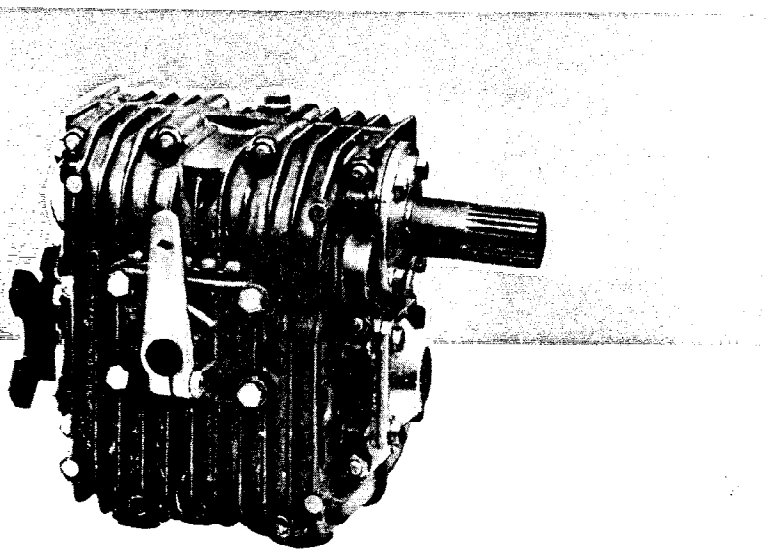
HURTH

Boat Reversing Gearbox Units

5

10

20



Installation – Operation

Maintenance – Assembly

Repair – Spare Parts List for
HBW5/HBW10/HBW20

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1. Description

1.1 Brief description

HURTH boat reversing gearbox units of the HBW line are equipped with a positively driven, mechanically operated helical gearing system. 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 spped, for example in emergency cases.

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

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 sea water 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).

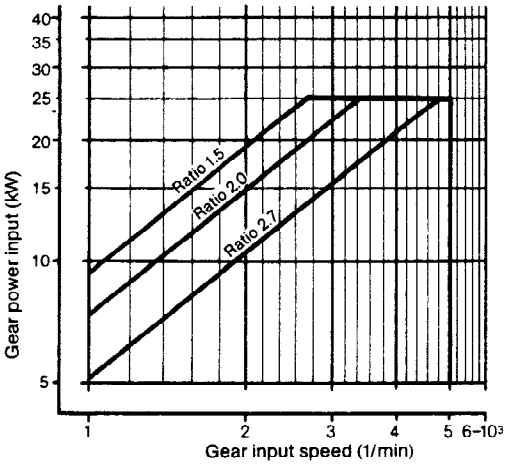
The shafts are supported by heavy-duty taper roller bearings and the gearbox is designed to take the axial propeller thrust (for permissible values see "Technical data", item 1.2).

All transmission sizes are available for right-hand (R) and left-hand (L) rotation of the input shaft.

1.2 Technical data and main dimensions

1.2.1 HBW 5

Power diagram



The diagram is based on engine power B to DIN 6270.
A shock factor has to be taken into account for engines having less 4 cylinders.

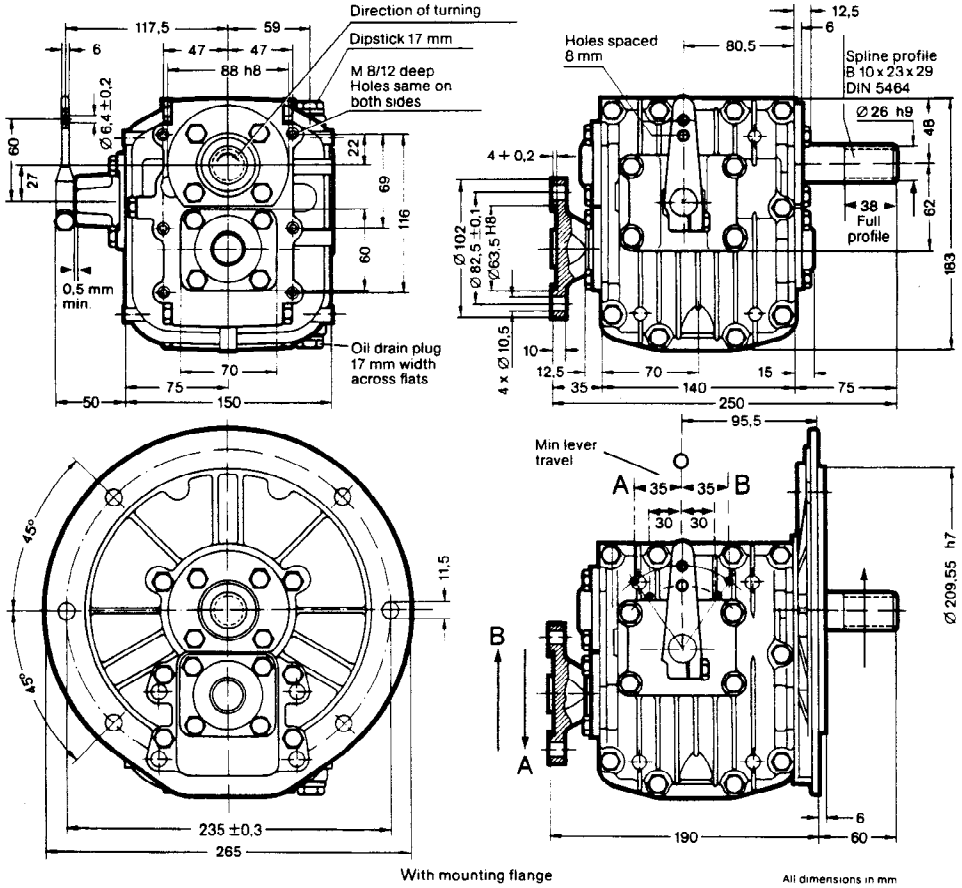
Technical data

		Gear ratios		
Forward Gear	A*	1.5	2.0	2.7
Reverse gear	B*	1.9	1.9	1.9
Input torque	M_{max}	90 Nm	70 Nm	50 Nm
Power input	P_{max}	25 kW		
Input speed	n_{max}	5000 1/min		
Propeller thrust	F_{max}	2000 N		
Weight without oil		9.5 kg		
Oil capacity		0.35 ltr		
Oil grade		Automatic transmission fluid (ATF), Type A		

* A = output shaft rotating opposite to input shaft

* B = output shaft rotating in same direction as input shaft

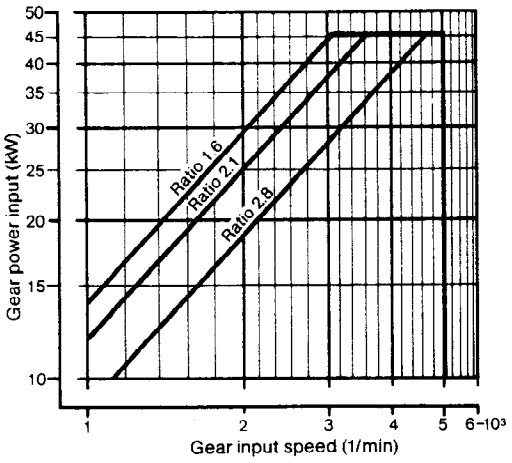
Main dimensions



1.2 Technical data and main dimensions

1.2.2 HBW 10

Power diagram



Technical data

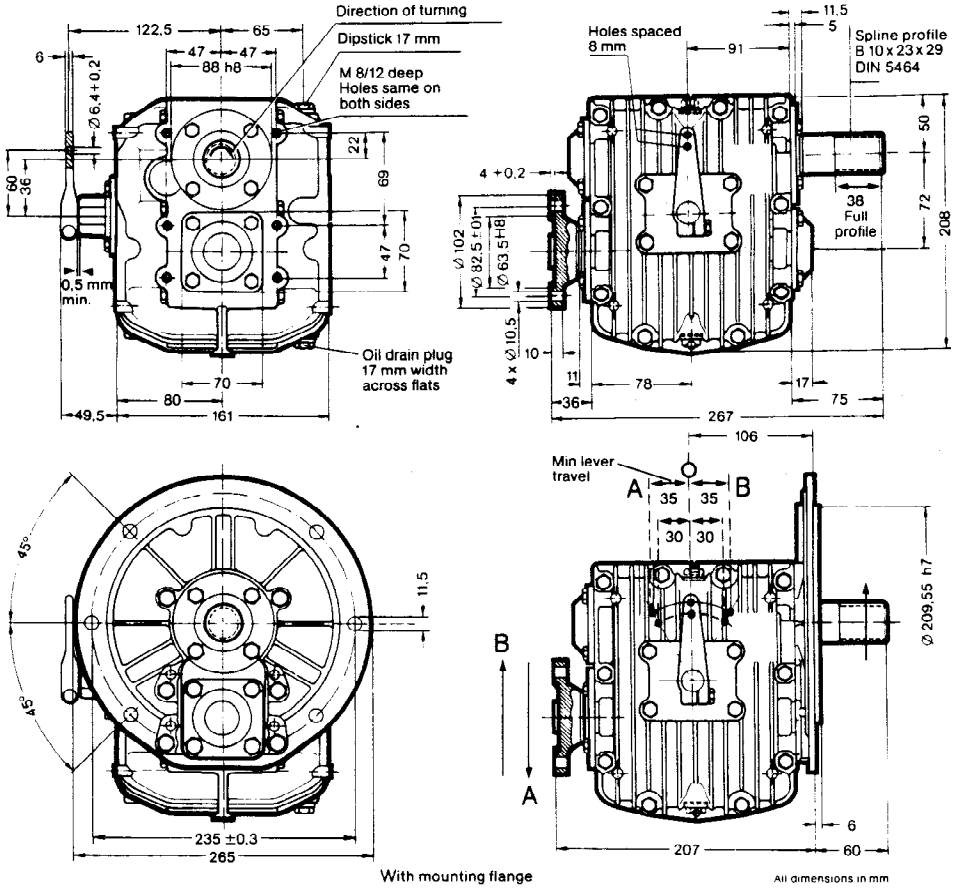
		Gear ratios		
Forward gear	A*	1.6	2.1	2.8
Reverse gear	B*	2.0	2.0	2.0
Input torque	M_{max}	140 Nm	120 Nm	90 Nm
Power input	P_{max}	45 kW		
Input speed	n_{max}	5000 1/min		
Propeller thrust	F_{max}	3500 N		
Weight without oil		13 kg		
Oil capacity		0.56 ltr		
Oil grade		Automatic transmission fluid (ATF), Type A		

* A = output shaft rotating opposite to input shaft

* B = output shaft rotating in same direction as input shaft

The diagram is based on engine power B to DIN 6270.
A shock factor has to be taken into account for engines having less 4 cylinders.

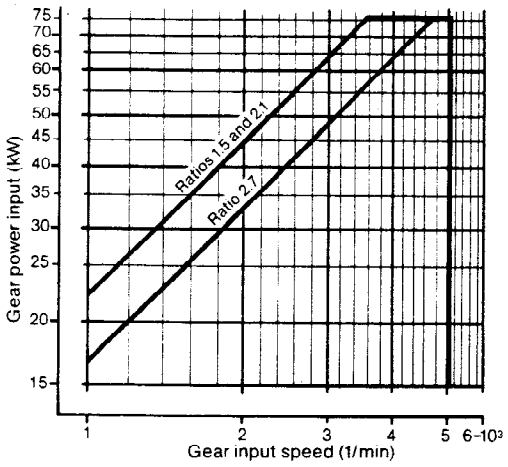
Main dimensions



1.2 Technical data and main dimensions

1.2.3 HBW 20

Power diagram



The diagram is based on engine power B to DIN 6270.
A shock factor has to be taken into account for engines having less 4 cylinders.

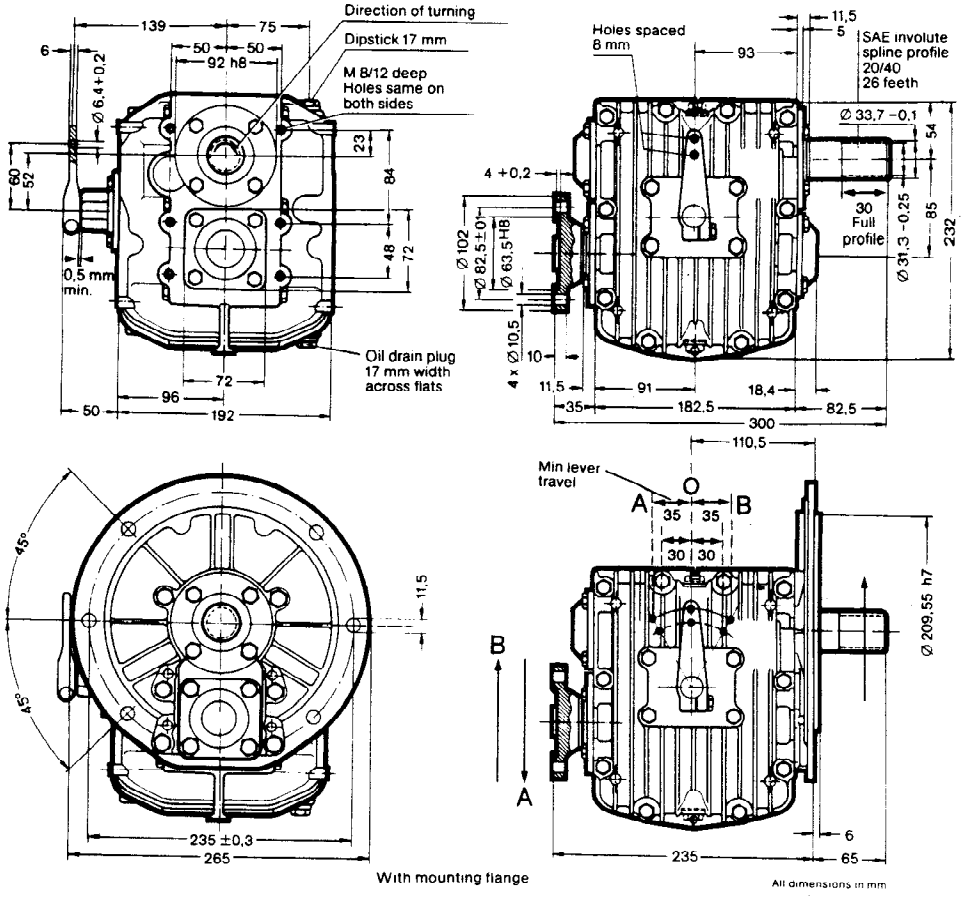
Technical data

		Gear ratios		
Forward gear	A*	1.5	2.1	2.7
Reverse gear	B*	2.1	2.1	2.7
Input torque	M_{max}	200 Nm	200 Nm	150 Nm
Power input	P_{max}	75 kW		
Input speed	n_{max}	5000 1/min		
Propeller thrust	F_{max}	6000 N		
Weight without oil		18 kg		
Oil capacity		0.75 l		
Oil grade		Automatic transmission fluid (ATF), Type A		

* A = output shaft rotating opposite to input shaft

* B = output shaft rotating in same direction as input shaft

Main dimensions



1.3 Gear casing

The rotating parts of the HBW transmission are accomodated in an oil-tight casing divided into two halves in the plane of the vertical axis. Amply dimensioned cooling ribs 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 shaft for actuating the multiple-disc clutch extends through a cover on the side of the gear casing.

