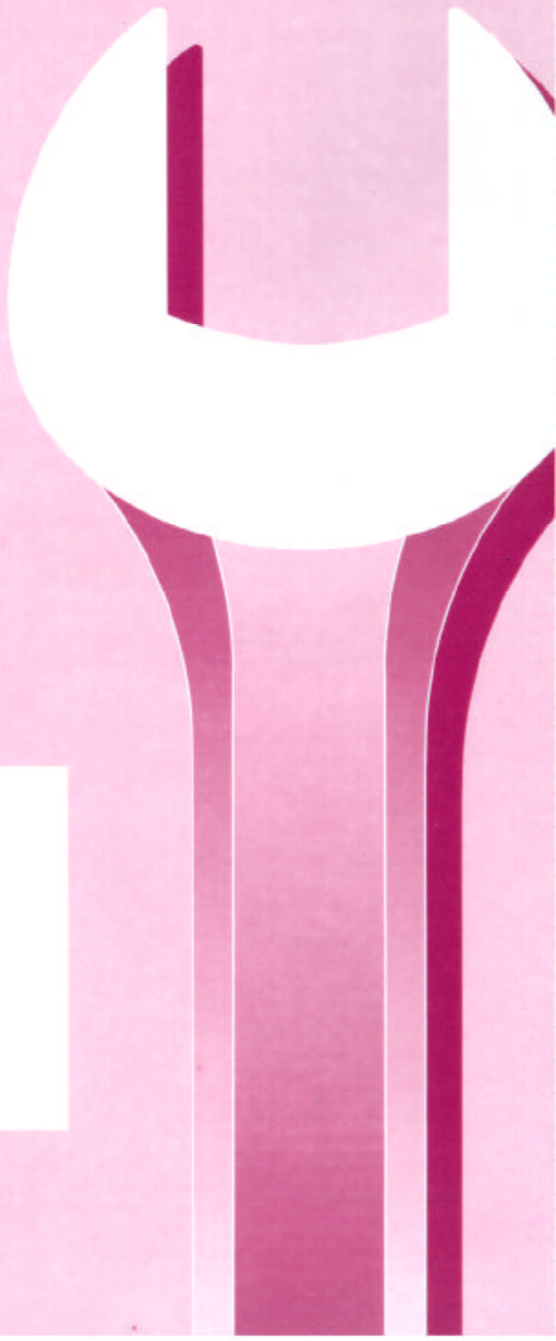
REPARATURANLEITUNG • MANUEL DE REPARATION
MANUAL DE REPARACIONES • MANUALE DI RIPARAZIONI

ZF MARINE

REPAIR MANUAL



HBW 360
HBW 360 A
HBW 450
HBW 630

Document No. 310.01.0001

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 360, HBW 360A, HBW 450 and HBW 630, 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. Brief description

HURTH marine transmissions of the HBW 360 to HBW 630 line are servo-automatically controlled helical gear transmissions developed for use in pleasure craft and commercial 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 predominent features of the HBW gearbox units.

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

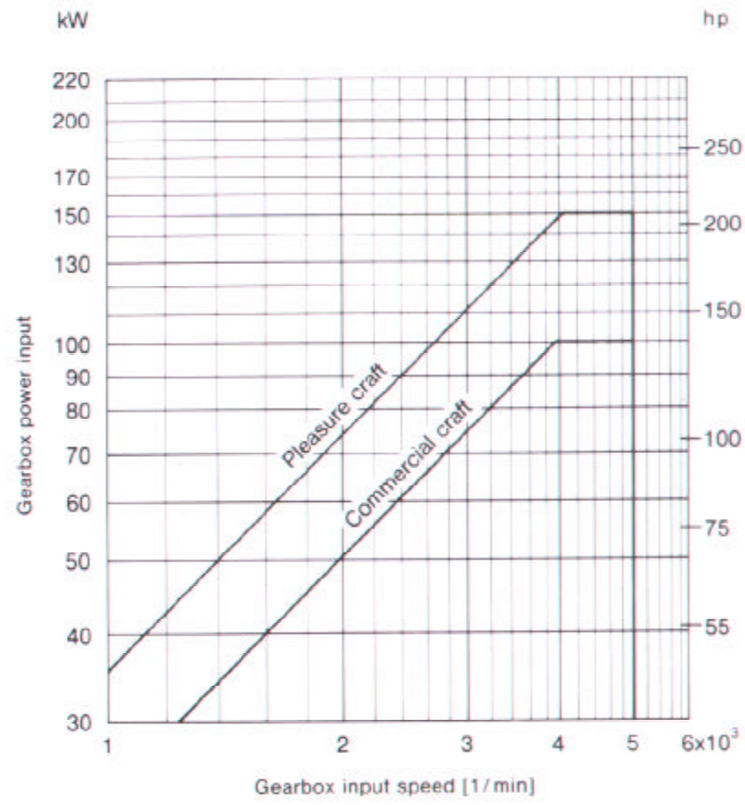
The shafts are supported by heavy-duty tapered roller bearings and the gearbox is designed to take the axial propeller thrust (for permissible values see 'Technical data').

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.

Engine manufacturers should note that the direction of rotation refers to an observer facing the flywheel, so that left-hand rotation of the engine corresponds to right-hand rotation of the gearbox input shaft.

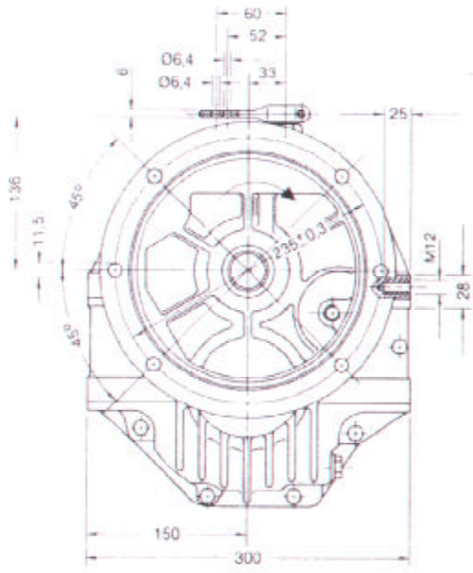
1.1 Technical data and main dimensions
1.1.1 HBW 360

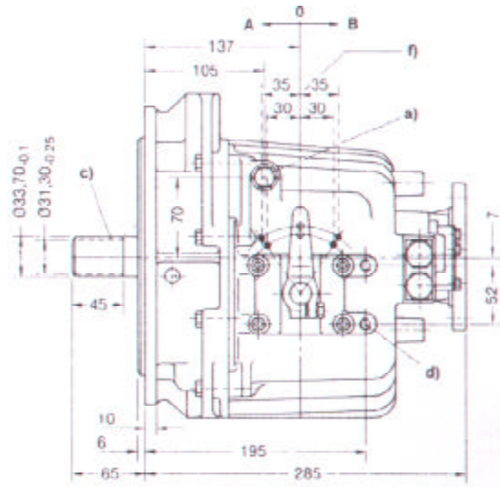
Power diagram

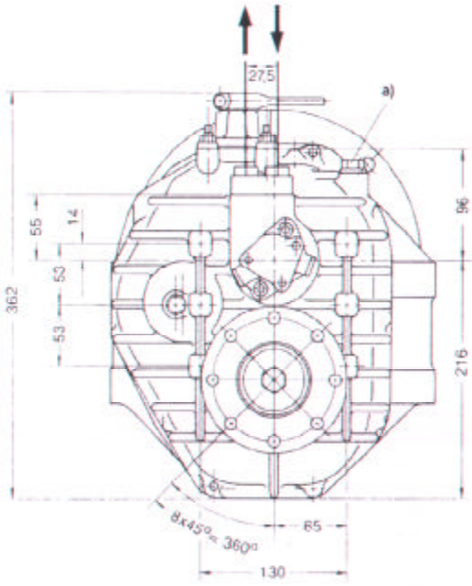


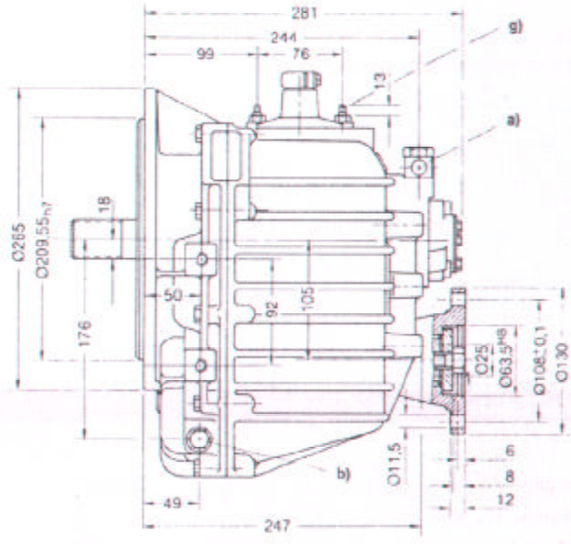
Technical data			HBW 360-1,5	HBW 360-2	HBW 360-3
Forward gear 'A', ratio		i	1.58	2.13	2.95
Reverse gear 'B', ratio		i	1.58	2.10	2.90
Input torque $M_{max.}$	pleasure craft	Nm	350		
	commercial craft	Nm	250		
Power input $P_{max.}$	pleasure craft	kW(hp)	150(204)		
	commercial craft	kW(hp)	100(136)		
Input speed $n_{max.}$		1/min	5000		
Propeller thrust $F_{max.}$		N	9300		
Weight without oil		kg	28		
Oil quantity		l	1.4		
Oil grade			Automatic Transmission Fluid (ATF)		

HBW 360









View of mounting flange, engine side

Marine Transmissions

a) Oil dipstick and filler screw 17 mm
b) Oil drain plug 17 mm width across flats
c) SAE 26 teeth; DP 20/40; 30°; Flat Root, Class t6
d) 2 tapped holes M 8/12 deep for mounting bracket for control cable
e) Adapter omitted if cooler is used, 2 tapped holes 3/8" BSP/14 deep for cooler connection hoses

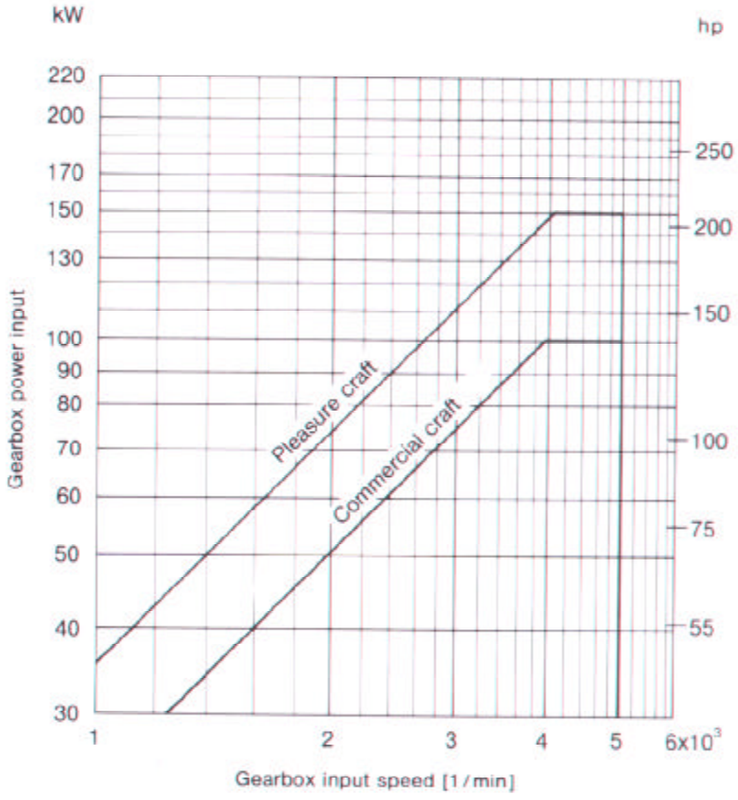
Rotation of output shaft in lever position

f) Minimum lever travel
4 bolt threads M8 for mounting bracket for control cable.

A = Propeller rotating anti engine
B = Propeller rotating as engine

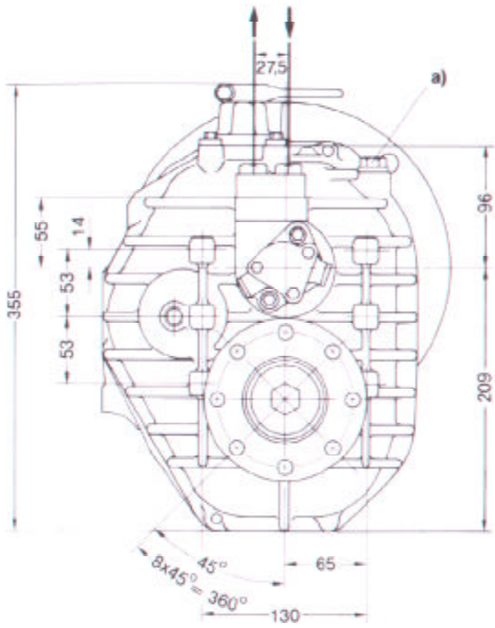
1.1 Technical data and main dimensions
1.1.2 HBW 360A

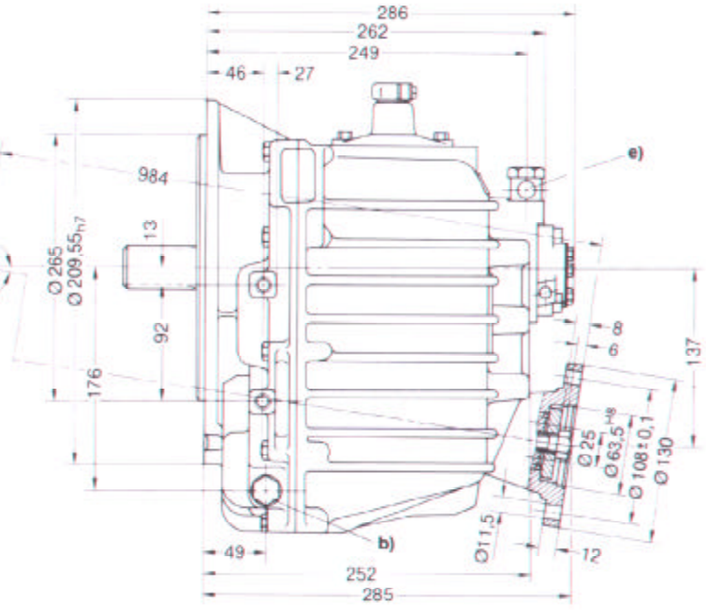
Power diagram



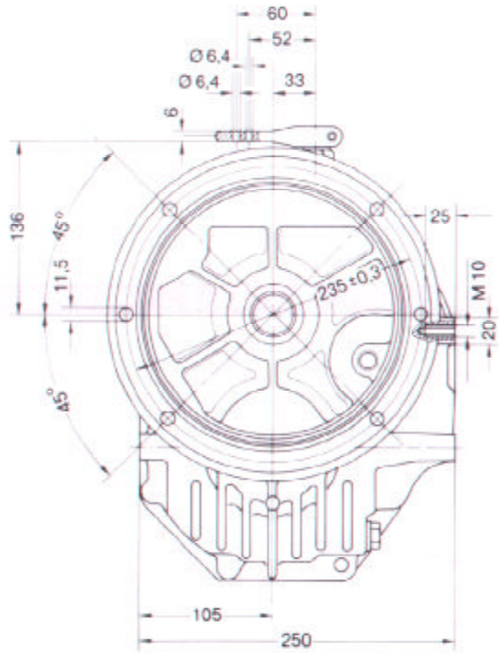
Technical data			HBW 360A–1.5	HBW 360A–2	HBW 360A–3
Forward gear 'A', ratio		i	1.65	2.22	3.05
Reverse gear 'B', ratio		i	1.64	2.19	3.14
Input torque $M_{max.}$	pleasure craft	Nm	350		
	commercial craft	Nm	250		
Power input $P_{max.}$	pleasure craft	kW(hp)	150(204)		
	commercial craft	kW(hp)	100(136)		
Input speed $n_{max.}$		1/min.	5000		
Propeller thrust $F_{max.}$		N	9300		
Weight without oil		kg	30		
Oil quantity		l	1.5		
Oil grade			Automatic Transmission Fluid (ATF)		

