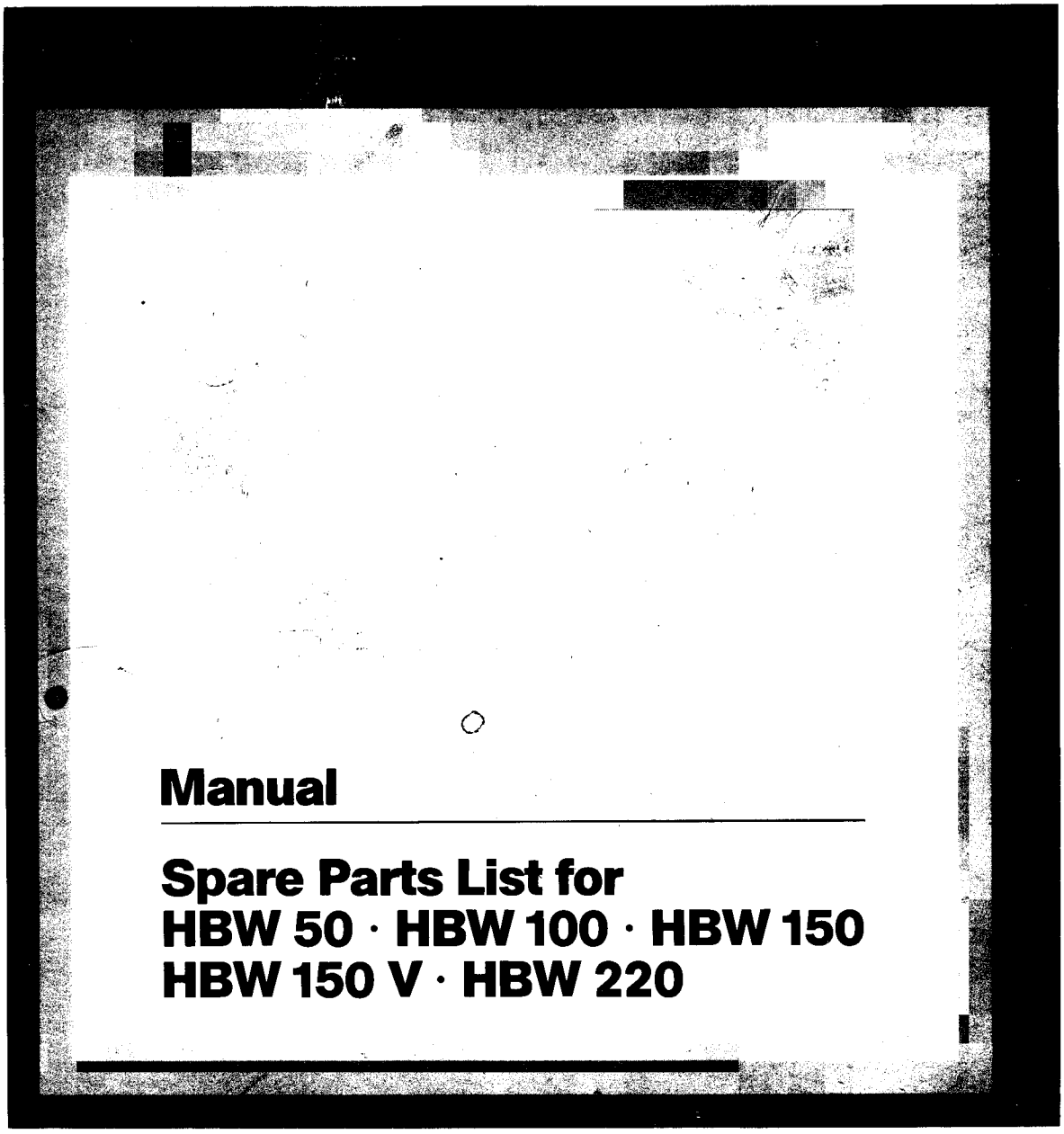
HURTH

HBW - 150 V

HBW Boat Reversing Gearbox Units



Manual

Spare Parts List for
HBW 50 · HBW 100 · HBW 150
HBW 150 V · HBW 220

This HBW manual has been prepared for all those who have to do with HURTH boat reversing gearbox units of the HBW line, including models HBW 50, HBW 100, HBW 150, HBW 220 and HBW 150 V, in particular for
– power plant suppliers,
– shipyards,
– craft owners.

The HBW manual is intended as an aid for handling HBW transmissions and will answer all questions that may arise in daily operation and in connection with the installation and repair of HBW transmissions.

This manual contains:

– a technical description of the gearbox units and a number of important technical data;
– instructions for proper installation of the gearbox in the craft;
– explanatory notes on correct operation and maintenance;
– a detailed description of all disassembly and reassembly procedures (with drawings);
– a troubleshooting table with possible causes of trouble and the required remedial action;
– a spare parts list with stock numbers of all spare parts;
– explosive-view drawings showing each part with the reference numerals used in the text.

No problems will be encountered in handling, installing and operating the HBW gearbox units if the instructions in this manual are duly observed. Should a repair ever be necessary, a qualified technician will have no difficulty in doing the repair work in accordance with the detailed instructions given on the following pages.

In addition, HBW Service Stations (distributors and dealers) are available for any repairs and for supplying the spare parts required. The manufacturer will always be glad to name the Service Station nearest to your location.

All transmission units are covered by a worldwide guarantee given by the manufacturer. The manufacturer's warranty will be subject to the condition that –
– the instructions in this manual are strictly observed in handling the transmission units;
– no work is performed by persons not authorized by Hurth;
– no changes or alterations of any kind are made on the transmission.

Failture to observe these points will invalidate all and any warranty claims.

Caution: never start doing any work on the transmission unless and until the engine and the propeller have come to a complete standstill.

Table of contents

1 Description

1.1 Brief description

HURTH boat reversing gearbox units of the HBW line are servo-automatically controlled helical gear transmissions developed for use in pleasure craft and commerical craft. The servo-operated multiple-disc clutch requires only minimum effort for gear changing, making the HBW transmission suitable for single-lever remote control via a rod linkage or Bowden cable.

The HBW permits direct reversing at full engine speed, for example in emergency cases.

The torque transmission capacity of the clutch is exactly rated, preventing shock loads from exceeding a predetermined value to ensure maximum protection of the engine and thus providing the effect of a safety clutch.

The transmission units are characterized by low weight and small overall dimensions. The gearbox castings are made of a high-strength, corrosion-resistant aluminium alloy, chromized for improved seawater resistance and optimum adhesion of paint.

A choice of gear ratios, a high efficiency rating and low-noise operation are other prominent features of the HBW gearbox units.

The transmissions are immersion-lubricated. Maintenance is restricted to oil level checks (see 'Maintenance', chapter 4).

The shafts are supported by heavy-duty taper roller bearings and the gearbox is designed to take the axial propeller thrust (for permissible values see 'Technical data', item 1.2).

All transmission sizes are available for right-hand (RH) and left-hand (LH) rotation of the input shaft, the direction of rotation being specified as seen by an observer facing the input shaft. In gear lever position A, the engine shaft and the propeller shaft rotate in opposite directions, in position B in the same direction (Fig 1). On model HBW 150 V, the directions of rotation are the other way round (Fig 2). Engine manufactures should note that the direction of rotation refers to an observer facing the flywhell, so that left-hand rotation of the engine corresponds to right-hand rotation of the gearbox input shaft.

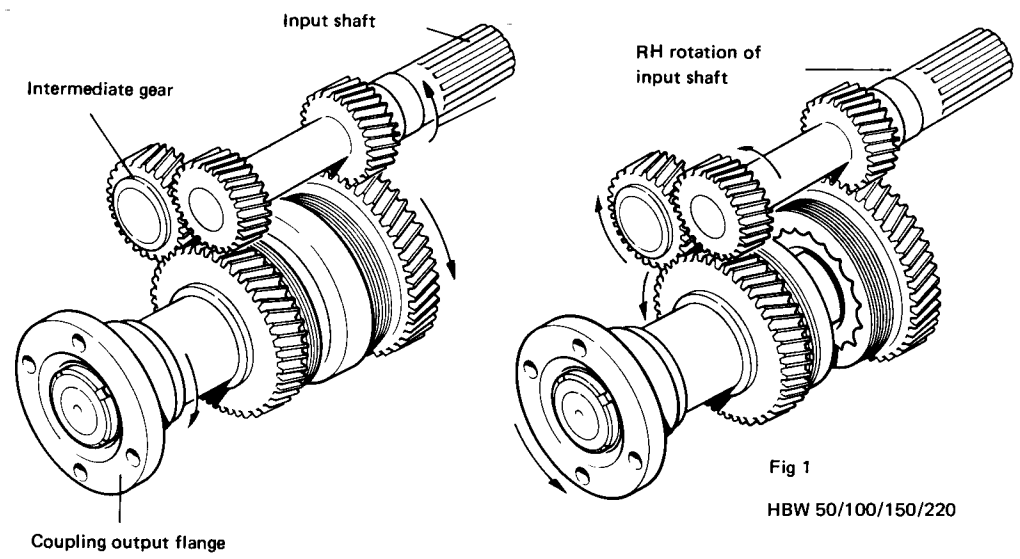
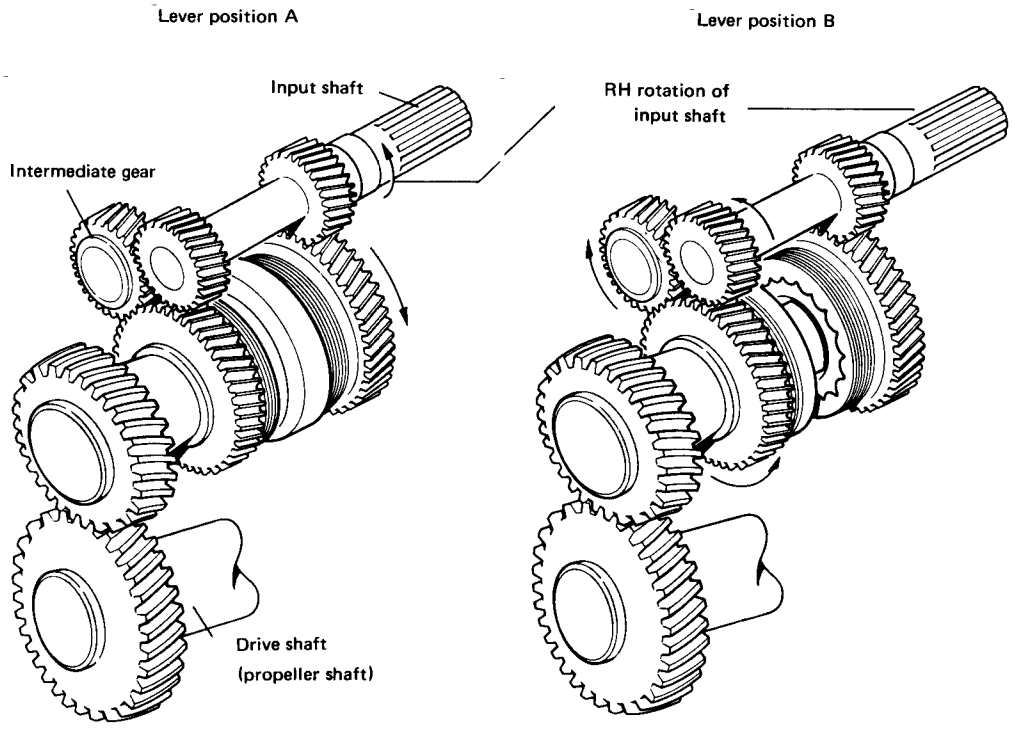


Fig 1

HBW 50/100/150/220

Power transmission using engine with LH rotation



Power transmission using engine with LH rotation

Fig 2

HBW 150 V

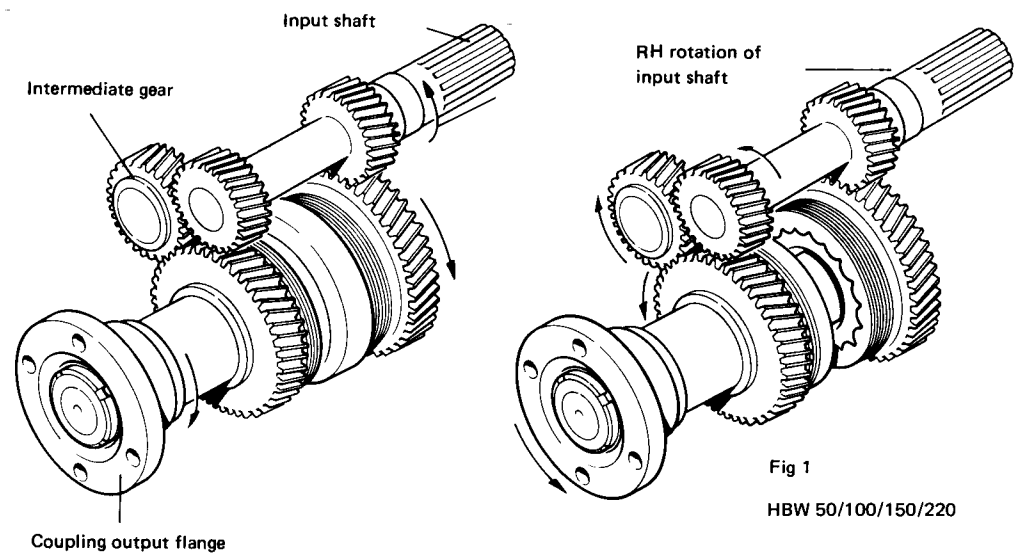
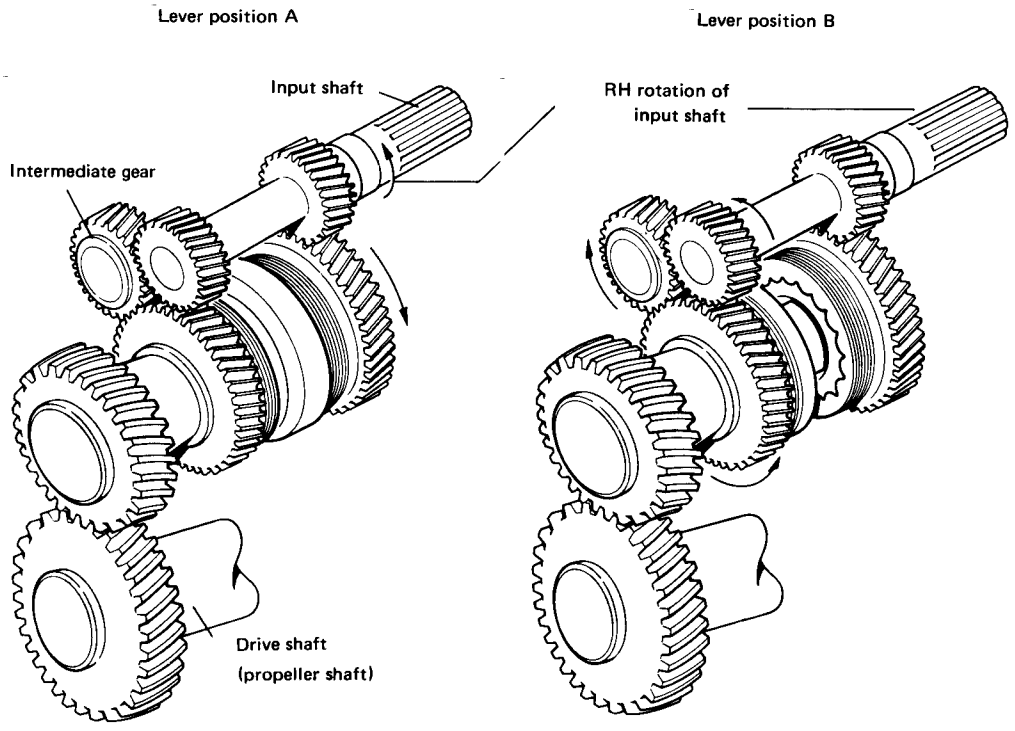


Fig 1

HBW 50/100/150/220

Power transmission using engine with LH rotation



Power transmission using engine with LH rotation

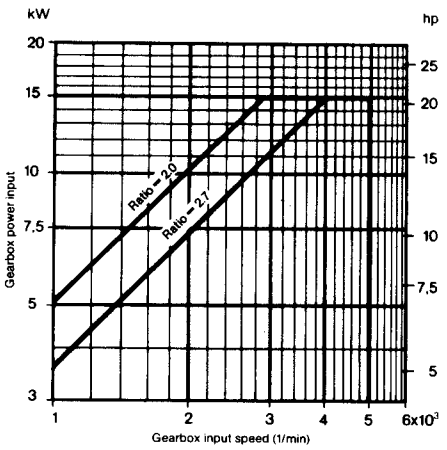
Fig 2

HBW 150 V

1.2 Technical data and main dimensions

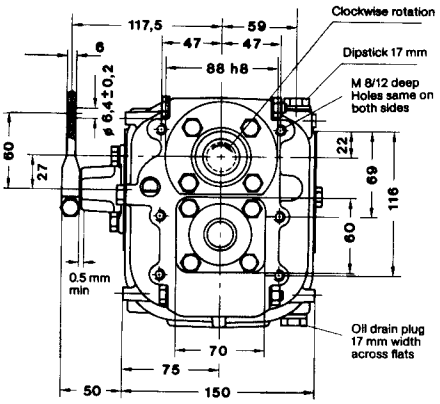
1.2.1 HBW 50

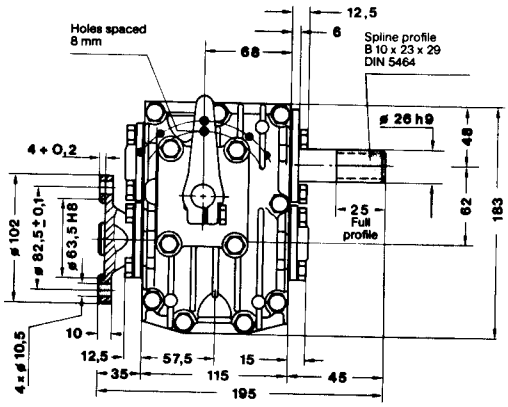
Power diagram*

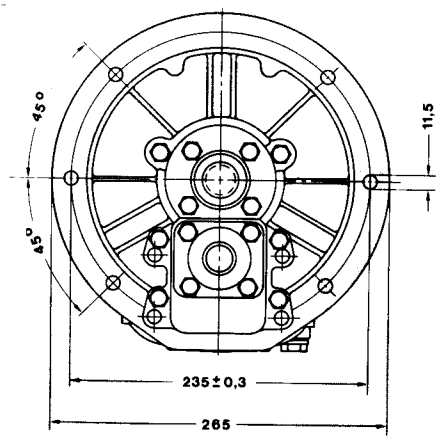


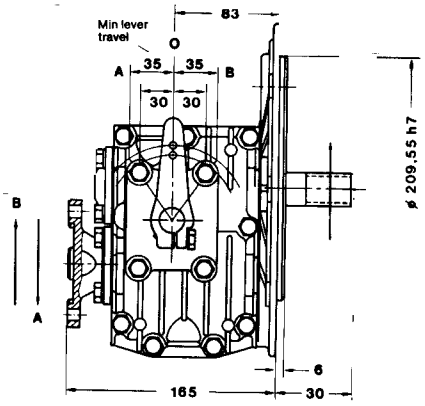
Technical data			HBW 50–2	HBW 50–3
Forward gear 'A', ratio		i	2.05	2.72
Reverse gear 'B', ratio		i	1.86	1.86
Input torque $M_{max.}$	pleasure craft	Nm	50	35
	commercial craft	Nm	50	35
Power input $P_{max.}$	pleasure craft	kW (hp)	15 (20)	
	commercial craft	kW (hp)	15 (20)	
Input speed $n_{max.}$		1/min	5000	
Propeller thrust $F_{max.}$		N	775	
Weight without oil		kg	8	
Oil quantity		l	0.3	
Oil grade			Automatic Transmission Fluid (ATF)	

Main dimensions





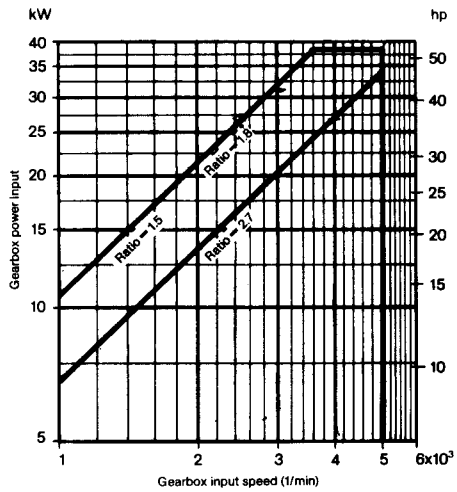




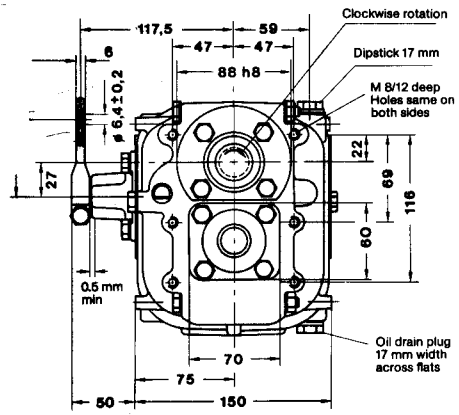
With mounting flange

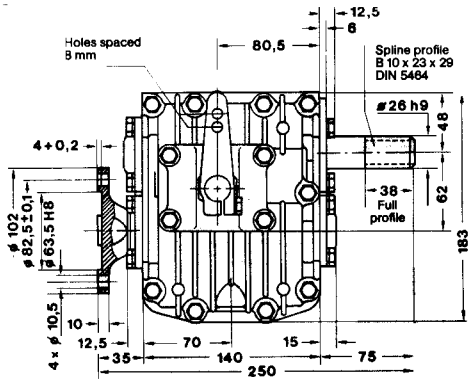
1.2 Technical data and main dimensions
1.2.2 HBW 100

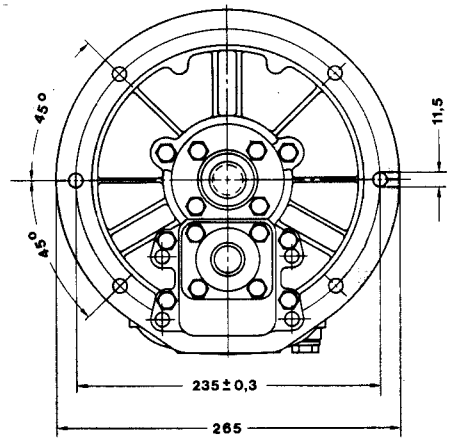
Power diagram*

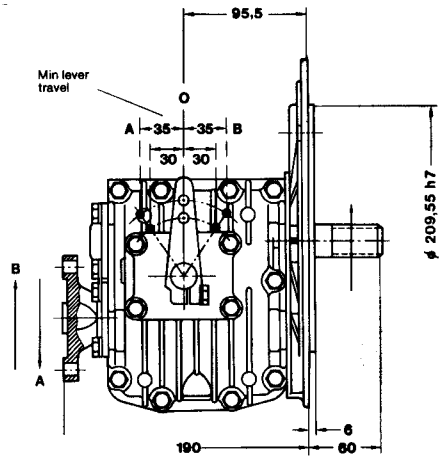


Technical data			HBW 100–1,5	HBW 100–2	HBW 100–3
				1.79	2.72
			1.86	1.86	1.86
	pleasure craft	Nm	103	103	
	commercial craft	Nm	85	75	
Power input $P_{max.}$	pleasure craft				
	commercial craft				
Input speed $n_{max.}$		1/min	5000		
Propeller thrust $F_{max.}$		N	1500		
Weight without oil		kg	9.5		
Oil quantity			0.35		
			Automatic Transmission Fluid (ATF)		







