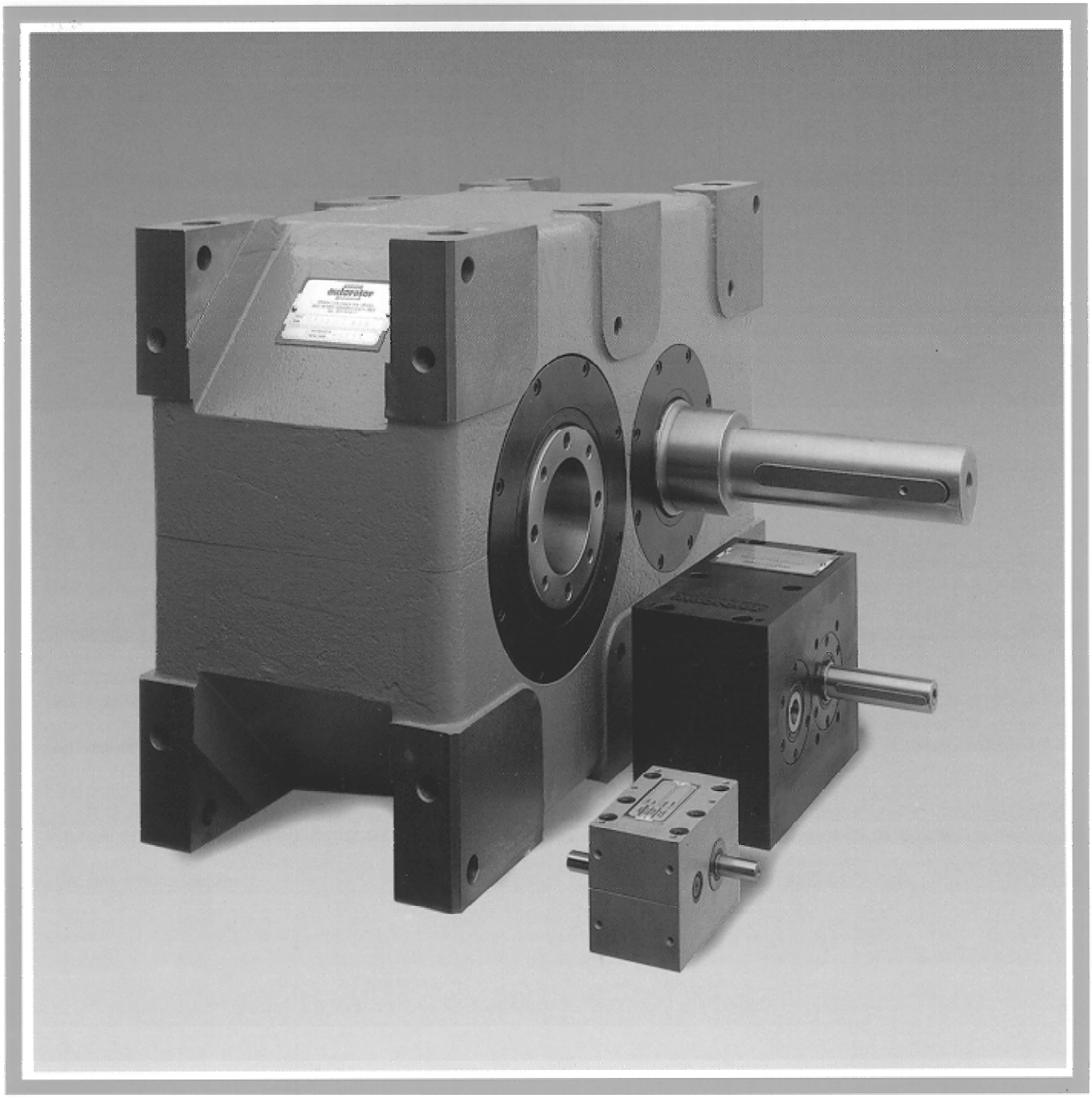
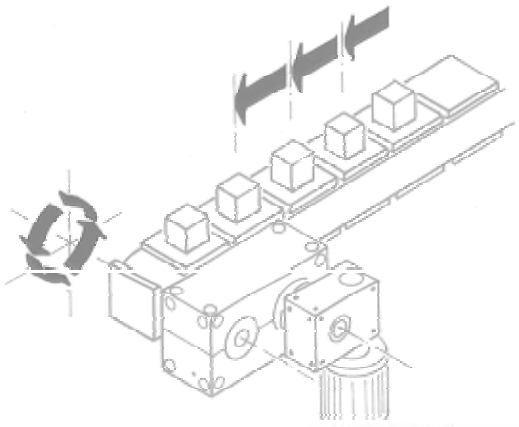


PARALLEL AXIS INTERMITTENT/OSCILLATING DRIVES



DIRECTIONS FOR USE AND MAINTENANCE

USA - 3/2001

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autorotor

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autorotor

DIRECTIONS FOR USE AND MAINTENANCE

Edition April 2001

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❋ ❋ ❋ ❋

1 MACHINE DESCRIPTION.

The parallel axis intermittent drive (AP) is a mechanical device that sets the output shaft into intermittent motion. It can be motor driven.
The parallel axis oscillating drive (OP) is a mechanical device that sets the output shaft into oscillating motion. It can be motor driven.
The AP/OP are parallel axis mechanical units which transform the uniform rotation of the inlet shaft into an intermittent/oscillating rotation of the output shaft by means of a cam and cam followers. The cam profile determines the indexer's transfer and dwell cycle.
They are generally framed into another machine.

2 FORESEEN AND UNFORESEEN USE.

The parallel axis intermittent / oscillating drive have been designed to set in motion equipment (conceived and developed by the customer, who is responsible for it), with mass, speed, movement law, system's rigidity, axial load, side load, torque within the limits set by the specifications shown in the technical data sheets (see from page 12 on and catalogue).
Should the indexer be used with higher loads than the ones mentioned in customer's order, a defective working may result, along with a premature wear of the system. Said operating conditions can be anomalous also from the point of view of operator's safety.
A dynamic shock during the deceleration phase hints at a load exceeding the one expected when designing. The customer must carefully plan the overall safety conditions of the machine designed to frame the parallel axis intermittent / oscillating drive Autorotor and must take into account the specific features of the indexer itself.