HBW 360 A

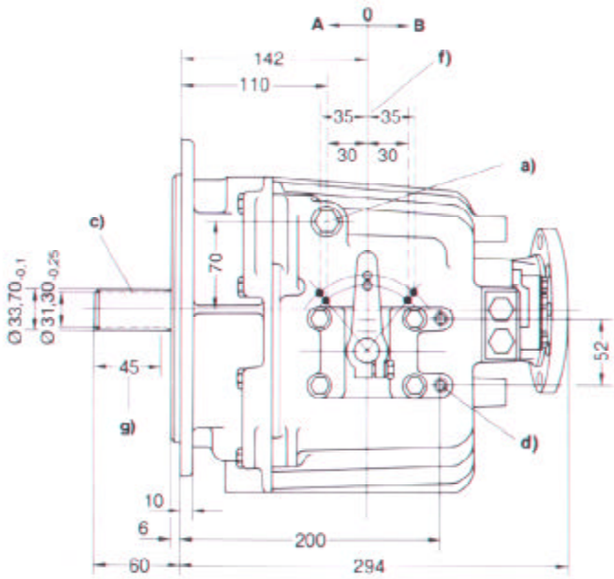




a) Oil dipstick and filler screw 17mm **b)** Oil drain plug 17mm width across flats **c)** SAE 26 teeth • DP 20/40 • 30° • Flat Root • Class t6
d) M 8/12 deep **e)** Adapter omitted if cooler is used, fitting 3/8" BSP / 14 deep oil ↑ to cooler ↓ from cooler **f)** Minimum lever travel
g) full profile



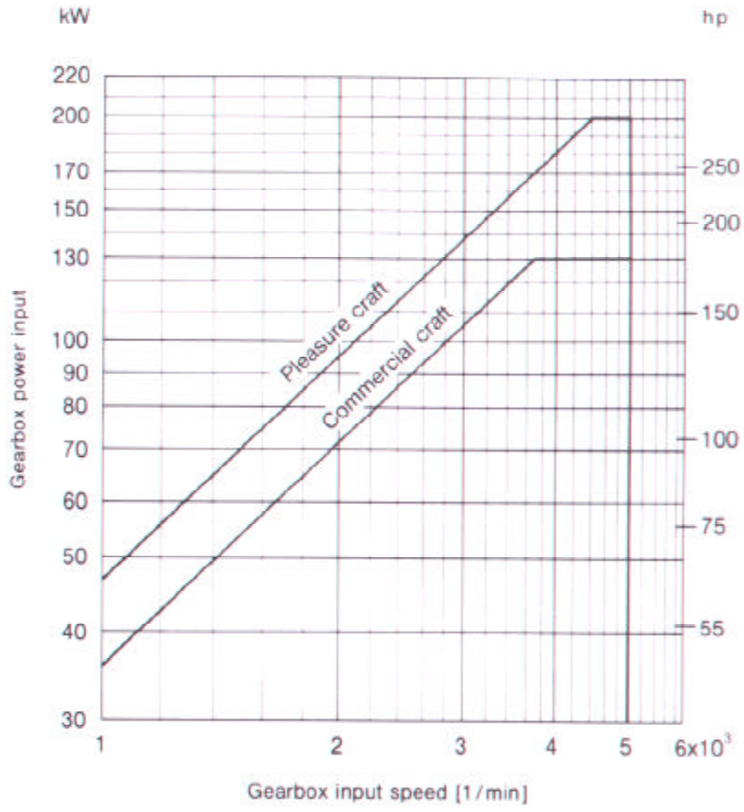
View of mounting flange, engine side



Rotation of output shaft in lever position **A** = opposite direction
B = same direction

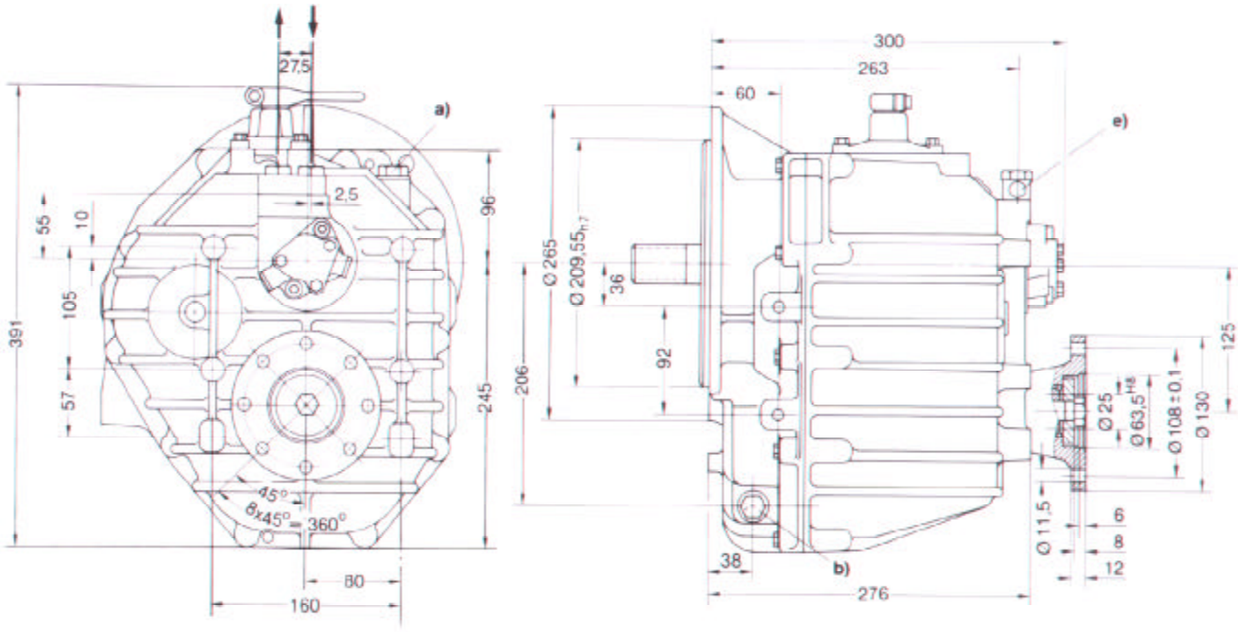
1.1 Technical data and main dimensions
1.1.3 HBW 450

Power diagram

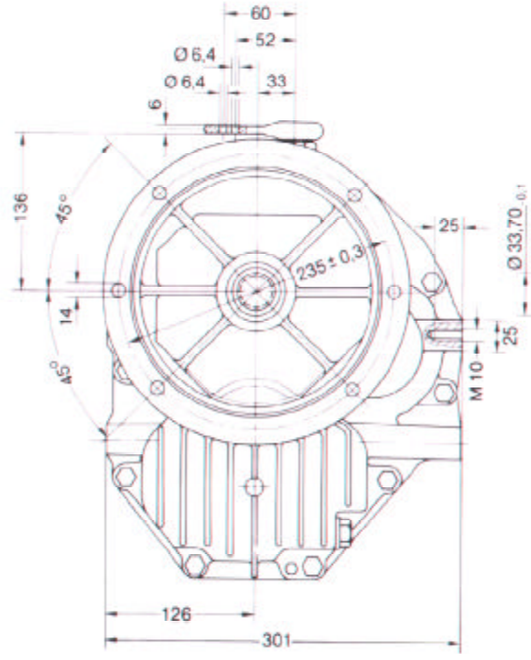


Technical data			HBW 450–1,5	HBW 450–2	HBW 450–3
Forward gear 'A', ratio		i	1.55	2.04	2.95
Reverse gear 'B', ratio		i	1.55	2.06	3.01
Input torque $M_{max.}$	pleasure craft	Nm	440		
	commercial craft	Nm	350		
Power input $P_{max.}$	pleasure craft	kW(hp)	200(272)		
	commercial craft	kW(hp)	132(180)		
Input speed $n_{max.}$		1/min	5000		
Propeller thrust $F_{max.}$		N	13 500		
Weight without oil		kg	36		
Oil quantity		l	1.8		
Oil grade			Automatic Transmission Fluid (ATF)		

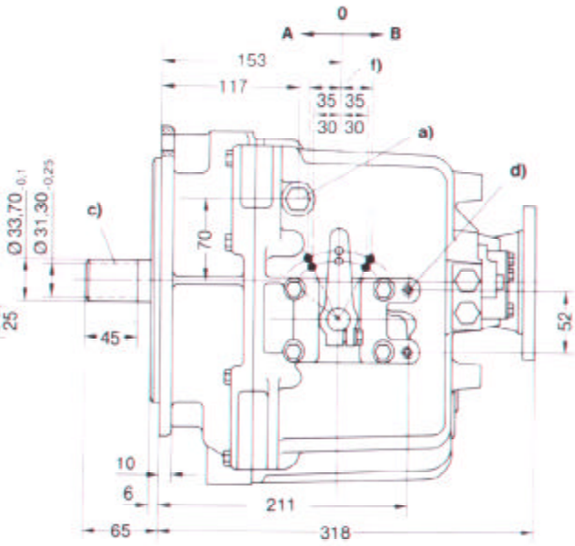
HBW 450



a) Oil dipstick and filler screw 17mm **b)** Oil drain plug 17mm width across flats **c)** SAE 26 teeth • DP 20/40 • 30° • Flat Root • Class 6
d) M 8 / 12 deep **e)** Adapter omitted if cooler is used, fitting 3/8" BSP / 14 deep oil ↑ to cooler ↓ from cooler **f)** Minimum lever travel



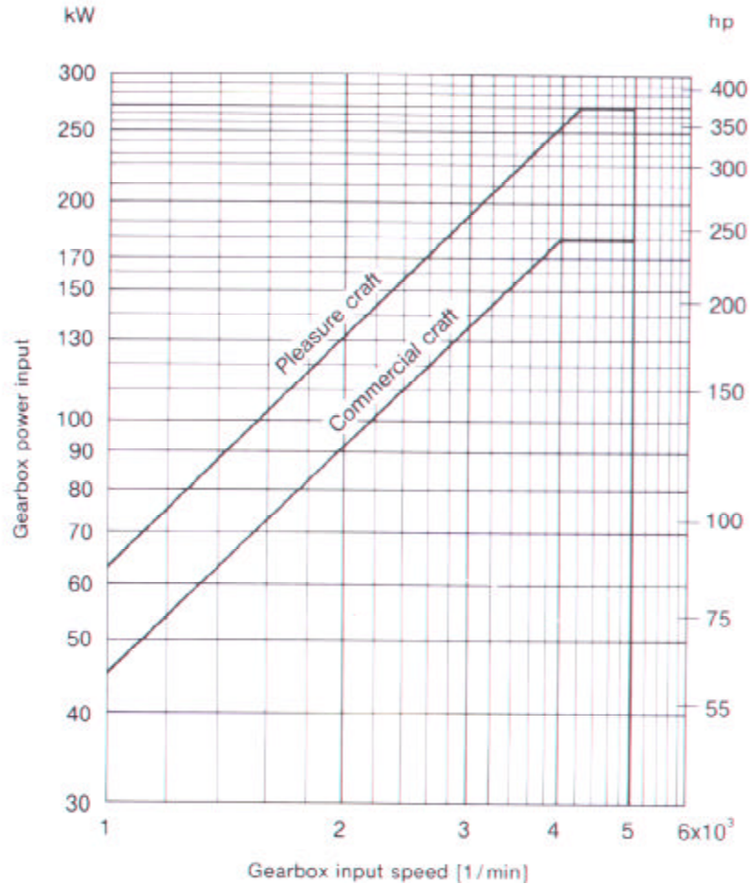
View of mounting flange, engine side



Rotation of output shaft in lever position **A** = opposite direction
B = same direction

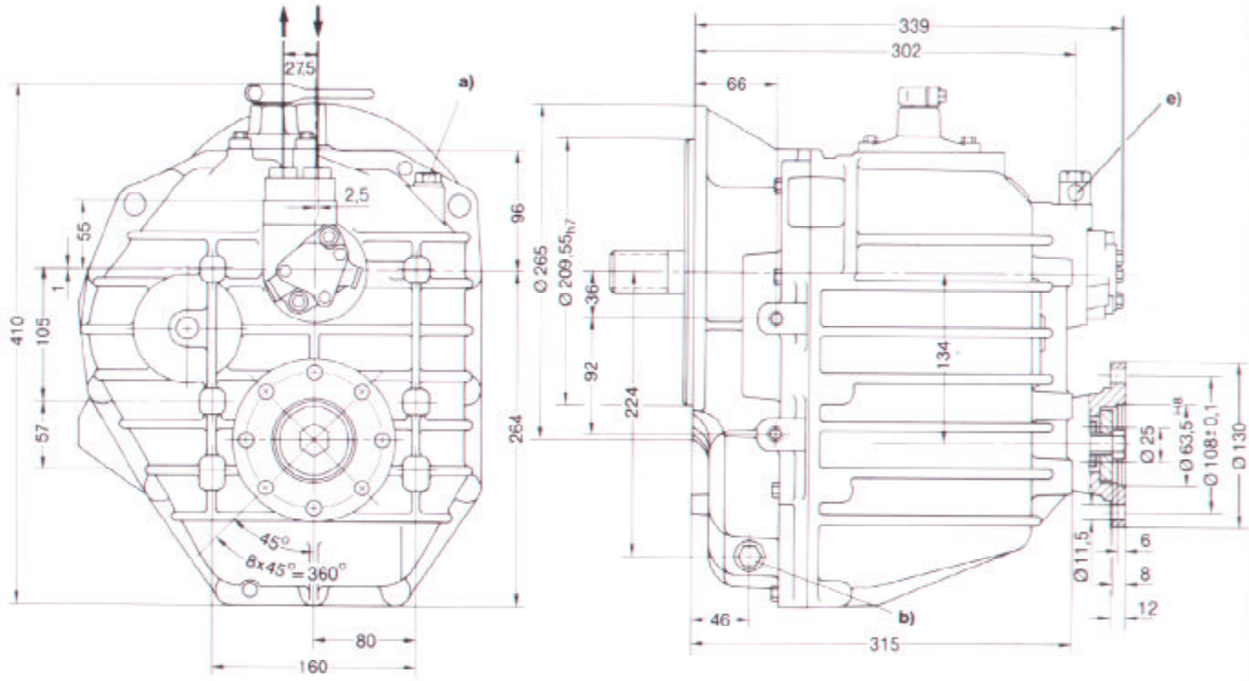
1.1 Technical data and main dimensions
1.1.4 HBW 630

Power diagram

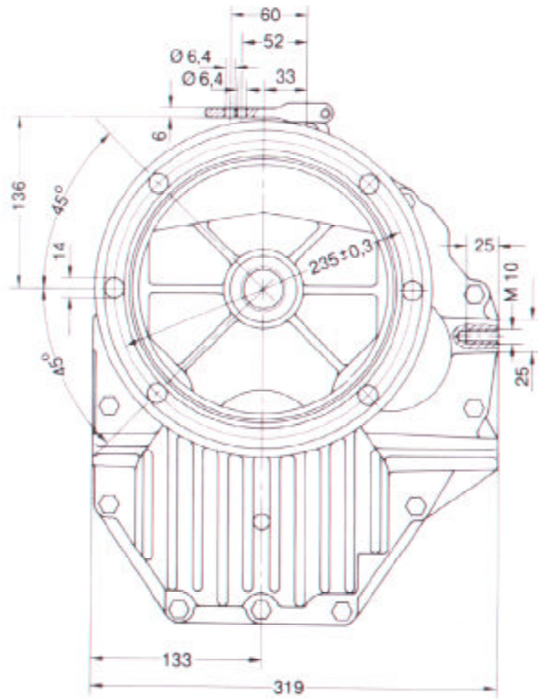


Technical data			HBW 630–1,5	HBW 630–2	HBW 630–3
Forward gear 'A', ratio		i	1.58	2.04	3.05
Reverse gear 'B', ratio		i	1.58	2.05	3.11
Input torque $M_{max.}$	pleasure craft	Nm	630		
	commercial craft	Nm	440		
Power input $P_{max.}$	pleasure craft	kW(hp)	280(380)		
	commercial craft	kW(hp)	177(240)		
Input speed $n_{max.}$		1/min	5000		
Propeller thrust $F_{max.}$		N	17 000		
Weight without oil		kg	46		
Oil quantity		l	2.0		
Oil grade			Automatic Transmission Fluid (ATF)		

