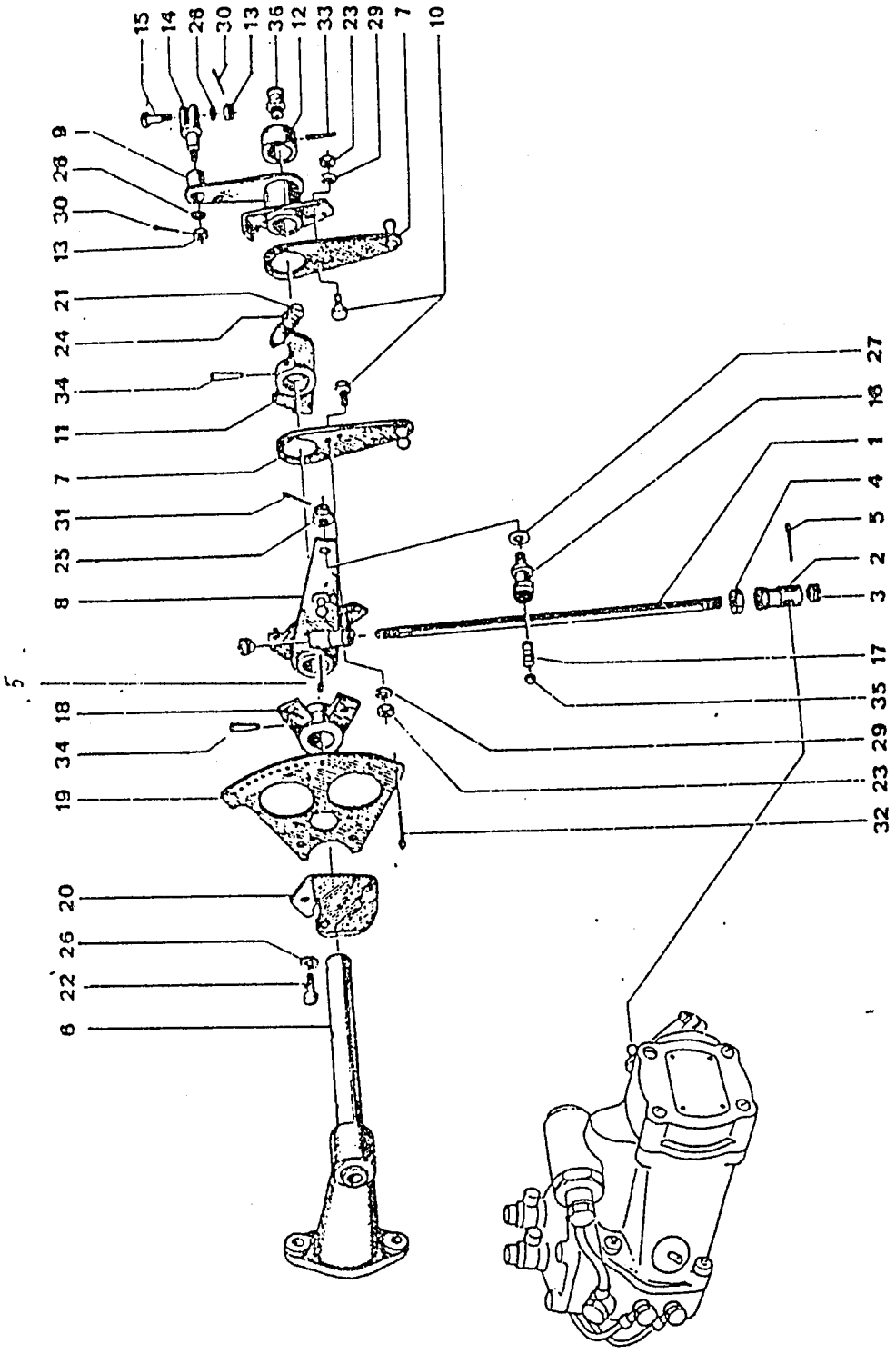


Fig. 9-6

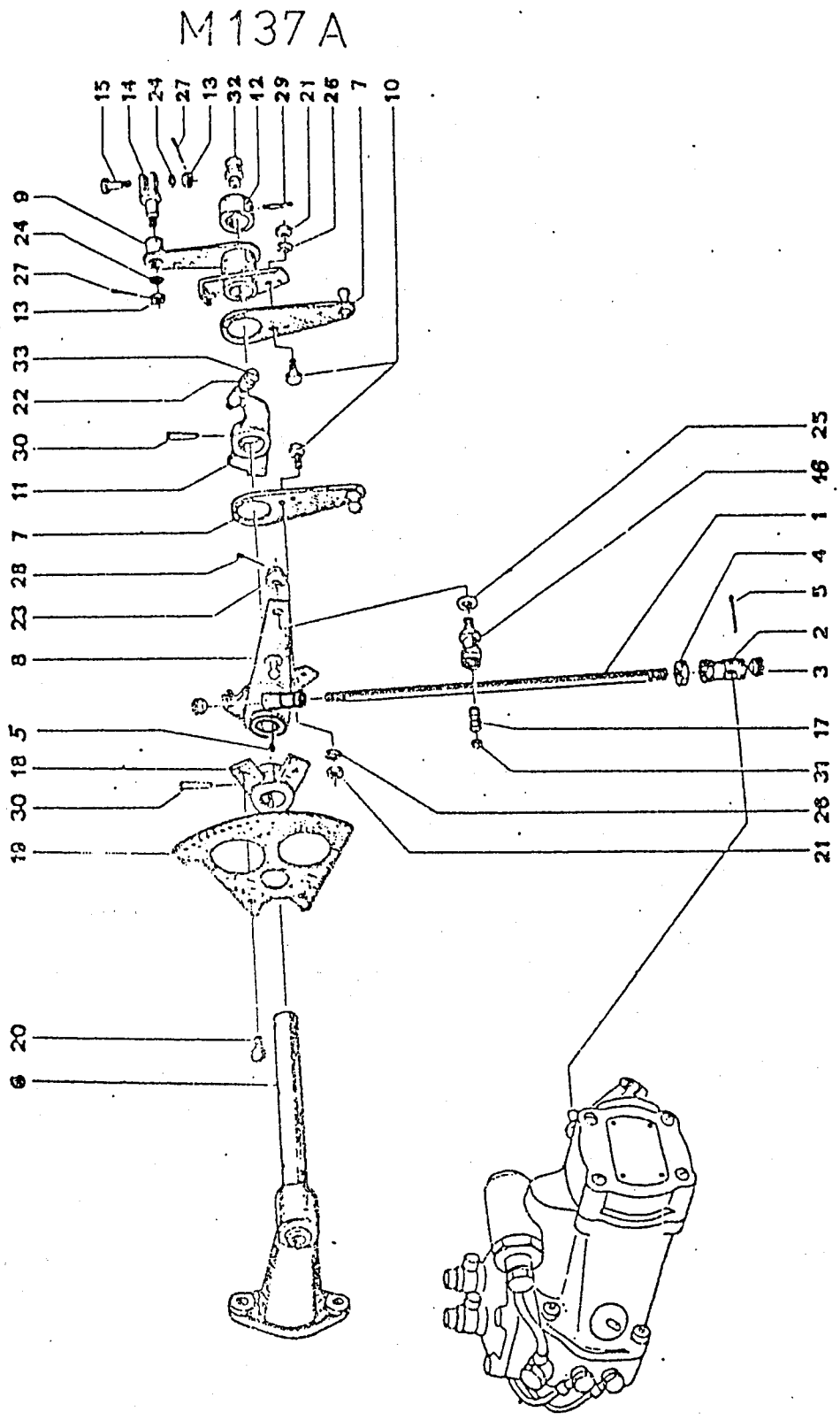

M137A
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Fig. 9-5

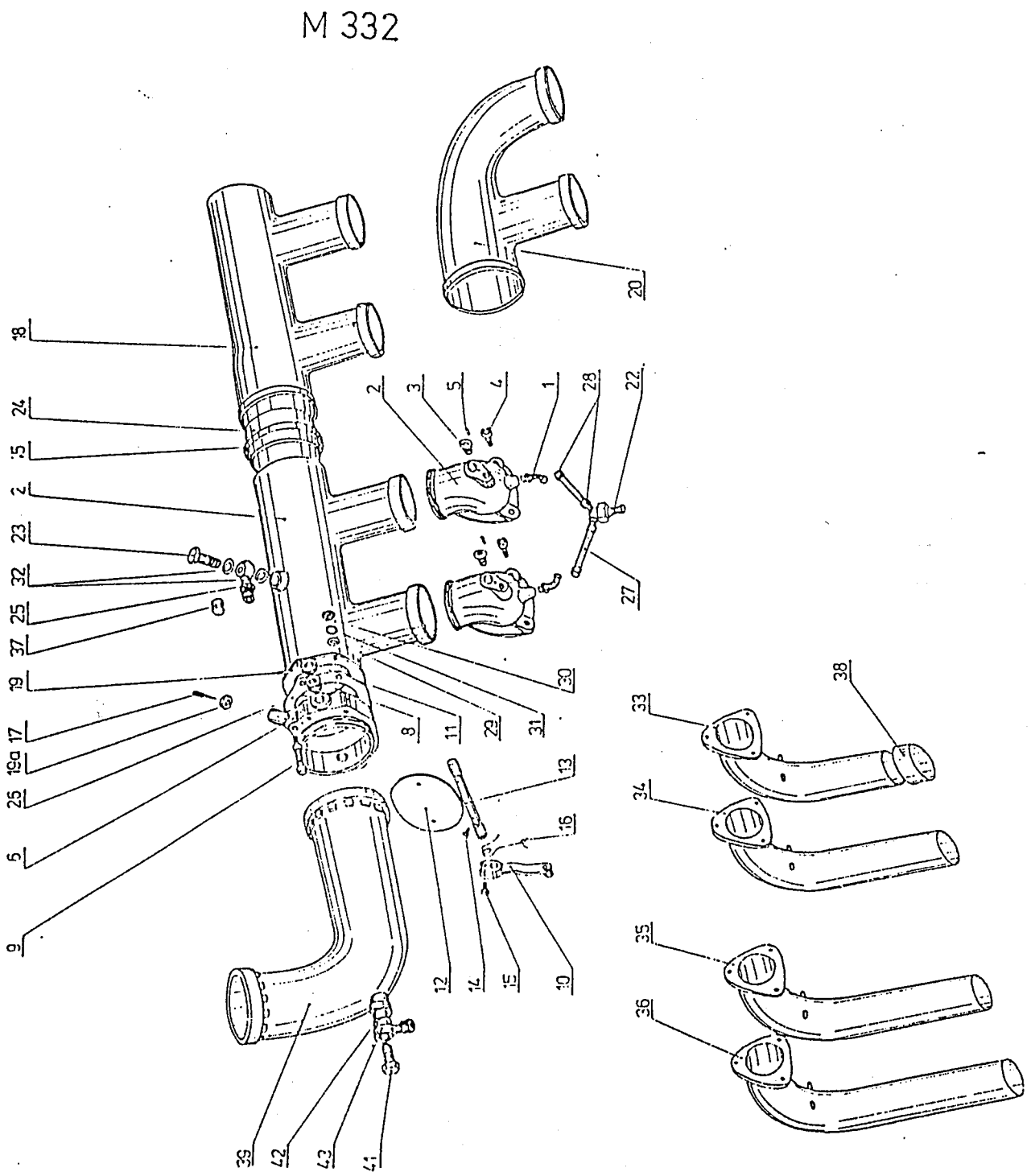
M 332
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Fig. 9-4

M337A,AK

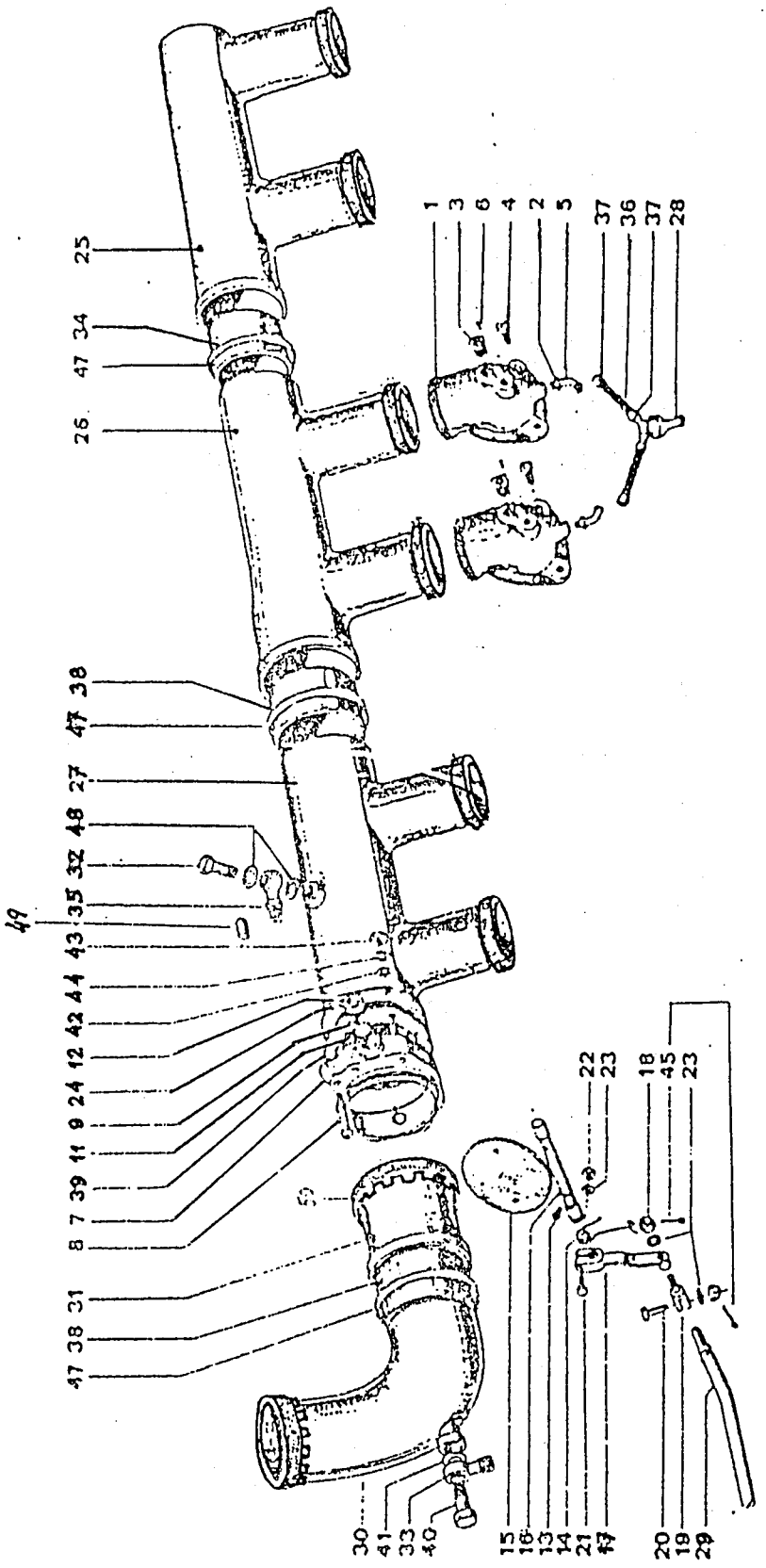

Fig. 9-3

M137 AZ

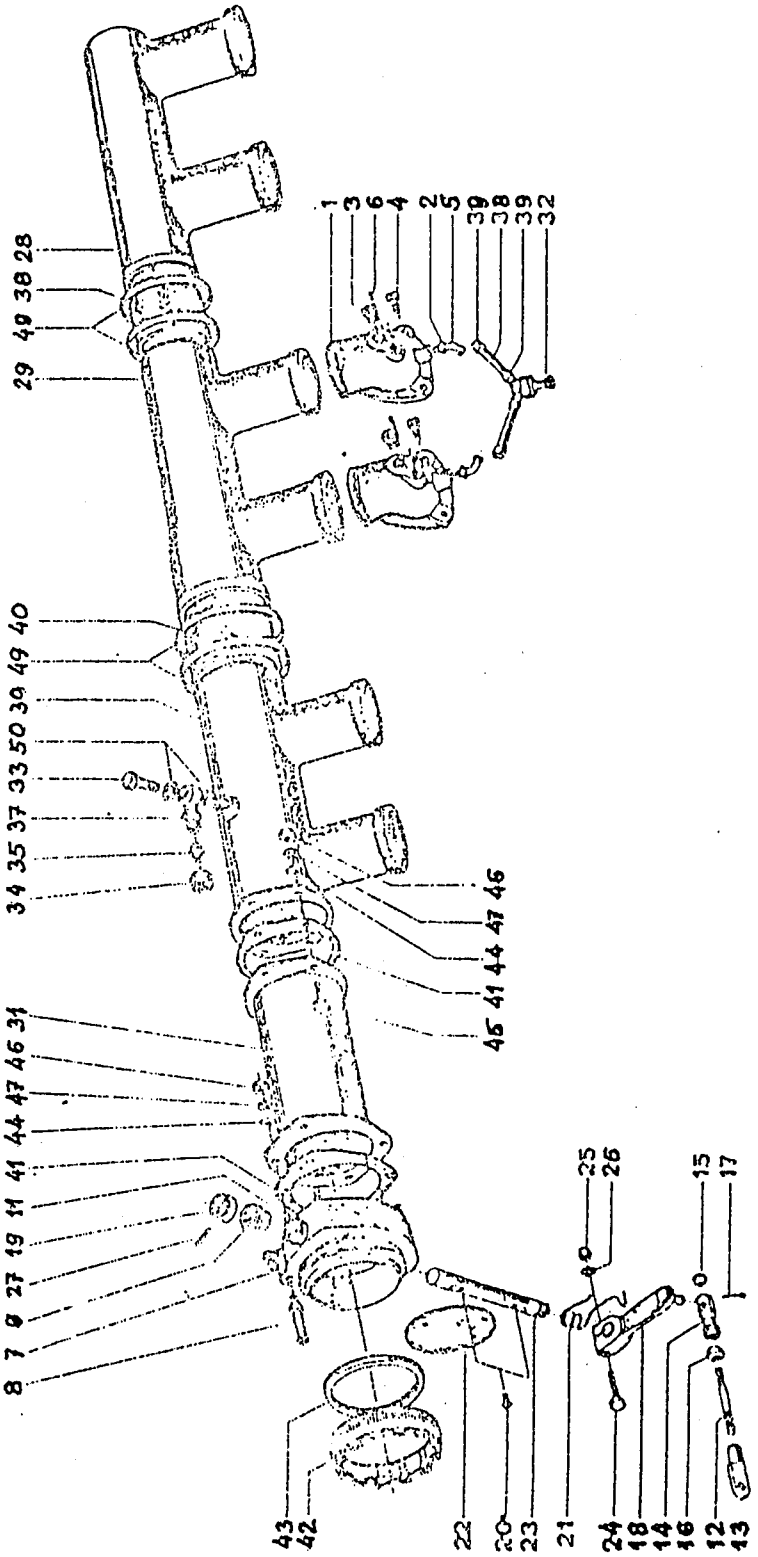

Fig. 9-2

M137A

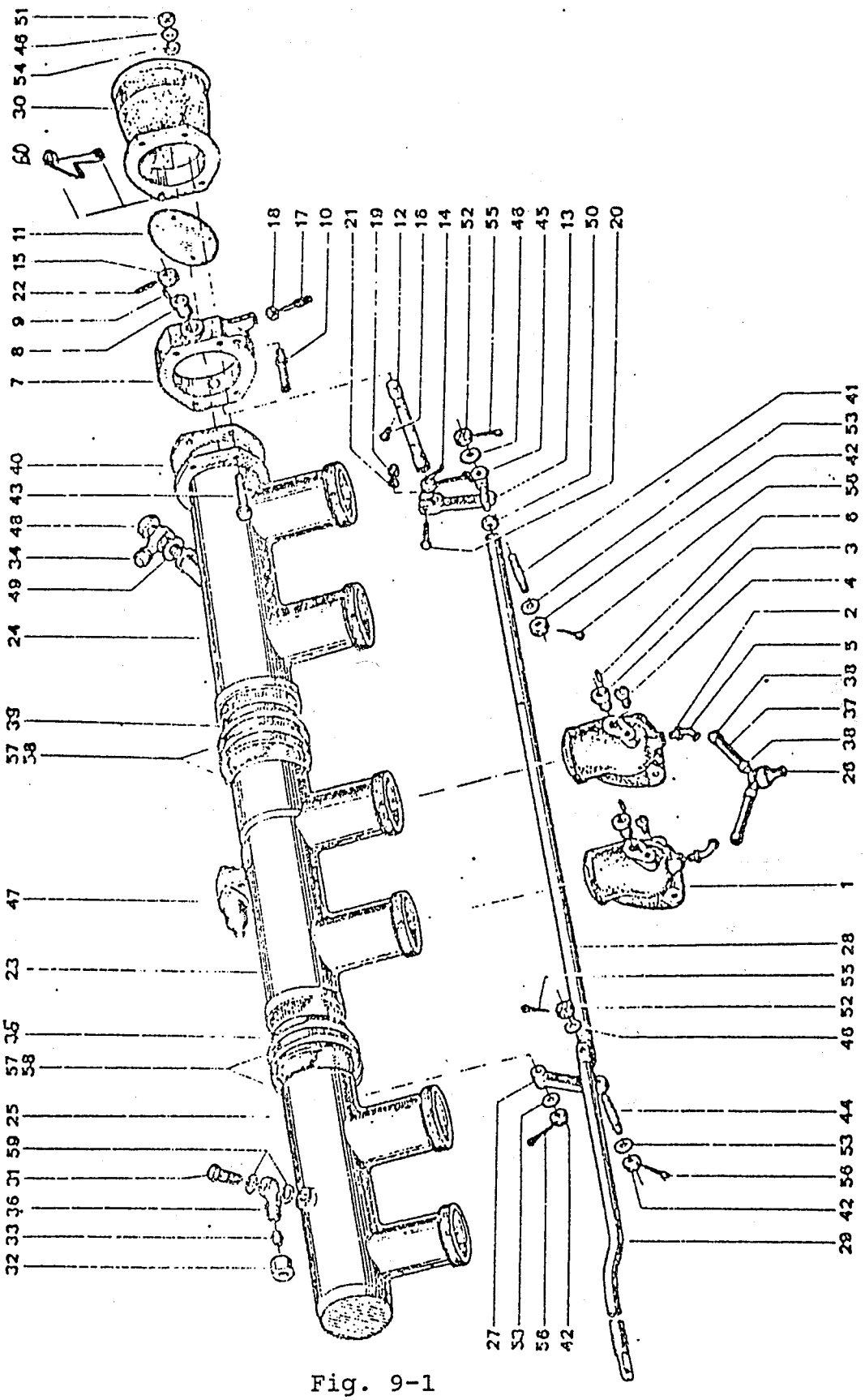
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Fig. 9-1

Pos.	Designation	p/n	Qty.	Remark
32.	Seal	8x12 CSN 03 9310.3	2	
33.	Exhaust stack, 1st cyl.,compl.	Sc 0785	1	(M 332)
34.	Exhaust stack, 2nd cyl.,compl.	Sc 0786	1	(M 332)
35.	Exhaust stack, 3rd cyl.,compl.	Sc 0787	1	(M332) Sc 0078
36.	Exhaust stack, 4th cyl.,compl.	Sc 0788	1	(M 332)
37.	Protection nut	Sc 8519	1	Sc 0066
38.	Flange,exhaust	Sc 0669A	1	(M332) Sc 0078
39.	Superch.air conduct, compl.	Sc 0669	1	(M 332)
40.	Superch.air conduct, compl.	Sc 0669A	1	(M 332A)
41.	Injection nozzle	Yc 070	1	Sc 0066
42.	Sealing washer	Yc 707	1	
43.	Eye-type fitting	Sc 5456	1	
44.	Clamp	5 CSN 02 2752.9	2	Sc0066 unshown
45.	Fixing strip	5x1200 CSN 02 2757.9	1	
1a	Fitting set-nut	Sc 6637	4	Sc 0663A,B unshown
19a	Nut	Sc 6736	1	unshown
19b	Lock-nut M4,compl.	057 2351	1	Sc0665 unshown
19c	Washer	4,3 CSN 02 1701.14	1	unshown
18.	Front stack,compl.	Si 0688	1	(M332A)

Pos.	Designation	p/n	Qty.	Remark
1.	Drain fitting	Sc 6650	4	
2.	Intake elbows	Sc 6636	4	
3.	Thread insert	Sc 6642	4	Sc 0663 A,B
4.	Clevis-type inject. nozzle holder	Sc 6643	4	
5.	Cylindric pin	2x16 CSN 02 2150.2	4	
6.	Throtlle housing	Sc 6620	1	
7.	Stud	M4x18 LMN 3169	4	Not shown Sc 0666
8.	Bushing, throt. shaft	Sc 6619		
9.	Fitting,air cor.inlet	Sc 6632	1	
10.	Throttle lever	Sc 0667	1	
11.	Distance bushing	Sc 6617	1	
12.	Throtle plate	Sc 6621	1	
13.	Throtlle shaft.	Sc 6622	1	
14.	Throtlle screw	Sc 6623	2	Sc 0665
15.	Screw	M4x20 CSN 02 1101.44	1	
16.	Throtlle spring	Sc 6627	1	
17.	Adjusting screw	Sc 6735	1	
19.	Elastic pin	2x14 CSN 02 2156	1	
20.	Front stack,compl.	Sc 0661	1	(M332)possible to use Si 0688 on M 332
21.	Central stack,compl.	Sc 0662	1	
22.	Drain valve,compl.	Sc 0670	2	
23.	Hollow screw	Sc 1517	1	
24.	Rubber sleeve	Sc 6618	1	
25.	Orientable fitting	Sc 6633	1	
26.	Gasket	Sc 6646	1	
27.	Hose,drain valve	Sc 6657	4	
28.	Hose end piece	Sc 6658	8	
29.	Thin washer	017 7821	4	
30.	Nut	M4 CSN 02 1403.44	4	
31.	Elastic washer	4,1 CSN 02 1740.04	4	

pin and disassemble the stop ring and the correction hub with its lever.

Remove securing pin from the hub areting sector and then the areting device. When disassembling the areting housing,after the areting locations sector has been extracted, the ball and the spring leap out.

Inspect each part, dress out damages or replace.

Remake the surface protection.

9.7.5. Measure each diameter, observe prescribed dimensions and clearances.

When reassembling the areting sector to hub, use M4 screws (see table). Secure screws after tightening by punching.Coat the shaft and the moving parts with NH-2 grease during reassembly.

9.7.6. If mounting new correction and throttle hubs, use the P 137-392 fixture to drill together.Ream the ϕ3 mm hole with a tappered reamer. Observe the axial clearance between correction hub and the stop ring, loose fit L=0.1 mm. The clearance between the throtlle hub and the hub holder is, loose fit L_{ax}=0.1 mm. Secure the 2x16 mm cylindric pins by punching. Reassemble.

9.7.7. When reassembling the correction hub on the cantilever shaft, observe the clearance between sector hub and cantilever shaft, loose fit L=0.016-0.052 mm. Check control levers for correct limit positions.

NOTE:

The Sh 6786 sector hub must be chamfered to 0.8x45° due to the M4 screws.

See Fig. 9-5, 9-6, 9-7

Designation	p/n	M137 A	M137 AZ	M337	M337 A	M337 AK	M332	M332 A
Throttle lever	Sc 0667						x	x
Rod lever	Sh 0696	x						
	Sh 0653		x					
	Sh 0684			x	x	x		
Pipe nut	Sh 6690		x					
Throtlle shaft	Sh 6678	x	x	x	x	x		
	Sc 6622						x	x
Throtlle plate	Sh 6677	x	x	x	x	x		
	Sc 6621						x	x
Distance shim	Sc 6617	x	x	x	x	x	x	x

9.7. CONTROL CANTILEVER.

It forms a bulkhead,from where the throtlle and the injection pump controls are connected to the cockpit controls.The Model M 137 and M 337 cantilever differs from Model M 332 cantilever by the length of the control levers and by the areting device of Model M 137 and M 337 - see table.

Disassembly of the whole cantilever is carried on if necessary for the visual inspection.

It is allways necessary to remove the greaser, clean the rests of old grease and add fresh NH-2 grease.

9.7.1.Cleaning

It is performed in technical gasoline.

9.7.2.Failure Inspection.

Mark damaged levers, loose parts, parts with damaged surface protection, corroded and cracked parts.

Clearances are indicated in the "Tolerances and Fits" sect.

9.7.3.Repair, Reassembly.

