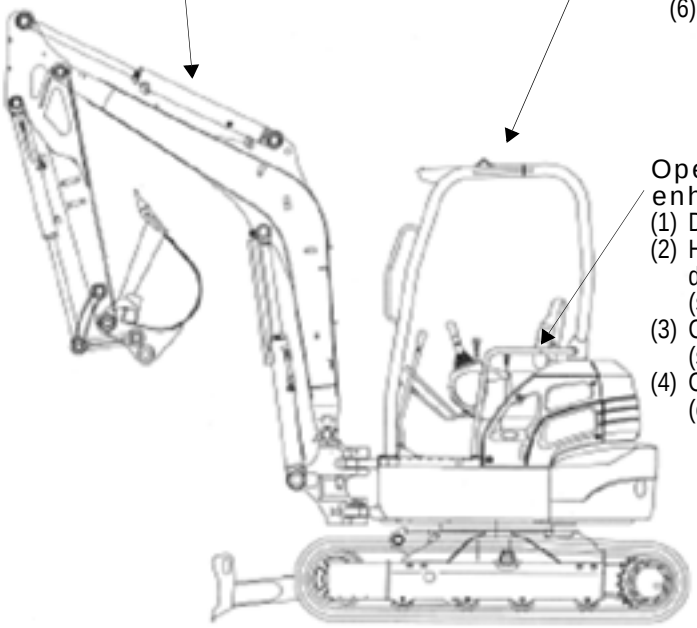
A. Quick feature chart

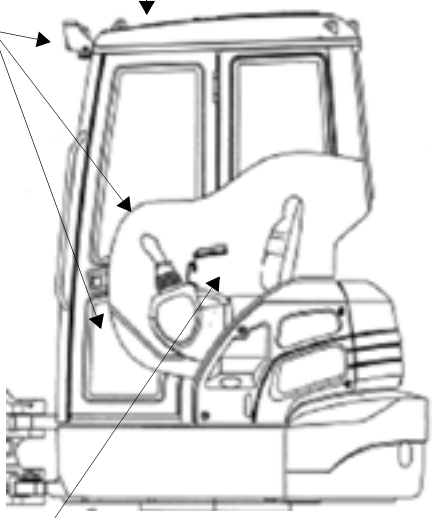
a. KX91-3S, KX91-3α, KX101-3α, U35S, U35-3S, U35-3α

Basic performance improved (new)
Greater working range of this class
(1) Maximum digging and dumping heights
(2) Maximum digging depth

Safeness upgraded
(1) Full-scale 4-post ROPS/FOPS canopy
(3) Standard equipped with ROPS/FOPS cabin (cab type)(with steel-framed skylight)
(4) Engine neutral start
(5) Travel lock
(6) Master key-compatible immobilizer (option)



Operator's comfort enhanced
(1) Digital navigation system
(2) Heater with outside-air inlet defroster
(standard on cab type)
(3) Cup holder
(standard on cab type)
(4) Optional headlights
(option on cab type)



Maintainability
(1) Hydraulic components collectively located on the right machine side
(2) Right hood fully opened
(3) Sectional dozer hose, etc.

Better maneuverability
(1) Service port local control (wrist rest type)
(2) Travel bi-speed button (dozer lever)
(3) Independent swing pedal on the left side (hydraulic pilot)

E. Engine upgrade

a. General

Only the engine of KX161-3S for PP-version (KTC, KCL, KTA) has been upgraded due to the strong market requirement.

b. Engine specifications

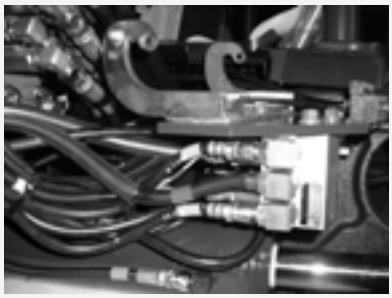
		KX161-3
Model		V2403-M-E2BH-1 (Standard-version) V2403-M-E2BH-2 (Air conditioner-version)
No. of cylinder		4
Bore × Stroke	mm	87 × 102.4
	in	3.43 × 4.03
Displacement	cc	2.434
	in^3	148.5
Max. output/rpm(gross)	kW/rpm	32.8/2200
	PS/rpm	44.6/2200
	HP/rpm	44.0/2200
Compression ratio		23.8
Max. torque(gross)	N·m	163.5
	kgf·m	16.7
	ft·lbf	120.6
Dimensions:L × W × H	mm	705 × 511 × 700
	in.	27.8 × 20.1 × 27.6
Dri weight	kg	180
	lbs	396.8
Valve clearance	mm	0.18-0.22
	in.	0.0071-0.0087
Firing sequence		1-3-4-2
Compression pressure (A)/(B)	Mpa	3.53-4.02/2.55
	kgf/cm^2	36-41/26
	psi	512-583/370
Fan belt		REMF6405
Fuel consumption ratio	g/kWh	299
	g/Psh	220
	lbs/Hph	0.49
Fuel consumption	l/h	11.4
	gal/h	3.01
Max.speed without load	rpm	2470ÅÜ
Speed with 2 pumps relief	rpm	ÅH
Speed with idling	rpm	900-950
Engine oil pressure with rated engine rpm	kPa	294-441
	kgf/cm2	3.0-4.5
	psi	42.7-64.0
Injection pressure	MPa	13.7-14.7
	kgf/cm2	140-150
	psi	1991-2133
Engine oil consumption ratio	g/kWh	1.36
	g/Psh	1
	lbs/Hph	0.002

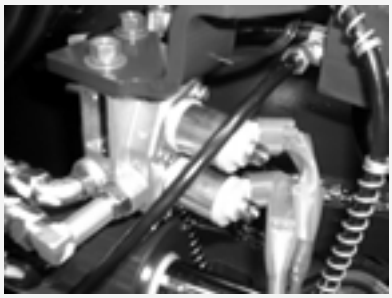
b. Photos of main modified parts

No.1 Knob switch

No.8 Digital meter panel

No.8 Digital meter panel, AI-version





No.2 S/P solenoid valve

No.4 Arm with thumb bracket

No.5 Accumulator in pilot line

No.6 Fuel-water separator

No.7 Two speed switch

No.9 Anti-theft system
(EU-version)