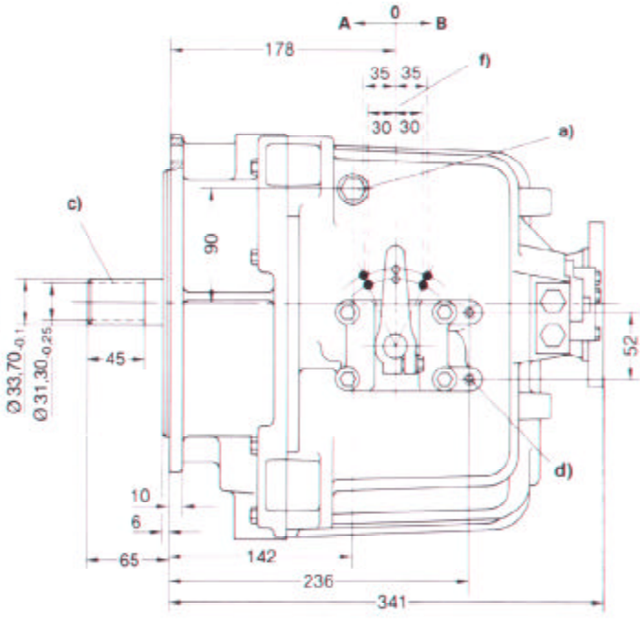
HBW 630



a) Oil dipstick and filler screw 17mm **b)** Oil drain plug 17mm width across flats **c)** SAE 26 teeth · DP 20/40 · 30° · Flat Root · Class t6
d) M 8/12 deep **e)** Adapter omitted if cooler is used, fitting 3/8" BSP / 14 deep oil ↑ to cooler ↓ from cooler **f)** Minimum lever travel



View of mounting flange, engine side



Rotation of output shaft in lever position **A** = opposite direction
B = same direction

2. Installation

2.1 Delivery conditions

HURTH HBW marine transmissions 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, perpenticular to the input shaft. Changes of lever positions are possible.

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 anti-corrosive agent for shipment and storage. The casting 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 one 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 anti-corrosive agent, but never emery cloth or paper, since otherwise the sealing elements might be damaged.

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

2.4 Painting the gearbox

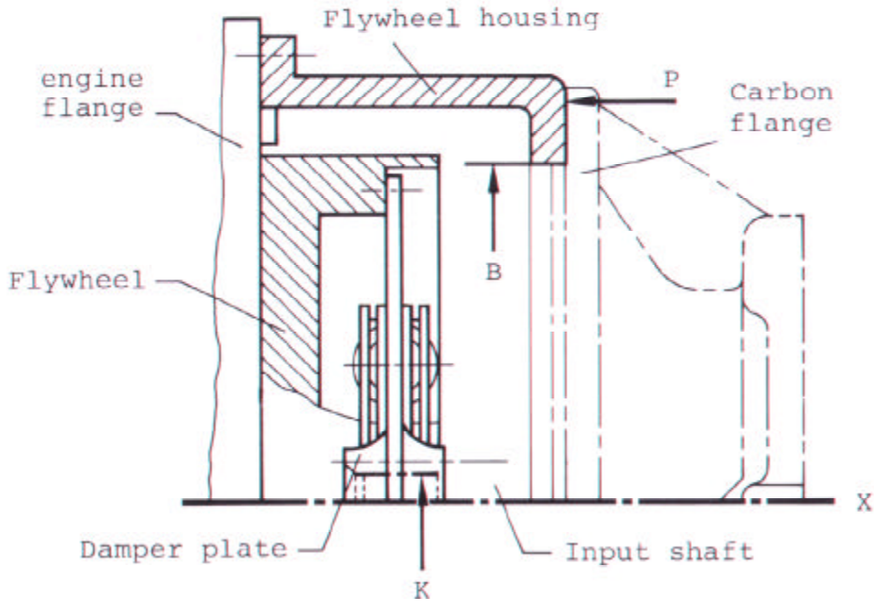
Always cover the running surfaces and sealing lips of the radial sealing rings on both shafts before painting. Make certain that the breather valve is not closed by paint. Indicating plates should remain clearly legible.

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.

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



Permissible radial and axial runout

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

Gearbox size	Involute spline profile of shaft
HBW 360 HBW 360 A HBW 450 HBW 630	SAE 26 teeth DP 20/40 30° Flat Root Class t 6

2.6 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' 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.

Even with the engine solidly mounted the use of flexible coupling reduces stresses in gearbox bearings caused by hull distortions, especially in wooden boats or where the distance between gearbox output flange and sterngland is less than about 800 mm.

2.7 Suspension of engine-gearbox assembly in the boat

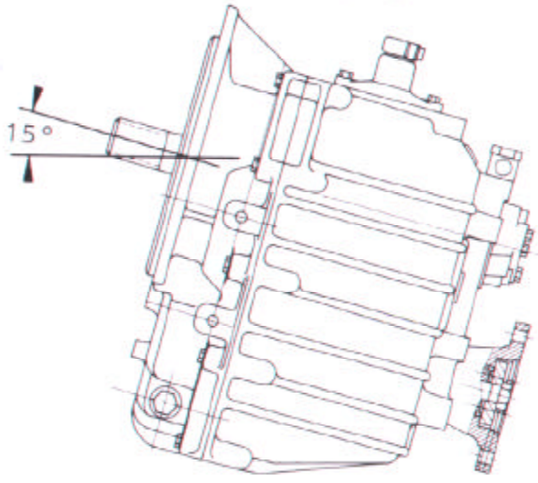
Special care should be taken to protect the gearbox from detrimental stresses and loads if the engine-transmission assembly is not elastically suspended in the boat or craft.

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.

2.8 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 15 degrees (see illustration).

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 cases.



2.9 Operation of gearbox

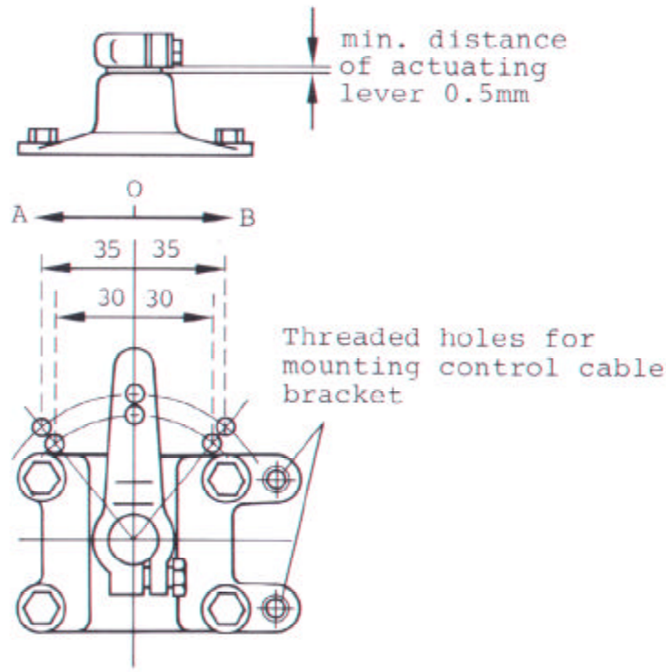
The gearbox is suitable for single lever remote control. Upon loosening the retaining screw, the actuating lever (see illustration) can be moved to any position required for the control elements (cable or rod linkage). Make certain that the lever does not contact the actuating lever cover plate:the minimum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

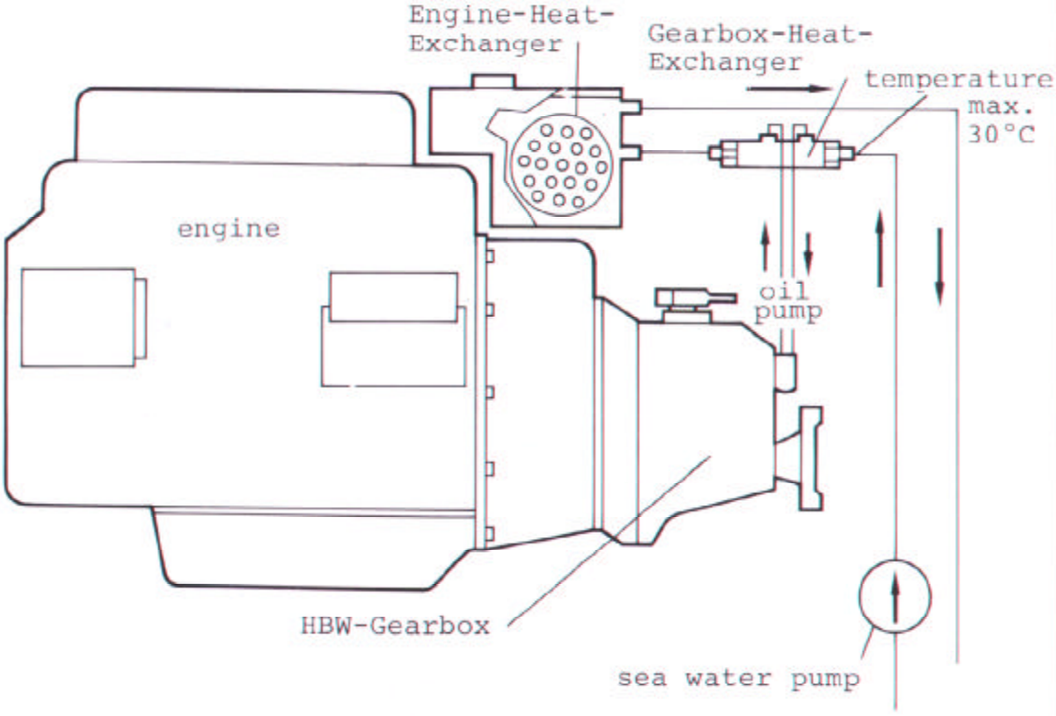
If this cover is removed in exceptional cases, reajustment should only be made by factory authorized personell.

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.

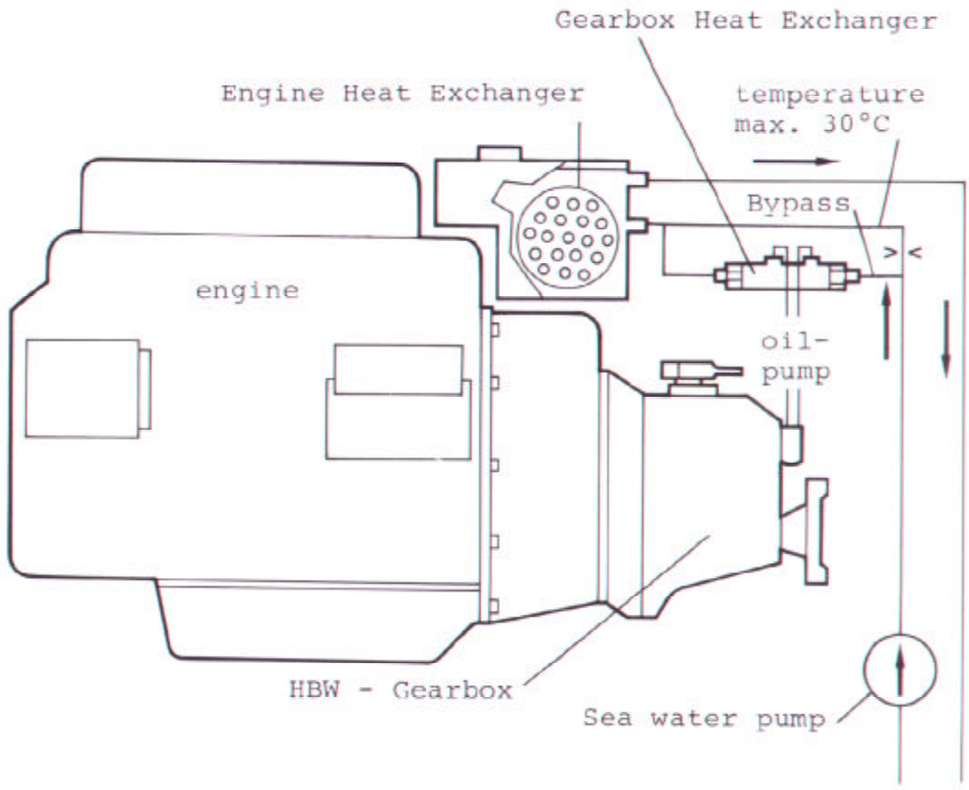
In order to mount support bracket of control cable connection kit use the two threaded holes M8 x 12 deep located next to the shift cover on top of the gear housing, see technical data, main dimensions point d).

2.10 Cooling

Marine Transmission HBW 360 to HBW 630 need additional cooling, if they are continuously operated in lever position "B", or if the power input (kW/hp) is above the limit for continuous operation in position "A". The cooling unit should be connected to the water pressure line (external circuit) of the engine in accordance with the drawing below.



Installation of gearbox heat exchanger in the main line of sea water pump is practical if pump capacity is less or equal heat exchanger capacity.



Installation of gearbox heat exchanger in the bypass line of sea water pump is necessary if pump capacity is higher than heat exchanger capacity.

2.11 Selection of the heat exchanger

The amount of heat in kW; which needs to be absorbed by the heat exchanger, is shown in the following chart:

Gearbox	Application at M max.	RPM and Lever position 2000 A	2000 B	3000 A	3000 B	4000 A	4000 B	5000 A	5000 B
HBW 360	PC 350 Nm	1,4	2,5	1,8	3,1	2,4	3,6	3,2	4,3
	CC 250 Nm	1,1	1,9	1,5	2,5	2,1	3,0	2,9	3,7
HBW 360 A	PC 350 Nm	1,3	2,4	1,7	2,8	2,6	3,5	4,3	4,7
	CC 250 Nm	1,0	1,7	1,4	2,1	2,2	2,8	4,0	4,6
HBW 450	PC 440 Nm	1,7	2,8	2,2	3,2	3,0	3,8	4,2	4,8
	CC 350 Nm	1,3	2,0	1,8	2,4	2,6	3,0	3,8	4,1
HBW 630	PC 630 Nm	2,3	3,9	2,9	4,5	4,2	5,5	5,5	7,0
	CC 440 Nm	1,7	2,7	2,3	3,3	3,6	4,3	4,9	5,8

PC = pleasure craft; CC = commercial craft

2.11.1 The oil pump on the gearbox delivers 2,3 l/min at 1.000 RPM and the quantity increases with the RPM in a linear ratio.

RPM	2000	3000	4000	5000
quantity l/min	4,6	6,9	9,8	11,5

Power input - cooling requirements for continuous operation (engine - kW/HP)

Lever position	HBW 360	HBW 360A	HBW 450	HBW 630
A	55 kW and above	55 kW and above	60 kW and above	65 kW and above
B	use heat exchanger			

suitable heat exchangers for HBW 360 up to HBW 630 e.g. Type DC 60 of Bowman

In border line cases please contact our After Sales Service Department.

2.12 Assembly of the heat exchanger

2.12.1 The heat exchanger should be installed with the oil line connections on the top, in order to prevent oil drainage when the engine stops.

2.12.2 The flow of cooling water and transmission oil in the heat exchanger should lead in opposite directions.

2.12.3 The min. flow quantity of the cooling water should be 20 Liter/min. This figure is valid for the heat exchanger Type DC 60 of Bowman mentioned under para. 2.10.
Those figures may vary when using other heat exchanger makes.

2.12.4 Cooling water entrance temperature should not exceed 30°C.

2.12.5 The oil circuit of the gearbox is closed by a connection piece, which is mounted on the oil outlets on the housing.