2.1 AP / OP indexer's casing fixing.

The AP/OP casing is machined on four sides, to allow mounting in several position.
The parallel axis intermittent / oscillating drive must be suitably anchored and supported according to their own weight and to the loads applied (see Pict.4, Pict.6 and table 4).

2.2 Features of what applied (tooling etc.) to the AP/OP output shaft.

It must be suitable for the AP/OP speed and power characteristics.

2.3 Risk of crushing, trapping, cutting, friction, and that pieces are projected due to the parts/equipment moved by the indexer.

Should the a.m. risks be there, suitable protection screens are to be prepared. They have to be evaluated depending on what follows.

2.3.1. Motor stop in dwell position.

The parallel axis intermittent / oscillating drive must not be stopped during the transfer phase. The cam holder shaft can be stopped during the output shaft dwell position, that is when the masses are still.
The (optional) position sensing device triggering the motor stop during the dwell position has a functional nature, and therefore it is not a safety device.
Should this stop have to be ensured to protect the safety of the machine in which the table is framed, then the a.m. sensing device must be replaced with another suitable one (possibly to be supplied by Autorotor).
The position sensing device must be adjusted while being installed (See § 6).

2.3.2. Motor stop due to power failure.

The stop of the system is triggered by the motor mechanical or dynamic brake if they are there (See § 2.3.3. e §3.). Should the calculated values still entail residual unacceptable risks, interblocked protection systems are to be applied, or a different kind of indexer must be requested to Autorotor.

2.3.3. Emergency stop.

Although you mustn't stop the intermittent / oscillating units during the transfer time, the Autorotor AP/OP are mechanically designed as to allow the emergency stop at any moment of the cycle. Furthermore an electric braking system in countercurrent - within the current values set in the table depicting the features of the electric system of the motor - can be added to the built-in brake motor braking.

The stop during the displacement phase entails a peak torque on the AP/OP output shaft due to the inertia of the system causing a dynamic shock to occur, the intensity of which depends on the cam position at the very moment when the stop occurs. The dynamic shock discharges onto the intermittent/oscillating unit and the reducer.

As the residual life of the parallel axis intermittent / oscillating drive is reduced by the stress of a dynamic shock, the use of emergency stop as an ordinary cycle stop is forbidden.

A torque limiter between AP/OP and reducer, limiter which under emergency stop conditions allows the motion to be continued by means of its (limiter's) slipping and the kinetic energy accumulated to dissipate, reduces the effect of the dynamic shock on the mechanical parts.

The emergency stop does not cause the motion to come immediately to a standstill; in fact the output shaft is likely to rotate, after the stop, for an angle, which depends on the initial mass inertia of the system and on the instant when the emergency stop occurs.

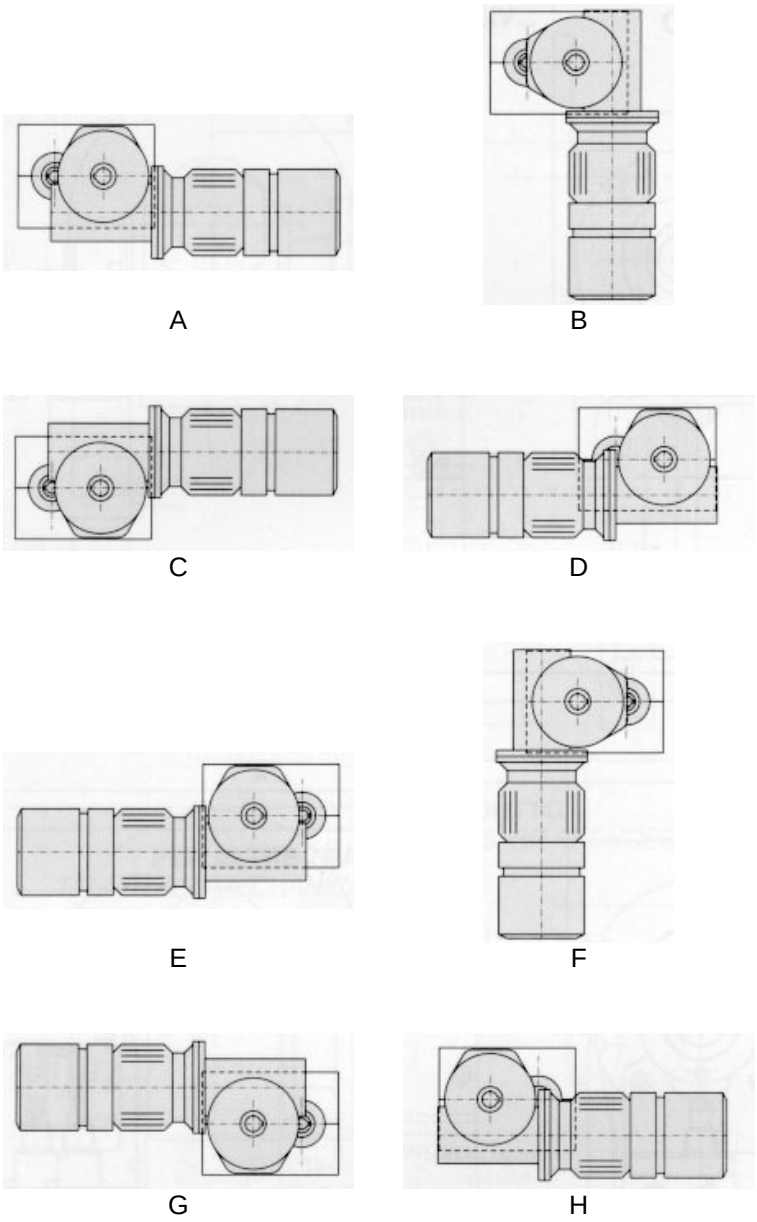


fig. 2 Power drive unit assembling position

The torque limiter must be checked every now and then to check that the original setting figure is kept.

In case it wasn't, it has to be set to the pristine value.

3. EMERGENCY STOP TIME CALCULATION.

The emergency stop time can be calculated from the balance between the braking action and the kinetic energy related to the table and motor inertia (passive phenomena are not taken into account).