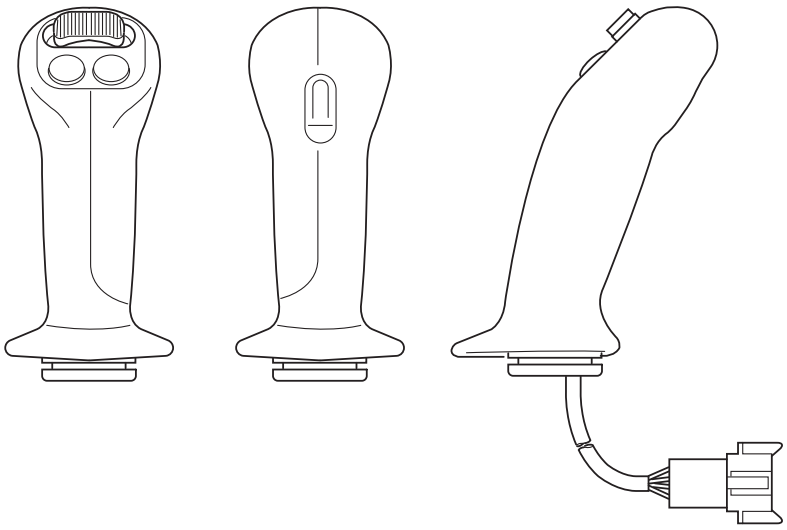
No		Specificatios Items			Unit	U35S (KTC, KCL) U35-3S (KTA)	KX91-3S (KTC, KCL, KTA)	Remarks
5	8	Front attach-ment	Max. digging radius		mm	**5255 ± 79**	5245 ± 79	
					inch	**206.9 ± 3.1**	206.5 ± 3.1	
	9		Ground level Max. digging radius		mm	5140 ± 77	5135 ± 77	
					inch	202.4 ± 3.0	202.2 ± 3.0	
	10		Ground level Min. finish radius		mm	1755 ± 35	1410 ± 28	Bucket bottom horizontal
					inch	69.1 ± 1.4	55.5 ± 1.1	
	11		Max. digging depth		mm	3115 ± 62	3185 ± 64	
					inch	122.6 ± 2.4	125.4 ± 2.5	
	12		Max. vertical digging depth		mm	2185 ± 44	2390 ± 48	
					inch	86.0 ± 1.7	94.1 ± 1.9	
	13		Max. digging height	Conopy	mm	4890 ± 98	4875 ± 98	
					inch	192.5 ± 3.9	191.9 ± 3.9	
	14			Cabin	mm	4660 ± 93		
					inch	183.5 ± 3.7		
	15		Max. dump height	Conopy	mm	3470 ± 69		
					inch	136.6 ± 2.7		
	16			Cabin	mm	3265 ± 65		
					inch	128.5 ± 2.6		
	17		Max. dump height (Arm vertical)	Conopy	mm	1230 ± 37	965 ± 29	
					inch	48.4 ± 1.5	38.0 ± 1.1	
	18			Cabin	mm	1125 ± 34		
					inch	44.3 ± 1.3		
	19		Mini. turning radius	Conopy	mm	2065 ± 62	1940 ± 116	
					inch	81.3 ± 2.4	76.4 ± 4.6	
	20			Cabin	mm	2190 ± 66		
					inch	86.2 ± 2.6		
	21		Mini. turning radius (Left swing)	Conopy	mm	-		
					inch	-		
	22			Cabin	mm	-		
					inch	-		
6	1	Dozer	Width		mm	1700 ± 5	1550 ± 5	
					inch	66.9 ± 0.2	61.0 ± 0.2	
	2		Height		mm	335 ± 25	355 ± 10	
					inch	13.2 ± 1.0	14.0 ± 0.4	
	3		Max. lift above GL		mm	**370 ± 26**	375 ± 26	
					inch	**14.6 ± 1.0**	14.8 ± 1.0	
	4		Max. below GL		mm	**370 ± 26**	365 ± 26	
					inch	**14.6 ± 1.0**	14.4 ± 1.0	
Q2		**Main Specs JIS A8404**						
1	1	Bucket tooth slaggish			mm	70 >		
					inch	2.76 >		
	2	Tilt amount of front attachment			mm	10 >		
					inch	0.39 >		
	3	Dozer's declination			mm	10 >		
					inch	0.39 >		
2	1	Eccentric amount from swing center			mm			From swivel center
					inch			
	2	Distance to swing center			mm	72 ± 25.0	135 ± 25.0	
					inch	2.83 ± 1.0	5.31 ± 1.0	
3	1	Approach angle			deg	31.4 ± 3.5	30 ± 3	

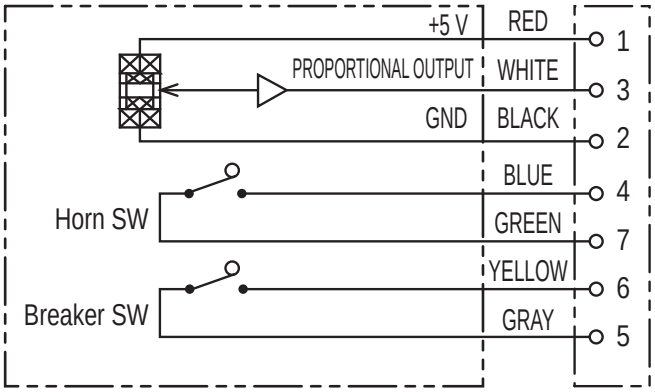
d. Knob structure and function

The knob has a built-in IC chip that is different from that for potentiometers.

