

SERVICE MANUAL

Crawler Excavator
R160LC-9
R180LC-9

HYUNDAI

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1. STRUCTURE

This service manual has been prepared as an aid to improve the quality of repairs by giving the serviceman 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 service manual mainly contains the necessary technical information for operations performed in a service workshop.

For ease of understanding, the manual is divided into the following sections.

SECTION 1 GENERAL

This section explains the safety hints and gives the specification of the machine and major components.

SECTION 2 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.

SECTION 3 HYDRAULIC SYSTEM

This section explains the hydraulic circuit, single and combined operation.

SECTION 4 ELECTRICAL SYSTEM

This section explains the electrical circuit, monitoring system and each component. It serves not only to give an understanding electrical system, but also serves as reference material for trouble shooting.

SECTION 5 MECHATRONICS SYSTEM

This section explains the computer aided power optimization system and each component.

SECTION 6 TROUBLESHOOTING

This section explains the troubleshooting charts correlating **problems** to **causes**.

SECTION 7 MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

SECTION 8 DISASSEMBLY AND ASSEMBLY

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

SECTION 9 COMPONENT MOUNTING TORQUE

This section shows bolt specifications and standard torque values needed when mounting components to the machine.

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

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

Any additions, amendments or other changes will be sent to HYUNDAI distributors.

Get the most up-to-date information before you start any work.

Filing method

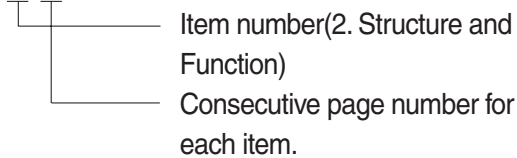
1. See the page number on the bottom of the page.

File the pages in correct order.

2. Following examples shows how to read the page number.

Example 1

2 - 3



3. Additional pages : Additional pages are indicated by a hyphen(-) and number after the page number. File as in the example.

10 - 4

10 - 4 - 1

10 - 4 - 2

Added pages

10 - 5

Revised edition mark(①②③...)

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

Revisions

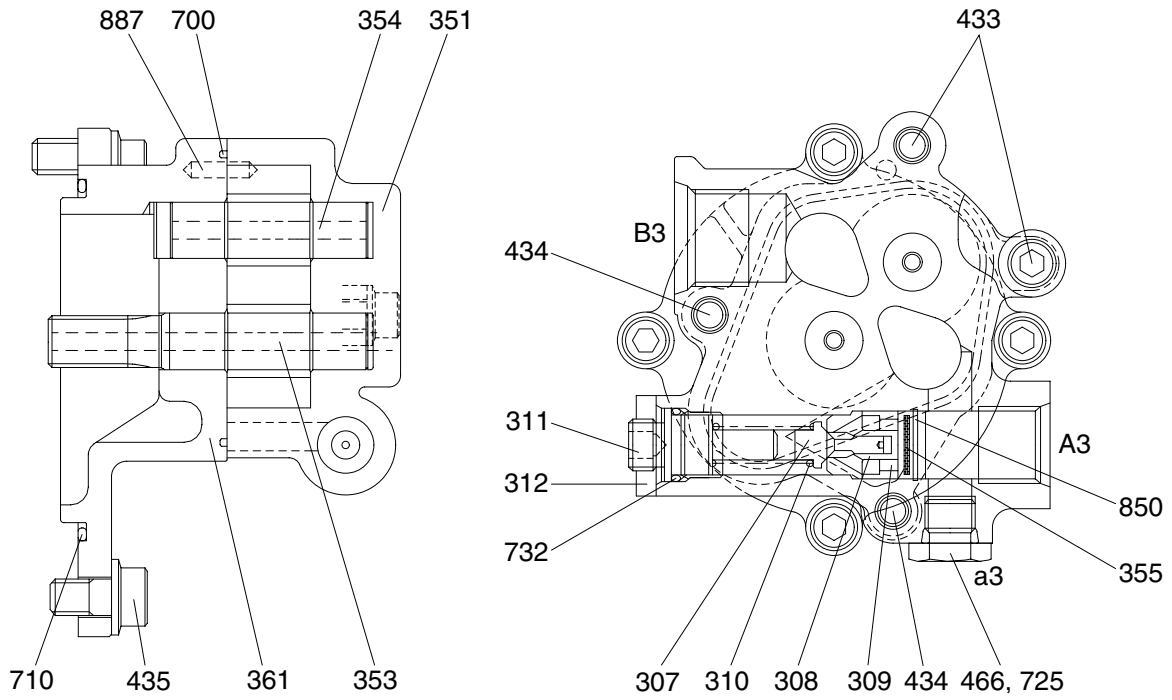
Revised pages are shown at the list of revised pages on the between the contents page and section 1 page.

Symbols

So that the shop manual can be of ample practical use, important places for 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.

3) GEAR PUMP



14092MP06

307 Poppet
 308 Seat
 309 Ring
 310 Spring
 311 Screw
 312 Nut
 351 Gear case

353 Drive gear
 354 Driven gear
 355 Filter
 361 Front case
 433 Flange socket
 434 Flange socket
 435 Flange socket

466 Plug
 700 Ring
 710 O-ring
 725 O-ring
 732 O-ring
 850 Snap ring
 887 Pin

2. FUNCTION

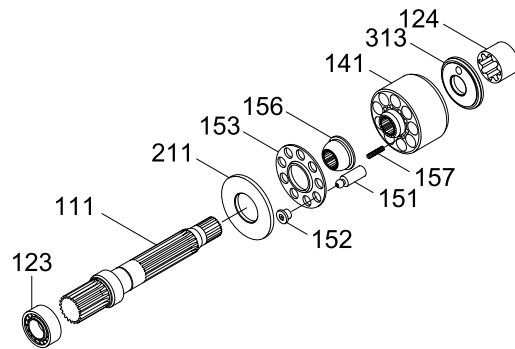
1) MAIN PUMP

The pumps may be classified roughly into the rotary group performing a rotary motion and working as the major part of the whole pump function: the swash plate group that varies the delivery rates: and the valve cover group that changes over oil suction and discharge.