- Maximum kinetic energy with respect to the motor shaft, brought about by the inertia of the rotating masses applied to the indexer's output shaft:

$$E_{k\max i} = \frac{1}{2} \cdot Jt \cdot \left(\left| \omega_m \cdot \frac{2}{i} \cdot \frac{2\pi}{S \cdot \beta} \right| \right)^2$$

- Motor kinetic energy

$$E_{k\,mot} = \frac{1}{2} \cdot Jm \cdot \omega_m^2$$

- Energy dissipated by the brake

$$E_f = \frac{1}{2} \cdot Mf \cdot \omega_m \cdot t_f$$

It is therefore possible to calculate the braking time and the slipping angle:

$$t_f = \left(\left| \frac{\omega_m \cdot \left| Jm + Jt \cdot \left(\left| \frac{2}{i} \cdot \frac{2\pi}{S \cdot \beta} \right| \right)^2 \right|}{Mf} + t_i \right| \right) \cdot K$$

$$\alpha_f = \omega_m \cdot t_f$$

Caption:

Mf	braking torque [Nm]
Jt	moment of inertia on the output shaft/disk [Kgm$^{2]}$,
ω_i	input shaft angular speed [rad/s],
S	station number,
β	displacement angle [rad],
i	gearbox reduction ratio,
ω_m	motor shaft angular speed [rad/s],
Jm	inertia of the motor [Kgm^2]
t_f	braking time [s]
α_f	slipping angle [rad]
t_i	turn-on time of the brake [s]
K	safety factor (1.5 ÷ 2)

Check periodically the motor braking system efficiency.

4. GENERAL TECHNICAL DATA.

Type	Stations number						Type	
	1	2	3	4	6	8		
AP40	0.000055	0.000064	0.000055	0.000064	0.000055	0.000064	**OP40**	0.000055
AP55	0.000143	0.00016	0.000143	0.00016	0.000143	0.00016	**OP55**	0.000143
AP70	0.000328	0.000364	0.000328	0.000364	0.000328	0.000364	**OP70**	0.000328
AP85	0.00147	0.00164	0.00147	0.00164	0.00147	0.00164	**OP85**	0.00147
AP110	0.004604	0.005244	0.004604	0.005244	0.004604	0.005244	**OP110**	0.004604
AP135	0.014697	0.015794	0.014697	0.015794	0.014697	0.015794	**OP135**	0.014697
AP165	0.06417	0.06732	0.06417	0.06732	0.06417	0.06732	**OP165**	0.06417
AP200	0.1218	0.1253	0.1218	0.1253	0.1218	0.1253	**OP200**	0.1218
AP250	0.4592	0.53028	0.4592	0.53028	0.4592	0.53028	**OP250**	0.4592

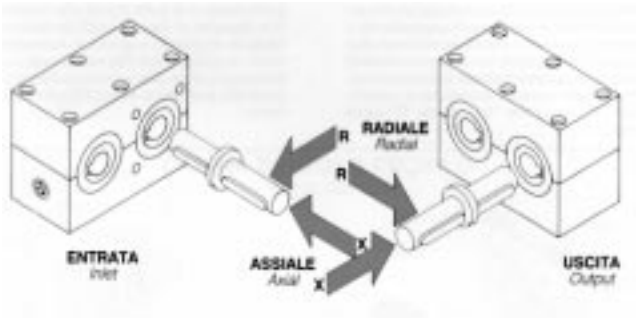
table 1: indexer's inside parts inertia J_a (Kg m^2)
[lb in$^{2=}$ 3417.17 Kg m^2]

AP							OP
Stations number	1	2	3	4	6	8	
Cam follower's number	**6**	**8**	**6**	**8**	**6**	**8**	**2**

table 2: number of cam followers depending on the stations number.

Type	Axial load X daN	Radial load R daN
AP/OP40	150	2
AP/OP55	250	3
AP/OP70	450	13
AP/OP85	600	20
AP/OP110	1000	35
AP/OP135	1400	45
AP/OP165	1900	85
AP/OP200	2600	115
AP/OP250	4650	190

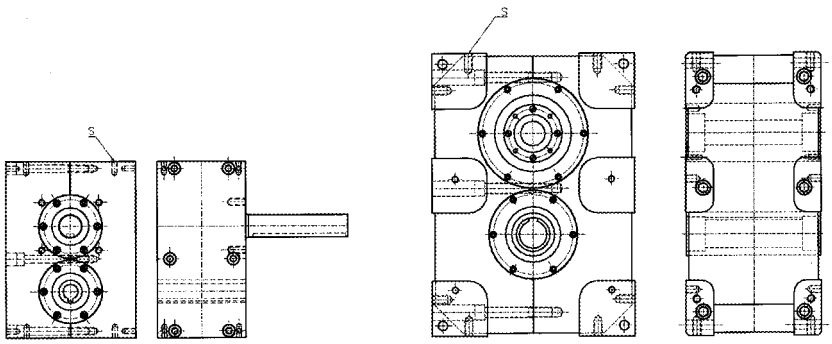
table 3: maximum bearable single loads on output shaft



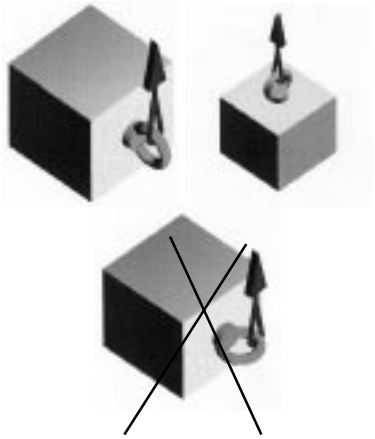
pict. 3.
Load application

5. HANDLING AND TRANSPORTATION.

Since AP/OP40, AP/OP55 and AP/OP70 weigh less than 25 Kg., they can be lifted manually.
The powered versions and the types weighing more must be lifted by means of lifting eyebolts to be locked in the suitable holes (pict. 4, pict. 5, and table 4) in accordance with what stated by UNI ISO 3266 regulation.



pict. 4: Lifting up and fastening holes.



pict. 5
Lifting up through lifting eyebolts

	weight Kg	fastening screw	lifting trebolts
AP/OP40		M5X8	
AP/OP55	5	M6x12	
AP/OP70	8	M6x12	
AP/OP85	27	M8X15	2 TIPO 1 UNI ISO 3266 M8X15 (sollevamento inclinato)
AP/OP110	47	M10X20	2 TIPO 1 UNI ISO 3266 M10X20 (sollevamento inclinato)
AP/OP135	92	M12X25	2 TIPO 1 UNI ISO 3266 M12X25 (sollevamento inclinato)
AP/OP165	150	M14X25	2 TIPO 1 UNI ISO 3266 M14X25 (sollevamento inclinato)
AP/OP200	275	M16X30	2 TIPO 1 UNI ISO 3266 M16X30 (sollevamento inclinato)
AP/OP250	480	M18X35	2 TIPO 1 UNI ISO 3266 M18X35 (sollevamento inclinato)

table 4: weight, fastening and lifting.