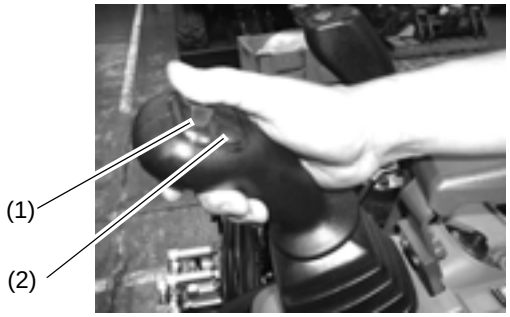
1) Service mode:Press the center switch of the meter panel to call the service mode.
2)Knob control: Shift the knob to L or R direction to call two way PTO operation.
3) Breaker operation:Press the back button of the knob to call the breaker mode.

1. Structure of knob switch

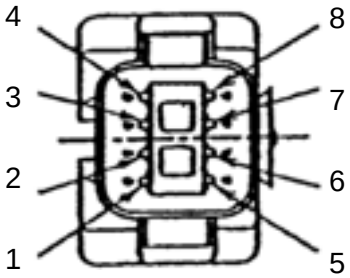


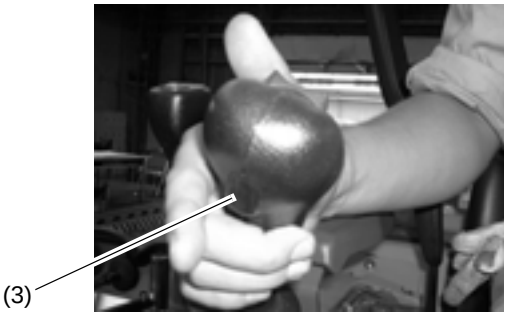


ELECTRIC CIRCUIT



(1) Knob switch (2) Horn switch

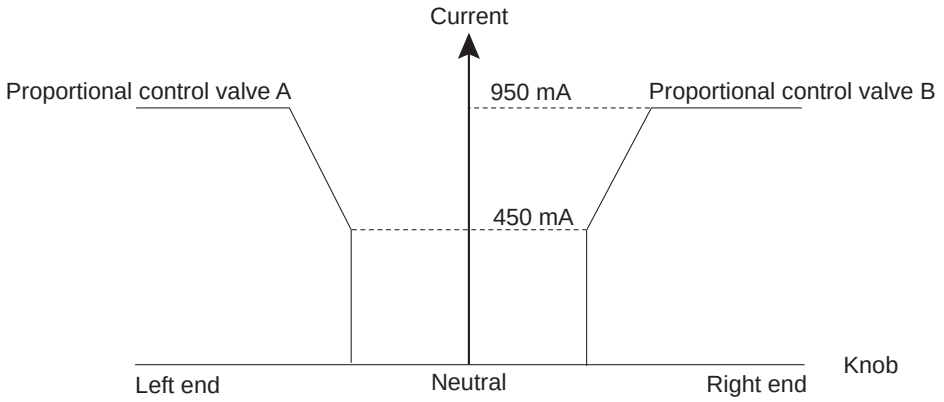




(3) Breaker switch

f. S/P valve start point setting

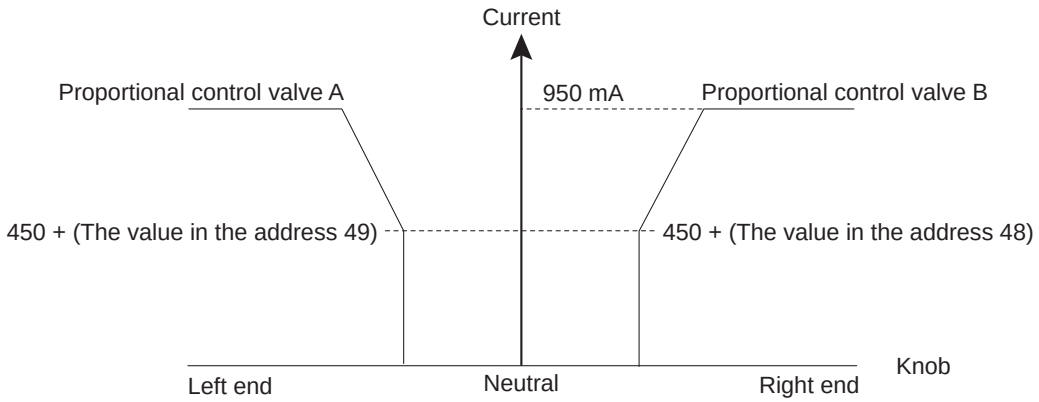
1. Performance characteristics profile: Knob shift amount vs Output current