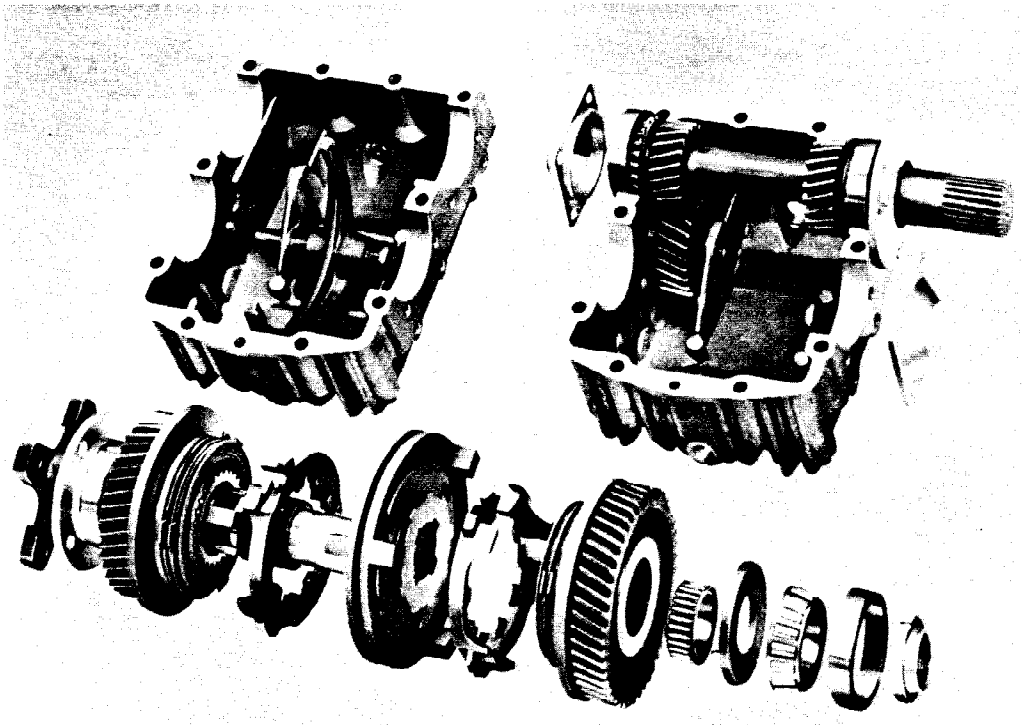
Tapped holes (see "Main dimensions", item 1.2) are provided on the face sides for bolting the transmission to a flywheel housing or an adaptor flange. All parts of the gear casing are chromized.

1.4 Gear sets

The transmission is equipped with shaved, casehardened helical gears made of forged low-carbon alloy steel. The multi-spline driving shaft connecting the transmission with the engine is hardened as well.

The driven shaft (propeller side) of the transmission is fitted with a forged coupling flange.

The direction of rotation of the input shaft is governed by the clutch system, but all HBW transmission units are available for clockwise (R = right hand) or counter-clockwise (L = left-hand) rotation.



1.5 Multiple-disc clutch including 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).

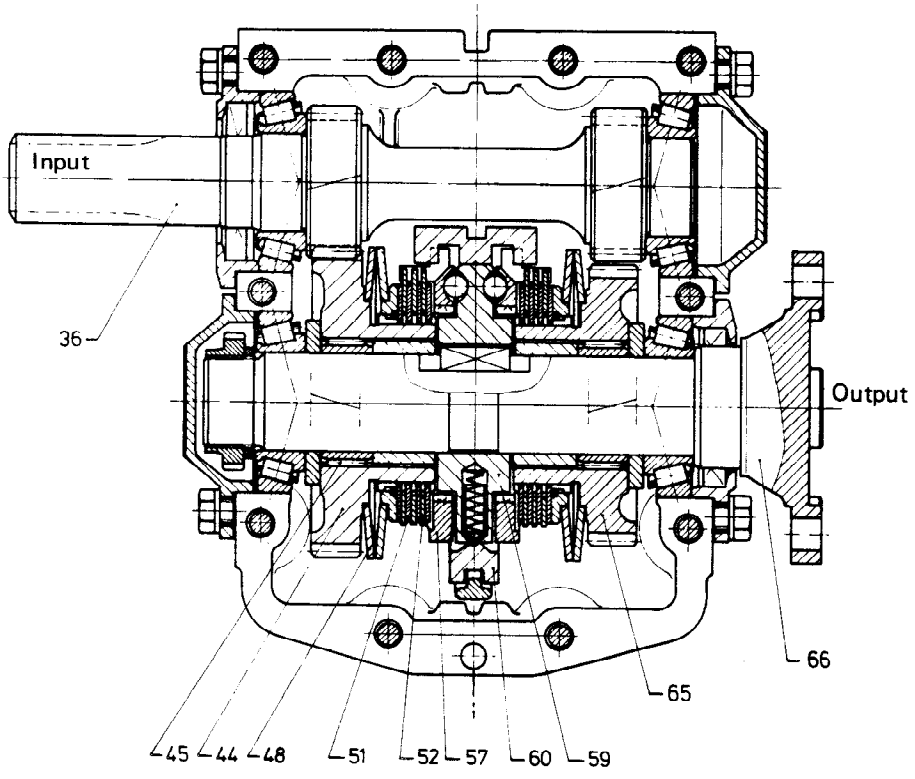
In shifting position B (see item 1.2), the torque is transmitted from the input shaft (36) via intermediate gear (26), gear (65), clutch discs (51 and 52) to the external disc carrier (57), the guide sleeve (59) and the output shaft (66).

– 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 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 cannot exceed a predetermined value, so that the torque transmission capacity of the clutch is limited.

The actuating sleeve (60) is held in the middle position by spring-loaded pins. To initiate 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 as described above.

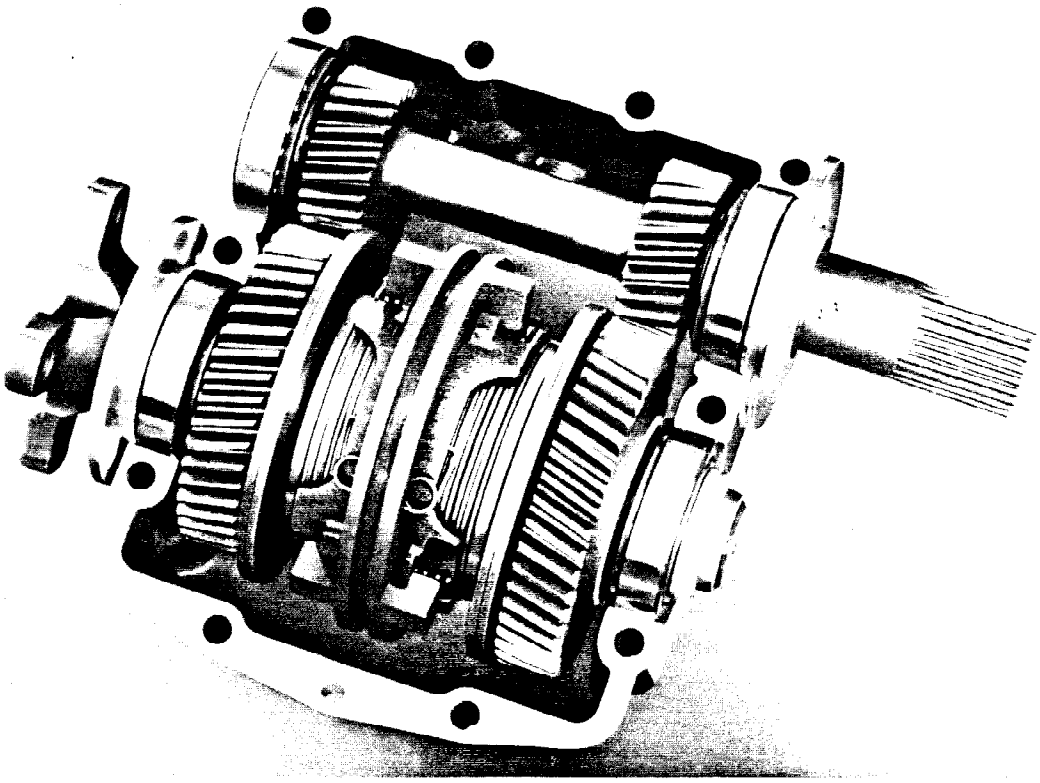


1.6 Shaft bearings

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.



1.7 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 and oil mist.

1.9 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. 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.

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 particularly to the input and output shafts.

2.3 Removal of preservative

Use a suitable solvent (e.g. diluent for cellulose lacquers) 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 the residual oil from the test run.

2.4 Painting the gearbox

Before painting the gearbox, take care to remove any oil films by means of suitable agents (e.g. HST safety cleansing fluid).

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 the 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 play should be at least 0.5 mm.

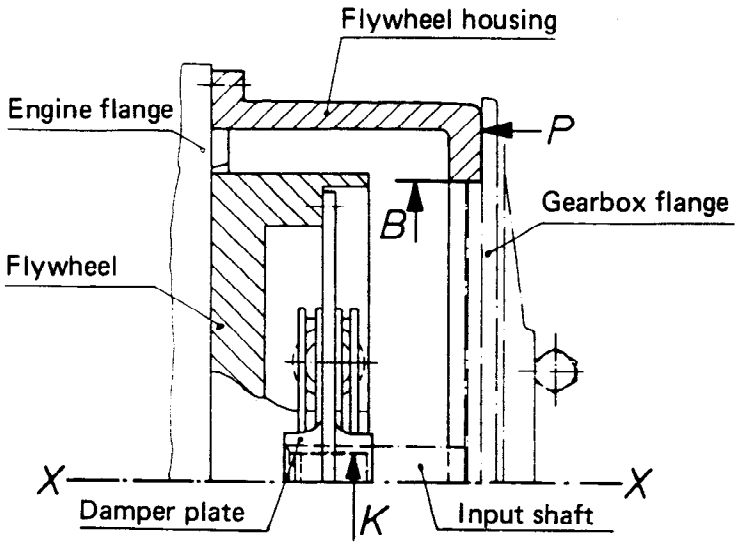
If the flywheel housing of the engine is of suitable design, the gearbox unit should be directly bolted to such housing by means of the tapped holes provided in the gearbox.

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 5	Similar to B10x23x29 DIN 5464	A10x23x29 DIN 5464
HBW 10	B10x23x29 DIN 5464	A10x23x29 DIN 5464
HBW 20	SAE 20/24 – 26 teeth	SAE 20/40 – 26 teeth

2.6 Connection of gearbox with propeller

Provision should be made for a flexible connection between the gearbox and the propeller shaft, in order to compensate for angular deflections and permit the transmission of thrust forces. The installation of a special propeller thrust bearing is not required, since the propeller thrust will be taken by the transmission bearing. 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.

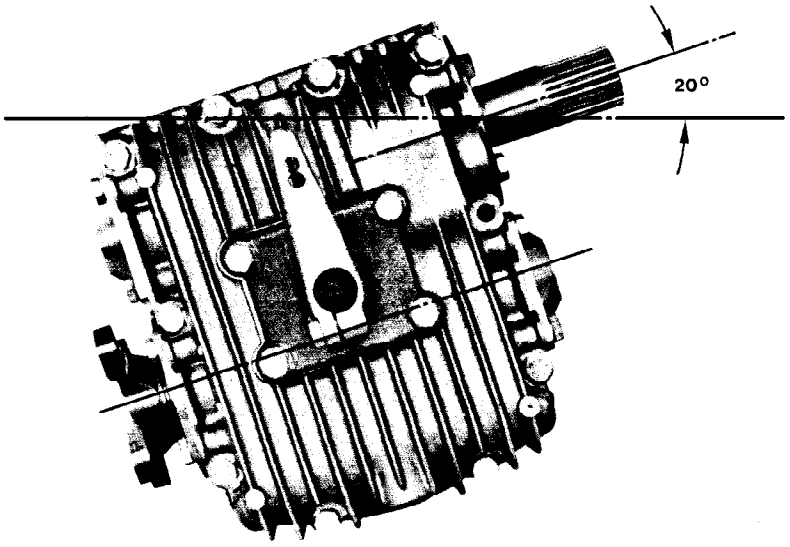
2.7 Suspension of engine-gearbox assembly in the boat

To protect the gearbox from detrimental stresses and loads, provision should be made for elastic suspension of the engine-gearbox assembly in the boat or craft.

The oil drain plug of the gearbox should be conveniently accessible.

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 20 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 case.