6. ASSEMBLY AND INSTALLATION.

The parallel axis intermittent / oscillating drive has to be mounted only on the already machined casing sides. Only adequate supports (i.e.: which can bear the load and cushion vibrations and noise) are to be used.
The fastening must be performed through screws the type of which is described in table 4.
What applied (equipment, tooling, etc.) to the AP/OP output shaft must be designed and manufactured according to the technical features of the indexer and must fulfil the minimum safety and health requirements stated in the machines guideline.
To be transported, the indexer must be crated with the reducer mounted along its side. If the desired operating position is different, you must unscrew the gear box's adaptation flange to the indexer (be careful of not shacking the motoreducer), rotate the reducer to the desired position and then rescrew the flange to the AP/OP casing. See the indexer's serial number on the first page of this handbook to learn the electrical data.

6.1 Motion transmission to the unit.

Should the parallel axis intermittent / oscillating drive be supplied without gearbox and motor, to have it run well you must

- consider the output torque of the reducer with reference to the data declared by the supplier. It must be less by
    - 35% for cam angles ranging from 180° to 330°
    - 65% for cam angles ranging from 90° to 150°
- check the maximum torque
- be sure of reduced backlash between the screws and the gear of the reducer
- consider a further reduction factor of the useful torque (K=1.3) for transmission through chains, joints, pulleys, bevel gears etc.
- pinions and pulleys must have the largest possible pitch diameter compatible with the overall needed dimensions; chains and belts must be inextensible, joints must be free of backlash.

As a consequence of what written above on the dynamic shock in case of stop during the indexer's displacement time, it is highly recommended to use a torque limiter, to avoid stresses which can bend and break the cam followers' pin.
The torque limiter is to be set at a torque value no more than 15% higher than the normally used torque.

6.2 Backlash on transmissions.

The transmissions rigidity is crucial to the good operating of the indexer. Check that there are no slacks between motor shaft and cam holder shaft. If any, by taking them away the pristine efficiency of the indexer is regained.

7. PUTTING INTO OPERATION.

Before putting the parallel axis intermittent / oscillating drive into operation you must:

- clean it carefully, by taking away dust and any foreign and smudging substance
- clear the rust inhibitor from the parts that are not painted
- adjust the position and operating of the position sensing device, if it is there, which stops the motor during the dwell position of the AP/OP
- check the right working of all protection and safety systems of the machine which incorporates the rotary index table

8. LUBRICATION.

Autorotor units are lubricated with longlife grease. Accessories, too, (reducers, speed variators, etc.) are adequately lubricated when supplied already assembled on the units.
The grease quantity in each unit is shown in table 5.
The lubricant quantity is checked through the level plugs.

TYPE	LUBRICANT	Q.TY (L)
	ROLOIL LITEX EP00 C.A./ 73 S	
AP 40		0,20
AP 55		0,30
AP 70		0,40
AP 85		1,00
AP 110		2,00
AP 135		2,50
AP 165		5,00
AP 200		9,0
AP 250		14,00
OP 40		0,30
OP 55		0,40
OP 70		0,50
OP 85		1,10
OP 110		2,20
OP 135		2,70
OP 165		5,20
OP 200		9,20
OP 250		14,30

Equivalent lubricants:

AGIP	GR SLL
BP	ENER GREASE FG00EP
ESSO	BEACON EPO
SHELL	SUPER GREASE EP0 TIVELA COMPOUND

table 5: lubrication.

9. MAJOR OVERHAULING.

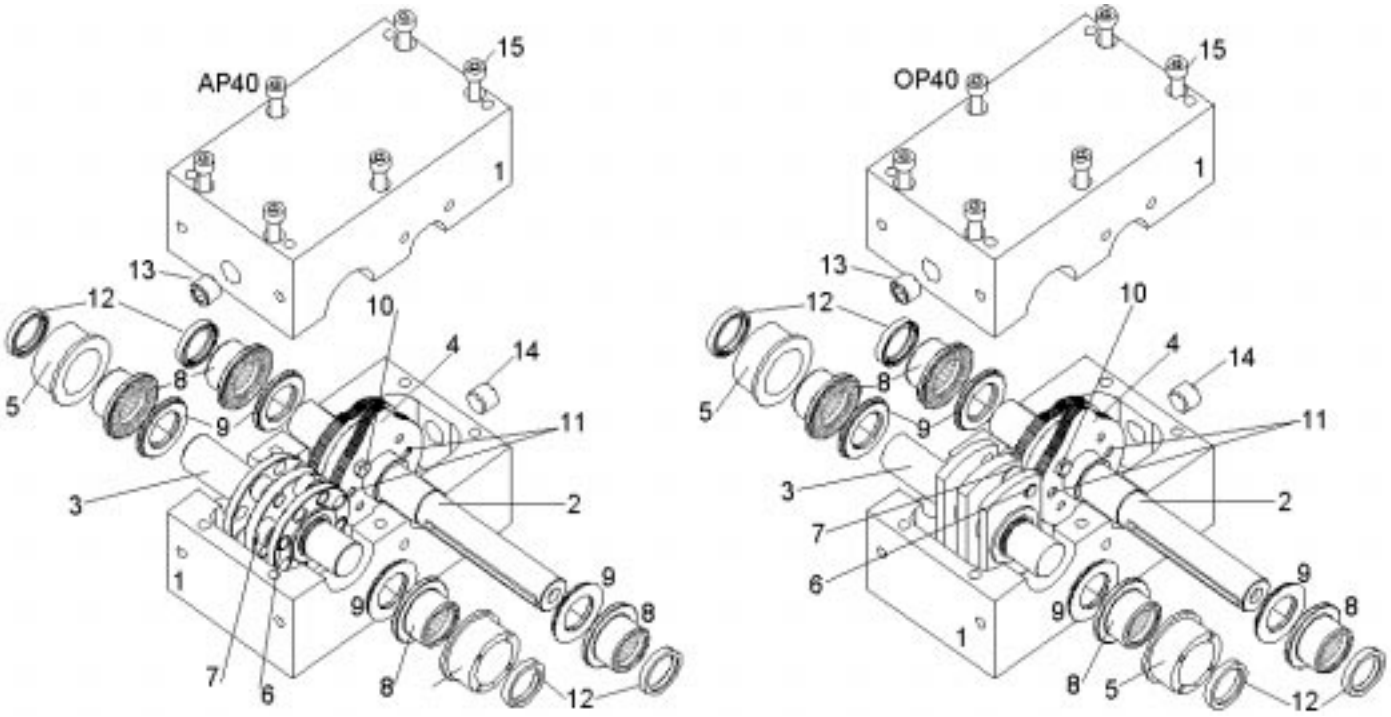
Major overhauling is carried out at Autorotor workshop; please call after-sale service.