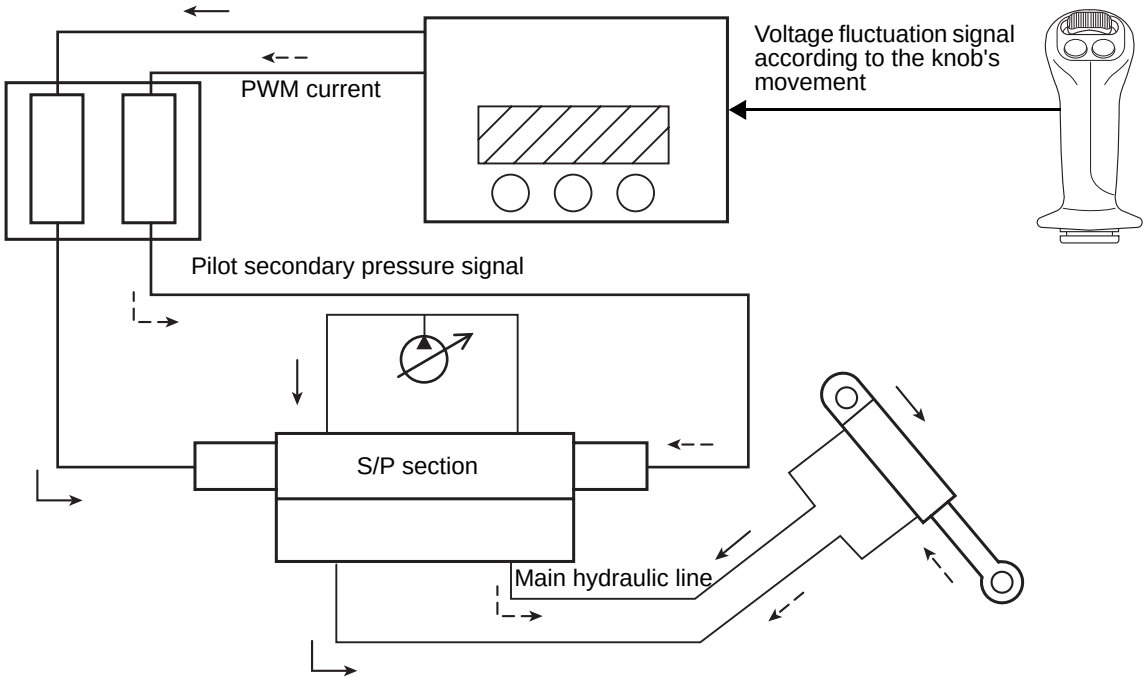
1) A dead zone is provided to keep the thumb intact in neutral. Some margins are also given to start the thumb at each end.
2) The right-end, neutral, and left-end settings of the knob are presupposed to be in memory.
3) The profile is flexibly modifiable even for maximum engine rpm and idling speed. When the engine runs at middle speed, for example, the average is determined from the idling map and maximum map and finally outputted.
4) Suppose that the thumb starts moving at the current of 500 mA. The knob's operating map must begin with 450 mA because it is necessary to provide an inching zone and give better feeling.
5) At the 500mA level, however, there could be fluctuations due to the control valve, proportional control valve, hoses and other factors. The meter keeps the initial map and performs as well, but the inching zone might be longer or shorter depending on the machine.
6) The starting point setting is made to cope with such problem. In the setting mode, the meter shows the current gradually higher from 450 mA. When the thumb starts moving, the operator is supposed to press and release the button twice for releasing and grasping of the thumb. The meter memorizes the then setting.

   Address 48: → Release R Deviation
   Address 49: → Grasp L Deviation

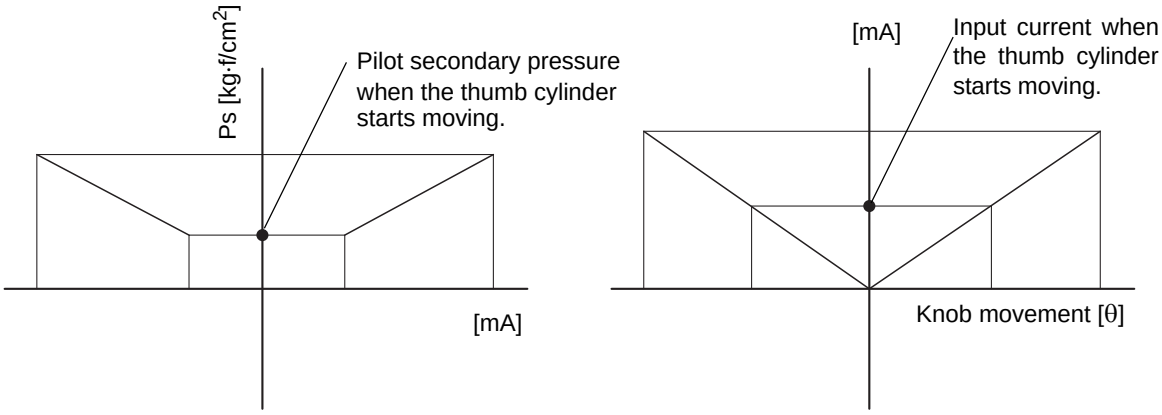
   The following correction is made for control.



3. Illustration of the start-point setting



Move the knob, and you will find the point where the thumb cylinder starts moving. Just when the cylinder gets activated, press the selector switch. Do this for the right and left movements of the knob.
Does control start when the start-point has been reached?