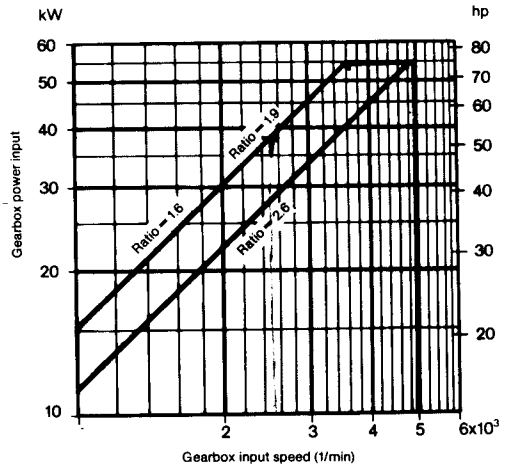


With mounting flange

1.2 Technical data and main dimensions

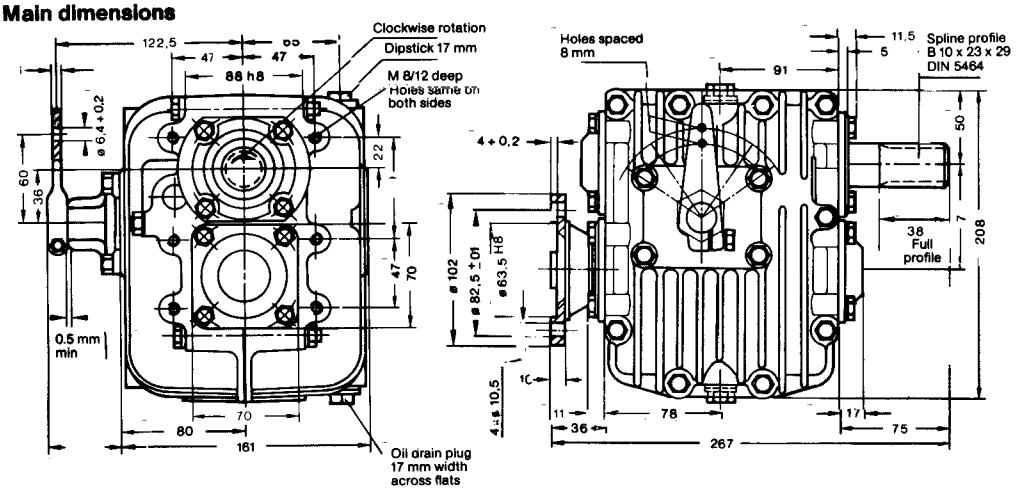
1.2.3 HBW 150

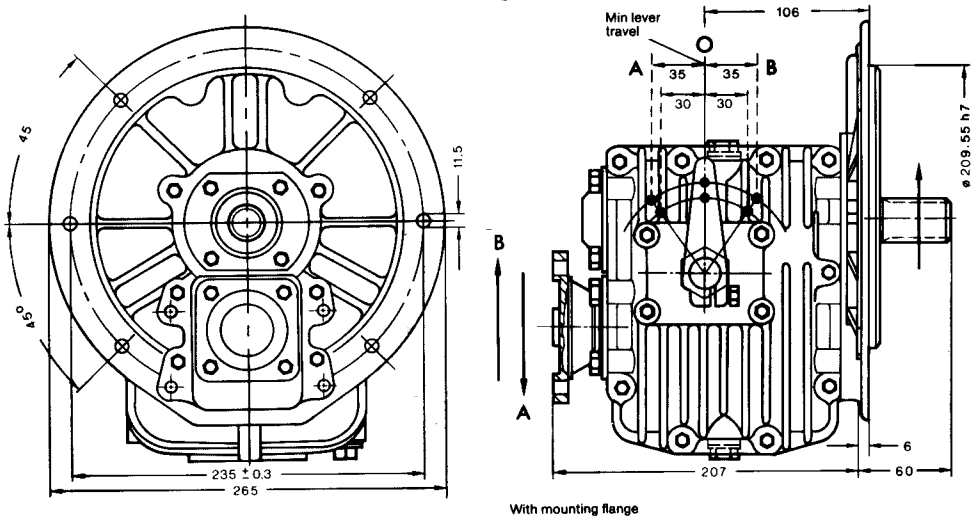
Power diagram*



Technical data			HBW 150–1,5	HBW 150–2	HBW 150–2,5
Forward gear 'A', ratio		i	1.56	1.88	2.63
Reverse gear 'B', ratio		i	1,95	1.95	1.95
Input torque $M_{max.}$	pleasure craft	Nm	145		106
	commercial craft	Nm	120		90
Power input $P_{max.}$	pleasure craft	kW (hp)	55 (75)		
	commercial craft	kW (hp)	40 (54)		
Input speed $n_{max.}$		1/min	5000		
Propeller thrust $F_{max.}$		N	3000		
Weight without oil		kg	13		
Oil quantity			0.56		
Oil grade			Automatic Transmission Fluid (ATF)		

Main dimensions



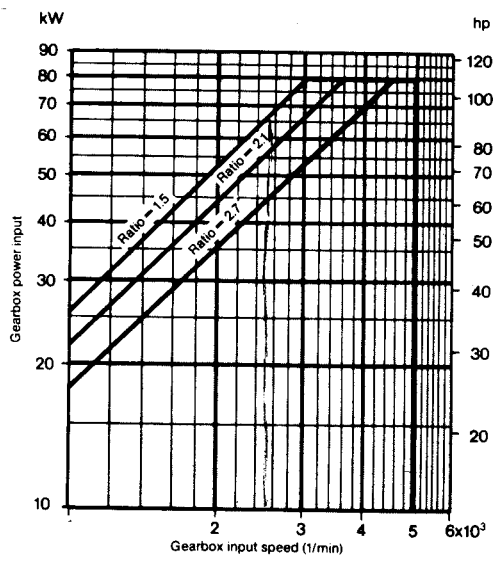


With mounting flange

1.2 Technical data and main dimensions

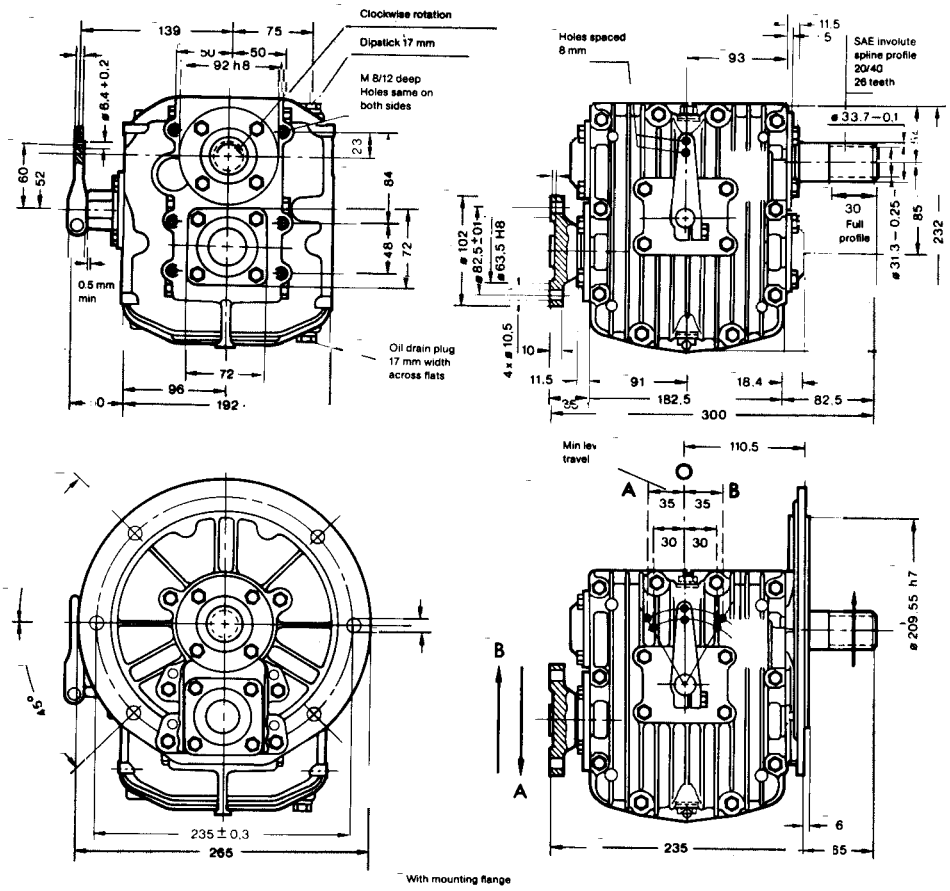
1.2.4 HBW 220

Power diagram*



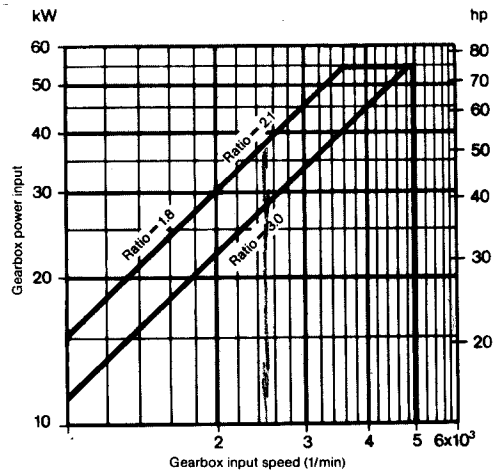
Technical data			HBW 220–1.5	HBW 220–2	HBW 220–3
Forward gear 'A', ratio		i	1.54	2.09	2.74
Reverse gear 'B', ratio		i	2.09	2.09	2.72
Input torque $M_{max.}$**	pleasure craft	Nm	250	220	170
	commercial craft	Nm	180	150	120
Power input $P_{max.}$	pleasure craft	kW (hp)	80 (109)		
	commercial craft	kW (hp)	57 (78)		
Input speed $n_{max.}$		1/min	5000		
Propeller thrust $F_{max.}$		N	4300		
Weight without oil		kg	18		
Oil quantity		l	0.75		
Oil grade			Automatic Transmission Fluid (ATF)		

Main dimensions



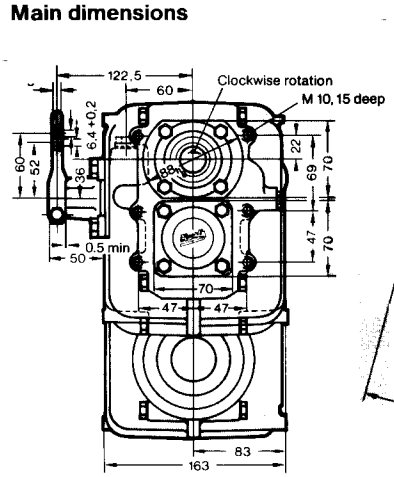
1.2 Technical data and main dimensions
1.2.5 HBW 150 V

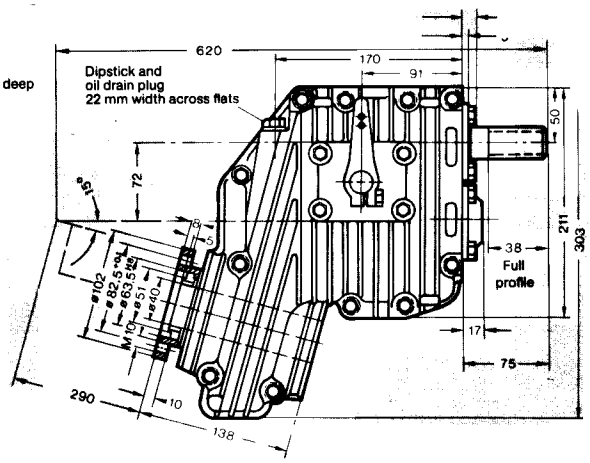
Power diagram*

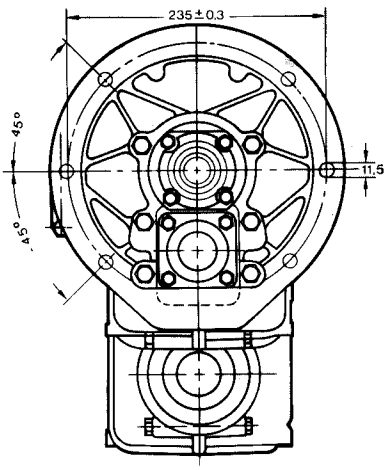


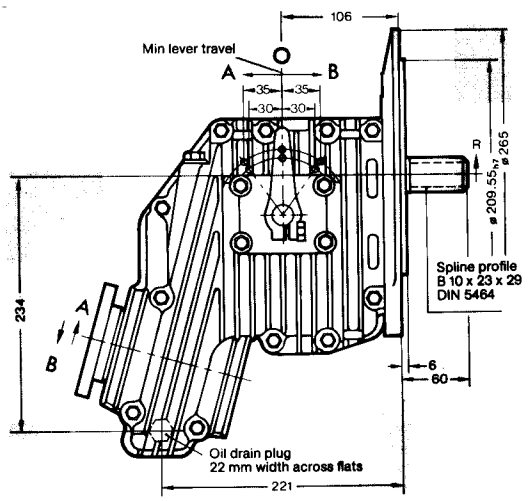
Technical data			HBW 150–1.8 V	HBW 150–2 V	HBW 150–3 V
Forward gear 'A', ratio			1,77	2,13	2,99
Reverse gear 'B', ratio			2,22	2,22	2,22
Input torque M_{max}	pleasure craft	Nm	145	145	106
	commercial craft	Nm	120	110	90
Power input $P_{max.}$	pleasure craft	kW (hp)	55 (75)		
	commercial craft	kW (hp)	40 (54)		
Input speed $n_{max.}$		1/min	5000		
Propeller thrust $F_{max.}$		N	4000		
Weight without oil		kg	20.2		
Oil quantity		l	1.0		
Oil grade			Automatic Transmission Fluid (ATF)		

Main dimensions









With mounting flange

1.3 Gear casing

The oil-tight gearbox housing is made of a corrosion-resistant aluminium alloy chromized for added protection from corrosion. The gear casing is divided in a vertical plane into two equal halves. Amply dimensioned cooling fins ensure good heat dissipation and mechanical rigidity.

An oil filler screw with dipstick and an oil drain plug are screwed into the gear casing. The filler screw is provided with a breather hole.

The actuating lever, acutating cam and cover plate are a pre-assembled unit fitted laterally to the gearbox unit.

Tapped holes (see 'Main dimensions' item 1.2) are provided on the face sides for bolting the transmission to a flywheel housing or an adapter flange.

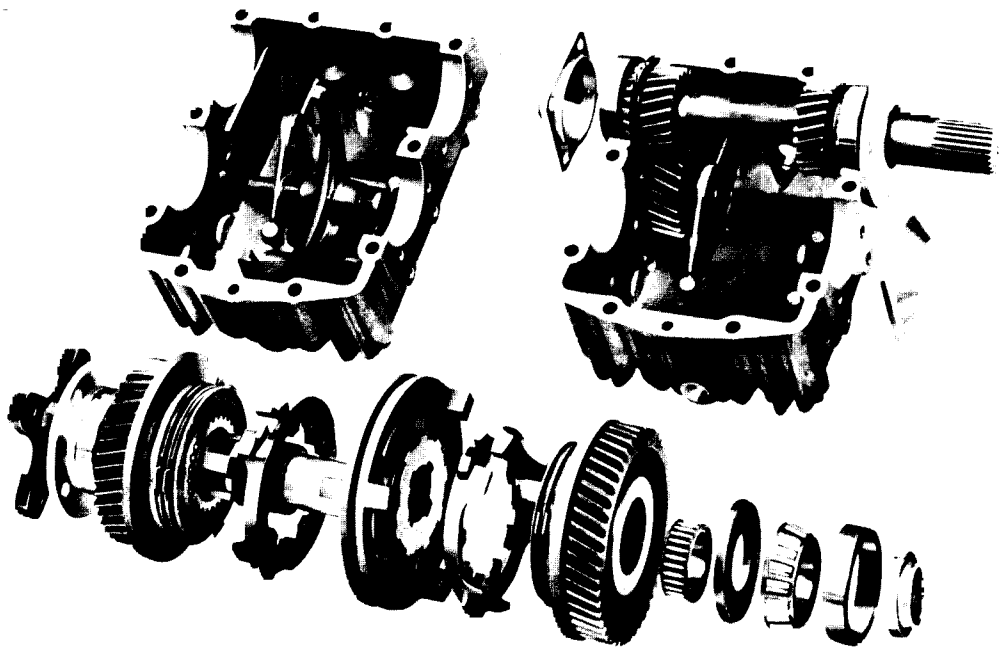
1.4 Gear sets

The transmission is equipped with shaved, casehardened helical gears made of forged low-carbon alloy steel and casehardened, lapped spiral bevel gears (V drive). The drive shaft with the drive gear are an integral unit.

The multi-spline driving shaft connecting the transmission with the engine is hardened as well.

The driven shaft (propeller side) of the transmission, with the exception of the HBW 150 V model, is fitted with an integrally forged coupling flange.

The servo-automatic clutch system governs the direction of rotation of the input shaft, but all HBW transmission units are available for clockwise (RH = right hand) or counterclockwise (LH = left-hand) rotation.



1.5 Multiple-disc clutch and clutch operation – power train

The engine torque is applied to the input shaft (36) in the specified direction of rotation and, **in shifting position A** (see item 1.2), via gear (44), the frictionally engaged clutch discs (51 and 52) to the external disc carrier (57) and from there via the guide sleeve (59) to the output shaft (66).

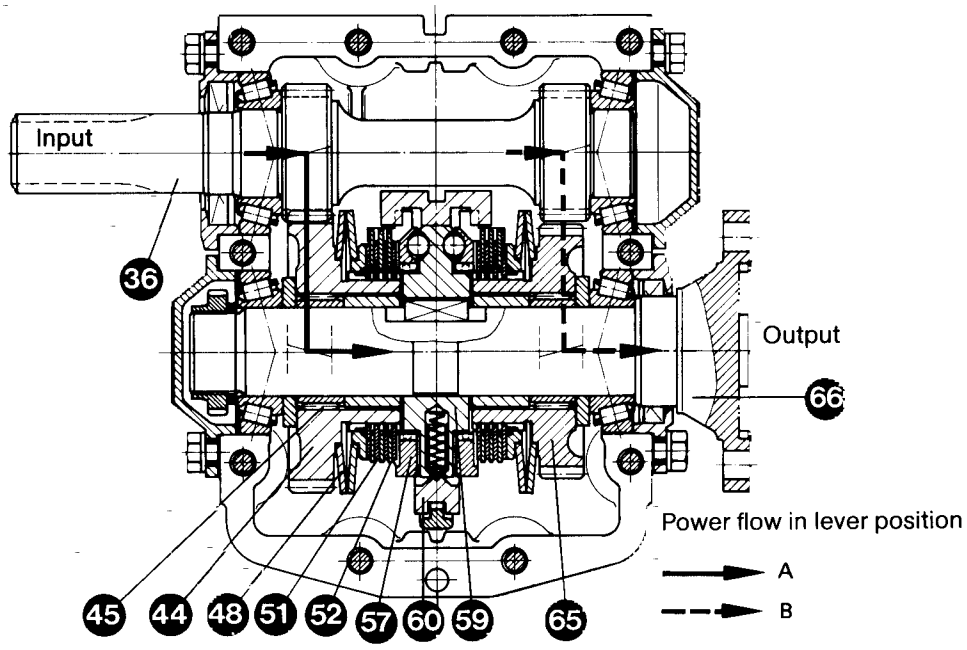
In shifting position B (see item 1.2), the torque is transmitted from the input shaft (36) via intermediate gear (26), gear (65), clutch discs (51 and 52) to the external disc carrier (57), the guide sleeve (59) and the output shaft (66).

Function

The transmission uses a positively driven, mechanically operated multiple-disc clutch system mounted on the output shaft.

The thrust force required for obtaining positive frictional engagement between the clutch discs is provided by a servo-automatic system. This essentially comprises a number of balls which, by the rotary movement of the external disc carrier, are urged against inclined surfaces provided in pockets between the guide sleeve and the external disc carrier and in this manner exert axial pressure. The thrust force and, as a result, the transmittable friction torque are thus proportional to the input torque applied. Due to the cup springs (48) supporting the clutch disc stack and a limitation of the range of axial travel of the external disc carrier (57), the thrust force will not exceed a predetermined value.

The actuating sleeve (60) is held in the middle position by spring-loaded pins. To initiative the shifting operation, the actuating sleeve (60) need merely be displaced axially by a shifting fork until the arresting force has been overcome. Then the actuating sleeve (60) is moved automatically by the spring-loaded pins, while the external disc carrier, which follows this movement, is rotated by the frictional forces exerted by the clutch discs, and the shifting operation is completed servo-automatically as described above.

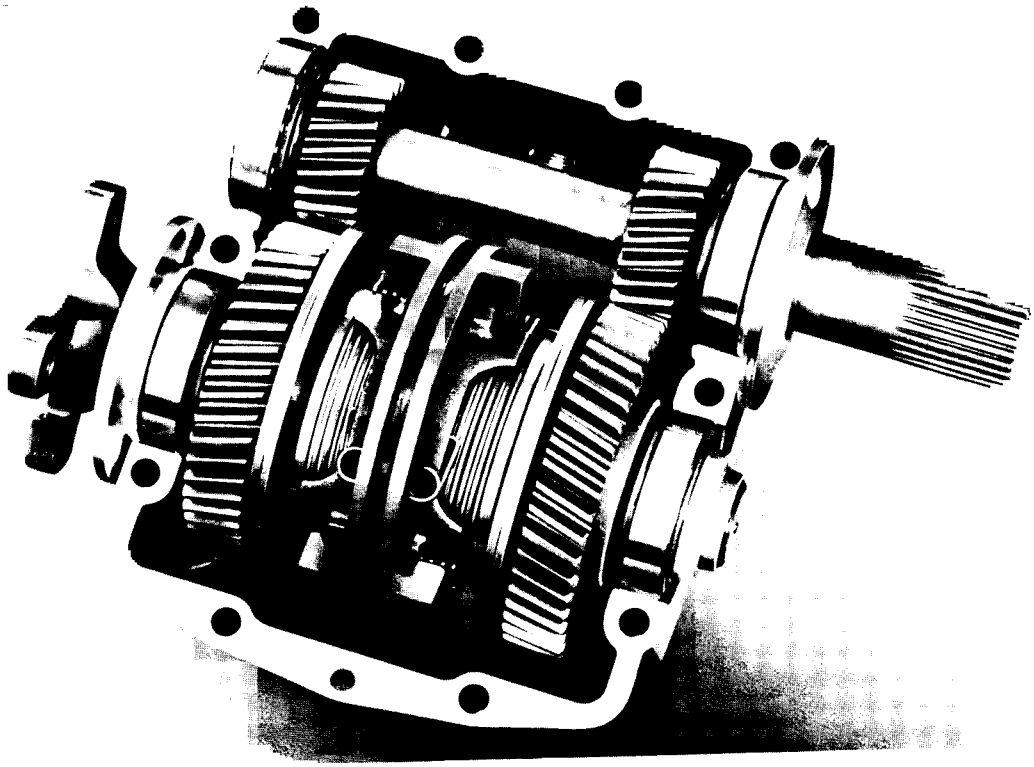


1.6 Shaft bearings

Both the input and the output shafts are carried in amply dimensioned taper roller bearings.