Fasten the cantilever in the P 137-392 fixture. Remove the greaser pos.10. Measure the axial clearance of the levers at the correction and throtlle hub. Loose fit L=0.1 (max.0.2) mm. If greater clearance,remove levers.

9.7.4.Remove the clevis with pin from the throtlle hub. Remove the securing pin from the hub distancer and extract the distancer the hub together with the lever. Remove securing

pin and flare its ends.

9.6.2. Mount the spring and the lever to the shaft throtlle in such a manner to achieve a 42°30′ range or 47°30′ at Model M 332. Verify by means of the P 137-149 fixture.
Install the washer and the screw and tighten the nut.
Check the throtlle for free movement.
The spring must return the throtlle from every position.

Intake Manifold

Designation	p/n	M137 A	M137 AZ	M337	M337 A	M337 AK	M332	M332 A
Intake manif.scoop	Sh 0669A	x						
	Sh 0688AK	x						
Rear stack	Sh 0693		x		x	x		
	Sh 0669			x				
Central stack	Sh 0664	x/AK/	x	x	x	x		
	Sc 0662						x	x
	Sh 0687	x						
Front stack	Si 0688		x		x	x		x
	Sc 0661			x			x	
Superch.air inlet	Sh 0685			x				
	Sc 0542						x	
	Sc 0669						x	
Front air inlet	Sh 0691				x	x		
	Sc 0669A							x
Superch.air inlet	Sh 0686			x				
Rear air inlet	Sh 0690				x	x		
Intake elbow	Sh 6659	x	x	x	x	x		
	Sc 0663A,B						x	x
Throlle housing	Sh 0695	x						
	Sh 0651		x		x	x		
	Sh 0681			x				
	Sc 0666						x	x
Throttle lever	Sh 6804	x						
	Sh 0652		x					
	Sh 6685				x	x		
	Sh 0682			x				

Tighten the M4 nuts with washers. Mount the Sc 1517 hollow screw with the Sc 6633 and the 8x12 mm seals to the rear stack. Mount the Sh 1601 obturating bevel with the Sc 1522 nut to the orientable fitting.
Mount the Sh 0684 rod to the throtlle lever. Install the Yc 070 injection nozzle together with the Yc 707 sealing and the Sc 5456 fuel supply eye-type terminal to the supercharger intake elbow. Joint the front and rear stacks of the supercharger intake manifold by means of the rubber sleeve.
Install the fixing strips with clamps.

See Fig. 9-3

9.5.4. Model M 332.

Install the rubber sleeve on the front stack and connect with the central stack. Mount the fixing strips with clamps. Install the sealing with assembled throtlle to the central stack and tighten the M4 nuts with washers. Mount the Sc 1517 hollow screw with the Sc 6633 and the 8x12 mm seals to the central stack.

See Fig. 9-4

9.6. THROTLLE REASSEMBLY

Measure both bushing: in the housing - $\phi 8^{+0}/_{-0.015}$ mm and from the throtlle shaft end- $\phi 8^{-0.013}/_{-0.028}$ mm. Loose fit : L=0.013-0.043 mm - max. 0.06 mm.

9.6.1. Insert the throtlle shaft together with the distance bushing into the housing bushing.Install the throtlle plate into the canal in shaft and fasten by means of the two screws. Check the throtlle plate mating on the contour. In must be tight along the whole contour. Admitted deviation : max. 0.02 mm along 1/6 of the length.Check for tightness against light by means of a 0.03 mm thick feeler gage. It may not protrude. Verify the clearance between bushing front and distance shim, L=0.1-0.3 mm. Check the throtlle for free and continous movement. Secure the screws on the P 137-150 fixture.

NOTE:

When mounting a new shaft, provide a 0.1 mm clearance between the bushing front and the distance shim, drill a $\phi 2$ mm hole together in distance shim and shaft, tap the 2x14 mm elastic

Align stacks in plane and easyly tighten the fixing strips. Finally tighten after reassembly on the engine. Mount the hollow screw with orientable fitting and 8x12 mm seals to the rear stack. Obturate the fitting by means of the Sh 1601 bevel and the Sc 1552 nut.

Install the Yc 070 injection nozzle with seals and the Sc 5456 orientable fitting to the front stack and obturate. Tighten during engine reassembly. Install the lever with washer and nut on the pin from the rear stack and tighten. Check the lever to pin axial clearance, L_{ax}=0.1-0.2 mm. Mount the rod with eye terminal, washer and the Sh 6807 nut to the front lever. Mount the connected rods with washer and nut to the rear pin and tighten. Check the axial clearance of the lever on pin L_{ax}=0.1-0.2 mm. Secure by 1x12 mm cotter pins consequently to engine reassembly and rod adjustment.

See Fig. 9-1

9.5.2.Model M 137AZ.

Install the rubber sleeve on the central stack and connect to the front stack. Mount the fixing strips with clamps. On the central stack, install the second rubber sleeve, connect to the rear stack and mount the fixing strips with clamps. Fasten the intermediate stack past the seal to the rear stack by means of M4x12 mm screws, washers and nuts. Install the seal with the assembled throtlle on the intermediate stack and tighten the M4 nuts with washers.Mount the Sc 1517 screw with orientable fitting and 8x12 mm seals to the rear stack. Assemble the Sh 1601 bevel and the Sc 1522 nut to the orientable fitting. Fasten the Sh 0653 rod to the throtlle lever. Adjust rod length following assembling on engine.Tighten the fixing strips during mounting on engine.

See Fig. 9-2

9.5.3.Model M 337A,AK.

Install the rubber sleeve on the front stack and connect with the central stack. Mount the fixing strips with clamps. On the central stack, install the rubber sleeve, connect to the rear stack and mount the fixing strips with clamps. Install the sealing with assembled throtlle to the front stack.

Remake damaged surface protection.

9.3.4. Throtlle Lever.

Cracked lever - discard.

Deteriorated surface protection - remake by zinc plating.

Pin hole enlarged beyond ϕ5.55 mm - discard.

9.3.5. Control Rod Lever (M 137).

Cracked lever - discard.

Hole wear beyond ϕ6.05 mm and ϕ55 mm - discard.

Deteriorated surface protection - remake.

9.3.6. Lever Pin.

Mutilated thread - discard.

Pin wear beneath ϕ5.48 mm and ϕ4.46 mm - discard.

Apply magnetic inspection to check for cracks - discard.

9.4. REPAIR,REASSEMBLY.

Intake Elbows.

Straighten mating surfaces, possibly lap.

Replace damaged clevis-type injection nozzle holders.

Recondition the taper and the thread of the intake manifold nut. Chamfer sharp edges of the flange and dress out scoring produced by washers on the mating surface.

Calibrate the M9x1.25 thread from the nozzle thread insert.

9.4.1. Install the clevis-type injection nozzle holders, the fuel drain fitting with nut. Locate in position conforming to Fig.

9.5. INTAKE MANIFOLD REASSEMBLY.

Place cleaned components on the work bench. Inspect mating surfaces, nuts and threads.

9.5.1. Model M 137A.

Install the rubber sleeve on the central stack and connect to the rear stack. Mount the fixing strips with clamps. On the front stack, install the rubber sleeve, connect to the central stack and mount the fixing strips with clamps. Install the sealing with assembled throtlle to the front stack and the intake scoop to the throtlle housing. Fasten by means of the Sh 6808 screws, washers and nuts. Meanwhile mount the throttle lever stop on the left side of the intake scoop.

lapping,
-injection nozzles thread for condition-discard if mutilated,
-intake stacks nuts M 52x1,5 thread for condition - discard if mutilated (severely damaged). Light damages (one half of the first thread winding) may be repaired by recalibration with a suitable thread die,
-sealing taper for condition - dress out light damages by lapping and filing,
-drain fitting thread for condition - discard if mutilated,
-paint for condition - remake if damaged,
Structural Inspection:
Check for cracks applying the fluorescent method.

9.3.2. Intake Stacks.

Visually Inspection:
Straighten indents not deeper than 0.8-1.5 mm. Discard the part if deeper.
Dress out deformation of the mating surfaces.
Superficial wear not deeper than 0.3 mm - dress out, deeper than 0.3 mm - weld.
Mutilated tube nut thread, damaged tube nut-discard affected item.
Damaged surface protection - chemically remove by dipping.
Loose rivets or deflector at the M 137A p/n Sh 0687 front stack - redrive six ϕ3 mm riveets.
Weld max. 10 mm long cracks and perforations.

9.3.3. Throtlle Housing.

Discard throtlle with indents and severe corrosion.
Light damaged housing - discard.
Mutilated air fitting thread - discard.
Damaged air inlet fitting - replace.
Housing lightly damaged taper and thread - repair. If damage is more severe - 1 tread or more - reject housing.
Damaged and corroded shaft - replace.
Damaged or corroded reset spring - discard.
Ream bushing showing an out-of-roundness greater than 0.2 mm and then chrome plate the shaft end. Observe the loose fit L=0.013-0.06 mm. If severe wear, replace bushing.

9. INTAKE SYSTEM

The intake system consists of the different sub-parts of the intake manifold, of the throtlle body, of the intake elbows and of the compressor intake manifold at supercharged engines. Each pair of elbows is connected by two short hoses to a drain valve, which collects and drains out the fuel in excees from starting. The different components of the intake system are joined by means of rubber sleeves according to the requirements of flexibility of the system. The throtlle is actuated over the rods from the control cantilever. The intake manifold is provided with injection nozzles and a priming fuel line to boost starting when engine is cold. Repair, inspections, reassembly refers to each part in the list. Differences between parts are set forth in the table.

9.1. DISASSEMBLY

Remove different rubber stripes and sleeves and disconnect the stacks.Disassemble the injection nozzles from each stack and the fitting of the priming fuel line. Disconnect throtlle.

9.1.1.Throtlle Dismount.

Loose throtlle lever screw,remove lever and spring. Dismount rod clevis from lever. Drill and loose the two screws fixing the throtlle obturator on the control rod.Remove the elastic pin and the distance bushing from the other shaft end.Extract the throtlle shaft.

9.2. CLEANING

Remove all sealing and its rests from mating surfaces. Wash all companent parts of the intake system in technical gasoline.

9.3. INSPECTIONS

9.3.1.Air Intake Elbows P/N Sc 0663, Sh 0663.

Visually check:

-intake elbows mating surface for true shape - dress out by

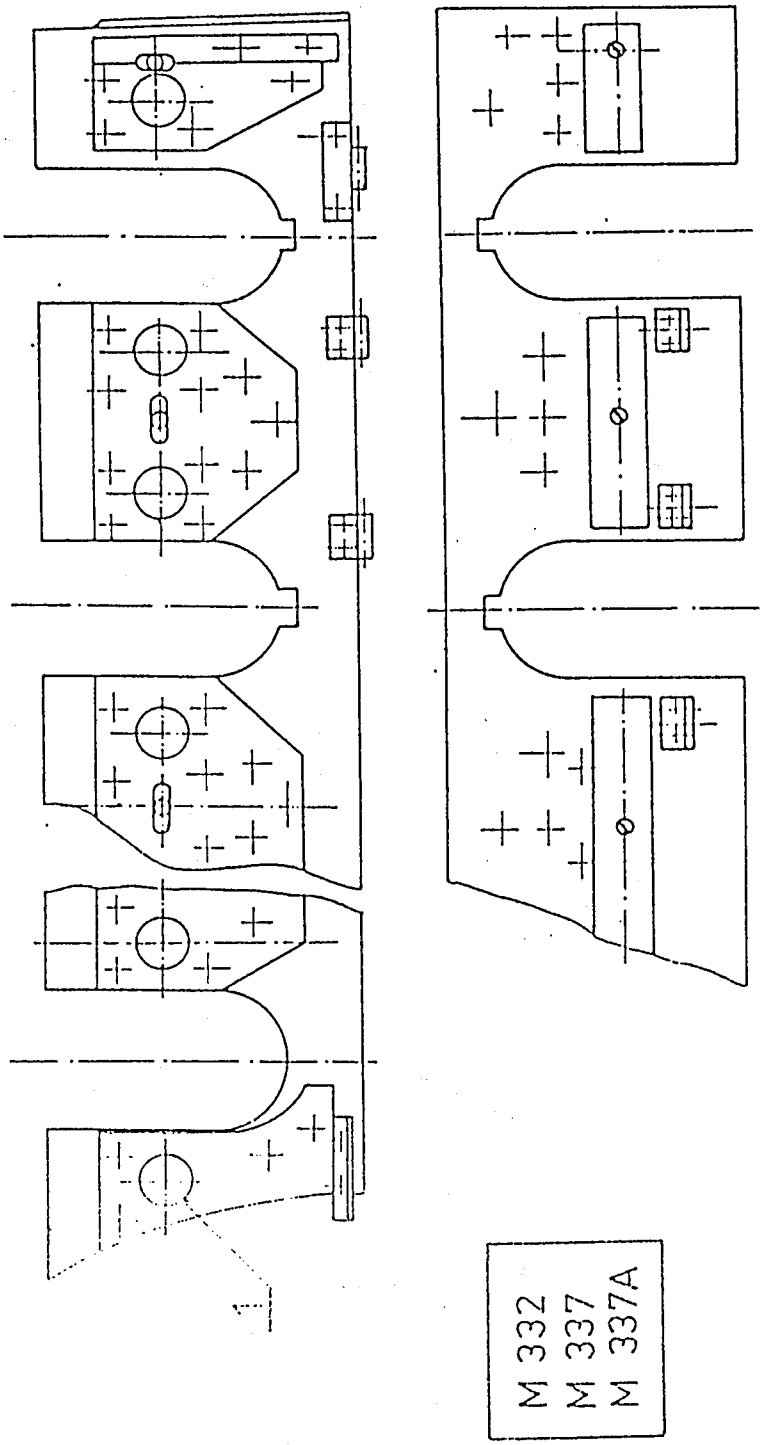
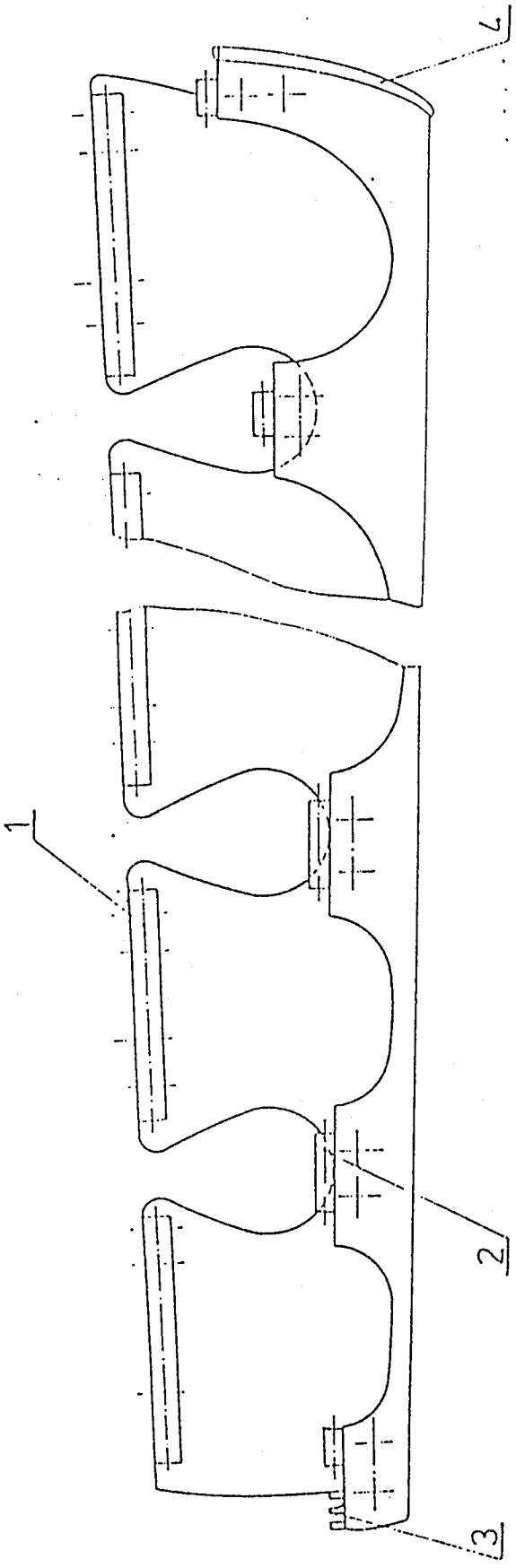

Air Scoop Lower Part
1 Modification for cyl.head torquing
M 332
M 337
M 337A

Fig.8-6

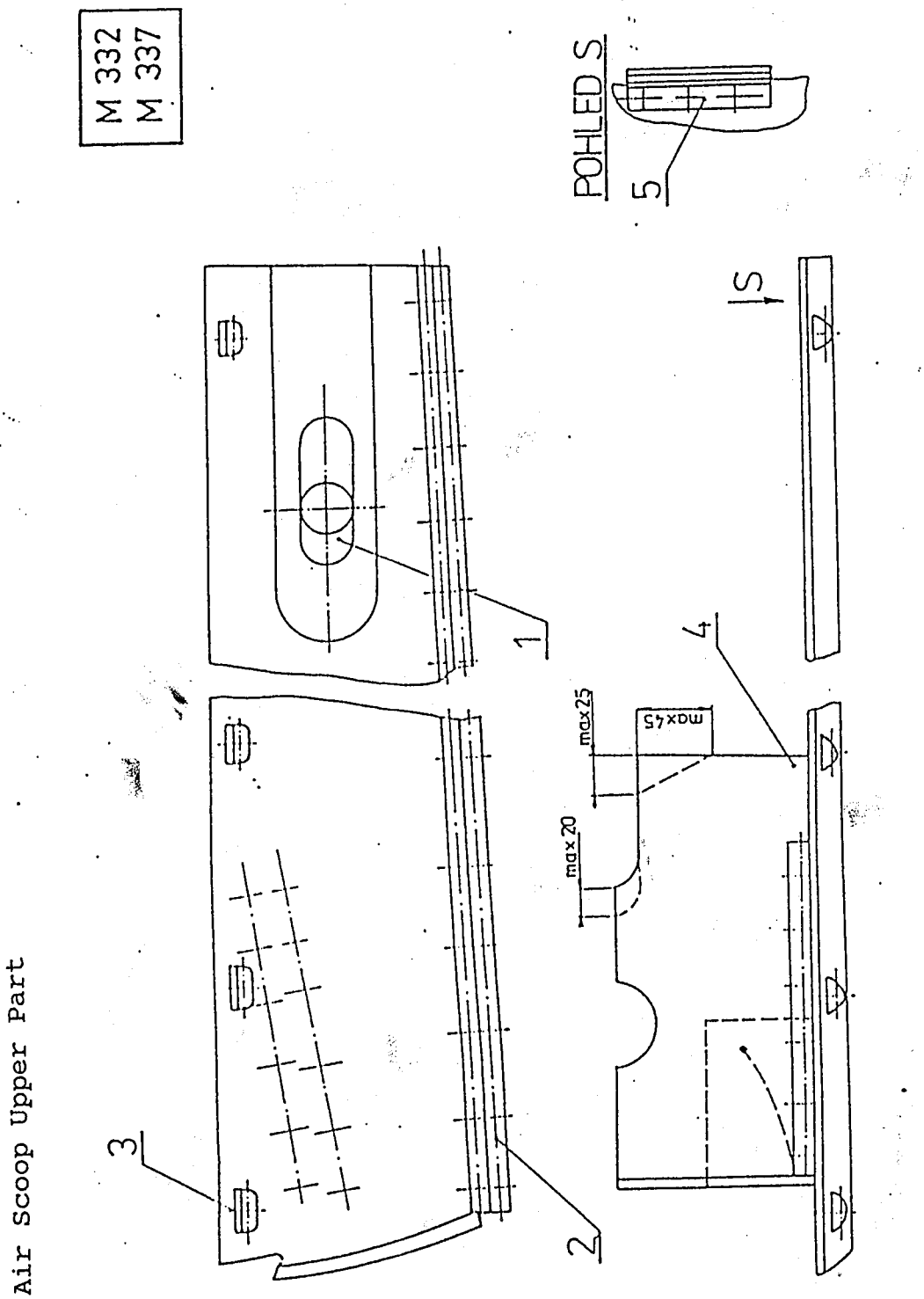
M 332
M 337
M 337A



Air Scoop Central Part

1,2 Brackets,Hinges
3,4 Stiffeners,Ribbing

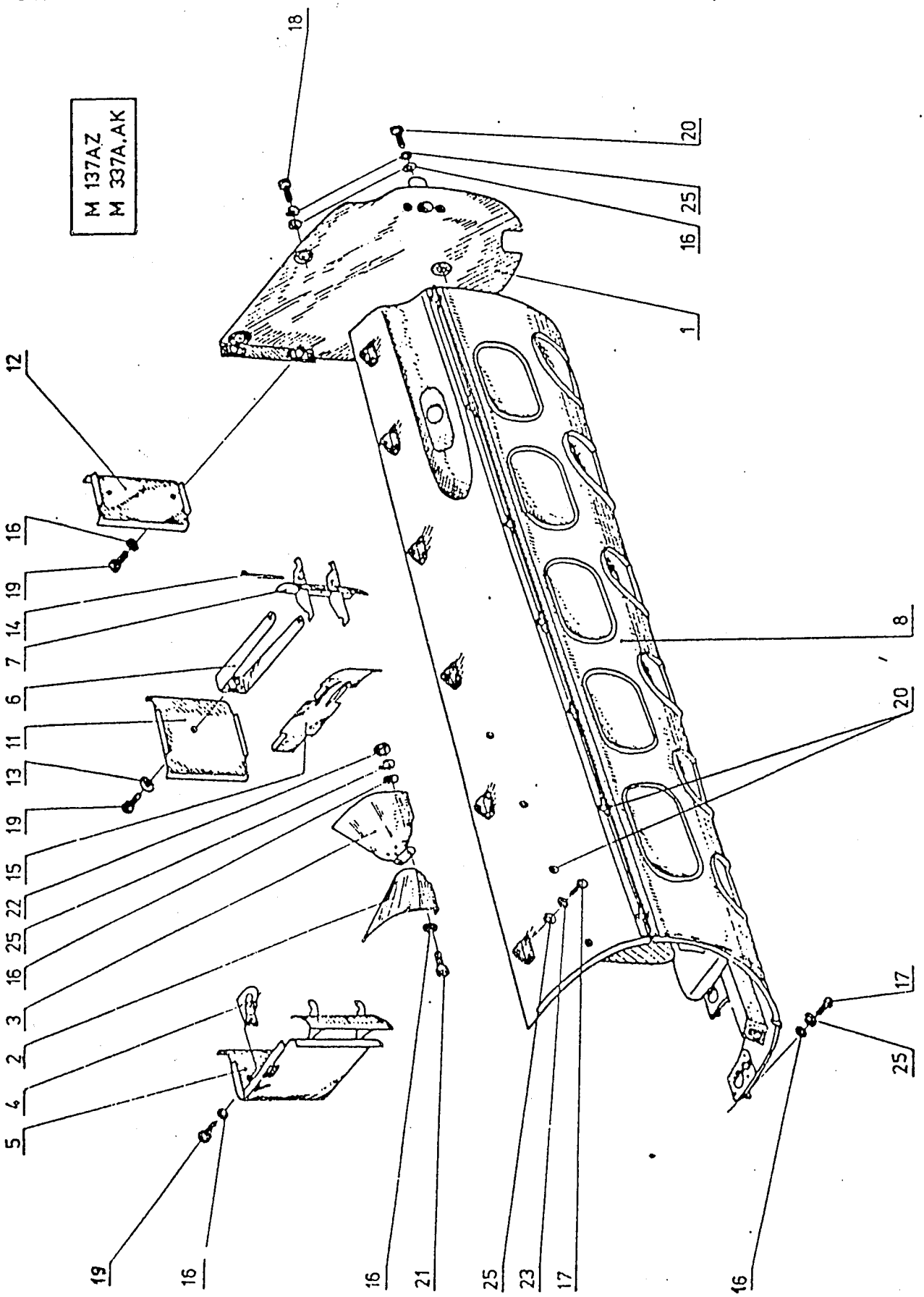
Fig.8-5



Air Scoop Upper Part

1 Generator cooling hole
2 Mounting L-profile
3 Brackets
4 Baffle

Fig.8-4


M 137AZ
M 337A,AK
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22
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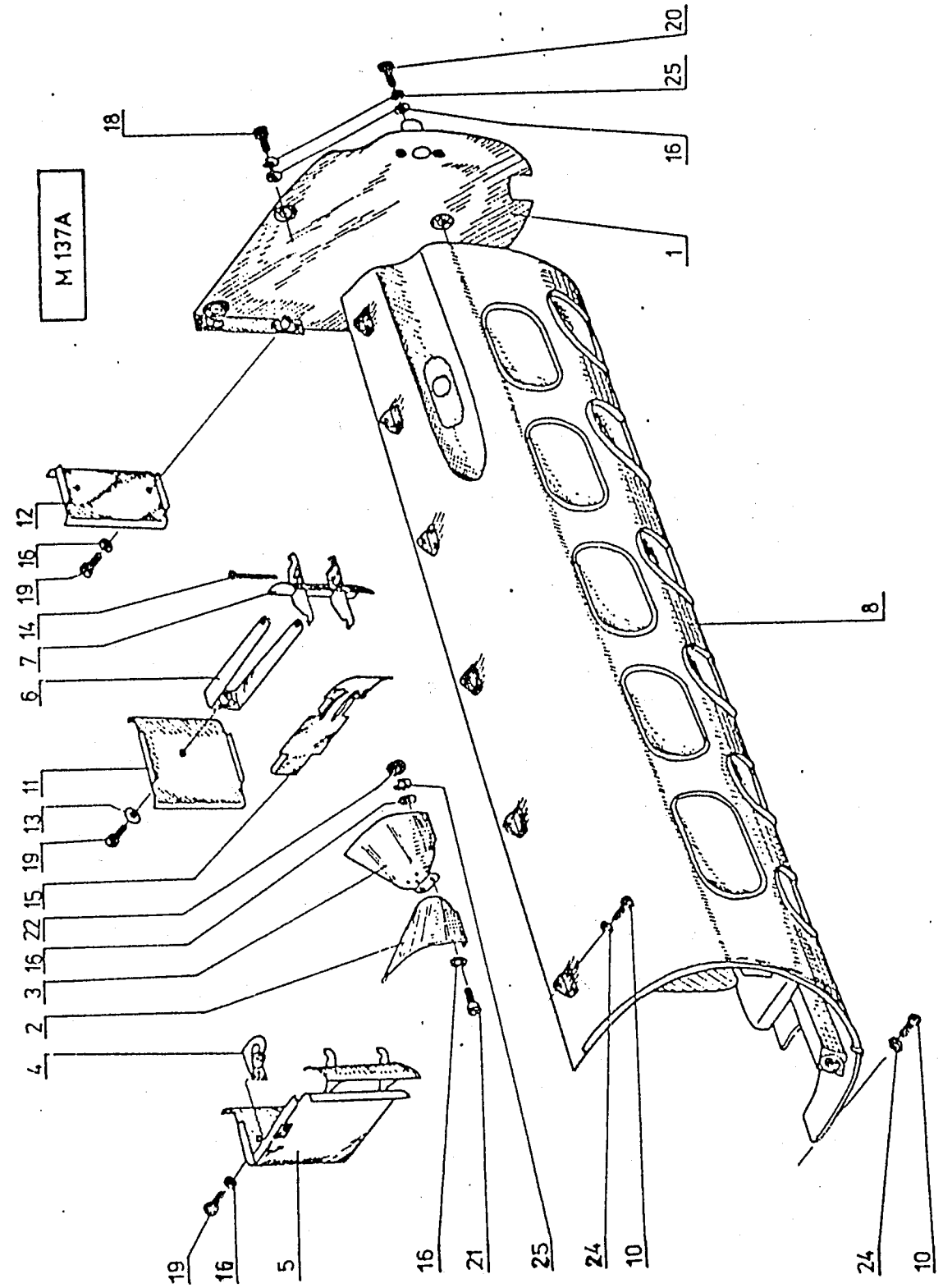
Fig.8-3