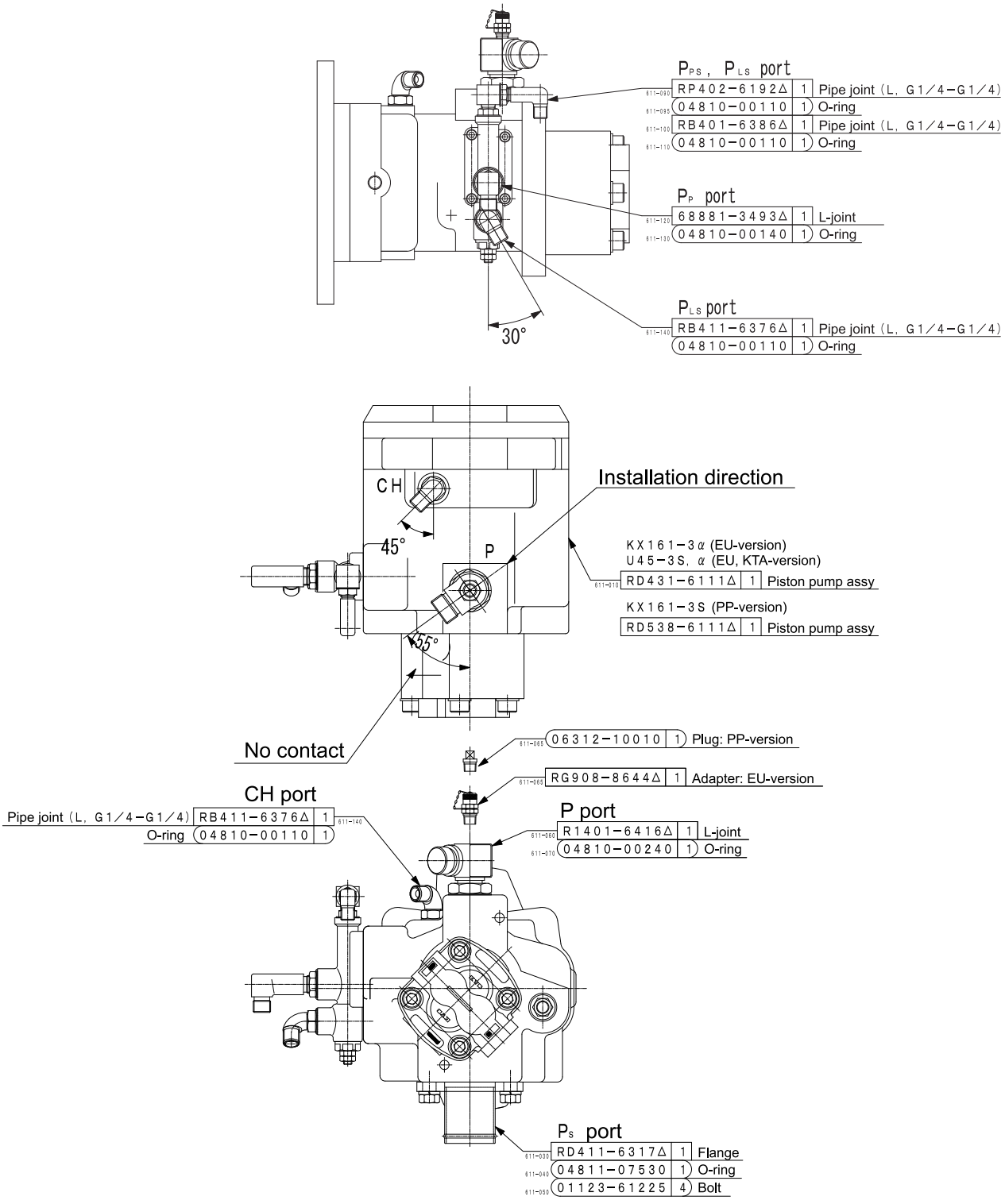


b. Hydraulic pump: KX161-3s, KX161-3α

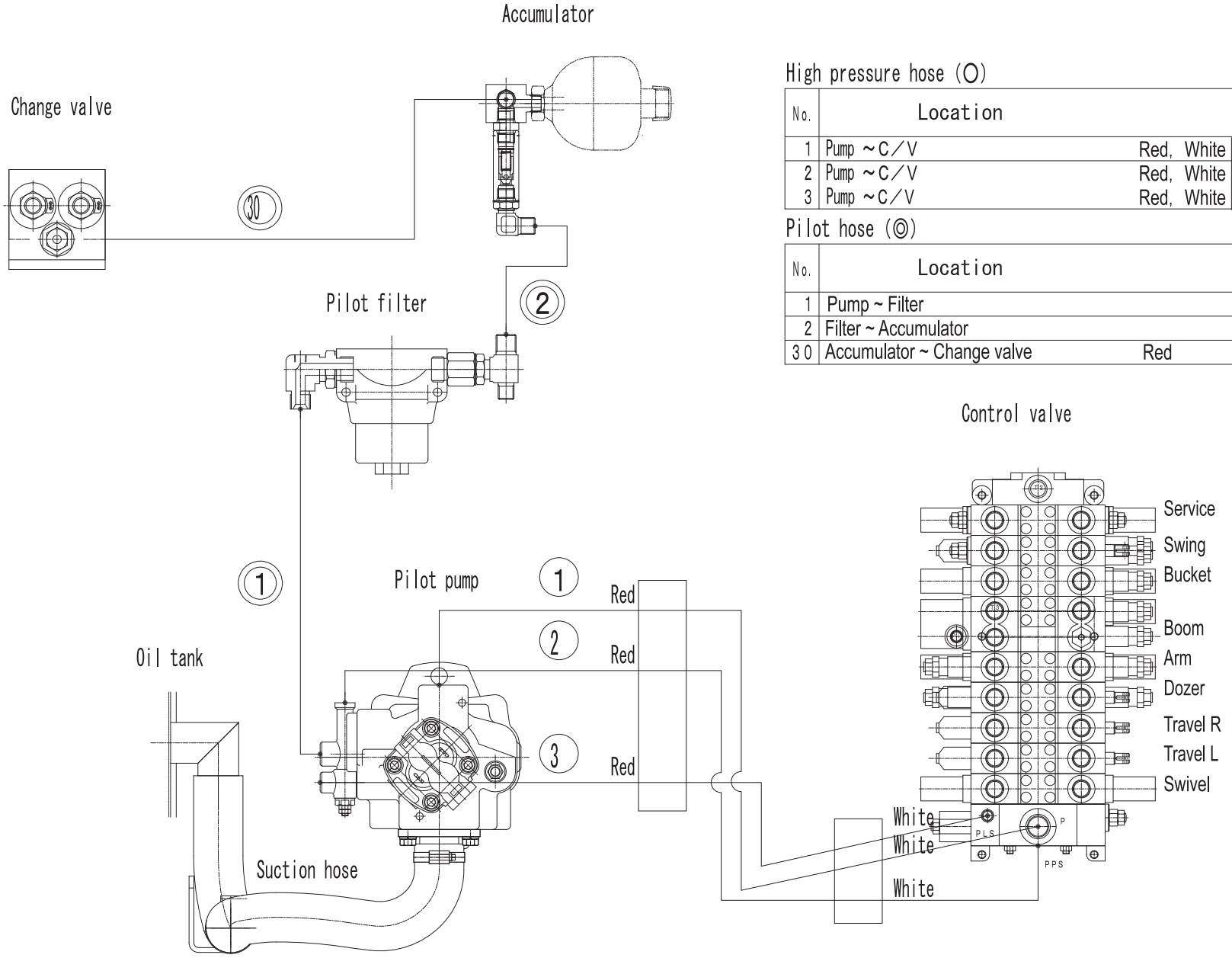
1. Pump installation: KX161-3S·α, U45-3α

(1) Adapter tightening torque

P port (G3/4)	117.6 ~ 127.4N·m (12.0 ~ 13.0kgf·m)
P_{PS}, P_{LS}, CH port (G1/4)	24.5 ~ 29.4N·m (2.5 ~ 3.0kgf·m)
P_P port (G3/8)	49.0 ~ 53.9N·m (5.0 ~ 5.5kgf·m)