The propeller thrust can be absorbed by the bearings (for permissible values see 'Technical data', item 1.2).

The intermediate gear and the movable gears are carried in sturdy needle roller bearings.



Shaft seals

External sealing of the input and output shafts is provided by radial sealing rings. The running surfaces on the shafts are casehardened.

1.8 Lubrication

The transmissions are immersion-lubricated. The bearings are generously supplied with splash oil.

Cooling unit

Transmissions intended for use at high ambient temperatures and for continuous operation at high power (especially when shifting position B is used for the main direction of movement of the craft), can optionally be supplied with a cooling unit (see item 2.10).

2. Installation

2.1 Delivery condition

HURTH HBW gearbox units leave the factory in fully assembled condition. For safety reasons, the gearbox is **not** filled with oil for shipment. The actuating lever is mounted on the actuating shaft. On request, the gearbox is delivered with the cooling unit attached (see item 2.10).

The multi-spline shaft end on the engine side is provided with an oil film and protected by a plastic cap. The bright surfaces of the coupling flange on the output side are coated with an anticorrosive agent for shipment and storage. The casing is chromized and thus resistant to seawater.

Before leaving the factory, each transmission is subjected to a test run with the prescribed ATF oil. The residual oil remaining in the transmission after draining acts as a preservative and provides reliable protection against corrosion for at least 1 year if the units are properly stored.

2.2 Transport

Care should be taken when transporting the gearbox or the engine-gearbox assembly to prevent undue shocks and impacts. This applies particulary to the input and output shafts.

2.3 Removal of preservative

Use a suitable solvent for removing the anticorrosive agent, but never emery cloth or paper, since otherwise the sealing elements might be damaged.

It is at advisable, especially after long periods of storage, to flush the transmission with the prescribed oil and remove residual oil.

2.4 Painting the gearbox

Always cover the running surfaces and sealing lips of the radial sealing rings on both shafts before painting. Make certain that the breather hole on the oil filler screw is not closed by paint. Indicating plates should remain clearly legible.

2.5 Connection of gearbox with engine

Insert a torsio-elastic damping plate between the engine and the transmission to compensate for minor alignment errors and protect the input shaft from external forces and loads. Radial clearance should be at least 0.5 mm.

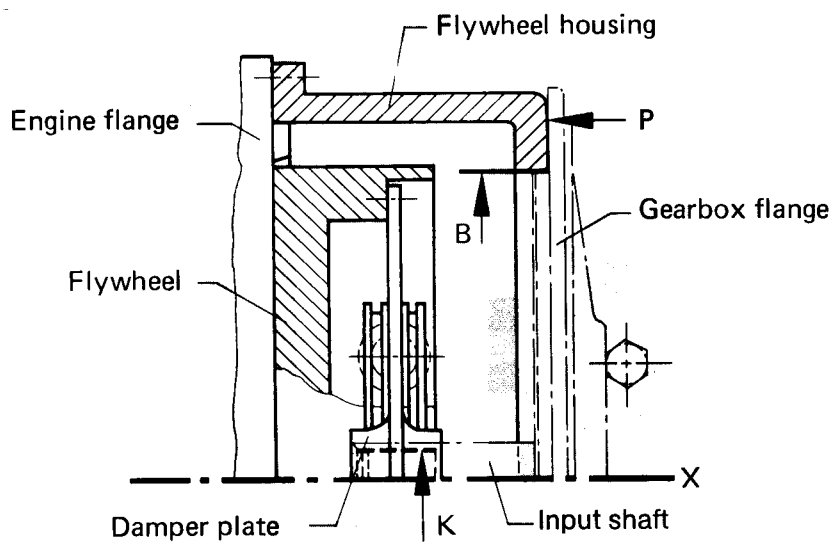
If the flywheel housing of the engine is of suitable design, the gearbox unit should be directly bolted to such housing by means of the tapped holes provided in the gearbox. Make certain to use bolts of appropriate length and tighten them to the correct torque.

An adapter flange is available on request for each gearbox unit (see 'Main dimensions', item 1.2).

The radial and axial runout values shown in the drawing below should never be exceeded between the engine and transmission.

The input shaft end is provided with a multi-spline or involute spline profile (for dimensions see table below).

Connection of gearbox with engine



Permissible radial and axial runout

X : B = 0,1 mm X : K = 0,1 mm X : P = 0,1 mm

Gearbox size	Multi-spline or involute spline profile of shaft	Multi-spline or involute spline profile of hub
HBW 50	Similar to B10x23x29 DIN 5464	A10x23x29 DIN 5464
HBW 100	Similar to B10x23x29 DIN 5464	A10x23x29 DIN 5464
HBW 150	B10x23x29 DIN 5464	A10x23x29 DIN 5464
HBW 150 V	B10x23x29 DIN 5464	A10x23x29 DIN 5464
HBW 220	SAE 20/24 – 26 teeth	SAE 20/40 – 26 teeth

Connection of gearbox with propeller

We recommend a flexible connection between the gearbox and the propeller shaft if the engine is flexibly mounted, in order to compensate for angular deflections. The installation of a special propeller thrust bearing is not required, since the propeller thrust will be taken by the transmission bearing, provided the value specified under 'Technical data' (item 1.2) is not exceeded. However, the output shaft should be protected from additional loads. Special care should be taken to prevent torsional vibration. When using a universal joint shaft, make certain to observe the manufacturer's instructions.

2.7 Suspension of engine-gearbox assembly in the boat

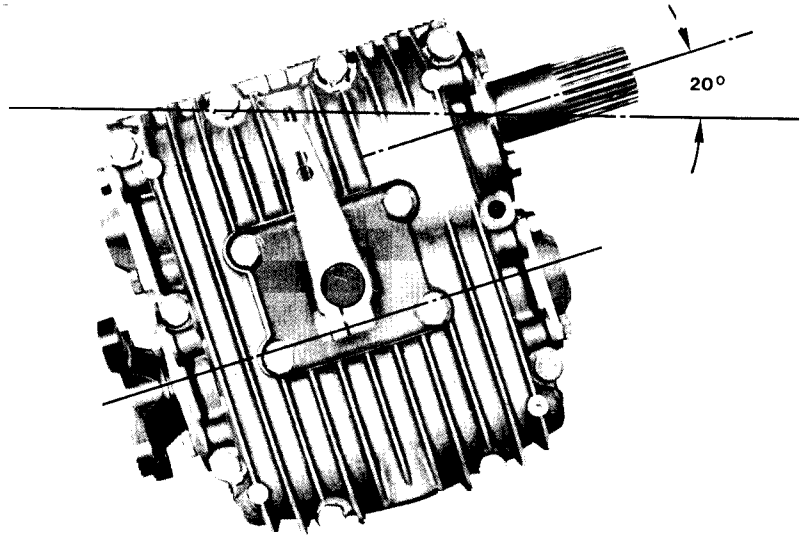
Special care should be taken to protect the gearbox from detrimental stresses and loads if the engine-transmission assembly is not elastically suspended in the boat or craft.

The gearbox should be conveniently accessible for maintenance.
If the oil drain plug of the gearbox is not accessible, the oil will have to be sucked off.

Position of gearbox in the boat

The inclination of the gearbox unit in the direction of the shafts should not permanently exceed an angle of 20 degrees (see illustration). (15° for HBW150 V)

The gearbox can also be mounted with the output shaft in the upward position. Interchange the oil dipstick and the oil drain plug in this case.



2.9 Operation of gearbox

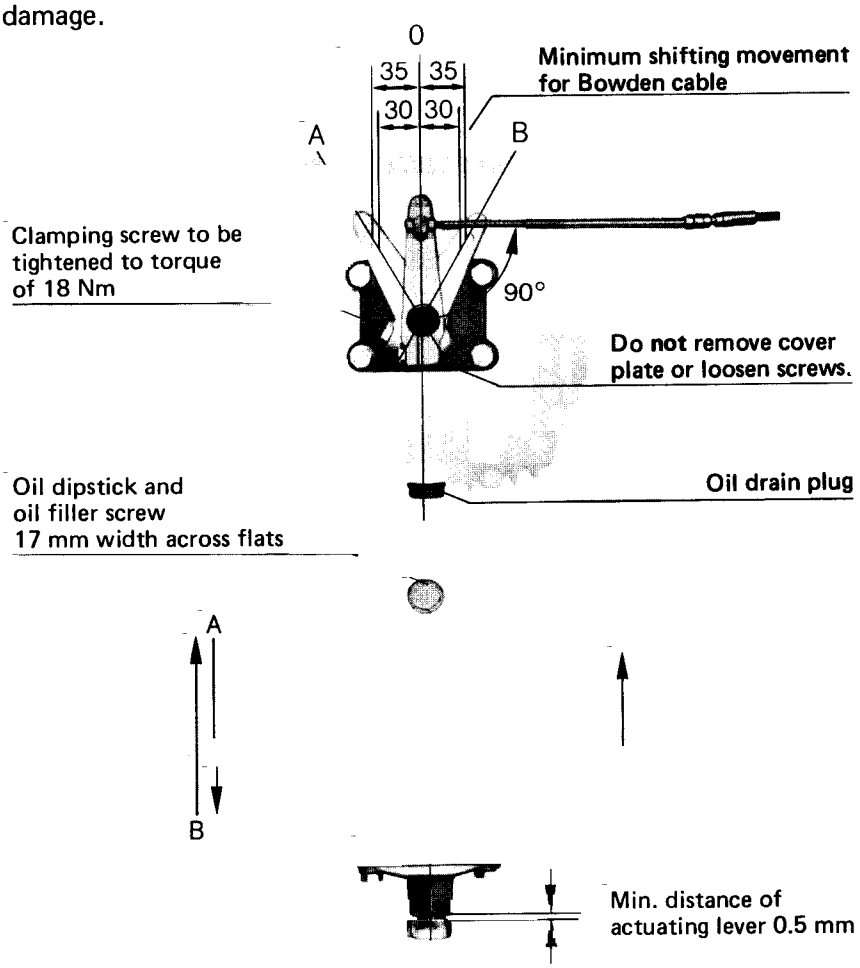
The gearbox is suitable for single lever remote control. Upon loosening the retaining screw, the actuating lever (see illustration) can be moved to any position required for the control elements (cable or rod linkage). Make certain that the lever does not contact the actuating lever cover plate (9): the minimum distance between lever and cover should be 0.5 mm.

The control cable or rod should be arranged at right angles to the actuating lever in the neutral position of the lever. The zero position of the operating lever on the control console should coincide with the zero position of the actuating lever on the gearbox.

The shifting travel, as measured at the pivot point of the actuating lever, between the neutral position and end positions A and B should be at least 35 mm for the outer and 30 mm for the inner pivot point.

A larger amount of lever travel is in no way detrimetal.

However, if the lever travel is shorter, proper gear engagement might be impeded which, in turn, would mean premature wear, excessive heat generation and resulting damage.



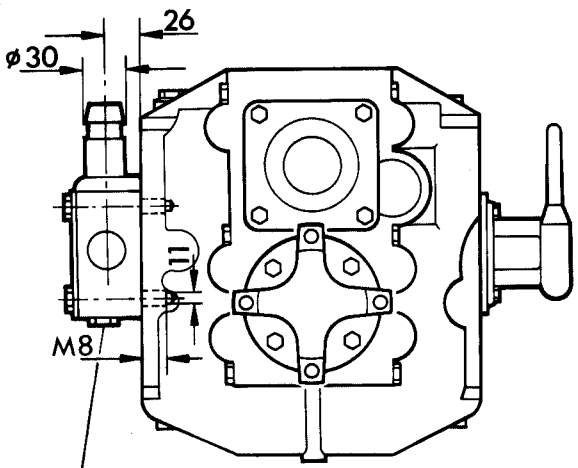
The position of the cover plate underneath the actuating lever is factory-adjusted to ensure equal lever travel from neutral position to A and B.

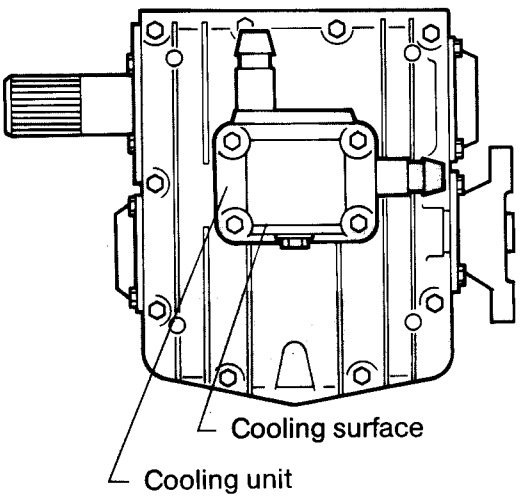
If this cover is removed in exceptional cases, proceed as described under item 6.13 of this manual.

When installing the gearbox, make certain that shifting is not impeded by restricted movability of the Bowden cable or rod linkage, by unsuitably positioned guide sheaves, too small a bending radius, etc.

2.10 Cooling unit

The arrangement of the cooling unit for the HBW 100, 150, 150 V and 220 (no cooling is required for HBW 50) can be seen from the following drawings.





The table below shows the maximum power output in continuous operation (lever position A and B) usable without cooling. When these values are exceeded, a cooling unit is required.

Max engine power (kW) usable without cooling in continuous operation

Lever position	HBW 50	HBW 100	HBW 150	HBW 150 V	HBW 220
A	no cooling	no cooling	40	25	40
B	no cooling	25	25	20	always with cooling unit

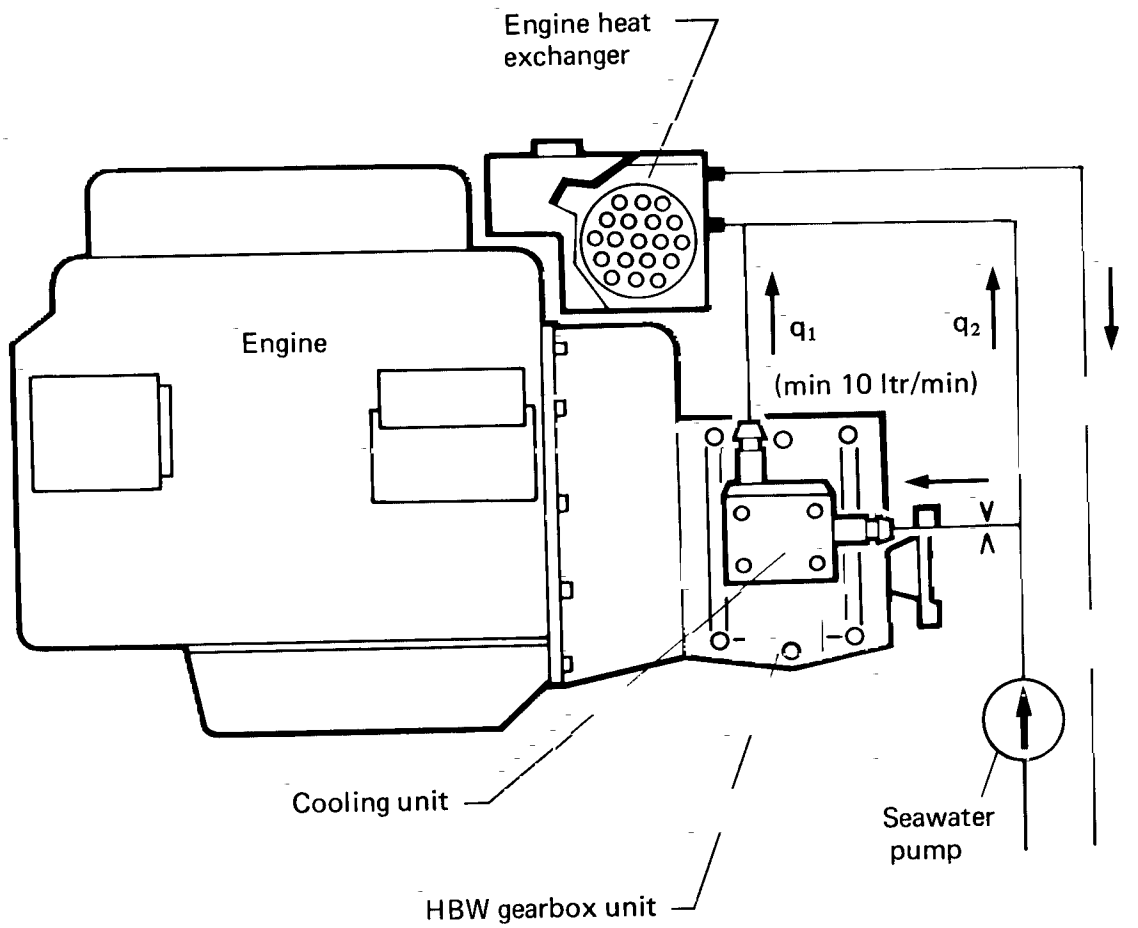
In case of doubt please contract the transmission manufacturer.

2.10 Cooling unit, cont'd

The cooling unit should be connected to the fresh-water pressure line (external circuit) of the engine in accordance with the diagram shown below. The minimum volume of flow is 10 ltr/min. Retrofitting of the cooling unit involes no problems (see item 6.14).

2.11 Engine-gearbox compartment

Care should be taken that the engine-gearbox compartment is properly ventilated.



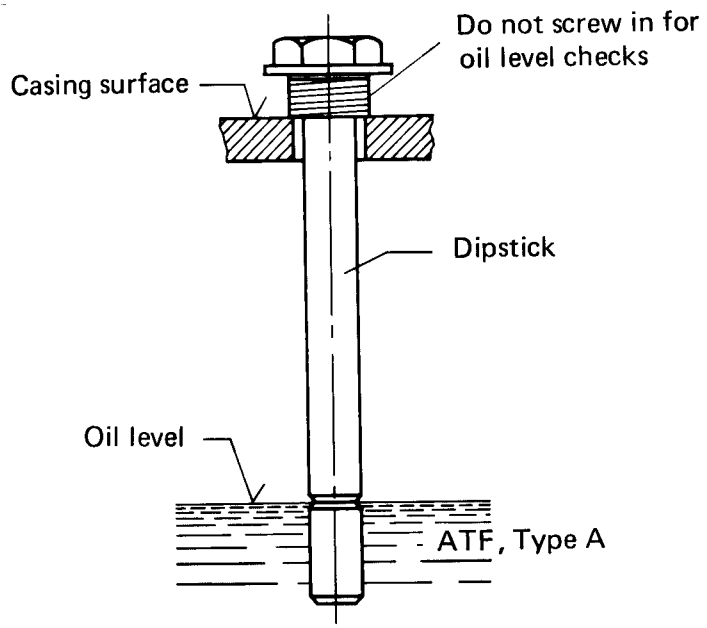
3.1 General information

All HBW boat reversing gearbox units are test-run on a test stand at the factory prior to delivery.

For safety reasons the oil is drained before shipment.

3.2 Initial operation

Fill the gearbox with oil (ATF) of the recommended grade. The oil level should be up to the index mark on the dipstick (see illustration).



Correct readings up to 20^{o} inclination in direction of shafts (15^{o} for HBW150 V)

To check the oil level, just insert the dipstick, do **not screw in.** Retighten the hex screw with the dipstick after the oil level check. Do not forget sealing ring.

3.3 Operating temperature

The maximum permissible temperature of the transmission oil is 130 °C.

Operation of gearbox

The zero position of the operating lever on the control console must coincide with the zero position of the actuating lever on the transmission. Shifting is initiated by a cable or rod linkage via the actuating lever and an actuating cam. The completion of the gear changing operation is servo-automatically controlled.

Gear changing should be smooth, not too slow, and continuous (without interruption). Direct changes from forward to reverse are permissible, since the multiple-disc clutch permits gear changing at high rpm, including sudden reversing at top speeds in the event of danger.

Sailing and moving in tow

Rotation of the propeller without load while the boat is sailing, being towed, or anchored in a river, as well as operation of the engine with the propeller stopped (for charging the battery), will have no detrimental effects on the gearbox.

Important
When the boat is sailing (engine stopped), the gear lever must be in zero position. Never put the gear lever in the position corresponding to the direction of travel of the boat.

Locking of the propeller shaft by an additional brake is not required: use the gear lever position opposite your direction of travel for this purpose.

3.6 Lay-up periods

If the transmission is not used for periods of more than 1 year it should be completely filled with oil of the same grade to prevent corrosion. Protect the input shaft and the output flange by means of an anticorrosive coating if required.

3.7 Preparation for re-use

See item 2.3

4. Maintenance

4.1 Transmission oil chgd. 6-1-92 @ 825 hrs.

To ensure trouble-free operation of the clutch only use Automatic Transmission Fluid (ATF).

4.2 Oil quantity

HBW 50	0.3 ltr
HBW 100	0.35 ltr
HBW 150	0.55 ltr
HBW 150 V	1.0 ltr
HBW 220	0.75 ltr

Use the index mark on the dipstick as a reference (see item 3.2).

4.3 Oil level checks

Check the oil level in the gearbox about once a month. Correct oil level: index mark on dipstick (see item 3.2). Always use the same oil grade when topping up.

4.4 Oil change chgd @ 25HR chgd @ 146 hrs - 11 months 7/8/82

Change the oil fore the first time after about 25 hours of operation, then at intervals of at least 1 year.

4.5 Checking the Bowden cable or rod linkage

The Bowden cable or rod linkage should be checked at shorter time intervals. Check the zero position of the operating lever (on the control console) and of the actuating lever (on the gearbox) on this occasion. The minimum lever travel from the neutral position to operating positions (0—A = 0—B) should be 35 mm for the outer and 30 mm for the inner pivot point. Make certain that these minimum values are safely reached. Check the cable or rod linkage for easy movability (see item 2.9).

4.6 Cooling

If the transmission is equipped with a cooling unit, drain the cooling water before long periods of non-use at temperatures around or below freezing point. For drain plug see drawing under item 2.10.