M 137A
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12
16
19
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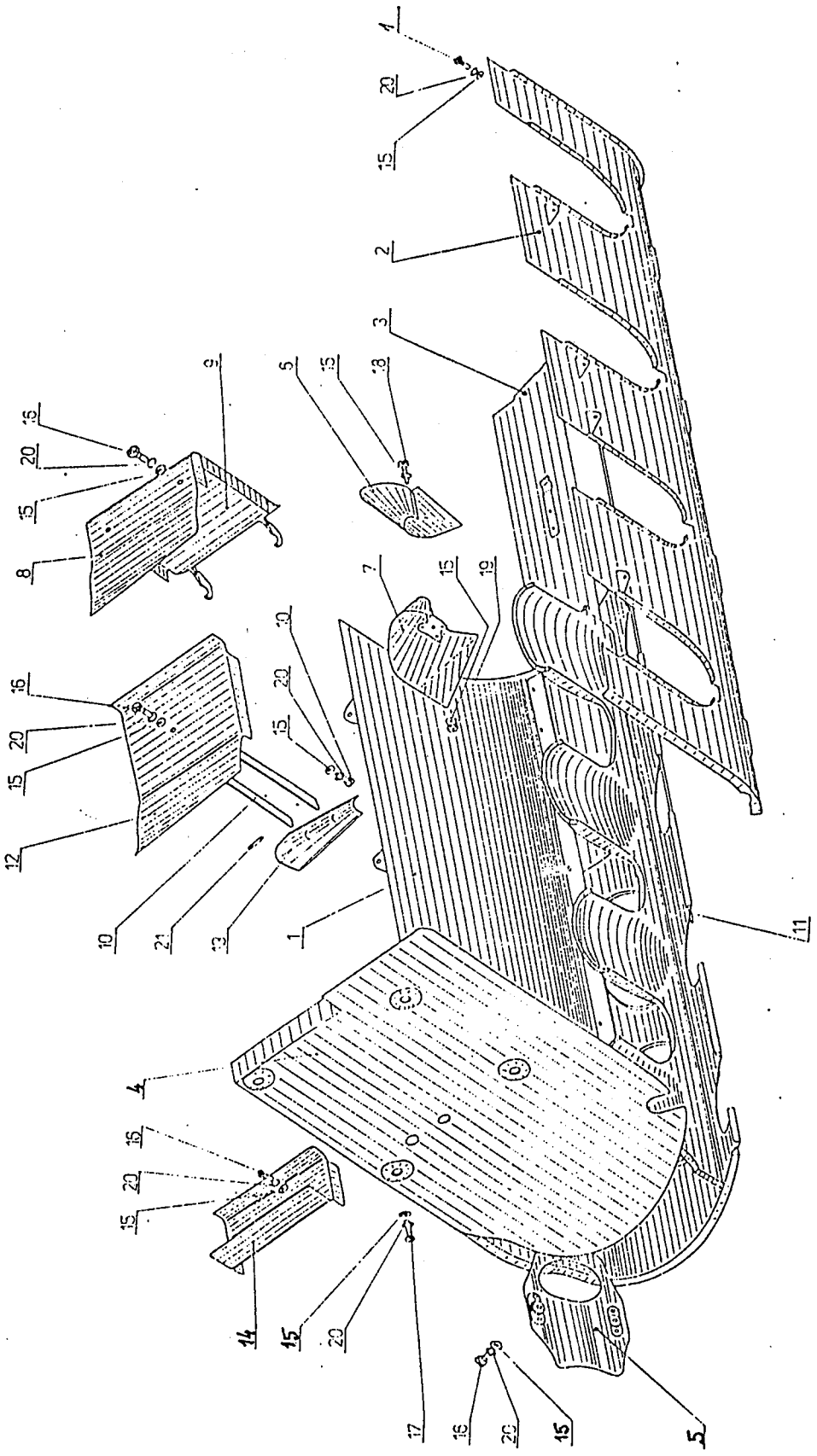
Fig.8-2


1
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16
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15
12
10
21
13
1
11
4
16
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14
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20
15
5

Fig.8-1

M 332 Fig. 8-1

Pos.	Designation	P/N//Spec.	Qty.	Remark
1	Air scoop-upper part	Sc 0773	1	
2	Air scoop-lower part compl.	Sc 0774	1	
3	Scoop access sheet-compl.	Sc 0775	1	
4	Scoop rear wall-compl.	Sc 0764	1	
5	600 W generator baffle	Sc 7626	1	
6	Cyl head baffle-front part compl.	Sc 0768	4	
7	Cyl.head baffle-rear compl.	Sc 0769	4	
8	1st cyl. baffle-compl.	Sh 0790	1	
9	1st cyl. baffle joint-compl.	Sc 0771	2	
10	Fixing bracket-compl.	Sh 0791	3	
11	Scoop hinge needle	Sc 7621	1	
12	Inter cylindric baffle	Sh 7686	3	
13	Slot between cyl.-compl.	Sh 0792	3	
14	Rear cyl. baffle	Sh 7687	1	
15	Thin washer	0177831	36	
16	Screw	M4x10 CSN 021131.24	18	
17	Screw	M4x12 CSN 021131.24	2	
18	Screw	M4x18 CSN 021131.24	8	
19	Nut	M4 CSN 021401.24	8	
20	Elastic washer	4,1 CSN 021740.24	21	
21	Cotter pin	Sh 7692	3	
22	Rubber sleeve	8 LDN 2501	1	unshown
14a	Washer	Sh 7691	3	

8.4. LIGHTLY damaged deflectors or with worn edges, where the removed material does not exceed 5-7 mm from edge may be repaired to a continous contour.
Replace damaged supports and brackets.
Scoring and scratches to 0.3 mm depth, dress out.

8.5. LIST of PARTS for EACH MODEL

Designation	P/N	Qty M137A	M137AZ	M332	M337A	M337AK
Rear wall	Sh 0765	1	1		1	1
Rear wall	Sc 0764			1		
Cyl.head baffle,front	Sc 0768	6	6	4	6	6
Rear cyl. baffle	Sh 7682			1		
Cyl.head baffle,rear	Sc0769	6	6	4	6	6
Scoop access sheet	Sc 0775			1		
1st cyl.baffle joint	Sc 0771	2	2	2	2	2
Generator baffle	Sc 7626			1		
1st cyl. baffle	Sh 0790	1	1	1	1	1
Needle	Sc 7621			1		
Fixing bracket	Sh 0791	1	1	1	1	1
Scoop,lower part	Sc 0774			1		
Scoop,upper part	Sc 0773			1		
Scoop	Sh 0781		1		1	1
Scoop	Sh 0796	1				
Intercyl. baffle	Sh 7686	5	5	3	5	5
Rear cyl. baffle	Sh 7687	1	1		1	1
Baffle between cyl. heads	Si 7693	5	5		5	5
Slot	Sh 0792	5	5	3	5	5

8. COOLING SYSTEM

Due to the necessity of an efficient cooling, the engine is provided with a system of baffles, which direct the cooling air flow to achieve an efficient cooling of all engine's cylinder and heads.
These baffles are made from aluminium alloy sheet and are profiled with respect to the requirements of a high efficiency. They are provided with visiting holes to facilitate the ignition system inspection.
The air scoop equipping the M 137A, AZ and M 332A is composed from two parts. The M 337A, AK model air scoop is composed from three parts. It is possible to dismount into individual sub-parts and to repair independently each one.

8.1.CLEANING

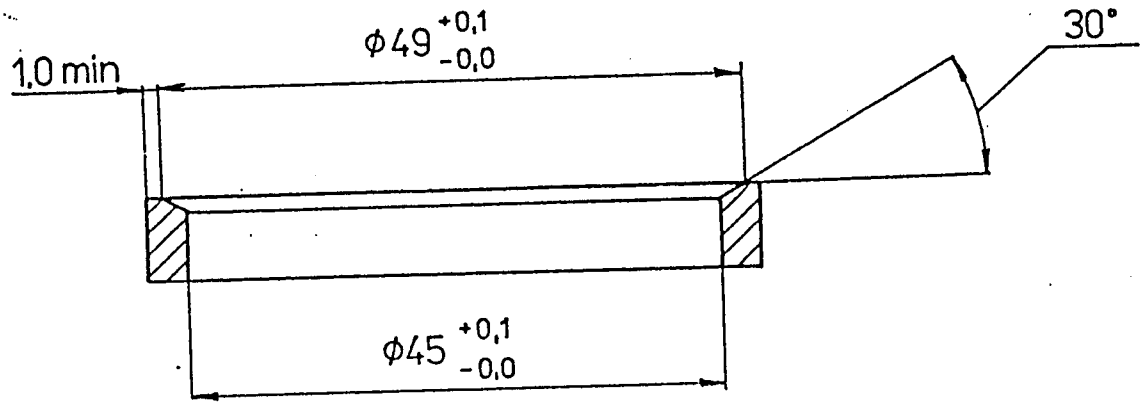
Clean each sub-part separately in technical gasoline.

8.2.INSPECTION

Deformations, indentations of the scoop, deflectors-straighten, repair, replace.
Damaged surface protection - anodize.
Loose rivets, brackets - replace.
Broken parts or cracked - replace.

8.3.REPAIR, REASSEMBLY

Straighten indicated parts,replace the damaged or loose rivets and stiffeners.
Drill possible cracks (to max. length 10 mm).
Visually inspect each bracket, dress out possible fretting. If severly damaged, drill out the bracket and replace. Rivet back using roundhead rivetd of suitable diameter.
Check the generator cooling baffle for free translation and for its holes condition. Dress out fretting, strighten indents and check for free translation.


1,0 min
ϕ49 +0,1 -0,0
30°
ϕ45 +0,1 -0,0

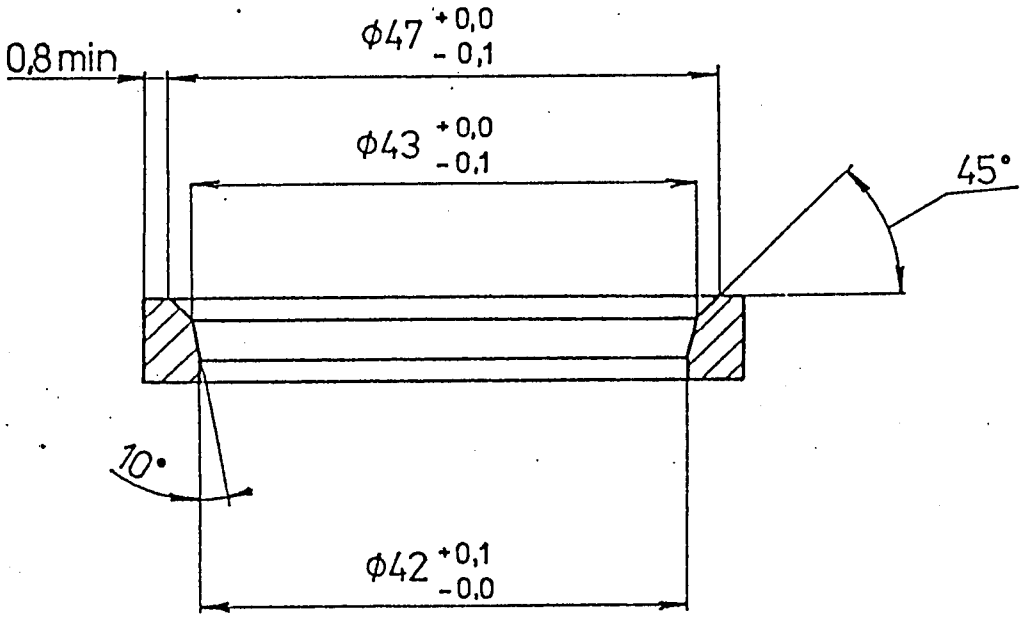

0,8 min
ϕ47 +0,0 -0,1
ϕ43 +0,0 -0,1
45°
10°
ϕ42 +0,1 -0,0

Fig. 7-7

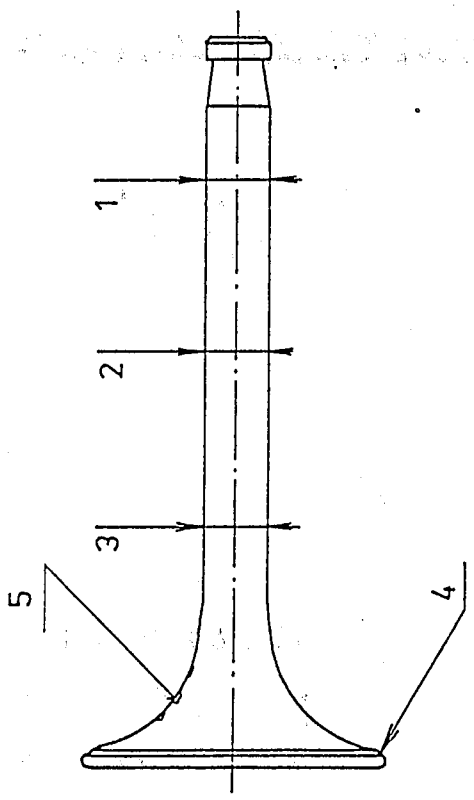


Fig. 7-6

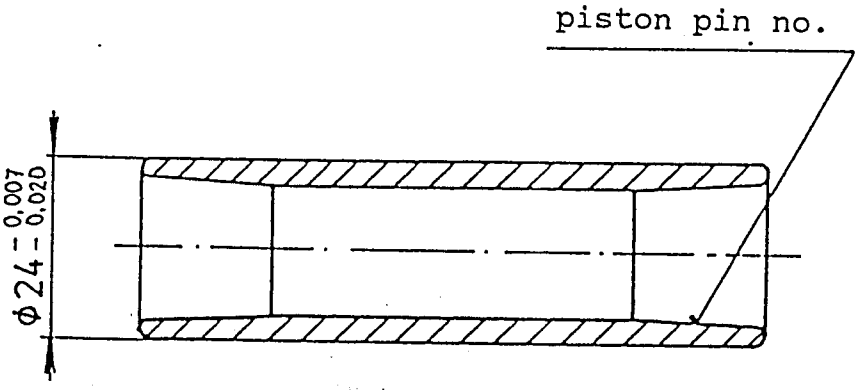


Fig. 7-4

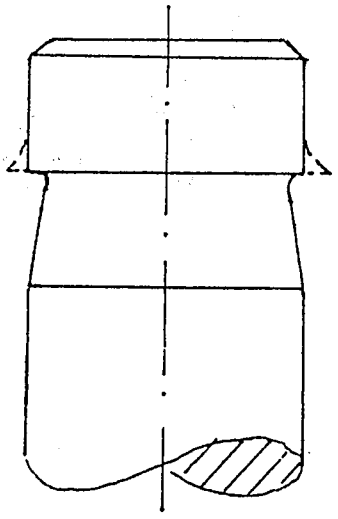


Fig. 7-5

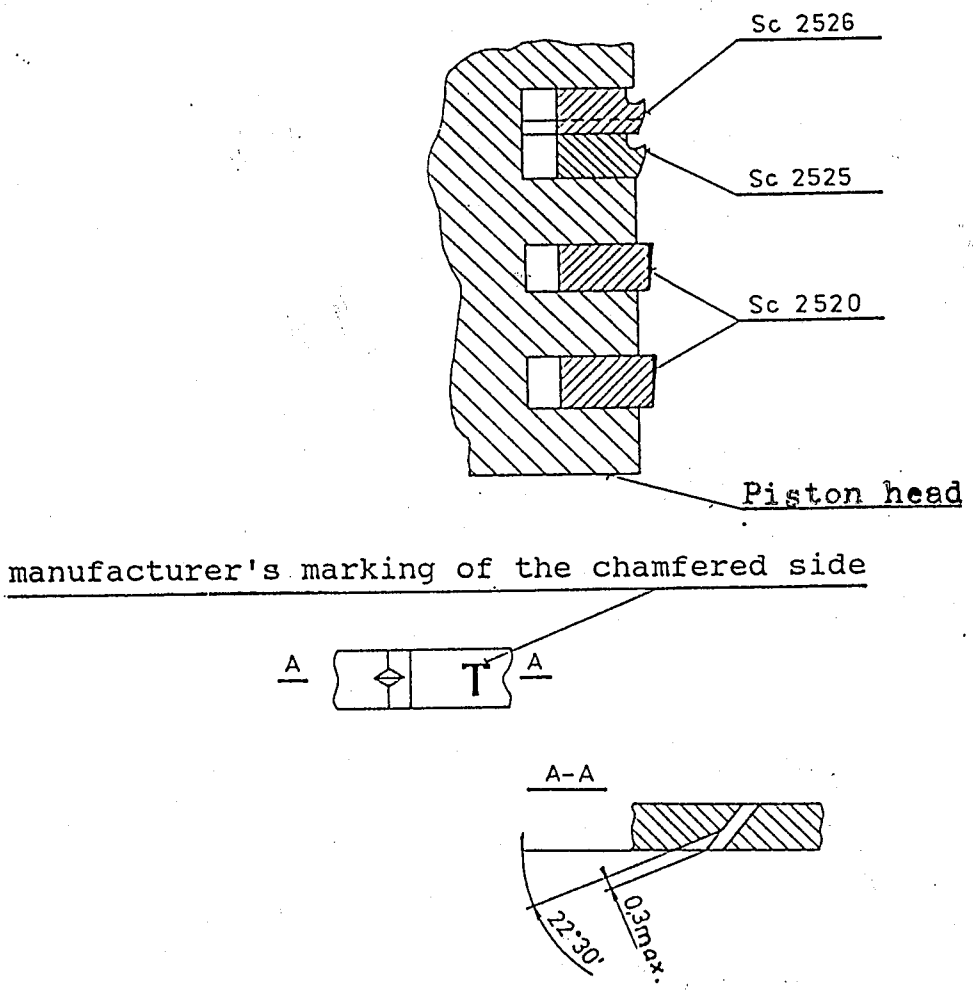
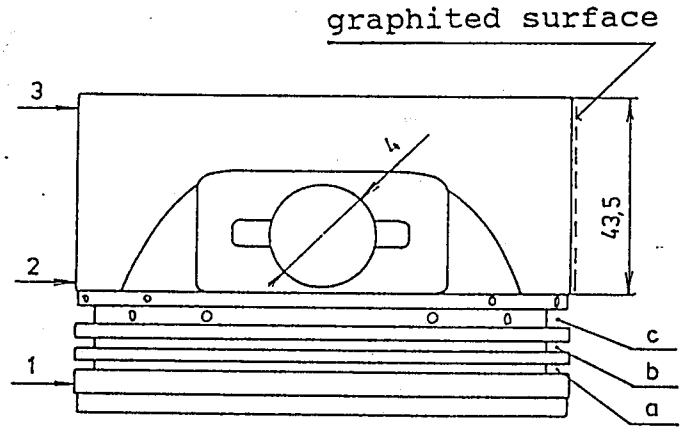

Sc 2526
Sc 2525
Sc 2520
Piston head
manufacturer's marking of the chamfered side
A
T
A
A-A
22°30'
0,3max.

Fig. 7-3


graphited surface
3
2
1
4
43,5
c
b
a

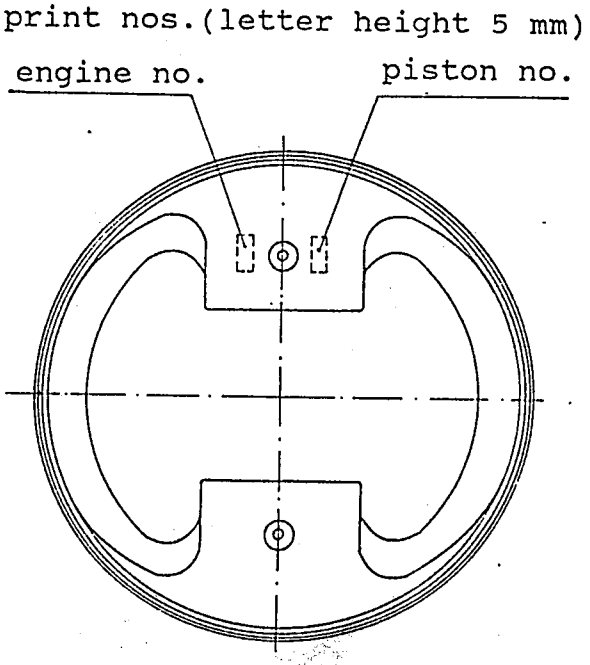
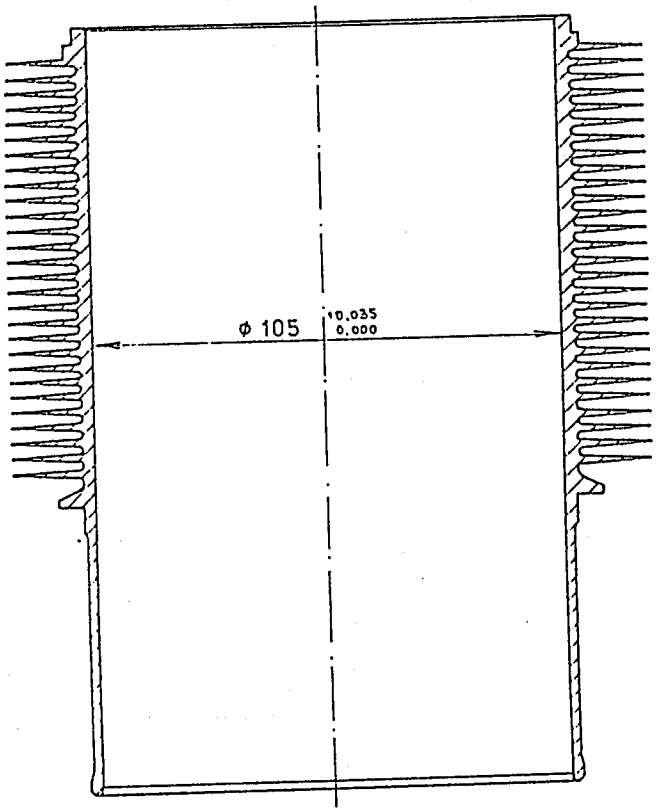

print nos.(letter height 5 mm)
engine no.
piston no.

Fig. 7-2



Sc 2606

Fig. 7-1

a) The Sc 2727 outer spring must indicate a length of 34 mm at a load of 285±14.7 N.
b) The Sc 2726 inner spring must indicate a length of 33 mm at a load of 118.6±6 N.

7.9.3. Prior to remake the surface protection, demagnetize the springs, then grit blast (metal, glass or similar particles) and spray with S 1071 resol dope.
The dope film must be smooth without peeling or accumulations.

7.9.4. Upper Spring Seats.
Galling on the taperred area, scoring caused by springs - reject.
Damaged surface protection - remake protection.
Cracks evidenced applying the magnetic method - reject.

7.9.5. Valve Retaining Keys.
Galling at taper and scoring - reject.
Surface protection - remake.

7.10. CYLINDER BARREL REASSEMBLY.

7.10.1. After damaged parts replacement : valve guides, thread inserts, studs have been replaced, complete the repair.
In case of severe damages of the valve seat, rework it to prescribed angles and dimensions by means of a manual cutter.
Fixtures for the exhaust valve: P 137-067, P 137-068
P 137-072, P 137-073.

See Fig.7-7.

7.10.2. In case of light damages, it may be sufficient to reciprocally polish the repaired valve in its seat using an abrasive paste with oil. The valves must be polished following seat cutting too.
Mount the valves and springs. Fill the intake and exhaust canals with gasoline and check the ventils for leaks.

NOTE :

If leaks are evidenced, dismount again and remake grinding.
Assembly the valves, springs pads spring seats and keys to the head. Use the P 137-076, P 137-077 fixtures.

Scoring, galling not exceeding 0.45 mm - rework and grind valve seat.
Loose valve seat - reject cylinder head.

7.7.6. Check cylinder head for cracks applying the fluorescent method.

7.8. VALVES.

7.8.1. The valves are made from AKVS steel. The exhaust valve is filled up with sodium to improve cooling.

7.8.2. The valves cleaning succeeds by grit blasting.

7.8.3. Exhaust valve stem $\phi\ 10^{-0.05}/_{-0.07}$ mm may be regrind to ϕ 9.93 mm. Beyond 9.91 mm, grind and chrome plate to original ϕ. Observe the loose fit L=0.11 mm max.
The valve sealing face (4) run-out is acceptable up to 0.03 mm - grind and chrome plate.
If run-out exceeds 0.05, reject valve.
Damage, corrosion at the tullip (5) and the sliding area - grind to min. diameter or reject.
Exhaust valve stem diameter : $\phi\ 12^{-0.08}/_{-0.1}$ mm.Respect the loose fit L=0.15 mm.
The valve sealing face run-out (4) to 0.03 mm, grind and chrome. If run-out exceeds 0.05 mm, reject valve.
Damage, corrosion at the tullip (5) and the sliding area - grind to min. diam. or reject.
See Fig.7-6.

7.9. VALVE SPRINGS
The surface protection of the springs is achieved by applying a special dope, which guarantees no changes in spring characteristics. Cadmium plating or similar chemical procedures are not recommended due to material enbritllement and increased possibility of corrosion.

7.9.1. Visual Inspection. Cracked, broken corroded springs - reject.
Evidenced cracks - reject.
Deteriorated surface protection - remake protection.

7.9.2. Dimensional Inspection. The fatigue of the springs is indicated by loading:

number of fins enabling cooling. The ventil seats are shrunk, where the shrink fit measures S=0.18-0.23 mm. The bronze valve guides are shrunk too at a shrink fit S=0.032-0.060 mm. The burning chamber should be cleaned and burnished. The spark plug threaded insert is mounted shrunk at the thread, shrink fit S=0.031-0.051 mm and secured against turning by two 3x6 mm pins. These parts are mounted while chilled in carbonic ice (CO_2).

7.7.1. Cylinder Barrel Removal. Install the head on the fixture, compress the valve spring seats and remove the valve retaining keys and then the seats and the springs.

NOTE:

Visually inspect the valve stem and notice possible enlargement of the key groove upper side. If positive, it is necessary to dress out by means of a stone in order to avoid to damage the valve guide bore when extracting the valve.

See Fig.7-5

7.7.2. Cylinder barrel Cleaning. Washing and cleaning coarse dirt succeeds in a Synalod EFCO 3024 solution for 20-30 min and then the part is rinsed in hot water and air dried.
Deposits and carbon are removed by grit blasting to avoid damaging the valve seats, guides and inserts.

7.7.3. Inspections.

7.7.4. Visual and Dimensional Inspection.
Check the camcase mating surfaces by means of a rule and a feeler gage 0.05. In case of greater deterioration, grind the surface on a surface plate.
Check the thread of all screws and inserts with a suitable gage.
Mutilated, bent or torn thread - reject the screws.

7.7.5. Intake Valve Guide $\phi\ 10^{+0.022}$mm :if wear exceeds ϕ 12.07 mm than reject.
Exhaust Valve Guide $\phi\ 12^{+0.027}$ mm :if wear exceeds ϕ 12.07 mm than reject. The ϕ 12 finish (roughness) should be $\sqrt{0.4}$ - $\sqrt{0.6}$.
Indented valve seat more than 0.5 mm deep - reject.

piston diameter

with graphit		without graphit
1. ϕ 104.00	Fit	
2. ϕ 104.60	+ 0.00	2.min.ϕ 104.50
3. ϕ 104.65	- 0.02	3.max.ϕ 104.75

4. ϕ $24^{+0.01}$-max. ϕ 24.02 mm-otherwise discard.

Piston ring grooves: a+b width=$2.2^{0.014}$ mm
c width=$4.12^{+0.018}$ mm

7.4.6. Check for cracks applying the fluorescent method.

7.5. PISTONS RINGS

Due to wear, the piston rings are allways being replaced during overhaul.
The 1st and the 2nd : compression rings.
The 3rd and the 4th : oil control knife - edged rings.
Install piston rings allways with the marked side toward the piston top.
Use phosphatated compression rings with nitrided cylinder barrels.
Use nitrided compression rings with chrome plated cylinder barrels.
Piston ring gap when assemblied : loose fit L=0.4-0.8 mm, max. 1.2 mm.

See Fig. 7-3

7.6. PISTON PINS

Lap the piston pin OD surface to max. ϕ 23.98 mm.
Check for cracks applying the magnetic method. Reject if cracks are evidenced.
Measure piston pin - ϕ $24^{-0.007}/_{-0.020}$ mm. Dress out scraps or damages not exceeding the ϕ 23.98 mm, reject beyond this limit. Mark the pin referance using an electric pen.
The clearance between pin and piston bore at assembly : loose fit L=0.01-0.03 mm. See Fig.7-4.

7.7. CYLINDER HEAD is a light alloy casting with a sufficient

ced, reject barrel.

7.3.4. Perform honing of the barrel and then work matt to max.bore 105.08 mm (ensure a roughness after matting about $^{0.4}$ - $^{0.8}$).
If the bore exceeds 105.08 mm, grind to 105.08±0.02, then chrome plate to a max. 0.1 mm thick layer and regrind.
Min. chrome layer thickness after regrinding is 0.05 mm.
Out-of-roundness and taper: max. 0.02 mm.
Hardness in layer min. 785. Perform honing and matting to $\phi 105^{+0.035}/_{+0.0}$ mm. Work the bore porous .
Drill a ϕ 3 mm hole in the first fin to mark chrome plated barrels.
Reject chrome plated barrels, which show enlarged bore when TBO ellapsed.