This connection piece has to be removed. The oil in- and outlet holes are open. They have to be connected with the heat exchanger. The oil circuit is closed again.

2.12.6 When connecting the heat exchanger it is a must to keep oil clean of impurities.

2.12.7 During storage of the boat (i.e. in winter) it is recommended to drain the cooling circuit for the gearbox. For this purpose disconnect the water hose on the pressure side and clean the opening of the heat exchanger, if necessary.

3. Operation

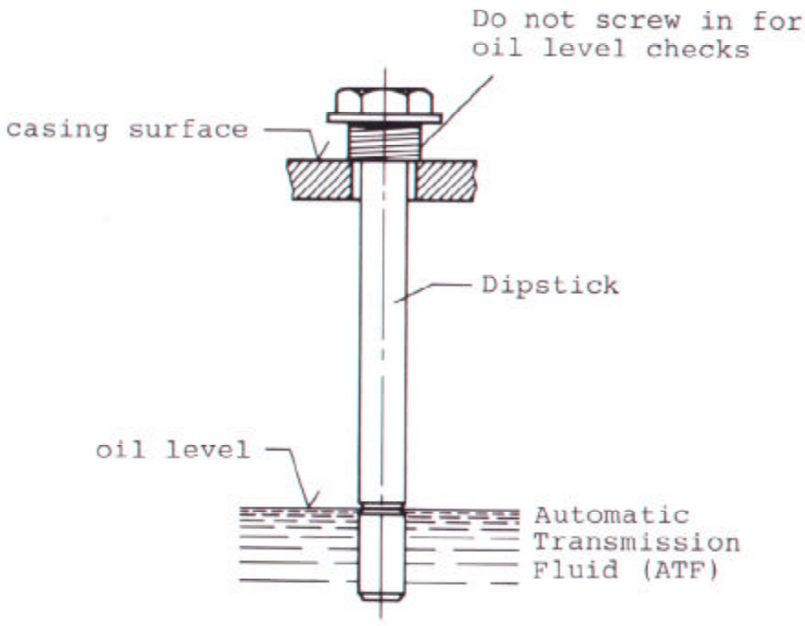
3.1 General informations

All HBW marine transmissions 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 Automatic Transmission Fluid (ATF) as recommended. The oil level should be up to the index mark on the dipstick (see illustration).

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 110°C.

3.4 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 revers are permissible, since the multiple-disc clutch permits gear changing at high rpm, including sudden reversing at top speeds in the event of danger.

3.5 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. Installation of a propeller driven generator is possible.

Important

When the boat is sailing (engine stopped), the gear lever must be in zero position. The propeller is at idle.

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. Never put the gear lever in the position corresponding to the direction of travel of the boat.

3.6 Lay-up periods

If the transmission is not used for periods of more than one 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.

4. Maintenance

4.1 Transmission oil

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

4.2 Oil quantity

HBW 360 - 1,5 ltr (plus quantity of cooling device)
HBW 360 A - 1,4 ltr (plus quantity of cooling device)
HBW 450 - 2,0 ltr (plus quantity of cooling device)
HBW 630 - 2,5 ltr (plus quantity of cooling device)

When filling gearbox with oil, proceed as follows:

- fill oil quantity of above liter
- run engine until pipes and cooling device is filled with oil
- refill oil quantity up to the index mark on the dipstick.

4.3 Oil level checks

Change the oil for the first time after about 25 hours of operation, then at intervals of 1000 hours of operation or at least one year.

4.4 Oil change

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

Attention:

When changing oil, also drain cooling device, clean it if necessary.

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.

5. Disassembly

5.1 Removing output-flange

Remove hex head screws (14) M 12 x 40 and disc (28), take off flange (4) with pulling device.

5.2 Removing of actuating lever cover plate and disassembly

5.2.1 Always set actuating lever in neutral position.

5.2.2 Remove hex head screws (9) from cover (5), using 13 mm spanner wrench and take off spring washers (10).

5.2.3 Remove cover plate assembly (5) with seal (12) lever (6) and actuating cam (65).

5.2.4 Remove screw (72) from lever (6). Pull off lever (6) and actuating cam (65).

5.3 Separating the gearbox sections and removing the input, output and intermediate shafts

5.3.1 Remove hex units (11) using 13 mm spanner wrench, take off spring washers and remove screws.

5.3.2 Separate cover (1) from gearbox housing (2) by light hammer blows on cover.

5.3.3 Lift complete input, output and intermediate shaft out of the gearbox housing.

5.3.4 Remove shims (36 a-d, 38 a-d) from input, output and intermediate shaft and keep them separately. For proper reassembly it is advisable to note down the thickness and location of each of the shims in order to obtain correct bearing play.

If none of the bearings on the input (23), output (35) and intermediate shaft (37) have been changed, the shims can be reused in the same position. It is, however, recommended to check the dimensions of the gear set relative to the casing and reshim accordingly. If bearings have been replaced, shimming has to be measured and suitable shims have to be installed.

5.4 Removing the shifting fork (32)

5.4.1 Pull actuating shaft (30) out of bearing.

5.4.2 Remove shifting fork (32).

5.5 Disassembling the output shaft (35) and intermediate gearshaft (37)

5.5.1 Remove bearing inner races together with gears.

5.5.2 In the event of bearing damage, continuously drive inner races off the input shaft with a punch tool (away from gear).

5.6a Enclosure HBW 360-360A

1. Disassembly of input shaft

Remove shifting fork (item 1).
Figure 1-1

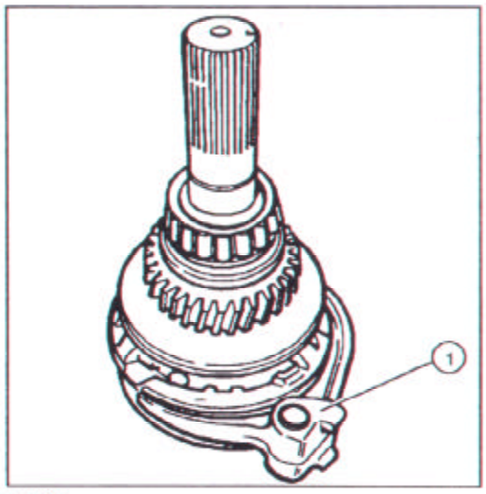


Fig. 1-1

Remove grooved nut (item 1) with socket wrench "A".
Figure 1-2

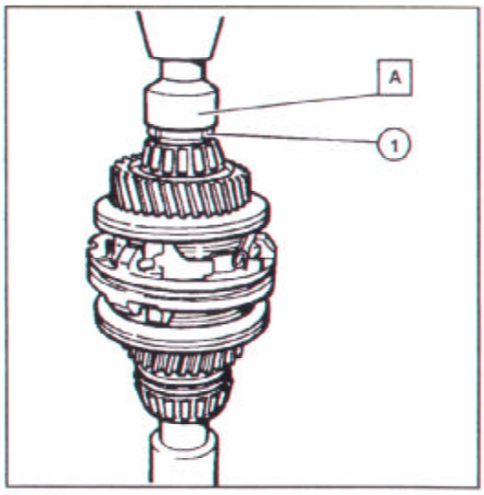


Fig. 1-2

Insert tool "B" (divided ring) beneath the outer disc carrier and press out the input shaft with a suitable pin.

Remove all disassembled parts:

1. Taper roller bearing inner race (item 1)
2. Thrust washer (item 2)
3. Gear (item 3)
4. Needle bearing iner race (item 4)
5. Needle bearing cage, two halfs (item 5)
6. Spacer bush (item 6)
7. Shims (item 7)
8. Friction and steel discs (item 8 and 9)
9. Shifting parts (item 10)

Figure 1-3

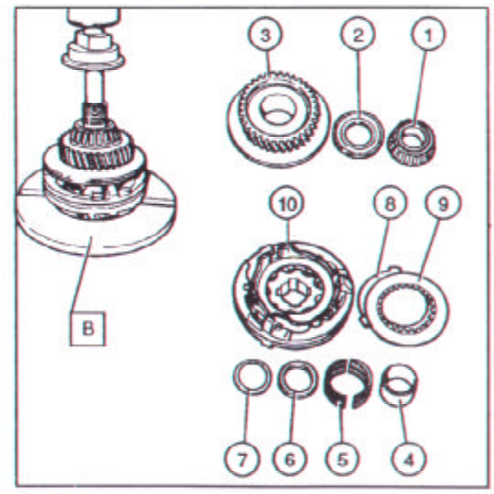


Fig. 1-3

1. Disassembly of input shaft

Remove keys (item 1), shim (item 2), support ring (2 halfs) (item 3) and gear (item 4).

Remove spacer bush (item 5) and needle bearing cage (2 halfs) (item 6).

Figure 1-4

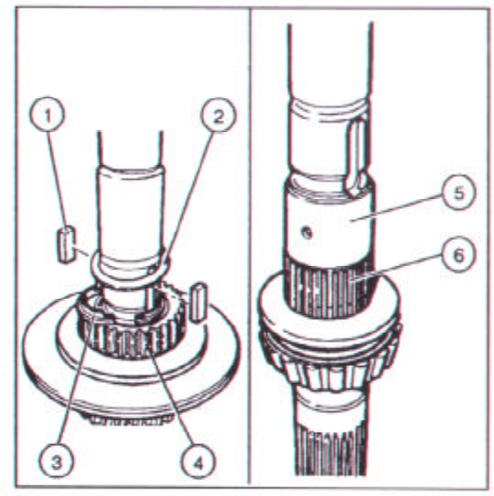


Fig. 1-4

Press off thrust washer (item 1) using tool "C" (divided ring).
Press off taper roller bearing inner race using tool "C".

Figure 1-5

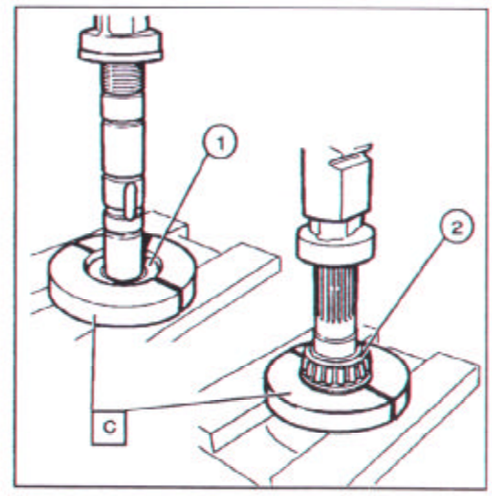


Fig. 1-5

2. Disassembly of shifting parts

Remove springs (item 1) with a screw driver.
Remove outer disc carriers (item 2) and balls (item 3).
Use a cloth to cover guide sleeve (item 4) and actuating sleeve (item 7) in order to avoid the escaping of detent pins (item 5) and springs (item 6).
Push out guide sleeve (item 4) fromactuating sleeve (item 7).

WARNING

Escaping of springs and detent pins can cause injuries!

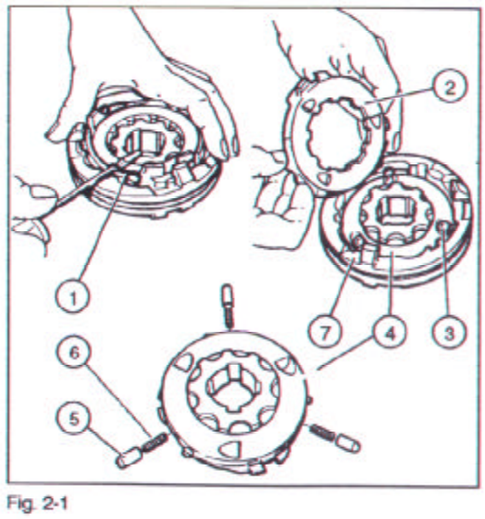


Fig. 2-1

3. Removal of cup springs

Use tool "D" and load cup springs (item 1) untill the ring halfs (item 2) can be removed.
Remove ring halfs (item 2), end disc (item 3) and remove cup springs (item 1).
Figure 3-1

WARNING

Decompress cup springs carefully!

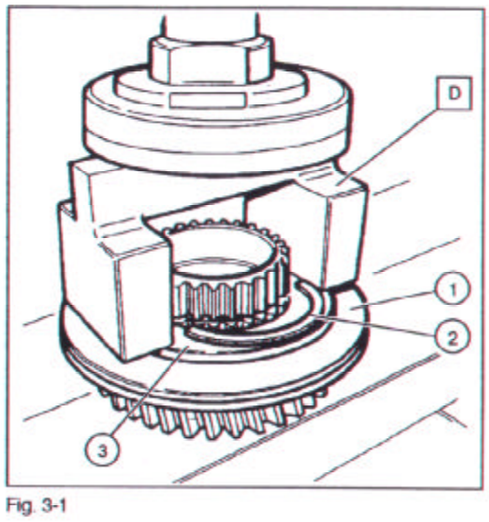
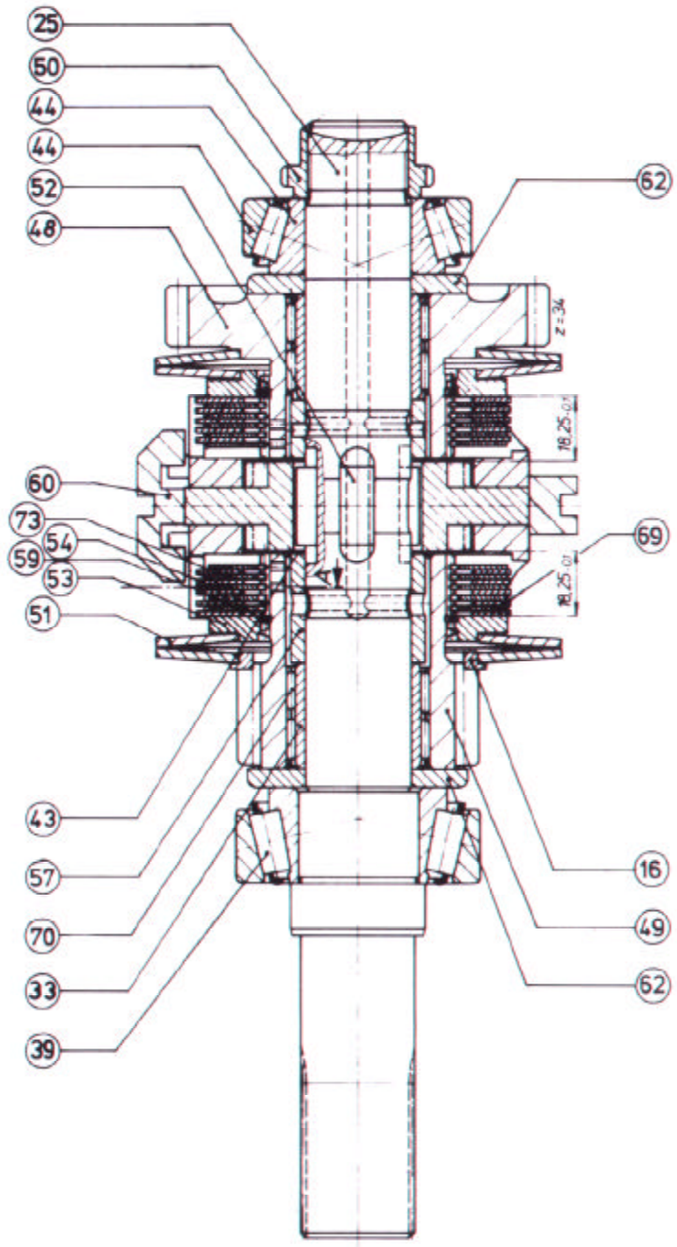


Fig. 3-1

5.6b Disassembling the input shaft (23)

5.6.1 Place input shaft (23) vertically on a vice with the grooved ring nut (50) pointing upwards.

5.6.2 Remove grooved ring nut (50) by means of a special socket spanner and take off outer bearing race (44).



5.6.3 Place face side of gear (49) against divided flange and use pin of suitable size to press off the shaft from threaded end.