5. Disassembly

Note: fold out illustration sheets 1 and 2 or (for HBW 150 V) sheets 3 and 4 (exploded views) for reference.

5.1 Removing the cooling unit

Unscrew 4 hex head screws M 8 x 50 and take off unit with seal (see illustration under item 6.14.2).

5.2 Removing and disassembling the actuating lever cover plate

Always set actuating lever to neutral position.

5.2.2 Remove hex head screws (5) from cover plate (9), using 13 mm spanner (wrench) and take off spring washers (4).

Remove cover plate assembly (9) with seal (29), lever (6) and actuating cam (11).

Remove screw (7) from lever (6). Pull off lever (6). Remove actuating cam (11).

5.3 Removing the bearing shields

5.3.1 Remove hex head screws (5) from bearing shields (2) and (3), using 13 mm spanner (wrench), and take off spring washers (4).

5.3.2 Remove cover (3) and bearing shield (2) on input shaft (36) together with seals (28).

Separating the gearbox sections and removing the input and output shafts

5.4.1 Remove hex nuts (22) from gearbox (1), using 13 mm spanner (wrench), take off spring washers (4) and remove screws (21).

Separate the two halves of gearbox (1) by light hammer blows on the oil filler screw and oil drain plug (19) and (20).

Remove shims (37, 38, 39, 40) from the input and output shafts and keep separately. For proper reassembly it is advisable to note down the thickness and location of each of the shims to obtain the correct bearing play.

If none of the parts (2, 3, 32, 33, 36) on the input shaft and of the parts (2, 3, 34, 35, 43, 46, 47, 59) of the output shaft are replaced, the shims can be re-used in the same positions. Should any of these parts be replaced, the dimensions of the gear set relative to the casing have to be measured anew and suitable shims have to be installed.

Removing the shifting fork (15)

5.5.1 Remove screw plug (17).

5.5.2 Pull actuating shaft (16) out of bearing.

5.5.3 Remove shifting fork (15).

Removing the intermediate gear (26)

Heat gearbox section with intermediate gear to a temperature of approx 80 °C.

Knock pin (24) out of its bearing by light hammer blows, using a driving pin of suitable size.

5.6.3 Remove intermediate gear (26), retaining plates (25) and roller cage (27)

Disassembling the input shaft (36)

Remove outer bearing races (32).

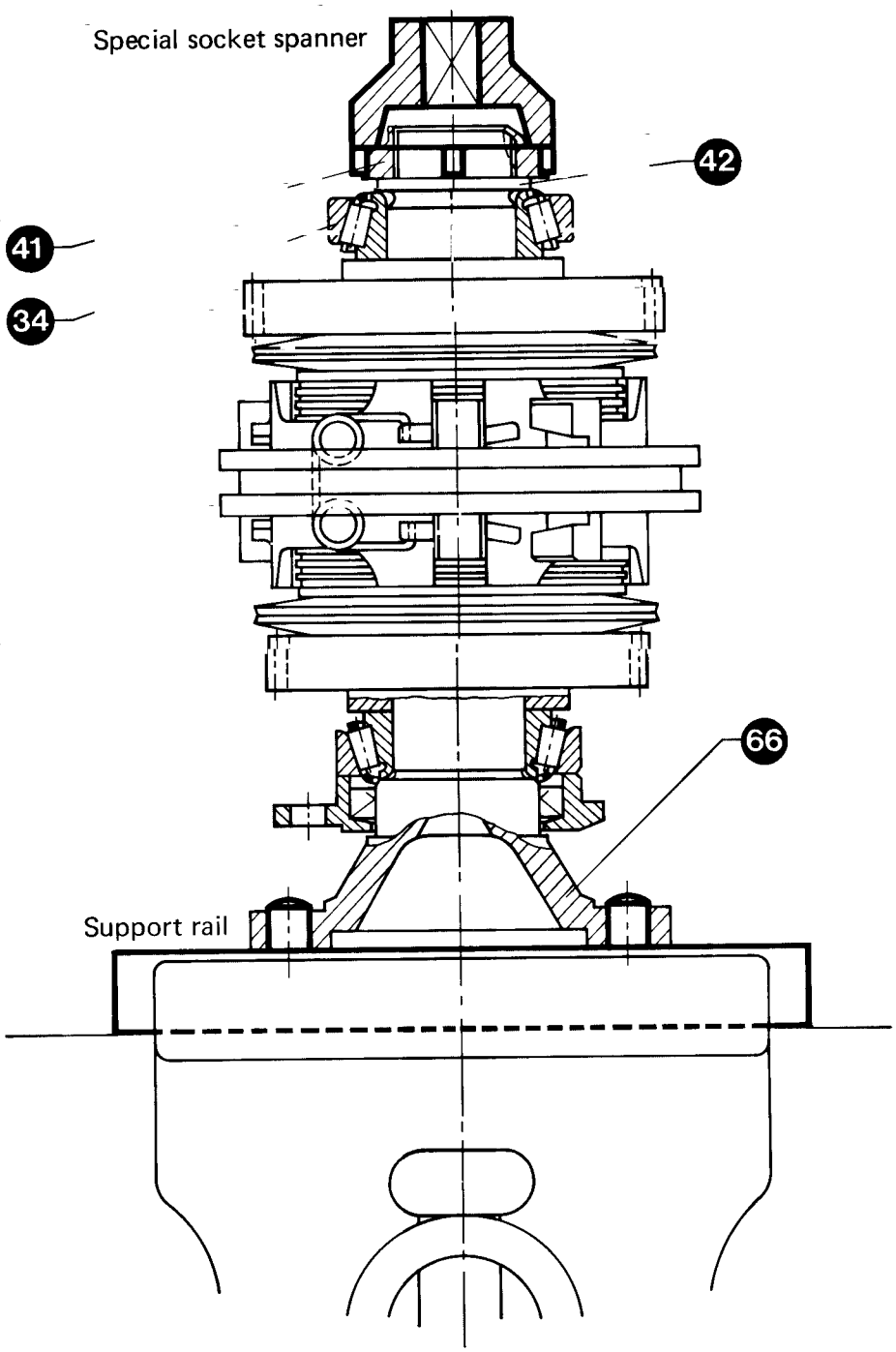
In the event of bearing damage, cautiously drive inner races (33) off the input shaft (36) with a punch (away from gear).

5.8 Disassembling the outout shaft (66)

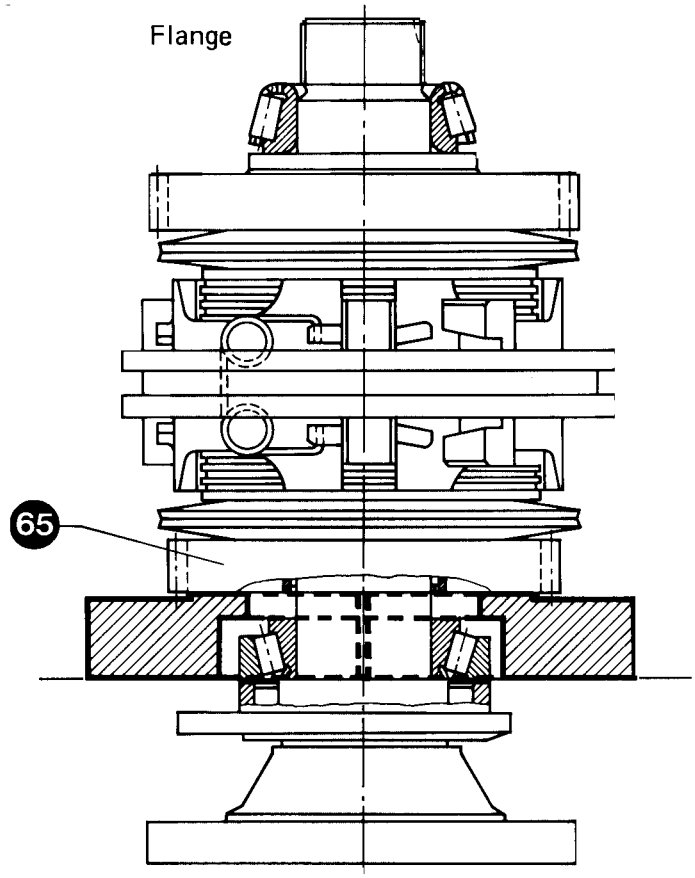
Mount support rail on a vice with the pins pointing upwards (not on HBW 150 V)

5.8.2 Place output shaft (66) vertically on the support rail with the flange side down.

Remove grooved ring nut (41) by means of special socket spanner and take off spacer (42) and outer bearing race (34). On HBW 150 V remove central screw (41)



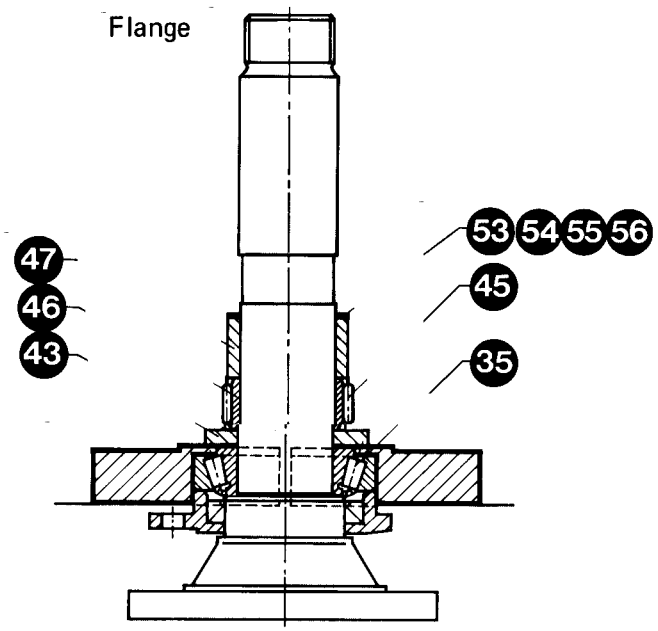
5.8.4 Place face side of gear (65) adjacent to shaft flange against divided flange and use pin of suitable size to press off the output shaft (from the threaded end).



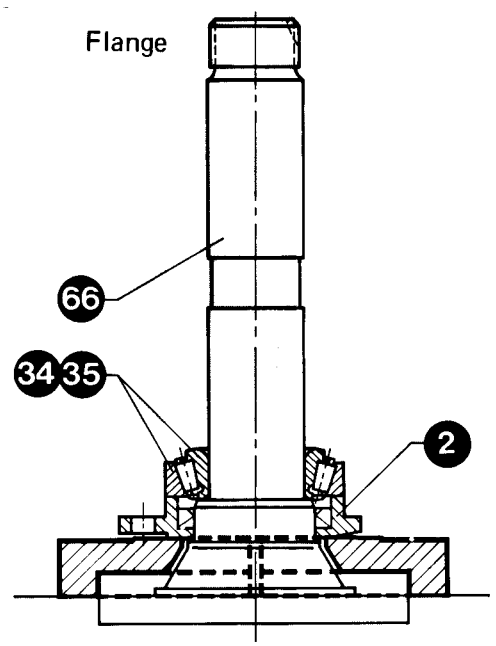
The parts removed from the threaded side of the shaft are not interchangeable with the parts removed from the flange side. Keep separately.

5.8.5 Remove keys (67) from the output shaft and keep in a separate place (1 key for HBW 50, 2 keys for HBW 100 and HBW 150, and 4 keys for HBW 220).

5.8.6 Attach divided flange between taper roller bearing (35) and thrust ring (43) and press off spacers (47), needle bearing inner races (46), thrust ring (43) and shims (53, 54, 55, 56) from the output shaft.



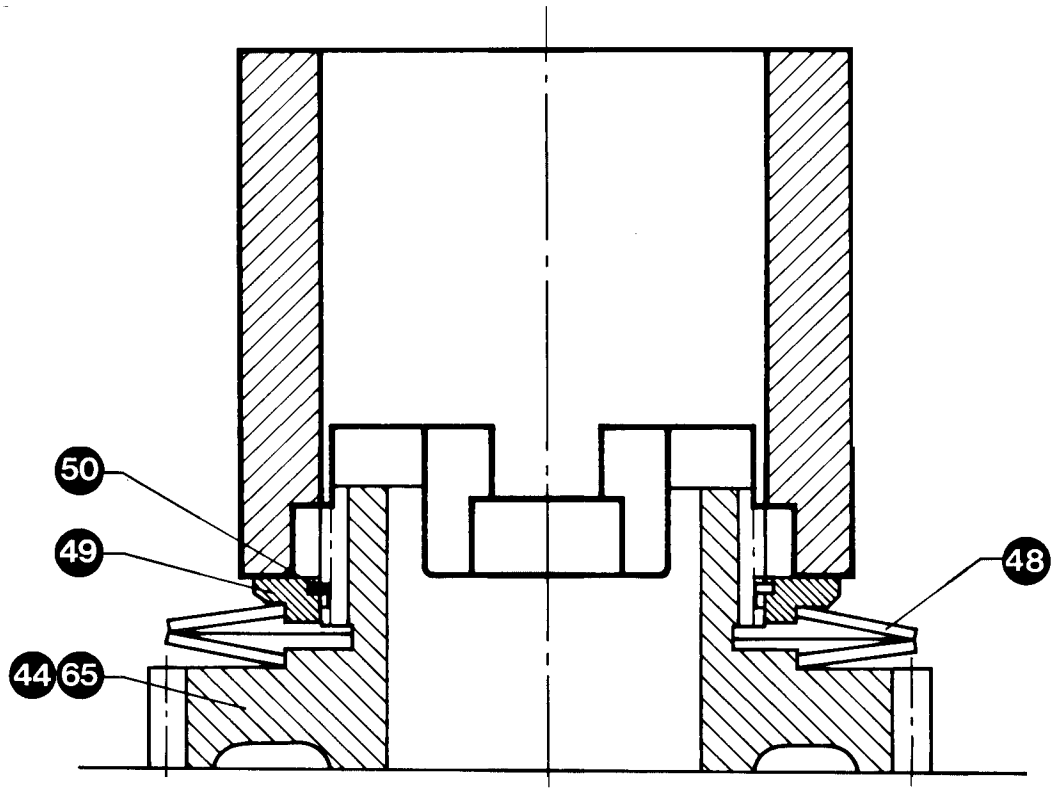
5.8.7 Attach divided flange to face side of bearing shield (2) and pull off taper roller bearing (34, 35) with shield. On HBW 150 V only pull off taper roller bearing (34, 35).



Remove internal and external clutch discs from gears (44) and (65).

Dismantling the gears

Compress cup springs (48) by means of dismantling tool. Remove circlip (50) and take off thrust plate (49).



5.8.10 Dismantling the actuating members

Detach springs (64), watching for balls (58).

5.8.11 Remove disc carrier (57).

5.8.12 Place actuating sleeve (60) on a plane surface and press out guide sleeve (59). Watch for detent pins and springs jumping off the guide sleeve. It will be advisible to wrap a rag around the actuating sleeve (60) and the guide sleeve (59) to catch any parts that might jump off.

Disassembling the quill shaft (HBW 150 V)

Note: fold out illustration sheets 3 and 4 (exploded views).

5.9.1 Remove grooved ring nut (83) by means of socket spanner and take off flange (82) with sealing ring (31).

5.9.2 Place divided flange against face side of bevel gear (80) and force bevel gear (80), spacer ring (76) and bearing (74) off quill shaft.

Remove key (81) and spacer ring (76).

5.9.4 Force off bearing (74/75) by means of divided flange.

6. Reassembly

Note: fold out illustration sheets 1 and 2 (exploded views) for reference. For HBW 150 V use illustration sheets 3 and 4.

6.1 General information

The following points should be observed when reassembling the gearbox

Clean all parts thoroughly, especially sealing surfaces, inspect for wear, damage and cracks, and replace if required.

– Check shifting fork (15) for wear. The contact surfaces of this fork are provided with a molybdenum coating. Should this coating be worn away at any point, replace the shifting fork. Max wear on guiding surfaces 0.2 mm on each side.

Thrust rings (43) require replacement if wear exceeds 0.25 mm

Internal discs (51) have a sintered metal coating of 0.3 mm on each side. If the surface structure (after cleaning) shows indications of wear, replace the discs.

– Apply thin coat of oil to antifriction bearings before installation.

6.2 Pre-assembling the intermediate gear shaft in gearbox section without opening

Heat gearbox section (1) **without** opening for the actuating lever to a temperature of approx 100 °C.

Insert retaining plate (25).

Important
Note that the bevelled corners of retaining plates (25) have to be placed in different positions (see illustration on sheet 1).

Insert needle cage (27) into intermediate gear (26) and place complete assembly on retaining plate (25).

6.2.4 Insert second retaining plate (25)

6.2.5 Use a suitable pin for correct concentric alignment of all parts.

6.2.6 Fit O-ring (23) to intermediate gear shaft (24) and insert into gearbox section.

Important
On HBW 220, insert intermediate gear shaft (24) without O-ring (23) and close bore in gearbox section with sealing compound by pressing in a plug (23), (see illustration on sheet 1).

6.3 Pre-assembling the shifting fork in gearbox section with opening

6.3.1 Insert shifting fork (15) into gearbox section (1) with opening for the actuating lever in such a way that the **long** arm of the fork points **downwards.**

6.3.2 Insert shifting rod (16) through bores in gearbox and shifting fork.

6.3.3 Fit screw plug (17) to gearbox, making certain that the clearance between shifting rod (16) and screw plug (17) is approx 0.5 mm. Seal screw plug with sealing compound.

6.3.4 Check shifting fork for easy movability.

6.4 Pre-assembling the actuating lever cover plate

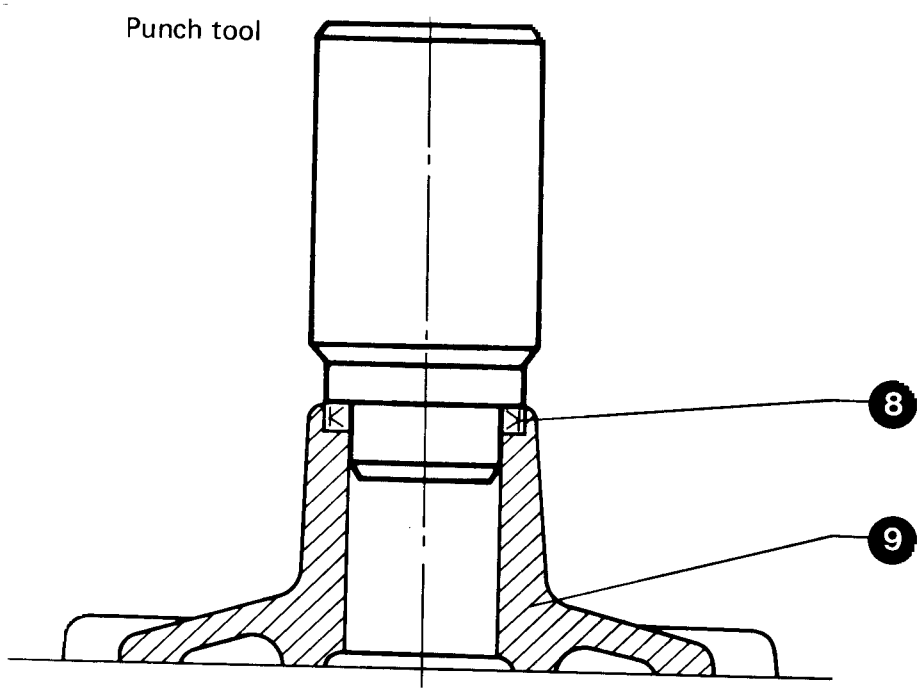
Use punch tool to press sealing ring (8) into cover plate (9). Spread antifriction bearing grease between sealing lips.

Insert actuating cam assembly (11) into cover plate (9).

6.4.2 Fit acutating lever (6).

Important
Clearance between actuating lever and cover plate 0.5 mm.

6.4.3 Clamp actuating lever by means of retaining screw (7), using a 13 mm spanner (wrench).



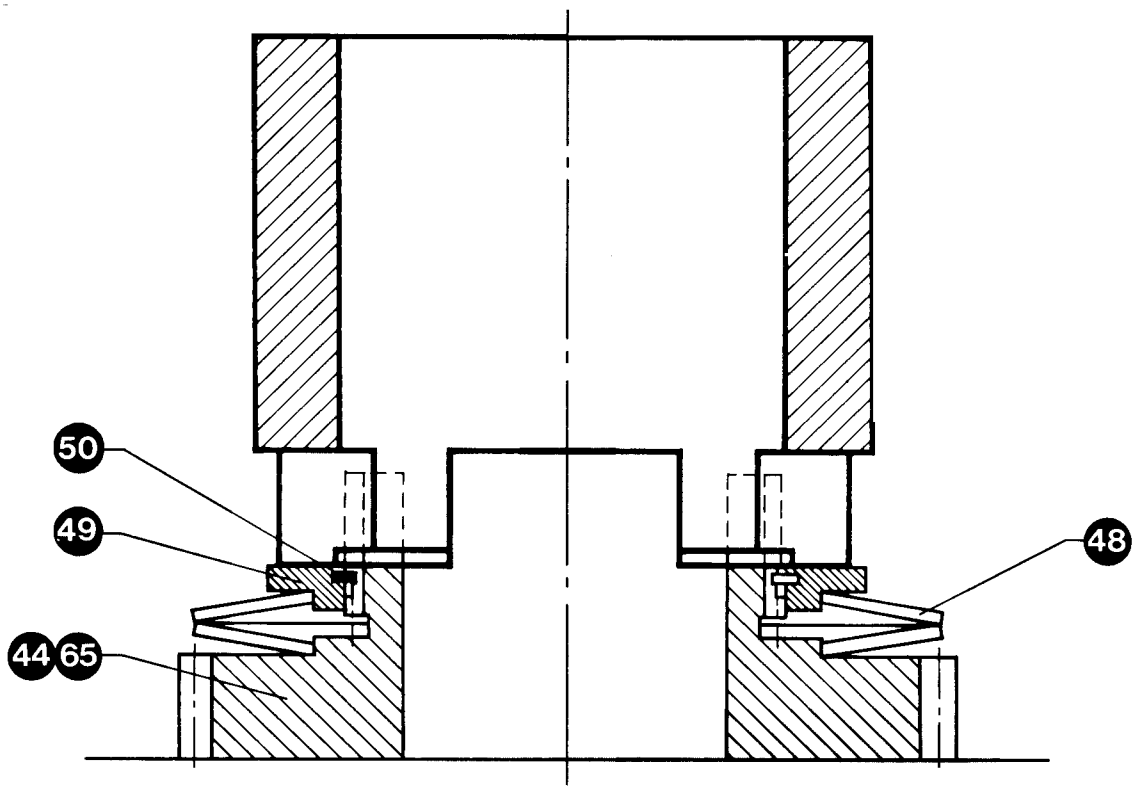
Pre-assembling the gears (65) and (44) with cup springs (48) and clutch discs (51 and 52)

Important
If previously disassembled parts are used, make certain that only mating and associated parts are reassembled (see item 5.8.4).