7.4. PISTONS - valid for M332,M337,M137.

7.4.1. The pistons are manufactured from light alluminium alloy and are protected by anodizing. The piston skirt is coated with a 0.03-0.05 mm thick graphit layer begining at a distance of 26.5 mm from piston bottom along 43.5 mm in order to improve sliding properties during engine run-in.
Disassembly-remove the piston pin retainers,the compression and the oil control rings.

7.4.2. Coarse dirt is washed off in Synalod EFCO 3024 for 20-30 min and then the parts are rinsed in hot water and air dried.
Remove carbon by dry grit blasting. Remove carbon rests in ring grooves by means of a scraper or a ring. Care must be taken to avoid damaging of the groove lateral walls.
Place cleaned pistons in wooden boxes.

7.4.3. Inspections.

7.4.4. Visually check pistons for general condition. If burning of the piston top or distorsion of the piston pin retainer ways are evidenced, reject the piston.

7.4.5. Dimensional Inspection.

See Fig. 7-2

7. CYLINDER BARRELS AND HEADS, PISTONS AND VALVE MECHANISM

7.1. AT THE IN-LINE MODEL M332,M137,M337 engines,each barrel and head is self-standing. This fact facilitates a more simple inspection and repair, meanwhile a cheaper part replacement in case of damage.
The dismount of each part is described in the section dealing with Engine Disassembly.
This section sets forth the inspection, repair and assembling procedures for each sub-assembly.

7.2. CYLINDER BARRELS
Following removal from the engine, wash and clean from carbon (oil deposits). Clean by splashing with Synalod EFCO 3024 for 20-30 min. to remove coarse dirt, then rinse with warm water and dry.To remove carbon, immerse the barrels in Dekarbon-Special for 2-24 hours (depending upon the carbon structure).Remove dislocated carbon by brushing,possibly by scraping in Diesel oil. Wash then the barrels in gasoline.
Cylinder heads-remove carbon by grit blasting (rice, walnut shells etc).
Pistons - remove carbon by ball blasting.

7.3. INSPECTIONS

7.3.1. Visually inspect the barrels.
Strighten bent fins,whose deformation does not exceed 1 mm.
Fins cracked to 2 mm depth - dress out cracks by abrasion.
Badly deformated,worn fins - discard barrel.
Superficially rusted barrels and fins - remove rust (sand blasting and phosphatate, protecting the barrel bore).

7.3.2. Measure barrel bore-ϕ $105^{+0.035}/_{+0.0}$ mm.
Measure the barrel OD-ϕ $111^{+0.99}/_{+0.02}$ mm.
See Fig. 7-1

7.3.3. Submit barrels to magnetic inspection. If cracks are eviden-

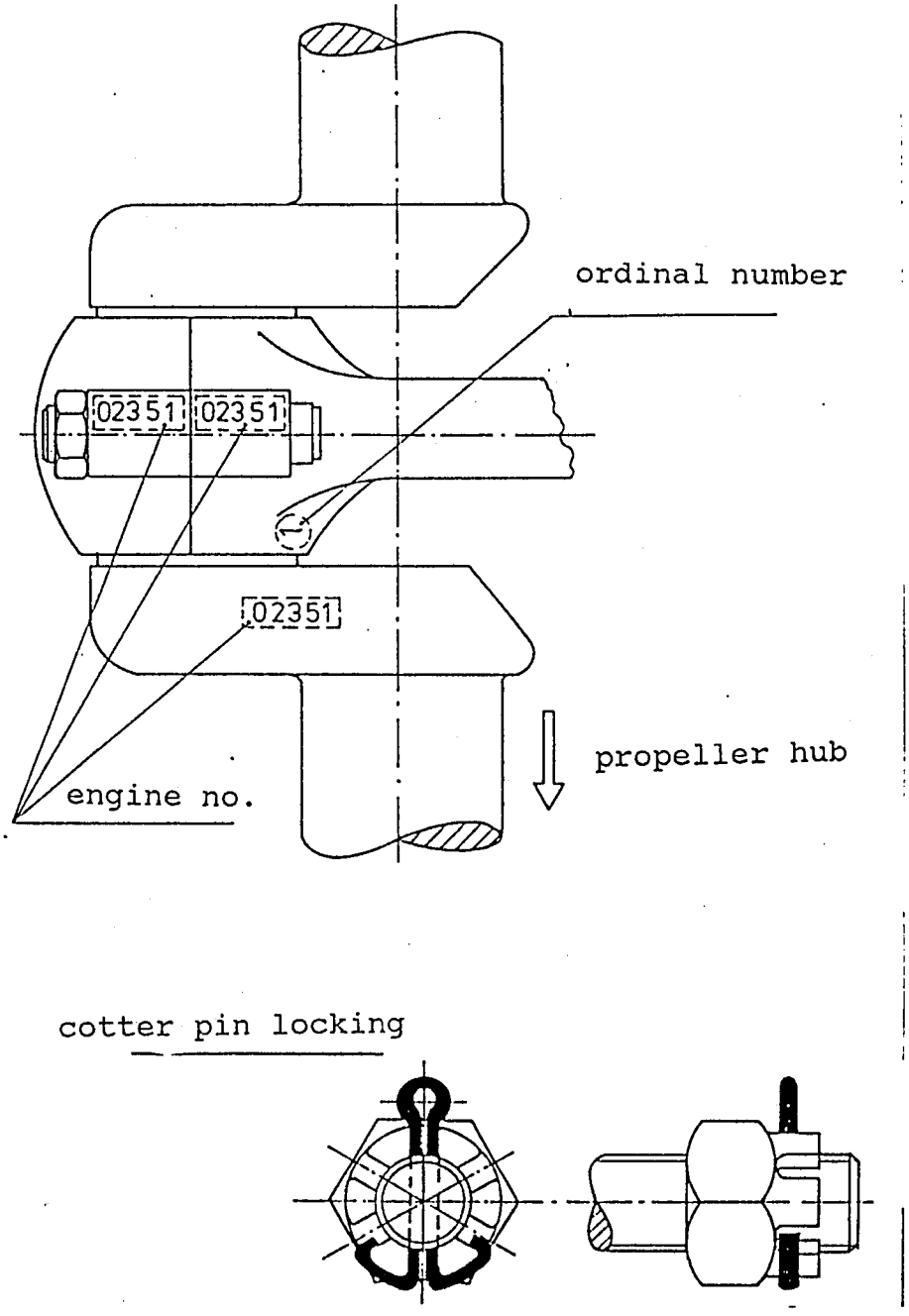
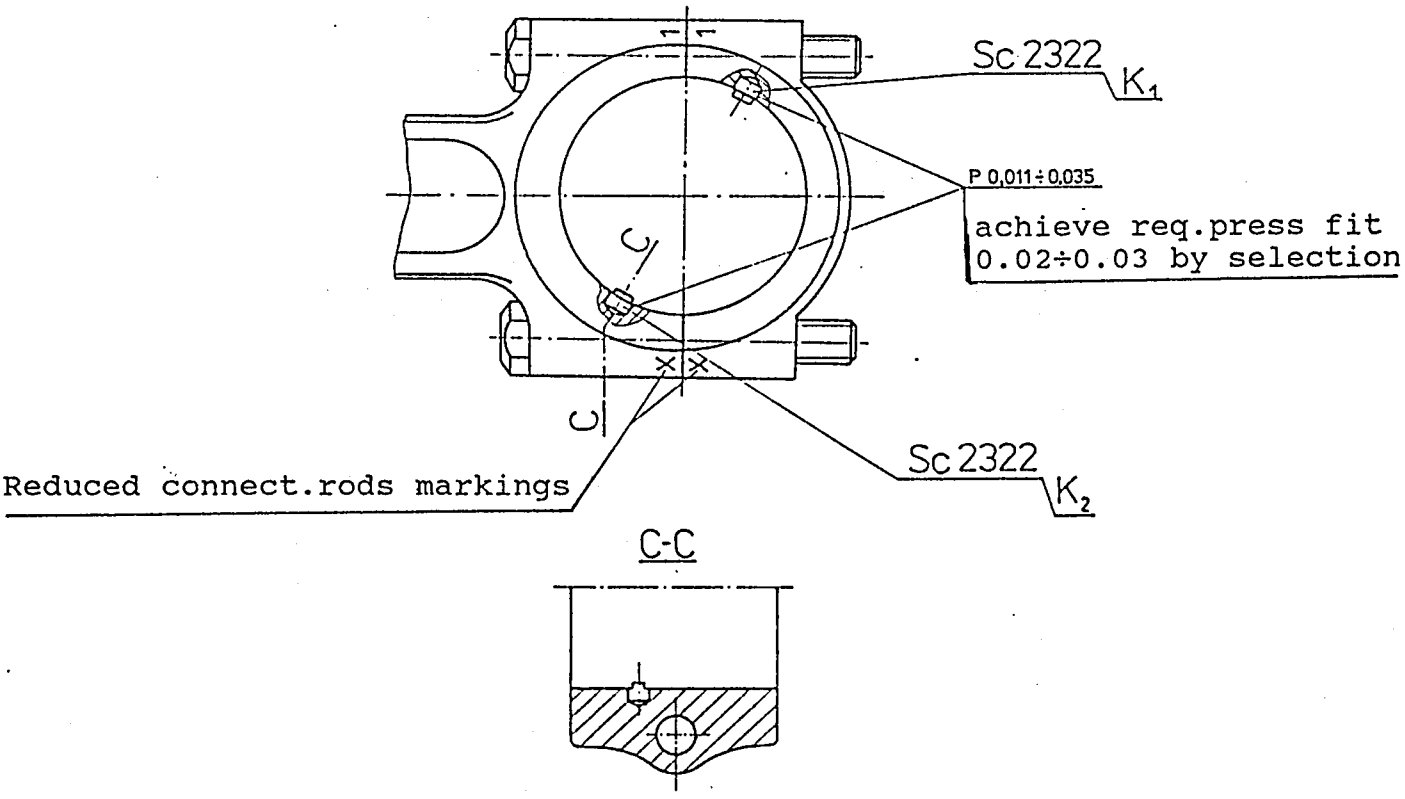
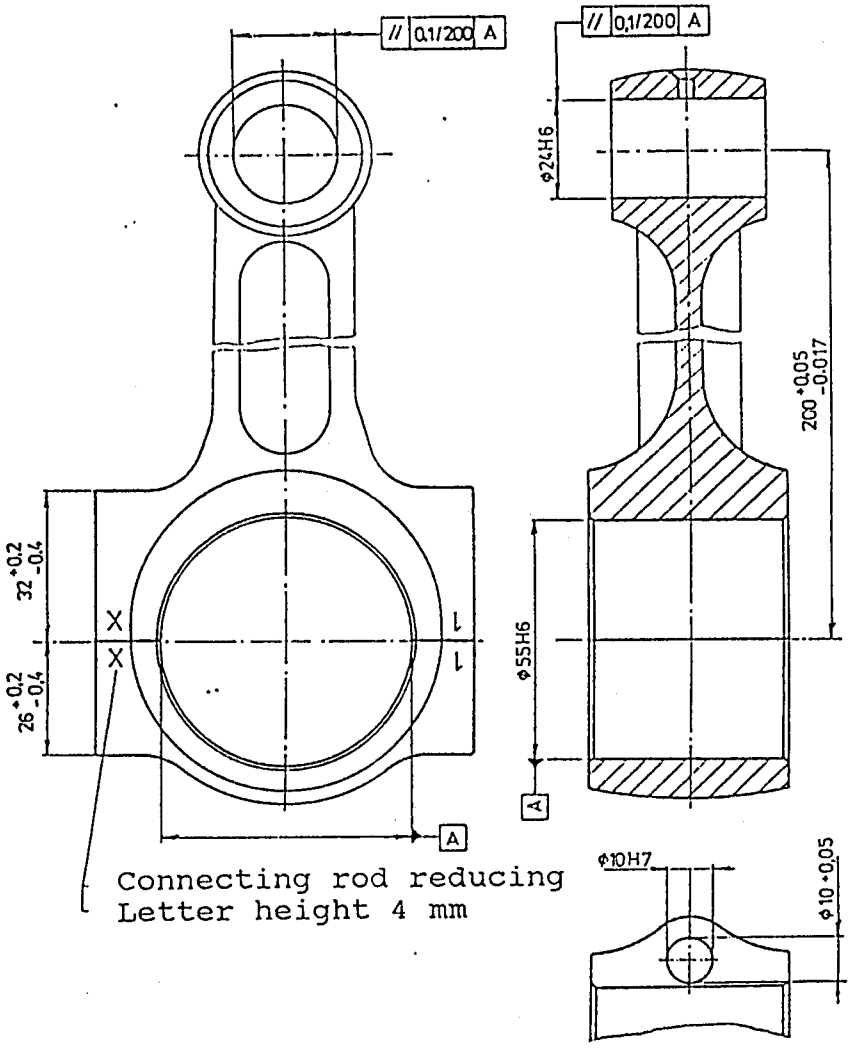

ordinal number
02351
02351
02351
propeller hub
engine no.
cotter pin locking

Fig. 6-7



Observe K_2 lock pin location

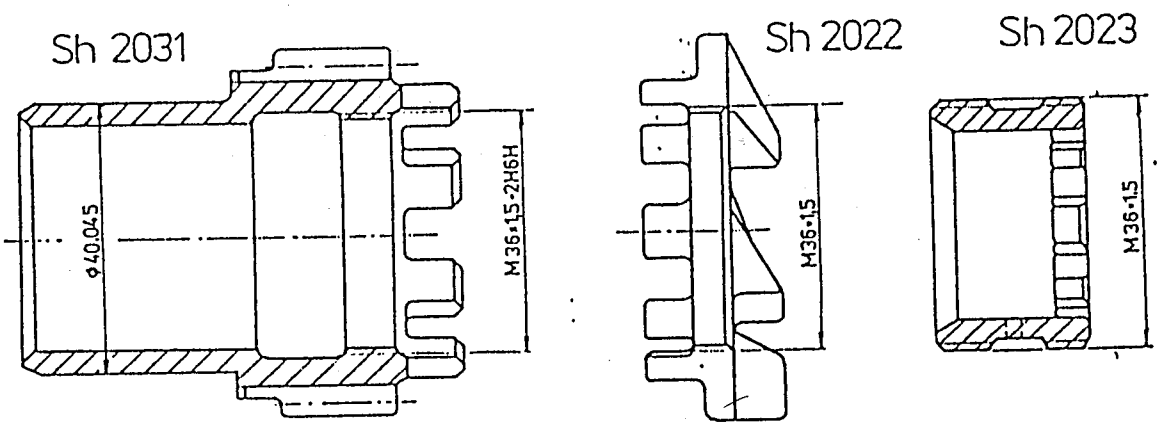
Fig. 6-6



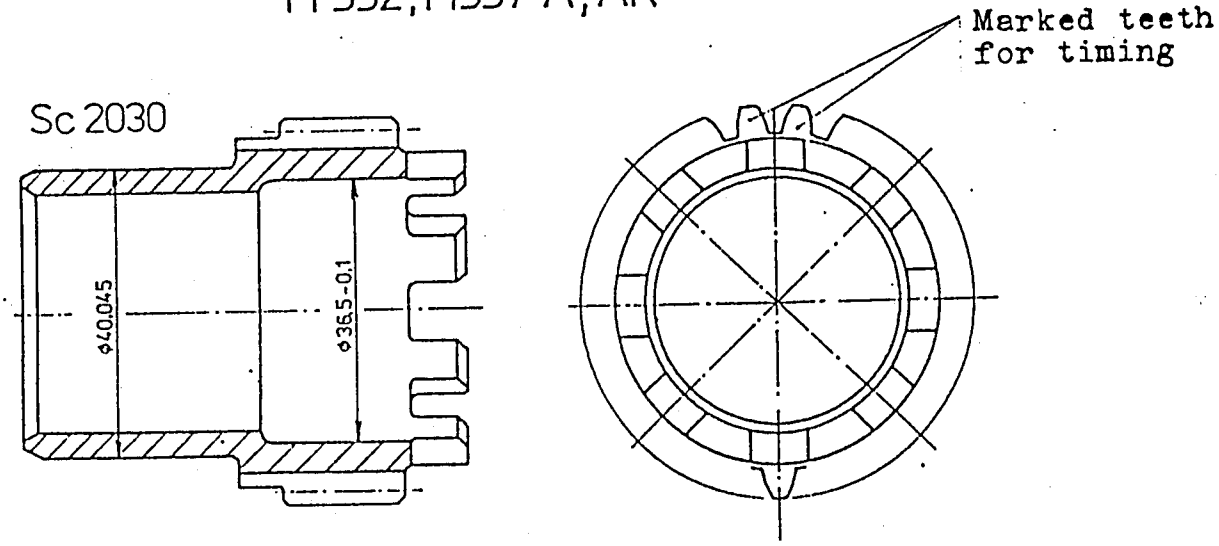
	φ24	φ55
out-of-round	0.02	0.03
taper	0.02	0.03

Fig. 6-5

M137 A,AZ



M 332,M337 A,AK



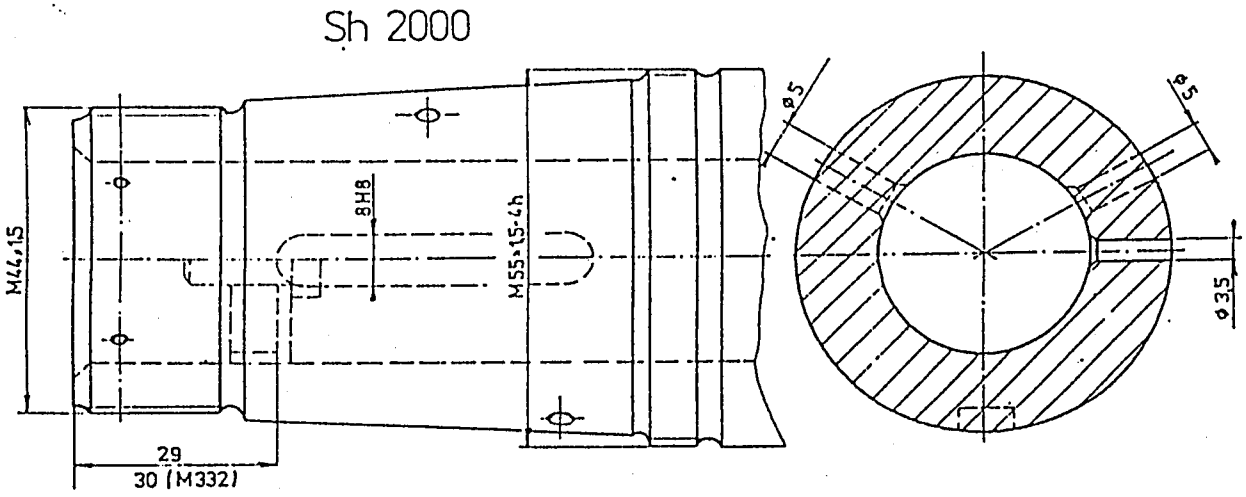


Fig. 6-4

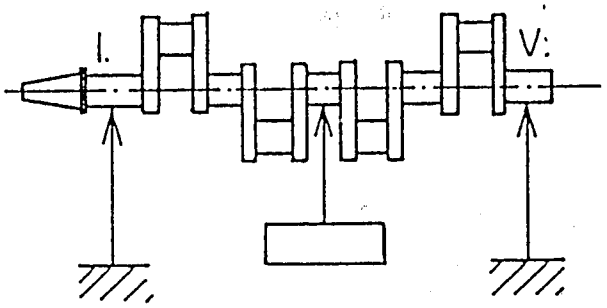


Fig. 6-1

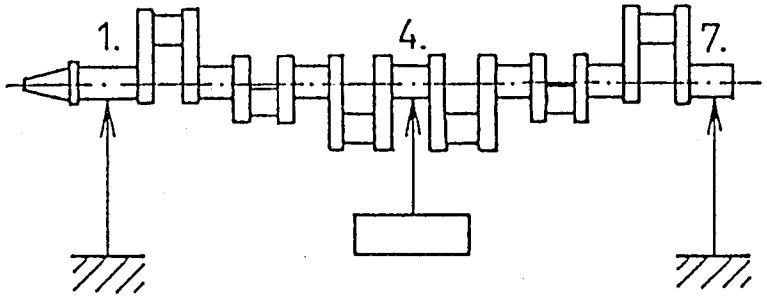


Fig. 6-2a

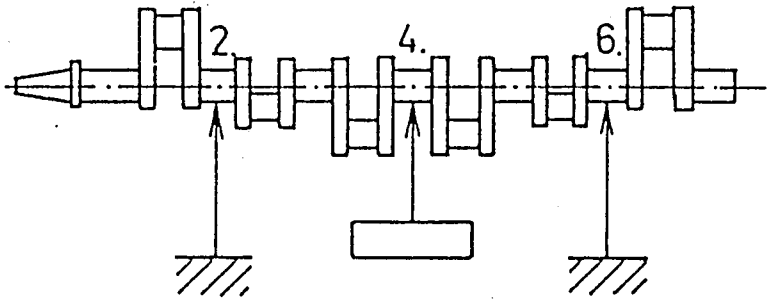


Fig. 6-2b

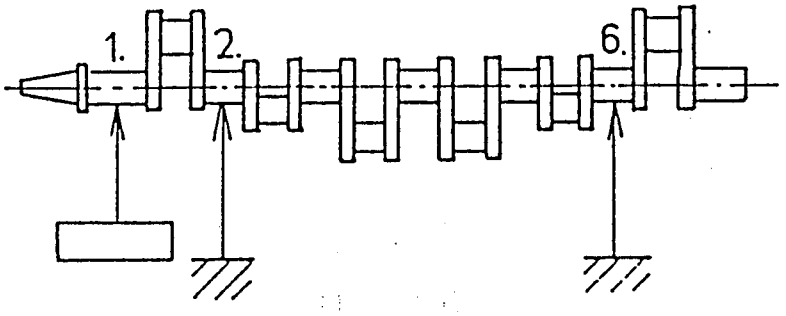


Fig. 6-3

mm, in case of insufficient press fit. Number each inserts by means of an electric pen.
Ream and lead plate the bearing inserts. Loose fit between inserts and crankpin L=0.03-0.05 mm including the lead layer.
Lead layer thickness at new bearing inserts 0.005-0.007 mm.
Lead layer thickness for original insearts 0.005-0.035 mm.
Match inserts to pins following reaming.Scrap to straighten overhang spots on the ground layer. Match to pin (by scraping) following the lead plating.
Torque to 32 Nm at reassembly.Measure connecting rod axial clearance $L_{ax.}$=0.1-0.262 mm.

See Fig. 6-7

mm) - discard bearing inserts.
The $\phi 10^{+0.015}$ for bolt-if enlarged more than ϕ10.02 mm,then ream to $\phi 10.05^{+0.015}$ and use bolts marked by "R".
Connecting rod bolt fit, loose, L=0.014 up to, press, P=0.01 mm.
Worn off bolt to ϕ10.00 mm - discard.
Bearing insert to connecting rod fit, press, P=0.04-0.05 mm.
If press fit is decreased, then cadmium plate the bearing insert OD to max.0.03 mm thick layer.

NOTE:

Carry on measurings, when the bearing cap is properly mounted and tightened to 32 Nm. Measure bearing inserts in the P 137-017.

Bearing inserts ID-max. 0.02 mm out-of-round, taper max. 0.015 mm, observing the bearing insert to pin loose fit 0.06 mm, max.0.08 mm.
Regrind and lead plate, min. thickness 0.005 mm, max. 0.035 mm.
If the fit exceeds 0.08 mm, discard the insert.
Install a new insert, lead plate, layer thickness 0.005 mm to 0.007 mm.
Connecting rod reducing - permitted in case of enlarging, taper or galling of the $\phi 55^{+0.019}$ mm dimension. Distance between axis is $l=200^{+0.05}/_{-0.17}$ mm. The reducing is permitted about 0.1 mm. Min. distance l=199.85 mm.

6.6.5. Check for cracks applying the fluorescent method.

6.6.6. Connecting Rod Repair. See Fig. 6-5, 6-6
Connecting rod reducing - max.remove 0.1 mm from the mating surfaces of the connecting rod and bearing cap. Assemble the parts, machine to $\phi 55^{+0.019}$ mm at a distance of $l=200^{+0.05}/_{-0.17}$ mm.
Install abnormal pins for bearing inserts locking.
Required press fit 0.02-0.3 mm.Mark the connecting rod by "X".
Bearing inserts - press fit against connecting rod P=0.04-0.05 mm. Reduce inserts at contact area in case of excess press fit;cadmium plate inserts, max. thickness 0.03

by means of the P 137-029 and P 137-028 plugs and check for tightness with oil at 6 atm for 6 min.

6.5.12. Connecting Rod Mounting

Mount the connecting rods to crankshaft according to ordinal numbers.The engine number marked on connecting rods must be on the left with respect to the crankshaft. Begin tightening from the side with engine number. Tighten to 32 Nm.

All sliding surfaces should be coated with engine oil during mounting.

6.6. CONNECTING ROD

It is manufactured of light alloy casting. The surface protection against corrosion is achieved by anodizing of the whole surface. The ID surfaces are highly finished and are not anodized. Each connecting rod is marked with the engine number and an ordinal number. This ordinal number locates the connecting rod and its cap after machining. Seize the connecting rod during repair or machining between soft jaws (plastic Pertinax and similar).

6.6.1. Dismount.

According to paragraph at Crankcase Dismounting.

6.6.2. Cleaning and Washing.

Performed with gasoline and by brushing.

6.6.3. Inspections.

Visual Inspection.

If anodized layer is damaged, polish and remake anodizing.

Damaged connecting rod bolts threads - discard.

Loose bearing inserts lock pins - replace by oversize ones.

6.6.4. Dimensional Inspection.

If the ϕ24 mm piston pin bore evidences wear to a max. 0,04 mm clearance, dress out; otherwise discard.

Connecting rod twist greater than 0.1 mm (measured at arbor diameters ϕ24 and ϕ55 mm at a distance of 200 mm), without bearing inserts - discard.

Connecting rod with bearing inserts twisted more than 0.05 mm (ϕ24 mm and ϕ55 mm arbors measured at a distance of 200

P=0.44÷0.70 mm. Heat the shaft end to 130°C, chill the gear in carbonic ice to -50°C. Shrink the gear to shaft so that the interval between the marked teeth be up, in the axis of the shaft while the crankpins 1 and 6 are up too. Tap the gear by means of a drift.

Following cooling, check the gear for run-out by means a ϕ4 mm roller while the crankshaft is supported on the 1st and 7th journals (M137/337) or the 1st and 5th journals (M332). Max. run-out is 0.05 mm.

6.5.9. Sh 0207 (M137,M337)/Sc 2011 (M332) Plug Mounting.

Measure the ϕ30 mm - plug to crankshaft fit, press P=0.067÷0.15 mm.

Press and tap the plug to the crankshaft. Distance - 29 mm (M137/337), 30 mm (M332).

6.5.10. For M137 model:mount the ratchet gear and tighten the bolt. Use the P 137-002 wrench.If holes in shaft and gear do not correspond, replace the bolt by a new one, drill a ϕ2.7 mm hole in the bolt according to hole in gear. Secure with a 3x20 mm cotter pin.

See Fig. 6-4

6.5.11. Crankshaft Mounting.

Install key into crankshaft way.

Fit, loose, L=0.016 up to, press, P=0.021. In case of increased clearance, copper plate the key sides, max. copper layer 0.008 mm.

Plug main journals using the Sc 2035 (M137/337)/Sc 2015 (M332) plugs, the Sc 0202 screws and M5 nuts.

Plug crankpins by the Sh 2036 (M137/337), Sc 2016 (M332) plugs, the Sh 0206 (M137/337), Sc 0203 (M332) and M5 nuts. Secure with 1x12 mm cotter pins.

Align and center the plugs, torque to 6+2 Nm using the P 137-306 wrench.

NOTE:

Install the screws with the heads toward propeller. In case of longer screws, add two 5.3 mm washers.

Obturate the lubricating canals in journals and crankpins

6.5. CRANKSHAFT REPAIR

6.5.1. Remove rust and corrosion from crankshaft canals, passages and recesses and phosphatate.
Locally phosphatate damaged surface protection from cranks.
After completion of repair, match the main bearing inserts to crankcase and the crankpin bearing inserts to crankshaft in compliance with repair procedures of the crankcase and of the connecting rods.

6.5.2. Obturators taper is remade in a fixture using abrasing paste with grain size 200. After abrasing, the taper should have a circumference without interruptions. The angle is 90^{o}.