3. Pilot delivery line: KX161-3S



High pressure hose (O)

No.	Location		
1	Pump ~C/V	Red, White	P (Delivery)
2	Pump ~C/V	Red, White	PPS
3	Pump ~C/V	Red, White	PLS

Pilot hose (◎)

No.	Location		
1	Pump ~ Filter		P4
2	Filter ~ Accumulator		P4
30	Accumulator ~ Change valve	Red	P4

E. Engine upgrade

a. General

Only the engine of KX161-3S for PP-version (KTC, KCL, KTA) has been upgraded due to the strong market requirement.

b. Engine specifications

		KX161-3
Model		V2403-M-E2BH-1 (Standard-version) V2403-M-E2BH-2 (Air conditioner-version)
No. of cylinder		4
Bore × Stroke	mm	87 × 102.4
	in	3.43 × 4.03
Displacement	cc	2.434
	in^3	148.5
Max. output/rpm(gross)	kW/rpm	32.8/2200
	PS/rpm	44.6/2200
	HP/rpm	44.0/2200
Compression ratio		23.8
Max. torque(gross)	N·m	163.5
	kgf·m	16.7
	ft·lbf	120.6
Dimensions:L × W × H	mm	705 × 511 × 700
	in.	27.8 × 20.1 × 27.6
Dri weight	kg	180
	lbs	396.8
Valve clearance	mm	0.18-0.22
	in.	0.0071-0.0087
Firing sequence		1-3-4-2
Compression pressure (A)/(B)	Mpa	3.53-4.02/2.55
	kgf/cm^2	36-41/26
	psi	512-583/370
Fan belt		REMF6405
Fuel consumption ratio	g/kWh	299
	g/Psh	220
	lbs/Hph	0.49
Fuel consumption	l/h	11.4
	gal/h	3.01
Max.speed without load	rpm	2470ÅÜ
Speed with 2 pumps relief	rpm	ÅH
Speed with idling	rpm	900-950
Engine oil pressure with rated engine rpm	kPa	294-441
	kgf/cm2	3.0-4.5
	psi	42.7-64.0
Injection pressure	MPa	13.7-14.7
	kgf/cm2	140-150
	psi	1991-2133
Engine oil consumption ratio	g/kWh	1.36
	g/Psh	1
	lbs/Hph	0.002

a. Development concept

1. Background of Adoption of New Meter

(1) The L1 (3-ton class) Series, which was released in Japan in 1999 for domestic users, adopted a new meter of LCD type (called YUYU NAVI). Since then, this meter has been one of the sales points of the Series.
(2) Presently, the new meter is applied to only models for domestic users. No models for overseas users adopt this meter.
(3) The new meter has a stable reputation for providing advanced performance, convenience, and user-friendliness. This sales point should be added to models for overseas users.
(4) As of 2004, LCD type meter has alrady been incorporated in KX41-3, KX61-3 and KX71-3. Now this meter is going to applied to KX91-3 to KX161-3 and U35 to U45-3 all of models.

2. Features of New Meter

(1) Advanced performance:
Digital display (multi-language support for EU-version), alarm sound, and design performance (see fig. 2 on the right-hand side)
(2) Parts integration:
Relays and controllers supporting a variety of functions for conventional models are integrated into the new meter for space saving and high cost performance. (Relays partly need to be installed externally.)
(3) Functions in a Wide Variety
1. Warning and self-diagnostic functions:
The following items are displayed on the LCD with graphics, failure (warning) numbers, and characters along with an alarm sound.
- Remaining fuel (see fig. 3 on the right-hand side)
- Oil pressure (see fig. 4 on the right-hand side)
- Charge (see fig. 5 on the right-hand side)
- Overvoltage
- Overheating

2. Inspection time instruction function:
"SERVICE HOURS" appears whenever the time has come for the inspection and replacement of the oil filter as explained in the manual, and prompts the user to make an inspection.
3. Fuel replenishment assist function:
The meter beeps intermittently at the time of fuel replenishment, and the interval between beeps is shortened when the tank is almost filled to prevent the fuel from overflowing.
The beep functions with the key turned OFF, but one of the switch needs to be pressed.
4. Service tester function:
This function allows the monitoring of the operation of electrical devices (e.g., an oil pressure switch) connected to the meter and provides the history of failures resulted in the past (see figs. 6 and 7 on the right-hand side).
While in harness manipulation mode, it is possible to diagnose and single out harness components that have internal failures (e.g., contact failures).
5. Other functions
- Low Travel speed reset at the time of restarting the engine (if the engine is turned OFF with high - low switch set to the high range).
- Engine start check (preventing the engine from starting with the lever unlocked).
- Starter motor automatic disconnection → Auto release
- Auto glow
- Built-in hour meter and display
- Built-in tachometer and display

6. Expansion function for this minor change : KX91-3, 101-3, 121-3, 161-3, U35, U35-3, U45-3
- Monitoring with theft prevention set up (EU-version only, optional)
- Service port (thumb) hand-held proportional control
- Air-conditioner idling control
- Auto idling

3-12 Service hour meter

A service maintenance message will appear when the preset hour meter item is activated.
The message will disappear in 10 seconds. Hereafter, whenever the key is turned OFF and ON, the message will appear for the first 10 seconds.
There are two modes (i.e., auto mode and manual mode) to turn OFF the inspection icon perfectly, either of which is selectable by the user's settings.
While the system is in auto mode, the icon will disappear when the key is turned OFF and ON 10 times in total. Then icon will not appear again with the key further pressed. This is convenient because the icon will disappear only with the key turned OFF and ON, in which case the actual maintenance of the equipment will be up to the user's choice.
While in manual mode, the icon will disappear with the working lamp pressed continuously for 3 seconds. In this case, the message will be eliminated after the user's maintenance work. Therefore, the problem of the careless omission of maintenance will be prevented. This method is, however, complicated. Therefore, it is necessary for each dealer to make maintenance management.
When all the described inspection items in the Operation Manual are considered, a message will be displayed at 50-hour intervals, which is not so meaningful. In view of the foregoing, important items (e.g., items related to the engine oil, operating oil, air filter, and engine oil filter) should be targeted so that a message will appear in the case of maintenance necessity for any of these items. The meter with North American specifications and that with European specifications share the same software, but the timing of maintenance varies with the specifications and the size of the system. Therefore, the displayed frequency of each item is changed according to the specifications. Fig. 2 shows an example of the display of the KX41-3, KX71-3 and super series models with North American specifications.
Usually, the service hour meter advances in synchronization with the hour meter, thus causing no problems. If the hour meter is replaced, however, the new hour meter will start with zero hour. In that case, the service hour meter will be asynchronous. Due to ethics reasons, the system cannot incorporate functions that allow the alternation of the hour meter. There are, however, no problems in altering the service hour meter. Therefore, items that can be input for the service hour meter have been prepared.