Join two cup springs (48) face to face (external diameters in contact) and place them on the centering collar of gears (65) and (44).

Place thrust ring (49) on cup springs.

Place circlip (50) on gear hub and use mounting tool and press to fit circlip into groove on hub.



Attach clutch discs (51 and 52), first internal disc (51), then alternatingly external disc (52), internal disc (51), etc.

6.6 **Measuring the pre-assembled gears (65) and (44) to determine seeting value 'a'**

If no parts had to be replaced, the previously disassembled shims (53, 54, 55, 56) can be re-used in their former arrangement and positions without any measuring operation.

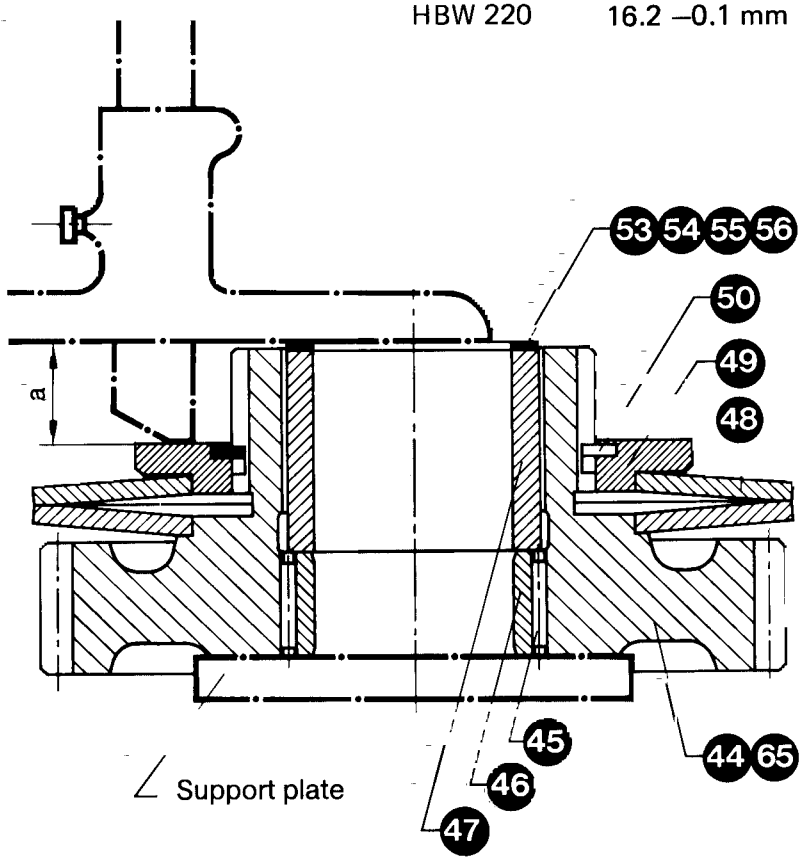
If measuring is required, proceed as follows:

6.6.1 Place pre-assembled gear (65), and subsequently gear (44), on a supporting plate (end face of hub downwards, see illustration).

Insert needle cage (45), inner race (46) and spacer (47) into bore of gear.

Fit shims (53, 54, 55, 56), as required, until prescribed setting value 'a' is obtained (see illustration).

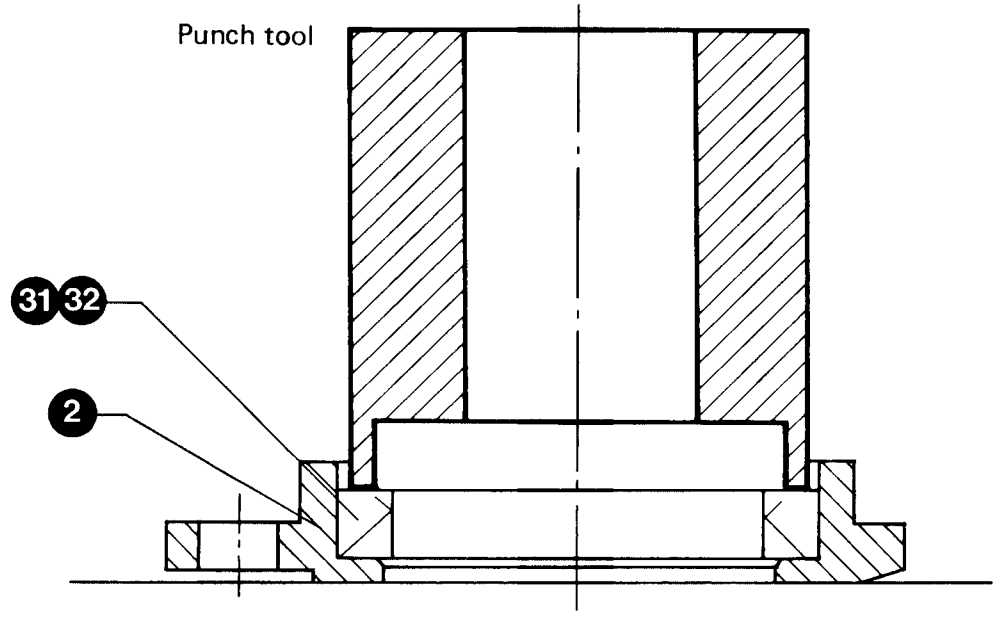
Type	Setting value 'a'
HBW 50	8.0 –0.1 mm
HBW 100	13.0 –0.1 mm
HBW 150 (V)	13.2 –0.1 mm
HBW 220	16.2 –0.1 mm



Shims are available in thicknesses of 0.4 – 0.5 – 0.6 and 0.7 mm.

6.7 **Pre-assembling the bearing shields (2) for the input and output shafts**

Use punch tool to press shaft sealing rings (30 input and 31 – output) into shield (2).



6.8 **Pre-assembling the actuating members**

6.8.1 Fit driving pins (63), springs (61) and detent pins (22) to guide sleeve (59)

6.8.2 Place actuating sleeve (60) on press platen.

6.8.3 Place guide sleeve (59) on top of actuating sleeve (60) with the three driving pins (73) in alignment with the three grooves in the actuating sleeve. Watch for correct position of detent pins (62) relative to angular pockets of sleeve.

6.8.4 Press guide sleeve (59) into actuating sleeve (60) up to midway position (noticeable click).

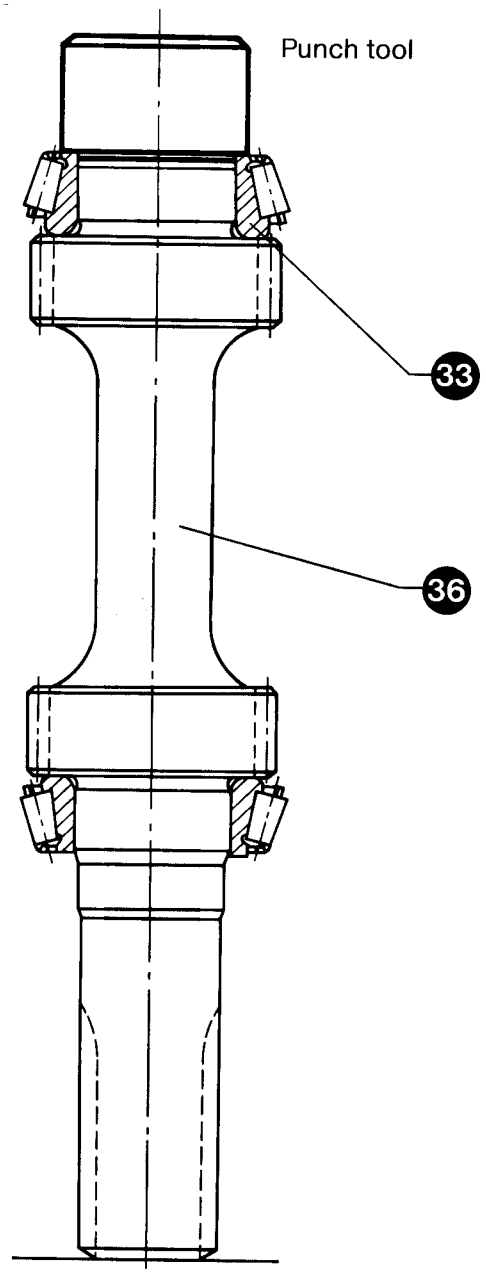
Insert balls (58) into ball pockets of guide sleeve, attach disc carrier (57), then fit balls on opposite face side and attach second disc carrier (57).

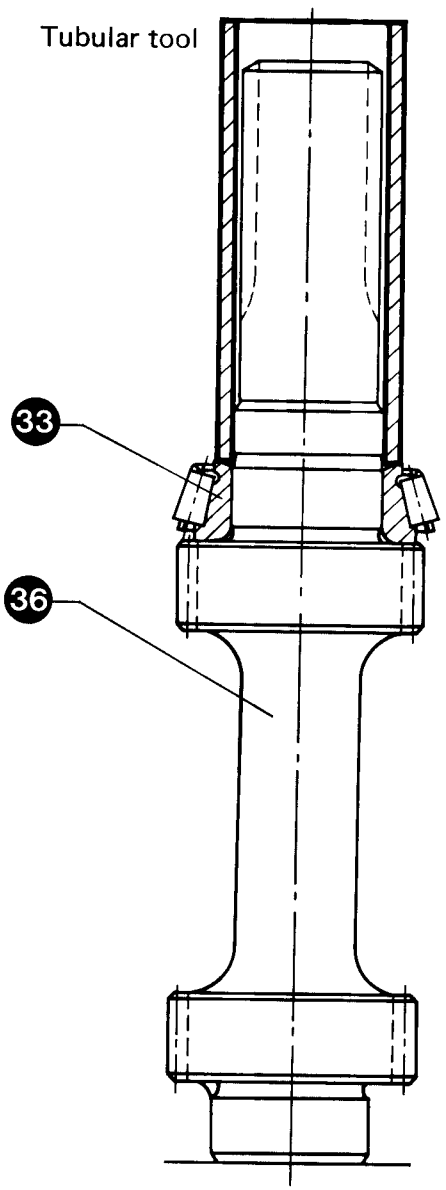
Attach springs (64) with closed part of spring windings pointing outwards.

6.9 Reassembling the input shaft

Preheat inner races (33) of taper roller bearings to a temperature of 100 °C and, using tubular or punch tool, press races on input shaft (36) on both sides.

Important: repress after colling down, so that no gap is left.





6.10 Reassembling the output shaft

6.10.1 Place pre-assembled bearing shield (item 6.7) with seal (28) on output shaft (66) (not applicable to HBW 150 V)

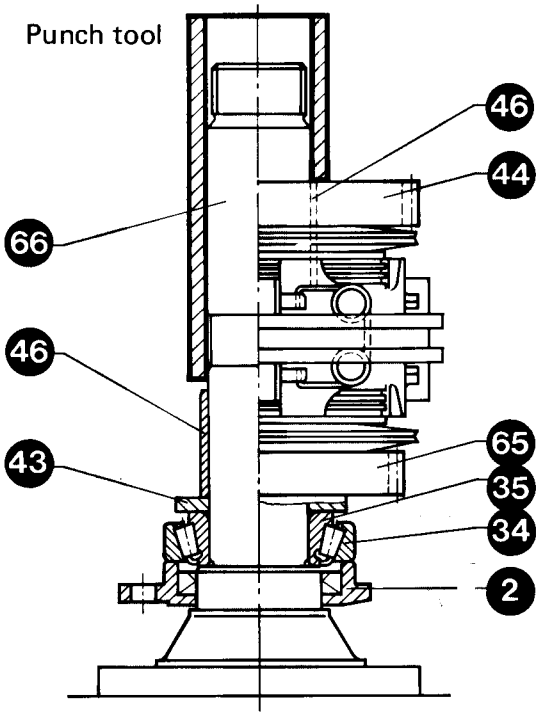
6.10.2 Attach outer race (34) of taper roller bearing.

6.10.3 Pre-heat inner race (35) of taper roller bearing to a temperature of approx. 100 °C and press on output shaft (66) in hot condition, with smaller diameter adjacent to collar on shaft. On HBW 150 V press complete bearing assembly (35/68) on shaft (66).

Important: repress after cooling down, so that no gap is left.

6.10.4 Fit thrust ring (43) in such a way that sintered surface (brown colour) faces gear.

6.10.5 Use tubular tool to press on inner race (46) of needle bearing for gear (65)



6.10.6 Attach needle cages (45) and completely pre-assembled gear (65) with cluch discs (51 and 52).

6.10.7 Fit spacer (47) and shims (53, 54, 55, 56) to gear (65).

6.10.8 Fit keys (67) to shaft (2 for HBW 50, 2 for HBW 100, 2 for HBW 150 and 4 for HBW 220).

6.10.9 Press pre-assembled actuating members (see item 6.8) on output shaft (66).
Important: align external clutch discs radially relative to disc carrier.

6.10.10 Attach shims (53, 54, 55, 56) to gear (44).

6.10.11 Attach spacer (47) to gear (44)

6.10.12 Use tubular tool to press on inner race (46) of needle bearing for gear (44).

6.10.13 Attach pre-assembled gear (44) with needle cage (45) and clutch discs (51 and 52).

Align external discs for proper engagement with actuating member.

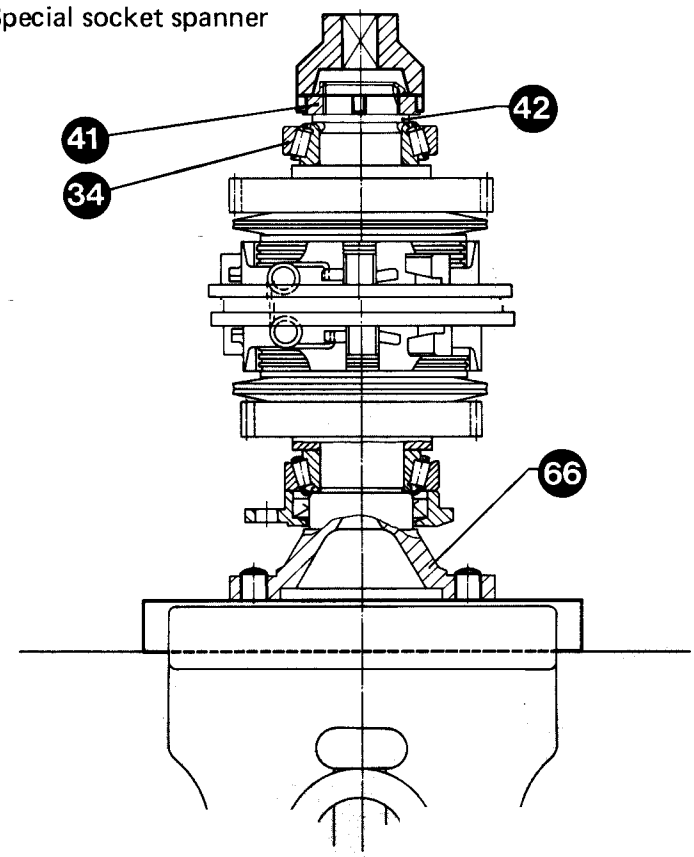
6.10.14 Attach thrust ring (43) in such a way that sintered surface (brown colour) faces gear.

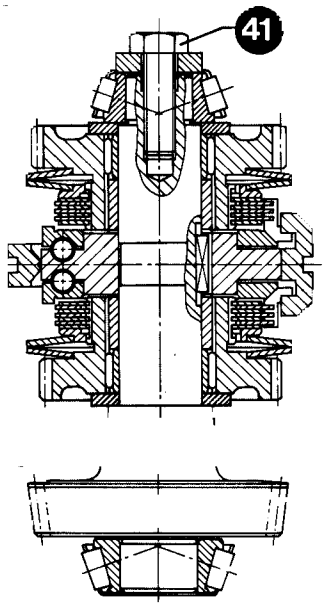
6.10.15 Pre-heat inner race (35) of taper roller bearing to a temperature of approx. 100 °C and press on shaft, with larger diameter adjacent to thrust ring.

Important: repress after cooling down, so that no gap is left.

6.10.17 Screw on grooved ring nut (41) by means of special socket spanner and tighten to torque of 95 Nm (on HBW 220 to torque of 150 Nm). On HBW 150 V fit central screw (41) and tighten to torque of 100 Nm.

Special socket spanner





6.10.18 Secure ring nut by punching outer rim into groove of shaft.

6.10.19 Check gears (44) and (65) for free movability in an axial direction.

6.10.20 Attach outer race (34) of taper roller bearing.

6.11 Reassembling the quill shaft (HBW 150 V)

6.11.1 Press on bearing (74/75)

6.11.2 Fit spacer ring (76) and key (81).

6.11.3 Push on bevel gear (80).

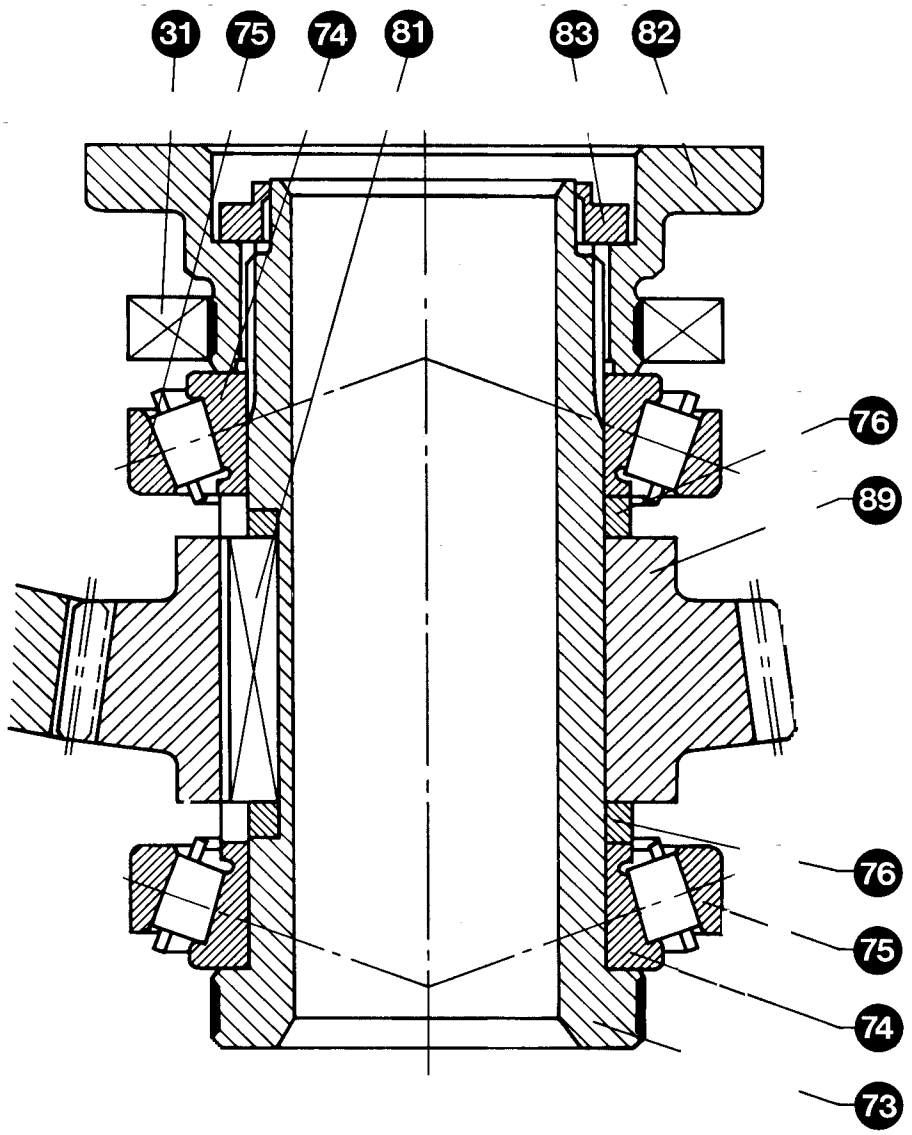
6.11.4 Fit spacer ring (76).

6.11.5 Press on bearing (74/75)

6.11.6 Attach flange (82)

6.11.7 Tighten grooved ring nut (83) to a torque of 95 Nm, using socket spanner.

6.11.8 Secure grooved ring nut (83) by pressing rim into groove in shaft.



6.12 Final assembly of gearbox

6.12.1 Place pre-assembled gearbox section (1) – (with intermediate gear) on side wall.

6.12.2 Place pre-assembled output shaft (66) in lower part of gearbox with flange side towards intermediate gear side (on HBW 150 V, bevel gear towards intermediate gear side).

6.12.3 Place pre-assembled input shaft (36) in upper part of gearbox.

6.12.4* Place pre-assembled quill shaft (73) in lower part of gearbox (watching for correct engagement of marked teeth).

6.12.5* Check backlash (0.10 to 0.16 mm). To correct backlash grind off spacer ring on one side of quill shaft bevel gear (80) and add shims (77) on the other side.

6.12.6 Spread sealing compound on sealing surface of pre-assembled gearbox section (1) (with shifting fork) and place upper section on lower section of gearbox.

6.12.7 Insert two screws (21) preferably in the middle, and screw in finger-tight to secure the two gearbox sections together.

6.12.8 Use a rubber mallet to align the two gearbox section (1) by tapping them gently into position.

6.12.9 Fit bearing shield (2) to output shaft (66) by means of spring washers (4) and screws (5), using a 13 mm spanner (wrench). Tighten to torque of 14 Nm.

6.12.10 Slide pre-assembled bearing shield (2) with seal (28) over input shaft and secure by means of springer washer (4) and screws (5), using a 13 mm spanner (wrench).

