WEBM000400

SHOP MANUAL

WB91R-2
WB93R-2

BACKHOE-LOADER

SERIAL NUMBER

WB91R-2 91F20001 and up

WB93R-2 93F20001 and up

KOMATSU

CONTENTS

The affected pages are indicated by the use of the following marks. It is requested that necessary actions be taken to these pages according to table below.

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●	Page to be replaced	Replace
( )	Page to be delete	Discard

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IMPORTANT SAFETY NOTICE

Proper service and repair is extremely important for the safe operation of your machine.
The service and repair techniques recommended by FKI and describe in this manual are both effective and safe methods of operation. Some of these operations require the use of tools specially designed by FKI for the purpose.

To prevent injury to workers, the symbols ⚠ and ⚠ are used to mark safety precautions in this manual. The cautions accompanying these symbols should always be carefully followed. If any danger arises or may possibly arise, first consider safety, and take necessary steps to face.

SAFETY

GENERAL PRECAUTIONS

Mistakes in operation extremely dangerous.
Read all the Operation and Maintenance Manual carefully BEFORE operating the machine.

1. Before carrying out any greasing or repairs, read all the precautions written on the decals which are suck on the machine.
2. When carrying out any operation, always wear safety shoes and helmet. Do not wear loose work clothes, or clothes with buttons missing.
   - Always wear safety glasses when hitting parts with a hammer.
   - Always wear safety glasses when grinding parts with a grinder, etc.
3. If welding repairs are needed, always have a trained, experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, glasses, cap and other clothes suited for welding work.
4. When carrying out any operation with two or more workers, always agree on the operating procedure before starting. Always inform your fellow workers before starting any step of the operation. Before starting work, hang UNDER REPAIR signs on the controls in the operator's compartment.
5. Keep all tools in good condition and learn the correct way to use them.
6. Decide a place in the repair workshop to keep tools and removed parts. Always keep the tools and parts in their correct places. Always keep the work area clean and make sure that there is no dirt or oil on the floor.
   Smoke only in the areas provided for smoking. Never smoke while working.

PREPARATIONS FOR WORK

7. Before adding or making any repairs, park the machine on hard, level ground, and block the wheels to prevent the machine from moving.
8. Before starting work, lower ourigger, bucket or any other work equipment to the ground. If this is not possible, use blocks to prevent the work equipment from falling down. In addition, be sure to lock all the control levers and hang warning sign on them.
9. When disassembling or assembling, support the machine with blocks, jacks or stands before starting work.
10. Remove all mud and oil from the steps or other places used to get on and off the machine. Always use the handrails, ladders or steps when getting on or off the machine.
    Never jump on or off the machine.
    If it is impossible to use the handrails, ladders or steps, use a stand to provide safe footing.

PRECAUTIONS DURING WORK

11. When removing the oil filler cap, drain plug or hydraulic pressure measuring plugs, loosen them slowly to prevent the oil from spurting out.
    Before disconnecting or removing components of the hydraulic circuit and engine cooling circuit, first remove the pressure completely from the circuit.
12. The water and oil in the circuits are not hot when the engine in stopped, so be careful not to get burned.
    Wait for the oil water to cool before carrying out any work on the cooling water circuits.

13. Before starting work, remove the leads from the battery. Always remove the lead from the negative (–) terminal first.
14. When raising heavy components, use a hoist or crane. Check that the wire rope, chains and hooks are free from damage.
    Always use lifting equipment which has ample capacity. Install the lifting equipment at the correct places.
    Use a hoist or crane and operate slowly to prevent the component from hitting any other part.
    Do not work with any part still raised by the hoist or crane.
15. When removing covers which are under internal pressure or under pressure from a spring, always leave two bolts in position on opposite sides. Slowly release the pressure, then slowly loosen the bolts to remove.
16. When removing components, be careful not to break or damage the wiring.
    Damage wiring may cause electrical fires.
17. When removing piping, stop the fuel or oil from spilling out. If any fuel or oil drips on to the floor, wipe it up immediately.
    Fuel or oil on the floor can cause you to slip, or can even start fires.
18. As a general rule, do not use gasoline to wash parts. In particular, use only the minimum of gasoline when washing electrical parts.
19. Be sure to assemble all parts again in their original places. Replace any damage parts with new parts.
    - When installing hoses and wires, be sure that they will not be damaged by conctat with other parts when the machine is being operated.
20. When installing high pressure hoses, make sure that they are not twisted. Damaged tubes are dangerous, so be extremely careful when installing tubes for high pressure circuits. Also, check that connecting parts are correctly tightened.
21. When assembling or installing parts, always use specified tightening torques.
    When installing the parts which vibrate violently or rotate at high speed, be particulary careful to check that they are correctly installed.
22. When aligning two holes, never insert your fingers or hand.
23. When measuring hydraulic pressure, check that the measuring tool is correctly assembled before taking any measurement.
24. Take sure when removing or installing tracks of in particular rubber tracks. When removing the track, the track separates suddenly, so never let anyone stand at either end of the wheel.

FOREWORD

This shop manual has been prepared as an aid to improve the quality of repairs by giving the operator an accurate understanding of the product and by showing him the correct way to perform repairs and make judgements. Make sure you understand the contents of this manual and use it to full effect at every opportunity.

This shop manual mainly contains the necessary technical information for operations performed in a service workshop.

The manual is divided into chapters on each main group of components; these chapters are further divided into the following sections.

STRUCTURE AND FUNCTION

This section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting.

TESTING AND ADJUSTING

This sections explains checks to be made before and after performing repairs, as well as adjustments to be made at completion of the checks and repairs.

Troubleshooting charts correlating «Problems» to «Causes» are also included in this section.

DISASSEMBLY AND ASSEMBLY

This section explains the order to be followed when removing, installing, dissassembling or assembling each component, as well as precautions to be taken for these operations.

MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

NOTICE

The specifications contained in this shop manual are subject to change at any time and without any notice.
Contact your FKI distributor for the latest information.

HOW TO READ THE SHOP MANUAL

VOLUMES

Shop manual are issued as a guide to carry out repairs. These various volumes are designed to avoid duplicating the same information.

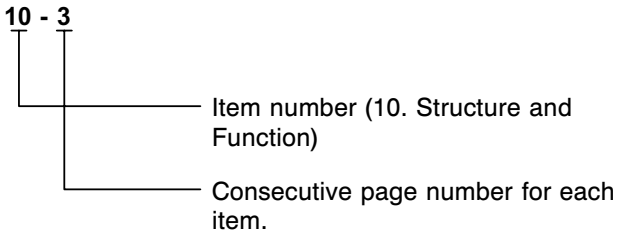
DISTRIBUTION AND UPDATING

Any additions, amendments or other changes will be sent to FKI distributors.
Get the most up-to-date information before you start any work.

FILING METHOD

1. See the page number on the bottom of the page. File the pages in correct order.
2. Following examples show you how to read the page number.

   Example



3. Additional pages: additional pages are indicated by a hyphen (-) and number after the page number.
   Fle as in the example.
   Example:
   10-4
   10-4-1
   10-4-2] Added pages
   10-5

REVISED EDITION MARK
(① ② ③ ….)

When a manual is revised, an edition mark is recorded on the bottom outside corner of the pages.

REVISIONS

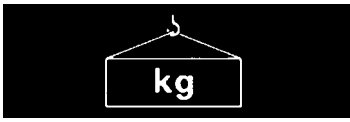
Revised pages are shown on the LIST OF REVISED PAGES between the title page and SAFETY page.

SYMBOLS

In order to make the shop manual greatly chelpful, important points about safety and quality are marked with the following symbols.