2.9 Operation of gearbox

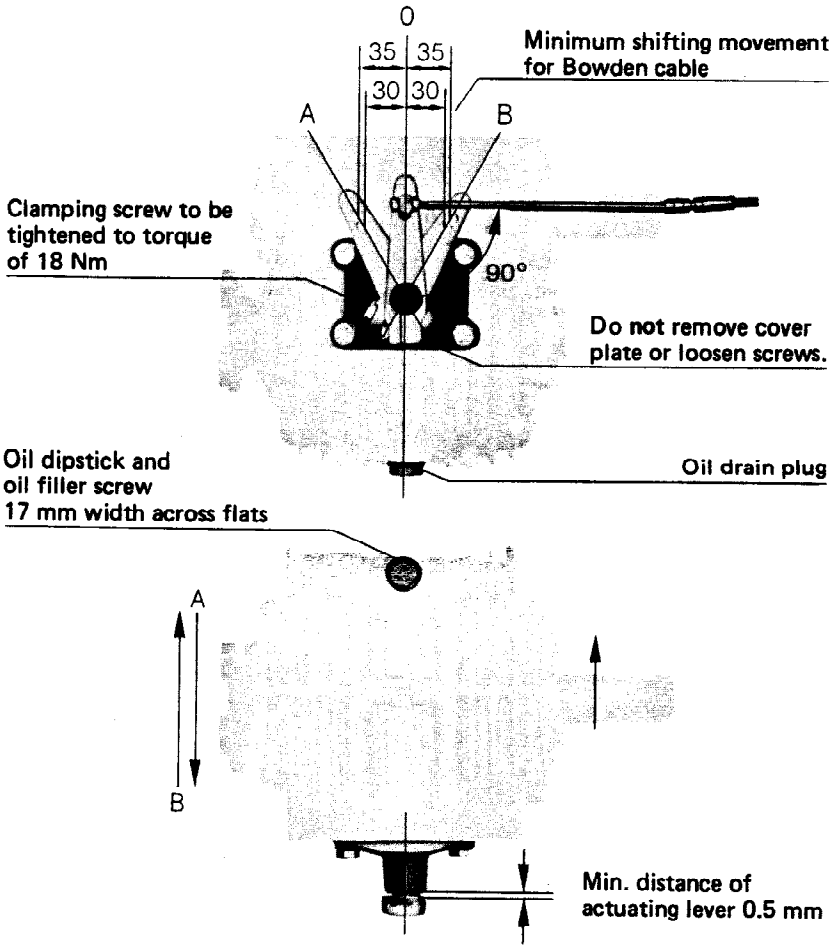
Gear changing requires only minimum effort. The gearbox is suitable for single lever remote control. Upon loosening the retaining screw, the actuating lever (see illustration) can be moved to any position required for the control elements (cable or rod linkage). Make certain that the lever does not contact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



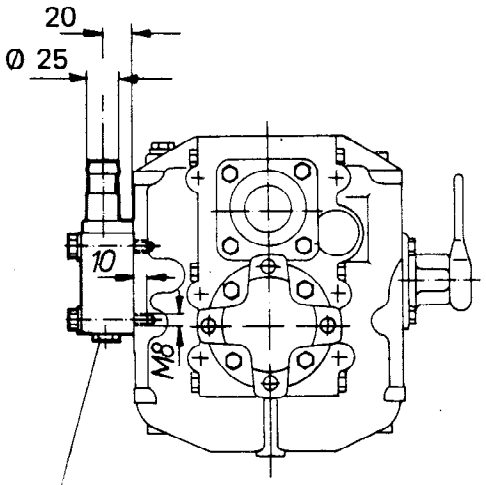
The position of the cover plate underneath the actuating lever is factory-adjusted to ensure equal lever travel from neutral position to A and B.

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

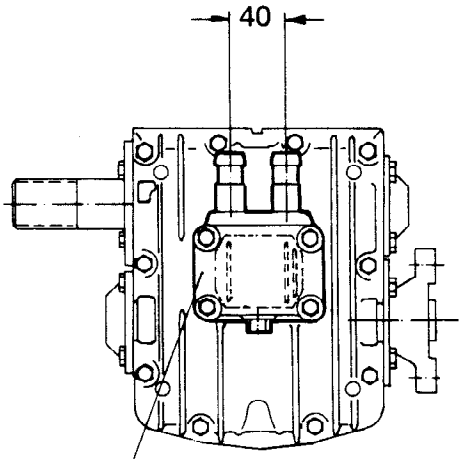
When installing the gearbox, make certain that shifting is not impeded e.g. by restricted movability of the Bowden cable or rod linkage, by unsuitably positioned guide sheaves, too small bending radius, etc.

2.10 Cooling unit

The arrangement of the cooling unit for the HBW 10 and HBW 20 (no cooling is required for HBW 5) can be seen from the following drawings.



Cooling water drain plug
17 mm width across flats



Cooling unit

The table below shows the maximum power output in continuous operation (lever positions 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 5	HBW 10	HBW 20
A	no cooling	no cooling	40
B	no cooling	30	always with cooling unit

In case of doubt please contact the transmission manufacturer.

2.9 Operation of gearbox

Gear changing requires only minimum effort. 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.

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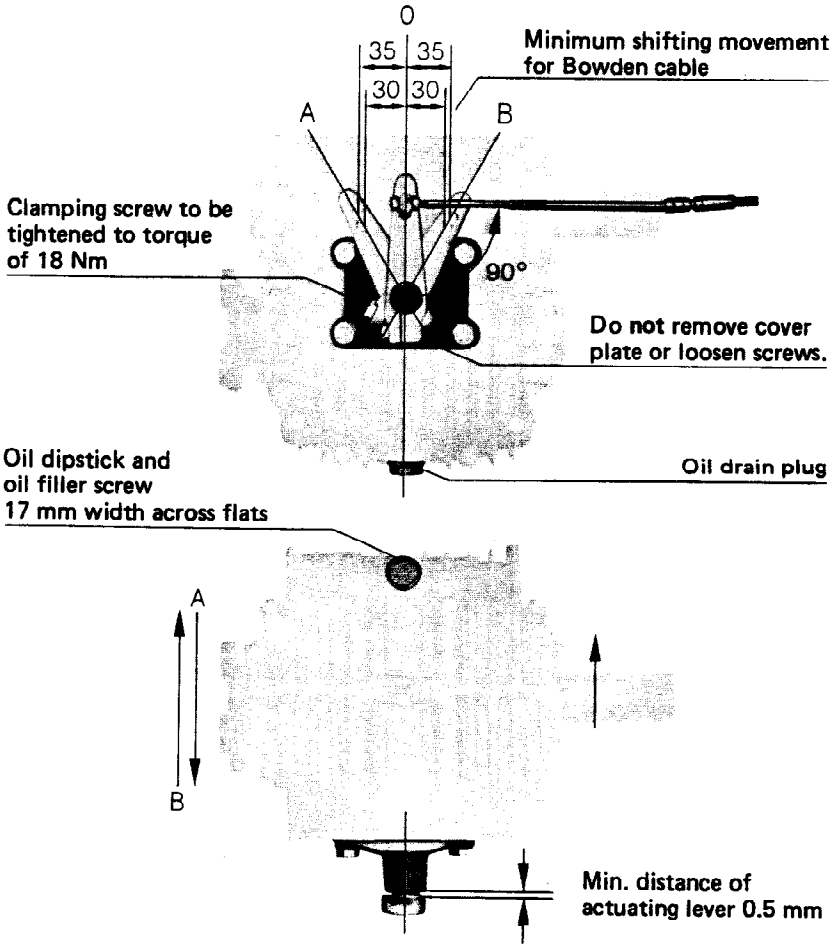


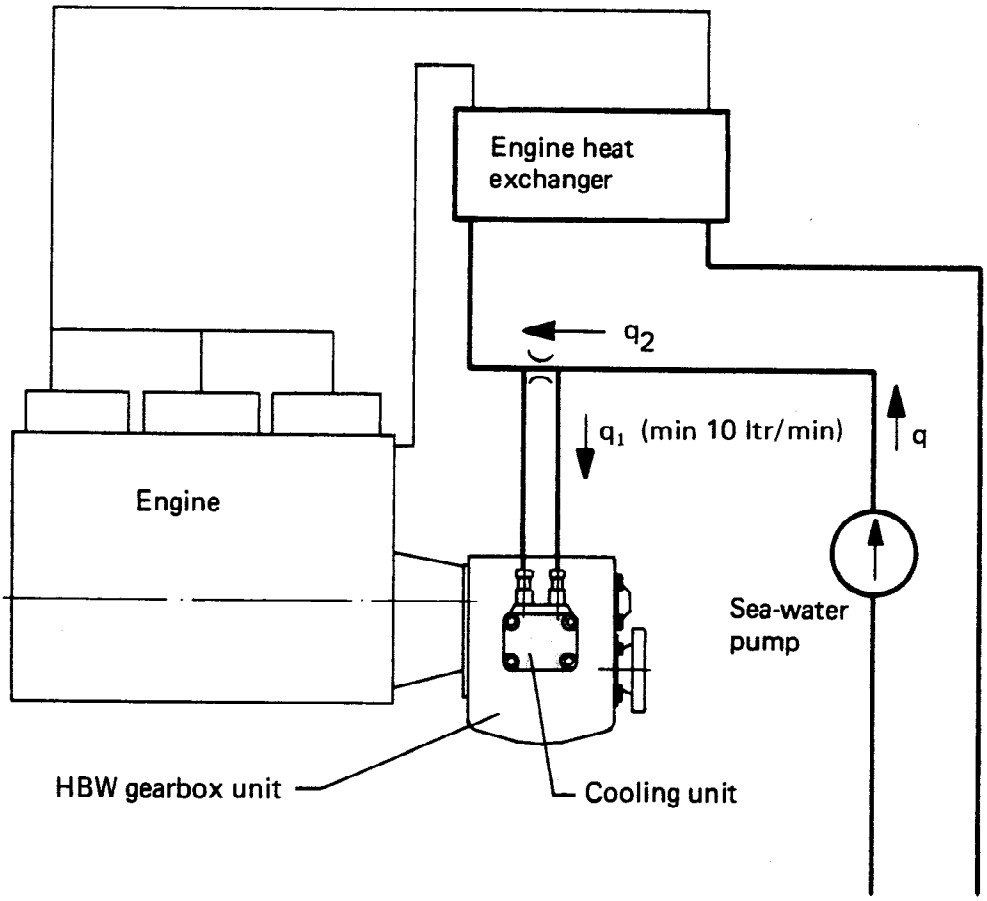
The position of the cover plate underneath the actuating lever is factory-adjusted to ensure equal lever travel from neutral position to A and B.

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

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

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 involves no problems (see item 6.14).



2.11 Engine-gearbox compartment

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

3. Operation

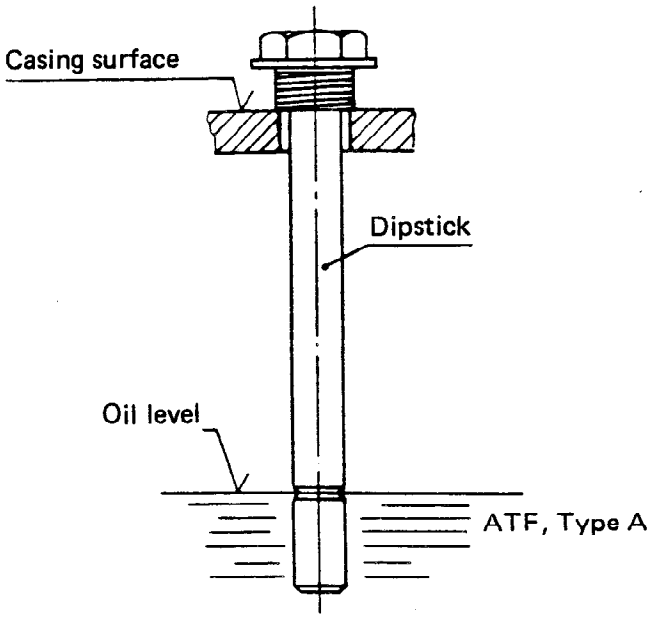
3.1 General information

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 of the recommended grade (see items 4.1 and 4.2). The oil level should be the index mark on the dipstick (see illustration).



Correct readings up to 20° inclination in direction of shafts

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.

3.3 Operating temperature

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

3.4 Operation of gearbox

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 **automatic** and cannot be influenced by external control. The actuating lever is mounted on an actuating shaft and fixed by means of a retaining screw.

Gear changing should be smooth, not too slow, and continuous (without interruption). The multiple-disc clutch permits gear changing at high engine rpm, including sudden reversing at top speeds in the event of danger.

3.5 Operation without load

Rotation of the propeller without load, e.g. while the boat is sailing, being towed, or anchored in a river, as well as idling of the engine with the propeller stopped, will have no detrimental effects on the gearbox.

Locking of the propeller shaft by an additional brake is not required, since locking is possible by engaging the reverse gear.

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

To ensure trouble-free operation of the clutch, only use oil of the recommended type.

Under no circumstances should the oil contain any additives such as molybdenum sulphite.

We recommend commercial Automatic Transmission Fluid (ATF), Type A.

4.2 Oil quantity

HBW 5 approx 0.4 ltr
HBW 10 approx 0.6 ltr
HBW 20 approx 0.8 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

Change the oil for 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. 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**

5.1 Removing the cooling unit

5.2 Removing and disassembling the actuating lever cover plate

5.3 Removing the bearing shields

5.4 Separating the gearbox sections and removing the input and output shafts

5.5 Removing the shifting fork

5.6 Removing the intermediate gear

5.7 Disassembling the input shaft

5.8 Disassembling the output shaft

5. Disassembly

Note: fold out illustration 9.1 and 9.2 (exploded views) for reference.

The tools and fixtures marked by thick lines in the drawings shown in the following instructions are available from HURTH.

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 level cover plate

5.2.1 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).

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

5.2.4 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).

5.4 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).

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

5.4.4 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.

5.5 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).

5.6 Removing the intermediate gear (26)

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

5.6.2 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).