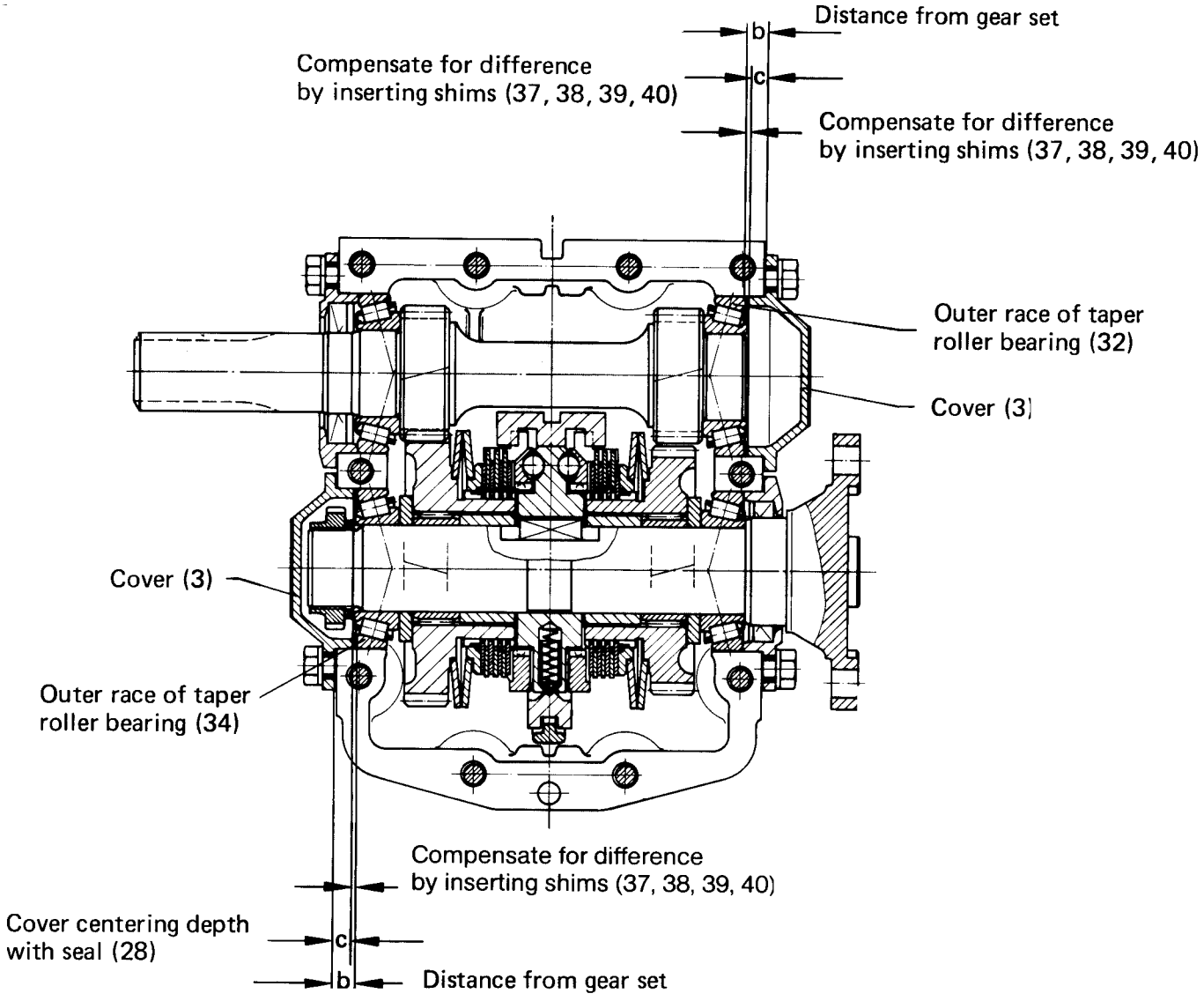
6.12.11* Fit radial packing rings (31), removing coupling flange for this purpose. Secure grooved ring nut (83) by means of notch when finally assembling the parts.

*HBW – 150V

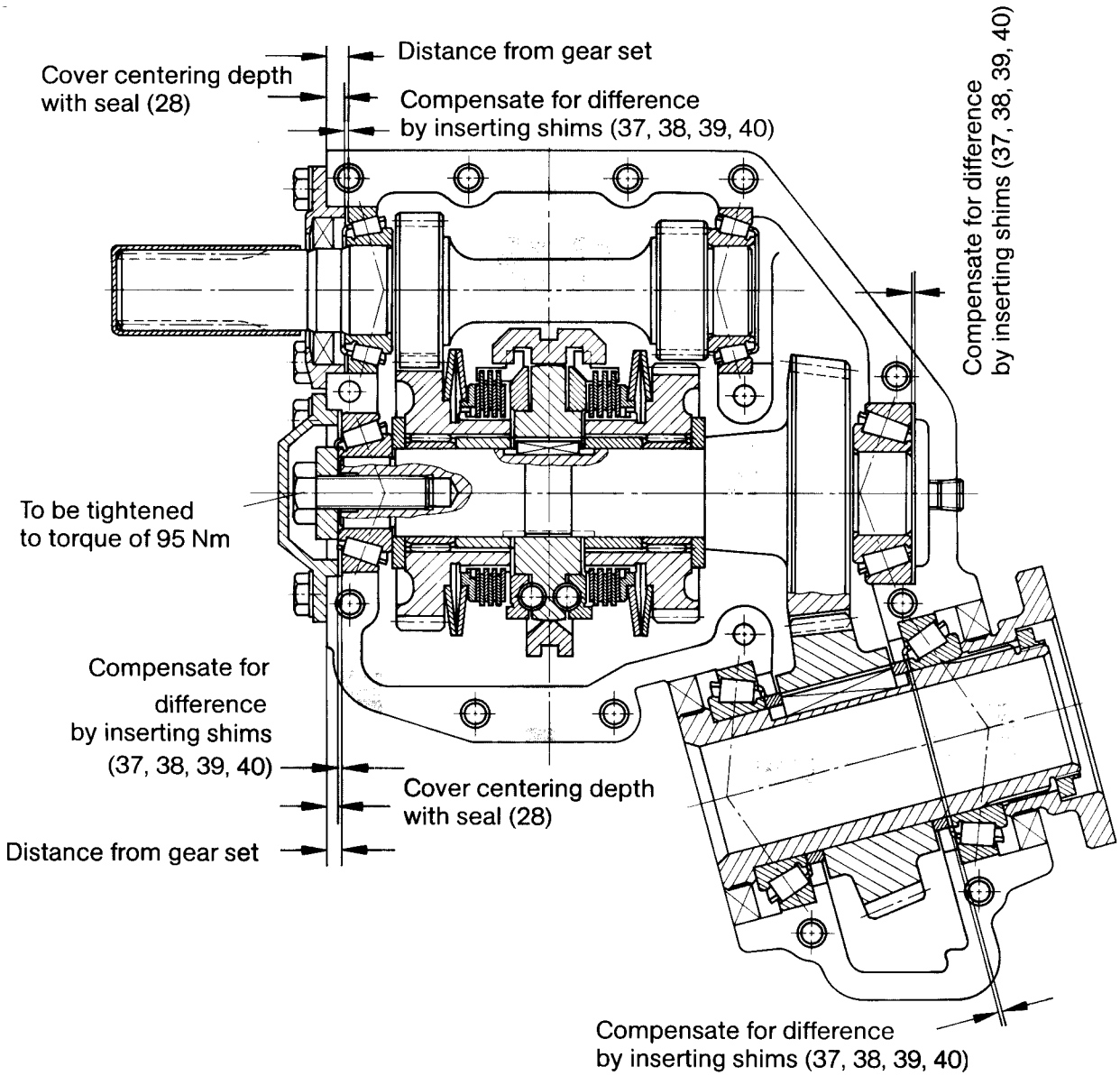
6.13 **Measuring the gears sets of input shaft and output shaft (see illustration)**

6.13.1 Tap outer races (32) and (34) on output and input shafts to eliminate bearing play, simultaneously rotating the shafts.

6.13.2 Determine dimension 'b' by means of depth gauge (see illustration)



6.13.3 Measure dimension 'c' on cover (3) with seal (28) installed, using a depth gauge (see illustration). The difference between the two dimensions indicates the distance to be filled up with shims (37, 38, 39, 40). Shims are available in thicknesses of 0.1 – 0.15 – 0.2 – 0.3 and 0.5 mm.
On HBW 150 V, a hole is provided on the output side of the housing to permit this measuring operation: move shaft via gear (65) by means of a lever through opening in gearbox (see illustration).

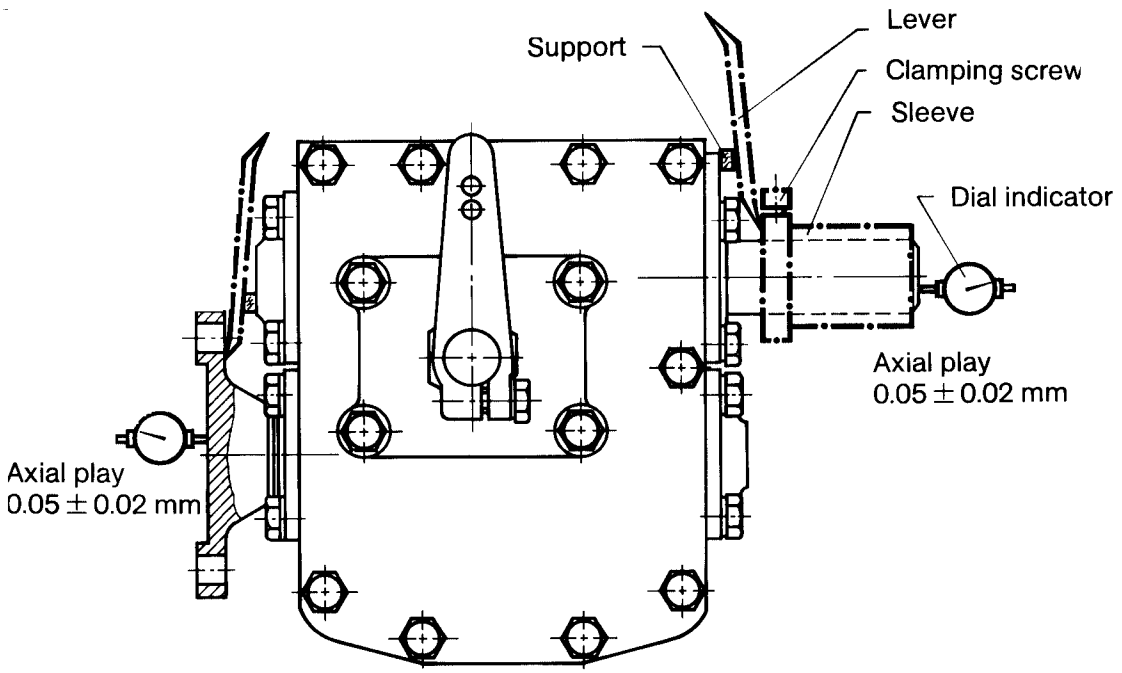


6.13.4 Insert the required number of shims into the bearing bores of the gearbox to obtain an axial clearance of the output and input shafts of 0.05 ± 0.02 mm.

If no parts had to be replaced (see item 5.4.4), the previously disassembled shims (37, 38, 39, 40) can be re-used in the previous arrangement and positions. It will be advisable, however, to check the bearing clearance and correct it if required.

6.13.5 Mount the previously measured covers (3) on the output and input shafts by means of spring washers (4) and screws (5), using a 13 mm spanner (wrench). Tighten to torque of 14 Nm.

Make certain that bearing shield (2) and cover (3) on the input side are screwed in place in such a way that the flanges are in alignment with each other at the level of the gearbox.

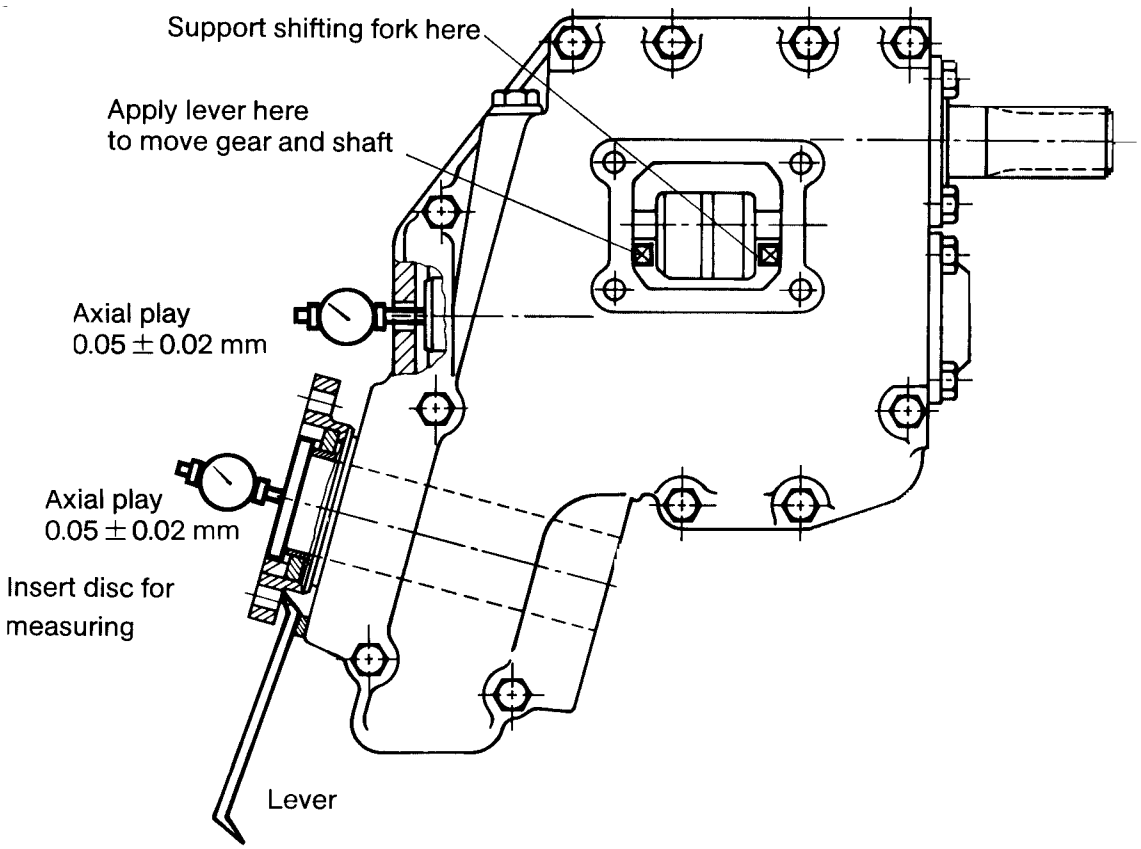


6.13.6 Place spring washers (4) underneath all screws (21) and tighten screws to a torque of 22 Nm, using a 13 mm spanner (wrench).

6.13.7 Tap output and input shafts lightly in an axial direction while rotating the shafts, to ensure freedom of movement.

6.13.8 Axial clearance of input and output shafts: 0.05 ± 0.02 mm, measured by means of dial indicator in contact with the end faces of the shafts (see illustration).

6.13.9 Measure axial clearance of quill shaft (on HBW 150 V), also with dial indicator in contact with end face of shaft (see illustration). Permissible clearance: 0.05 ± 0.02 mm.



6.14 **Mounting the actuating lever cover plate**

6.14.1 Place seal (29) on pre-assembled cover plate (9) and attach cover plate to gearbox. Watch for proper engagement of actuating cam and shifting fork. The cover plate can be mounted when the shifting fork is in the middle (= neutral) position. It is important to adjust the actuating lever to exactly midway position in neutral.

The lever travel from 0 to A and from 0 to B should be equal. After a lever travel of 28 to 31 mm the transmission should be in gear. Screw the cover plate in place in this position.

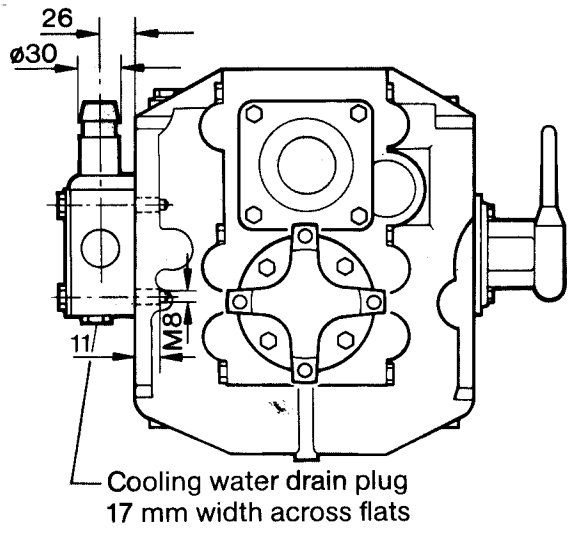
6.14.2 Fit spring washers (4) and screws (5), using a 13 mm spanner (wrench). Tighten to a torque of 14 Nm. Check actuating lever for proper operation.

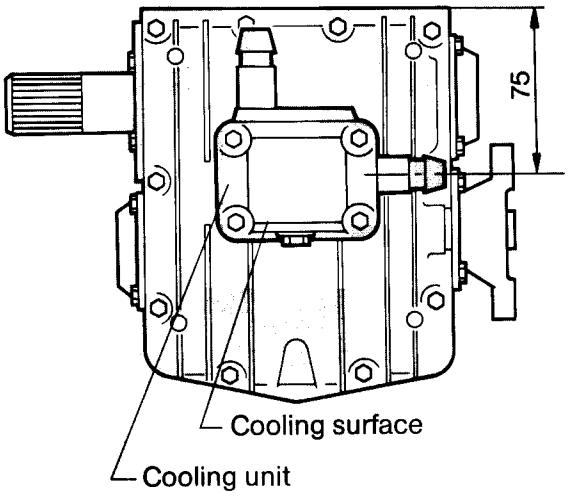
6.15 **Mounting the cooling unit** (if provided)

Attach the cooling unit on the side opposite the cover plate (9).

6.15.1 Tap the existing four blind holes: metric thread, 8 mm diameter, 10 mm deep.

6.15.2 Coat cooling surface on gearbox housing with a seawater-resistant paint.





6.15.3 Fit seal (29) and attach cooling cover by means of 4 screws M 8 x 60. Tighten to a torque of 15 Nm.

Note
It should be noted that the attached spare parts list is based on **illustration sheets (exploded views) 1 and 2 for HBW 50, HBW 100, HBW 150, HBW 220 transmissions**
and
illustration sheets (exploded views) 3 and 4 for HBW 150 V transmission.

When placing spare parts orders please specify the following information and data:

- size and model of gearbox;
- serial number of gearbox;
- item number with associated part number and identification number as well as name of part.

Tools

The following special tools are required for the disassembly and reassembly of HBW transmission units and can be obtained from the manufacturer:

Mounting plate (for support of casing)	No 220.299.0	(HBW 50, 100, 150, 220)
Mounting plate (for support of output shaft)	No 214.850.10	(HBW 50, 100, 150, 220)
Clamping sleeve (for measuring axial clearance)	No 219.354.3	(HBW 50, 100, 150, 220)
Socket spanner (wrench)	No 218.639.0	(HBW 100)
Socket spanner (wrench) (for assembling input shaft)	No 214.462.0	(HBW 150, 220)
Magnetic holder with dial indicator (for measuring bearing clearances)	No 440.10.0	(all HBW models)

All other tools shown in this manual are commercially available workshop equipment.
For prices please inquire with transmission manufacturer.

Item No	Part name		Number per gearbox	HBW 50		HBW 100		HBW 150		HBW 220	
				Part No	Id No	Part No	Id No	Part No	Id No	Part No	Id No
1	Gearbox assembly		1	947.71.701.01.1	325952	947.61.700.02.1	288079	947.41.700.01.1	206447	947.51.700.01.1(1) 947.51.700.02.1(2)	274223 288960
2	Bearing shield	input output	1 1	947.61.004.01.4 947.61.003.01.4	288768 288787	947.61.004.01.4 947.61.003.01.4	288768 288787	947.41.004.01.4	206450	947.51.004.01.4	274248
3	Cover		2	947.61.005.01.4	288730	947.61.005.01.4	288730	947.41.005.01.4	206452	947.51.005.01.4	274219
4	Spring	HBW 100, 150, 220	40	———	—	B8 DIN 137 Cd-plated	159843	B8 DIN 137 Cd-plated	159843	B8 DIN 137	159843
	washer	HBW 50	36	A8 DIN 137 Cd-plated	337661	———		———	—	———	—
5	Hex head screw (cover)		20/16/12	M8x16 DIN 933 8.8	215870	M8x16 DIN 933 8.8	215870	M8x16 DIN 933 8.8	215870	M8x16 DIN 933 8.8	215870
6	Actuating lever		1	947.23.006.01.4	195062	947.23.006.01.4	195062	947.23.006.01.4	195062	947.23.006.01.4	195062
7	Hex head screw (actuating lever)		1	M8x20 DIN 933 8.8	199807	M8x20 DIN 933 8.8	199807	M8x20 DIN 933 8.8	199807	M8x20 DIN 933 8.8	199807
8	Radial sealing ring		1	SD 20 x 26 x 4	106864	SD 20 x 26 x 4	106864	SD 20 x 26 x 4	106864	SD 20 x 26 x 4	106864
9	Cover plate		1	947.71.003.01.3	326207	947.41.003.01.3	206448	947.41.003.01.3	206448	947.41.003.01.3	206448
10	Spring dowel pin		1	4 x 12 DIN 1481	104559	4 x 12 DIN 1481	104559	4 x 12 DIN 1481	104559	4 x 12 DIN 1481	104559
11	Actuating cam assembly		1	947.53.703.01.4	304332	947.53.703.01.4	304332	947.53.703.01.4	304332	947.53.703.01.4	304332
15	Shifting fork assembly		1	947.63.700.02.4	326000	947.63.700.02.4	326000	947.43.700.01.4	223563	947.53.700.01.4	274224
16	Actuating shaft		1	947.73.001.01.4	325963	947.43.002.01.4	206484	947.43.002.01.4	206484	947.53.002.01.4	288673
17	Screw plug		1	O-Ring OR 10–2	105524	M16x1.5 DIN 906 5.8	215877	M16x1.5 DIN 906 5.8	215877	M16x1.5 DIN 906 5.8	215877
18	Sealing ring		2	947.41.016.01.4	326578	947.41.016.01.4	326578	947.41.016.01.4	326578	947.41.016.01.4	326578
19	Oil dipstick/ breather ass'y		1	947.61.701.01.4	288729	947.61.701.01.4	288729	947.41.701.01.4	206929	947.51.701.01.4	274217
20	Oil drain plug		1	947.41.008.01.4	228566	947.41.008.01.4	228566	947.41.008.01.4	228566	947.41.008.01.4	228566
21	Hex head screw		10/14	M8x90 DIN 931 8.8	215869	M8x90 DIN 931 8.8	215869	M8x90 DIN 931 8.8	215869	M8x110 DIN 931 8.8	279058
22											
	Hex nut		8/10/11	M8 DIN 934 5	103876	M8 DIN 9345	103876	M8 DIN 934 5	103876	M8 DIN 934 5	103876