9.1 Spare parts.

In case of order for spare parts, please let us know the unit type and serial number (they are shown in the table plate) and the spare part number (see technical data sheets).

13. TECHNICAL DATA SHEETS.

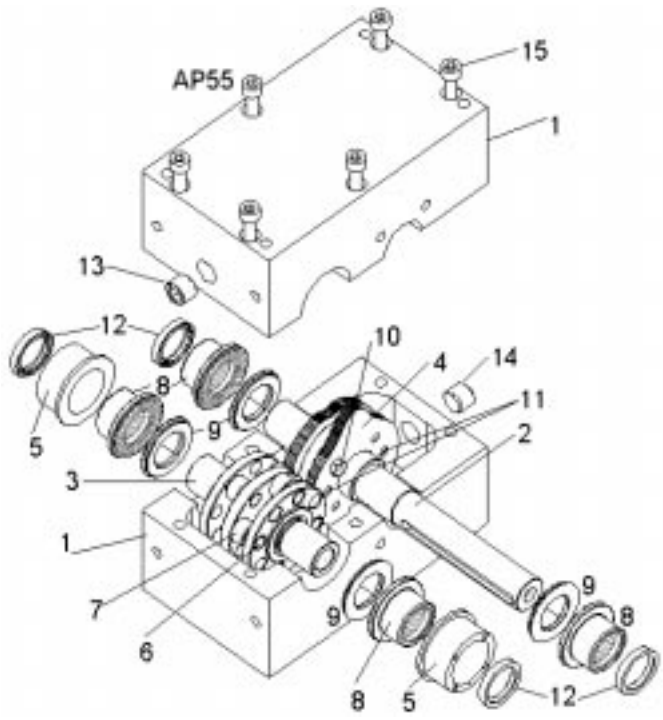
13.1 AP/OP40

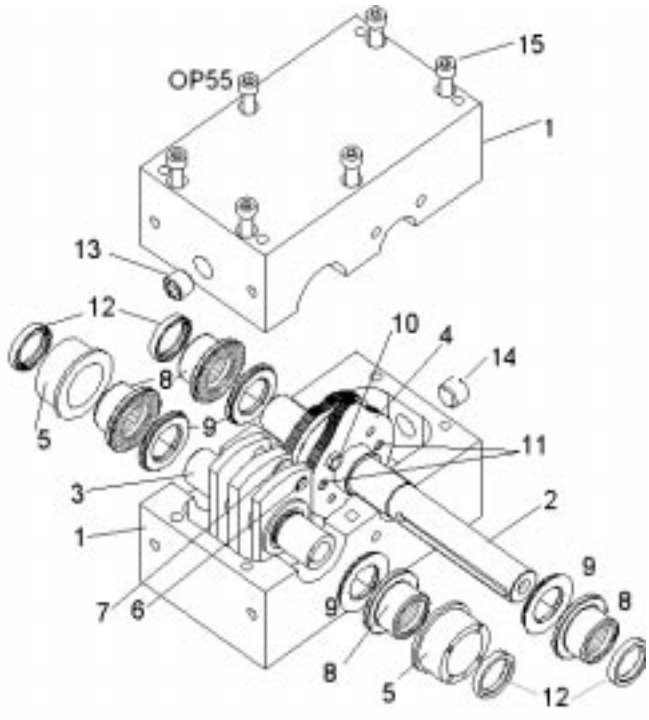


Ref.	Part name	Qty.
1	CASING	1
2	INPUT SHAFT	1
3	OUTPUT SHAFT	1
4	CAM	2
5	ECCENTRIC BUSH 17013	2
6	PIN	S
7	CAM FOLLOWER	S
8	DOUBLE BEARING RAX715	4
9	WASHER CP21528	4
10	HEXAGONAL HEAD SCREW M4X20	4
11	PARALLEL PIN 5X20	2
12	SEAL ET 1521	4
13	OIL PLUG ¼”	1
14	OIL PLUG ¼”	1
15	HEXAGONAL SOCKET SCREW UNI5931 M5X45	6

S value: see table 2, page 7.