Service Hour Meter with North American Specifications

No.	Check points		Intervals	Hour meter indicator									Consequently
				50	100	250	300	500	550	750	800	1000	
1	Engine oil		change	○			○		○		○		every 250 hrs
2	Hydraulic oil											○	every 1000 hrs
3	Air filter element	Outer element	replace									○	every 1000 hrs
		Inner element										○	every 1000 hrs
4	Drive unit oil		change		○			○				○	every 500 hrs
5	Engine oil filter		replace	○			○		○		○		every 250 hrs
6	Hydraulic return filter element					○				○			every 500 hrs
7	Hydraulic suction filter element											○	every 1000 hrs

The message appears. The message shows up as follows.

Fig. 2

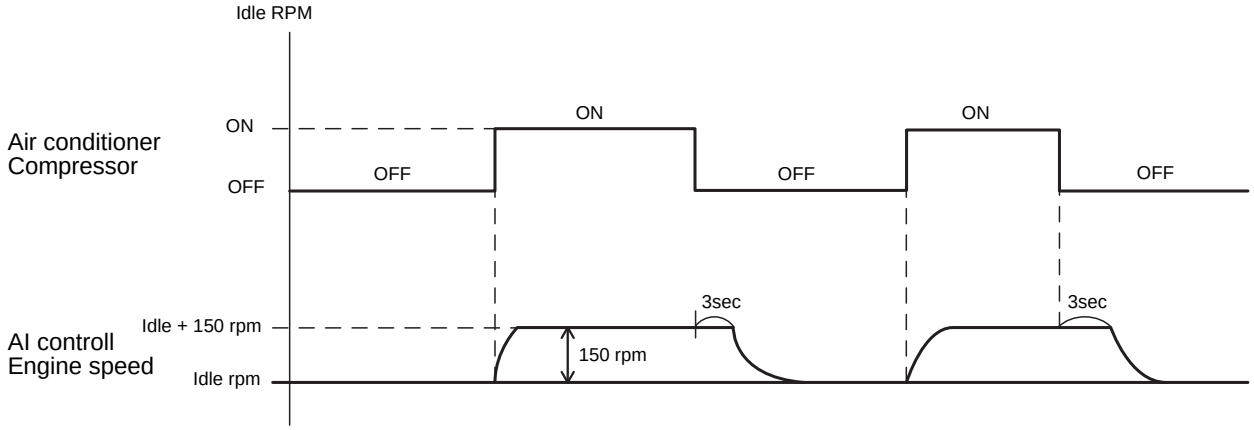
EU - version machine

A message appears initial at 50-hour intervals and 250-hour intervals (i.e., every 250, 500, 750, and 1000 hours).

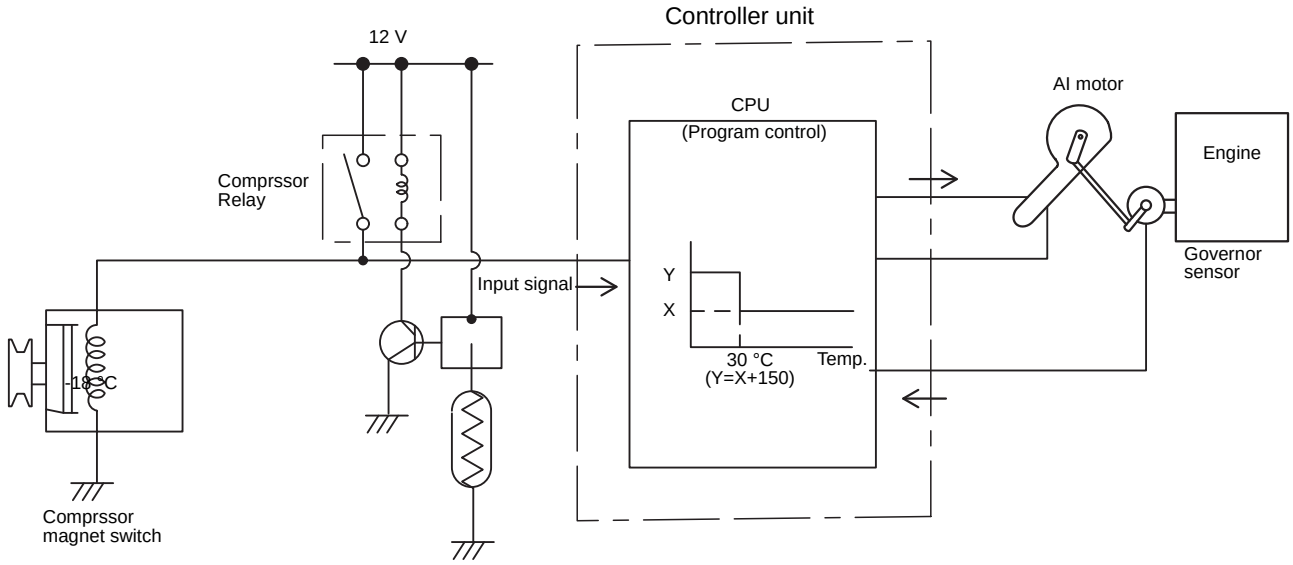
(5) Compressor control

When the compressor is on, the idling speed is raised by 150 rpm.
The idea is as follows.
If the compressor is repeatedly turned on and off kept off for 3 seconds, the idling speed gets back to its original rpm. In this way, the AI motor can be kept from getting activated many times.
(Reason: If the compressor is on and the alternator barely generates power, the battery, if connected to an external load, may fall to work.)