Symbol	Item	Remarks
	Safety	Special safety precautions are necessary when performing the work.
		Extra special safety precautions are necessary when performing the work because it is under internal pressure.
★	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing the work.
	Weight	Weight of parts or systems. Caution necessary when selecting hoisting wire, or when working posture is important, etc.
	Tightening torque	Parts that require special attention for the tightening torque during assembly.
	Coat	Parts to be coated with adhesives and lubricants etc.
	Oil, water	Places where oil, water or fuel must be added, and their quantity.
	Drain	Places where oil or water must be drained, and quantity to be drained.

HOISTING INSTRUCTIONS



⚠ Heavy parts (25 kg or more) must be lifted with a hoist etc. In the **Disassembly and Assembly** section, every part weighing 25 kg or more is clearly indicated with the symbol kg

1. If a part cannot be smoothly removed from the machine by hoisting, the following checks should be made:
   - Check for removal of all bolts fastening the part to the relative parts.
   - Check for any part causing interference with the part to be removed.

2. Wire ropes

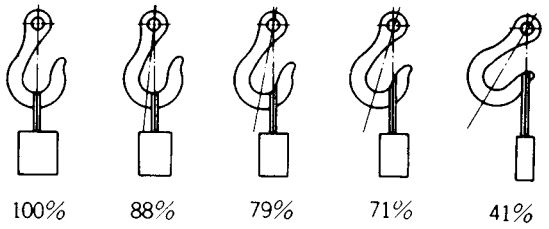
1) Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

WIRE ROPES
(Standard «S» or «Z» twist ropes without galvanizing)

Rope diameter (mm)	Allowable load (tons)
10	1.0
11.2	1.4
12.5	1.6
14	2.2
16	2.8
18	3.6
20	4.4
22.4	5.6
30	10.0
40	18.0
50	28.0
60	40.0

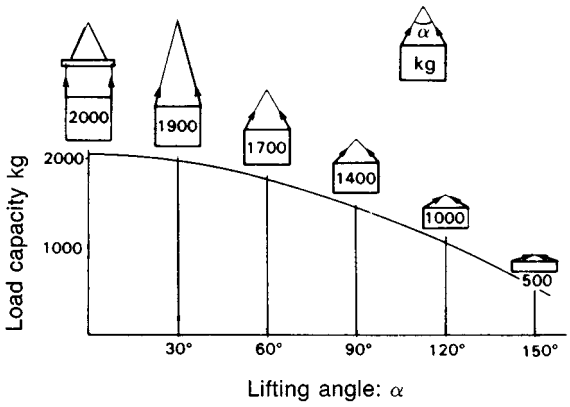
The allowable load value is estimated to be one-sixth or one-seventh of the breaking strength of the rope used.

2) Sling wire ropes from the middle portion of the hook. Slinging near the edge of the hook may cause the rope to slip off the hook during hoisting, and a serious accident can result.
Hooks have maximum strenght at the middle portion.



3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound on to the load.
⚠ Slinging with one rope may cause turning of the load during hoisting, untwisting of the rope, or slipping of the rope from its original winding position on the load, which can cause dangerous accidents.

4) Do not sling a heavy load with ropes forming a wide hanging angle from the hook.
When hoisting a load with two or more ropes, the force subjected to each rope will increase with the hanging angles.
The table below shows the variation of allowable load (kg) when hoisting is made with two ropes, each of which is allowed to sling up to 1000 kg vertically, at various handing angles.
When two ropes sling a load vertically, up to 2000 kg of total weight can be suspended.
This weight becomes 1000 kg when two ropes make a 120° hanging angle.
On the other hand, two ropes are subjected to an excessive force as large as 4000 kg if they sling a 2000 kg load at a lifting angle of 150°.



STANDARD TIGHTENING TORQUE

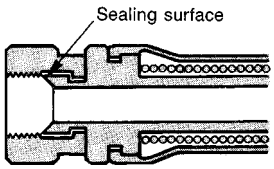
The following charts give the stardard tightening torques of bolts and nuts. Exceptions are given in sections of «**Disassembly and Assembly**».

1. STANDARD TIGHTENING TORQUE OF BOLTS AND NUT

Thread diameter of bolts (mm)	Pitch of bolts (mm)	Width across flat (mm)		8.8		10.9	
		S	S	kgm	Nm	kgm	Nm
6	1	10	5	0.96±0.1	9.5±1	1.3±0.15	13.5±1.5
8	1.25	13	6	2.3±0.2	23±2	3.2±0.3	32.2±3.5
10	1.5	17	8	4.6±0.5	45±4.9	6.5±0.6	63±6.5
12	1.75	19	10	7.8±0.8	77±8	11±1	108±11
14	2	22	12	12.5±1	122±13	17.5±2	172±18
16	2	24	14	19.5±2	191±21	27±3	268±29
18	2.5	27	14	27±3	262±28	37±4	366±36
20	2.5	30	17	38±4	372±40	53±6	524±57
22	2.5	32	17	52±6	511±57	73±8	719±80
24	3	36	19	66±7	644±70	92±10	905±98
27	3	41	19	96±10	945±100	135±15	1329±140
30	3.5	46	22	131±14	1287±140	184±20	1810±190
33	3.5	50	24	177±20	1740±200	250±27	2455±270
36	4	55	27	230±25	2250±250	320±35	3150±350
39	4	60	—	295±33	2900±330	410±45	4050±450

This torque table does not apply to bolts or nuts which have to fasten nylon or other parts non-ferrous metal washer.

★ **Nm (Newton meter): 1 Nm = 0.102 kgm**



Nm

2. TIGHTENING TORQUE FOR NUTS OF FLARED

Use these torques for nut part of flared.

Thread diameter of nut part (mm)	Width across flats of nut part (mm)	TIGHTENING TORQUE	
		kgm	Nm
1/2" - 20	17	2.6±0.5	25.5±4.9
9/16" - 18	17	4±0.5	39.2±4.9
3/4" - 16	22	6.7±2	65.7±19.6
7/8" - 14	27	8±2	78.5±19.6
1.1/16" - 12	32	9.7±3	95.15±29.4
1.5/16" - 12	38	17±3	166.7±29.4
1.5/8" - 12	50	20±5	196.2±49
22	27	8±2	78.5±19.6
33	41	20±5	196.2±49

COATING MATERIALS

The recommended coating materials prescribed in FKI Shop Manuals are listed below:

Nomenclature	Code	Applications
Adhesives	ASL800010	Used to apply rubber pads, rubber gaskets and cork plugs.
	ASL800020	Used to apply resin, rubber, metallic and non-mettalic parts when a fast, strong seal is needed.
	Loctite 222	Used for low resistance locking of screws, check nuts and adjustment nuts.
	Loctite 242	To prevent the loosening of bolts, nuts and plugs and the leakage of oil. Used for medium resistance locking of screws and nuts of every type, and for locking keys and bearings.
	Loctite 262	Used for high resistant of threaded parts that can be removed with normal tools.
	Loctite 270	Used for high resistant locking and for sealing threaded parts, bolts and stud bolts.
	Loctite 542	Used for sealing the union threads for hydraulic tubes.
	Loctite 573	Used for sealing rather exact plane surfaces when the option of possible future dismantling is required.
	Loctite 601	Used for high resistant locking of mechanical components that can be removed only after heating
	Loctite 675	Used to lock cylindrical couplings and for the permanent locking of threaded parts, and also to lock shafts to bearings, gears, pulleys, pins, bushings, etc.
Gasket sealant	ASL800060	Used by itself to seal grease fittings, tapered screw fittings and tapered screw fittings in hydraulic circuits of less than 50 mm in diameter.
	Loctite 510	Used by itself on mounting flat surface (Clearance between surfaces within 0.2 mm)
	Loctite 518	Used by itself on mounting flat surface (Clearance between surfaces within 0.5 mm)
Antifriction compound (Lubricant inclunding Molybdenum disulfide)	ASL800040	Applied to bearings and taper shaft to facilitate press-fitting and to prevent sticking, burning or rusting.
Grease (Lithium grease)	ASL800050	Applied to bearings, sliding parts and oil seals for lubrication, rust prevention and facilitation of assembling work.
Vaseline	–	Used for protecting battery electrode terminals from corrosion.