13.2 AP/OP55

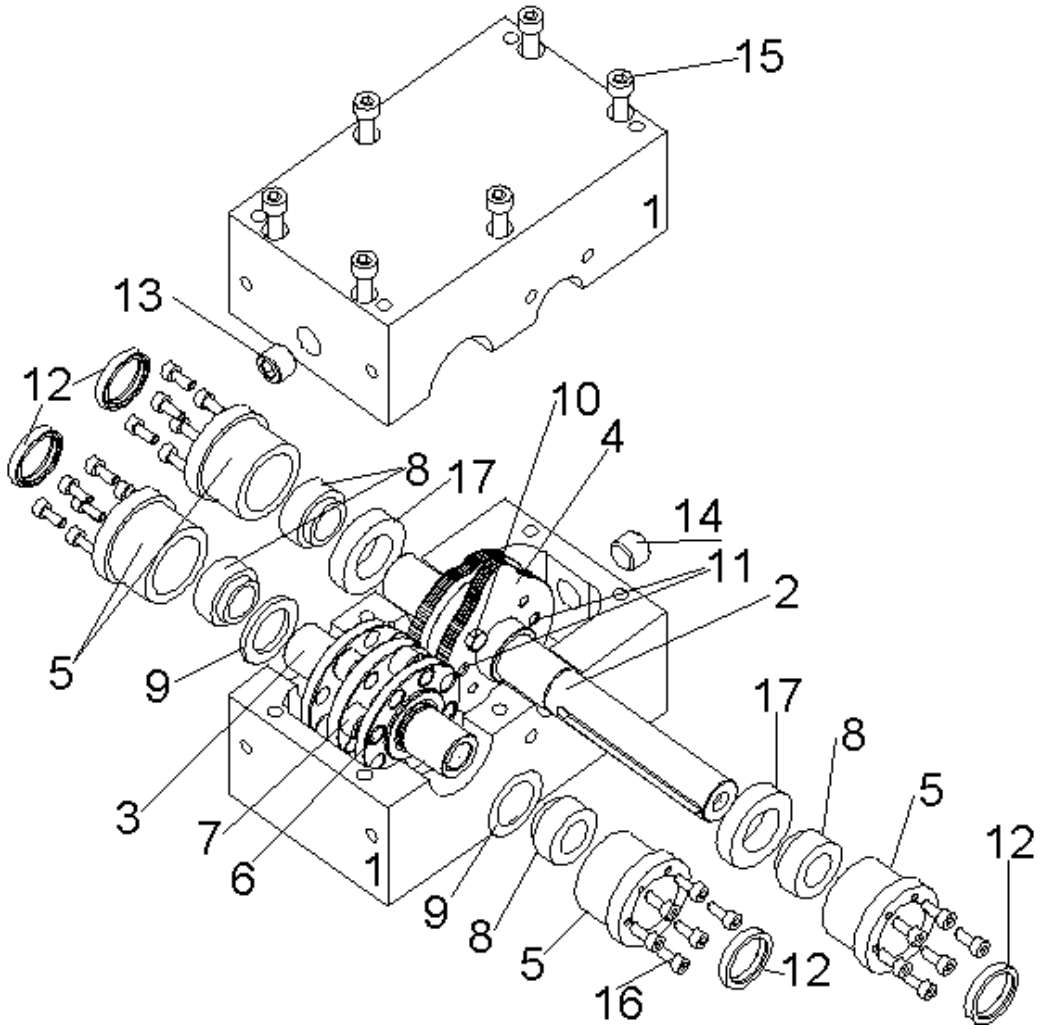




Ref.	Part name	Qty.
1	CASING	1
2	INPUT SHAFT	1
3	OUTPUT SHAFT	1
4	CAM	2
5	ECCENTRIC BUSH 17013	2
6	PIN	S
7	CAM FOLLOWER	S
8	DOUBLE BEARING RAX715	4
9	WASHER CP21528	4
10	HEXAGONAL HEAD SCREW M4X20	4
11	PARALLEL PIN 5X20	2
12	SEAL ET 1521	4
13	OIL PLUG ¼”	1
14	OIL PLUG ¼”	1
15	HEXAGONAL SOCKET SCREW UNI5931 M5X45	6

S value: see table 2, page 7.