6.5.3. The repair of the 1:10 bevel for propeller hub is carried on using the P 337-430 fixture and polishing paste of grain size 400 proceeding to min.removal of material.Colour touch min.75%. If greater damage is evidenced,grind out the bevel about 0.15÷0.20 mm,metallize. Regrind so that the remaining layer thickness be 0.13÷0.2 mm.

6.5.4. The ϕ50 and ϕ55 swivels - dress out by manual polish up to max. taper 0.02 mm. Finish by means of lapping cloth grain size 320. The fillets must be continous without damages.

6.5.5. In case of greater damages, grind the ϕ50 swivel to max. $\phi 49.9^{-0.02}/_{-0.03}$ mm and the ϕ55 to max.$\phi 54.9^{-0.02}/_{-0.03}$ mm. Remake the continuity of fillets.

6.5.6. M44x1.5 and M55x1.5 Thread Repair.
Remake the windings using a fine file and calibrate by means of a thread die. The repaired areas should have a continous fillet to the adjacent material.

6.5.7. Work the edge of the key way to R 0.3 fillet. Chamfer the key edges to $0.5x45^{o}$.

6.5.8. Replacement of the Sc 2030 (M332,M337)/Sh 2031 (M137) Gear.
Extract the plug from the crankshaft front end by means of the P 137-035 extractor.
At M137 model,firstly remove the bolt with the ratchet gear for starter. Use the P 137-002 wrench. Tap out the gear by means of the drift.
Recondition the bore for plug and gear.
Measure the bores in shaft and in gear. Shrink fit

Mutilated propeller hub threading-dressing out is permitted in the extension of only one thread winding. Reject if excessively damaged.

The ϕ55 mm and ϕ50 mm swivels-light damages,dress out scores by lapping and finishing. Seizing of the ϕ55 mm and ϕ50 mm swivels with staining - discard.

Corrosion in recesses - remove rust and phosphatate.

Untight obturator taper - polish. Crankshaft gear teeth evidencing wear, pitting - discard gear (p.ref Sh 2031 for M137, Sc 2030 for M332 and M337).

Corrosion, galling, wear on the 1:10 taper - dress out by lapping,

NOTE:

if damaged areas do not exceed 10% of the whole or 25% of the mating surface circumference.

If an extended area is damaged to max.0.2 mm deep,repair by metallizing and regrinding

Reject crankshaft for damages deeper than 0.2 mm.

6.4.2. Dimensional Inspection

The max. run-out of the M 332 central main journal with the crankshaft supported on the 1st and 5th journals is 0.08 mm.

See fig. 6-1.

Max. run-out of the M137, M337 central main journal with crankshaft supported on the 1st and 7th journals is 0.15 mm.

Max. run-out of the central main journal while supported on the 2nd and 6th journals is 0.08 mm.

See fig.6-2a and 6-2b.

Max. run-out of the ϕ55 mm area for ball bearing basing is 0.15 mm. For greater run-out reject.

See fig. 6-3.

0.03 mm out-of-round and greater at the ϕ50 and ϕ55 mm diameters Scoring up to 0.1 mm deep	Grind to dia = ϕ49.9 - 0.02 mm ϕ54.9 - 0.03 mm

6.4.3. Structural Inspection

Proceed to a magnetic inspection to reveal cracks.

6. CRANKSHAFT

6.1. THE CRANKSHAFT is a one-piece, heat-treated forging.In each crank there are drilled oil passages for the connecting rod lubrication. The crankshaft is hollow. Different orifices are plugged permitting the connection of all oil passages to each crank.
The crankshaft front end has a machined area for ball bearing basing and 1:10 taper for propeller hub. The main drive gear is pressed to the crankshaft rear end and it drives engine accessories and supercharger with starter.
The crankshaft is balanced both dinamicly and staticly. The balance succeeds by drilling holes on crank chamfered area.
The main journals and crankpins are nitrided to 0.2-0.3 mm depth. The hardness min. HV=720.

6.2. DISASSEMBLY
Set crankshaft with connecting rods on the stand and secure.Dismount the connecting rods and extract the bearing inserts. Reassemble the caps to connecting rods having the same number and position them so that numbers on the connecting rod and cap are face to face and then deposit them in special cases.Deposit all bearing inserts into wood cases too. Remove all plugs from crankcase and the key from the bevel end.

6.3. CLEANING and WASHING
Remove the carbon from all crankshaft orifices using a scraper.
Immerse crankshaft in a vessel containing synalod EFCO 3204 to rinse coarse dirt, then in Decarbon-special for 2-24 hrs. After the Decarbon bath, continue cleaning parts in Diesel oil by brushing. Then rinse in clean gasoline.

6.4. INSPECTIONS

6.4.1. Visual Inspection.

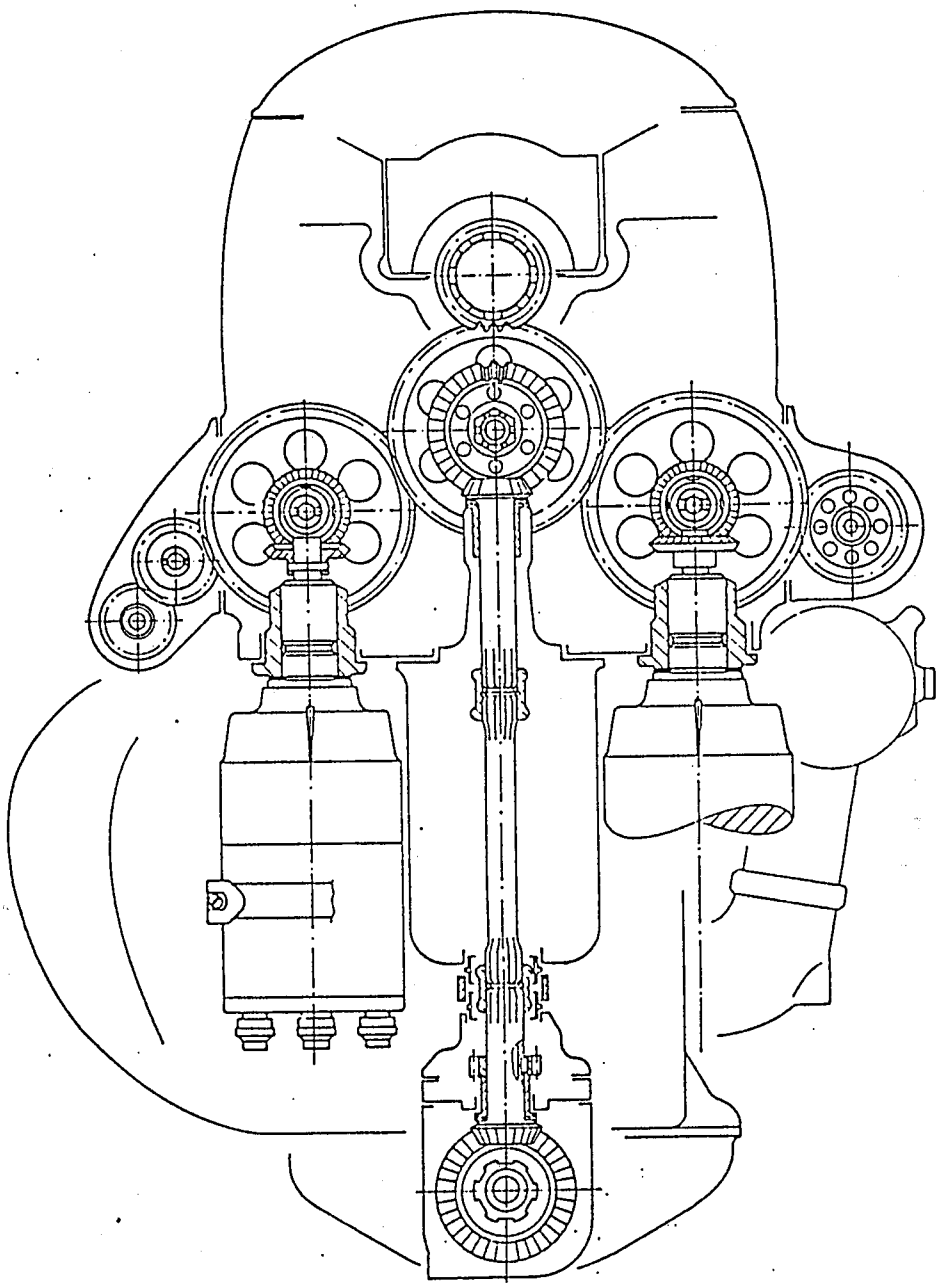


Fig. 5-8

5.11.5. The Sc 1530 Central Gear Shaft.
Dress out scores and scratchings at the ϕ14 mm area.
Check for cracks applying the magnetic method.

5.11.6. The Sc 1531, Sc 1532 Central Gear Bushings.
Discard, if unpermitted wear of the inner and/or outer diameter is evidenced. (See Tolerances and Fits).
Check for cracks applying the magnetic particle method.

5.11.7. The Sc 0103 Central Gear (Sc 1533 + Sc 1534).
Reject for damages, pitting, worn and enlarged ϕ20 mm ID.
Together with the Sh 0148 vertical shaft, replace both gears at once by new matched gears referenced as Sh 0166, the Sc 1409 plug included.
If the rivets at the Sc 1534 gear are loose or damaged, replace the Sc 0166 sub-assembly.
Check for cracks applying the magnetic method.

5.11.8. The Sc 1539, Sc 1541 Intermediate Gears.
Reject for damages, teeth pitting, enlarged ϕ18 mm ID.
Check for cracks applying the magnetic method.

5.11.9. The Sh 0148 Shaft.
If the shaft has to be rejected, then discard the Sc 0103 gear too and replace by the Sh 0166 matched gear assembly.
Check for cracks applying the magnetic method.

5.11.10. The Sc 3772 Shafts Coupling.
Excessive damages - discard.
Check for cracks applying the magnetic check.

5.11.12. Gear and Swivel Repair.
Give a visual scrutiny to the swivels of the central gear and drive outlets. Dress out scores and damages and polish using abrasive cloth. Mark the gears from outlets by the letters "L" and "R".
Visually inspect all gears, dress out scores and scratches.
Reciprocally grind the beveled mating surfaces from swivels and gears using abrasive paste.
Repair damaged threads.

5.11.13. Dress out damages from the transversal bolts, restore surface protection by zinc plating,calibrate the M8 bolts.
Replace loose nuts or screws.

most remote from gear,the Sc 9119 basing ring and slip the oil seal by means of the P 137-204 drift in housing.Secure by means of the 40x1.75 lock ring. Verify the clearance between the Sc 9119 ring and the S9118 bushing, loose fit L_{min}=0.1 mm. Secure both nuts by 0.8 mm lock wire.

See Fig. 5-6

5.11. ACCESSORY DRIVES

They are located at the crankcase rear end and are separated from crankshaft by a stiffened wall. This wall is provided with bushings destined for fastening the accessory drive gears and shafts. The drives are composed from the central gear driven by the crankshaft and farther driving the camshaft over the the vertical (king's) shaft and the intermediate gears driving the oil pump, the RPM indicator and the generator drive gear.

See Fig. 5-8

5.11.1. Disassembly.

It was indicated at the general disassembly.

5.11.2. Washing and Cleaning.

They are to be carried on in decarbonizing solution and gasoline using brushes.

5.11.3. Inspections.

Sc 1537 (M337,M332) ,Sh 1590 (M137) Outlet Gear Swivels.

Mutilated threadings - discard

1 mutilated thread wind - calibrate by a pertinent die.

Damaged bevels - dress out light damages; discard if badly damaged.

Damages at $\phi 20^{-0.02}_{-0.041}$ mm - dress out by polishing to a loose fit + 0.08 mm calculated with respect to the bushing. If the fit is greater, replace bushing or chrome plate the new swivel up to ϕ20 only,while the chrome layer thickness is max. 0.05 mm.

Check for cracks applying the magnetic method.

5.11.4. The Sc 1047 Bushing of the Intermediate Gear.

Replace if loose bushing.

Respect the clearance of the shaft:loose fit

L=0.020÷0.070 mm.

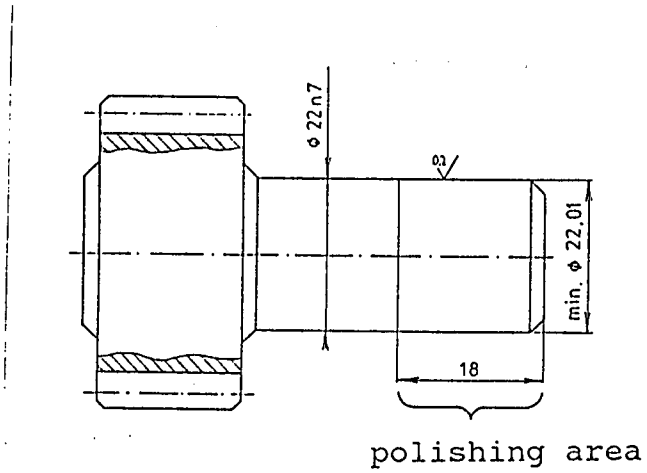


Fig. 5-7

5.10.8. Reassembly

Screw on the M8 nuts to the drive housing studs. Mount the Sc 9112 pinion swivel, the 14x20 mm seal and the Sc 9113 nut to the drive gear and tighten. Aplly the P 137-203 and P 137-206 fixtures.

Install the Sc 9110 bushing to the Sc 9107 gear. Introduce into it the Sc 9109 bushing, slip on the shims, one from each side, and install into the housing.

Install the P 137-205 dummy shaft to the gear and housing. Measure the gear axial fit, loose L_{ax}=0.1÷0.2 mm.

Decrease excessive fit by replacing the bushings.Slip on the Sc 9122 shim and the Sc 9104 bushing to the Sc 0917 pinion. Install this sub-assembly to the housing. Measure the gear teeth clearance:loose fit L_{teeth}=0.15÷0.2 mm - max. 0.25 mm.

Extract the P 137-205 dummy shaft, install instead of it the Sc 9107 swivel using the P 137-203 bushing. The swivel must be equipped with the Sc 9123 0.2 mm thick washer. Mount the 14x18 mm seal, the Sc 9113 nut and tighten.

Install the Sc 9118 bushing to the pinion with the collar

Badly scored bushing - reject.

Oil seal - reject.

Aluminium sealing rings - reject.

5.10.5. Dimensional Inspection

Bushing	Sc 9109		
		ϕ14 mm	fit L=0.022 ÷ P=0.004
Swivel	Sc 9108		
Swivel	Sc 9112		
		ϕ14.1	L=0.016÷0.038 max.0.05 mm
Bushing	Sc 9104		
Bushing	Sc 9104		
		ϕ18.1	L=0.04÷0.07
Pinion	Sc 0917		
Pinion	Sc 0917		
		ϕ11	L=0.06 ÷ P=0.036
Bushing	Sc 9118		
Housing	Sc 9100		
		ϕ40	P=0.1÷0.15
Seal	Sc 9120		
Housing	Sc 9100		
		ϕ14	L=0.011 ÷ P=0.02
Swivel	Sc 9108		
Housing	Sc 9100		
		ϕ14	L=0.011 ÷ P=0.018
Swivel	Sc 9112		
Interm. gear	Sc 9107		
		ϕ22	L=0.02÷0.07
Bushing	Sc 9110		
Bushing	Sc 9110		
		ϕ18	L=0.016÷0.07
Bushing	Sc 9109		

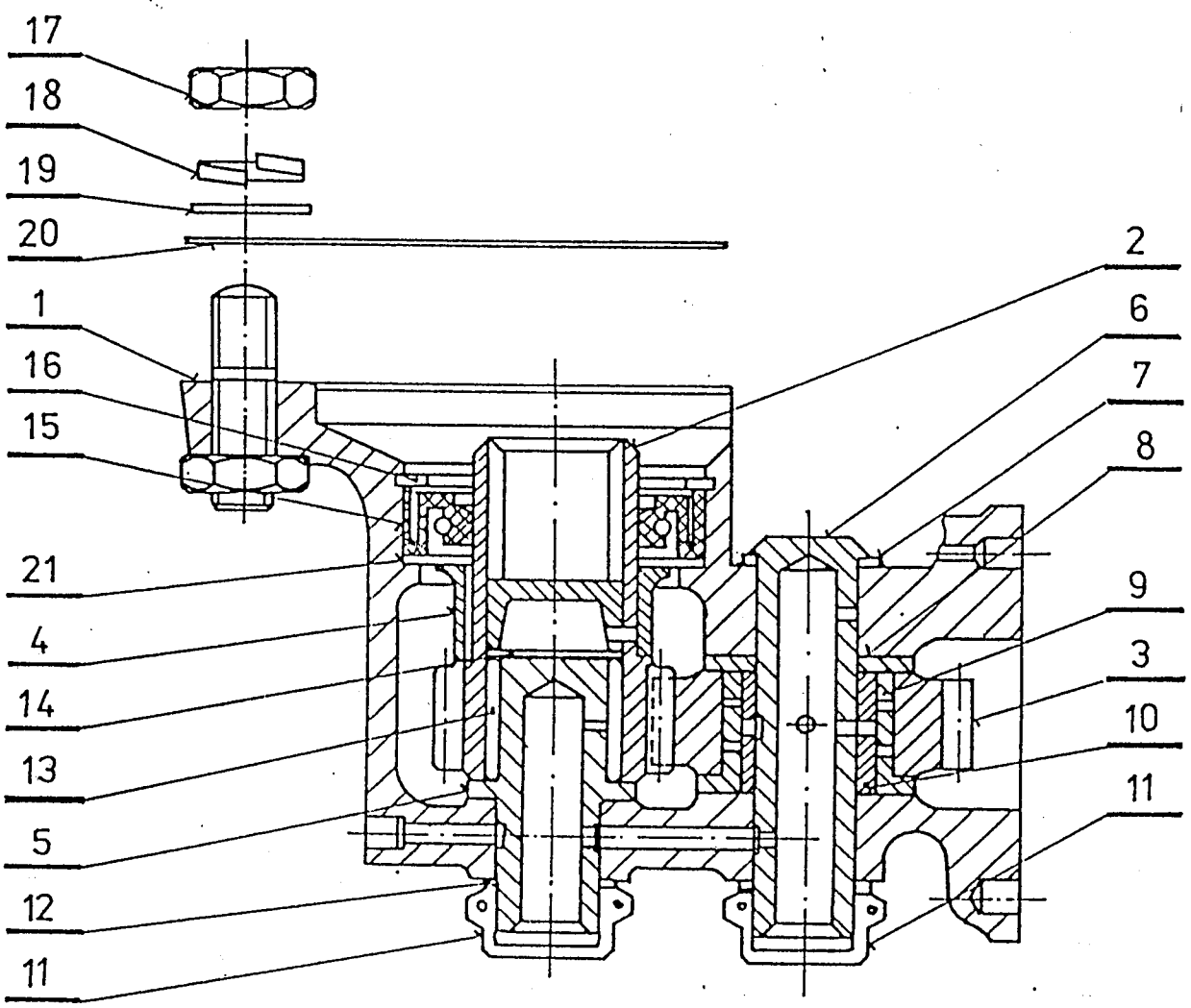
5.10.6. Structural Inspection.

Inspect the Sc 0917 and Sc 9107 gear apllying the magnetic method. Submit the Sc 9100 housing to fluorescent method inspection

5.10.7. Repair.

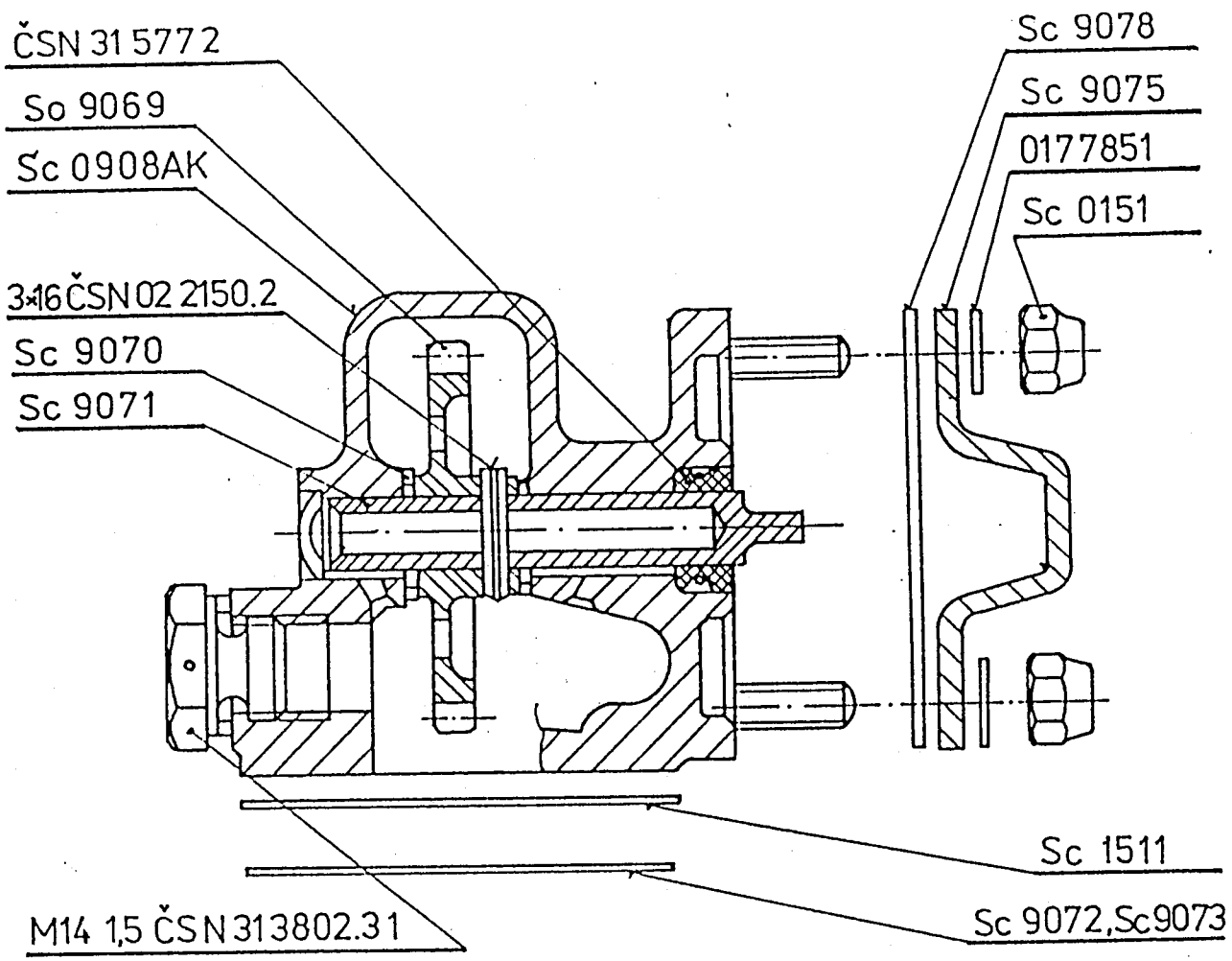
Remake the paint on the drive housing. Rework the bolt threadings by means of the M8 die. Straighten the sealing surfaces and polish gear shafts using fine abrasive paper. Polish the bushing surfaces and bores using lapping paper. Polish the seal print area on the Sc 0917 gear ϕ22 to ϕ20.01. Discard in case of diameter decrease.

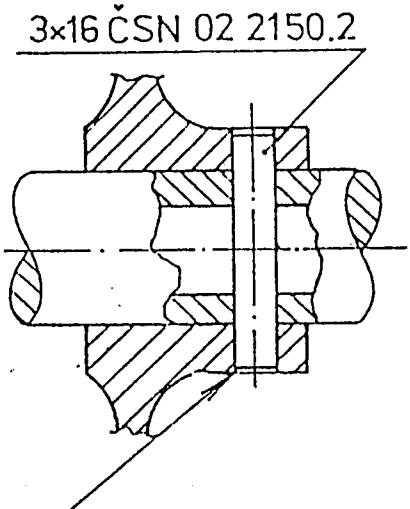
See Fig. 5-7



1. Sc 0916 gener. drive hous.
2. Sc 0917 pinion
3. Sc 9107 gener.intermed. gear
4. Sc 9118 bushing
5. Sc 9112 pinion shaft
6. Sc 9108 interm.gear shaft
7. Sc 9123 gasket
8. Sc 9111 interm.gear shim
9. Sc 9110 loose bushing
10. Sc 9109 shaft bushing
11. Sc 9113 shaft cap nut
12. CSN 02 9310.3 sealing
13. Sc 9104 gener.drive gear bushing
14. Sc 9122 needles shim
15. Sc 9120 sealing ring
16. CSN 02 2931 40x1.75 lock ring
17. CSN 02 1402.15 M8 nut
18. CSN 02 1740.04 8.2 elastic washer
19. 017 7881 washer
20. Sc 9073 drive hous.gasket
    Sc 9072 drive hous.gasket
21. Sc 9119 basing ring

Fig. 5-6


ČSN 31 5772
So 9069
Sc 0908AK
3×16 ČSN 02 2150.2
Sc 9070
Sc 9071
Sc 9078
Sc 9075
0177851
Sc 0151
Sc 1511
Sc 9072,Sc9073
M14 1,5 ČSN 313802.31


3×16 ČSN 02 2150.2
Secure lock pins by light crimping of both ends

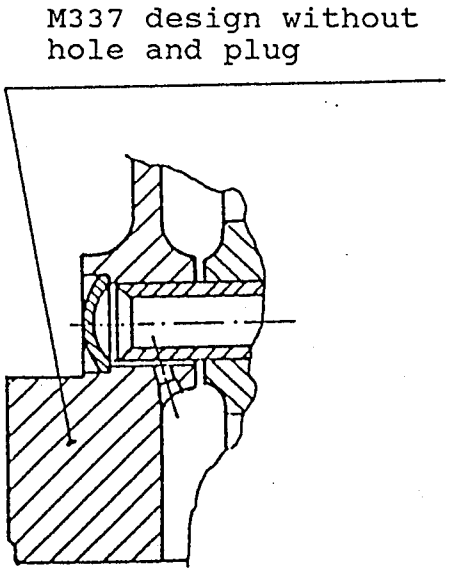

M337 design without hole and plug

Fig. 5-5

Chamfer the edges.

5.9.7. Reassembly

Install the Sc 9096 gear onto the drive outlet housing. Mount from both sides the Sc 9070 washers and then the P 137-179 dummy shaft. Measure the axial clearance: loose fit L=0.0-0.16 mm, max. 0.2 mm. Extract the dummy shaft and mount the right Sc 9071 shaft using the P 137-178 drift.The length of the shaft beyond the sealing surface: 11 mm. Verify the axial clearance of the gear. Install the 3x16 elastic element and secure.

Mount the M14x1.5 plug together with the ϕ14x18 mm sealing ring and secure.Install the shaft protection. Assemble the outlet with gakets to the crankshaft, according to general assembly instructions.

See Fig. 5-5

5.10. GENERATOR DRIVE

It is being installed on the left side of the engine and it is designed for the LUN 2111 generator 600 kW type.

5.10.1. Drive Disassembly.

Fix the drive in the P 137-208 fixture and this one in its turn in a vise. Remove the two Sc 9113 nuts. Extract the 40x1.75 securing ring from seal. Depress by means of the P 137-202 drift the pin of the pinion including the bushing, the shims, the gear and the seal ring.

Depress in the same way the intermediate gear and extract it together with the shims and bushings.

See Fig. 5-6

5.10.2. Washing.

Perform it in technical gasoline.Chemically remove damaged enamel from drive housing.

5.10.3. Inspections.

5.10.4. Visual Inspection.

Mating surfaces, threadings of bolts - dress out light damages.

Teeth matching surfaces showing wear, corrosion, pitting--reject.

5.9. RPM INDICATOR DRIVE

The RPM indicator drive has to be mounted on engine depending upon the used transmitters. The RPM indications transmission may also succeed over the oil pump shaft.

5.9.1. Disassembly.

Remove the M14x1.5 mm plug. Remove the elastic element, which fastens together the shaft and the gear. Using the P 137-177 fixture, extract the seal,the gear and the shaft.

5.9.2. Cleaning.

Clean in technical gasoline. If the enamel on the drive housing is damaged, remove it by a chemical method.

5.9.3. Inspections.

Visual Inspection.

If the bolts,threads or gear's teeth show damaged matching surface, repair them. If the shaft end shows bending - replace it.

5.9.4. Measure the $\phi 3^{+0.012}/_{+0.0}$ mm dimension at gear and shaft.

Measure the $\phi 10$ mm dimension - gear and shaft.

Press fit P=0.01-0.015 mm.