(1) Rotary group

The rotary group consists of drive shaft (F) (111), cylinder block (141), piston shoes (151,152), set plate (153), spherical bushing (156) and cylinder spring (157). The drive shaft is supported by bearing (123,124) at its both ends.

The shoe is caulked to the piston to form a spherical coupling. It has a pocket to relieve thrust force generated by loading pressure and to take hydraulic balance so that it slides lightly over the shoe plate (211). The sub group composed by a piston and a shoe is pressed against the shoe plate by the action of the cylinder spring via a retainer and a spherical bush. Similarly, the cylinder block is pressed against valve plate (313) by the action of the cylinder spring.



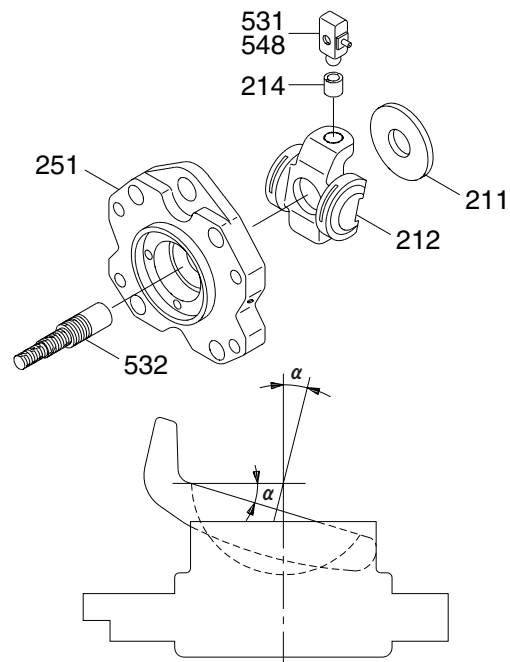
21092MP06

(2) Swash plate group

The swash plate group consists of swash plate (212), shoe plate (211), swash plate support (251), tilting bush (214), tilting pin (531) and servo piston (532).

The swash plate is a cylindrical part formed on the opposite side of the sliding surface of the shoe and is supported by the swash support.

If the servo piston moves to the right and left as hydraulic force controlled by the regulator is admitted to hydraulic chamber located on both sides of the servo piston, the swash plate slides over the swash plate support via the spherical part of the tilting pin to change the tilting angle (α).



2507A2MP14

(3) Valve block group

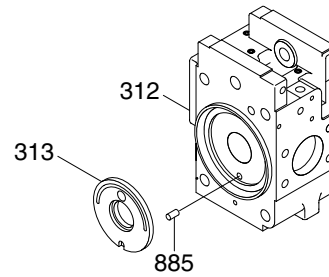
The valve block group consists of valve block (312), valve plate (313) and valve plate pin(885).

The valve plate having two melon-shaped ports is fixed to the valve block and feeds and collects oil to and from the cylinder block.

The oil changed over by the valve plate is connected to an external pipeline by way of the valve block.

Now, if the drive shaft is driven by a prime mover (electric motor, engine, etc), it rotates the cylinder block via a spline linkage at the same time. If the swash plate is tilted as in Fig (previous page) the pistons arranged in the cylinder block make a reciprocating motion with respect to the cylinder block, while they revolve with the cylinder block.

If you pay attention to a single piston, it performs a motion away from the valve plate (oil sucking process) within 180 degrees, and makes a motion towards the valve plate (or oil discharging process) in the rest of 180 degrees. When the swash plate has a tilting angle of zero, the piston makes no stroke and discharges no oil.



21092MP07

2) REGULATOR

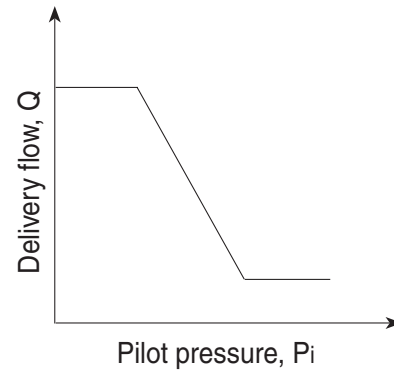
Regulator consists of the negative flow control, total horse power control and power shift control function.

(1) Negative flow control

By changing the pilot pressure P_i , the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in the figure.

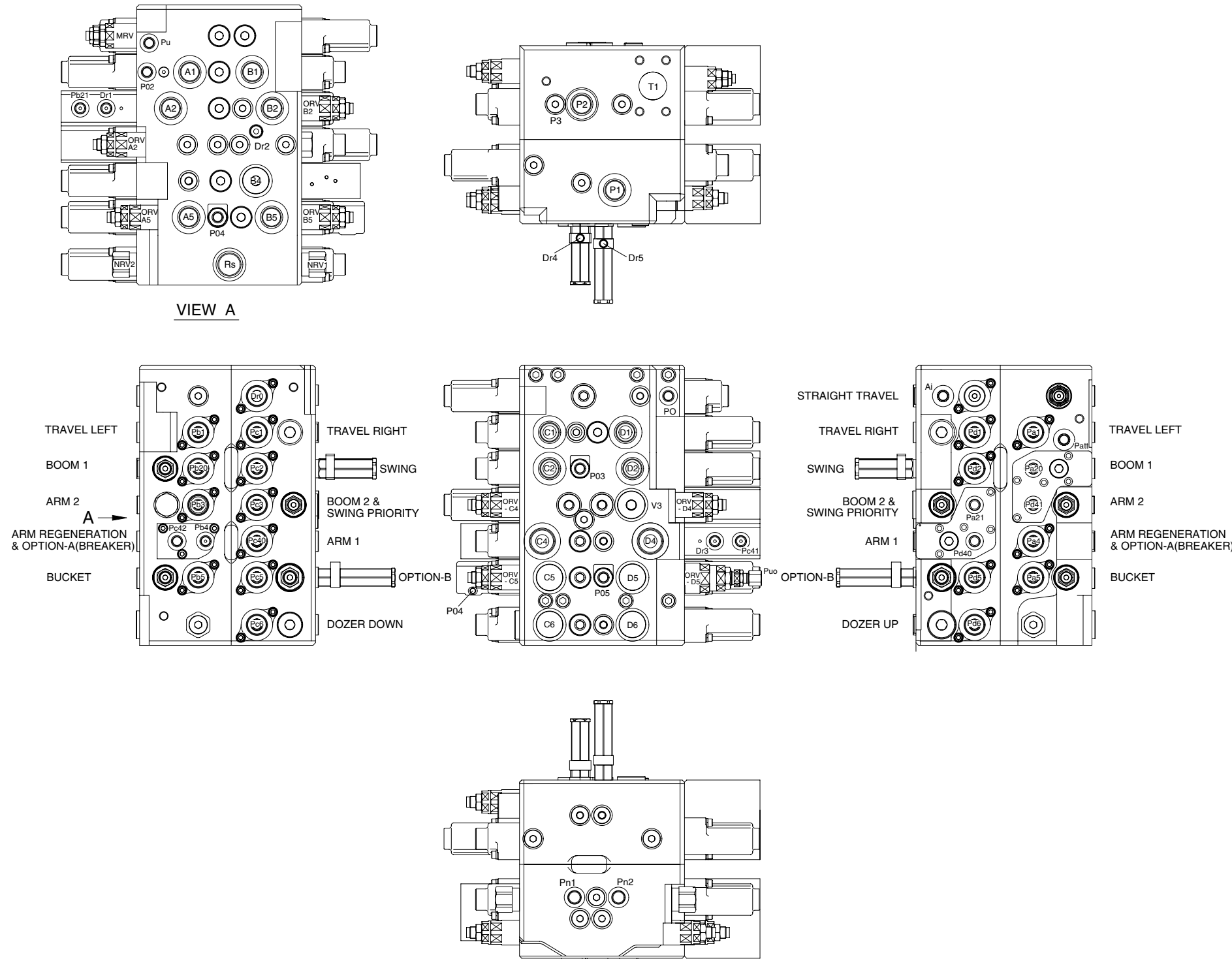
This regulator is of the negative flow control in which the delivery flow Q decreases as the pilot pressure P_i rises.