ELECTRIC

ELECTRIC WIRE CODE

In the wiring diagrams various colors and symbols are employed to indicate the thickness of wires.
This wire code table will help you understand WIRING DIAGRAMS.
Example: R -N 1.5 indicates a cable having a nominal number 1.5 and red coating with black stripe.

CLASSIFICATION BY THICKNESS

Nominal number	Copper wire			Cable O.D. (mm)	Current rating (A)	Applicable circuit
	Number strands	ø of strands (mm)	Cross section (mm^2)			

CLASSIFICATION BY COLOUR AND CODE

	Primary	Auxiliary									
Code											
Colour											
Code											
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COMPOSITION OF THE COLOURS

The coloration of two-colour wires is indicated by the composition of the symbols listed.
Example: G-V = Yellow-Green with longitudinal colouring.
G/V = Yellow-Green with transversal colouring.

WEIGHT TABLE

⚠ This weight table is a guide for use when transporting or handling components.

Unit: kg

Machine model	WB91R-2	WB93R-2
From serial no.	91F20001	93F20001
Engine assembly - Muffler - Exhaust pipe	400	410
Radiator - exchanger	37	37
Hydraulic tank (without hydraulic oil)	—	—
Fuel tank (without fuel)	—	—
Front counterweight	300	300
Engine hood	—	—
Cab (without seat)	595	595
Seat	34	34
Engine - gear-box - pump group	730	740
Piston pump	38	38
Transmission	230	230
Convertor	—	—
Front axle	316	316
Rear axle	511	511
Front wheel Rear wheel	65 163	65 163
2-spool control valve	24	24
3-spool control valve	30	30
Work equipment	—	—

Backhoe		
Work equipment	—	—
Boom	323	323
Arm	213	213
Long arm	245	245
Boom swing bracket	133	133
Backframe	—	—
6-spool control valve	47	47
7-spool control valve	53	53
8-spool control valve	59	59
Jig arm	392	392
Outriggers	—	—
Boom cylinder	65	78
Arm cylinder	69	69
Bucket cylinder	49	49
Outrigger cylinder	—	—
Swing cylinder	30	30

TABLE OF OIL AND COOLANT QUANTITIES

RESERVOIR	KIND OF FLUID	AMBIENT TEMPERATURE	CAPACITY (ℓ)	
		–20 –10 0 10 20 30°C	Specified	Refill
Crankcase sump	OIL • API CD	FKI 907 10W FKI 907 20W-20 FKI 907 SAE 30 FKI 907 SAE 40	8.6	8.6
Hydraulic circuit	OIL • API CD	FKI 909 10W-30	150	92
Front axle • differential	OIL • UTTO FLUID		6.5	6.5
• final red. gear (each)		FKI 918	1	1
Rear axle: • differential			15	15
• final red. gear (each)			3.5	3.5
Hydraulic transmission	OIL • GM DEXRON® II D (DEXRON® is a registered trademark of General Motors Corporation)	FKI 921	19	16
Braking system		FKI 921	0.8	0.8
Fuel tank	DIESEL OIL	* ASTM D975 N. 2	130	—
Engine coolant system	WATER + ANTI-FREEZE		18	—
	WATER		18	—
	PERMANENT LIQUID	FKI 931	18	—

*** ASTM D975 N. 1**

FKI 907 OLDEN TURBO UNIGRADO
FKI 909 MULTISERVICE 4
FKI 918 SPECIAL TRANSMISSION FLUID 68/F-100
FKI 921 ANDROS FLUID II D
FKI 921 ANTIFROST PRONTO (–25 °C)

ASTM: America Society of Testing and Materials
SAE: Society of Automotive Engineers
API: American Petroleum Institute
MIL: USA Military Specification
CCMC: Common Market Constructors Committe

First filling quantity: total quantity of oil, including the oil for the components and pipes.

Oil change quantity: quantity of oil necessary to fill the system or unit during the normal inspection and maintenance operations.

NOTE:

(1) When the diesel oil sulphur content is less then 0.5%, change the engine oil according to the periodic maintenance intervals indicated in the operation and maintenance manual. In the diesel oil sulphur content exceeds 0.5% change the engine oil according to the following table:

Sulphur content	Engine oil change interval
from 0.5 to 1.0%	1/2 of regular interval
over 1.0%	1/4 of regular interval

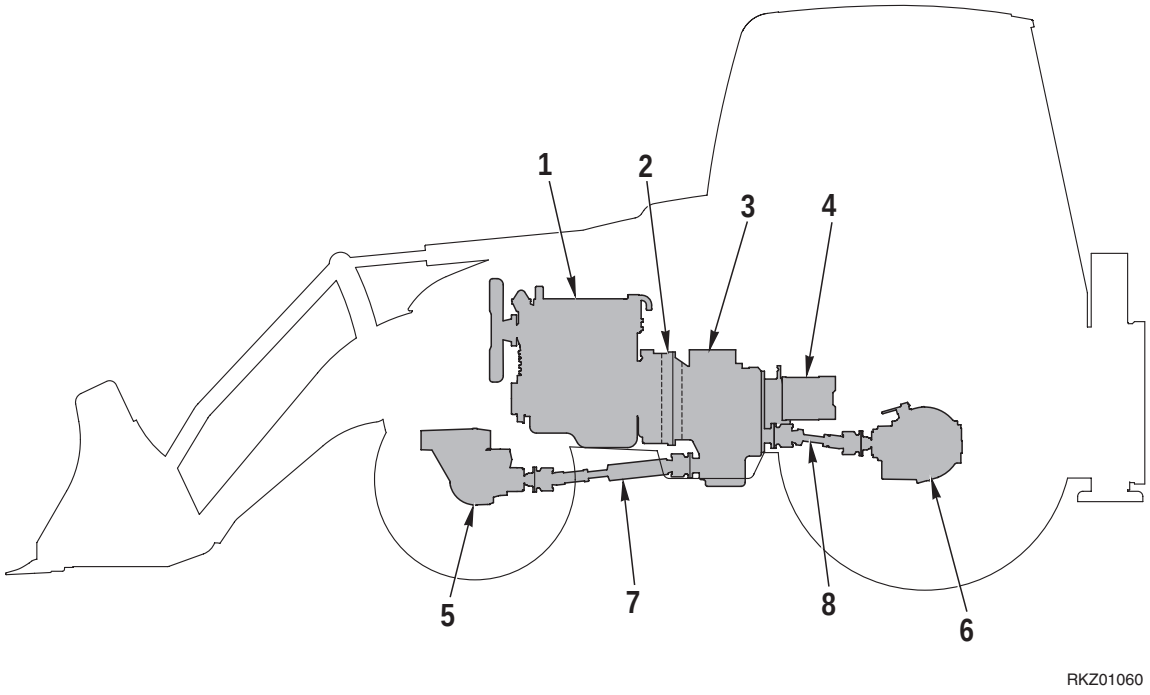
(2) When starting the engine at temperatures below 0 °C, use engine oil SAE 10W, 20W-20 and 10W-30, even if during the day the temperature increases by 10 °C.

(3) Use engine oil with CD classification; if oil with CD classification is used, reduce the engine oil change interval by a half.

(4) Use original products, which have characteristics specifically formulated and approved for the engine, the hydraulic circuit of equipment and for reductions.