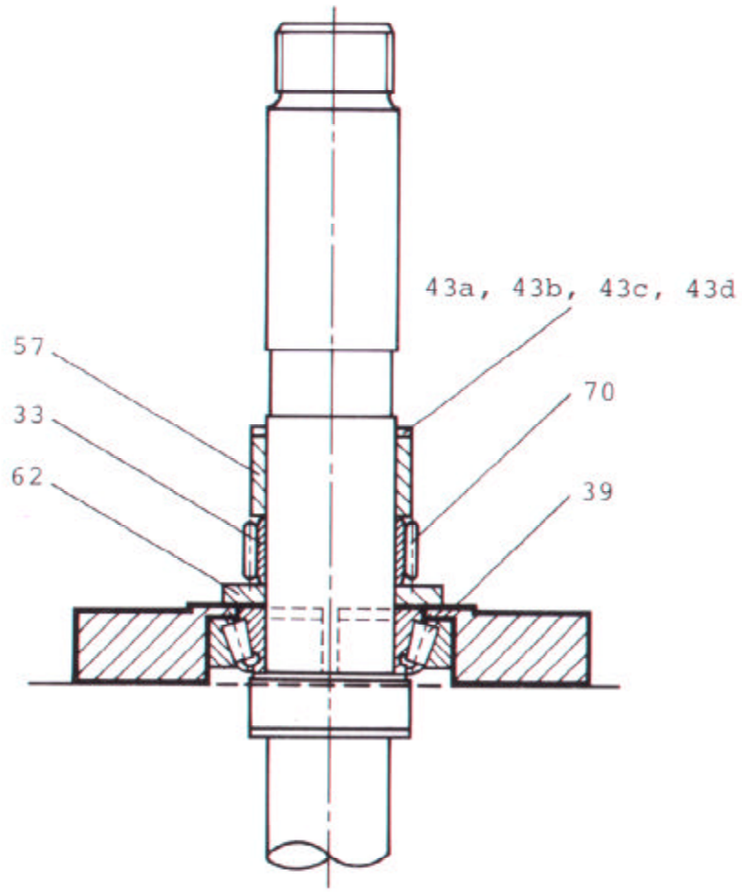
Parts removed from threaded side of the shaft are not interchangeable with the parts removed from the flange side. Keep them separately.

5.6.4 Remove keys (52) from input shaft and keep them in a separate place (4 keys).

5.6.5 Attach divided flange between tapered roller bearing (39) and thrust ring (62) and press off spacers (57), needle bearing inner races (33), thrust ring (62) and shims (43 a-d) from the input shaft.

Take care not to damage bearing cages (70, 39).

5.6.6 Attach divided flange to face side of bearing outer race (39) and press off taper roller bearing.



5.6.7 Remove internal and external clutch discs from gears (48) and(49).

5.6.8 Disassembly of the gears

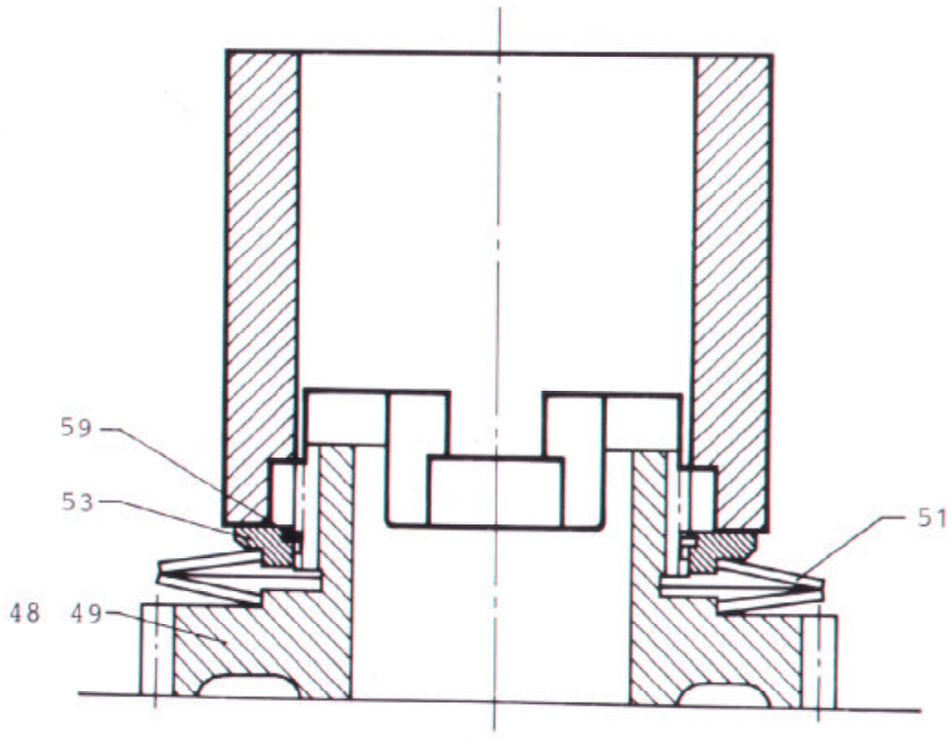
Compress cup springs (51) by means of dismantling tool. Remove circlip (59) and take off thrust plate (53).

5.6.9 Dismantling the actuating members, detach springs (68), watching for balls (47).

5.6.10 Remove disc carrier (53).

5.6.11 Place actuating sleeve (60) on a plane surface and press out guide sleeve (56). Watch for detent pins and springs jumping off the guide sleeve.

It will be advisible to wrap a rag around the actuating sleeve and the guide sleeve to catch any parts jumping off.



6. Reassembly

Note: For easy reference see illustration

6.1 General information

The following points should be observed when re-assembling the gearbox:

- Clean all parts thoroughly, especially sealing surfaces, inspect for wear, damage and cracks, and replace if required.
- In the event of damage on the teeth of any gears, always replace the damaged gear and its mating gear.
- Check shifting fork (32) for wear. The contact surfaces of this fork are provided with a molybdenum coating. Should this coating be worm away at any point, replace the shifting fork. Max. wear on guiding surfaces 0,2 mm on each side.
- Thrust rings (62) require replacement if wear exceeds 0,025 mm.
- Internal discs (73) have a sintered metal coating of 0,3 mm on each side. If the surface structure (after cleaning) appear "glazed", replace the discs.
- Immerse cleaned antifriction bearings in oil before installation.

6.2 Pre-assembling intermediate gearshaft (37) and output shaft (35)

Heat gears to a temperature of 80 - 100°C and slide them on shaft (35) and (37). Ensure proper fit by light hammer blows or pressing.

6.2.1 Heat bearing inner races (61) and (39) to a temperature of 80 - 100°C and press them on to shaft (37).

6.2.2 Heat bearing inner races (36) and (42) to a temperature of 80 - 100°C and press them on to shaft (55).

(Reassembling the output shaft on HBW 360-A see 6.15)

Important:

Repress after cooling down, so that no gap is left.

6.3 Pre-assembling the actuating lever cover plate

Use punch tool to press sealing ring (75) into cover plate (5). Spread antifriction bearing grease between sealing lips.

6.3.1 Insert actuating cam assembly (65) into cover plate (5).

6.3.2 Fit actuating lever (6).

Important:

Clearance between actuating lever and cover plate 0,5 mm.

6.3.3 Clamp actuating lever by means of retaining screw (72), using a 13 mm spanner (wrench).

6.4 Pre-assembling the gears (48) and (49) with cup springs (51) and clutch discs (54) and (69).

Important:

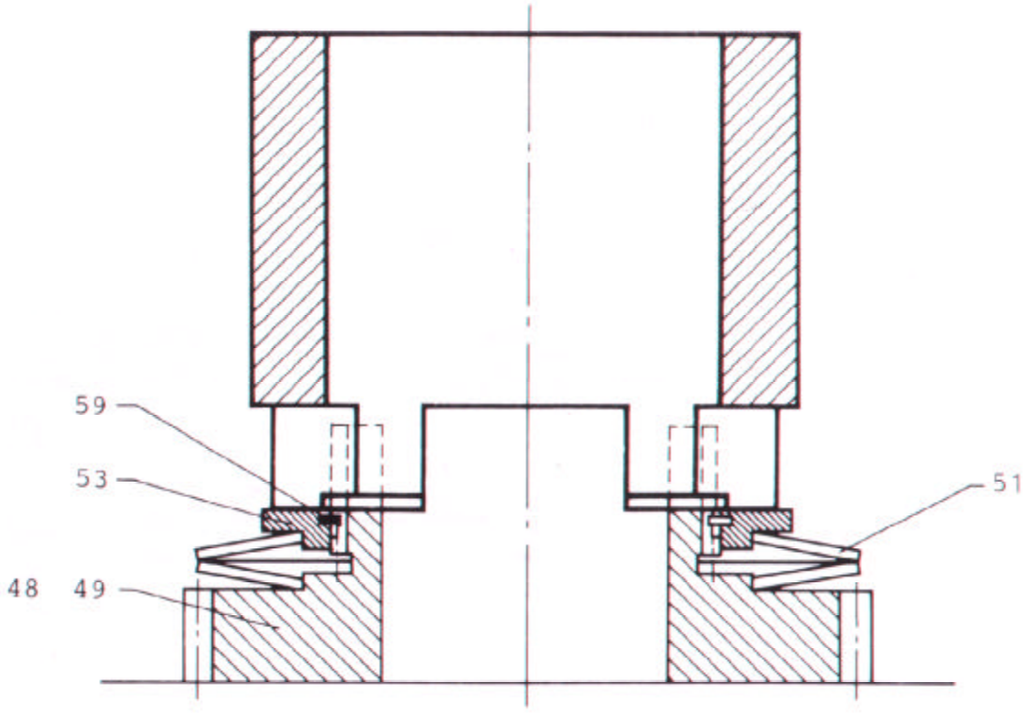
If previously disassembled parts are used, make certain that only mating and associated parts are reassembled.

6.4.1 Join two cup springs (51) face to face (external diameters in contact) and place them on the centering collar of gears (48) and (49).

6.4.2 Place thrust ring (53) on cup springs.

6.4.3 Place circlip (59) on gear hub and use mounting tool and press to fit circlip into groove on hub.

6.4.4 Attach clutch discs (54) and (69), first internal disc (54), then alternatively external disc (69), internal disc (54) etc.



6.5 Measuring the pre-assembled gears (48) and (49) to determine setting value "a".

If no parts had to be replaced, the previously disassembled shims (43 a-d) can be re-used in their former arrangement and positions without any measuring operation.

If measuring is required, proceed as follows:

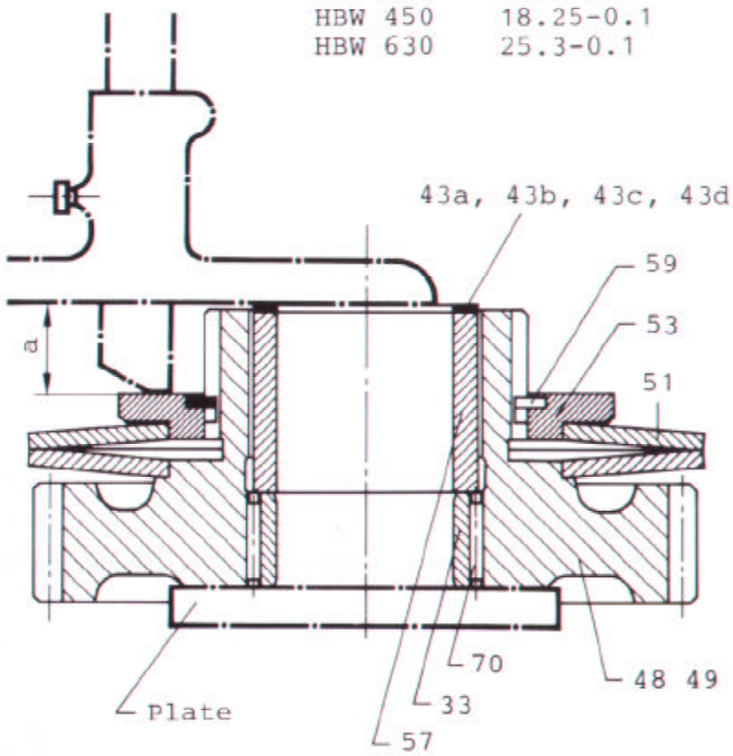
6.5.1 Place re-assembled gear (48) and subsequently gear (49), on a supporting plate (end face of hub downwards, see illustration).

6.5.2 Insert needle cage (70), inner race (33), and spacer (57) into bore of gear.

6.5.3 Fit shims (43 a-d), as required, until prescribed setting value "a" is obtained (see illustration).

6.5.4 Shims are available in thicknesses of 0,4 - 0.5 - 0.6 and 0.7 mm.

Type	Value "a"
HBW 360	15.2-o.1
HBW 450	18.25-0.1
HBW 630	25.3-0.1



6.6a Enclosure

1. Pre-assembly of input shaft

Press taper roller bearing inner race (item 1) onto the input shaft up to the stop using bush "E".
Figure 1-1

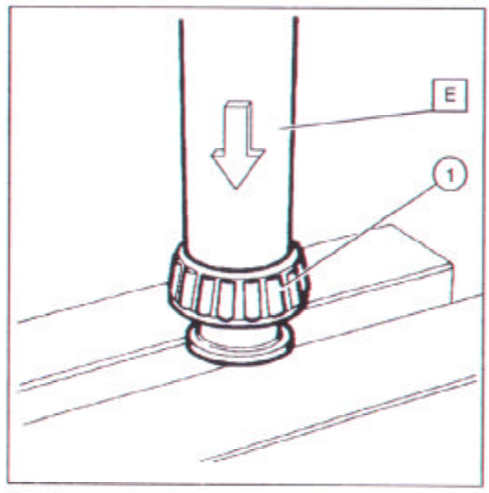


Fig. 1-1

Press thrust washer onto input shaft up to the stop using bush "E".
Figure 1-2

Caution

Sintered (brown colour) side of thrust washer must point to the gear.