With this mechanism, when the pilot pressure corresponding to the flow required for the work is commanded, the pump discharges the required flow only, and so it does not consume the power uselessly.



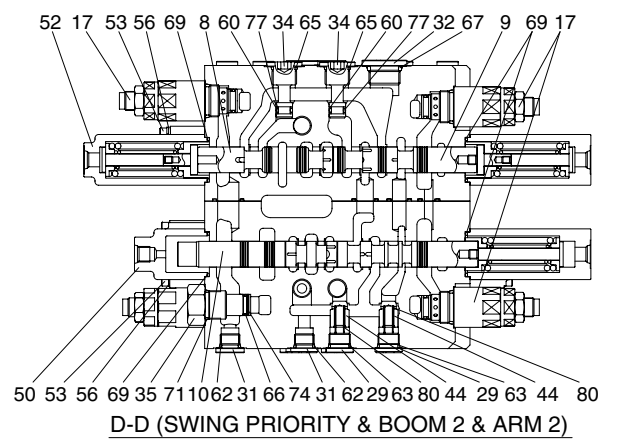
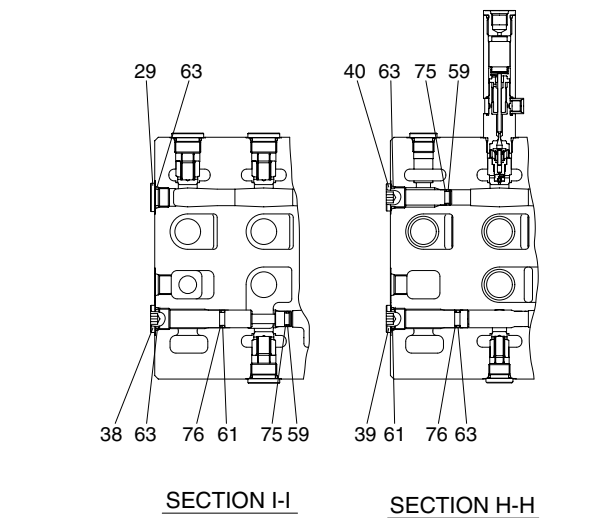
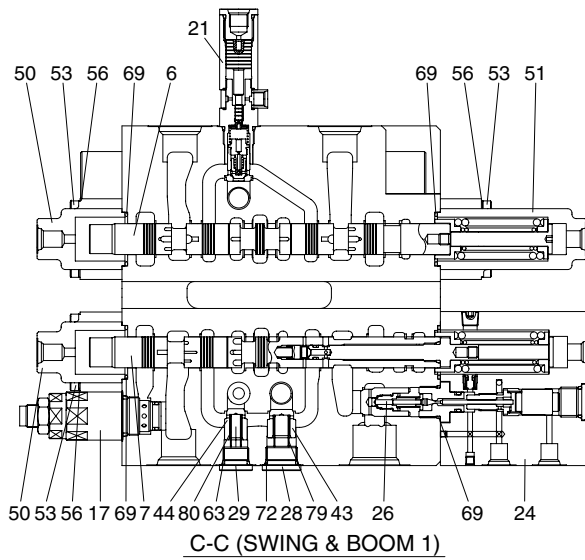