For the drive housing - shaft clearance, loose fit L=0.013-0.043 mm, max. 0.06mm.

5.9.5. Structural Inspection.

Shaft - magnetic inspection.

Gear - using a magnifyer, dye penetrant.

Carry on fluorescent inspection on housing.

5.9.6. Repair.

Remake the mating surfaces of the the body, calibrate the threading of the studs. The height of the stud should be 16±0.5 mm.

Polish the sliding surface of the shaft by means of lapping paper.

Dress out light damages. Remake the surface protection by repaint.

Fasten the sheet plug tightly by means of the P 137-175 special drift, replace if necessary. If the shaft or the gear is rejected, redrill them together in the P 137-174 fixture using a $\phi 2.8$ mm drill and then ream to $\phi 3$ mm.

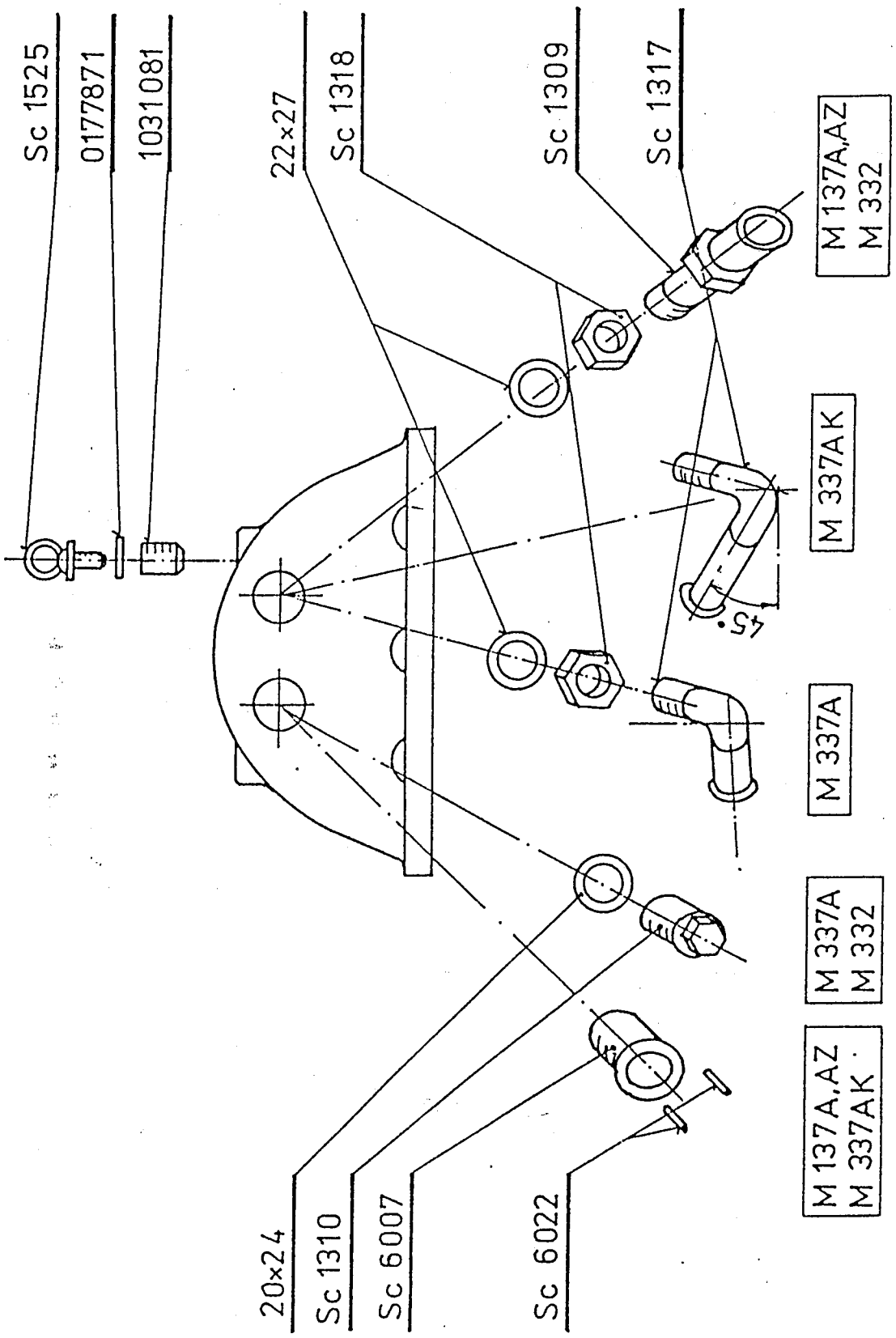

Sc 1525
0177871
1031081
22x27
Sc 1318
Sc 1309
Sc 1317
M 137A,AZ
M 332
M 337AK
45°
M 337A
M 337A
M 332
M 137A,AZ
M 337AK
20x24
Sc 1310
Sc 6007
Sc 6022

Fig. 5-4

5.4. TOP COVER

5.4.1. Visual Inspection.

Damaged mating surfaces - dress out.

Damaged, loose lifting eye-bolt, threaded insert included--replace.

Damaged and loose threaded inserts - replace.

Damaged Sc 6007 threaded bushing and pins - replace.

Damaged Sc 1310 plus (M337A) - replace.

Damaged surface protection - repaint.

Damaged breather pipe - replace.

Damaged elbows (M337A,AK),tube (M137,M332) of the crankcase breather - discard if excessive deformation is evidenced.

5.4.2. Dimensional Inspection.

Breather tube - measure the ϕ30 mm.

Press fit P=0.02-0.03 mm.

If decreased, coat with a max. 0.05 mm graphit film.

5.4.3. Structural Inspection.

Check for cracks applying the fluorescent method. If evidenced - discard.

5.4.4. Top Cover Repair.

Dress out damages of mating surfaces, chamfer sharp edges, replace damaged and loose threaded inserts.

Replace deteriorated lifting eye-bolts. Replace loose inserts of the eye-bolts and stick the new ones with Aldurit S100 or Loctite. Assure the position of the eye-bolt by selecting an adequate washer.

5.4.5. Visaully inspect the breather pipe,clean it.If it is loose in the bore, coat with graphit. Mount to have a press fit P=0.02-0.03 mm. Tighten the screw with nut and secure.

5.4.6. Breather fitting - dress out damages or replace. Calibrate threadings if necessary. Arbitrary replace the 22x27 sealing ring.

Eng.Model:M137A/AZ,M332 - Sc 1309 straight fitting

M337A/AK - Sc 1317 90° fitting

M337 - Sc 1312 90° fitting

See Fig. 5-4

Design.	ϕA	Bushing	Bushing ϕ	Reamer
R_{ch}	$17.05^{+0.011}$	Sc 1046	$17.05^{+0.01}$	N 137-293
R_1	$17.10^{+0.018}$	Sc 1046 R1	$17.10^{+0.029}_{+0.018}$	N 137-294
R_2	$17.20^{+0.018}$	Sc 1046 R2	$17.20^{+0.029}_{+0.018}$	N 137-295
R_3	$17.30^{+0.018}$	Sc 1046 R3	$17.30^{+0.029}$	N 137-296

5.3.27. Rework of the ϕ20 Bore of Gear Countershaft Swivel.

If out-of-roundness is evidenced at the bushing and at the $\phi 20^{+0.02}$ mm bore in the crankcase, ream both bushing and bore using adjustable reamers till the defect is dressed out, but not exceeding ϕ20.1 mm. If this dimension is exceeded, replace the bushing.

Chrome plate the swivel with respect to the reamed diameter. Max.chrome layer thickness after grinding is 0.05 mm. Loose fit between swivel and bore L=0.02÷0.062 mm. Use everytime new swivels for chrome plating.

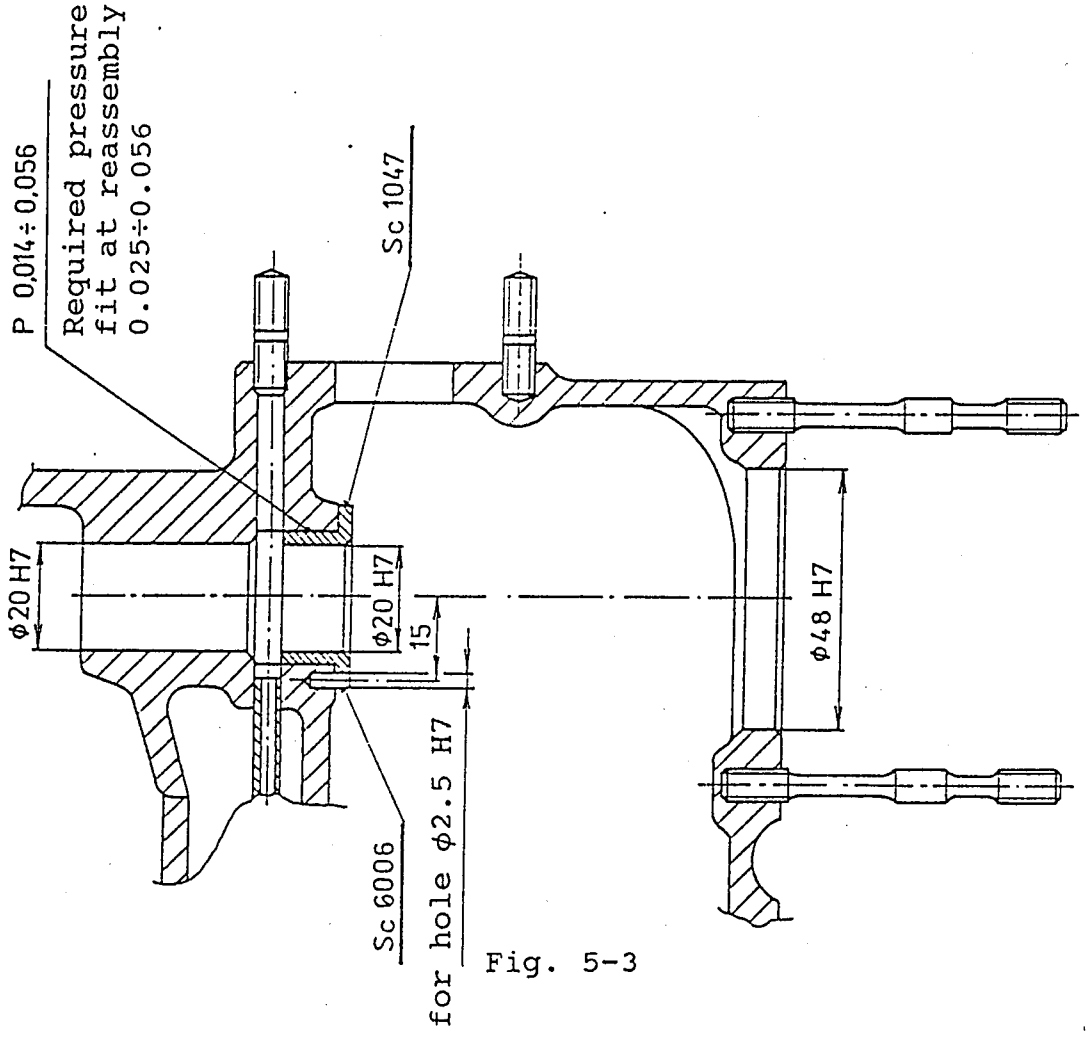


Fig. 5-3

walls and webbings and the cranks of the crankshaft. Minimum clearance is 0.5 mm.If it is smaller, scrape the adjacent areas of the crankcase. The crankcase wall may not be thinner than 4.5 mm.

5.3.23. Dismount parts and crankshaft including the bearing inserts. Check main journals and inserts surfaces for condition. Min. ground area must be 85% of the total surface. If necessary, scrape the inserts and repeat the check. Check the crankshaft for unrough rotation in the inserts. The rotation must be free, continous, without seizing.

5.3.24. Install the Sh 0043 overpressure valve in the P 137-141 fixture and check for proper operation with oil at 20°C-60°C. The valve should begin to release oil at 0.1±0.01 MPa.
Install the valve in the Sh 0043 housing and rinse oil conduits in housing with oil at 60°-80°C for 5 min. Obturate the main oil conduct at it front end and repeat the rinsing at a pressure of 0.2-0.6 MPa, check all oil conducts for free flow. Wash then with gasoline.

5.3.25. Cylinder Studs Inspection and Check
Install the technological cylinder and the P 30-1953 plate on the studs. Mount the nuts and washers coated with oil and uniformely torque to 31,4 Nm. Loose or elongated studs are not allowed. Replace by the Sh 1025 R1 studs.

5.3.26. Rework the ϕ17 bore for the bushing of the central gear swivel, if galling or excessive out-of-roundness are evidenced. Install the guiding gage P 137-298 on the starter (supercharger) flange,place excentrically by means of the technological arbor in the bore for swivel. Insert the technological bushing into the ϕ14 bore existing in the crankcase wall. Ream ϕ17 mm. Obturate the lubricating holes. After reaming, chamfer edges to 1x45° using the N 137-297 cutter.

See Fig. 5-1

Install at both ends (front and rear) of the crankcase the guiding gages.Introduce the rod with adjustable reamer and make true using the bevels. (Use the"C" reaming set).
Ream bores to $\phi 62^{+0.02}/_{0.0}$ mm.
If the galling is greater, or the out-of-roundness reaches 0.04 mm and the taper 0.03 mm,ream the bores to max.ϕ62.06 mm and then cadmium plate the bearing inserts,provided the cadmium layer is max.0.03 mm.Remove bolts and caps.Chamfer the edges and mount oversize retainers according to §5.3.18.

5.3.20. Fitting Bearing Inserts to Crankcase.
Measure bearing inserts diameter in the M 20-0030 fixture. Calculate the fit with respect to the bore, P=0.03-0.04 mm. If the press fit is to great, lower both halves along mating surfaces.Both halves must mate tightly.If the press fit is to small,cadmium plate the insert outer surfaces to max. 0.03 mm.Mark the inserts by the engine number and the ordinal number using an electric pen. Install inserts and caps according to the ordinal no. and torque to 34 Nm. Fasten the transversal bolts (the technological ones designated P 137-128) and torque to 9.2 Nm.

5.3.21. Install the gage P 20-0267 at front and rear end, the guiding rod P 10-0058 with the N 20-0023 reamer and align the rod by means of bevels. Ream the inserts to calculated dimension.Prior to ream obturate the lubricating canals by graese. The required loose fit between main journals and bearing inserts (lead layer included) is L=0.04-0.06 mm. Permitted lead layer on inserts is 0.01÷0.03 mm, max. 0.05 mm. Dismount transversal bolts, remove bearing caps using the Z2-00204-00 fixture, extract the inserts. Chamfer the edges in the P 30-193 fixture and lead plate the inserts.

5.3.22. Install the inserts, the repaired crankshaft, the bearing caps, the transversal bolts and torque to prescribed value. Mount the technological front cover with the bearing the gaskets, the splashing ring and the nut. Tighten using the P 137-002 wrench. Rotate the crankshaft several turns. Meanwhile measure the clearance between the crankcase's

If M8x36 studs (from starter or supercharger) are loose, stick them using Aldurit S100 or Loctite. The height above surface $l=19^{+0.5}/_{0.0}$ mm.

NOTE:

If threads in crankcase are damaged, replace the studs by oversize ones ad follows:

M6 studs by M7 Sr2, height above surface l=16±0.5 mm

M8 studs by M10 Sp2, height above surface l=20±0.5 mm

5.3.16. Measure the cylinder bore $\phi 111^{+0.05}/_{-0.1}$ mm.
The clearance between cylinder and crankcase must be loose L=0.03-0.11 mm, max. L=0.2 mm.
Scrape bore if necessary and locally pasivate.

5.3.17. If damages on the surfaces for cylinder basing are not deeper than 0.05 mm,dress out by normal scraping.If deeper galling or scoring, machine the surfaces straight.Pasivate each time. Check surfaces if straight.

5.3.18. Replace loose Sc 1025 and Sc 1026 bearing insert locking pins. Extract loose locking pins using the P 10-0055 and P 10-0056 fixtures. Ream the hole to ϕ6.2 mm or to $\phi 6.4^{+0.02}/_{0.0}$ mm, using the fixtures P 137-166, P 137-167 and the reamer N 137-287 for ϕ6.2 mm or N 137-288 for ϕ6.4 mm. Dimensionally check using the N 40-0136 and N 40-0305 gages. Prior to ream, obturate the lubricating holes with grease. Remove the grease after reaming.Install the Sc 1025 R1,R2 locking pins. The required press fit

5.3.13. Structural Inspection.

Check the crankcase for cracks applying the fluorescent method.

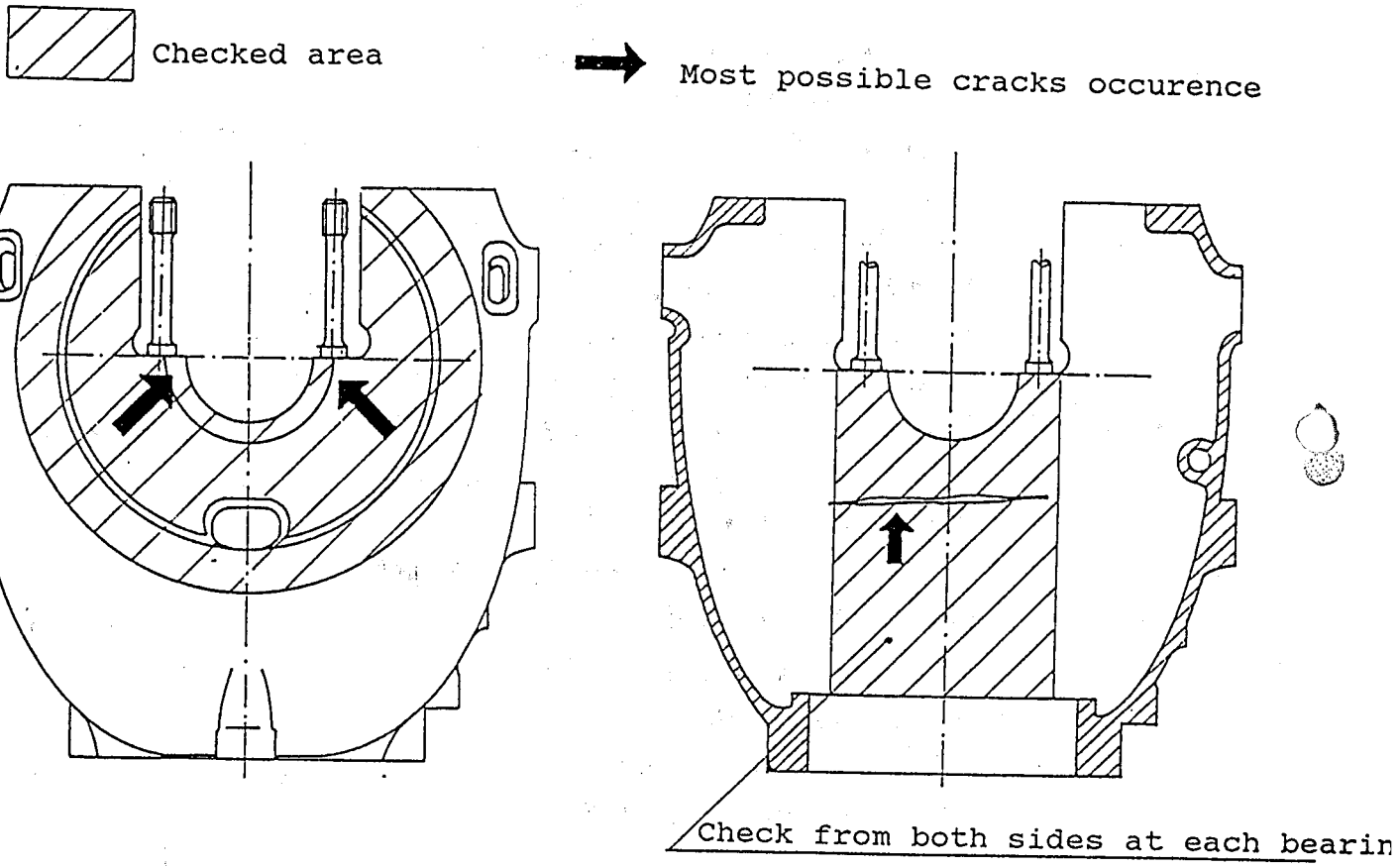


Fig. 5-2.

5.3.14. Crankcase Repair.

Inspect the surfaces mating the engine mounts. Dress out possible damages, screw out loose 1031081 threaded insert and check thread for damages, degrese a new insert and the thread, coat the insert with Aldurit S 100 or Loctite compound. Tighten using the P 137-129 fixture. The insert sunk below flush must be 0.5±0.1 mm.

If mutilated thread, cut a M14x1.5 mm thread and install an abnormal insert and stick.

5.3.15. Install the P 30-0154 and the P 20-0116 brackets and fasten using the M8x20 mm bolts.Install onto the Z1-01501-00 stand. Clean and repair all sealing and mating surfaces. Repair or replace damaged studs.

5.3.7. If the cylinder bore diameter $\phi 111^{+0.05}/_{-0.1}$ mm shows decrease, remake by scraping. The clearance between piston and case should be loose L=0.03 -0.11 mm, max. 0.2 mm.

5.3.8. If the Sc 1537 pin bore diameter $\phi 20^{+0.021}/_{0.00}$ mm is enlarged due to wearing, machine it to max.ϕ 20.1 mm and consequently chrome plate the pin, the Cr layer not exceeding 0.05 mm.

5.3.9. If diameter wear exceeds ϕ 20.1 mm, replace the Sc 1047 bushing.

5.3.10. In case of enlargement of the ϕ17 mm hole,thus the Sc 1046 bushing becoming loose, chrome plate the bushing, provided the layer thickness does not exceed 0.02 mm. Loose fit L=0.00 - 0.029 mm.

5.3.11. Sc 1046 bushing having $\phi 14^{+0.017}/_{+0.006}$ worn: stick the pin if the fit is not looser than 0.08 mm. Beyond this limit replace the bushing.

5.3.12. ϕ14 Sc 1530 pin worn: if diameter enlarged, stick the pin if the loose fit does not exceed 0.08 mm. Beyond this limit, install the M 137-10-002.14 bushing.

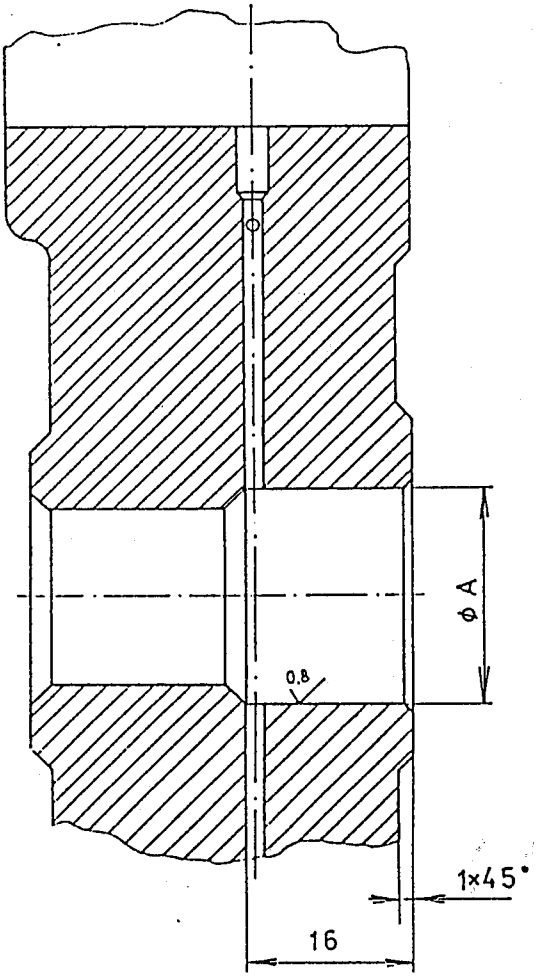


Fig. 5-1

Dress out burrs and scores deeper than 0.5 mm from covers and accessories surfaces.
Dress out scores not deeper than 0.7mm on the lateral sides of the crankcase, caused by brackets and sheet parts.
If M6 studs are still used to fasten the front cover, replace these studs at overhaul by M8 studs and modify the cover.
Remake damaged surface protection.
Replace cylinder studs if damaged, if their surface protection is deteriorated or deep corrosion evidenced.
Repair if threading for the Sh 0043 valve is mutilated or loose, install the Sc 1036 insert.

5.3.2. Dimensional Inspection.
Measure the bearing inserts OD in the fixture. Required press fit P=0.03÷0.04 mm. Cadmium plate the inserts to max. thickness 0.03 mm.

5.3.3. Main Bearing Bore: out-of-roundness-0.04 mm; taper-0.03 mm. Machine possible scoring to max.ϕ62.06 mm and consequently cadmium plate the bearing inserts.

5.3.4. Main Bearing Inserts ID Wear: peeling off or wrapping of the lead layer, galling or scratching to be machined off and applied a new lead layer measuring 0.01÷0.005 mm. To remake the bearing insert, lead plate to 0.01-0.015 mm while observing the loose fit between journal and insert (lead layer included) L=0.04÷0.06 mm.

5.3.5. If scoring, galling and indentation on crankcase surfaces result in exceeding l=102.035 mm for main bearing caps or in decreasing below l=101.985 mm for bearing caps sides, straighten surfaces and copper plate the sides of the bearing caps, so that the layer may not exceed 0.03 mm. Observe the fit, loose L=0.05 to press P=0.02 mm.

5.3.6. Repair scored surfaces for cylinder basing as follows:
-if scoring depth does not exceed 0.05 mm - by scraping.
-if the depth is between 0.05 mm and 0.35 mm, mill each area separately and stick limiting pads.
-if the depth is greater than 0.35 mm - mill the entire surface from each cylinder.

5. CRANKCASE

The crankcase is a one-piece, light aluminium casting. It consists of three parts:the proper crankcase,the top cover and the front cover, all having the same part (sub-assembly) reference.

All these three parts are reciprocally ground during manufacturing and this fact should be further respected. Each individual component is equipped with studs, brackets, plugs, numbered main bearing caps, threaded inserts, etc. The main bearing caps must not be used with an other engine as the center line may not be true.

5.1. THE CRANKCASE DISASSEMBLY is performed during engine general disassembly.

5.2. THE WASHING and CLEANING (crankcase, top and front cover, oil sump, drive outlets) is performed in decarbonizer and gasoline.

5.3. INSPECTIONS

5.3.1. Crankcase Visual Inspection.

Inspect the studs.Replace if threads are mutilated or stud deformation is evidenced.

Loose threaded inserts, damaged threads - replace.

Check thoroughly the threaded inserts no.103 1081 used for attaching the engine mounting pads, if loose. Visually inspect if damaged or loose.Check the M8x1 SH6 thread with gage, replace if damaged.

Measure,if inserts are sunk from crankcase.If smaller than 0.2 mm, replace. Install the 10-0.2 mm thick steel pad together with the Sc 8825 aluminium alloy pad. Torque the M8x20 bolts to 23-27 Nm and maintain for 30 sec. If the torque decreases, mark the inserts and replace them.

Recondition damaged mating surfaces, indentations and damaged edges.

Dress out scoring on the mating surfaces of the air scoop holders.

cylinder no.1. Dismount the cylinders, remove the piston pin retaining rings and the piston pin. Remove pistons.

NOTE:

Fasten the connecting rods to cylinder studs by means of rubber bands to avoid damage to rods and crankcase.

4.5.TURN back engine cylinders down.

Extract cotter pins from main bearings and from connecting rod bearing caps. Remove the gears retaining nuts from countershafts using the P 137-006 wrench, the central gear nut using the P 137-083 wrench. Remove the gears. Extract the gears from countershafts by means of the P 137-087 extractor. Extract the swivel from the central gear using the P 137-084 extractor. Extract the bushing using the P 137-086 fixture.

NOTE:

Mark the Sc 0103 central gear and the Sh 0148 vertical shaft by the engine's number.

Dismount the main bearing covers caps using the Z2-0024-00 fixture.

Remove the crankshaft and deposit it in the Z3-01395-00 support, remove bearing inserts and put them into the collecting case.

4.6.REMOVE piston rings from pistons.

Remove the springs and valves from the cylinder heads using the P 137-068 fixture.

Dismount the other sub-assemblies in compliance with the pertinent overhaul sections.

Dis. Incl. 7.4.1 page
Incl note 7.4
Incl 7.7.1

4. ENGINE DISASSEMBLY

Install the engine in the overhaul stand Z1-01501-00 using the mounting fixtures P 30-0154, P 30-0116. Torque the M8x20 mm bolts from the mounting fixture to 10-12 Nm.

The angle brackets must be 10 mm thick,insert Sc 8825 aluminium pads between brackets.