10 STRUCTURE AND FUNCTION

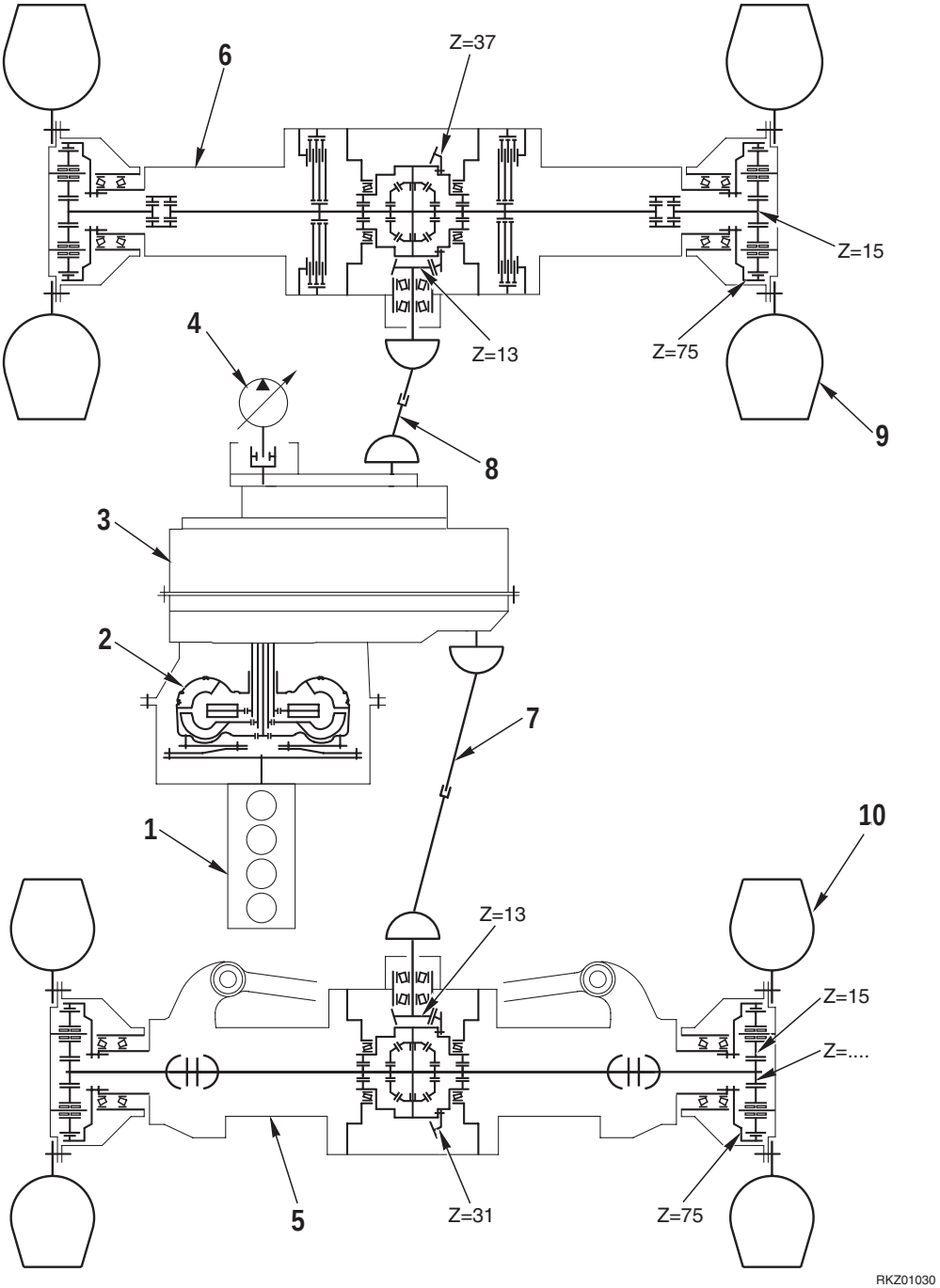
POWER TRAIN



DESCRIPTION

- The driving power for the engine (1) is transmitted through the flywheel to the converter (2).
  The converter (2) uses hydraulic oil to convert the torque transmitted by the engine (1) into driving power. The converter (2) transmits motion to the drive shaft of the transmission (3) and to the drive shaft of the hydraulic pump (4).
- The transmission (3) has two hydraulically-activated clutches that can be selected by an electrically-controlled gear selector. It also has manual gear selection (four forward gears and four reverse gears).
- The driving power is transmitted from the transmission flanges (3) to the front (5) and rear (6) axles through the Cardan drive shafts (7 and 8).
- The driving power transmitted to the front (5) and rear (6) axles is reduced by the differentials and then transmitted to the planetary gear through the differential shafts.

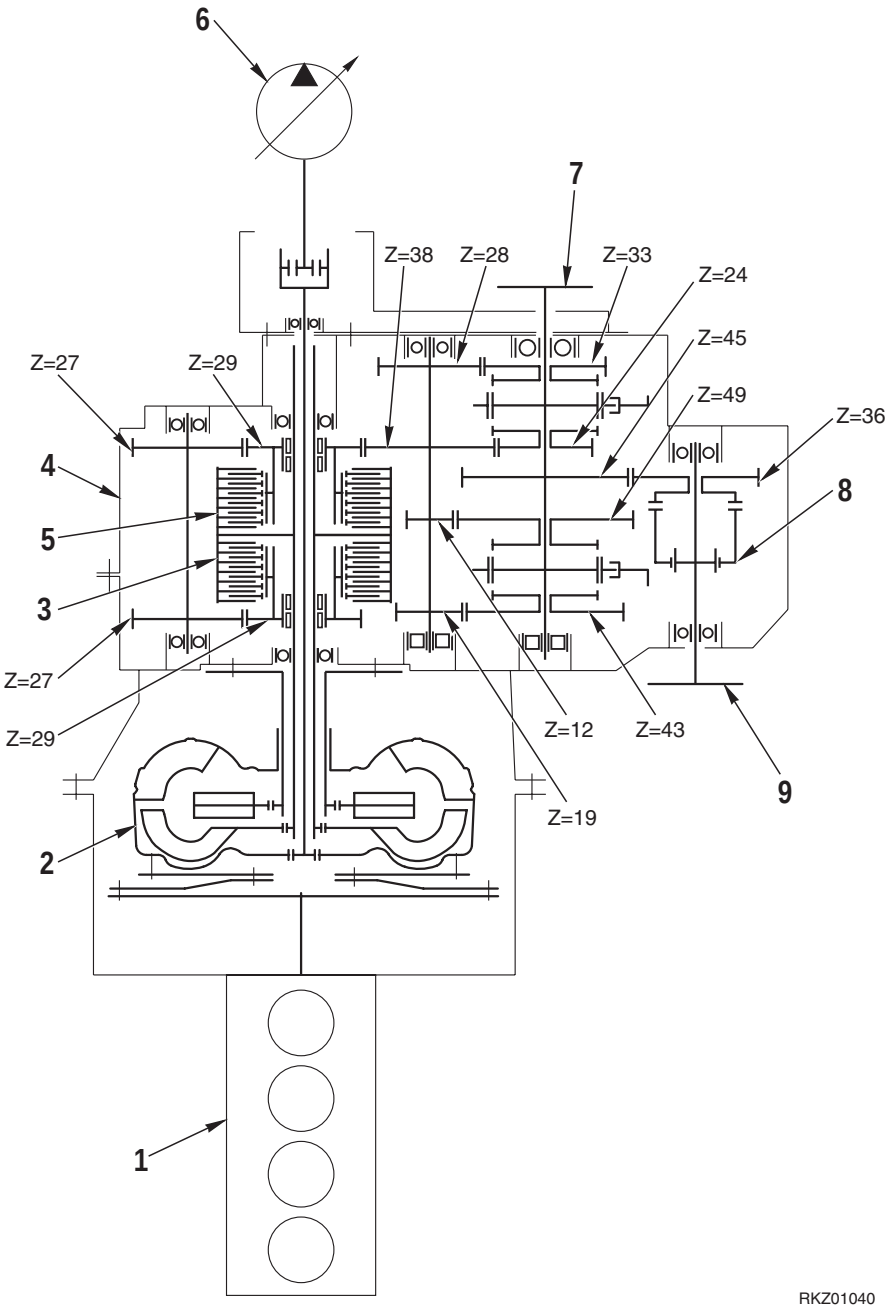
Gears	Front axle				Rear axle			
	Transmission	Differential	Planetary	Total	Transmission	Differential	Planetary	Total
1st gear	4.280	2.385	6.000	61.238	5.350	2.846	6.000	91.362
2nd gear	2.372			33.939	2.965			50.633
3rd gear	1.236			17.685	1.544			26.367
4th gear	0.662			9.472	0.827			14.123