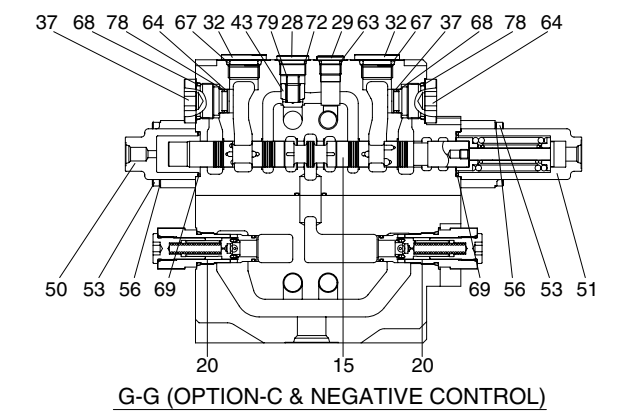
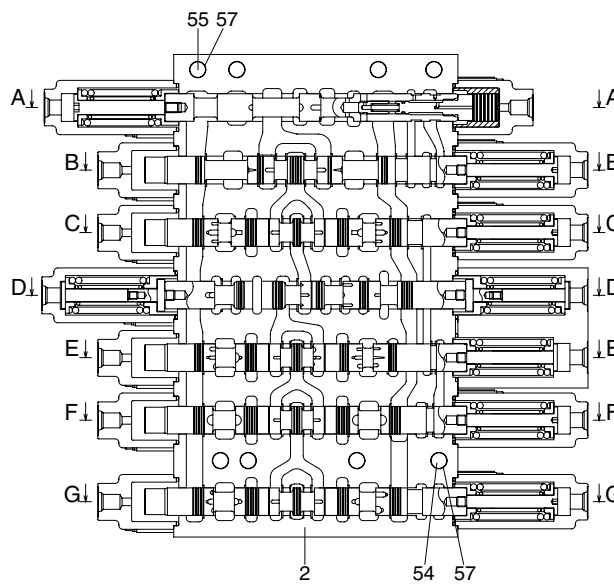
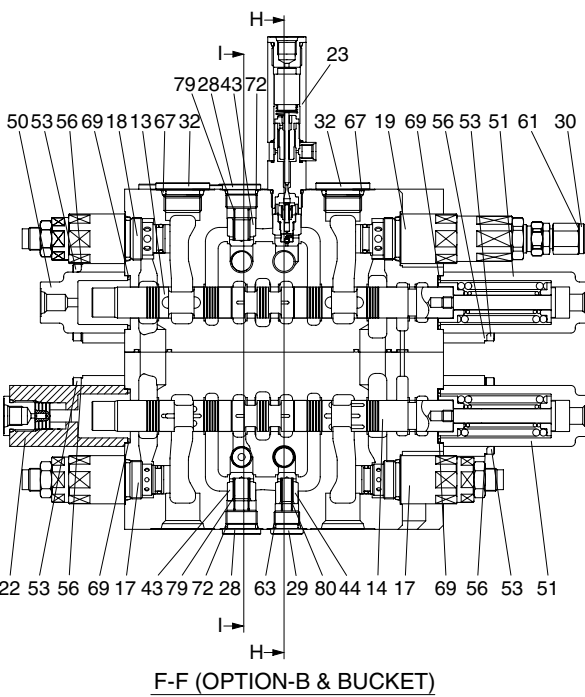
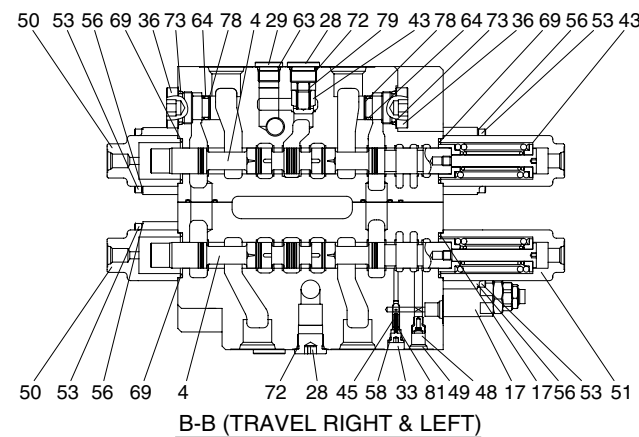
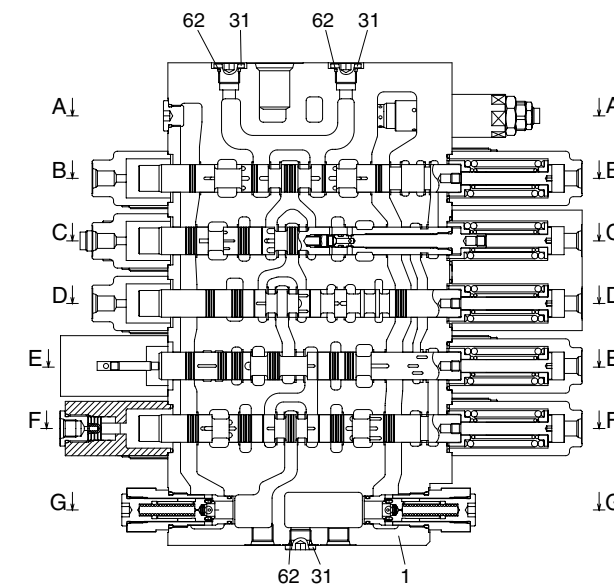
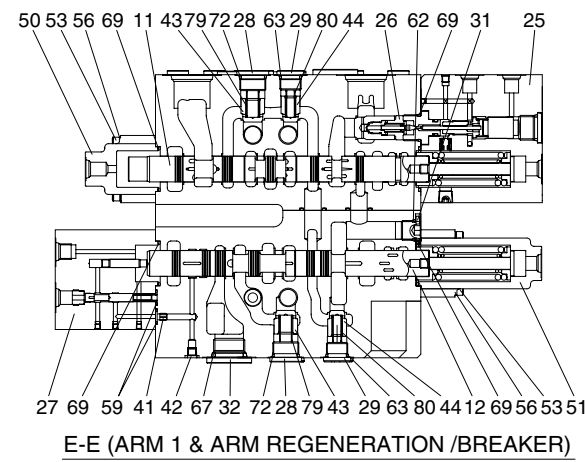
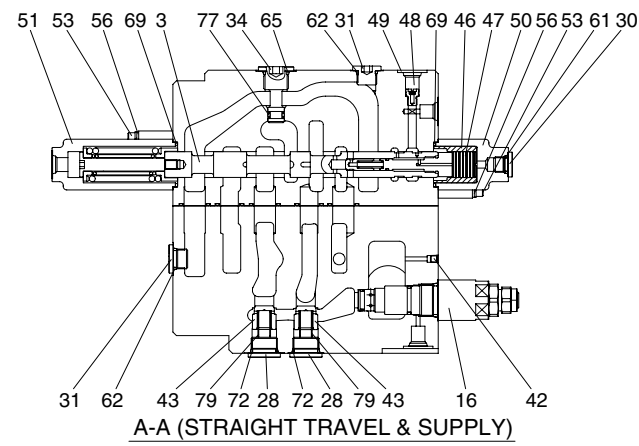
GROUP 2 MAIN CONTROL VALVE