4.1.REMOVE from engine the generator, the starter, disconnect the controls from the air manifold and injection pump,dismount the air intake conduct, supercharger included and the oil conducts. Remove the air scoop. Disassemble the cylinder heads using the Z3-00136-00 wrench and the P 137-081 extractor.

4.2.TURN the engine cylinders up.
Remove rocker plugs with the P 137-082 wrench. Remove exhaust piping, magnetos blocks with the ignition harness and spark plugs. Dismount the injection pump and the magnetos.

4.3.TURN back engine cylinders down.
Drain off oil from engine. Remove crankshaft nut together with the Sc 2020 splashing ring, remove the front cover with the thrust bearing using the Z4-00191-00 extractor.
Remove the top cover and the breather tube from it, using the P 137-085 extractor.
Remove the side covers and the transversal bolts from the crank bearing inserts.

NOTE:

When removing the bolts, extract also the washers to avoid them falling between the transversal walls.

4.4.TURN the engine cylinders up.
Dismount the camcase, including the camshaft and the rockers. Remove the air inlet elbows from the cylinder heads. Remove cylinder baffles and the rear wall of the air scoop. Loose the cylinder heads and dismount them progressively beginning from

lifting fixtures,remove engine from airframe.While the engine is hanging, attach prescribed fixtures and bolts and deposit the engine on the overhaul stand (or shipping mount).

3.34.CORROSION PREVENTION and STORAGE

Protect engine surface a soft film of preservative oil (Konkor-101). Wrap in paraffin paper or plastic foil and store the engine together with the shipping mount in the case. Store all in a dry atmosphere.

Place a vessel under the engine during conservation. Remove spark plugs on one side and spray preservative oil inside cylinders. Screw back the spark plugs.

3.35.CONSERVATION REMOVAL

Take engine out from the case, remove exterior conservation using technical gasoline or a suitable degreaser. (Place a vessel under engine). Perform this operation in a space with good aeration or in free space. Attach mounting brackets with aluminium pads 5 mm thick using M8x20 bolts.

CAUTION:

Do not use longer bolts,because it may damage the crankcase.

Install engine on the overhaul stand.

premature failures before the TBO may be reached and, in some cases, may cause the engine to be removed from the airframe. For this purpose,it's very important to observe the following recommendations during assembly. The following parts must be 100% coated with pre-lubricant:

a) camshaft lobes
b) mating surfaces of rockers
c) intake and exhaust valve tips and stems
d) valve guides

The other parts should be lubricated with a mixture of 15% pre-lubricant and 85% SAE no.50 grade aviation mineral lubrication oil.

NOTE:

Success was recorded by the factory with the following pre-lubricants:

a/ Texaco Molytex "0", Texas co.,
b/ Kendall Refining Co., Steam Cylinder Oil No.1,
c/ Atlantic Ebony R., Atlantic Refining Co.

The above listed products are not the only suitable pre-lubricants. This is only a list of factory experienced products.

3.32.LIST of PARTS SUBMITTED to MANDATORY REPLACEMENT

Several parts must be replaced at overhaul, regardless of their condition. They are listed below:

-all engine oil hoses
-all oil seals
-all gaskets
-all securing rings, lockwashers and piston rings
-ignition cables
-all selflocking nuts
-all crankshaft plugs
-bearing inserts and bushings

3.33.ENGINE REMOVAL from the AIRFRAME

As soon as the propeller was removed, install a crankshaft protection cap to avoid thread damage. By using a hoist and

damaging the thread. During stud replacement, coat the thread with an anti-seize compound.

3.27.CORROSION PREVENTION

Following completion of all repair operations and inspections, all steel parts must be corrosion protected by using a preservative oil.

3.28.REASSEMBLY-CORROSION PREVENTION

Prior to reassemble all sub-assemblies, preservative oil and foreign matters must be removed from parts. During assembly, all steel parts must be protected with a heavy coat of preservative oil (Sinclair Rust-O-Lene 50 and equivalent).
Apply this procedure for all machined surfaces,especially for bearing surfaces, cylinder bores and piston rings.

3.29.TABLE of CLEARANCE

is part of this Overhaul Manual. The bulletin of the Table of Clearances is periodically revised to reflect the latest data. The Bulletin must be referred to during dimensional inspections and mating fits. The table sets also forth clearances between moving parts and torque limits for various nuts and screws. Charts showing locations of dimensional inspection are included too.

3.30.OIL SEALS and GASKETS

All oil seals and gaskets must be replaced during overhaul.

3.31.PRE-LUBRICATION of PARTS prior to REASSEMBLY

A series of failures have been evidenced to be caused by improper pre-lubrication during engine assembly.
The purpose of this paragraph is to introduce the procedures recommended by the manufacturer and the approved products for part pre-lubrication prior to assemble. If parts are not properly lubricated or the used lubricant is improper, many engine parts may become scored at the first running, till the oil goes through and lubricates the engine.This is a cause of

of maiting surfaces. The manufacturer does not recommend priming paint of aluminium parts. Grey, blue and red enamel must be air dried to hard after application. The part may be baked for 1/2 hour at 82°C instead of air drying. The grey enamel is a phtalate resin type enamel thinned with Toluol or similar.

3.25.ENGINE ENAMEL (GREY)

The grey enamel is the same type as the enamel used in the paragraph 3.23. and time intervals for drying or baking are the same. The enamel has to be sprayed, but if brush application is found necessary, special care must be taken to avoid ununiform layer or run.

3.25.MAGNESIUM PART PAINTING

Magnesium parts must be cleaned applying a dichromate treatment prior to painting. This treatment consists of cleaning off all traces of grease and oil by using a neutral, non-corrosive degreasing medium followed by rinsing, after which the part is immersed for at least 45 min. in a hot solution of dichromate (0.75 pound of sodium dichromate to one gallon of water at 180°-200°F; quantity as required). The part must be carefully washed in running water, immersed in hot water and dried in air blast. The part must be immediately primed with a thin coat of zinc-chrome primer and then either allowed to air dry for 2 hrs. or to be baked for 1/2 hr. at 177°F (350°C). After this, when the ground is dry, apply engine enamel (grey,blue,black) as indicated in § 3.23.

3.25.STUD REPLACEMENT

All bent, broken, damaged or loose studs should be replaced. After the studs have been removed, check hole threads for condition. If it is necessary to retap stud hole,use oversize studs. Oversize studs are delivered in 0.003, 0.007 and 0.012 inch oversize. The studs broken flush with case must be drilled and removed with an "Easy-Out" or similar. While performing this operation, attention should be payed to avoid

determination.

3.20.CORROSION PREVENTION

Following inspection, preserve all steel parts with preservative oil.

3.21.REPAIR and REPLACEMENT of PARTS

Abnormal damages such as: burrs, nicks, scratches, galling should be dressed out using fine stones, crocus cloth or similar abrasive matters. The part should be thoroughly cleaned after repairs of this kind.Rests of abrasive material remained on parts can cause excessive wear.Reciprocally check the parts and its mating part to determine if clearance is within limits.Flanged surfaces,that are bent,nicked or warped, may be repaired by lapping on a surface plate.

These parts must also be thoroughly cleaned to remove abrasive rests. Damaged threads can be repaired with suitable dies or taps. Satisfactory removal of smaller nicks may be achieved by using Swiss pattern files or a small edge stone. After scratches and galling have been removed from bearing journal surfaces,polish to a high finish.The most of cracks is difficult to repair. Under certain conditions it is permitted to weld in some areas, provided that those areas are not situated in stressed locations.

3.22.PAINTED PARTS

Parts requiring painting, either for protection or for appearance will be painted in accordance with pertinent procedures.

NOTE:

All machined areas and threads must be masked off before painting.

3.23.ALUMINIUM ALLOY MADE PARTS

Aluminium alloy made parts should have smooth surface and those to be painted must be perfectly clean. Avoid painting

3.16.STRESSED AREA CORROSION

Part failure can be caused by corrosin in highly stressed ares. For this cause, corrosion should be thoroughly checked for in the following areas: piston pin interior surfaces, the fillets at edges of crankshaft main journal and crankpin surfaces and the axial bearing surfaces.If removal of th pitting by use of crocus cloth is not successful, the part must be rejected.

3.17.SCREWED FITTINGS

The designation screwed fittings indicates all kinds of screwed fasteninigs or plugs and they are submitted to a careful inspection of the threads. Badly damaged or mutilated threads are a cause for part rejection. Minor damages such as nicks or burrs may be dressed out by use of files, fine abrasive cloth or a polishing stone. The parts showing signs of distorsion,galling or mutilation caused by overtightening or by use of improper tools must be replaced. Whem damaged studs are to be replaced, use oversize studs.

3.18.MAGNETIC INSPECTION

All fero-magnetic parts should be inspected for cracks applying the magnetic particle inspection.The success in detecting structural failure using this method requires skilful and experienced personnel. Machined steel parts usually show different indications and thereby it is very important a correct evaluation. Unqualified interpretation could cause missing serious indications. Highly stressed areas should be carefully inspected for appearance of fatigue cracks. These areas include: key ways,gears teeth, splines, root of threads, small holes and fillets.

3.19.DANGER of IMPROPER CURRENT

The proper amperage of the current applied to magnetic inspection must be determined with care. Too little amperage can permanently damage the part by overheating and burning the areas at the electrode contact. Only skill and responsability on the part of the operator can guarantee proper current

3.12.VISUAL INSPECTION

Visual inspection should preceed all other inspection procedures. Do not clean parts before visual inspection, as unsafe operation conditions may be often evidenced by metallic particles deposits in different recesses in the engine.

3.13.OVERHAUL RECORD and INSPECTION FORM

This form registers overhaul and inspections as they are being carried on. The completion of each procedure is proved by the signature of the worker or of the the controller, therby avoiding needles repetition and important procedures to be missed.

3.14.BEARING SLIDING SURFACES

All bearing surfaces should be examined for evidence of scoring, indentation and wear. Indentation and light scoring on aluminium bearing surfaces are not harmful and should not be considered as a cause for part rejection, provided that these parts confirm dimensionally with the "Tolerances and Fits" table. The part should not be reused if serious defects are revealed, allthough it may correspond dimensionally. Ball bearings should be checked visually for free turning, flat spots on balls, cracks and pitting of races and wear, including radial and axial clearance. The journals should be thoroughly checked for races conditions, mis-alignement and out-of-round. Shafts, pins, etc should be checked for out-of-roundness and taper This may be done in most cases by use of Vee-blocks and a dial indicator.

3.15.GEARS

All gears should be checked for pitting and excessive wear. This is of exceptional importance on the involute of the teeth. The evidence of deep pitting in this area is a cause for part rejection. Bearing contact surfaces of all gears must be free of deep scratches. Light abrasions may be dressed out with fine abrasive paper.

3.7. GRIT BLASTING

Decarbonizing loosens most hard carbon deposits, but the complete removal will require brushing, scraping or grit blasting. Operations of this type require skill and care on the part of the personnel performing them. Avoid damage to machined surfaces. Never use wire brushes on bearing contact surfaces.

3.8. PART PROTECTION on GRIT BLASTING

Sand or metallic parts should be avoided when grit blasting. Preferable are plastic pellets or crushed wallnut shells. All machined surfaces must be masked off and openings and holes tightly plugged before blasting. An exception to this is the valve seat. It may remain unprotected, as grit blasting the valve seat often removes the glaze formed on the exhaust seat and thus facilitating seat overhaul. All drilled oil passages in all housings should be plugged, while blasting, to prevent foreign particles to enter.

3.9. ENAMEL REMOVAL

Decarbonizing solutions remove most of the enamel on exterior surfaces. Grit blast the the rest of enamel.

3.10. PARTS PRESERVATION

After cleaning operations,rinse parts in a petroleum solvent, dry and remove foreign particles by air blasting. Immerse in or coat the parts with preservative oil.

3.11. INSPECTION GENERAL

Overhaul inspection is divided into three categories. A thorough visual inspection is firstly provided. Further, non-destructive inspection methods (such as magnetic particles for cracks, X-ray, electric or other non-destructive methods) or acid etching will reveal structural failures.

Third, conduct a dimensional inspection. The first two inspections are employed to identify structural failures, while the third inspection is employed to determine dimensional wear.

There are applied two procedures for cleaning:
-soft deposits: vapor degreasing for dirt and sludge removal.
-hard deposits: decarbonizing, brushing, scraping and grit blasting.

3.5. DEGREASING

Dip or spray the part with a petroleum solvent (Varsol or equivalent). Do not use unverified solvents, as several products that have been marketed, are injurious to both aluminium and magnesium. If any water mixed degreasing solutions containing caustic components are used, it is necessary to avoid oil foaming due to impregnation of these substances in metal pores. These solutions may also be dangerous to aluminium and magnesium. Rinse all parts degreased in a water mixed solvent in clean boiling water. Coat all parts with lubricating oil following cleaning to prevent corrosion.

3.6. HARD DEPOSITS REMOVAL

The washing solution removes only dirt, grease and soft oil deposits. Hard deposits are being loosen in hot decarbonizing solution in the washing tank. There are many decarbonizing agents. Among those more known there are: Gunk, Penetrol, Carbrax,Gerlack and others. Decarbonizers,like the previously mentioned degreasers,fall into two categories: water soluable and hydro-carbons soluable. Apply the same caution to the water soluable decarbonizers as applicable to water soluable degreasers.

CAUTION:

Extreme caution should be exercised, when decarbonizing magnesium alloy parts. Avoid use of hot solutions, unless personnel are not thoroughly familiar with solutions being used. Corrosion to magnesium parts can result from dipping parts in the same decarbonizing solution used for steel parts.

3. GENERAL OVERHAUL PROCEDURES

3.1. GENERAL.

In order to avoid repetition and for the purpose of brevity and clarity, overhaul procedures concerning different components or sub-assemblies are shown in pertinent sections, which meanwhile represent independent overhaul books. The result is a sequence of individual overhaul books dealing with the Ignition System, the Accessory Drive, the Cylinders, the Pistons and Valve Mechanism, the Crankcase, the Cooling, Oil and Fuel Systems and the Engine Test. It becomes evident,that a number of overhaul procedures may be applied upon all basic engine parts. Exactly these procedures of unspecified character are contained and described in this section.

3.2. DISASSEMBLY

is presented as the progressive dismantling of the entire engine to individual sub-assemblies, in that order as these sub-assemblies can be dismounted. The disassembly of each sub-assembly, including the cleaning of the components, is described in the pertinent section in such a manner, so that to each component and part can be given a careful inspection consisting of a visual and a dimensional inspection, the check for cracks appearance included.

3.3. PREPARATION for OVERHAUL

As soon as the propeller has been removed from the engine, install the crankshaft protection cap to prevent damages to the crankshaft thread. Employing a suitable hoist, remove the engine from the airframe. Fasten the lifted engine on the overhaul stand by bolting it to the engine mounting brackets. The length of the bolts and the thickness of the mounting brackets must be observed. See different overhaul sections.

3.4. CLEANING

Soft and hard deposits removal.

c. The LUN 7810.01 propeller governor maintains propeller constant rotational speed,selected by the pilot by means of the propeller control, when throttle setting is changed.

d. The hydraulic system consists of an oil pipe through which the oil flows from the governor to the oil distributor, an oil hose through which the pressure oil from engine oil system flows to the propeller governor and the oil hose returning the oil from the governor to the oil sump.

The three-blade, constant speed, hydraulically actuated model V 506 propeller is also certified for use with the supercharged model M 337 engines.

advance regulator.

2.18.6. The LUN 2231 Starting Vibrator is an electromagnetic equipment connected to the battery,which boosts the engine ignition system during engine starting. It is fastened on the aircraft firewall.

2.18.7. The LUN 2253 Starter Motor is an electric motor, which cranks the engine during starting. It equips engines with supercharger.

2.18.8. The LUN 2111 Generator supplies the aircraft electric system with current. It operates in a common circuit with the LUN 2114 regulating relay.

2.18.9. The LUN 2141 Regulating Relay is the equipment, which maintains a constant voltage at different generator RPM and connects or disconnects the generator from the battery in the proper moment. It is mounted on the aircraft firewall.

2.19. PROPELLER

Model V 231 propeller is certified for use with the M 332A engine. It is a fixed pitch, two-blade propeller of wood-laminate compound construction, which is mounted to the crankshaft front end by means of the flange fixed at the crankshaft beveled end.

Model V-410 propeller a mechanical actuated,variable pitch propeller, is also certified for use in different configurations with M 332.

The automatic variable pitch V 503 propeller is certified for use with the M 137A/AZ.

The VJ 5.500 A propulsor unit is certified for use with the M 337A/AK. The constituent parts of this unit are:

a. The V 500 A propeller is a two-blade, constant speed, hydraulically actuated propeller mounted by means of the flange fastened at the crankshaft beveled end.

b. The P 7900.01 pressure oil distributor is destined to bring pressure oil from the propeller governor through oil lines to the propeller servomechanism.

2.15. PROPELLER GOVERNOR DRIVE

At the rear end of the crankcase, there is provided the flange for propeller governor installation. To the right rotating drive spline, driven from the right drive outlet, there is coupled the governor driving shaft.

2.16. GENERATOR DRIVE

The generator drive gear train is supported in the housing mounted on the left flange of the crankcase. The motion is transmitted from the left drive outlet gear, over the intermediate gear,to the generator pinion.The drive spline has interior grooves matching the generator shaft. Both drive gears are supported in bronze bushings. The oil sealing ring installed on generator drive hinders oil to penetrate inside generator. The generator is flanged, with grooved shaft end. The generator is mounted on the frontal generator drive housing flange and it is additionally fastened in the crankcase recess by means of a fixing belt.

2.17. ENGINE INSTALLATION

On each side of the crankcase there are two flanges cast together with the crankcase and intented for mounting the pins of the engine mounts.

2.18. ACCESSORIES

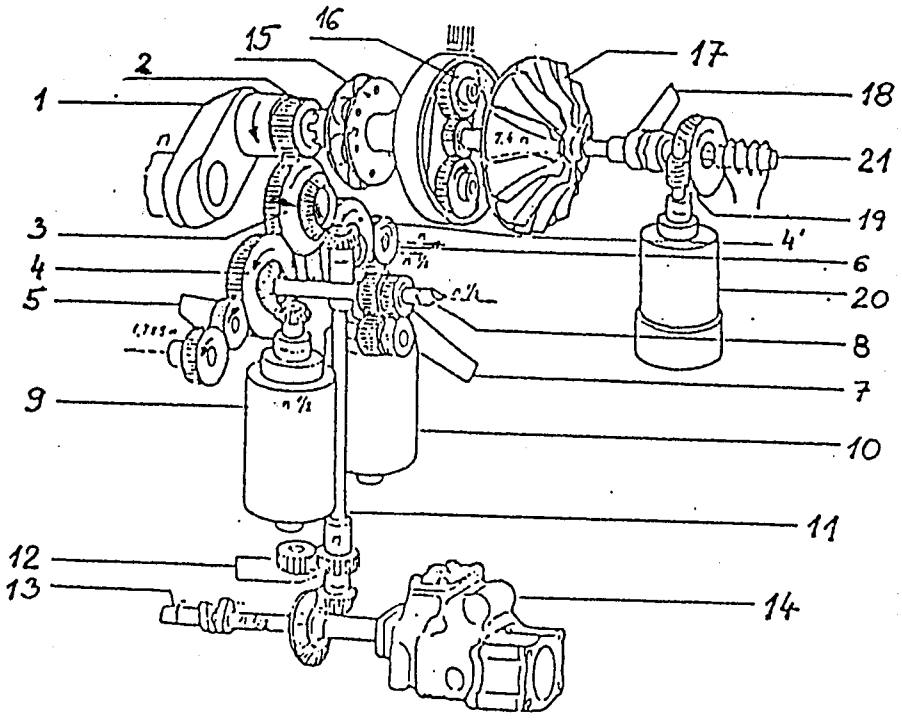
2.18.1. The LUN 5151.02 Injection Pump is destined for 4-cylinder, fully aerobatic engines. It is equipped with automatic fuel correction with respect to the manifold air pressure.

2.18.2. The LUN 5150.01 Injection Pump is destined for 6-cylinder, fully aerobatic engines. It is equipped with automatic fuel correction with respect to the manifold air pressure.

2.18.3. The Injection Nozzles Yc-070 serves to spray the fuel in the engine air intake piping.

2.18.4. The LUN 2225 Magneto is destined for 4-cylinder ignition engine. It is equipped with centrifugal ignition advance regulator.

2.18.5. The LUN 2221.13 Magneto is destined for six-cylinder ignition engine. It is equipped with centrifugal ignition



1-CRANKSHAFT
2-CRANKSHAFT GEAR
3-INTERMEDIATE DRIVE GEAR
4-LEFT OUTLET FOR LEFT MAGN. AND OIL PUMP DRIVE
4'-RIGHT OUTLET FOR RIGHT MAGN.AND RPM GOV.
5-GENERATOR DRIVE GEAR
6-ELECTRICAL RPM INDICATOR DRIVE GEAR
7-MAIN OIL PUMP
8-MECHANICAL RPM INDICATOR DRIVE SPLINE
10-RIGHT MAGNETO
11-VERTICAL DRIVE SHAFT
12-AUX.OIL SCAVENGE PUMP
13-CAMSHAFT
14-INJECTION PUMP
15-ELASTIC COUPLING
16-EPYCICLIC GEAR
17-SUPERCHARGER IMPELLER
18-STARTER RATCHET GEAR
19-STARTER WORM GEAR
20-STARTER ELECTROMOTOR
21-STARTER ENGAGING ELECTROMAGNET

Fig 2.7. Gear train diagram

2.11. COOLING SYSTEM

The engine is cooled by the air stream, which is aspirated through the scoop entrance in the engine front cowl by the air scoop fixied on engine. The cooling air is farther conducted along the cylinders and directed by baffles to stream between cylinder barrel and head fins. From the air scoop, cooling air is prelevated to cool the generator and the injection pump. See Fig.2-1 (longitudinal section).

2.12. ENGINE STARTING

To start engine, an electric starter mounted on the supercharger must be switched on during starting attempt. The starter consists of an electromotor and the gear case with the worm gear and the engaging ratched gear actuated by the electromagnet. When engaging the starter electromotor by pressing the starter button in the cockpit, the electromagnet is concomitently energized and the ratched gear is engaged against the supercharger shaft and make the crankshaft turn over the starter worm gear and the supercharger epicyclic gear. After depressing the starter button, the ratched gear is disengaged by the action of the reversal spring. See Fig.2-7.

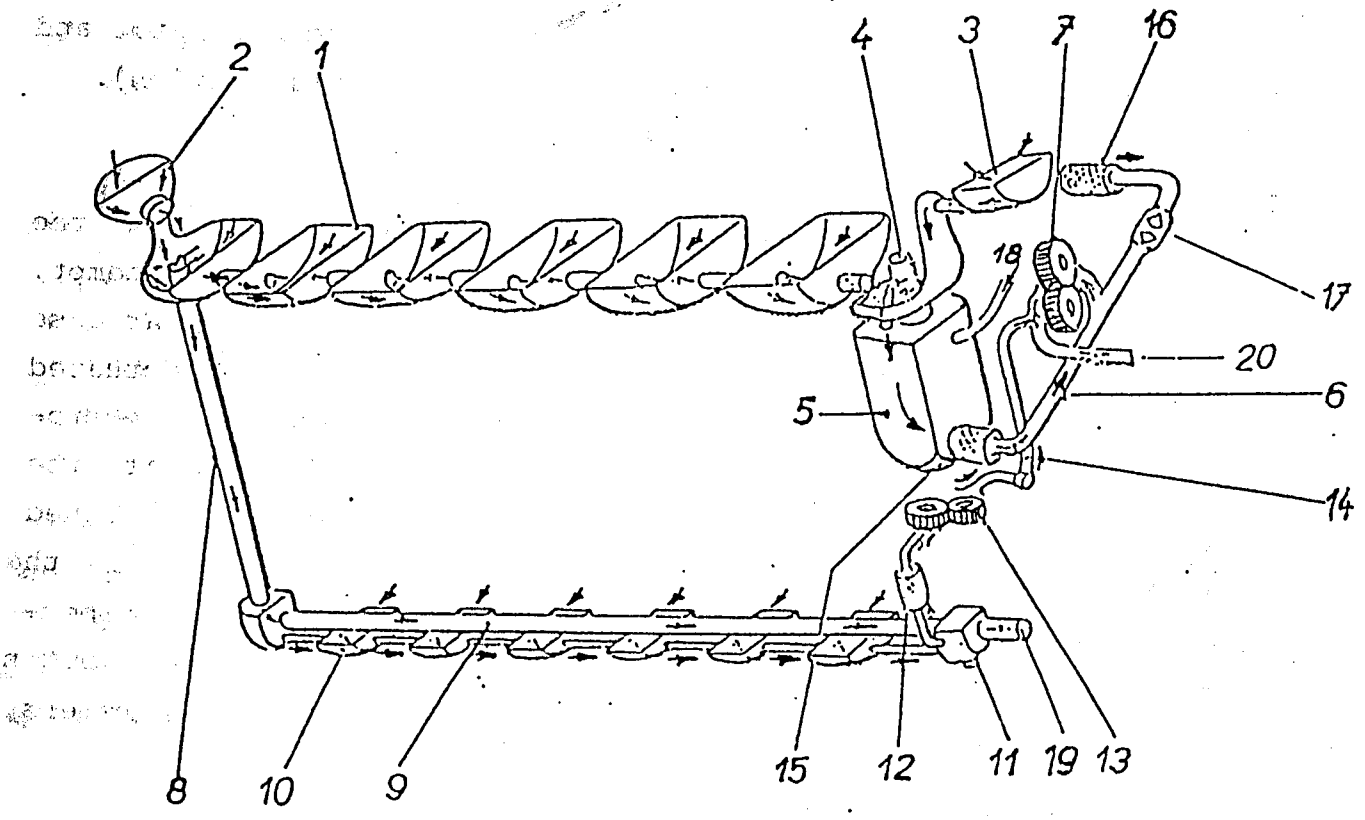
2.13. ACCESSORY DRIVE

Mechanical RPM Indicator Drive.

The main oil pump shaft is provided with a drive spline for the RPM indicator and an adapter fastened on the pump case. The RPM indicator flexible shaft is connected to the adapter by means of the socket nut and coupled by means of grooves to the drive outlet.

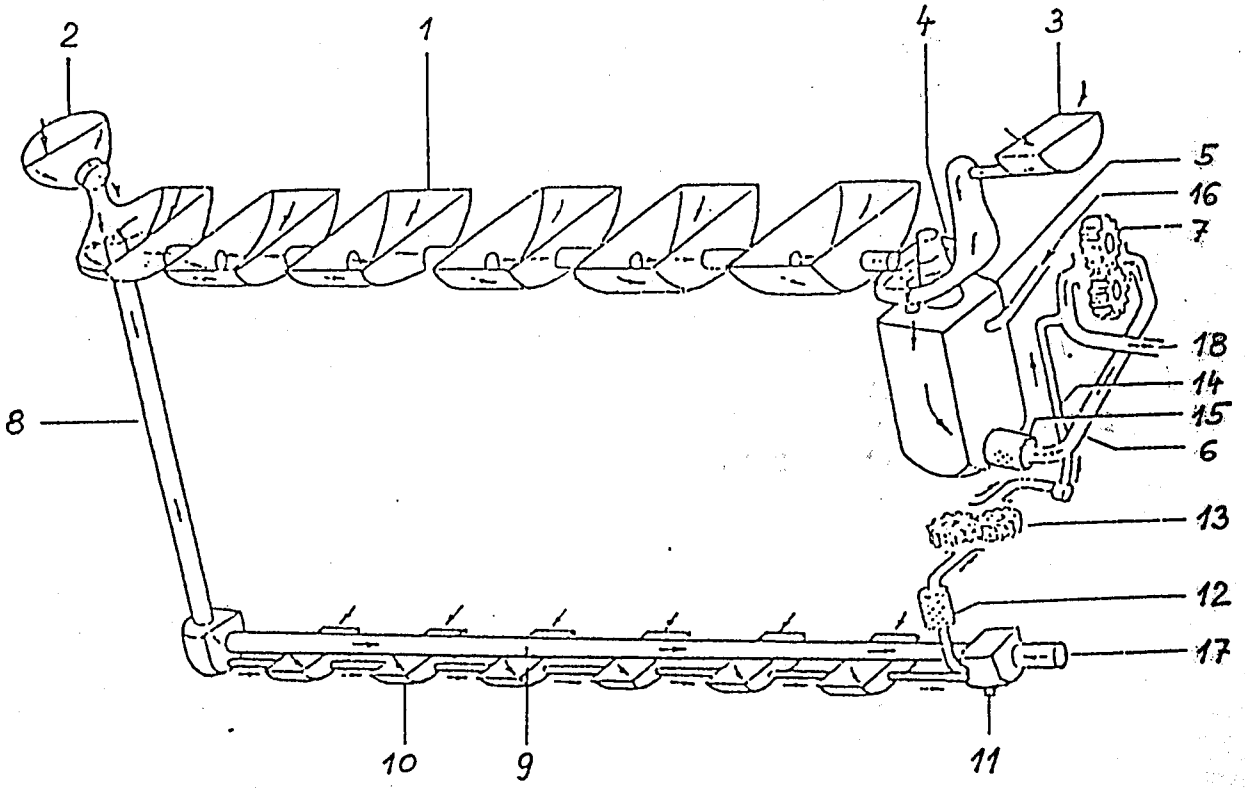
2.14. ELECTRICAL RPM INDICATOR DRIVE

On the right side of the crankcase, there is mounted the RPM indicator drive housing provided with flange for electrical RPM indicator installation.