5.7 Disassembling the input shaft (36)

5.7.1 Remove outer bearing races (32).

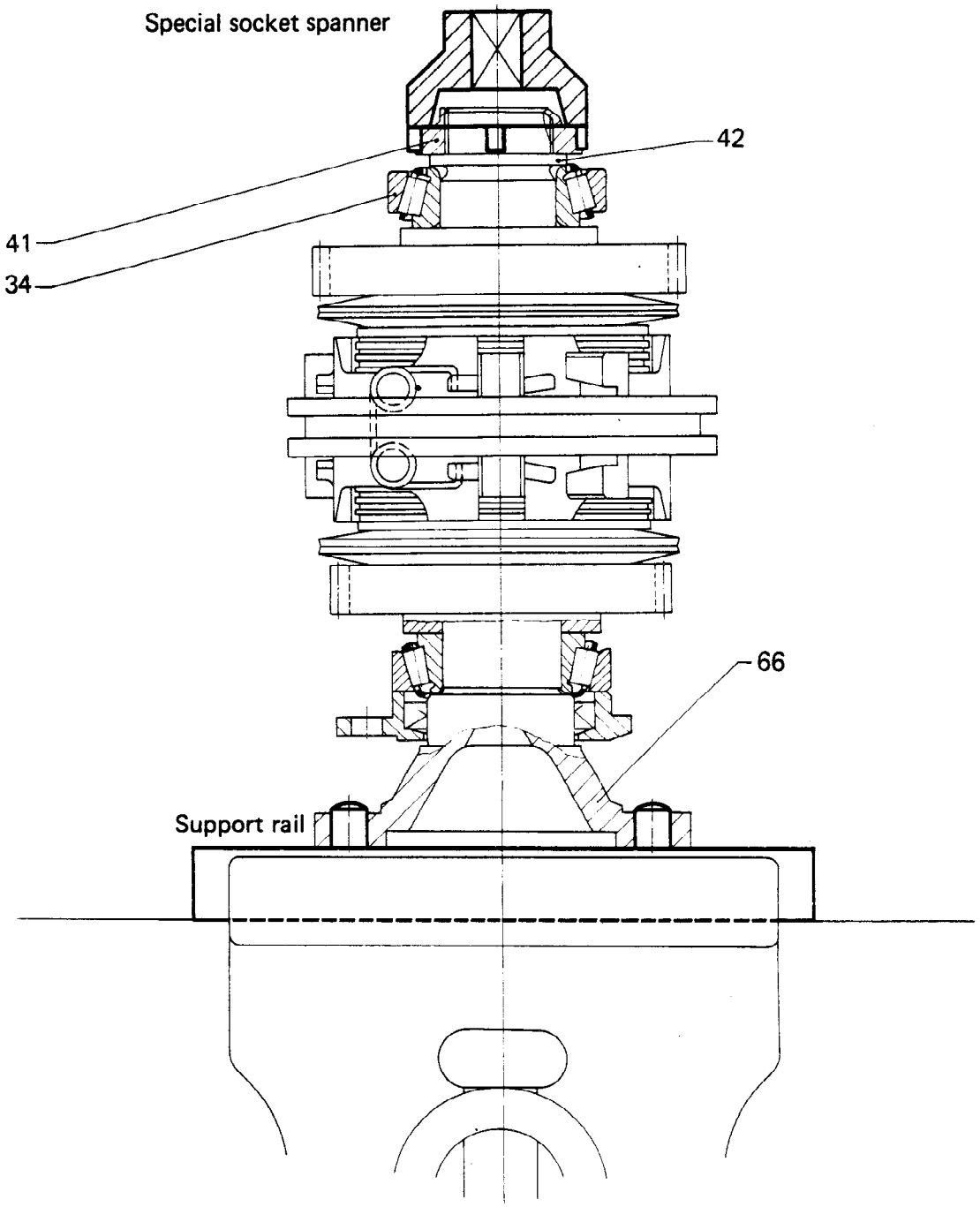
5.7.2 In the event of bearing damage, cautiously drive inner races (33) off the input shaft (36) with a punch (away from gear).

5.8 Disassembling the output shaft (66)

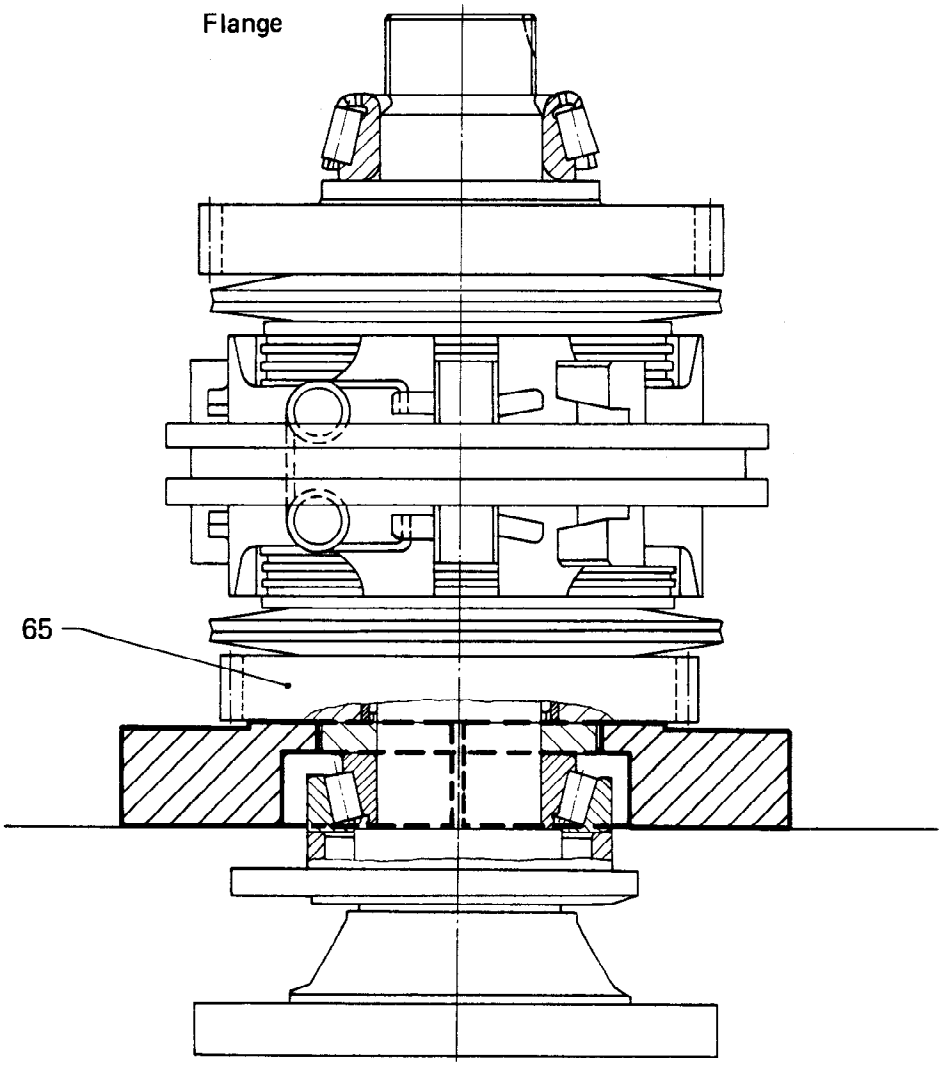
5.8.1 Mount support rail on a vice with the pins pointing upwards.

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

5.8.3 Remove grooved ring nut (41) by means of special socket spanner and take off spacer (42) and outer bearing race (34).



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).

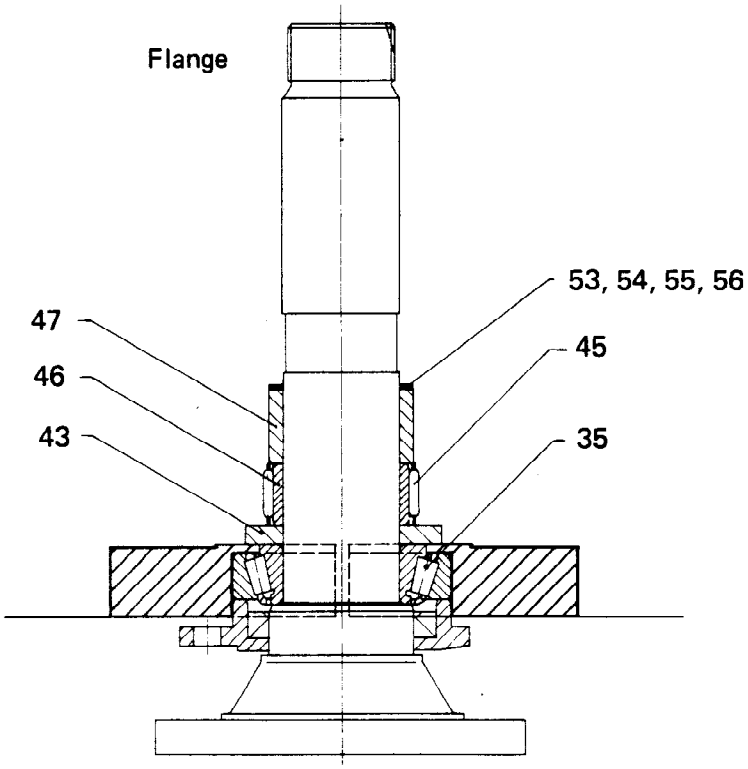


The parts removed from the threaded side of the shaft are not interchangeable with the parts removed from the flange side. Keep separately.

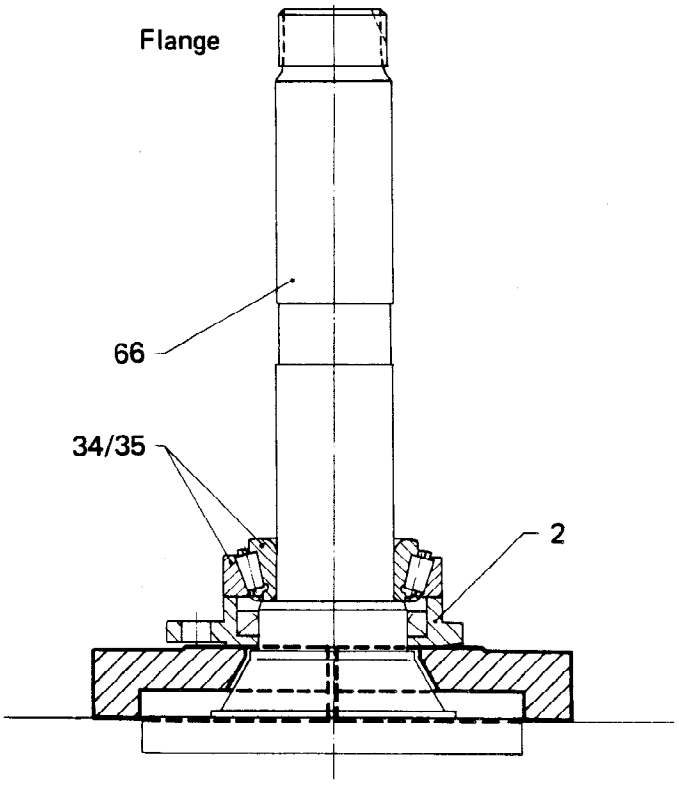
5.8.5 Remove keys (67) from the output shaft and keep in a separate place (2 keys for HBW 5, 1 key for HBW 10 and 4 keys for HBW 20).

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.

Take care not to damage cages (45 and 35).



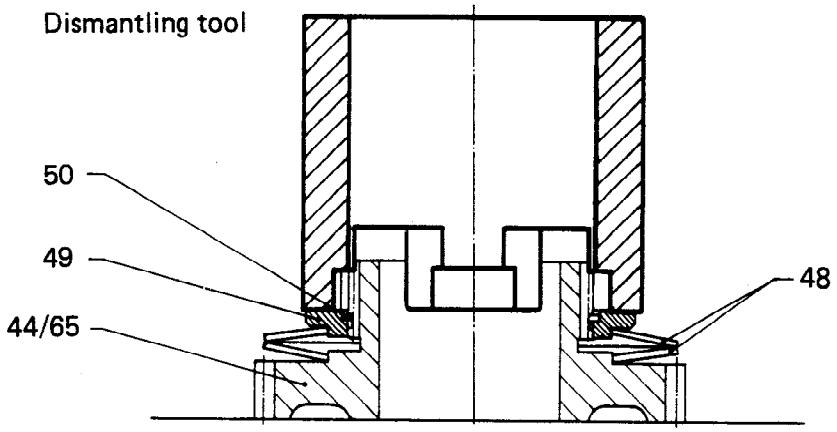
5.8.7 Attach divided flange to face side of bearing shield (2) and pull off taper roller bearing (34, 35) with shield.



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

5.8.9 **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.

6. Reassembly

Note: fold our illustrations 9.1 and 9.2 (exploded views) for reference.

The tools and fixtures marked by thick lines in the drawings shown in the following instructions are available from HURTH.

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.
- In the event of damage on the teeth of any gears, always replace the damaged gear and its mating gear.
- 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) appear "glazed", replace the discs.
- Immerse cleaned antifriction bearings in oil before installation.

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

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

6.2.2 Insert retaining plate (25).

Important
Note that the bevelled corners of retaining plates (25) have to be placed in different positions (see illustration 9.1).

6.2.3 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 20, 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 9.1).

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.**

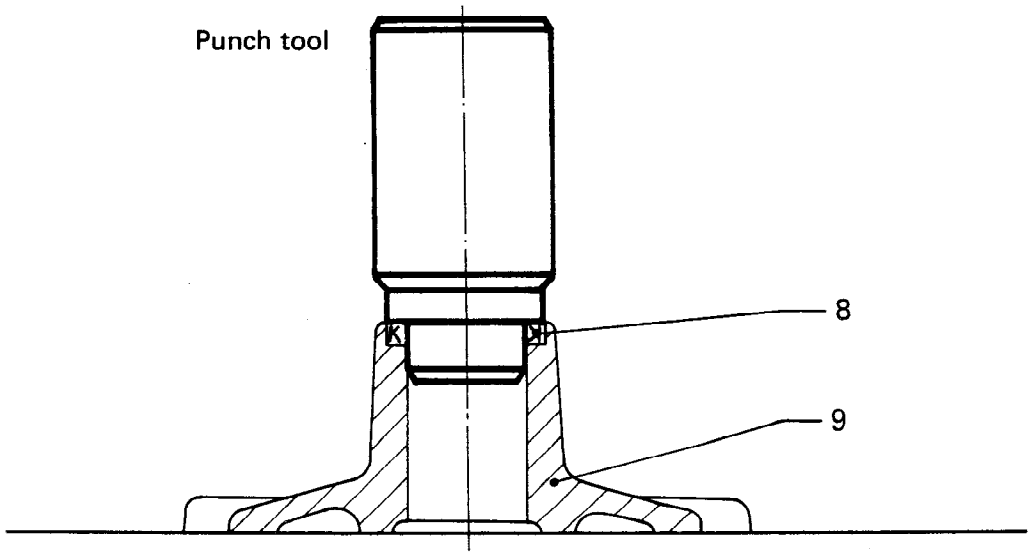
6.3.2 Insert shifting rod (16) through bores in gearbox and shifting fork.