1. STRUCTURE



Mark	Port name	Port size	Tightening torque
Rs	Make up for swing motor	UNF 1 3/16	18 kgf · m (130 lbf · ft)
Pa1	Travel left pilot port (BW)	PF 1/4	3.5~3.9 kgf · m (25.3~28.2 lbf · ft)
Pb1	Travel left pilot port (FW)		
Pc1	Travel right pilot port (FW)		
Pd1	Travel right pilot port (BW)		
Pa20	Boom up pilot port		
Pa21	Boom up confluence pilot port		
Pb20	Boom down pilot port		
Pb21	Lock valve pilot port (boom)		
Pc2	Swing pilot port (RH)		
Pd2	Swing pilot port (LH)		
Pb3	Arm in confluence pilot port		
Pc3	Swing priority pilot port		
Pa4	Option A pilot port (breaker)		
Pb4	Arm in regeneration cut port		
Pc40	Arm in pilot port		
Pc41	Lock valve pilot port (arm)		
Pc42	Arm in regen-cut signal selector port		
Pd40	Arm out pilot port		
Pd41	Arm out confluence pilot port		
Pa5	Bucket in pilot port		
Pb5	Bucket out pilot port		
Pc5	Option B pilot port		
Pd5	Option B pilot port		
Pc6	Option C pilot port (dozer blade down)		
Pd6	Option C pilot port (dozer blade up)		
P0	Pilot pressure port	PF 3/8	7~8 kgf · m (50.6~57.8 lbf · ft)
Pu	Main relief pressure up pilot port		
Ai	Auto idle signal port		
Patt	Auto idle signal-attachment		
P02	Pilot signal port		
P03	Boom priority pilot port		
P04	Boom parallel orifice pilot port		
P05	Breaker summation pilot port		
P3	Quick clamp port		
Pu0	Pilot pressure port		
Dr0	Drain port (travel straight)		
Dr1	Drain port (boom holding valve)		
Dr2	Drain port (boom 2 & swing priority)		
Dr3	Drain port (arm holding valve)		
Pn1	Negative control signal port (P1 port side)		
Pn2	Negative control signal port (P2 port side)		
A1	Travel motor left side port (BW)	PF 1	20~25 kgf · m (115~180 lbf · ft)
B1	Travel motor left side port (FW)		
C1	Travel motor right side port (FW)		
D1	Travel motor right side port (BW)		
B2	Boom rod side port		
C2	Swing motor port (RH)		
D2	Swing motor port (LH)		
B4	Option A port (breaker)		
A5	Bucket head side port		
B5	Bucket rod side port		
C5	Option B port		
D5	Option B port		
C6	Option C pilot port (dozer down port)	PF 1/8	1.5~1.9 kgf · m (10.8~13.7 lbf · ft)
D6	Option C pilot port (dozer up port)		
P1	Pump port (P1 side)	SAE3000, 1 1/2 (M12 × 1.75)	8.5~11.5 kgf · m (61.5~83.1 lbf · ft)
P2	Pump port (P2 side)		
A2	Boom head side port	PF 1	20~25 kgf · m (115~180 lbf · ft)
C4	Arm head side port		
D4	Arm rod side port		
Dr4	Drain port (swing logic valve)	PF 1/8	1.5~1.9 kgf · m (10.8~13.7 lbf · ft)
Dr5	Drain port (flow summation)		
T1	Return port	SAE3000, 1 1/2 (M12 × 1.75)	8.5~11.5 kgf · m (61.5~83.1 lbf · ft)