1. Diesel engine
2. Convertor
3. Transmission
4. Hydraulic pump
5. Front axle
6. Rear axle
7. Front Cardan drive shaft
8. Rear Cardan drive shaft
9. Rear wheels
10. Front wheels

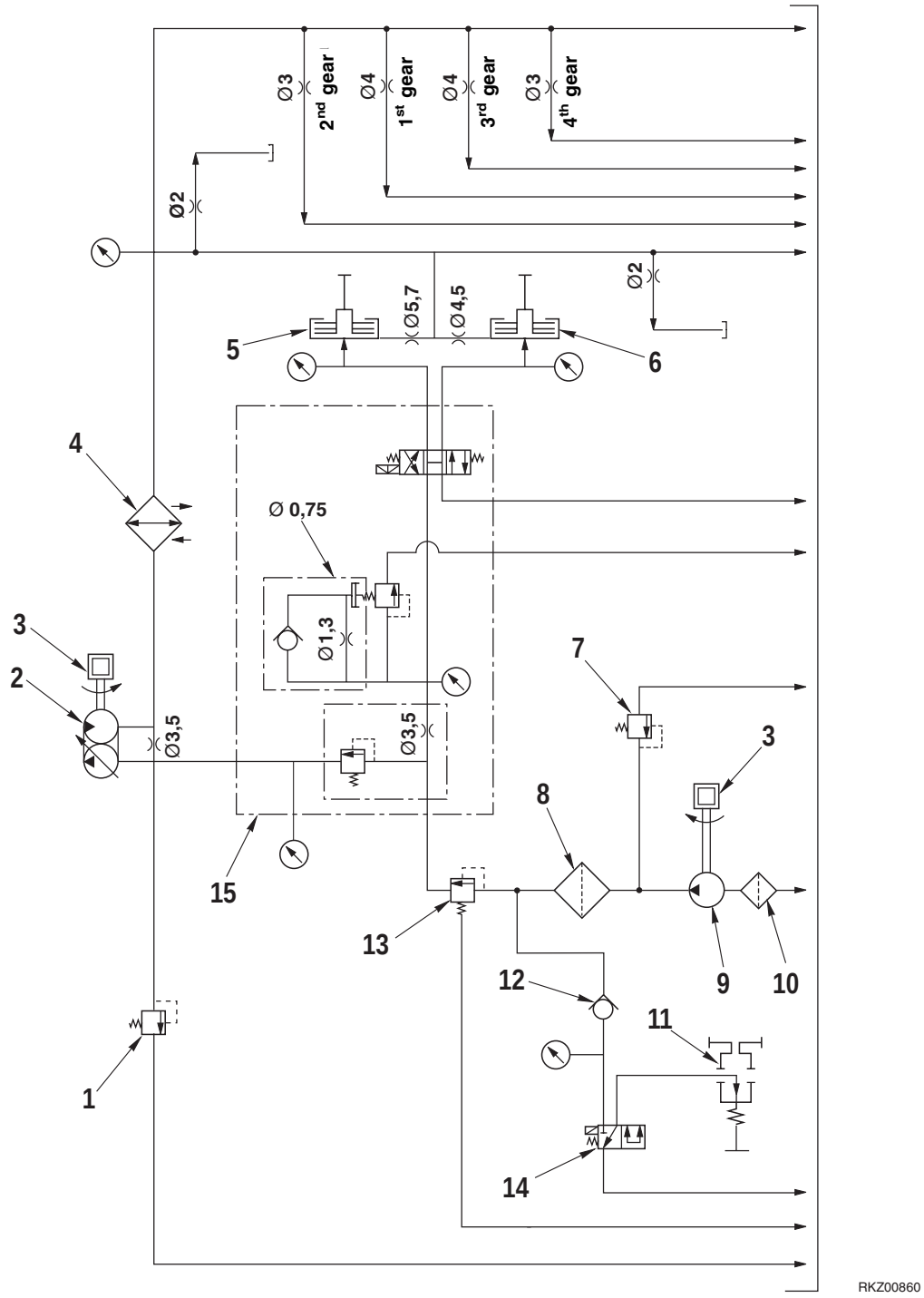
TRANSMISSION

Diagram of the power train



1. Engine
2. Convertor
3. Forward clutch
4. Transmission
5. Reverse clutch
6. Hydraulic pump
7. Rear flange
8. 4-WD engagement device
9. Front flange

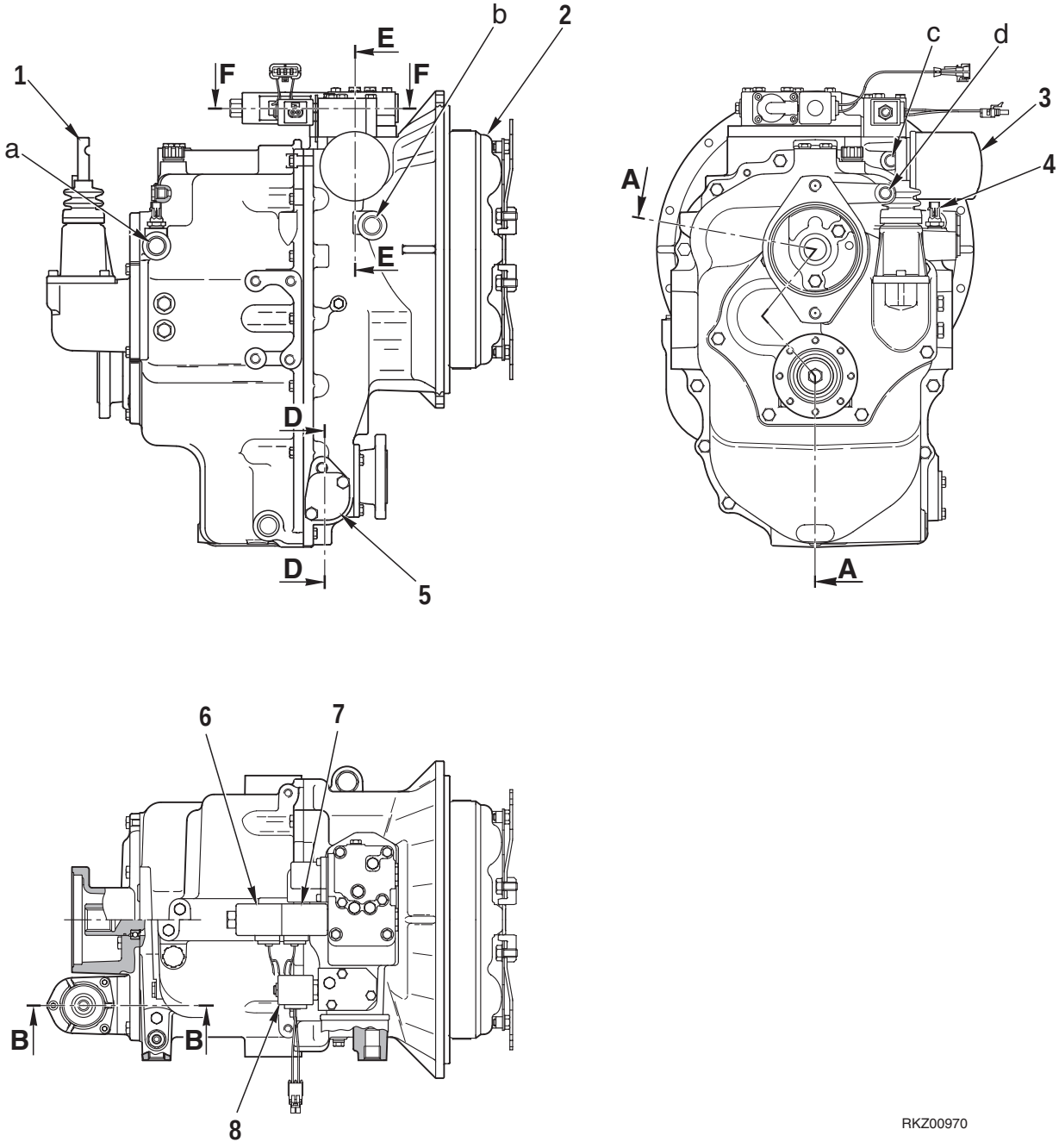
Hydraulic Convertor-Transmission Circuit Diagram