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.



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

6.4.2 Fit actuating 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).

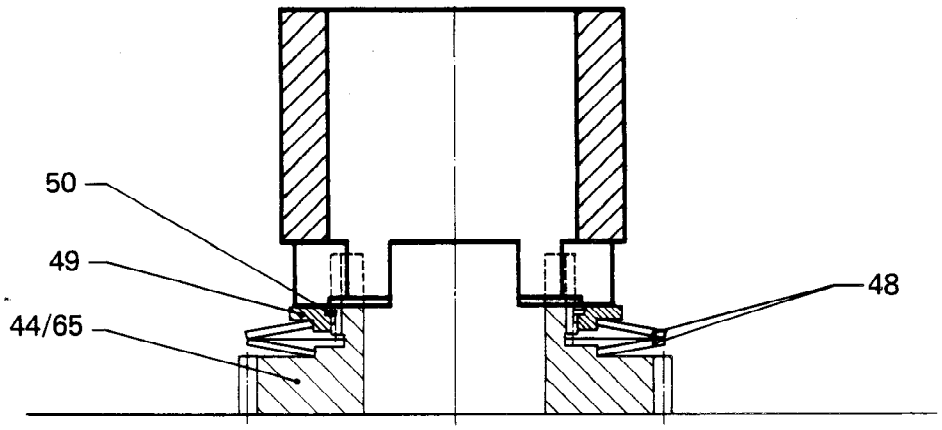
6.5 Pre-assembling the gears (65) and (44) with cup springs (48) and clutch discs (51 and 52)

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

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

6.5.2 Place thrust ring (49) on cup springs.

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



6.5.4 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 setting 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.

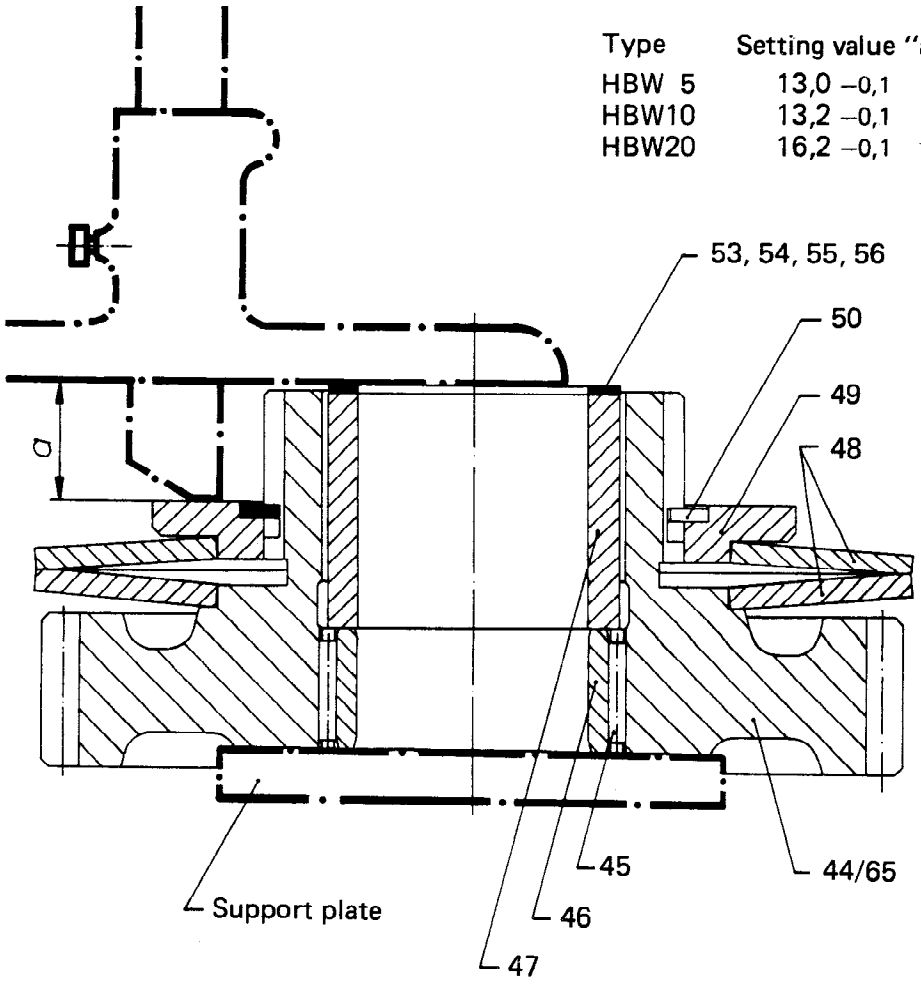
If measuring is required, proceed as follows:

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

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

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

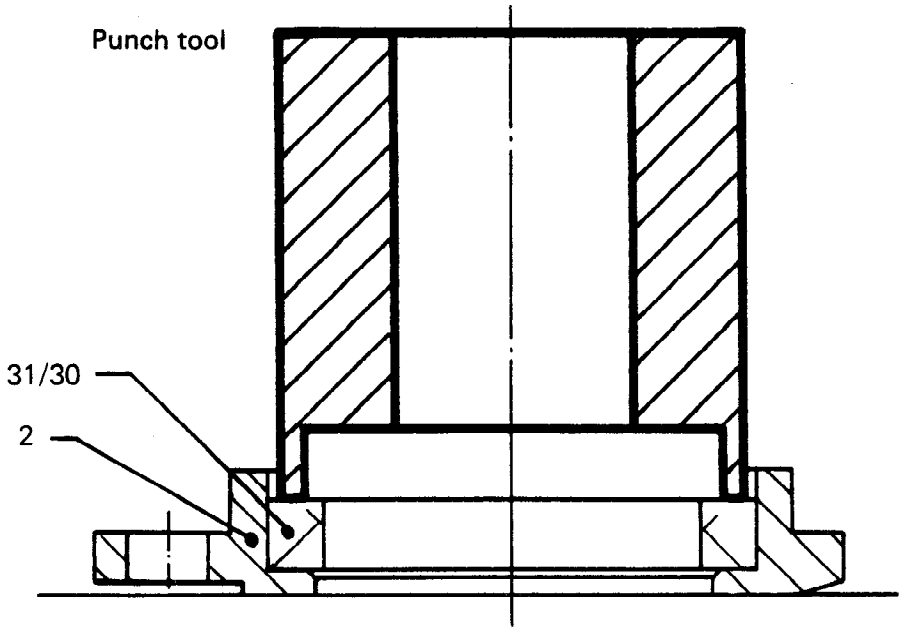
Type	Setting value "a"
HBW 5	13,0 –0,1
HBW10	13,2 –0,1
HBW20	16,2 –0,1



6.6.4 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).

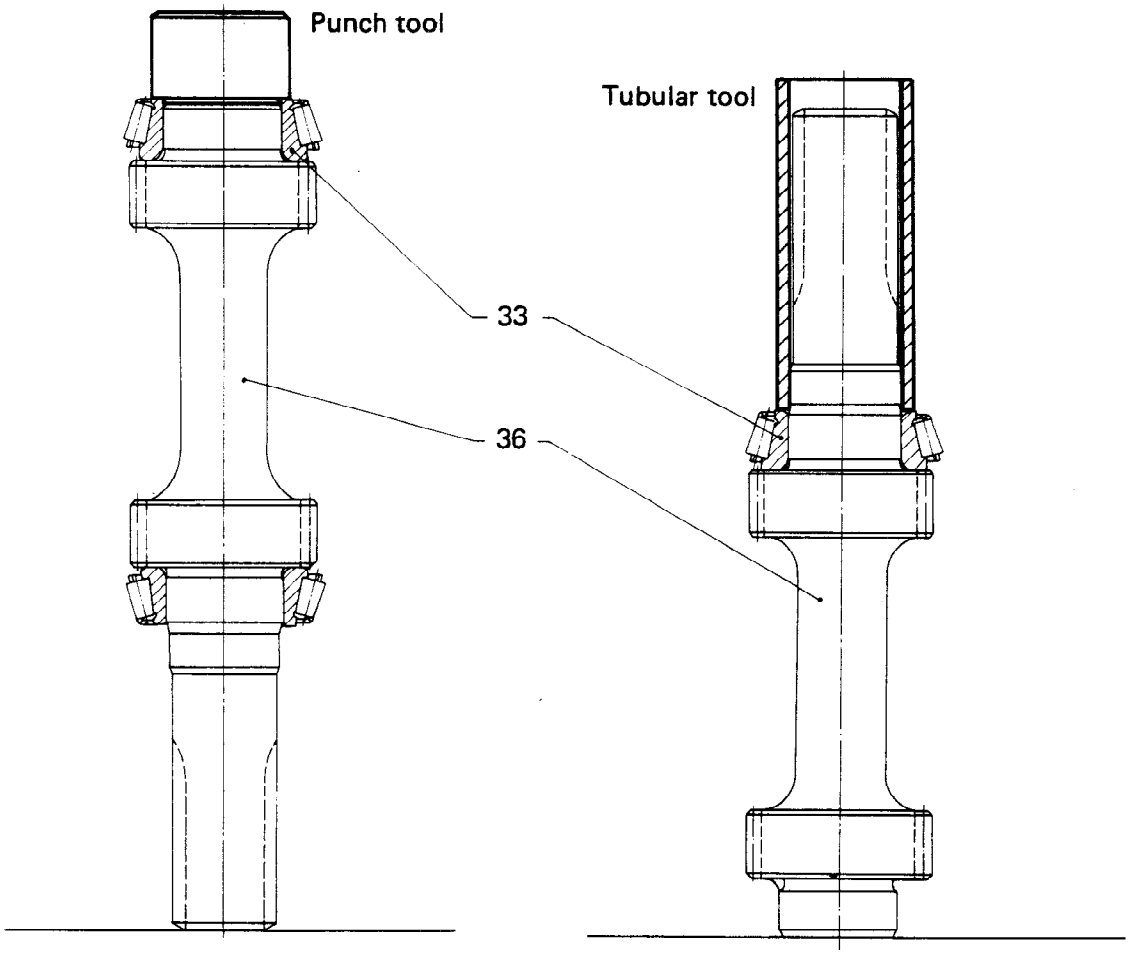
6.8.5 Insert balls (58) into ball pockets of guide sleeve, attach disc carrier (57), then fit balls on opposite face side and attach second disc carrier (57).

6.8.6 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 cooling 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).

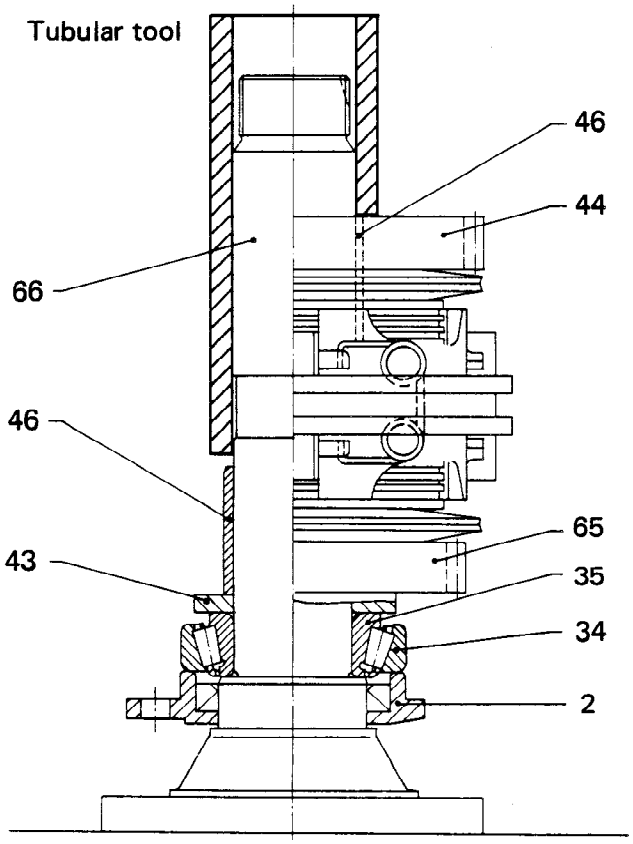
6.10.2 Attach outer race (34) of taper roller bearing.

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.

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 5, 1 for HBW 10 and 4 for HBW 20).

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).

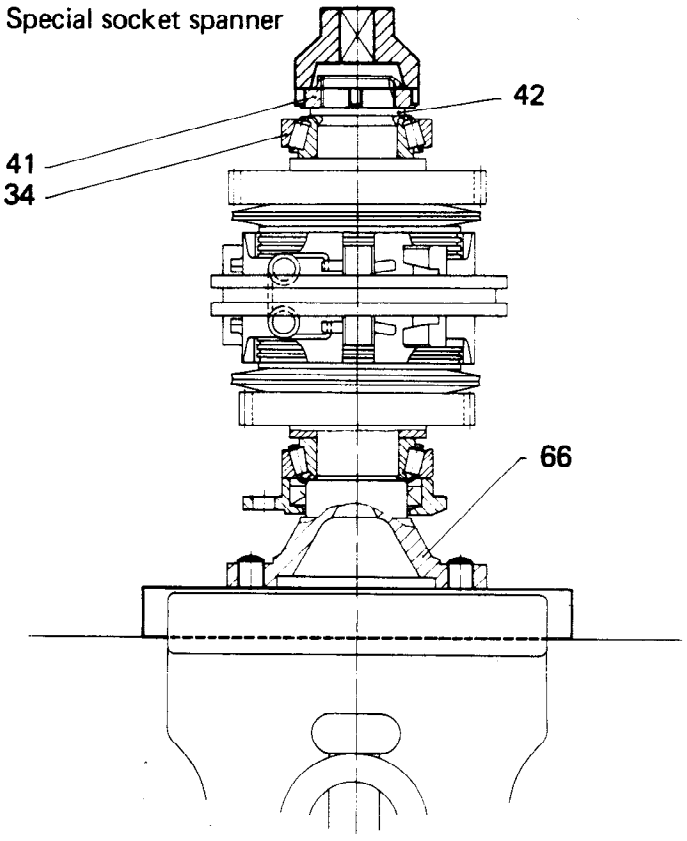
Align external discs for proper engagement with actuating member.