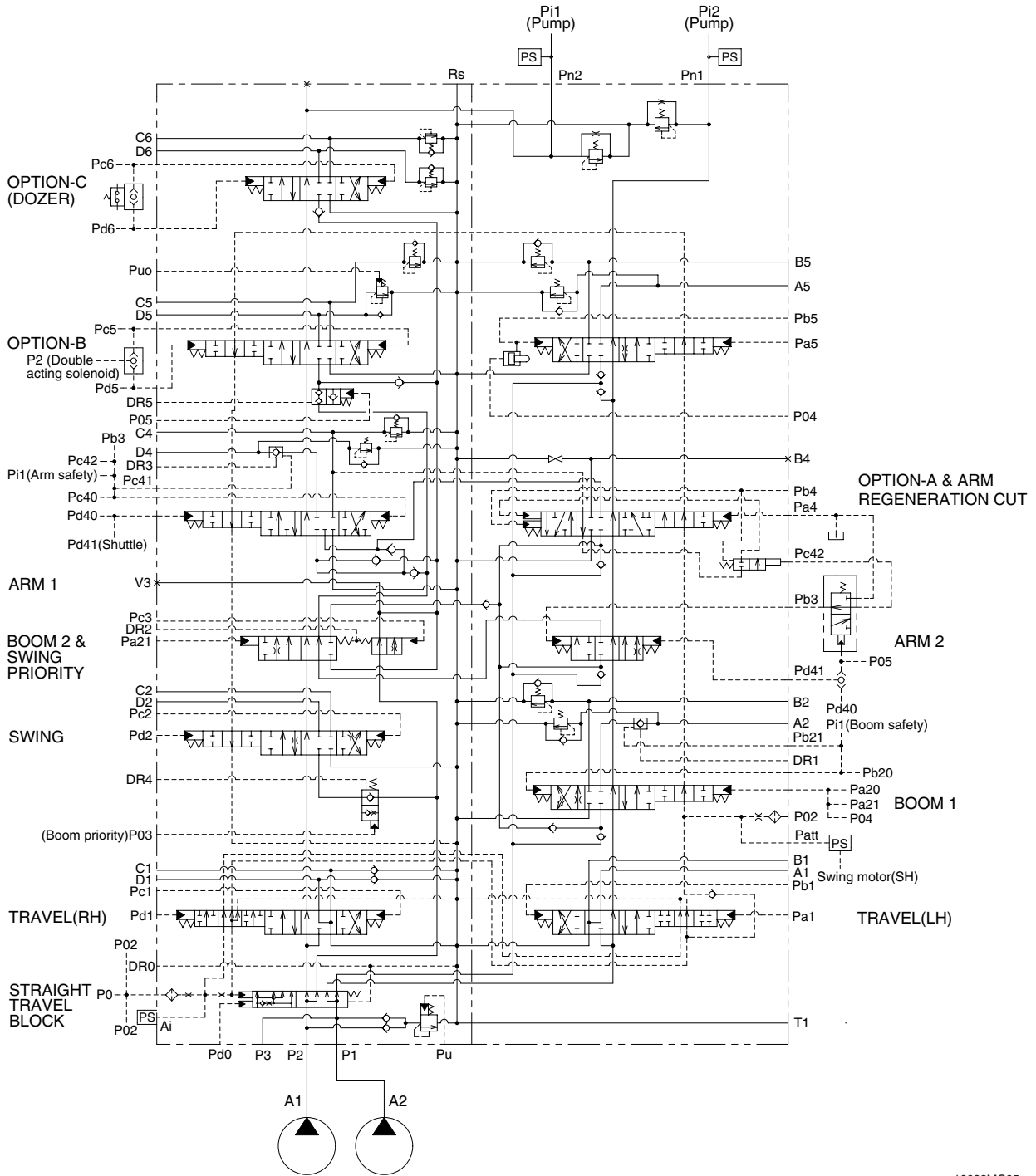
16092MC01



- | | |
|---------------------------|---------------------------|
| 1 Housing-P1 | 43 Load check-poppet |
| 2 Housing-P2 | 44 Load check-poppet |
| 3 Spool-straight travel | 45 Signal-poppet |
| 4 Spool-travel (LH, RH) | 46 Travel straight-sleeve |
| 6 Spool-swing | 47 Travel straight-piston |
| 7 Spool-boom 1 | 48 Orifice signal |
| 8 Spool-swing priority | 49 Coin type filter |
| 9 Spool-boom 2 | 50 Pilot cap |
| 10 Spool-arm 2 | 51 Pilot cap |
| 11 Spool-arm 1 | 52 Pilot cap |
| 12 Spool-arm regeneration | 53 Socket bolt |
| 13 Spool-option B | 54 Socket bolt |
| 14 Spool-bucket | 55 Socket bolt |
| 15 Spool-option C (dozer) | 56 Washer |
| 16 Main relief valve | 57 Spring washer |
| 17 Overload relief valve | 58 O-ring |
| 18 Overload relief valve | 59 O-ring |
| 19 Overload relief valve | 60 O-ring |
| 20 Negacon relief valve | 61 O-ring |
| 21 Swing logic valve | 62 O-ring |
| 22 Bucket logic valve | 63 O-ring |
| 23 Option on-off valve | 64 O-ring |
| 24 Holding valve kit A1 | 65 O-ring |
| 25 Holding valve kit A2 | 66 O-ring |
| 26 Holding valve kit B | 67 O-ring |
| 27 Regeneration block | 68 O-ring |
| 28 Plug | 69 O-ring |
| 29 Plug | 70 O-ring |
| 30 Plug | 71 O-ring |
| 31 Plug | 72 O-ring |
| 32 Plug | 73 O-ring |
| 33 Plug | 74 Backup-ring |
| 34 Plug-parallel | 75 Backup-ring |
| 35 Plug-relief cat | 76 Backup-ring |
| 36 Plug-relief cat | 77 Backup-ring |
| 37 Plug-relief cat | 78 Backup-ring |
| 38 Plug-bucket | 79 Load check spring |
| 39 Plug-bucket parallel | 80 Load check spring |
| 40 Plug-option | 81 Poppet signal spring |
| 41 Plug-orifice | 82 Pin |
| 42 Plug | |