(1) Gear ratios 1.5 : 1 and 2 : 1
(2) Gear ratio 3 : 1

Item No	Part name	Number per gearbox	HBW 50		HBW 100		HBW 150		HBW 220	
			Part No	Id No	Part No	Id No	Part No	Id No	Part No	Id No
23	O-ring or plug	1	SGRG 16x1 DIN 471	104 807	OR12, 30-2,40-00636/59	105 679	OR14,00-3,00-00794/09	105 530	A 32 DIN 443 Cd-plated	285 375
24	Intermediate gear shaft	1	947.72.011.01.4	325 962	947.62.006.01.4	288 741	947.42.006.01.4	206 470	947.52.006.01.4	274 225
25	Retaining plate	2	947.62.009.01.4	288 743	947.62.009.01.4	288 743	947.42.009.01.4	206 473	947.52.009.01.4	288 702
26	Intermediate gear	1	947.72.004.01.4	325 961	947.62.004.02.4	288 078	947.42.004.02.4	254 730	947.52.004.01.4	274 226
27	Cage	1	K 16x20x13	106 589	DKK 16x24x20	280 128	DKK 20x30x24	215 878	KK 20x30x28	222 273
28	Seal	4/2	947.61.008.01.4	288 739	947.61.008.01.4	288 739	947.41.010.01.4	254 715	947.51.011.01.4	274 251
29	Seal (cover plate)	1	947.41.011.01.4	254 716	947.41.011.01.4	254 716	947.41.011.01.4	254 716	947.41.011.01.4	254 716
30	Radial sealing ring, input	1	A27x37x7DIN3760	280 135	A27x37x7 DIN 3760 AC	280 135	B30x52x7 DIN 3760	215 875	35x52x7 B1 72NBR769	284 260
31	Radial sealing ring, output	1/2	B32x45x7DIN3760	105 153	B32x45x7 DIN 3760	105 153	B40x52x7 DIN 3760	105 159	B40x52x7 DIN 3760	105 159
32	Taper roller bearing, input	2	ASRG KL 44610	280 127	ASRG KL 44610	280 127	ASRG K-LM 67010	215 874	32007 X DIN 720	167 210
33	Taper roller bearing, input	2	INTL KL 44649	280 129	INTL KL 44649	280 129	INTL K-LM 67048	215 873		
34	Taper roller bearing, output	2	ASRG KL 44610	280 127	ASRG KL 44610	280 127	ASRG K-LM 67010	215 874	ASRG K 15245	279 059
35	Taper roller bearing, output	2	INTL KL 44649	280 129	INTL KL 44649	280 129	INTL K-LM 67048	215 873	INTL K 15123	279 061
36	Input shaft 1.5 R – 27/22 teeth	1			947.62.001.05.3	304 059	947.42.001.03.3	304 088		
	Input shaft 2 R – 22/22 teeth	1	947.72.001.05.3	326 900						
	Input shaft 3 R – 18/22 teeth	1	947.72.001.06.3	326 901	947.62.001.06.3	304 074				
	Input shaft 2 R – 24/22 teeth	1			947.62.001.07.3	305 605	947.42.001.05.3	325 811		
	Input shaft 2.5 R – 19/22 teeth	1					947.42.001.04.3	313 952		
	Input shaft 2 R – 22/22 teeth, short	1	947.72.001.03.3	325 970						
	Input shaft 3 R – 18/22 teeth, short	1	947.72.001.04.3	325 977	947.72.001.02.3	305 523				
	Input shaft 1.5 R – 28/21 teeth	1							947.52.001.04.2	304 081
	Input shaft 2 R – 23/21 teeth	1							947.52.001.01.2	274 231
	Input shaft 3 R – 19/18 teeth	1							947.52.001.02.2	288 967

Item No	Part name	Number per gearbox	HBW 50		HBW 100		HBW 150		HBW 220	
			Part No	Id No	Part No	Id No	Part No	Id No	Part No	Id No
37	Shim	2	947.62.010.01.4	288731	947.62.010.01.4	288731	947.42.010.01.4	206474	947.52.010.01.4	274252
38		2	947.62.010.02.4	288732	947.62.010.02.4	288732		206476	947.52.010.02.4	274253
39		2	947.62.010.04.4	288734	947.62.010.04.4	288734		228540	947.52.010.03.4	274254
40		2	947.62.010.05.4	288735	947.62.010.05.4	288735		228539	947.52.010.04.4	274255
41	Grooved ring nut/screw	1	SHRM 10 x 30 DIN 9338.8	320681	947.62.014.01.4	288750	947.02.014.01.4	145382	947.02.014.01.4	145382
42	Spacer	1	947.72.016.01.4	325960	947.62.018.01.4	288751	30x37x3HN 145 102	147998	30x37x3HN 145 102	147998
43	Thrust ring	2	947.62.017.01.4	288748	947.62.017.01.4	288748	947.22.025.03.4	195960	965.01.004.01.4	277109
44	Forward gear Ratio1.5 – 40 teeth	1			947.62.002.03.3	304060				
	Forward gear Ratio 2.0 – 45, 43 teeth	1	947.72.002.02.3	325971	947.62.002.04.3	305607				
	Forward gear Ratio 2.7 – 49 teeth	1	947.72.002.03.3	325976	947.62.002.02.3	287455				
	Forward gear Ratio 1.6 – 42 teeth	1					947.42.002.04.3	304090		
	Forward gear Ratio 1.9 – 45 teeth	1					947.42.002.06.3	325813		
	Forward gear Ratio 2.6 – 50 teeth	1					947.42.002.05.3	313959		
	Forward gear Ratio 1.5 – 43 teeth	1							947.52.002.03.3	304083
	Forward gear Ratio 2.1 – 48 teeth	1							947.52.002.01.3	274243
	Forward gear Ratio 2.7 – 52 teeth	1							947.52.003.02.3	288971
45	Needle cage	2	K30x34x13	220678	K32x36x15	280132	37x42x17	201187	K37x42x17	201187
46		2	947.72.020.01.4	326060	947.62.021.01.4	288759	947.42.008.02.4	251524	947.42.008.02.4	251524
47		2	947.72.019.01.4	326026	947.62.015.01.4	288756	947.42.015.01.4	250992	947.52.015.01.4	274242
48		4	947.72.007.02.3	325958	947.62.016.02.3	305537	947.42.016.02.3	326480	947.52.016.02.3	305536
49	Thrust ring/end disc	2	947.72.015.01.4	325959	947.62.008.01.4	288755	947.22.008.03.4	304155	947.52.008.01.4	274271
50	Circlip	2	SP 44 DIN 5417	320677	SB 46	280131	SW 55	199808	J60 x 2 V	277055
51	Internal clutch disc	8			947.62.019.01.04	288757	947.42.017.01.4	288912		
		4/10	947.62.019.01.4	288757					947.52.007.01.4	288889

Item No	Part name		Number per gearbox	HBW 50		HBW 100		HBW 150		HBW 220	
				Part No	Id No	Part No	Id No	Part No	Id No	Part No	Id No
52	HBW 100/HBW 150		6								
	External clutch			947.62.020.01.4	288758	947.62.020.01.4	288758	947.22.024.01.4	187872	947.32.024.01.4	206026
	HBW 220/HBW 50		8/4								
53	Shim 0.4 mm		2	947.62.022.01.4	288760	947.62.022.01.4	288760	947.22.033.01.4	195714	947.22.033.01.4	195714
54	Shim 0.5 mm		2	947.62.022.02.4	288761	947.62.022.02.4	288761	947.22.033.02.4	196715	947.22.033.02.4	195715
55	Shim 0.6 mm		2	947.62.022.03.4	288762	947.62.022.03.4	288762	947.22.033.03.4	195716	947.22.033.03.4	195716
56	Shim 0.7 mm		2	947.62.022.04.4	288763	947.62.022.04.4	288763	947.22.033.04.4	195717	947.22.033.04.4	195717
57	Disc carrier		2	947.72.017.01.2	325967	947.62.013.01.2	288713	965.11.013.01.2	288160	947.52.013.01.2	274245
58	Ball		6	7.5 mm III DIN 5401	280133	7.5 mm III DIN 5401	280133	8 mm III DIN 5401	106700	9 mm III DIN 5401	106732
59	Guide sleeve		1	947.72.018.01.2	325968	947.62.011.01.2	288717	947.42.011.02.2	288394	947.52.011.01.2	274247
60	Actuating sleeve		1	947.72.021.01.2	326063	947.62.012.01.2	288715	947.42.012.02.2	206817	947.52.012.01.2	274244
61	Compression spring (actuating members)		3	947.62.023.02.4	287525	947.62.023.02.4	287525	947.22.012.02.4	287401	947.22.012.02.4	287401
62	Detent pin		3	947.62.024.01.4	288766	947.62.024.01.4	288766	947.22.011.02.4	187840	947.22.011.02.4	187840
63	Driving pin			947.62.025.01.4	288767	947.62.025.01.4	288767	947.22.029.01.4	195271	947.22.029.01.4	195271
64	Spring			947.42.014.02.4	206798	947.42.014.02.4	206798	947.42.014.02.4	206798	947.42.014.02.4	206798
65	Reverse gear	Ratio 1.9 – 41 teeth		947.72.003.03.3	325966		288084				
		Ratio 2.0 – 43 teeth						947.42.003.02.3	254718		
		Ratio 2.1 – 44 teeth								947.52.003.01.3	274240
		Ratio 2.7 – 49 teeth	1							947.52.002.02.3	288969
66	Output shaft/bevel pinion shaft		1	947.72.005.02.3	325957	947.62.005.01.3	288749	947.42.005.02.3	254706	947.52.005.01.2	274239
67	Key	HBW 50/HBW 100	2			B8x7x	280130				
		HBW 150	2					947.22.013.02.4	187841		
			4							947.32.018.01.4	206121

Item No	Part name	Number per gearbox	HBW 150 V Part No	Id No
1	Gearbox assembly	1	947.45.701.01.1	326253
2	Bearing shield input output	1 1	947.41.004.01.4	206450
3	Cover	2	947.45.006.01.4	326369
4	Spring washer	40	B8 DIN 137 Cd-plated	159843
5	Hex head screw (cover)	12	M8x16DIN9338.8 Cd-plated	215870
6	Actuating lever	1	947.23.006.01.4	195062
7	Hex head screw (actuating lever)	1	M8x20DIN9338.8 Cd-plated	199807
8	Radial sealing ring	1	SD 20x26x4	106864
9	Cover plate	1	947.41.003.01.3	206448
10	Spring dowel pin	1	4x12 DIN 1481	104559
11	Actuating cam assembly	1	947.53.703.01.4	304332
15	Shifting fork assembly	1	947.43.700.01.4	223563
16	Actuating shaft	1	947.53.002.01.4	288673
17	Screw plug	1	M16x1.5DIN9065.8 Cd-plated	215877
18	Sealing ring	2	947.41.016.01.4	326578
19	Oil dipstick/ breather ass'y	1	947.61.701.01.4	288729
20	Oil drain plug	1	947.41.008.01.4	228566
21	Hex head screw	14	M8x90 DIN 9318.8	215869
22	Hex nut	11	M8DIN9345 Cd-plated	103876
23	O-ring or plug	1	A22DIN443 Cd-plated	322382
24	Intermediate gear shaft	1	947.42.006.01.4	206470
25	Retaining plate	2	947.52.009.01.4	288702
26	Intermediate gear	1	947.42.004.02.4	254730
27	Cage	1	DKK 20x30x24	215878
28	Seal	2	947.41.010.01.4	254715
29	Seal (cover plate)	1	947.41.011.01.4	254716
30	Radial sealing ring, input	1	B30x52x7 DIN 3760	215875
31	Radial sealing ring, output	1	B65x90x10DIN3760	199799
32	Taper roller bearing, input	2	ASRG K-LM 67010	215874
33	Taper roller bearing, input	2	INTL K-LM 67048	215873
34	Taper roller bearing, output	2	ASRG M 84510	311189
35	Taper roller bearing, output	2	INTL M 84548	

Item No	Part name		Number per gearbox	HBW 150 V	
				Part No	Id No
36	Input shaft	1.5 R – 27/22 teeth	1	947.42.001.03.3	304 088
		2 R – 24/22 teeth	1	947.42.001.05.3	325 811
		2.5 R – 19/22 teeth	1	947.42.001.04.3	313 952
37	Shim		2	947.42.010.01.4	206 474
38	Shim		2	947.42.010.03.4	206 476
39	Shim		2	947.42.010.06.4	228 540
40	Shim		2	947.42.010.05.4	228 539
41	Grooved ring nut/screw		1	SHRM 12x40 DIN 93310.9	320 201
42	Spacer		1	947.45.001.01.4	326 257
43	Thrust ring		2	947.22.025.03.4	195 960
44	Forward gear	Ratio 1.6 – 42 teeth	1	947.42.002.04.3	304 090
		Ratio 1.9 – 45 teeth	1	947.42.002.06.3	325 813
		Ratio 2.6 – 50 teeth	1	947.42.002.05.3	313 959
45	Needle cage		2	K 37x42x17	201 187
46	Needle bearing inner race		2	947.42.008.02.4	251 524
47	Spacer		2	947.42.015.01.4	250 992
48	Cup spring		4	947.42.016.02.3	326 480
49	Thrust ring/end disc		2	947.22.008.03.4	304 155
50	Circlip		2	SW 55	199 808
51	Internal clutch disc		8	947.42.017.01.4	288 912
52	External clutch disc		6	947.22.024.01.4	187 872

Item No	Part name	Number per gearbox	HBW 150 V	
			Part No	Id No
53	Shim 0.4 mm	2	947.22.033.01.4	195714
		2	947.22.033.02.4	195715
	Shim 0.6 mm	2	947.22.033.03.4	195716
	Shim 0.7 mm	2	947.22.033.04.4	195717
	Disc carrier	2	965.11.013.01.2	288160
	Ball	6	8 mm III DIN 5401	106700
	Guide sleeve	1	947.42.011.02.2	288394
	Actuating sleeve	1	947.42.012.02.2	206817
61	Compression spring (actuating members)	3	947.22.012.02.4	287401
62	Detent pin	3	947.22.011.02.4	187840
63	Driving pin	3	947.22.029.01.4	195271
64	Spring	3	947.42.014.02.4	206798
65	Reverse gear Ratio 2.0 – 43 teeth	1	947.42.003.02.3	254718
66	Output shaft	1	947.45.002.01.2 (1)	326258
67	Key	2	947.22.013.02.4	187841
68	Taper roller bearing	1	INTL M 86649	
69	Taper roller bearing	1	ASRG M 86610	
70	Spacer	2	50x63x0,1 DIN 988	
71	Spacer			
72	Spacer	1		
	Quill shaft	1		
	Shim			
	Shim			277128
	Crown gear – 33 teeth			326260
	Key			105334
	Flange			195411
	Grooved ring nut			195413

(1) only supplied together with pinion shaft – No 947.45.700.01.9 – 326251

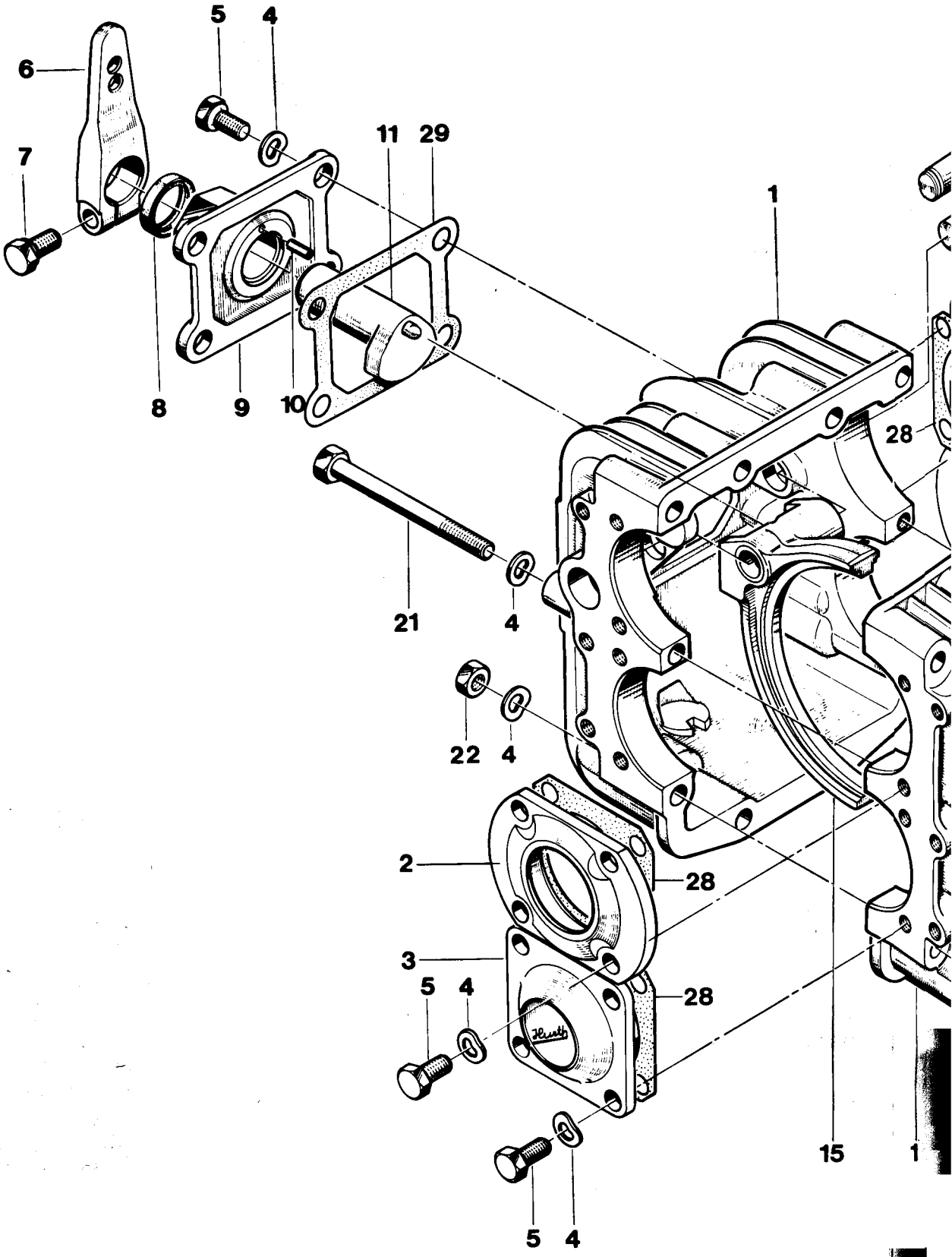
8. Trouble-shooting

In the event of any trouble, first check whether all instructions in this installation and operating manual have been observed.

The table below will, to a limited extent, assist you in finding the cause of mal functions.

To avoid the forfeiture of possible warranty claims it should be remembered that it is not permissible to do any repair or other work on the gearbox during the guarantee period.