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. Tighten to torque of 95 Nm.



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 Final assembly of gearbox

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

6.11.2 Place pre-assembled output shaft (66) in lower part of gearbox with flange side towards intermediate gear side.

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

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

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

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

6.11.7 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.

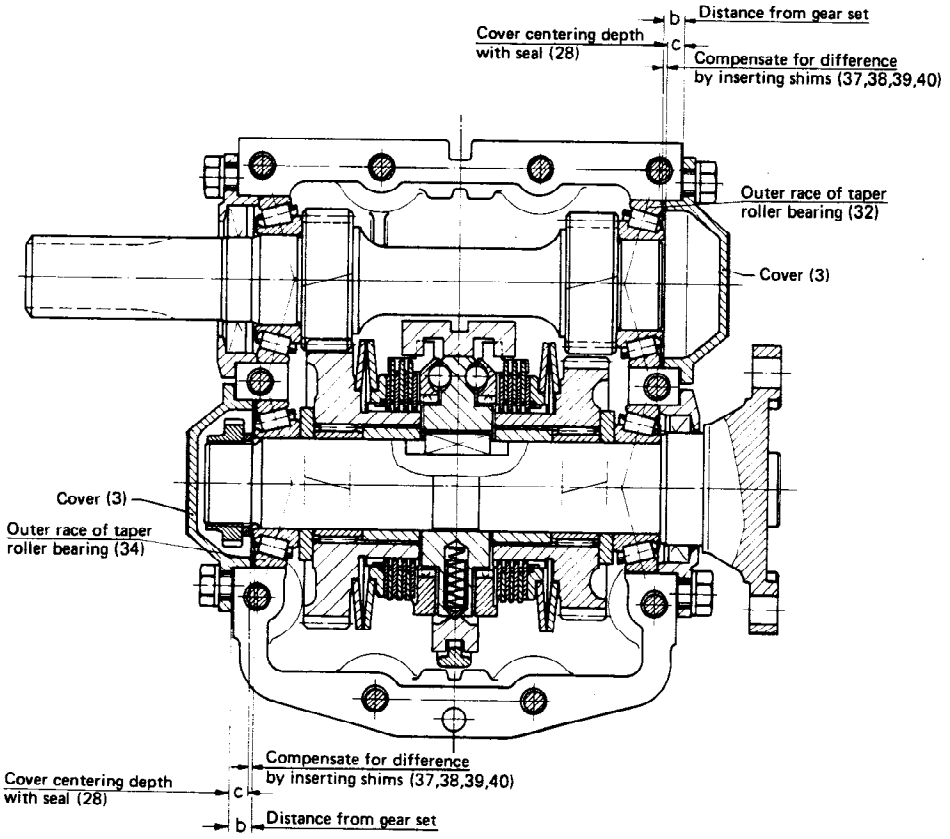
6.11.8 Slide pre-assembled bearing shield (2) with seal (28) over input shaft and secure by means of spring washer (4) and screws (5), using a 13 mm spanner (wrench).

6.12 Measuring the gear sets of input shaft and output shaft (see illustration)

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

6.12.2 Determine dimension "b" by means of depth gauge (see illustration).

6.12.3 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.



6.12.4 Insert the required number of shims into the bearing bores of the gearbox to obtain an axial play 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 without measuring.

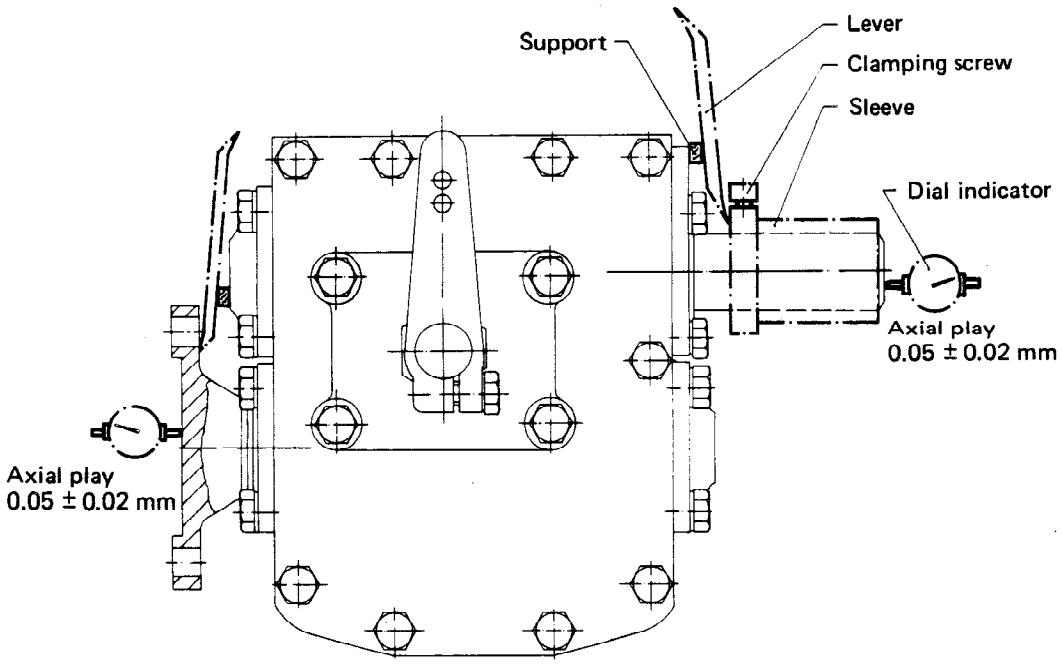
6.12.5 Mount the previously measured covers (3) on the output and input shafts by means of spring washers (4) and screws (5), using a 13 mm spanner (wrench). Tighten to torque of 14 Nm.

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.

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

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

6.12.8 Axial play 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 Mounting the actuating lever cover plate

6.13.1 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.

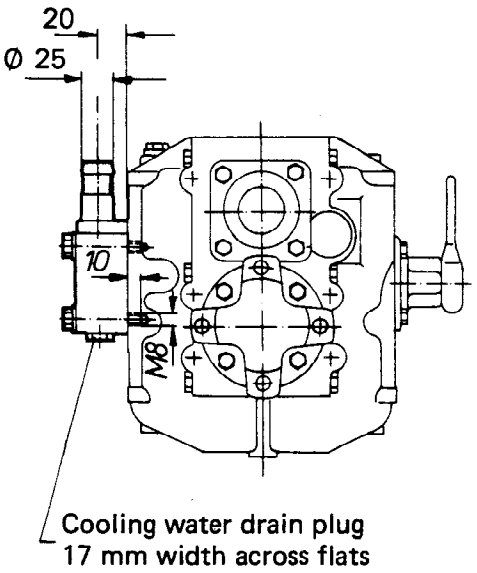
6.13.2 Fit spring washers (4) and screws (5), using a 13 mm spanner (wrench). Tighten to a torque of 14 Nm. Check actuating lever for proper operation.

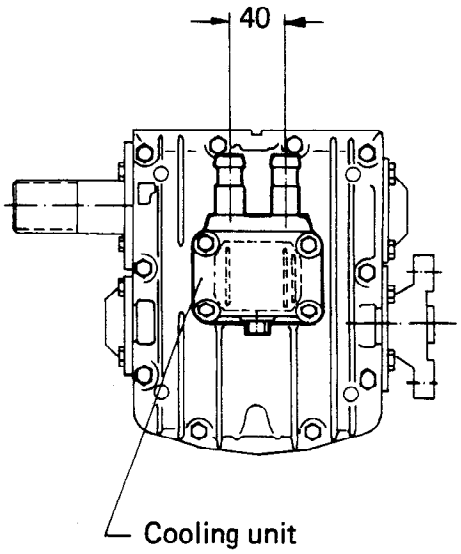
6.14 Mounting the cooling unit (if required)

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

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

6.14.2 Fit seal (29) and attach cooling cover by means of 4 screws M 8 x 50.





7. Spare parts list

7. Spare parts list

Note
It should be noted that the attached spare parts list is based on illustrations 9.1 and 9.2 (exploded views).

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.

Item No	Part name	Number per gearbox	HBW 5		HBW 10		HBW 20	
			Part No	Id No	Part No	Id No	Part No	Id No
1	Gearbox assembly	1	947.61.700.02.1	288 079	947.41.700.01.1	206 447	947.51.700.01.1 (1) 947.51.700.02.1 (2)	274.223 288 966
2	Bearing shield input output	1 1	947.61.004.01.4 947.61.003.01.4	288 768 288 787	947.41.004.01.4	206 450	947.51.004.01.4	274 248
3	Cover	2	947.61.005.01.4	288 730	947.41.005.01.4	206 452	947.51.005.01.4	274 219
4	Spring HBW 5 and 10	38	B8 DIN 137 Cd-plated	159 843	B8 DIN 137 Cd-plated	159 843		
	washer HBW 20	40					B8 DIN 137 Cd-plated	159 843
5	Hex head screw (cover)	20	M8x16 DIN 933 8.8 Cd-plated	215 870	M8x16 DIN 933 8.8 Cd-plated	215 870	M8x16 DIN 933 8.8 Cd-plated	215 870
6	Actuating lever	1	947.23.006.01.4	195 062	947.23.006.01.4	195 062	947.23.006.01.4	195 062
7	Hex head screw (actuating lever)	1	M8x20 DIN 933 8.8 Cd-plated	199 807	M8x20 DIN 933 8.8 Cd-plated	199 807	M8x20 DIN 933 8.8 Cd-plated	199 807
8	Radial sealing ring	1	SD 20 x 26 x 4	106 864	SD 20 x 26 x 4	106 864	SD 20 x 26 x 4	106 864
9	Cover plate	1	947.41.003.01.3	206 448	947.41.003.01.3	206 448	947.41.003.01.3	206 448
10	Spring dowel pin	1	4 x 12 DIN 1481	104 559	4 x 12 DIN 1481	104 559	4 x 12 DIN 1481	104 559
11	Actuating cam assembly	1	947.53.703.01.4	304 332	947.53.703.01.4	304 332	947.53.703.01.4	304 332
15	Shifting fork assembly	1	947.63.700.01.4	288 721	947.43.700.01.4	223 563	947.53.700.01.4	274 224
16	Actuating shaft	1	947.43.002.01.4	206 484	947.43.002.01.4	206 484	947.53.002.01.4	288 673
17	Screw plug	1	M16x1,5 DIN 906 5.8 Cd-plated	215 877	M16x1,5 DIN 906 5.8 Cd-plated	215 877	M16x1,5 DIN 906 5.8 Cd-plated	215 877
18	Sealing ring	2	A16x20 DIN 7603/AL	227 851	A16x20 DIN 7603/AL	227 851	A16x20 DIN 7603/AL	227 851
19	Oil dipstick/breather ass'y	1	947.61.701.01.4	288 729	947.41.701.01.4	206 929	947.51.701.01.4	274 217
20	Oil drain plug	1	947.41.008.01.4	228 566	947.41.008.01.4	228 566	947.41.008.01.4	228 566
21	Hex head screw	10	M8x90 DIN 931 8.8 Cd-plated	215 869	M8x90 DIN 931 8.8 Cd-plated	215 869	M8x110 DIN 931 8.8 Cd-plated	279 058

(1) Ratios 1.5:1 and 2:1
(2) Ratio 3:1

Item No	Part name	Number per gearbox	HBW 5		HBW 10		HBW 20	
			Part No	Id No	Part No	Id No	Part No	Id No
22	HBW 5 and 10	8						
	Hex nut		M8 DIN 934 5 Cd-plated	103 876	M8 DIN 934 5 Cd-plated	103 876	M8 DIN 934 5 Cd-plated	103 876
	HBW 20	10						
23	O-ring or plug	1	OR12,30-2,40-00636/59	105 679	OR14,00-3,00-00794/09	105 530	A32 DIN 443 Cd-plated	285 375
24	Intermediate gear shaft	1	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	947.42.009.01.4	206 473	947.52.009.01.4	288 702
26	Intermediate gear	1	947.62.004.02.4	288 078	947.42.004.02.4	254 730	947.52.004.01.4	274 226
27	Cage	1	DKK16x24x20	280 128	DKK 20x30x24	215 878	KK 20x30x28	222 273
28	Seal	4	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
30	Radial sealing ring, input	1	A27x37x7 DIN 3760 AC	280 135	B30x52x7 DIN 3760	215 875	35x52x7 B1 72 NBR 769	284 260
31	Radial sealing ring, output	1	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 K-LM 67010	215 874	32007 X DIN 720	167 210
33	Taper roller bearing, input	2	INTL KL 44649	280 129	INTL K-LM 67048	215 873		
34	Taper roller bearing, output	2	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 K-LM 67048	215 873	INTL K 15123	279 061

Item No	Part name		Number per gearbox	HBW 5		HBW 10		HBW 20	
				Part No	Id No	Part No	Id No	Part No	Id No
36	Input shaft	1.5 R – 27/22 teeth	1	947.62.001.05.3	304 059				
		2 R – 22/22 teeth	1	947.62.001.03.3	288 077				
		3 R – 18/22 teeth	1	947.62.001.06.3	304 074				
		2 L – 27/22 teeth	1	947.62.001.03.3	288 077				
		1.5 R – 27/22 teeth	1			947.42.001.03.3	304 088		
		2 R – 22/22 teeth	1			947.42.001.01.3	206 460		
		3 R – 18/22 teeth	1			947.42.001.02.3	206 786		
		2 L – 22/22 teeth	1			947.42.001.01.3	206 460		
		1.5 R – 28/21 teeth	1					947.52.001.04.2	304 081
		2 R – 23/21 teeth	1					947.52.001.01.2	274 231
		3 R – 19/18 teeth	1					947.52.001.02.2	288 967
		2 L – 23/21 teeth	1					947.52.001.03.2	288 241
37	Shim		2	947.62.010.01.4	288 731	947.42.010.01.4	206 474	947.52.010.01.4	274 252
38	Shim		2	947.62.010.02.4	288 732	947.42.010.03.4	206 476	947.52.010.02.4	274 253
39	Shim		2	947.62.010.04.4	288 734	947.42.010.06.4	228 540	947.52.010.03.4	274 254
40	Shim		2	947.62.010.05.4	288 735	947.42.010.05.4	228 539	947.52.010.04.4	274 255
41	Grooved ring nut		1	947.62.014.01.4	288 750	947.02.014.01.4	145 382	947.02.014.01.4	145 382
42	Spacer		2	947.62.018.01.4	288 751	30x37x3HN 145 102	147 998	30x37x3 HN 145 102	145 998
43	Thrust ring		2	947.62.017.01.4	288 748	947.22.025.03.4	195 960	965.01.004.01.4	277 109