16092MC02

2. HYDRAULIC CIRCUIT



16092MC05

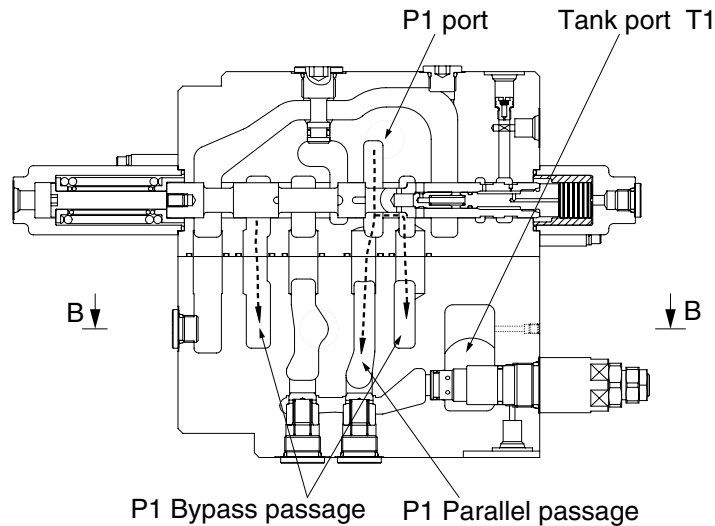
3. FUNCTION

1) CONTROL IN NEUTRAL

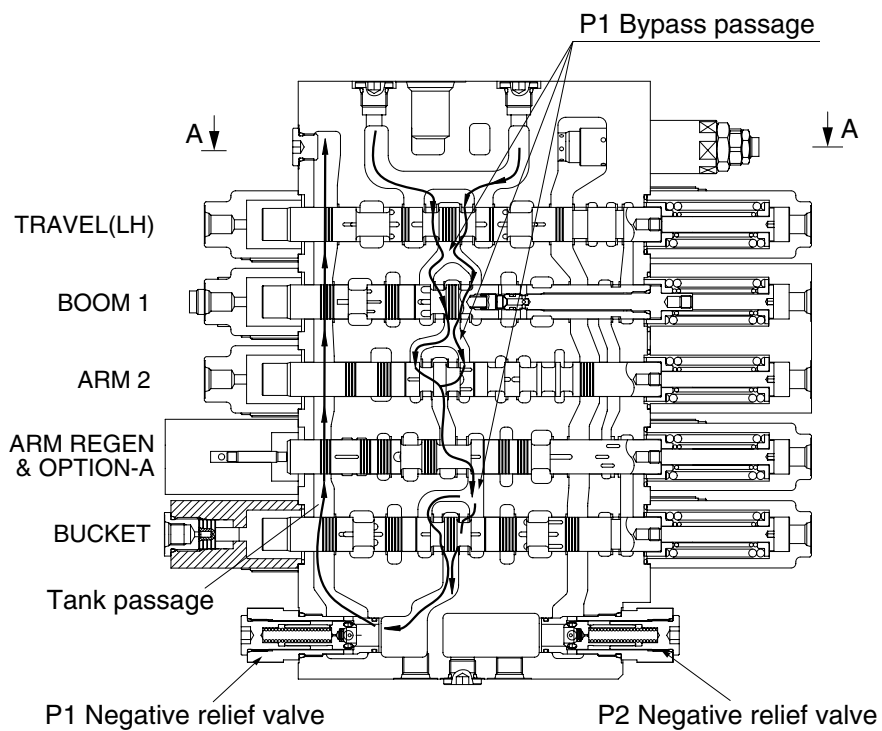
(1) P1 SIDE

The hydraulic fluid from pump A2 flows into the main control valve through the inlet port "P1", pass the straight travel spool into the P1 bypass passage and P1 parallel passage.

The hydraulic fluid from the pump A2 is directed to the tank through the bypass passage of spools : travel left, boom 1, arm 2, arm regeneration & option A and bucket, the negative relief valve of P1, tank passage, and the tank port "T1"



SECTION A-A



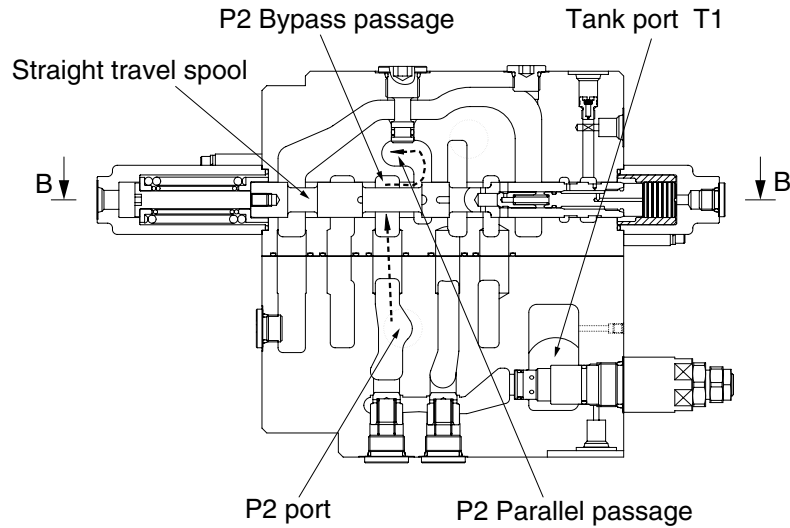
SECTION B-B

16092MC11

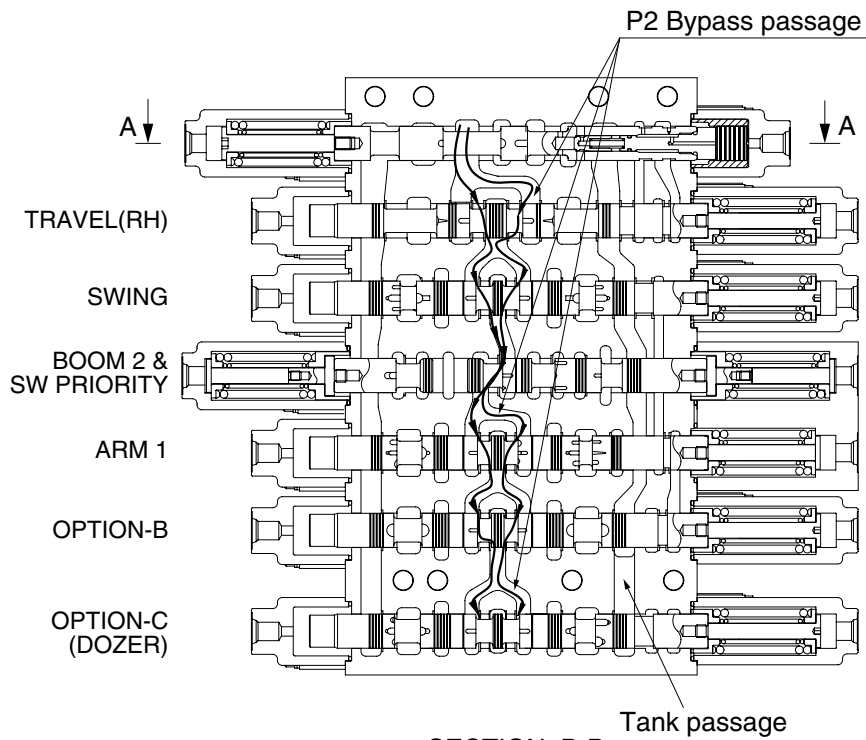
(2) P2 SIDE

The hydraulic fluid from pump A1 flows into the main control valve through the inlet port "P2", into the P2 bypass passage and P2 parallel passage.

The hydraulic fluid from the pump A1 is directed to the tank through the bypass passage of spools : travel right, swing, boom 2 & swing priority, arm 1, option "B" and option "C" (dozer), the negative relief valve of P2, tank passage and the tank port "T1".