1. Convertor pressurization valve
2. Convertor
3. Engine
4. Oil cooler
5. Forward clutch
6. Reverse clutch
7. Max. pressure valve: calib. 23 bar
8. Spin-on filter (15 Nm)
9. Pump
10. Suction filter (250 Nm)
11. 4-WD engagement device
12. Check valve
13. Pressure control
14. 4-WD engagement solenoid
15. Control valve group

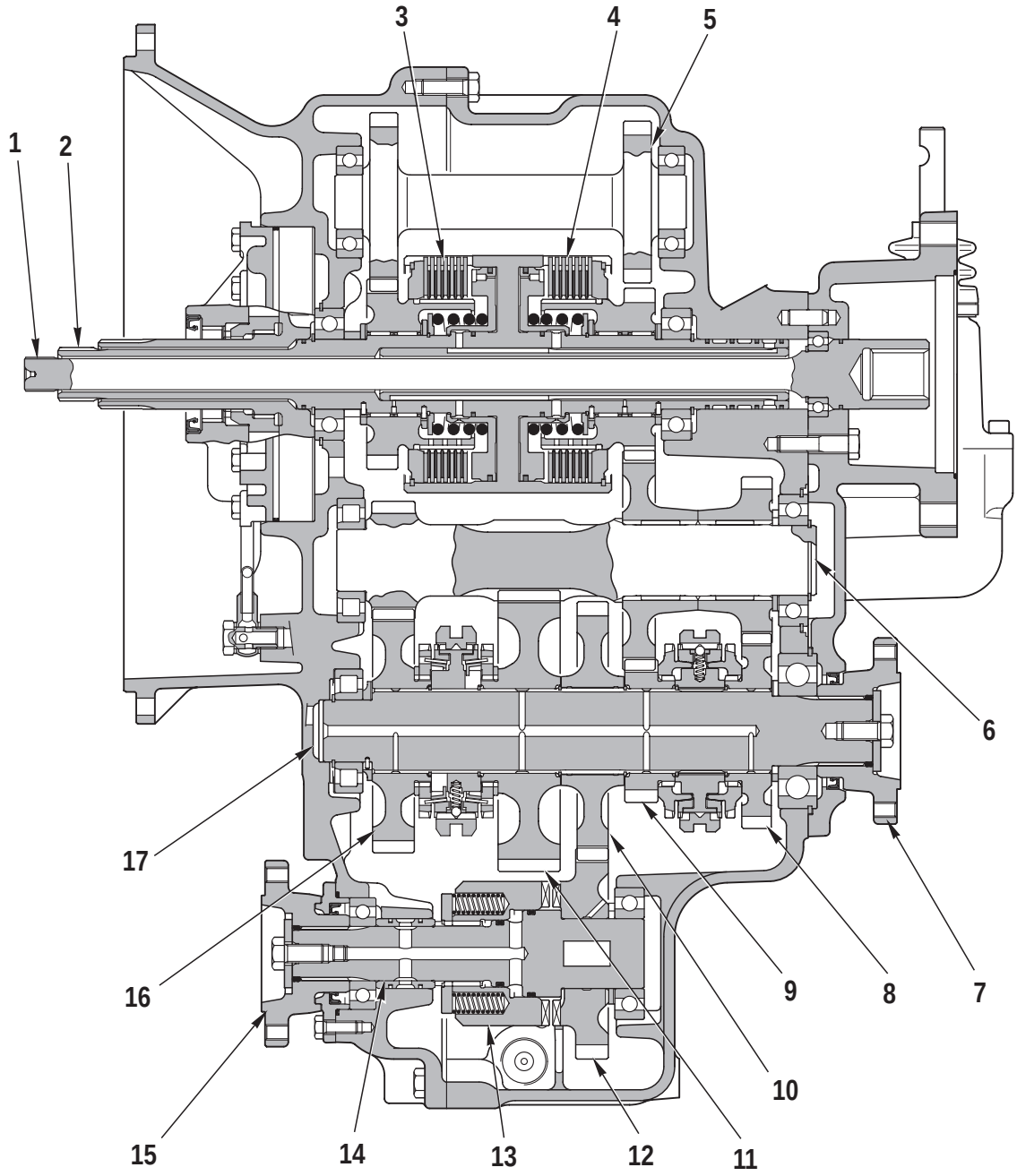
TRANSMISSION

Views



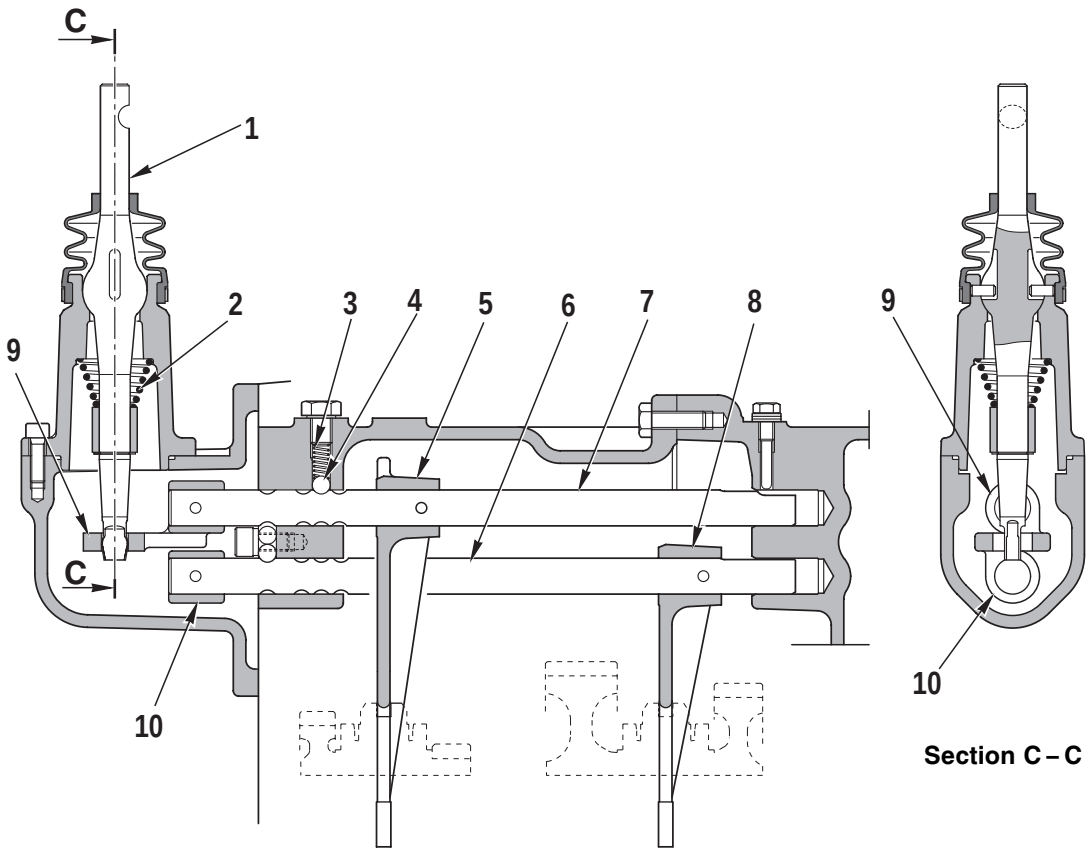
a. From the oil cooler
b. To the oil cooler
c. To the solenoid valve group ST1 (Port P)
d. From the solenoid valve group ST1 (Port T)