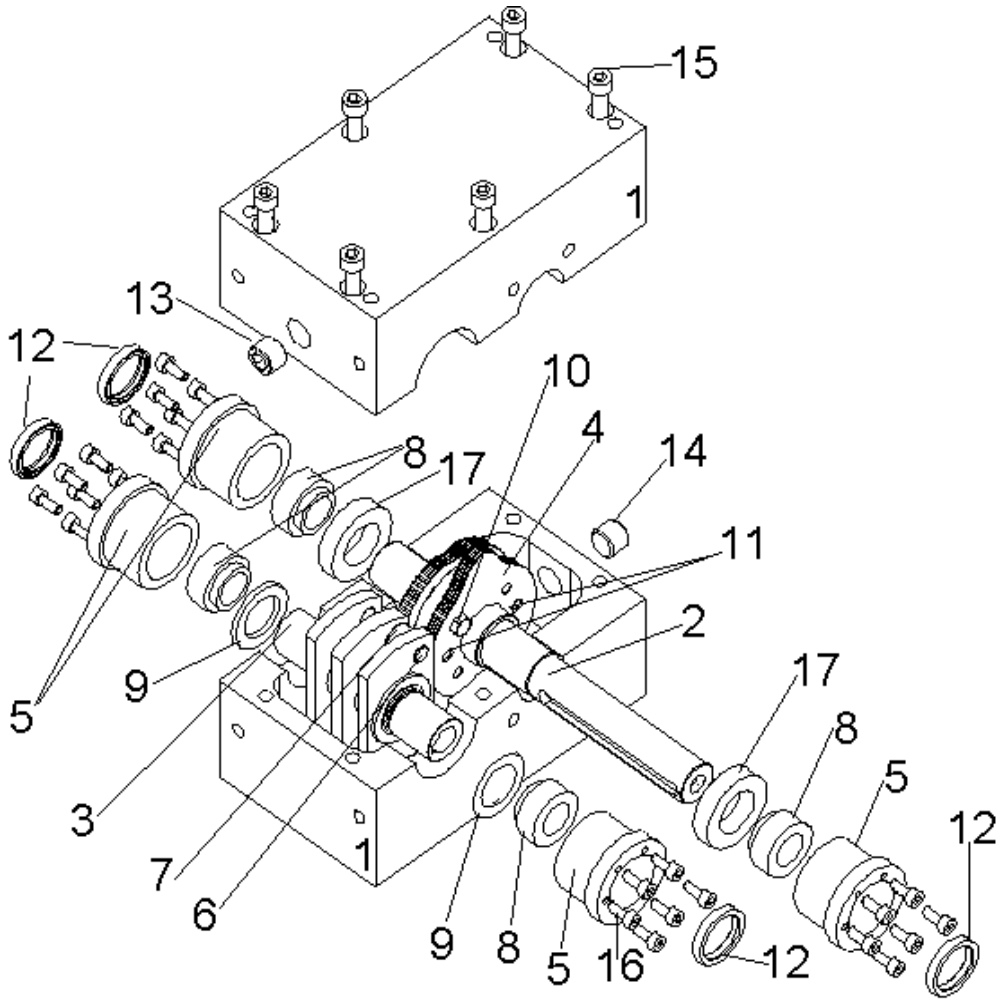
13.3 AP70, AP85, AP110, AP135



Ref.	Part name	AP70	AP85	AP110	AP135	Qty.
1	CASING					1
2	INPUT SHAFT					1
3	OUTPUT SHAFT					1
4	CAM					2
5	ECCENTRIC FLANGE	02690	02692	02695	02698	4
6	PIN					S
7	CAM FOLLOWER					S
8	BEARING	32005X	320/32X	32009X	32012X	4
9	WASHER	131235	131236	131237	131238	2
10	HEXAGONAL HEAD SCREW	M5X30	M6X35	M8X50	M10X60	4
11	PARALLEL PIN	6X25	8X36	10X6X50	12X60	2
12	SEAL	A25407	A32477	A45658	A60808	4
13	OIL PLUG	¼"	¼"	3/8"	3/8"	1
14	OIL PLUG	¼"	¼"	3/8"	3/8"	1
15	HEXAGONAL SOCKET SCREW UNI5931	M8X70	M10X85	M12X100	M16X130	6
16	HEXAGONAL SOCKET SCREW UNI5931	M4X10	M5X16	M6X16	M8X15	24
17	SPACER	131215	131216	131217	131220	2

S value: see table 2, page 7.

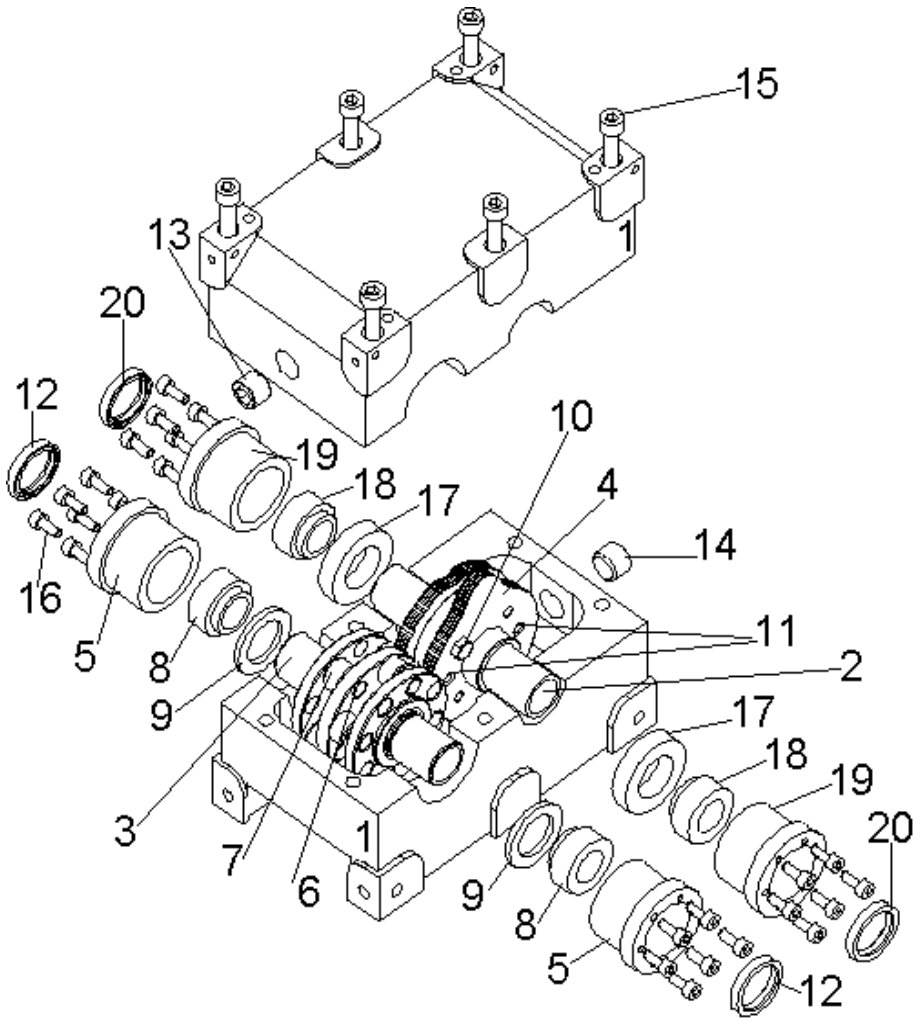
13.4 OP70, OP85, OP110, OP135



Ref.		OP70	OP85	OP110	OP135	Qty.
1	CASING					1
2	INPUT SHAFT					1
3	OUTPUT SHAFT					1
4	CAM					2
5	ECCENTRIC FLANGE	02690	02692	02695	02698	4
6	PIN					2
7	CAM FOLLOWER					2
8	BEARING	32005X	320/32X	32009X	32012X	4
9	WASHER	131235	131236	131237	131238	2
10	HEXAGONAL HEAD SCREW	M5X30	M6X35	M8X50	M10X60	4
11	PARALLEL PIN	6X25	8X36	10X6X50	12X60	2
12	SEAL	A25407	A32477	A45658	A60808	4
13	OIL PLUG	¼"	¼"	3/8"	3/8"	1
14	OIL PLUG	¼"	¼"	3/8"	3/8"	1
15	HEXAGONAL SOCKET SCREW UNI5931	M8X70	M10X85	M12X100	M16X130	6
16	HEXAGONAL SOCKET SCREW UNI5931	M4X10	M5X16	M6X16	M8X15	24
17	SPACER	131215	131216	131217	131220	2

S value: see table 2, page 7.