1-CRANKCASE BOTTOM
2-FRONTAL COVER LIWER PART
3-SUPERCHARGER HOUSING LOWER PART
4-CRANKCASE REAR END BOTTOM
5-OIL SUMP
6-PIPING TO SCAVENGE PUMP
7-MAIN SCAVENGE PUMP
8-CRANKASE FRONT END OIL SCAVENGE TUBE
9-CAMSHAFT INSERT
10-CAMCASE BOTTOM
11-OIL DRAIN PLUG
12-SCAVENGED OIL STRAINER WITH GRAVITY VALVE IN DRIVE GEAR HOUSING
13-AUX.SCAVENGE PUMP
14-AUX.SCAVENGE OIL OUTLET HOSE
15-OIL SUMP SCAVENGED OIL STRAINER
16-SCAVENGED OIL STRAINER IN TOP COVER FITTING
17-SCAVENGE OIL GRAVITY VALVE FOR INVERTED FLIGHT
18-PROP. GOVERNOR RETURNING OIL
19-INJECTION PUMP SCAVENGED OIL
20-ENGINE SCAVENGED OIL TO TANK

Fig. 2-6. M337AK scavenged oil circuit



1-CRANKCASE BOTTOM
2-FRONTAL COVER LIWER PART
3-SUPERCHARGER HOUSING LOWER PART
4-CRANKCASE REAR END BOTTOM
5-OIL SUMP
6-PIPING TO SCAVENGE PUMP
7-MAIN SCAVENGE PUMP
8-CRANKASE FRONT END OIL SCAVENGE TUBE
9-CAMSHAFT INSERT
10-CAMCASE BOTTOM
11-OIL DRAIN PLUG
12-SCAVENGED OIL STRAINER IN DRIVE GEAR HOUSING
13-AUX.SCAVENGE PUMP
14-AUX.SCAVENGE OIL OUTLET HOSE
15-OIL SUMP SCAVENGED OIL STRAINER
16-PROP. GOVERNOR RETURNING OIL
17-INJECTION PUMP SCAVENGED OIL
18-ENGINE SCAVENGED OIL TO TANK

Fig. 2-5. M337A scavenged oil circuit

tank through a flexible pipe. The oil splashed inside the camcases flows to the drive gear housing through the longitudinal orifices in the camshaft bearings. The oil from the frontal end of the crankcase flows, especially when engine has this end tilted downwards, through the frontal scavenge tube to the camcase frontal lid and from here through the insert in the camshaft to the accessory drive housing. The returning oil from the injection pump flows also to the accessory drive housing. From here, the oil is surged by the auxilliary scavenge pump and pumped through a flexible hose to the fitting on the main oil pump and from here, together with the oil scavenged from the oil sump, back into the oil tank.

2.9.2.2.M337AK Aerobatic Operation

The oil system of the M 337AK aerobatic model is adapted permitting the oil to be scavenged from engine during inverted flights. For this reason, a gravity valve is mounted in the scavenging section of the main oil pump, which automatically switches between scavenging from the oil sump and scavenging from the crancase cover, where the oil is collected during loopings and inverted flights. The drive gear housing is also provided with a gravity valve, which ensures during aerobatics flights the oil scavenging from either the top or the bottom.
The oil circulation is in this way ensured during aerobatics flights.

2.10. CRANKCASE VENTING

For crankcase venting, there is used a breather in the crankcase cover,provided with a fitting to which a hose is connected, whose second end is placed outside engine cowling in an underpressure region.The breather fitting is provided with an adapter retaining splashed oil and oil vapors. See Fig.2- (longitudinal section).

to the bearings of the accessory drive gears. At the crankcase longitudinal oil conduit end there is a fitting for oil pressure gage line.

b/ The oil flows toward supercharger and lubricates the bearings and the gears.

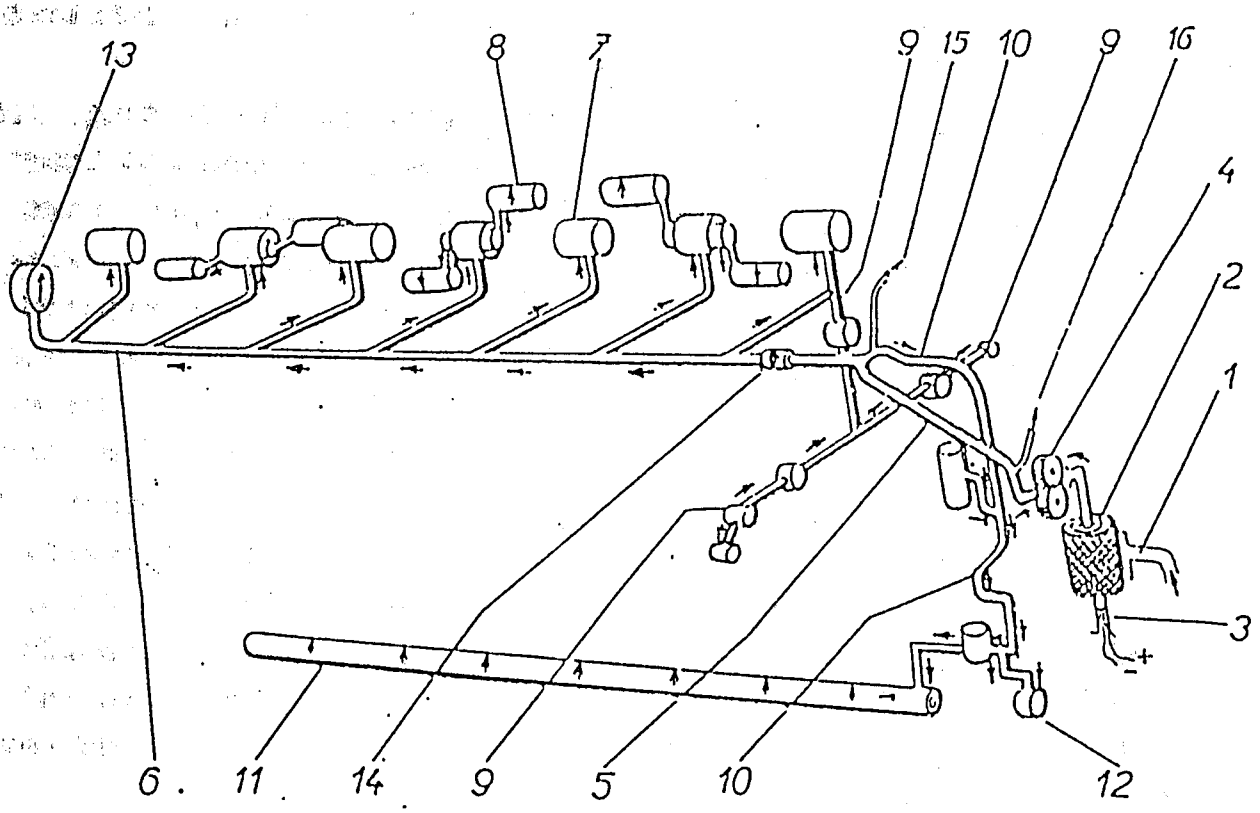
c/ The oil is flowing through a pipe to the fitting, from where it continues either to the crankcase and lubricates the bearing of the vertical shaft upper part or through a hose to the drive gear housing and lubricates the vertical shaft bearing. The oil is distributed in the drive gear housing to the injection pump and to the camshaft. Inside the injection pump it lubricates bearings and actuates the pump servomechanism. Inside the hollow camshaft there is installed an insert. The oil flows between this insert and the camshaft and lubricates, through the orifices in camshaft, the bearings and the cams. The oil splashed inside the camcases lubricates the rockers,the valve stems and the contact surface between valve stem tip and rocker adjust screw.

The pressure oil to the propeller governor is lead from the oil pump fitting through a flexible hose.

2.9.2. Oil Scavenging

2.9.2.1.M332A, M137A/AZ, M337A Normal Operation

Scavenging oil from engine is ensured by the scavenge section of the main oil pump concomitently with the auxilliary oil scavenge pump. The oil splashed inside the crankcase is collected at its lower side and flows through the orifices in the transversal walls to the rear end. The oil from the supercharger is also collected at the rear end of the crankcase. The oil collected at the crankcase rear end than flows into the oil sump mounted at the crankcase bottom side. The returning oil from the propeller governor is also collected through a flexible pipe in the oil sump. The oil from the oil sump is than surged by the scavenge section of the main oil pump over an oil screen and through the oil inlet line and pumped back to the oil



1-OIL INLET FROM TANK
2- TRIPLE INLET OIL STRAINER
3-TEMPERATURE INDICATOR
4-PRESSURE PUMP CAPABILITY
5-PRESSURE OIL LINE
6-MAIN LONGITUDINAL CRANK-CASE OIL CONDUIT
7-CRANKSHAFT MAIN BEARINGS LUBRICATION
8-CRANKPIN BEARINGS LUBRICATION
9-VERTICAL AND TRANSVERSAL OIL CONDUIT FOR ACCESSORY DRIVE GEAR LUBRICATION
10-PRESSURE OIL LINE TO DRIVE GEAR HOUSING
11-CRANKSHAFT PRESSURE OIL TO LUBRICATE CAMS
12-INJECTION PUMP PRESSURE OIL LUBRICATION
13-OIL PRESSURE GAGE FITTING
14-HIGH PRESSURE OIL VALVE
15-PRESSURE OIL TO SUPERCHARGER
16-PRESSURE OIL TO PROP.GOVERNOR

Fig. 2-4

with plates at each end, bearing a number corresponding to the pertinent cylinder and terminal on the magneto distributor block. Both magnetos have short-circuit wires provided with socket nuts for coupling in case of ignition grounding. To facilitate engine start, the spark intensity is increased, when pressing the starter button, by the action of the starting vibrator.

2.9. OIL SYSTEM

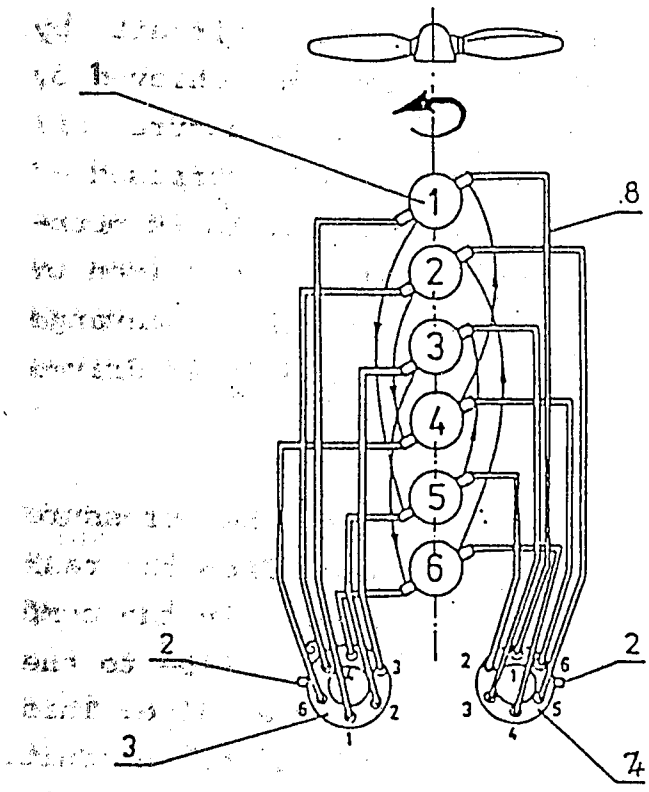
The engine lubrication is pressure, closed circuit, dry sump type having oil tank connected to the oil circuit by means of rubber hoses. The oil circulation is achieved by the action of gear type oil pumps: the main pressure oil pump and the scavange pump. The main pump is composed of the pressure section and the scavange section. It is mounted on the rear wall of the crankcase and it is driven by the drive gear on the left outlet. The auxilliar scavange pump is mounted on the drive gear housing and it is driven by the vertical drive shaft .

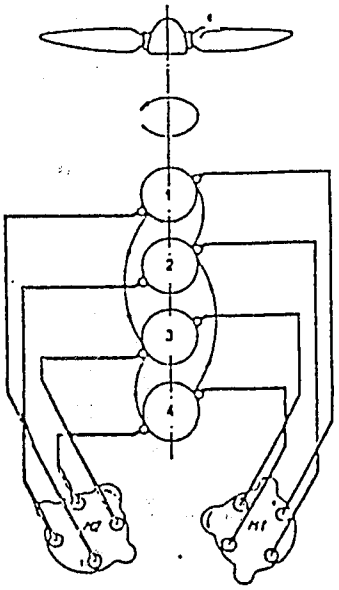
2.9.1. Pressure Oil Circuit

The pressure oil circulation is ensured by the pressure section of the main oil pump. It surges oil from the tank over the triple oil inlet strainer (placed in the pump case) and then evacuates the oil through a pipe to the three way fitting mounted on the high pressure valve. This valve is screwed to the crankcase longitudinal oil conduit. The oil is distributed from the three way fitting to different engine parts as follows:

a/ The oil flows through the high pressure valve along the crankcase main longitudinal conduit and the transversal conduits to the crankshaft main bearings and through the canals in the crankshaft to the connecting rod bearings. The oil splashed from bearings lubricates the cylinders, pistons and piston pins. The oil splashed from the first main bearing lubricates the crankshaft ball bearing.The oil from the rear main bearing is lead through the crankcase vertical and transversal conduit

BOTTOM VIEW



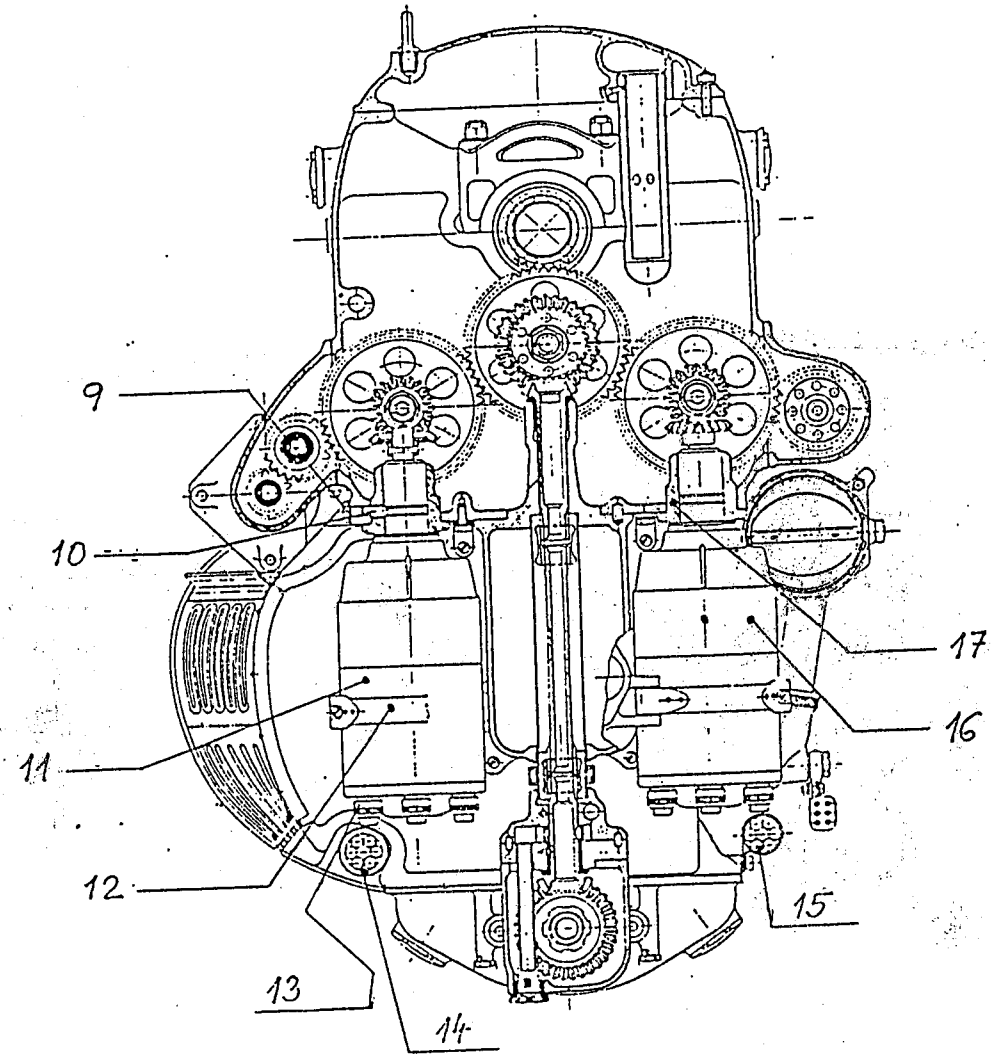


FIRING ORDER:1-5-3-6-2-4

1-3-4-2

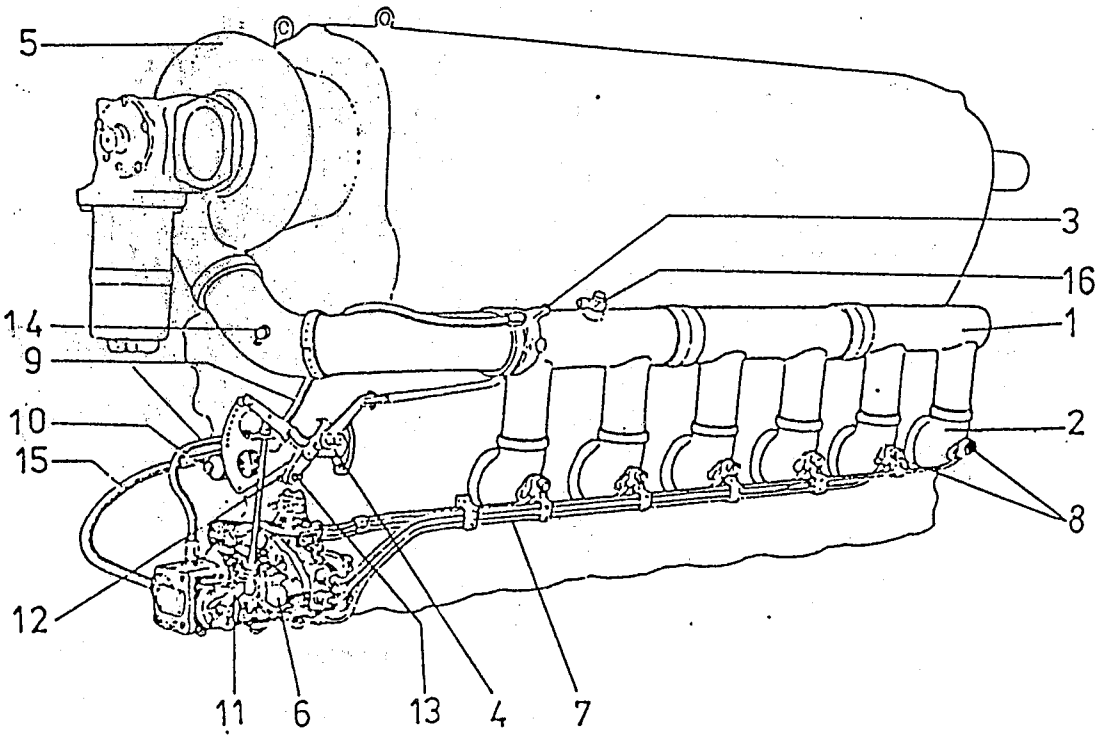
1-CYLINDER
2-SHORT-CIRCUIT TERMINAL
3-RIGHT MAGNETO
4-LEFT MAGNETO
8-IGNITION HARNESS

Fig.2-3 Ignition harness diagram



9-MAGNETO THREADED PIN PLUG
10-MAGNETO THREADED PIN
11-LEFT MAGNETO
12-MAGNETO FIXING BELTS
13-IGNITION WIRE OUTLETS
14-IGNITION HARNESS LEFT TUBE
15-IGNITION HARNESS RIGHT TUBE
16-RIGHT MAGNETO
17-MAGNETO DRIVE ADAPTER

Fig.2-3 Ignition system



1-AIR MANIFOLD
2-AIR INTAKE ELBOWS
3-THROTTLE HOUSING
4-CONTROL CANRILEVER
5-SUPERCHARGER
6-INJECTION PUMP
7-INJECTION LINES
8-INJECTION NOZZLES
9-CORRECTION HOSE
10-ADJUSTING SCREW
11-MIXTURE LEVER
12-CORRECTION LEVER
13-THROTTLE LEVER
14-FUEL PRIMING NOZZLE
15-INJECTION PUMP COOLING LINE
16-MANIF.PRESSURE INDICATOR FITTING

Fig.2-2

EXPLANATIONS

1- CRANCASE OIL SCAVENGE TUBE
2- CAMSHAFT
3- CAMCASES
4- OIL SUMP
5- INJECTION PUMP
6- AUX. OIL SCAVENGE PUMP
7- VERTICAL SHAFT
8- STARTER
9- SUPERCHARGER
10- EXHAUST VALVE
11- INTAKE VALVE
12- VALVE CLEARANCE ADJUST SCREW
13- THROTLLE HOUSING
14- INJECTION NOZZLE
15- AIR SCOOP
16- M 337A OIL STRAINER
17- M 337AK GRAVITY VALVE
18- CRANKCASE BREATHER
19- CRANKCASE BREATHER
20- THREE WAY FITTING WITH HIGH PRESSURE VALVE
21- MAIN OIL PUMP
22- OIL OUTLET
23- OIL INLET
24- GRAVITY VALVE

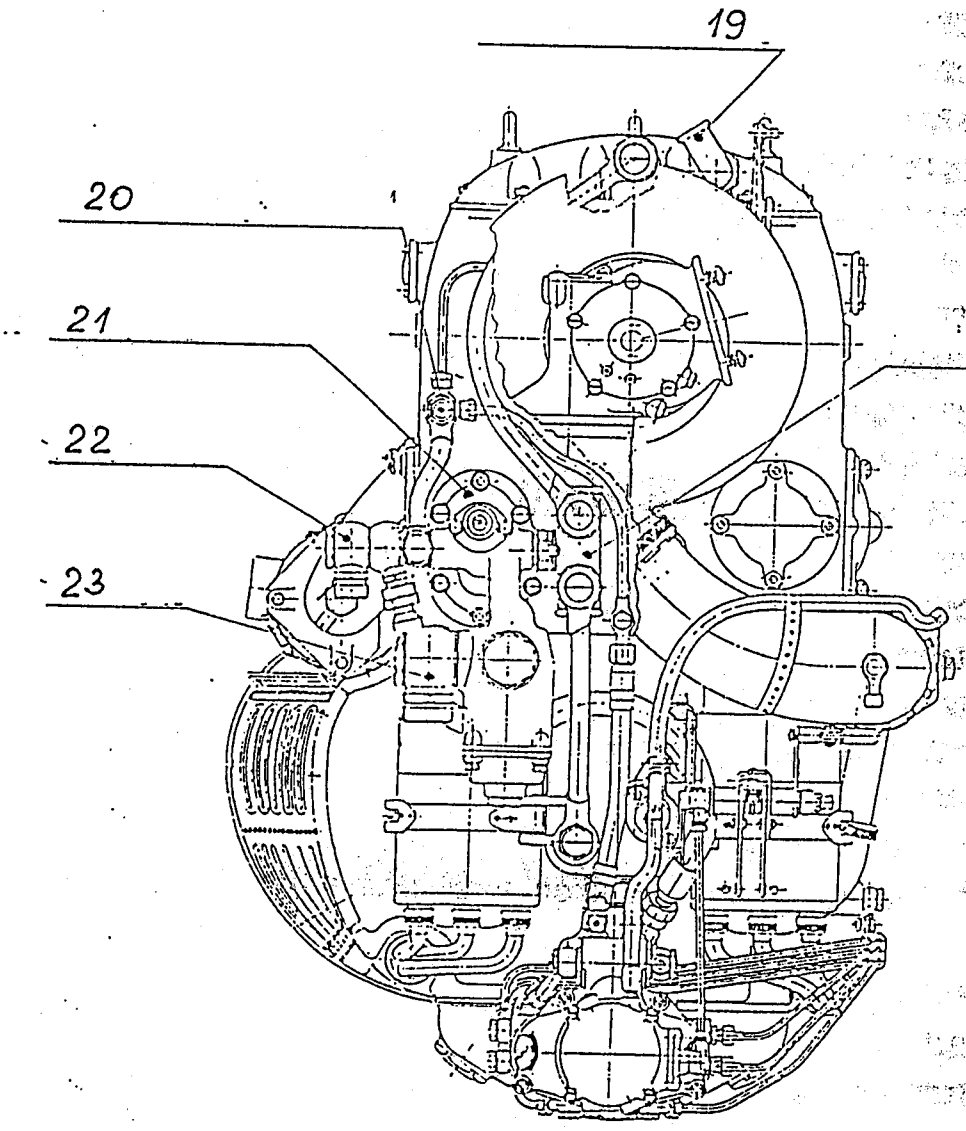


Fig. 2-1. Rear view-M337AK

2. GENERAL DESCRIPTION

2.1. CRANKCASE

The crankcase is composed from the proper crankcase, the upper cover and the front cover. All these mentioned parts are magnesium alloy castings (electronum). The covers are fastened to the crankcase by means of studs and nuts and interposed gaskets.

The main crankcase is divided by double transversal walls, which support the bearings of the crankcase. At the bottom of the crankcase there are studs to fasten the cylinder barrels and heads. On the lateral sides there are flanges for engine mounts pin assemblies and for the generator and RPM transmitter drives. The flanges for supercharger, oil pump and propeller governor are at the rear end. The flanges for magnetos and oil sump are at the rear end bottom.

The top cover is provided with three lifting eye-screws and with the crankcase breather located at the rear.

2.2. CRANKSHAFT

The crankshaft with four/six cranks is forged from a special nitriding steel. The journals and crankpins are nitrided. Both journals and crankpins are hollow and together with the canals in the cranks distribute lubricating oil to the connecting rod main bearing. These canals in journals and crankpins are obturated from both ends by means of plate-like obturators.

The crankshaft front end is beveled, with way for key and threaded for the propeller flange mounting nut.

At the crankshaft rear end there are assembled the valve gear drive and the supercharger drive.

The crankshaft is supported on seven slide bearings. The bearings consist of bearing inserts casted from lead bronze and galvanicly lead-plated. The bearing inserts are fastened by means of aluminum alloy caps.

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1. INTRODUCTION

Engine Models M 332A,M 337A and its aerobatic version M 337AK (fig.2-1) are air-cooled, in line, inverted, four/six cylinder engines with flanged propeller mounted on the bevel end of the crankshaft. These engines are equipped with a low-pressure fuel injection pump and with a disengageble centrifugal supercharger.

The valves are operated by a camshaft supported in the camcase mounted on cylinder heads.

M 337AK model is provided with aerobatic oil system enabling high class aerobatics, inverted flights included.

TERMINOLOGY

All location references used in this manual have unitary sense:

The engine front is the propeller location end.

The cylinders are numbered in the order beginning from the front end, where the cylinder designated as no.1 is located immediately behind the propeller.

The terms right and left designate locations on engine or the side of each particular part while viewing the engine from rear.

The top and the bottom designate locations on engine or the end of each particular part considering the engine normal position. At cylinder and their relative parts, the top designates nevertheless the location the most remoted from the crankcase.

The rotational sense of drives and accessories is established while viewing from the driving part to the driven part.

The rotational sense of driven accessories is the same as that of their drives.

The drive ratio is designated by the ratio between the driving part RPM and the driven part RPM. The resulting drive ratio indicates the cramkshaft RPM to accessory drive RPM ratio.

The abbreviation TDC, possibly BDC, indicates the top/bottom dead center.

1. INTRODUCTION

TABLE OF CONTENTS