1. Gear lever
2. Convertor
3. Filter
4. Oil temperature sensor
5. Suction filter
6. EV.... Reverse gears command solenoid
7. EV.... Forward gears command solenoid
8. EV.... 4-WD command solenoid



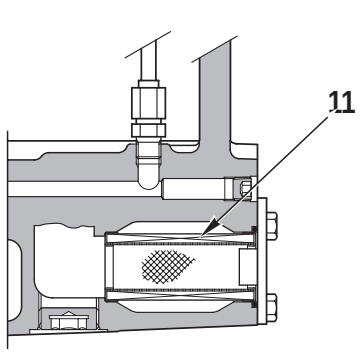
Section A – A

1. Hydraulic pump drive shaft
2. Propeller shaft
3. Reverse gears command clutch
4. Forward gears command clutch
5. Reverse gears idler shaft
6. Drive shaft
7. Flange
8. 3rd gear driven gear
9. 4th gear driven gear
10. 4-WD drive gear
11. 1st gear driven gear
12. 4-WD driven gear
13. 4-WD engagement device
14. Front output shaft
15. Flange
16. 2nd gear driven gear
17. Rear output shaft

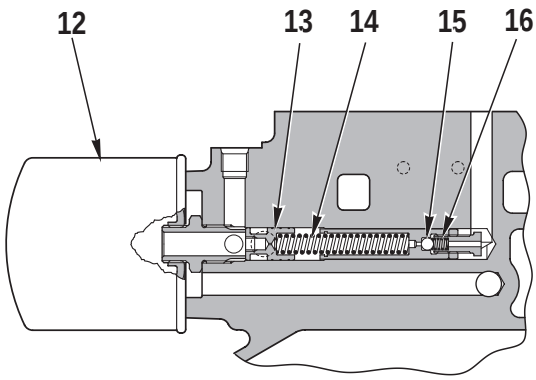


Section B – B

Section C – C



Section D – D



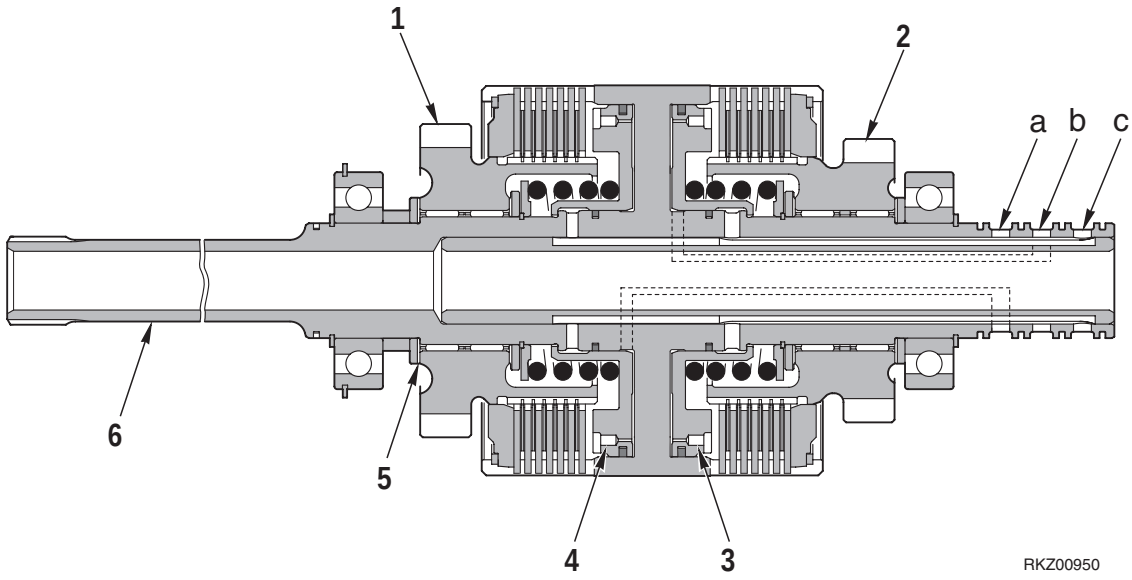
Section E – E

RKZ00990

1. Gear-shift piston
2. Spring
3. Spring
4. Ball
5. 3rd and 4th gear selecting fork
6. 1st and 2nd gear selector piston
7. 3rd and 4th gear selector piston
8. 1st and 2nd gear selecting fork
9. 3rd and 4th gear selecting fork
10. 1st and 2nd gear selecting fork
11. Suction filter (250 Nm)
12. Spin-on filter (15 Nm)
13. Valve
14. Spring
15. Ball
16. Spring

DRIVE SHAFTS

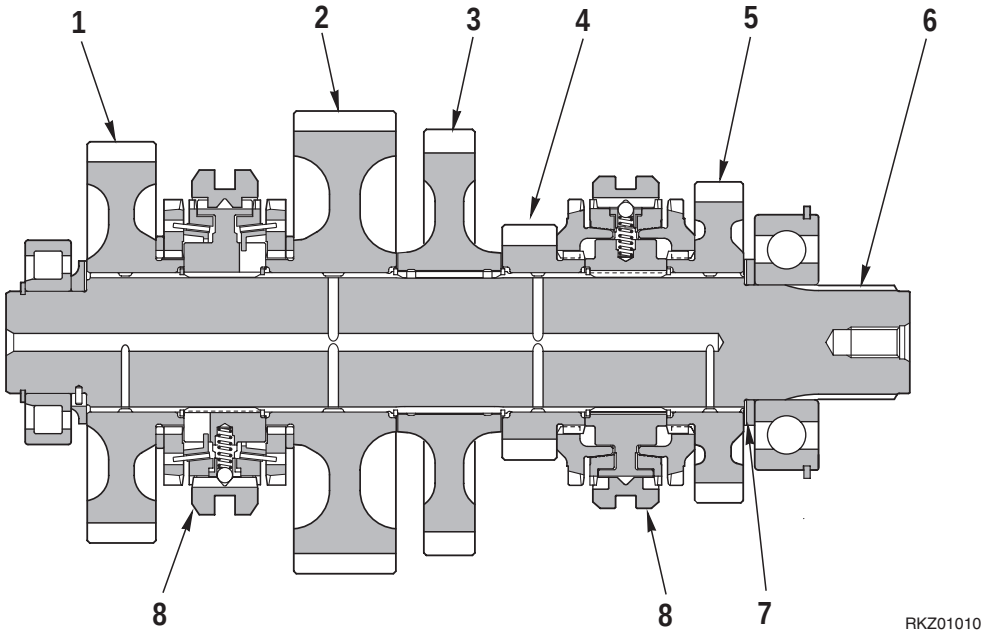
Drive shaft for forward and reverse movement



a. Port commanding reverse clutch
b. Port commanding forward clutch
c. Lubrication port