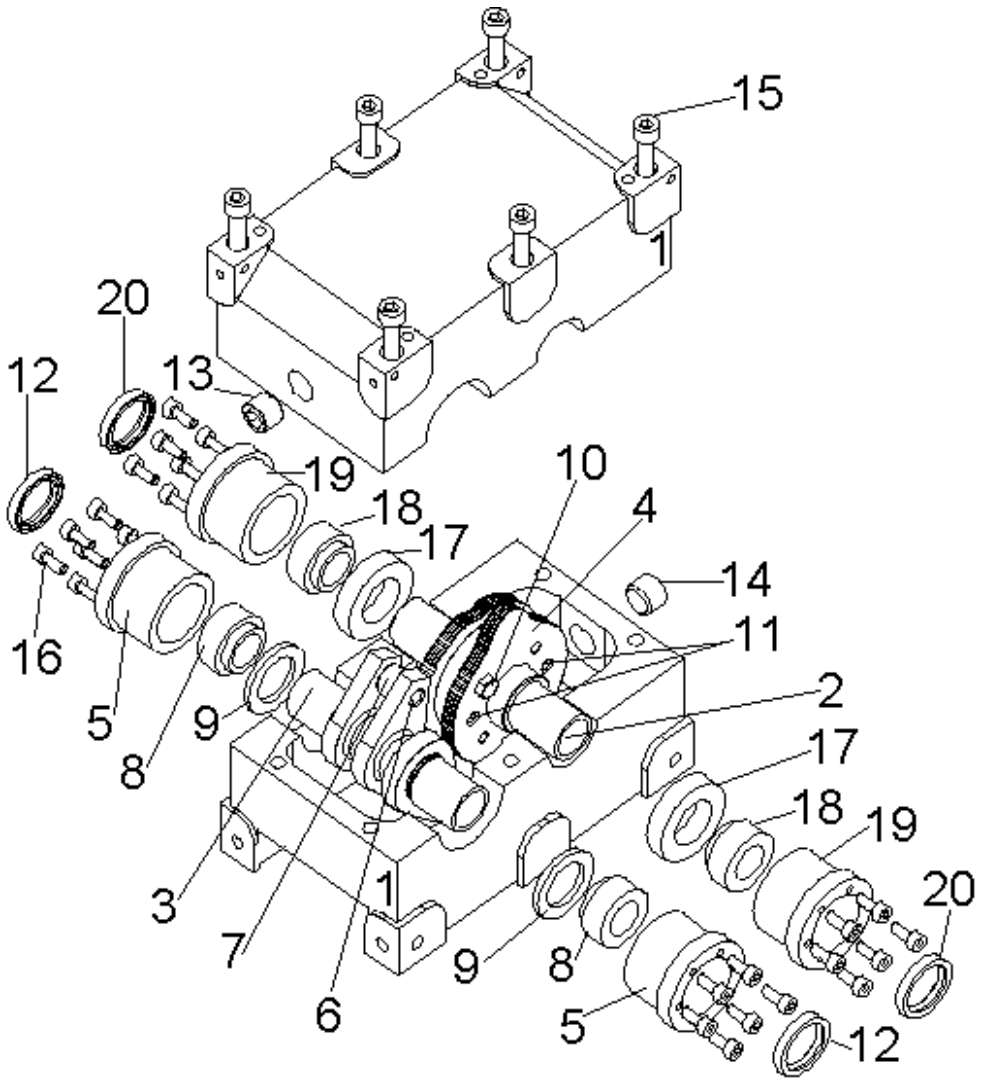
13.5 AP165, AP200, AP250.



Ref.		AP165	Qty.	AP200	Qty.	AP250	Qty.
1	CASING		1		1		1
2	INPUT SHAFT		1		1		1
3	OUTPUT SHAFT		1		1		1
4	CAM		2		2		2
5	ECCENTRIC FLANGE	02756	2	02801	2	02798	2
6	PIN		S		S		S
7	CAM FOLLOWER		S		S		S
8	BEARING	32019X	2	32024X	2	32030X	2
9	WASHER	131277	2	133337	2	133334	2
10	HEXAGONAL HEAD SCREW	M10X35	8	M10X35	8	M14X45	12
11	PARALLEL PIN	12X70	2	12X80	2	14X90	2
12	SEAL	95X125X12	2	120X150X12	2	150X180X12	2
13	OIL PLUG	½	1	½	1	½	1
14	OIL PLUG	½	1	½	1	½	1
15	HEXAGONAL SOCKET SCREW UNI5931	M16X120	6	M16X120	6	M20X1600	6
16	HEXAGONAL SOCKET SCREW UNI5931	M6X20	24	M6X20	24	M8X25	32
17	SPACER	131264	2	133336	2	133333	2
18	BEARING	32014X	2	32016X	2	32022X	2
19	FLANGE	02755	2	02802	2	02797	2
20	SEAL	70X90X10	2	80X110X10	2	110X130X12	2

S value: see table 2, page 7.

13.6. **OP165, OP200, OP250.**



Ref.		OP165	Qty.	OP200	Qty.	OP250	Qty.
1	CASING		1		1		1
2	INPUT SHAFT		1		1		1
3	OUTPUT SHAFT		1		1		1
4	CAM		2		2		2
5	ECCENTRIC FLANGE	02756	2	02801	2	02798	2
6	PIN		2		2		2
7	CAM FOLLOWER		2		2		2
8	BEARING	32019X	2	32024X	2	32030X	2
9	WASHER	131277	2	133337	2	133334	2
10	HEXAGONAL HEAD SCREW	M10X35	8	M10X35	8	M14X45	12
11	PARALLEL PIN	12X70	2	12X80	2	14X90	2
12	SEAL	95X125X12	2	120X150X12	2	150X180X12	2
13	OIL PLUG	½	1	½	1	½	1
14	OIL PLUG	½	1	½	1	½	1
15	HEXAGONAL SOCKET SCREW UNI5931	M16X120	6	M16X120	6	M20X1600	6
16	HEXAGONAL SOCKET SCREW UNI5931	M6X20	24	M6X20	24	M8X25	32
17	SPACER	131264	2	133336	2	133333	2
18	BEARING	32014X	2	32016X	2	32022X	2
19	FLANGE	02755	2	02802	2	02797	2
20	SEAL	70X90X10	2	80X110X10	2	110X130X12	2

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17 EC MANUFACTURER'S DECLARATION (ENCL. IIB).

We declare that the machine (mechanical indexer) described in these "Directions for use and maintenance" handbook meets the fundamental safety requirements envisaged by the EC Guideline 89/392 and its subsequent integrations.

The indexer is designed to be assembled onto another machine that likewise must meet the guideline requirements.

It is therefore forbidden to put into operation the mechanical indexer assembled on another machine if the manufacturer of the latter, or his representative settled in the European Community, has not declared in writing his machine to be as broadly in accordance with the above mentioned Guideline. His statement will be evidenced by the presence of the required CE mark on the machine

F. Bertolotti
General Manager