SECTION A-A

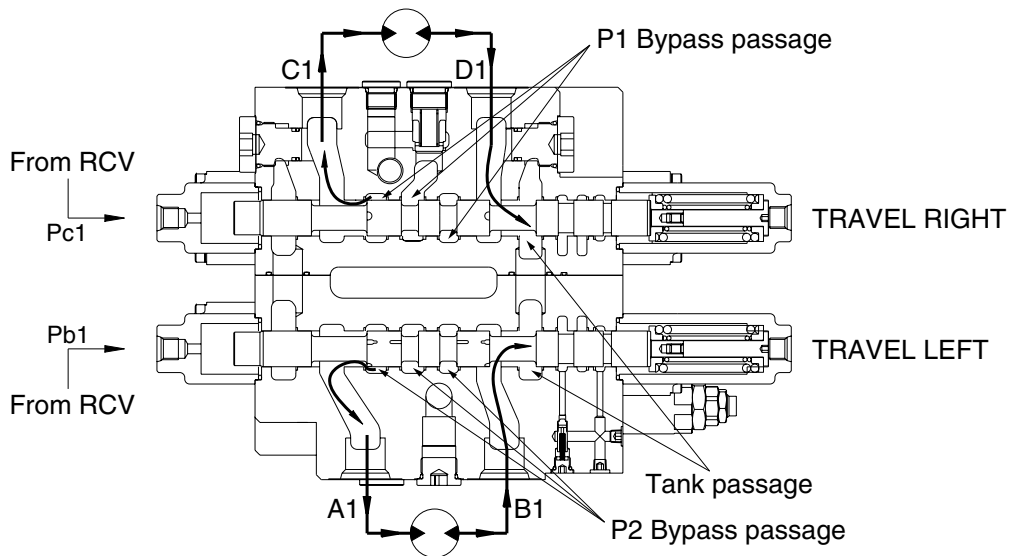


SECTION B-B

14092MC12

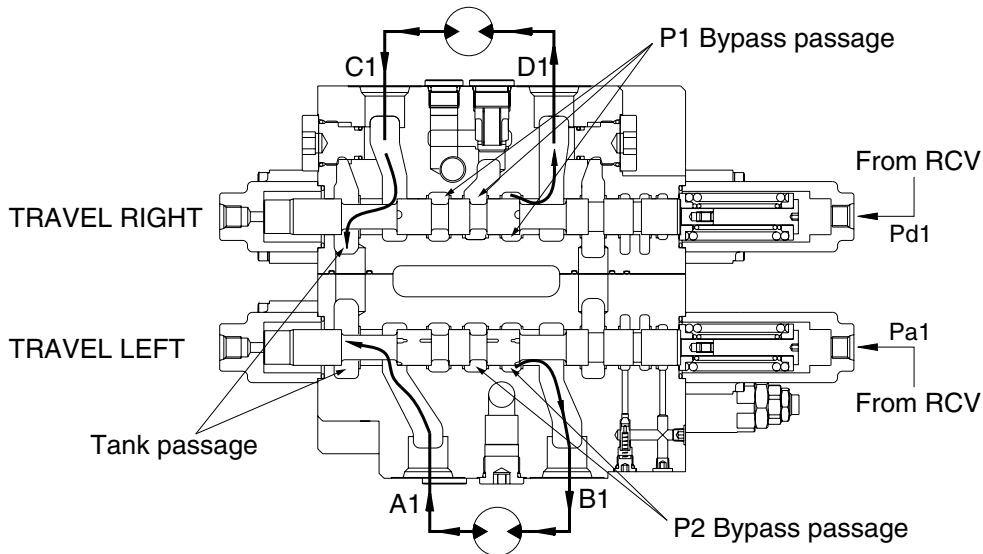
2) TRAVEL OPERATION

(1) TRAVEL FORWARD OPERATION



14092MC18

(2) TRAVEL BACKWARD OPERATION



14092MC17

During the travel forward operation, the hydraulic fluid of the pump A2 is supplied to the travel left motor and the hydraulic fluid of the pump A1 is supplied to the other travel right motor.

The pilot pressure from the pilot control valve is supplied to the spring side of pilot port (pb1, pc1).

And it shifts travel right and left spools in the left direction against springs. Hydraulic fluid from the pump A1 flow into the travel right spool through the bypass passage and hydraulic fluid from the pump A2 flow into the travel left spool through the bypass passage.

Then they are directed to the each travel motor through port A1 and C1. As a result, the travel motors turn and hydraulic fluid returns to the tank passage through the travel spools.

In case of the reverse operation, the operation is similar.

Diesel Engines

Machinery

ABS	Agco-Sisu
Akasaka	Baudouin
BMW	Bukh
Caterpillar	CHN 25/34
Cummins	Daihatsu
Detroit	Deutz
Doosan-Daewoo	Fiat
Ford	GE
Grenaa	Guascor
Hanshin	Hatz
Hino	Honda
Hyundai	Isotta
Isuzu	Iveco
John-Deere	Kelvin
Kioti	Komatsu
Kubota	Liebherr
Lister	Lombardini
MAK	MAN B&W
Mercedes	Mercruiser
Mirrlees BS	Mitsubishi
MTU	MWM
Niigata	Paxman
Perkins	Pielstick
Rolls / Bergen	Ruggerini
Ruston	Scania
Shibaura	Sisu-Valmet
SKL	Smit-Bolnes
Sole	Stork
VM-Motori	Volvo
Volvo Penta	Westerbeke
Wichmann	Yanmar

Drott	Dynapack
Extec	Faun
Fendt	Fiat
Fiatallis	Flexicoil
Furukawa	Gehl
Genie	Grove-gmk
Halla	Hamm
Hangcha	Hanix
Hanomag	Hartl
Haulpack	Hiab
Hidromek	Hino truck
Hitachi	Hyster
Hyundai	IHI
Ingersoll-rand	JCB
JLG	John-Deere
Jungheinrich	Kalmar
Kato	Kioti
Kleeman	Kobelco
Komatsu	Kramer
Kubota	Lamborghini
Landini	Liebherr
Linde	Link-belt
Manitou	Massey-Ferg.
Mccormick	MDI-Yutani
Mitsubishi	Moxy
Mustang	Neusson
New-Holland	Nichiyu
Nissan	OK
OM-Pimespo	others-tech
Pel-Job	PH-mining
Poclain	Powerscreen

Machinery

ABG	Airman
Akerman	Ammann
Astra	Atlas Copco
Atlas Weyha.	Atlet
Bell	Bendi
Bigjoe	Bobcat
Bomag	BT
Carelift	Case
Caterpillar	Cesab
Challenger	Champion
Claas	Clark
Combilift	Crown
Daewoo-Doosan	Demag
Deutz-Fahr	Dressta

Same	Samsung
Sandvik	Scania
Schaefer	Schramm
Sennebogen	Shangli
Shibaura	Steiger
Steinbock	Steyr
Still	Sumitomo
Super-pac	Tadano
Takeuchi	TCM
Terex	Toyota
Valpadana	Venieri
Versatile	Vogele
Volvo	Weidemann
Wirtgen	Yale
YAM	Yanmar