Possible troubles and remedies			
Kind of trouble	**Noticeable effect**	**Possible cause**	**Remedy**
Delay of gear engagement	Propeller will start rotating with several seconds delay or only after increase in engine speed		Detach Bowden cable and operate gearbox by hand to find whether malfunction is caused by gearbox or Bowden cable
			If caused by transmission:
		Lever travel 0–A not equal to lever travel 0–B.	Adjust cover plate (9) until lever is exactly in midway position. Travel 0–A = 0–B = 35 mm/30 mm.
		Insufficient clearance between actuating lever and cover plate (9).	Adjust to minimum clearance of 0.5 mm.
			If caused by Bowden cable:
		Bowden cable fails to move lever through required minimum travel 0–A = 0–B = 35 mm/30 mm.	Check total travel of Bowden cable If too short, adjust accordingly.
Transmission fails to move into gear	Excessive effort required to move actuating lever	Insufficient clearance between actuating lever and cover plate (9).	Detach Bowden cable and operate lever by hand. If lever jams, adjust clearance to 0.5 mm.
		Guide sheaves for Bowden cable unsuitably positioned: radii too small.	Check and adjust accordingly.
Boat fails to attain top speed specified.	Increased operating temperature	Use of wrong oil.	Use ATF oil and check oil level.
		Boat operated without cooling unit.	Install cooling unit.
		Transmission operating in upper limit range.	Use suitable HBW transmission unit.
Oil leakage	Oil leakage points visible on transmission unit.	Corrosion effects in area of radial sealing ring and shaft; damaged radial sealing rings.	Check and correct oil level. Remove and dismantle transmission, remachine shafts, replace radial sealing rings.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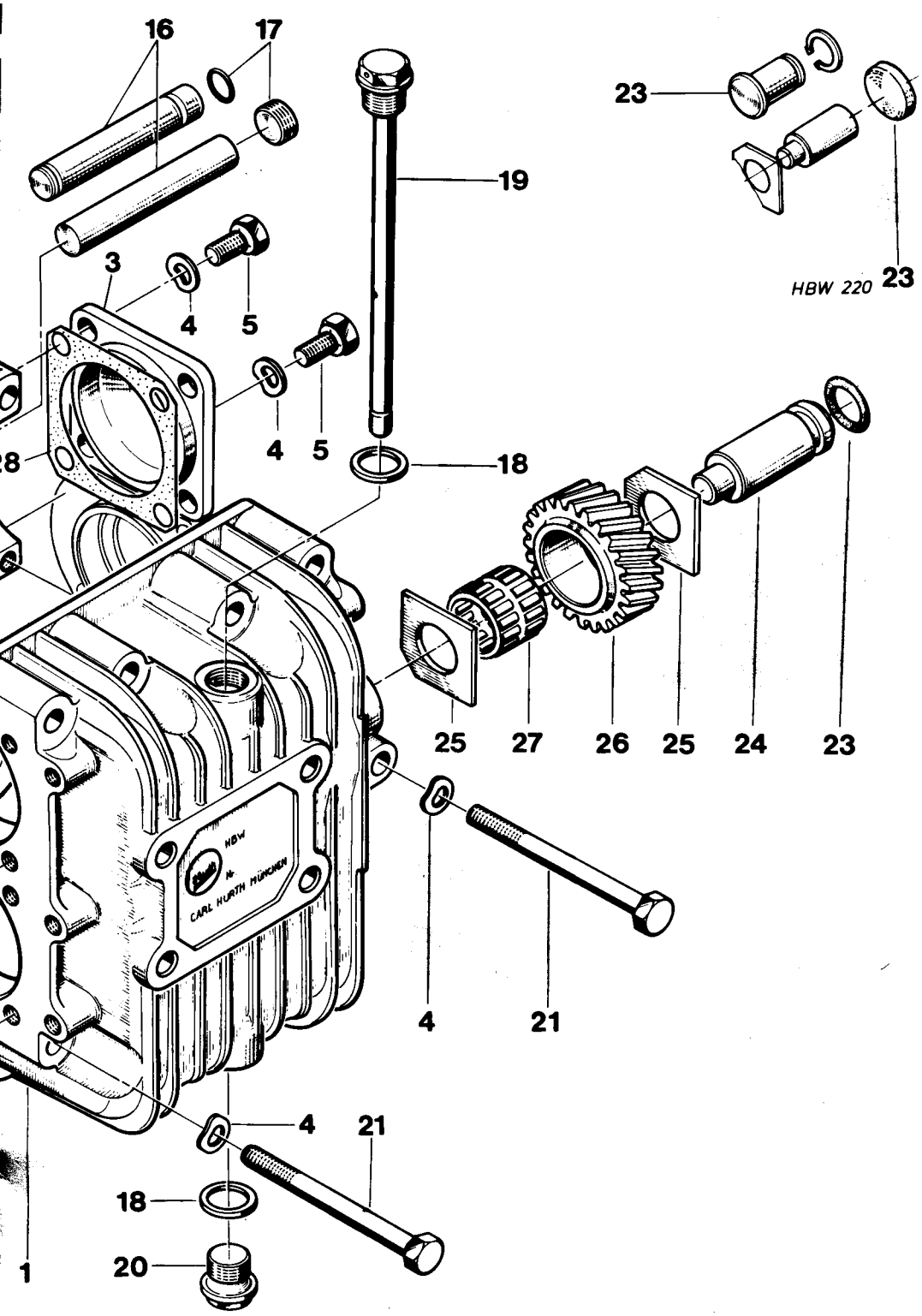
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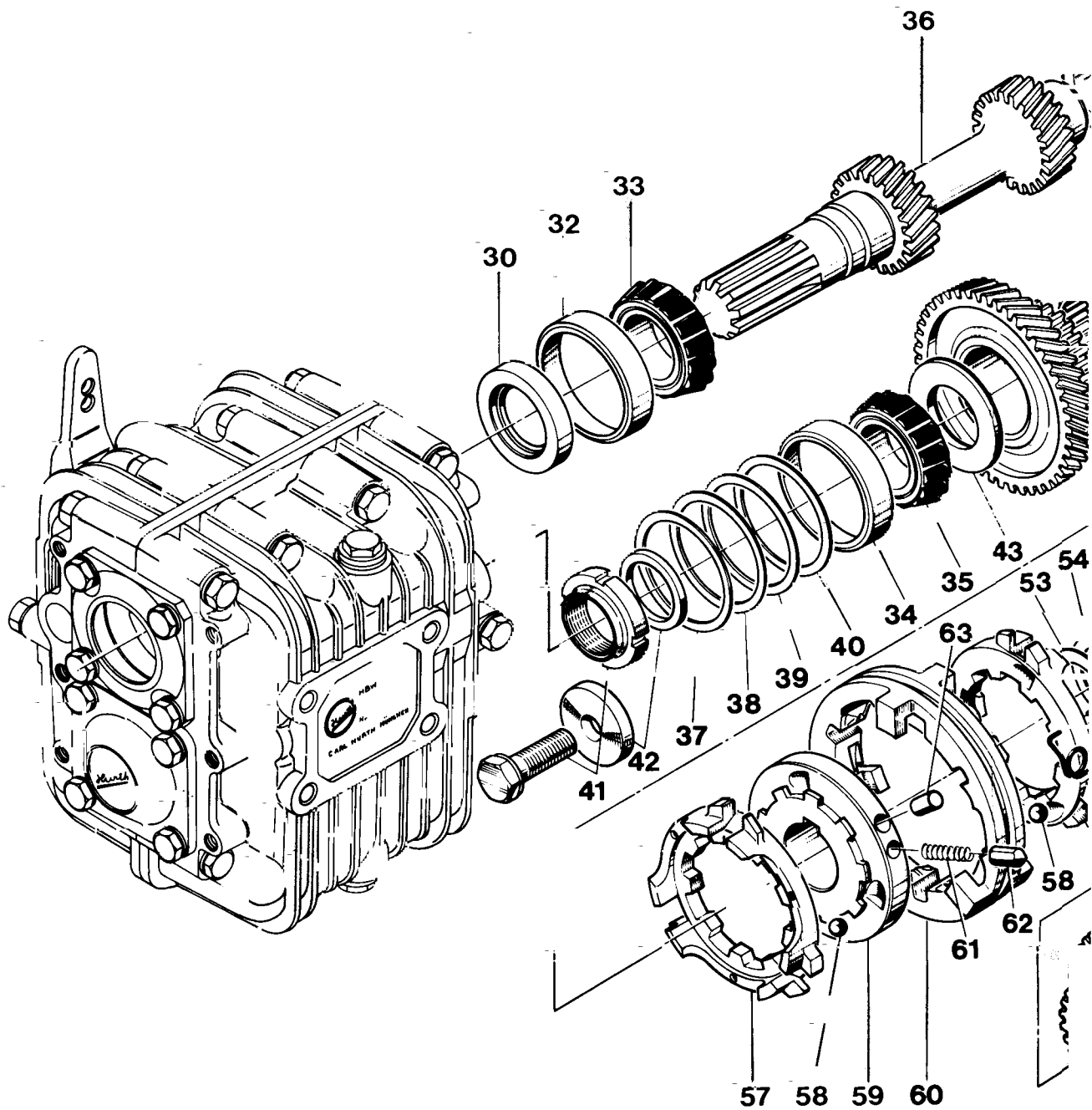
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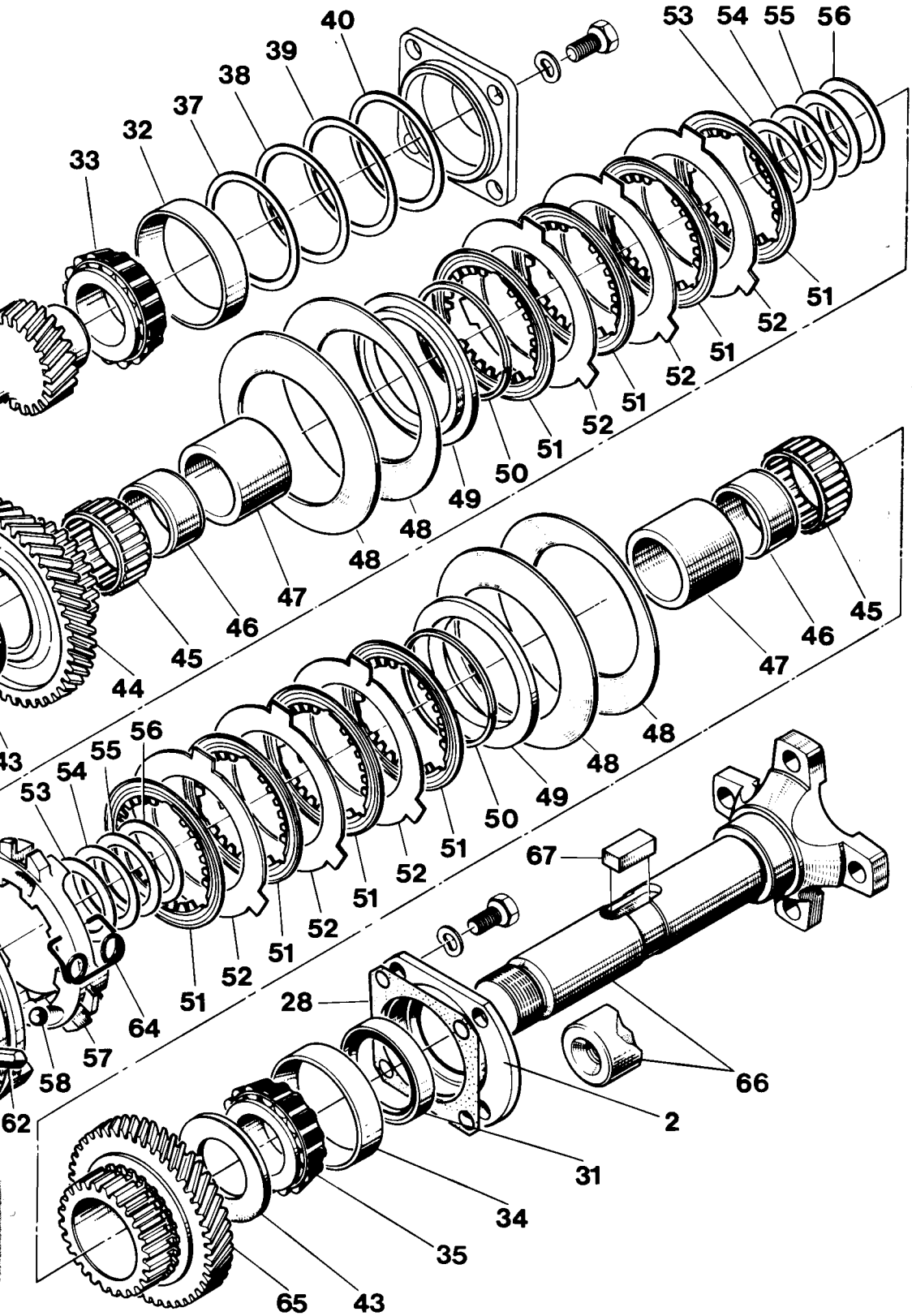
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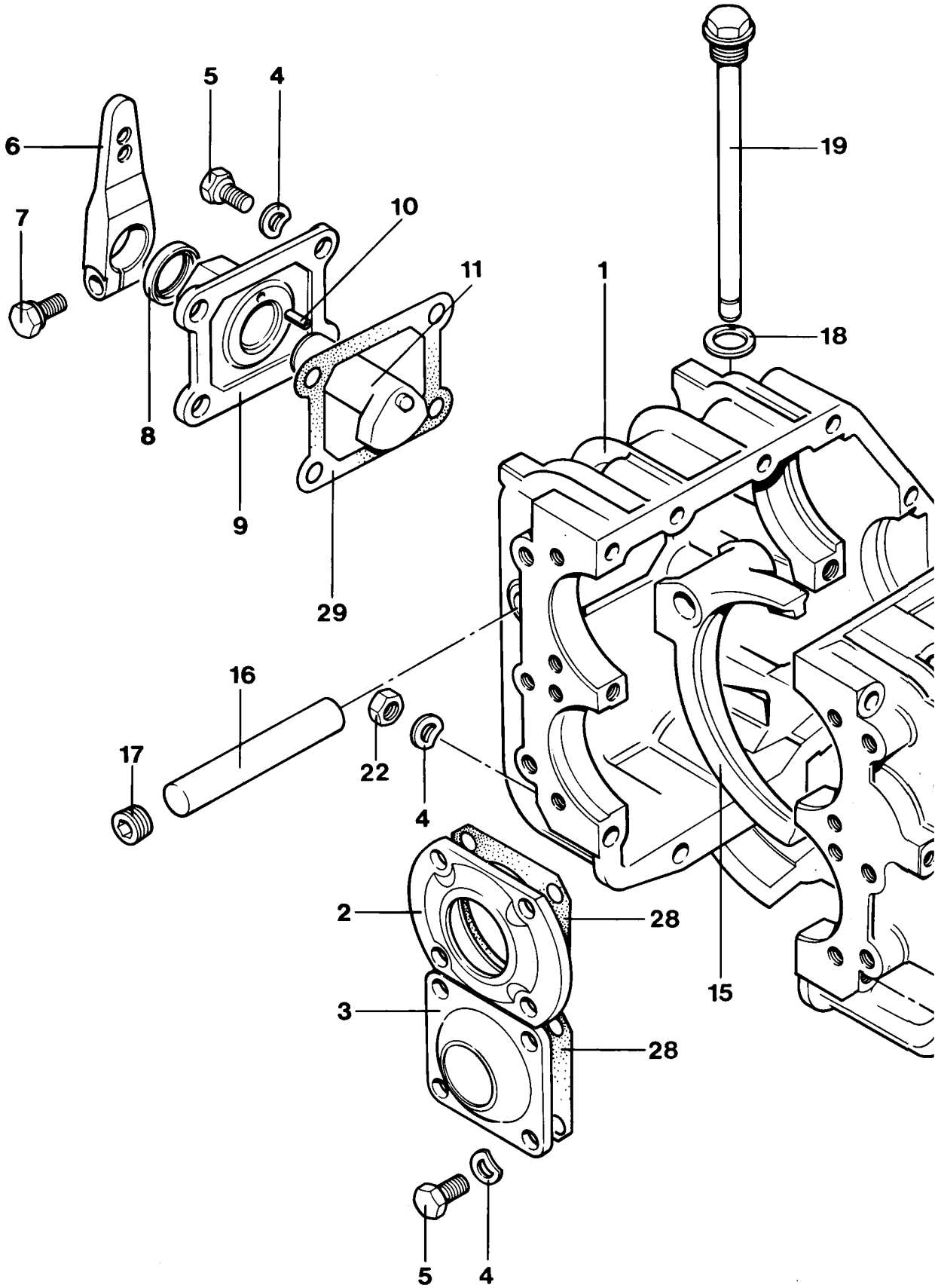
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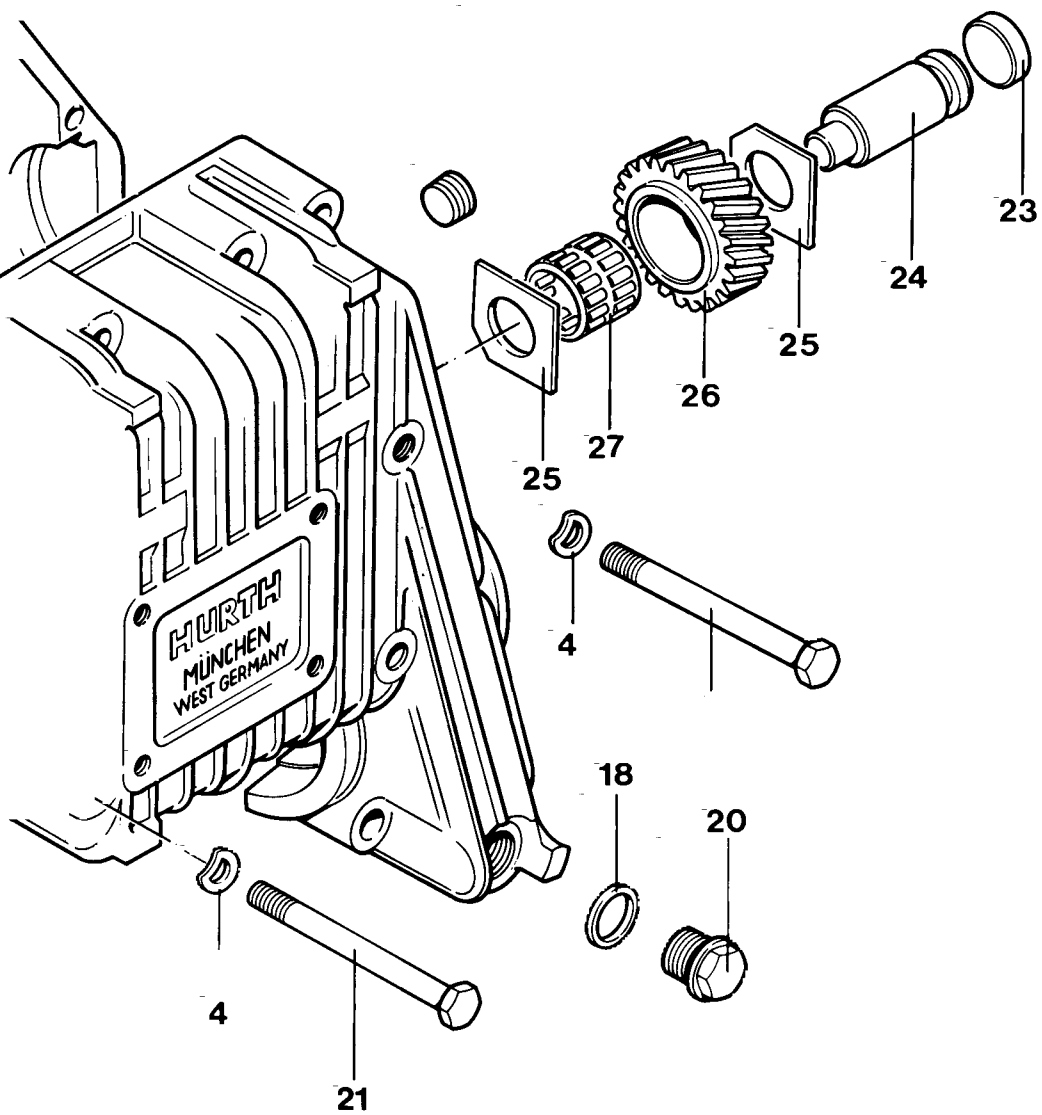

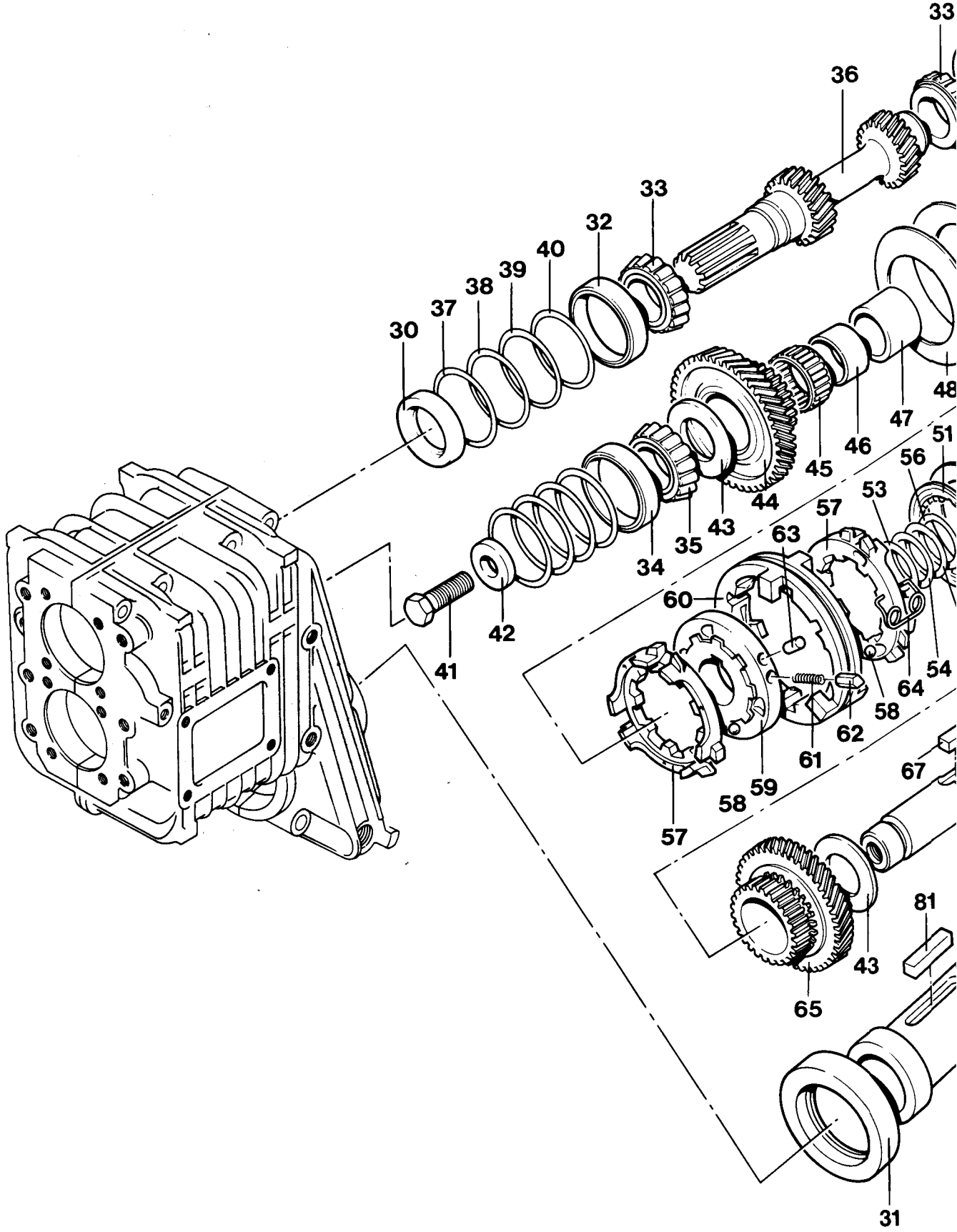
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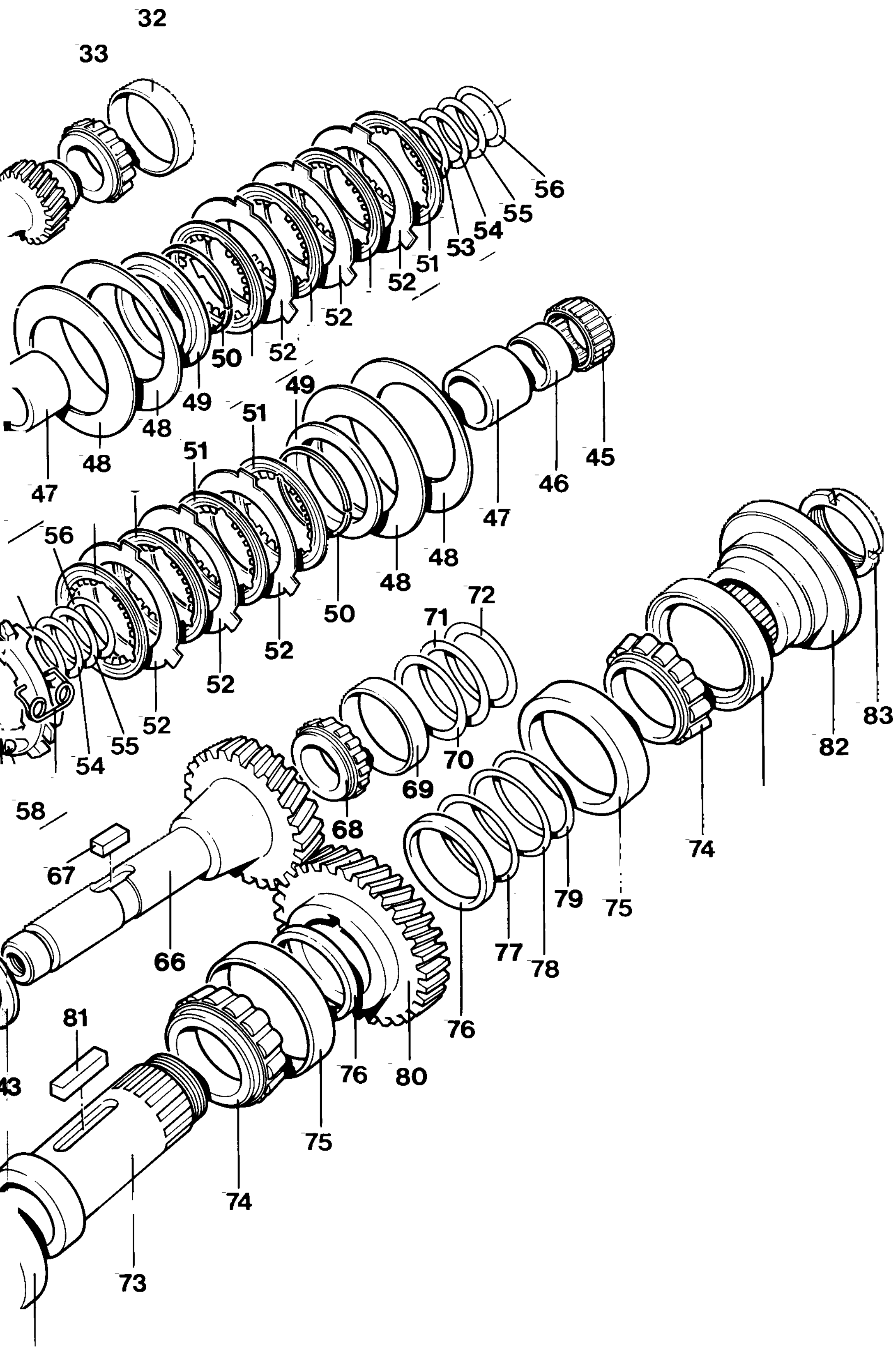

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