Item No	Part name		Number per gearbox	HBW 5		HBW 10		HBW 20	
				Part No	Id No	Part No	Id No	Part No	Id No
44	Forward gear	Ratio 1.5 – 40 teeth	1	947.62.002.03.3	304 060				
		Ratio 2.0 – 45 teeth	1	947.62.002.01.3	288 764				
		Ratio 2.7 – 49 teeth	1	947.62.002.02.3	287 455				
		Ratio 1.6 – 42 teeth	1			947.42.002.04.3	304 090		
		Ratio 2.1 – 47 teeth	1			947.42.002.03.3	254 720		
		Ratio 2.8 – 51 teeth	1			947.42.002.02.3	206 787		
		Ratio 1.5 – 43 teeth	1					947.52.002.03.3	304 083
		Ratio 2.1 – 48 teeth	1					947.52.002.01.3	274 243
		Ratio 2.7 – 52 teeth	1					947.52.003.02.3	288 971
45	Needle cage		2	K32x36x15	280 132	37x42x17	201 187	K 37x42x17	201 187
46	Needle bearing inner race		2	947.62.021.01.4	288 759	947.52.008.02.4	251 524	947.42.008.02.4	251 524
47	Spacer		2	947.62.015.01.4	288 756	947.42.015.01.4	250 992	947.52.015.01.4	274 242
48	Cup spring		4	947.62.016.01.3	288 754	947.42.016.01.3	254 712	947.32.012.03.3	270 175
49	Thrust ring		2	947.62.008.01.4	288 755	947.22.008.03.4	304 155	947.52.008.01.4	274 271
50	Circlip		2	SB 46	280131	SW 55	199 808	J60 x 2 V	277 055
51	Internal clutch disc	HBW 5 and 10	8	947.62.019.01.4	288 757	947.42.017.01.4	288 912		
		HBW 20	10					947.52.007.01.4	288 889
52	External clutch disc	HBW 5 and 10	6	947.62.020.01.4	288 759	947.22.024.01.4	187 874	947.32.024.01.4	206 026
		HBW 20	8						
53	Shim 0.4 mm		2	947.62.022.01.4	288 760	947.22.033.01.4	195 714	947.22.033.01.4	195 714
54	Shim 0.5 mm		2	947.62.022.02.4	288 761	947.22.033.02.4	195 715	947.22.033.02.4	195 715
55	Shim 0.6 mm		2	947.62.022.03.4	288 762	947.22.033.03.4	195 716	947.22.033.03.4	195 716
56	Shim 0.7 mm		2	947.62.022.04.4	288 763	947.22.033.04.4	195 717	947.22.033.04.4	195 717

Item No	Part name		Number per gearbox	HBW 5		HBW 10		HBW 20	
				Part No	Id No	Part No	Id No	Part No	Id No
57	Disc carrier		2	947.62.013.01.2	288 713	965.11.013.01.2	288 160	947.52.013.01.2	274 245
58	Ball		6	7.5 mm III DIN 5401	280 133	8 mm III DIN 5401	106 700	9 mm III DIN 5401	106 732
59	Guide sleeve		1	947.62.011.01.2	288 717	947.42.011.02.2	288 394	947.52.011.01.2	274 247
60	Actuating sleeve		1	947.62.012.01.2	288 715	947.42.012.02.2	206 817	947.52.012.01.2	274 244
61	Compression spring (actuating members)		3	947.62.023.02.4	287 525	947.22.012.02.4	287 401	947.22.012.02.4	287 401
62	Detent pin		3	947.62.024.01.4	288 766	947.22.011.02.4	187 840	947.22.011.02.4	187 840
63	Driving pin		3	947.62.025.01.4	288 767	947.22.029.01.4	195 271	947.22.029.01.4	195 271
64	Spring		3	947.42.014.02.4	206 798	947.42.014.02.4	206 798	947.42.014.02.4	206 798
65	Reverse gear	Ratio 1.9 – 41 teeth	1	947.62.003.02.3	288 084				
		Ratio 2.0 – 43 teeth	1			947.42.003.02.3	254 718		
		Ratio 2.1 – 44 teeth	1					947.52.003.01.3	274 240
		Ratio 2.7 – 49 teeth	1					947.52.002.02.3	288 969
66	Output shaft		1	947.62.005.01.3	288 749	947.42.005.02.3	254 706	947.52.005.01.2	274 239
67	Key	HBW 5	2	B8x7x18 DIN 6885	280 130				
		HBW 10	1			947.22.013.02.4	187 841		
		HBW 20	4					947.32.018.01.4	206 121

8. Trouble-shooting

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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 malfunctions.

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.

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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 malfunctions.

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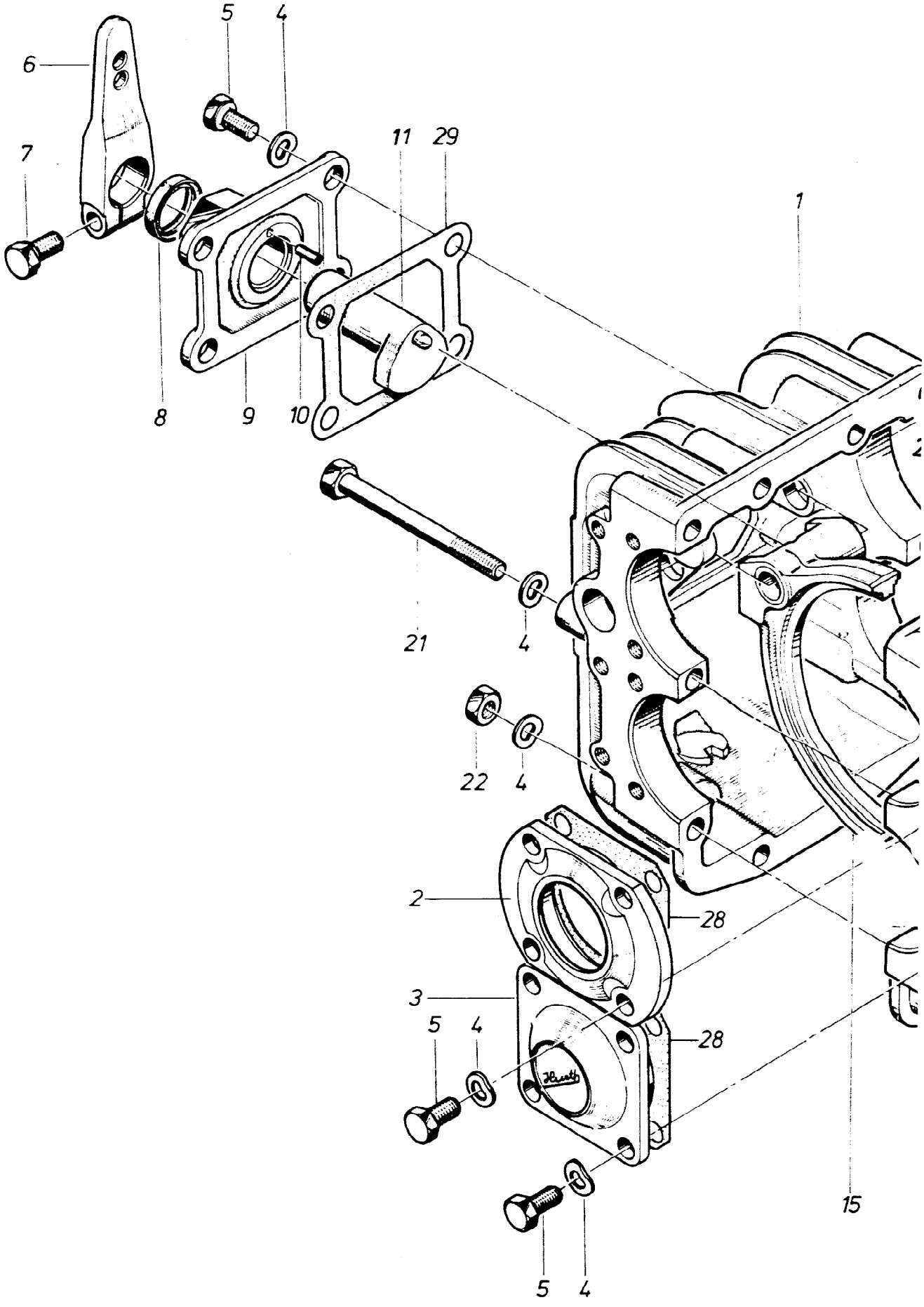
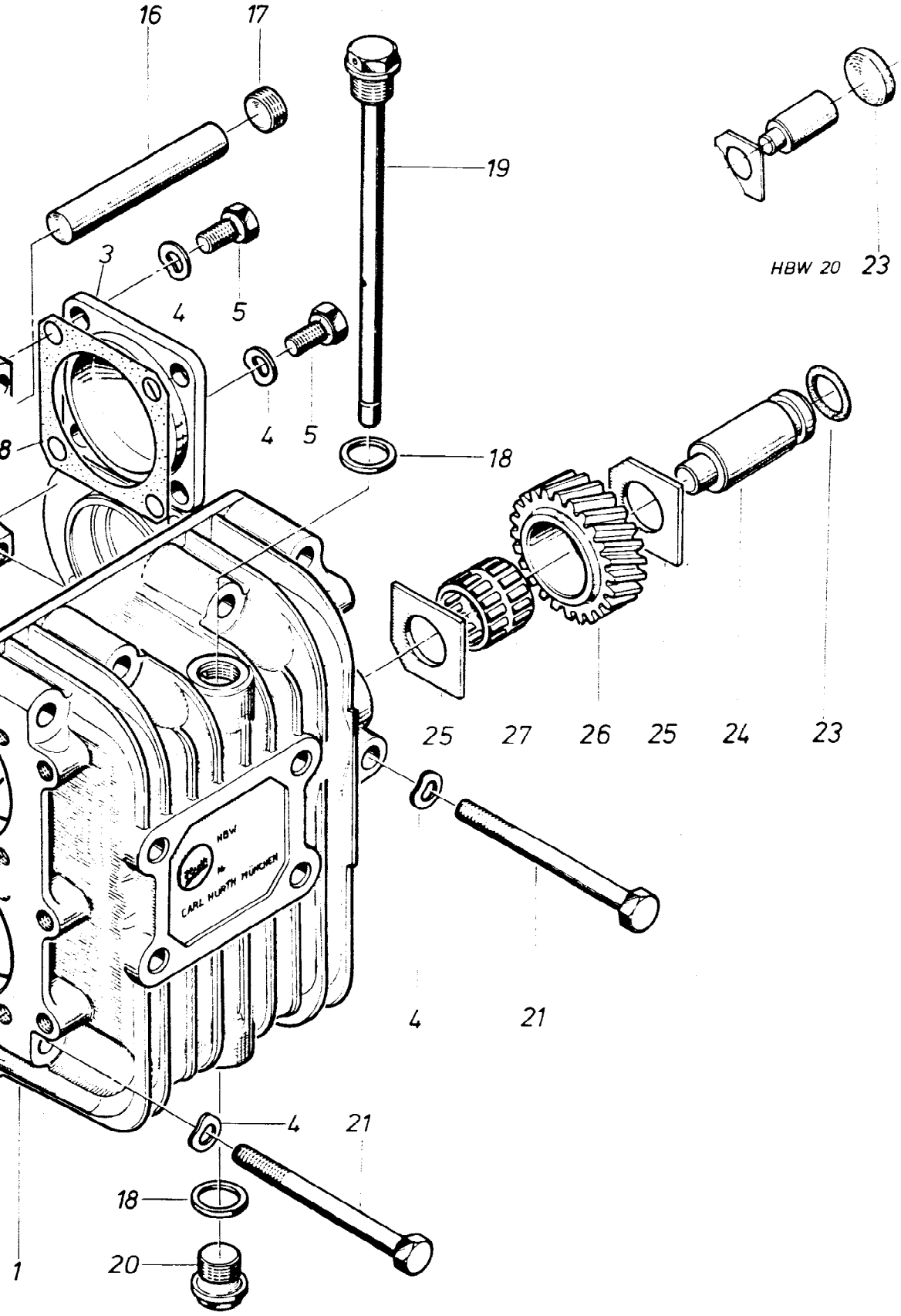
9. Drawings