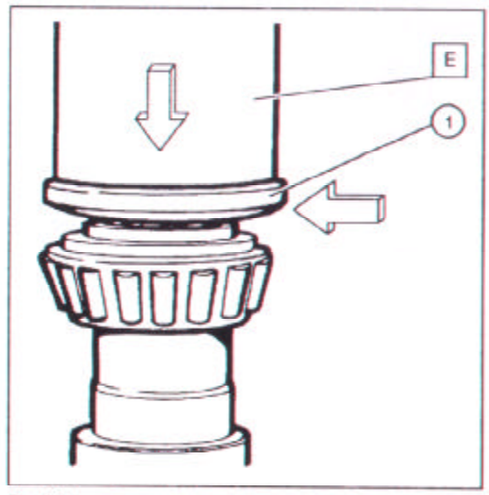


Fig. 1-2

Assemble gear (item 1), needle bearing cages (2 halfs) (item 2), spacer bush (item 3) and support ring (2 halfs) (item 4).
Figure 1-3

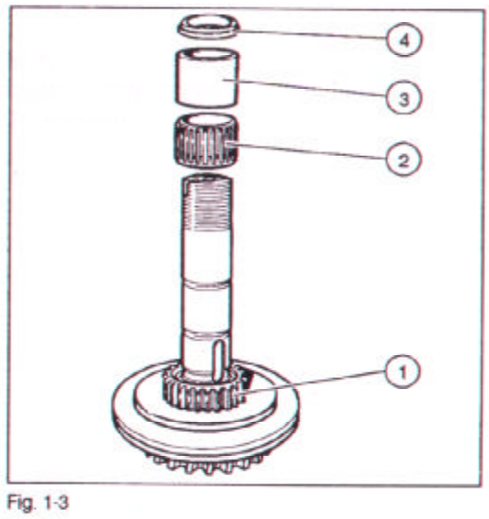


Fig. 1-3

1. Pre-assembly of input shaft

Adjustment of clutch disc clearance

Measure with a depth vernier from the support ring (item 4, Figure 1-3) to the end disc (item 1).
Dimension 15.20 mm (0.598 in.) plus minus 0.10 mm (0.003937 in.) must be achieved by adding or removing shims.
Figure 1-4

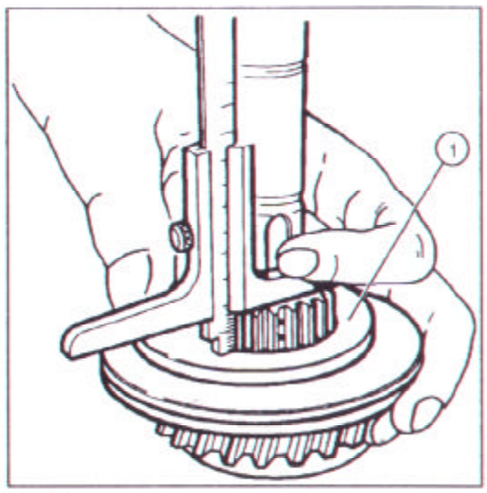


Fig. 1-4

Fit shims (item 1) onto support ring and insert keys (item 2 and 3).
Figure 1-5

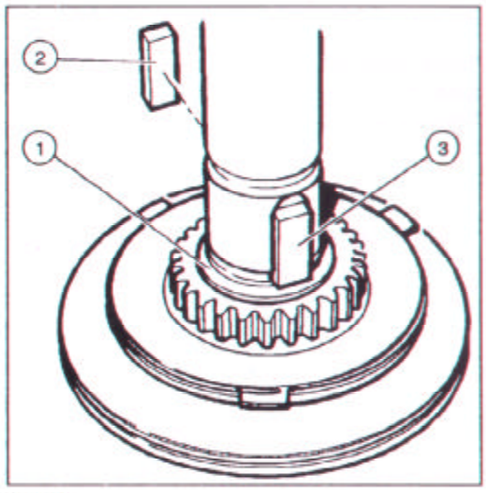


Fig. 1-5

2. Assembly of shifting parts

Knock in drive pins (item).
Insert springs (item 1) and detent pins (item 2) into the guide sleeve (item 3).
Align drive pins with the grooves in the actuating sleeve (item 4) and push detent pins into the holes until they snap.
Push guide sleeve uniformly into actuating sleeve until detent pins snap.
Figure 2-1

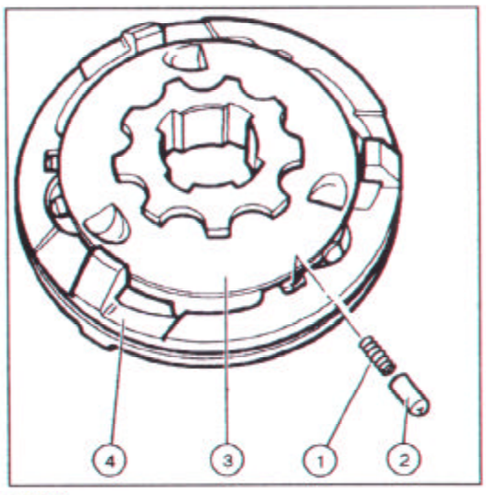


Fig. 2-1

Insert balls (item 1) into the ball-pockets of the steel disc carrier and fit shifting assembly.
Figure 2-2

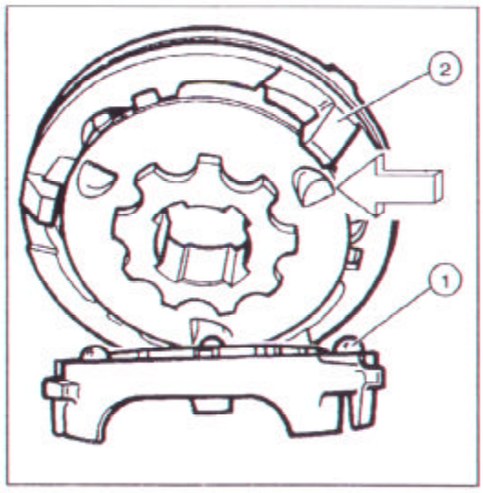


Fig. 2-2

Insert balls (item 1) into the ball-pockets of the guide sleeve and fit the second steel disc carrier.

Insert the retaining springs (item 2) and fit them into the holes.
Figure 2-3

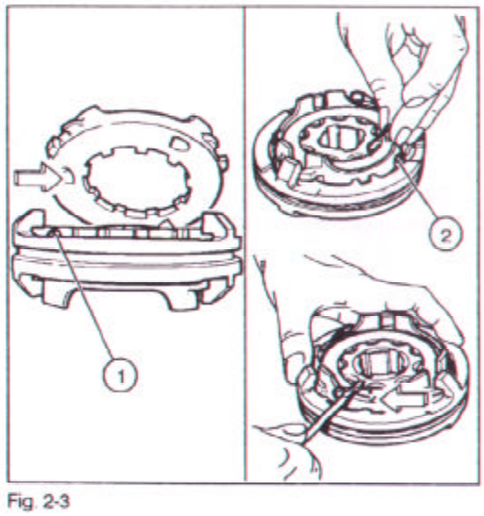


Fig. 2-3

3. Adjustment of clutch disc clearance

Use a plane plate (approx. dia. 65 mm/2.56 in. and 5mm/ 0.197 in. high) and match the parts the following:

1. Thrust washer (item 1)
2. Gear (item 2)
3. Needle bearing inner race (item 3)
4. Needle bearing cage (2 halfs) (item 4)
5. Spacer bush (item 5)
6. and the shims (removed at disassembly) (item 6)

Figure 3-1

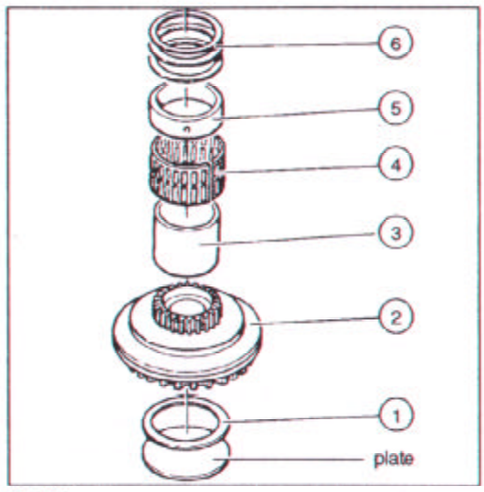


Fig. 3-1

Measure with a depth vernier from the shims (item 1) to the end disc (item 2).
Dimension 15.20 mm (0.598 in.) plus minus 0.10 mm (0.003937 in.) must be achieved by adding or removing shims.

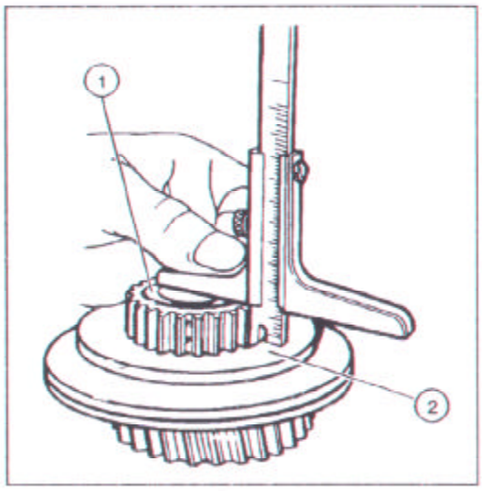


Fig. 3-2

4. Final assembly of input shaft

Fit steel discs (item 1) and friction discs (item 2) alternately onto the gear, starting with a steel disc.
Figure 4-1

Caution

Observe that the 3 grooves in the friction disc are opposit the lubrication holes in the gear.

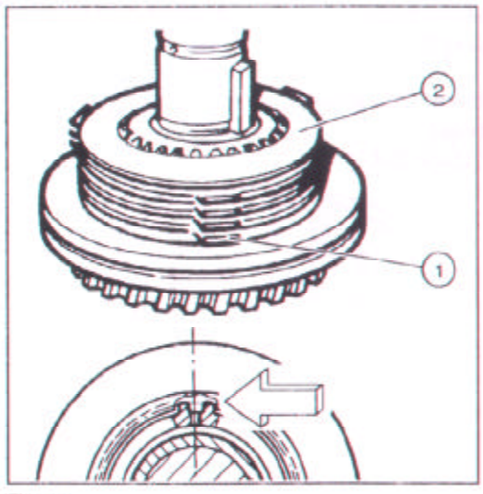


Fig. 4-1

4. Final assembly of input shaft

Fit shifting assembly on input shaft, observe that the grooves in the guide sleeve are aligned properly with the keys.

Press shifting assembly onto input shaft using bush "F", observe that lugs of the steel discs meet the grooves of the steel disc carrier.
Figure 4-2

Caution

The shifting assembly has to be mounted onto input shaft according to the input rotation. Rotation clockwise the thick lug must be at the right hand side (viewed from top). Rotation counterclockwise the thick lug must be at the left hand side (viewed from top).

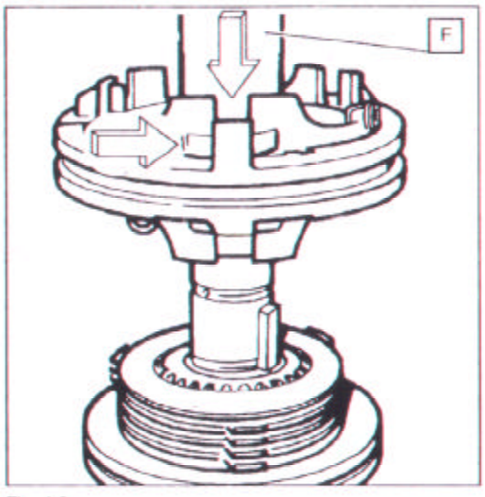


Fig. 4-2

Fit steel discs and friction discs (item 1 and 2) alternately onto the gear (item 3), starting with a steel disc.
Figure 4-3

Caution

Observe that the 3 grooves in the friction disc are opposit the lubrication holes in the gear.

Insert input shaft into gear.

Caution

Observe that lugs of steel discs meet the grooves of steel disc carrier.

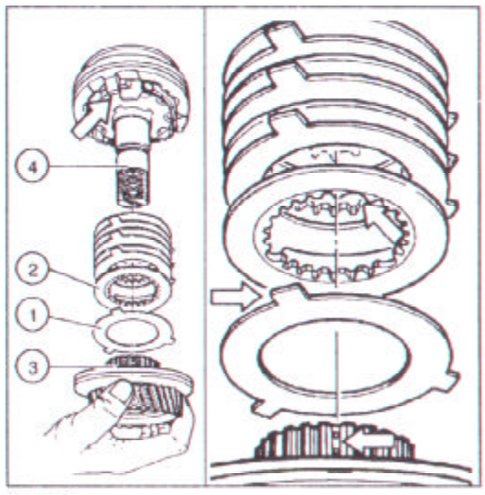


Fig. 4-3

Insert shims (item 1) and spacer bush (item 2) into gear (item 3).

Press needle bearing inner race (item 4) onto input shaft up to the stop.
Insert needle bearing cages (2 halfes) (item 5).
Press thrust washer (item 6) and taper roller bearing inner race (item 7) onto the input shaft up to the stop.
Figure 4-4

Caution

The sintered brown coloured side of the thrust washer must point to the gear.

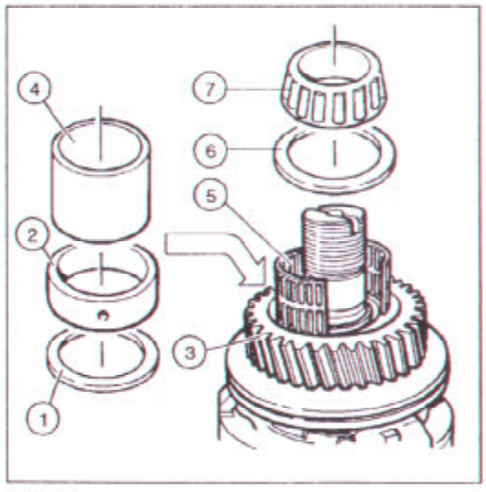


Fig. 4-4

4. Final assembly of input shaft

Screw on grooved nut (item 1) and tighten it with a torque wrench.
Tightening torque: 95 Nm (70 ft.lb.)

After tightening stake the nut to the input shaft.
Figure 4-5

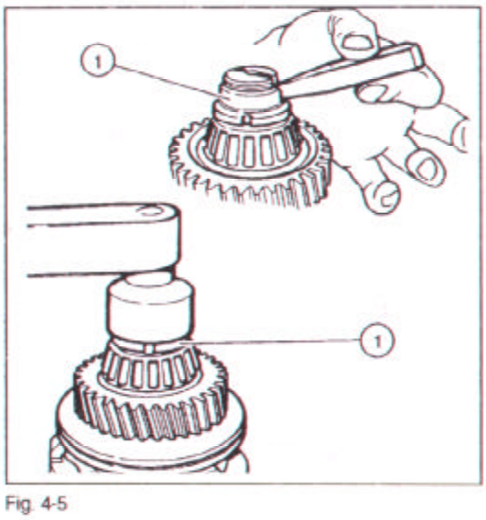


Fig. 4-5

6.6b Pre-assembling the actuating members

6.6.1 Fit driving pins (45), springs (71) and detent pins (34) to guide sleeve (56).

6.6.2 Place actuating sleeve (60) on press plate.

6.6.3 Place guide sleeve (56) on top of actuating sleeve (60) with the three driving pins (45) in alignment with the three grooves in the actuating sleeve. Watch for correct position of detent pins (34) relative to angular pockets of sleeve.

6.6.4 Press guide sleeve (56) into actuating sleeve (60) up to midway position (noticeable click).

6.6.5 Insert balls (47) into ball pockets of guide sleeve, attach disc carrier (63), then fit balls on opposite face side and attach second disc carrier (55).

6.6.6 Attach springs (68) with closed part of spring windings pointing outwards.

6.7 Reassembling the input shaft

6.7.1 Pre-heat inner race (39) of taper roller bearing up to 100°C and press on to shaft (25).

6.7.2 Attach outer race (39) of taper roller bearing.

Important: Repress after cooling down.

6.7.3 Fit thrust ring (62) in such a way that sintered surface (brown colour) faces gear.

6.7.4 Use tubular tool to press on inner race (33) of needle bearing for gear (48).
(Does not apply for HBW 360).

6.7.5 Attach needle cages (70) and completely pre-assembled gear (48)with clutch discs (54) and (69).

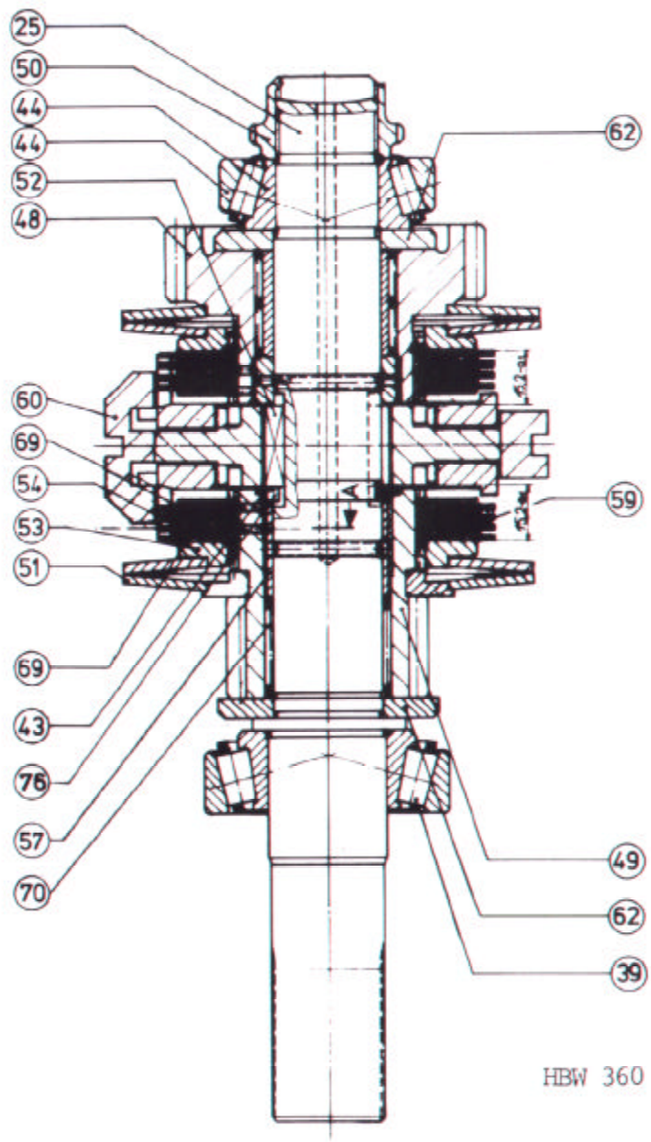
6.7.6 Fit spacer (57) and shims (43 a-d) to gear (48).