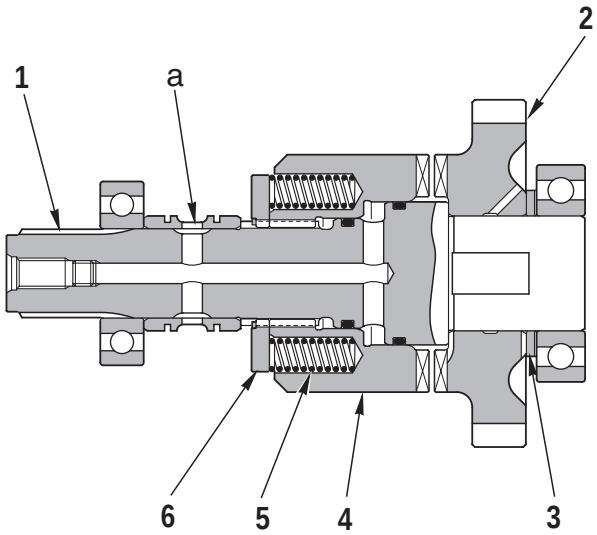
1. Reverse gear clutch (Z = 29)
2. Forward gear clutch (Z = 29)
3. Reverse clutch piston
4. Forward clutch piston
5. Thrust ring
6. Driven shaft

Driven gear shaft



1. Driven gear for 1st gear (Z = 49)
3. 4-WD drive gear (Z = 44)
4. Driven gear for 4th gear (Z = 24)
5. Driven gear for 3rd gear (Z = 33)
6. Rear output shaft
7. Thrust ring
8. Synchronizer

4-WD driven shaft

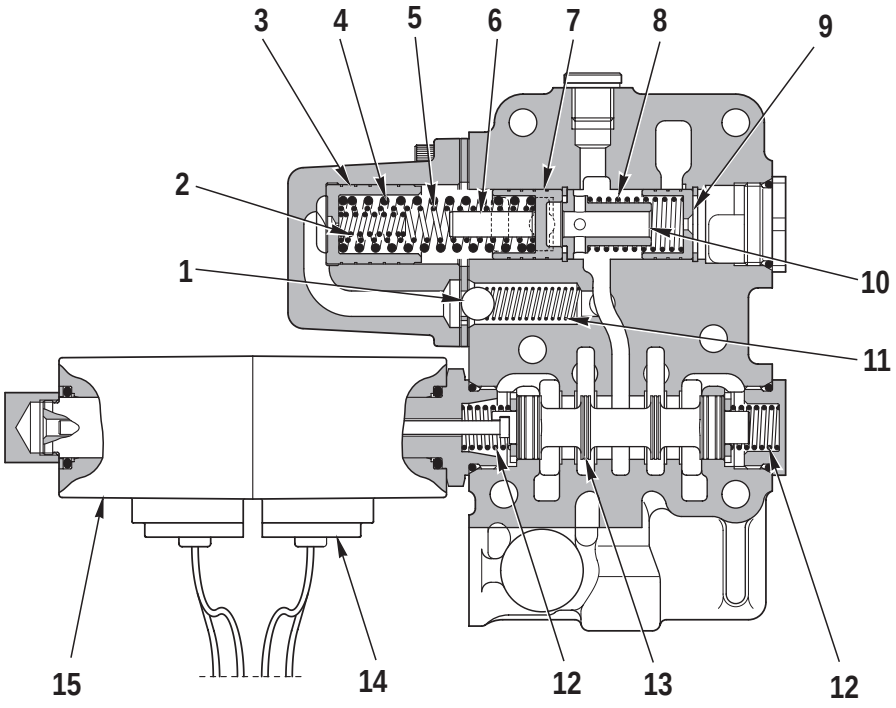


RKZ01020

a. 4-WD disengagement command port

1. Front output shaft
2. 4-WD driven gear (Z = 36)
3. Thrust ring
4. Cylinder
5. Spring
6. Disc

CONTROL VALVE BLOCK

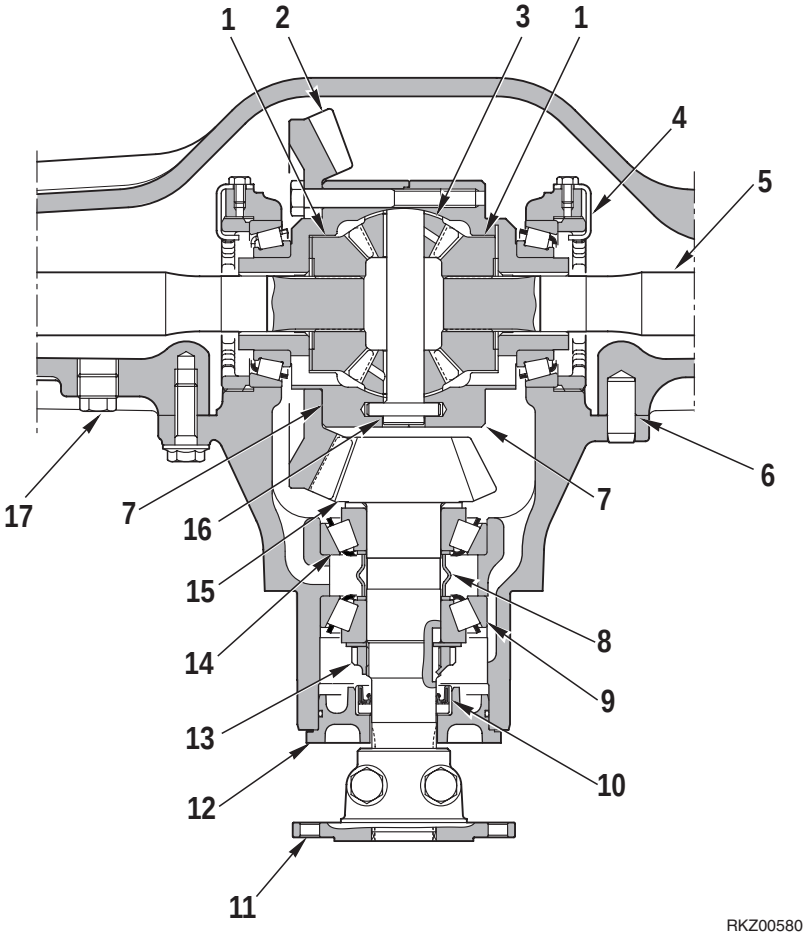


Section F – F RKZ01000

1. Ball
2. Spring
3. Piston
4. Spring
5. Spring
6. Spring-guide pin
7. Valve
8. Spring
9. Valve
10. Rod
11. Spring
12. Spool return spring
13. Spool
14. Forward gear command solenoid
15. Reverse gear command solenoid

FRONT AXLE

Differential



1. Planetary gear
2. Ring bevel gear (Z = 31)
3. Bevel gear
4. Lock nut
5. Half-axle
6. Pin
7. Differential housing
8. Spacer
9. Bearing
10. Seal
11. Flange
12. Cover
13. Lock nut
14. Bearing
15. Bevel pinion (Z = 13)
16. Pin
17. Oil drain plug