9.1 Exploded view of gearbox

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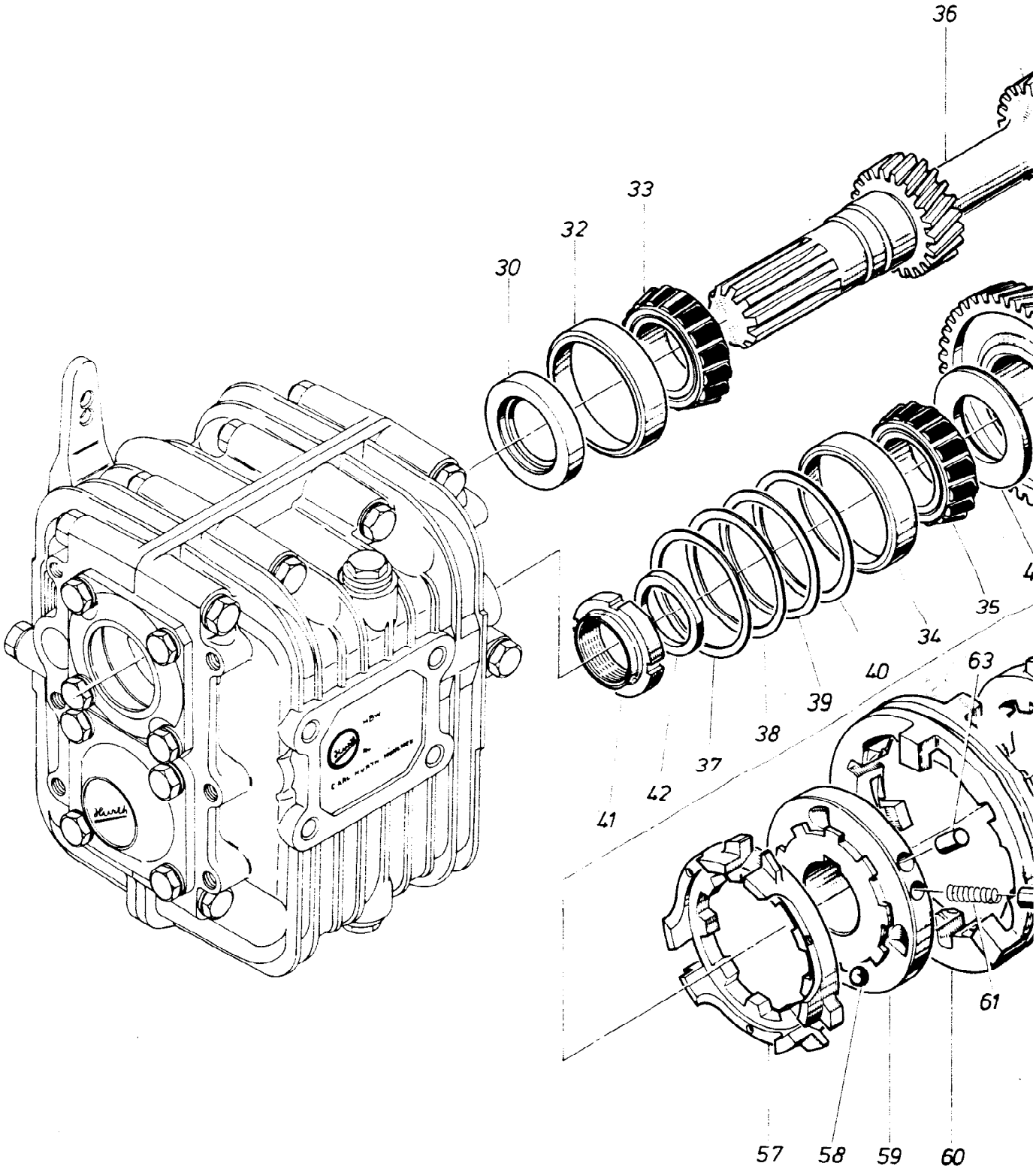
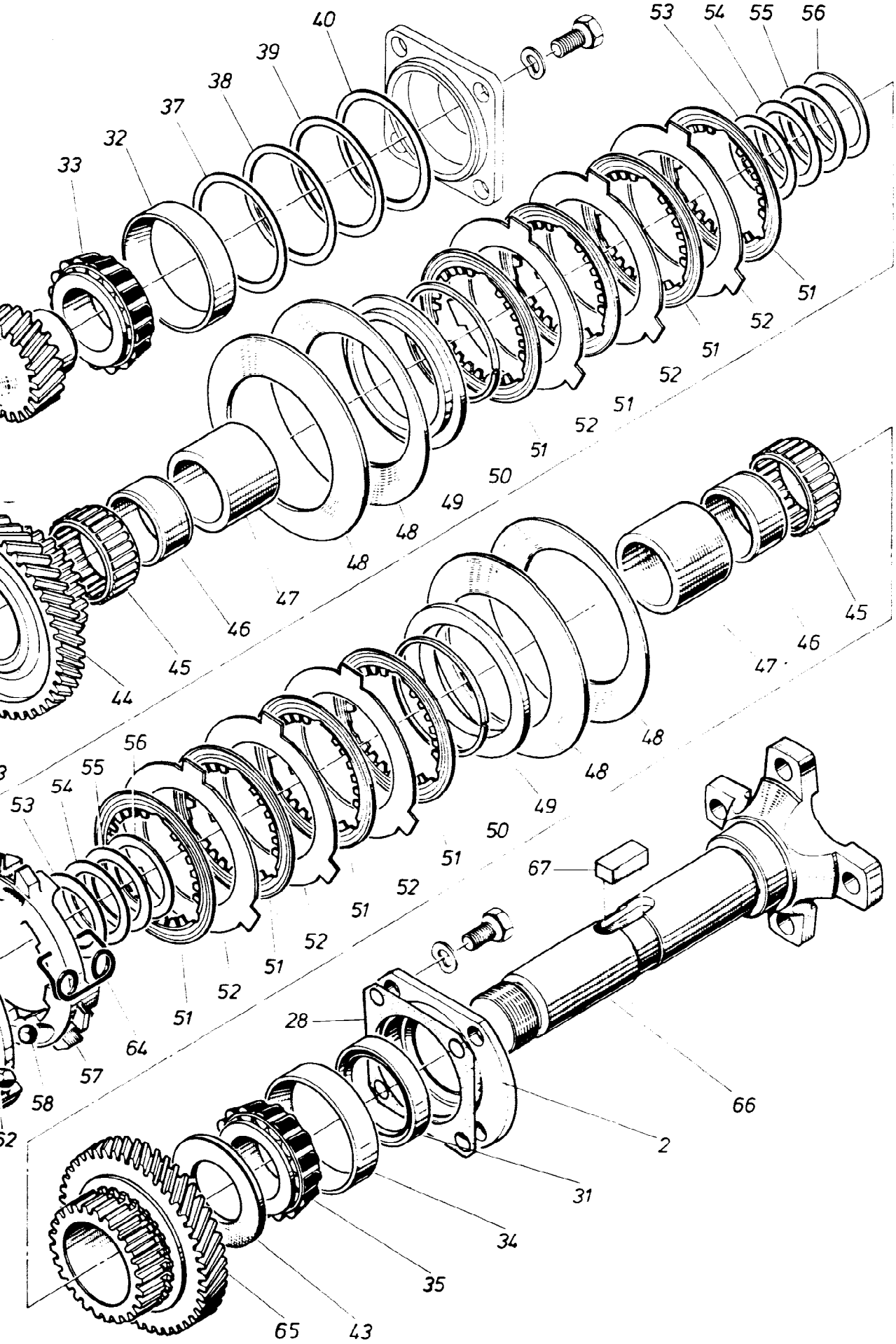
9.2 Exploded view of gear set

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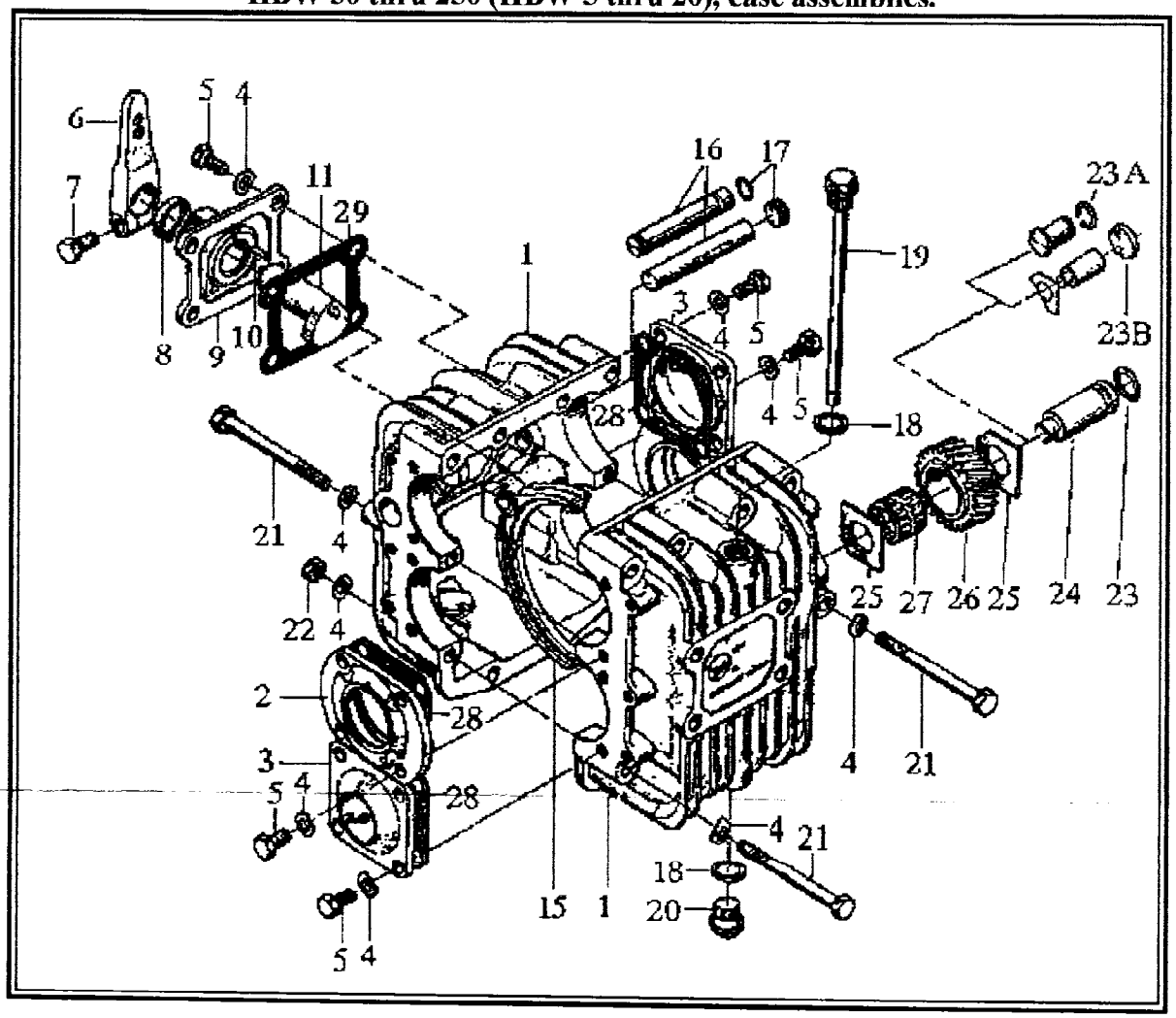
HURTH

HBW 50 thru 250 (HBW 5 thru 20), case assemblies.



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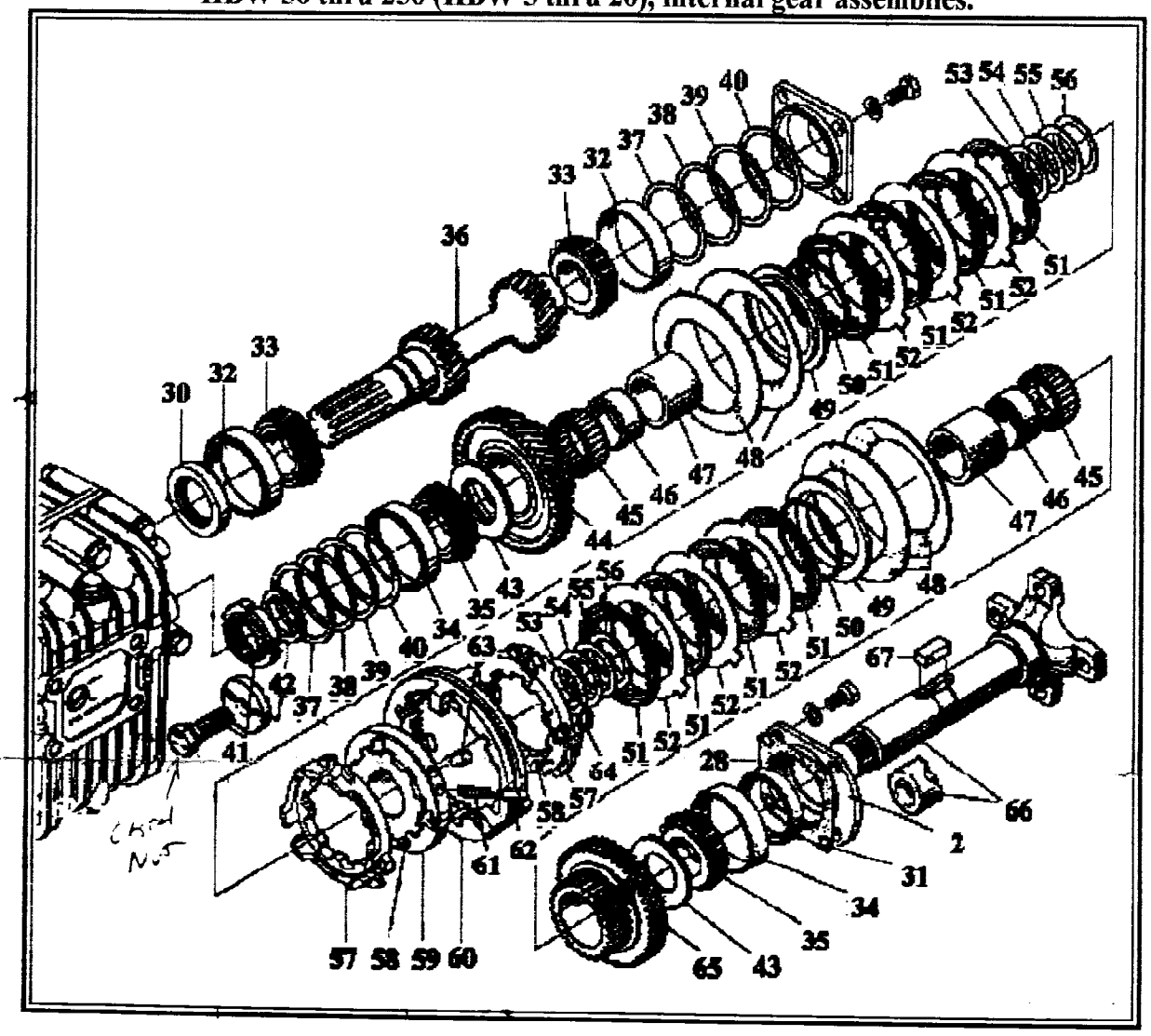
HBW 50 thru 250 (HBW 5 thru 20), internal gear assemblies.



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