6.7.7 Fit keys (52) to shaft (4 pieces).

6.7.8 Press pre-assembled actuating members (see item 6.6) on input shaft (25).

Important:

Align external clutch discs radially relative to disc carrier.



HBW 360

6.7.9 Attach shims (43 a-d) to gear (49).

6.7.10 Attach spacer (57) to gear (49).

6.7.11 Use tubular tool to press on inner race (33) of needle bearing for gear (49).

6.7.12 Attach pre-assembled gear (49) with needle cage (70) and clutch discs (54) and (69).

Align external discs for proper engagement with actuating member.

6.7.13 Attach thrust ring (62) in such a way that sintered surface (brown colour) faces gear.

6.7.14 Pre-heat inner race (44) of taper roller bearing to a temperature of approx. 110°C and press on shaft, with larger diameter adjacent to thrust ring.

Important:

Prepress after cooling down, so that no gap is left.

6.7.15 Screw on grooved ring nut (50) by means of special socket spanner. Tighten to following torque:

HBW 360	-	M_A	=	100 Nm
HBW 450	-	M_A	=	150 Nm
HBW 630	-	M_A	=	150 Nm

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

6.7.17 Check gears (48) and (49) for free movability in an axial direction.

6.7.18 Attach outer race (44) of taper roller bearing.

6.8 Pre-assembly of housing and cover

6.8.1 Press output shaft sealing ring (26) into housing (2) output shaft opening by using punch tool.

6.8.2 Press outer races of 3 tapered roller bearings (42, 44, 61) into housing (2) seats.

6.8.3 Press input-shaft sealing ring (24) into cover (1) input shaft opening, by using punch tool.

6.8.4 Press outer races of 3 tapered roller bearings (39, 22, 41) together with appropriate shims. (36 a-d, 38 a-d) into cover (1) seats.

6.9 Final assembly of gearbox

6.9.1 Place pre-assembled gearbox section (2) on bench with opening upright.

6.9.2 Place pre-assembled input-shaft (25) together with shifting fork (60) into gearbox section.

6.9.3 Place pre-assembled output shaft (35) and

6.9.4 pre-assembled intermediate gear shaft (37) together into gearbox section (2). (Watch for gears to be in mesh).

6.9.5 Insert shifting rod (30) through bores in gearbox and shifting fork (60).

6.9.6 Slide pre-assembled cover (1) with seal ring (24) over input shaft and

6.9.7 secure it with 2 screws (11) on housing (2).

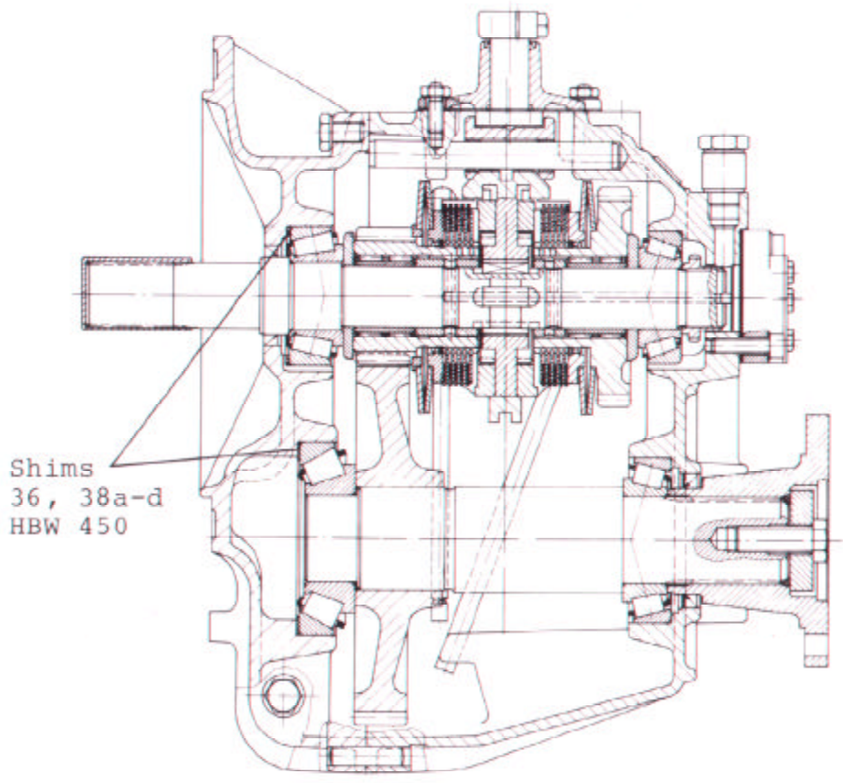
6.10 Measuring the gear sets of input shaft, output shaft and intermediate shaft

6.10.1 Put corresponding shims into the bearing seats of cover (1) in order to achieve an axial play of $0.05^{+}_{-}0.02$ mm on input shaft, output shaft and intermediate shaft. If no parts had to be replaced (as mentioned in section 5.3.4), the previously disassembled shims (36 a-d, 38 a-d) can be re-used in their previous arrangement and positions. It is, however, necessary, to measure the bearing play and adjust it.

6.10.2 Place spring washers (10) underneath the screws (21) and tighten screws to a torque of 22 Nm, using a 13 mm spanner (wrench).

6.10.3 Tap output and input shafts slightly in an axial direction while rotating the shafts by hand, to ensure freedom of movement.

6.10.4 Axial play of input and output shafts is 0.05^{+}_{-} 0.02 mm, measured by means of a dial indicator in contact with the end faces of the shaft (see illustration).



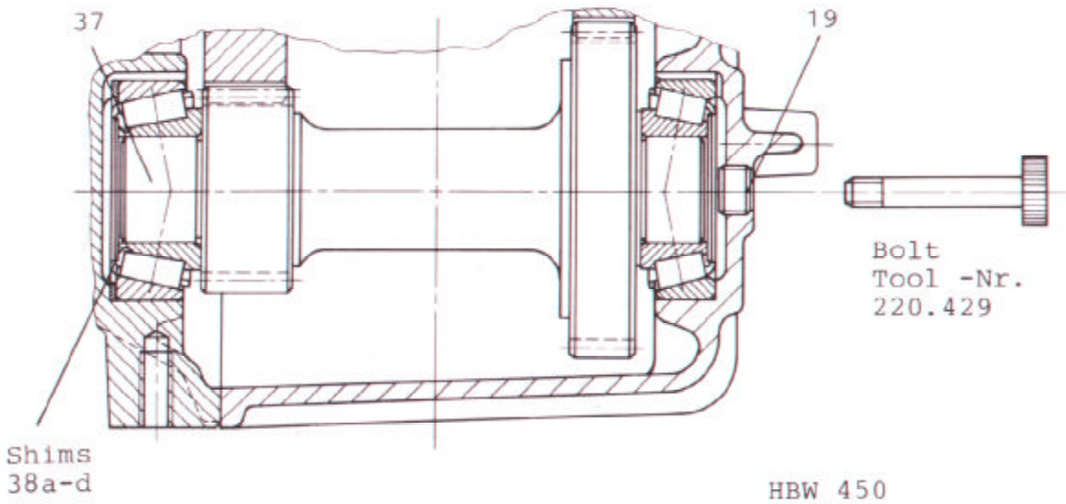
6.11 Measuring the gearset of intermediate shaft

6.11.1 Insert bolt with tool No. 220.429 into housing opening at position 19 and thread it into center hole of intermediate shaft (37). Tap intermediate shaft slightly in axial direction, while rotating by means of tool. Axial play of intermediate shaft is measured by means of a dial indicator in contact with end face of the tool-bolt-head. Move bolt head in axial direction by a lever.

Axial play for intermediate shaft: 0.05 ± 0.02 mm.

Plug hole in housing with screw 19 and use Loctite 242 for sealing.

6.11.2 After the adjustment of axial plug for input, output and intermediate shaft remove cover (1) by opening screws (11). Use Loctite Special 510 to seal mating areas of cover and housing. Refit cover again and adjust seating by positioning plugs (15). Then refit screws (11) with spring washers (74) and finally tighten them with a torque of 22 Nm.



HBW 450

6.12 Mounting the actuating lever cover plate

6.12.1 Place seal (12) on pre-assembled cover plate (5) 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.

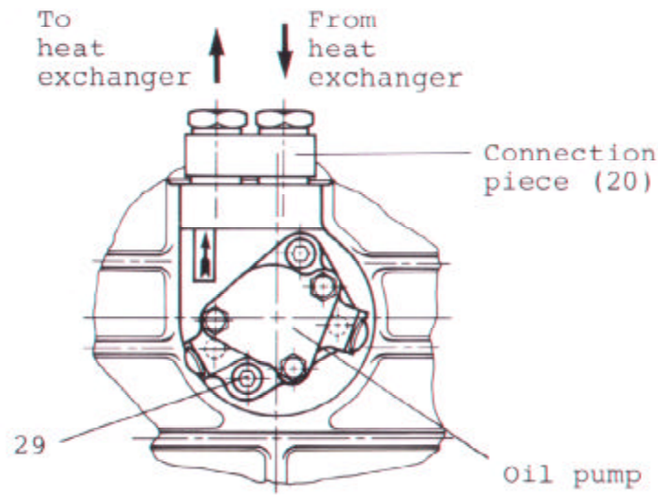
The lever travel from 0 to A and from 0 to B should be equal. After a lever travel of 28 to 31 mm the transmission should be in gear. Screw the cover plate in place in this position.

6.12.2 Fit spring washers (10) and screws (9) using a 13 mm spanner (wrench). Tighten to a torque of 14 Nm. Check actuating lever for proper operation.

6.13 Connection of the heat exchanger (if required)

All HBW 360, 360 A, 450, 630 transmissions are equipped with a connection piece (20), which is situated above the oil pump on the housing and connects the oil outlets.

When using a heat exchanger (see information about cooling) the connection piece (20 is removed and the pipes leading to the head exchanger are connected. The threads are R 3/8" 14 mm deep. An arrow on the oil pump indicates the preasure outlet of the oil. The connection of the heat exchanger is illustrated.



6.14 The oil pump (3) is fixed to the housing with two screws (29) and is driven by an end groove in the input shaft.

6.15 Reassembling the output shaft

(applicable for HBW 360 A - Down Angle only)

6.15.1 Preheat gear (40) up to 160°C and cool down output shaft (35) to -40°C prior to assembly. Position gear on shaft according to a distance of 183,5 - 0,2 mm measured from the splined end of the shaft to the face of the gear hub.

Important: Measuring areas of gear and shaft should be absolutely free from oil or grease.

6.15.2 Tapered roller bearing (41) should be preheated to 120°C and pressed on shaft.

6.15.3 Press bearing races (41, 42) into housing

6.15.4 Place shaft (35) with assembled bearing (41) and gear (40) into housing openings.

6.15.5 Preheat tapered roller bearing (41) up to 120°C and assemble on shaft (35) from output flange side by retaining shaft through center bolt. Output flange has to be pulled and hold in position until roller bearing has cooled off.

6.16 Measuring bearing clearance of output shaft

6.16.1 Remove center bolt (14) and disk (28). Measure difference between flange face and disk support in flange (measure b) and difference between flange face and face of shaft (measure a). According to the difference a minus b the thickness of washers (27) is determined and placed in position. Place disk (28) in position and tighten with center bolt (14).

6.16.2 Measure bearing clearance on the flange face with dial gauge. (Clearance should be 0,05 $\pm$ 0,02 mm)

6.16.3 Final Assembly of gearbox

6.16.4 Remove flange

6.16.5 Place cover (80) with O-ring (81) and seal ring (26) into housing and secure with spring ring (82).

6.16.6 Use Loctite No. 245 to secure flange on splined shaft and tighten central bolt with the disk, the washers and the O-ring for final assembly. (Torque for central bolt Md = 100 Nm).

7. Spare Parts List

Preface

The spare parts list is only valid for the type and versions of transmission, as shown below.
You will find the transmission type and version on your transmission name plate.
If the type and version indicated differs from that printed in this Manual, the relative Spare Parts List should be ordered from ZF HUTH MARINE GEAR.
The indicated dimensions and standard are as such not enough for ordering parts.

When ordering parts, please state:

- transmission type
- serial number
- item no. part name, ident no. and quantity of parts required.

The spare parts list is referring to the following versions:

HBW 360 H	versions	09; 10; 11; 12
HBW 360 A	versions	07; 08; 09
HBW 450	versions	09; 10; 11
HBW 630	versions	04; 05; 06

Name Plate

The name plate is mounted to the transmission

Item	Denomination	Marine Reversing Unit HBW 360		pieces per item	Marine Reversing Unit HBW 450		pieces per item	Marine Reversing Unit HBW 630		pieces per item
		Spare Part-No.	Ident-No.		Spare Part-No.	Ident-No.		Spare Part-No.	Ident-No.	
1	Cover, Housing	947.56.001.04	388 639	1	947.36.002.03	344 693	1	947.81.002.02	344 701	1
2	Housing Assy	947.56.002.02	387 700	1	947.36.701.05	344 691	1	947.81.701.02	345 188	1
3	Oil Pump	947.82.016.04	344 828	1	947.82.016.04	344 828	1	947.82.016.04.3	344 828	1
4	Flange, output	947.82.014.01	305 752	1	947.82.014.01	305 752	1	947.82.014.01	305 752	1
5	Shifting Cover	947.41.003.02	388 242	1	947.41.003.02	388 242	1	947.41.003.02	388 242	1
6	Shifting Lever	947.23.006.01	195 062	1	947.23.006.01	195 062	1	947.23.006.01	195 062	1
7	Sealing Ring	947.41.016.01	326 578	2	947.41.016.01	326 578	2	947.41.016.01	326 578	2
8	Drain Plug	947.41.008.01	228 566	1	947.41.008.01	228 566	1	947.41.008.01	228 566	1
9	Nut	006.101.0036	455 785	4	006.101.0036	455 785	4	006.101;0036	455 785	4
10	Spring Washer	011.103.0041	442 372	16	011.103.0041	442 372	6	011.103.0041	422 372	6
11	Screw Hex.	016.102.0097	360 757	10	016.102.0271	357 086	10	016.101.0090	320 200	12
12	Seal	947.41.011.01	254 716	1	947.41.011.01	254 716	1	947.41.011.01	254 716	1
13	Seal	947.82.029.01	345 228	1	947.82.029.01	345 228	1	947.82.029.01	345 228	1
14	Screw Hex.	016.111.0092	320 201	1	016.111.0092	320 201	1	016.111.0092	320 201	1
15	Dowel Pin	014.101.0073	104 664	2	014.101.0073	104 664	2	014.101.0073	104 664	2
16	Ring Support (i=2 ONLY)	947.32.020.05	326 829	1						
16	Ring Spacer (i=3 ONLY)	947.57.016.02	345 684	2	947.32.020.05	326 829	1	947.32.020.05	326 829	1
19	Plug	016.107.0120	442 373	2	016.107.0120	442 373	1	016.107.0120	442 373	1
20	Oil Bridge compl.	947.36.703.02	345 190	1	947.36.703.02	345 190	1	947.36.703.02	345 190	1
21	Cage Needle Bearing	005.104.0165	376 100	1						
22	Bearing Bevel Roller	005.101.0017	106 669	1	005.101.0218	320 203	1	005.101.0021	334 354	1
24	Sealing Ring	001.107.0004	105 156	1	001.107.0006	105 159	1	001.107.0006	105 159	1
25	Shaft Input	947.57.003.01	345 005	1	947.37.002.01	305 817	1	947.82.002.01.2	305 764	1
26	Sealing Ring	001.107.0007	105 165	1	001.107.0007	105 165	1	001.107.0007	105 165	1
27	O-Ring	001.105.0127	105 571	1	001.105.0127	105 571	1	001.105.0127	105 571	1
28	Disk	947.82.015.01	305 754	1	947.82.015.01	305 754	1	947.82.015.01	305 754	1
29	Bolted Screw	016.103.0112	320 202	2	016.103.0112	320 202	2	016.103.0112	320 202	2
30	Shifting Rod	947.53.002.01	288 673	1	947.53.002.01	288 673	1	947.53.002.01	288 673	1
31	Dipstick + Exhaust. Assy	947.56.701.01	345 289	1	947.36.702.02	344 871	1	947.81.702.02	345 189	1
32	Fork Shifting Assy	947.53.700.02	327 374	1	947.53.700.02	327 374	1	947.53.700.02	327 374	1

Item	Denomination	Marine Reversing Unit HBW 360		pieces per item	Marine Reversing Unit HBW 450		pieces per item	Marine Reversing Unit HBW 630		pieces per item
		Spare Part-No.	Ident-No.		Spare Part-No.	Ident-No.		Spare Part-No.	Ident-No.	
33	Ring Inner Needle bearing	965.01.037.01	304 148	1	965.01.037.01	304 148	1	965.01.037.01	304 148	1
33a	Ring Inner Needle bearing				965.01.037.01	304 148	1	947.82.021.01	305 767	1
34	Stopping Pin	947.22.011.02	187 840	3	947.22.011.02	187 840	3	947.22.011.02	187 840	3
35	Shaft Output	947.57.013.01	345 037	1	947.37.001.02	344 863	1	947.82.001.02	327 381	1
36	Washer 0.1mm	947.57.001.01	344 990	1	013.101.0238	147 921	2	658.021.005.01	305 737	2
36	Washer 0.15 mm	947.57.001.02	344 991	1	013.101.0239	147 922	2	658.021.005.02	305 738	2
36	Washer 0.2 mm	947.57.001.03	344 992	1				658.021.005.03	305 739	2
36	Washer 0.5 mm	947.57.001.04	344 993	1	013.101.0240	147 923	2	658.021.005.04	305 740	2
36	Washer 1.0 mm	947.57.001.05	344 994	1						
37	Gear Intermediate, 24/25/27 2,ØR	947.57.018.02	345 073	1	947.37.014.02	345 980	1	947.82.027.02	345 195	1
37	Gear Intermediate, 32/30/32 1,5R	947.57.018.03	345 074	1	947.37.014.01	345 978	1	947.82.027.03	345 196	1
37	Gear Intermediate, 21/19/20 3,ØR	947.57.018.01	345 071	1	947.37.014.03	345 982	1	947.82.027.01	345 194	1
38	Washer 0.1 mm	947.57.002.01	344 995	1	965.02.022.01	277 213	2	947.82.018.01	305 758	2
38	Washer 0.15 mm	947.57.001.02	344 996	1	965.02.022.02	277 214	2	947.82.018.02	305 759	2
38	Washer 0.2 mm	947.57.002.03	344 997	1	965.02.022.03	277 215	2	947.82.018.03	305 760	2
38	Washer 0.5 mm	947.57.002.04	344 998	1	965.02.022.04	277 216	2	947.82.018.04	305 761	2
38	Washer 1.0 mm	947.57.002.05	344 999	1	965.02.022.05	277 217	2			
39	Bearing Bevel Roller	005.101.0019	106 662	1	005.101.0218	320 203	1	005.101.0021	334 354	1
40	Gear, 49/48/52 1,5 R	947.57.014.03	345 028	1	947.37.006.03	325 807	1	947.82.006.03	305 808	1
40	Gear, 59/53/57 2, ØR	947.57.014.02	345 019	1	947.37.006.02	325 805	1	947.82.006.02	305 805	1
40	Gear, 49/59/64 3, ØR	947.57.014.01	345 021	1	947.37.006.01	305 826	1	947.82.006.01	305 795	1
41	Bearing Bevel Roller	005.101.0022	145 413	1	005.101.0375	106 654	1		159 847	1
42	Bearing Bevel Roller	005.101.0024	233 230	1	005.101.0268	106 664	1		320 206	1
43	Washer, 0.4 mm	947.22.033.01	195 714	2	947.22.033.01	195 714	2	947.22.033.01	195 714	2
43	Washer, 0.5 mm	947.22.033.02	195 715	1	947.22.033.02	195 715	1	947.22.033.02	195 715	1
43	Washer, 0.6 mm	947.22.033.03	195 716	1	947.22.033.03	195 716	1	947.22.033.03	195 716	1
43	Washer, 0.7 mm	947.22.033.04	195 717	1	947.22.033.04	195 717	1	947.22.033.04	195 717	1
44	Bearing Bevel Roller	005.102.0164	277 074	1	005.102.0243	277 059	1	005.102.0130	320 211	1
45	Driving Pin	947.22.029.01	195 271	3	947.22 .029.01	195 271	3	947.22.029.01	195 271	3
46	Pressure Spring Pin	014.102.0074	104 559	1	014.102.0074	104 559	1	014.102.0074	104 559	1

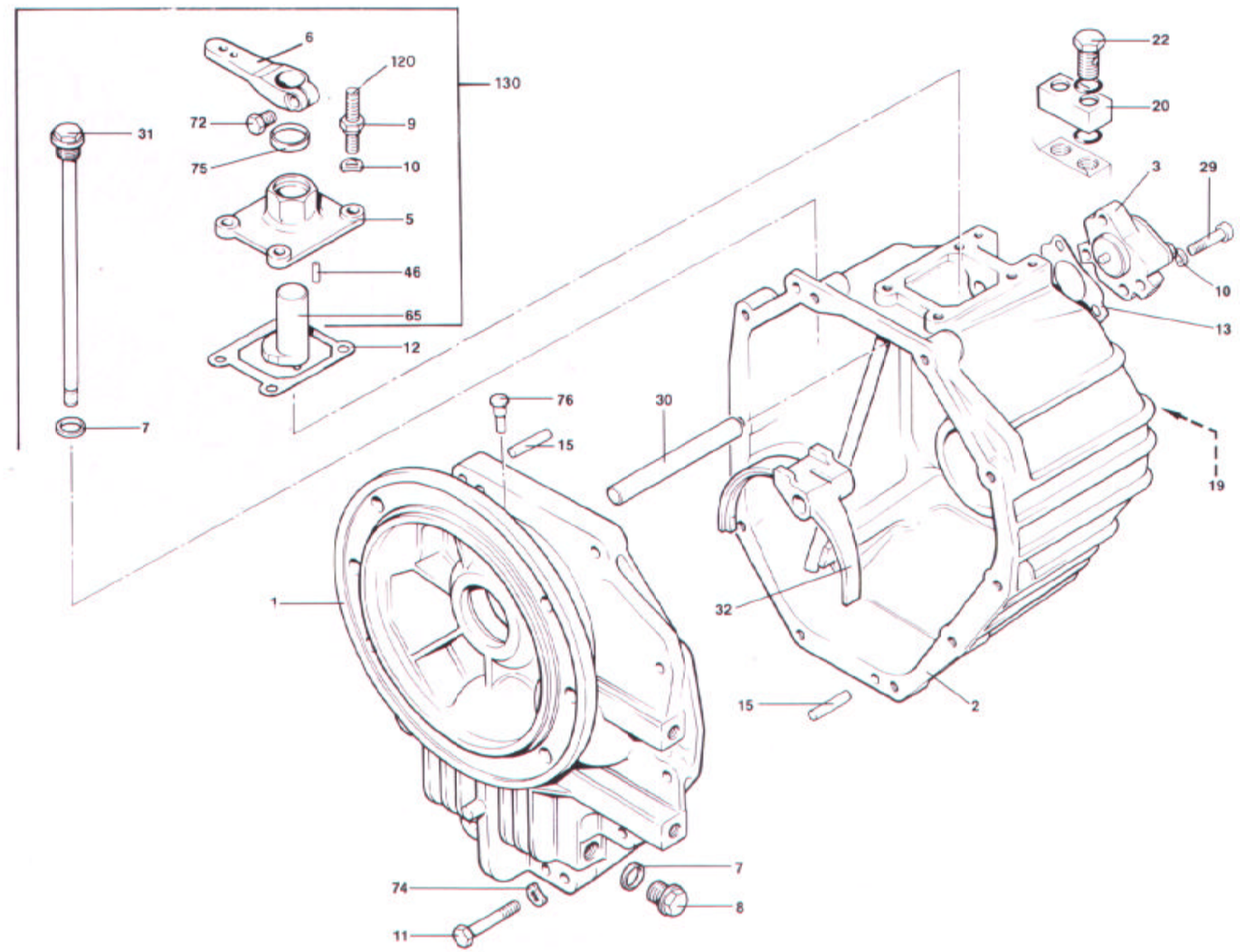
Item	Denomination	Marine Reversing Unit HBW 360		pieces per item	Marine Reversing Unit HBW 450		pieces per item	Marine Reversing Unit HBW 630		pieces per item
		Spare Part-No.	Ident-No.		Spare Part-No.	Ident-No.		Spare Part-No.	Ident-No.	
47	Ball	012.101.0052	106 732	6	012.101.0052	106 732	6	012.101.0275	106 717	6
48	Gear, T. 34/36	947.57.012.01	345 014	1	947.37.004.02	326 652	1	947.82.004.02	326 921	1
49	Gear, T. 20/21 3, ØR	947.57.015.01	345 023	1	947.37.003.04	326 649	1	947.82.003.04	326 918	1
49	Gear, T. 23/26/28 2, ØR	947.57.015.02	345 026	1	947.37.003.05	326 650	1	947.82.003.05	326 919	1
49	Gear, T. 31/33 1,5 R	947.57.015.03	345 030	1	947.37.003.06	326 651	1	947.82.003.06	326 920	1
50	Nut	947.83.022.01	325 874	1	947.82.022.01	325 874	1	947.82.022.01	325 874	1
51	Cup Spring	947.32.012.03	270 175	4	947.32.012.03	270 175	4	947.32.012.03	270 175	4
52	Key fitting	947.32.018.01	206 121	2	947.32.018.01	206 121	4	947.32.018.01	206 121	4
53	Starting Disk	947.37.011.01	326 841	2	947.37.011.01	326 841	2	947.37.011.01	326 841	2
54	Disk Outer	947.32.024.02	326 380	8	947.32.024.02	326 380	10	947.32.024.02	326 380	14
55	Carrier Left	947.57.010.02	407 429	1	947.52.013.04	327 128	1	947.82.012.03	387 975	1
56	Socket Guide	947.57.008.02	439 604	1	947.32.004.05	327 126	1	947.82.011.03	387 973	1
57	Spacer	947.57.006.01	345 008	1	947.37.008.01	325 785	1	947.82.007.01	305 768	1
58	Spacer	947.57.011.01	345 013	1	947.37.009.01	325 786	1	947.82.020.01	305 783	1
59	HALF Ring	947.37.012.02	459 341	4	947.37.012.01	326 830	4	947.37.012.01	326 830	4
60	Abutment Ring	947.32.005.03	407 436	1	947.32.005.02	206 809	1	947.82.030.01	387 972	1
61	Bearing Bevel Roller	005.102.0161	215 874	1	005.101.0019	106 662	1	005.102.0242	207 339	1
62	Disk	965.01.004.03	327 395	1	965.01.004.03	327 395	1	965.01.004.03	327 395	1
63	Carrier Right	947.57.009.02	407 428	1	947.32.010.07	327 127	1	947.82.013.03	387 974	1
64	Bearing Bevel Roller	005.103.0160	215 873	1	included in item 61			005.103.0241	207 338	1
65	Cam Control	947.53.703.02	407 211	1	947.53.703.02	407 211	1	947.83.701.02	388 067	1
66	Bearing Bevel	005.103.0163	277 073	1	005.103.0222	334 115	1	005.103.0134	320 210	1
67	Disk	947.57.004.01	345 006	1	965.01.004.03	327 395	1	947.82.009.02	344 530	1
68	Pressure Spring	947.57.020.01	408 269	3	947.57.020.01	408 269	3	947.57.020.01	408 269	3
70	Cage Needle Bearing	005.107.0166	353 855	1	005.107.0166	353 855	1	005.107.0166	353 855	1
70a	Cage Needle Bearing				005.107.0166	353 855	1		320 207	1
71	Pressure Spring	947.22.012.02	287 401	3	947.22.012.02	287 401	3	947.22.012.02	287 401	3
72	Screw Hex.	016.101.0084	199 807	1	016.101.0084	199 807	1	016.101.0084	199 807	1
73	Disk Inner	965.01.035.01	408 265	8	965.01.035.01	408 265	10	965.01.035.01	408 265	14
74	Spring Washer	011.103.0041	444 372	16	011.103.0042	442 371	10	011.103.0042	442 371	12

Item	Denomination	Marine Reversing Unit HBW 360		pieces per item	Marine Reversing Unit HBW 450		pieces per item	Marine Reversing Unit HBW 630		pieces per item
		Spare Part-No.	Ident-No.		Spare Part-No.	Ident-No.		Spare Part-No.	Ident-No.	
75	Seal Ring	001.106.0155	106 864	1	001.106.0155	106 864	1	001.106.0155	106 864	1
76	Vent Cap 06.9	875.46.005.02	344 605	1	875.46.005.02	344 605	1	875.46.005.02	344 605	1
77	Distance ring half(only HBW 360)	947.57.007.01	345 009	2						
78	Gear, T. 35(360)-33(450)-35(630)	947.57.017.01	345 069	1	947.37.015.01	345 983	1	947.82.028.01	345 207	1
79	Washer 0.10 mm	965.02.022.01	277 213	1						
79	Washer 0.15 mm	965.02.022.02	277 214	1						
79	Washer 0.20 mm	965.02.022.03	277 215	1						
79	Washer 0.50 mm	965.02.022.04	277 216	1						
79	Washer 1.00 mm	965.02.022.05	277 217	1						
120	Stud	017.101.0123	396 330	4	017.101.0123	396 330	4	017.101.0123	396 330	4
127	Needle Bearing	005.105.0193	268 620	2	005.105.0193	268 620	2	005.105.0193	268 620	2
130	Shift Cover Assembly	947.43.610.03	408 099	1	947.43.610.03	408 099	1	947.83.610 .02	388 066	1

Item	Denomination	Marine Reversing Unit HBW 360 A		pieces per item
		Spare Part-No.	Ident-No.	
1	Cover Housing	947.66.001.02	388 640	1
2	Housing Assembly	947.66.002.03	407 408	1
37	Gear Intermediate, 32 1,5 R	947.67.018.03	345 845	1
37	Gear Intermediate, 24 2,0 R	947.67.018.01	345 843	1
37	Gear Intermediate, 20 3,0 R	947.67.018.01	345 841	1
35	Output Shaft	947.57.013.01	345 037	1
40	Gear 51 1,5 R	947.67.014.06	407 360	1
40	Gear 51 2,0 R	947.67.014.05	407 358	1
40	Gear 61 3,0 R	947.67.014.04	407 356	1
41	Bearing Bevel Roller	005.101.0022	145 413	1
42	Bearing Bevel Roller	005.101.0024	233 230	1
27	O-Ring	001.105.0127	105 571	1
26	Sealing Ring	001.107.0007	105 165	1
15	Dowel Pin	014.101.0073	104 664	2
36	Washer 0.10	947.57.001.01	344 990	1
36a	Washer 0.15	947.57.001.02	344 991	1
36b	Washer 0.20	947.57.001.03	344 992	1
36c	Washer 0.50	947.57.001.04	344 993	1

The remaining parts positiones are the same as with HBW 360.

Drawings-Sheet 1



Drawings-Sheet 2