<Function chart>



<Function diagram>



Watching the voltage condition of compressor magnet switch, CPU in the controller commands the AI motor to regulate the engine idle speed.
If the magnet switch is ON, then CPU commands to output 150 rpm higher than the preset idle speed.
If the magnet switch is OFF, then CPU commands to output the preset idle RPM.
Actual output from the controller is PWM current to the AI motor.

g. Failure Diagnosis

1. Failure display and diagnosis criteria

The following table 1 shows data on failure diagnosis, for operating mode and service mode.

Note:

- Display items of the system in service mode can be checked with the fail record.
- In the case of a warning for fuel scarcity, the buzzer will be turned ON for a moment at five-minute intervals.
- No.11 ~ 61 except 31, 32, 51, 52, 53, 54, 55 will be incorporatrd in future version machine, such as auto idle (AI) model, anxilliary port (AUX) model and anti - theft system model.

Table 1. Failure diagnosis

Display		Buzzer	Lamp	Reset method	Function stop point	EEPROM address	Method of diagnosis
Operating mode	service mode						
1 Fuel	-	5-minute intervals	Yellow	Replenish fuel	---	---	Fuel scarcity rate is 90% min. after 60-s sampling
2 Engine oil	2 Engine oil	Continually	Red	Returns to normal	---	66, 86	At 5 V (normal). The following conditions continue 10 s: oil = L and 800 rpm min.
3 Charge	3 Charge	Momentarily	Red	Returns to normal	---	65, 85	At 5 V (normal). The following conditions continue 10 s: charge = L and 800 rpm min.
4 High voltage	4 High voltage	Continually	Red	Turn key OFF	AI AUX	67, 87	At 5 V (normal). A power supply voltage of 18 V min. continues 3 s.
5 Overheat	5 Overheat	Continually	Red	112°C±α max.	AI AUX	77, 97	At 5 V (normal). The following conditions continue: Engine revolution of 800 rpm min. with overheat warning When the water temperature sensor is normal, a water temperature of (124 ± α) C min. continues 5 s. (α : Adjustable between -10 C and +10 C.)
11 Accel sensor	11 Accel sensor	Momentarily	Red	Turn key OFF	AI	68, 88	At 5 V (normal). The accelerator sensor for AI specifications at 0.25 V max. or 4.75 V min. continues for 0.2 s.
12 Governor sensor	12 Governor sensor	Momentarily	Red	Turn key OFF	AI	71, 91	At 5 V (normal). The governor sensor for AI specifications at 0.25 V max. or 4.75 V min. continues for 0.2 s.
13 AI motor short	13 AImotor short	Momentarily	Red	Turn key OFF	AUX	69, 89	At 5 V (normal). AI specifications. The specifications are presently under consideration.
14 AI motor short	14 AI motor short	Momentarily	Red	Turn key OFF	AUX	70, 90	At 5 V (normal). AI specifications. The specifications are presently under consideration.

	Check item	Check parts	Check methods	Fail indication No.
10	Input & output	Motor Tr1, Tr2, Tr3, and Tr4 output AI operation switch input, travel switch input	Motor Tr1, Tr2, Tr3, and Tr4 are set to low output level. The AI operation switch is set to low level. The travel switch is set to low level.	8
	Input & output	Motor Tr1, Tr2, Tr3, and Tr4 output AI operation switch input, travel switch input	Motor Tr1 is set to high output level and Tr2, Tr3, and Tr4 are set to low output level. The AI operation switch is set to high level. The travel switch is set to high level.	
	Input & output	Motor Tr1, Tr2, Tr3, and Tr4 output AI operation switch input, travel switch input	Motor Tr1 and Tr4 are set to high output level and Tr2 and Tr3 are set to low output level. The AI operation switch is set to high level. The travel switch is set to low level.	
	Input & output	Motor Tr1, Tr2, Tr3, and Tr4 output AI operation switch input, travel switch input	Motor Tr2 is set to high output level and Tr1, Tr3, and Tr4 are set to low output level. The AI operation switch is set to high level. The travel switch is set to high level.	
	Input & output	Motor Tr1, Tr2, Tr3, and Tr4 output AI operation switch input, travel switch input	Motor Tr2 and Tr3 are set to high output level and Tr1 and Tr4 are set to low output level. The AI operation switch is set to low level. The travel switch is set to high level.	
11	Input & output	AUX sol (positive) (R) output, compressor clutch switch input	Turn OFF the AUX sol (positive) (R) and make sure that the compressor clutch switch is set to low level.	9
	Input & output	AUX sol (positive) (R) output, compressor clutch switch input AN2_7 input	Turn ON the AUX sol (positive) (R) and make sure that the compressor clutch switch is set to high level. The AN2_7 AD value varies more by 25 mV or more from the value with the input turned OFF. From theoretical values, 12 V and 240 Ω: 50 mA Voltage fluctuation corresponding to 50 mA: 50 mV	
12	Input & output	AUX sol (negative) (L) output, AI pressure switch input	Turn OFF the AUX sol (negative) (L) and make sure that the AI pressure switch is set to low level.	10
	Input & output	AUX sol (negative) (L) output, AI pressure switch input	Turn ON the AUX sol (negative) (L) and make sure that the AI pressure switch is set to high level.	
13	Input & output	AI self-hold relay output, breaker switch and AUX switch input	Turn OFF the AI self-hold relay and make sure that the breaker switch and AUX switch are set to low level.	11
	Input & output	AI self-hold relay output, breaker switch and AUX switch input	Turn ON the AI self-hold relay and make sure that the breaker switch and AUX switch are set to high level.	
14	AD (Analog and digital conversion)	fuel sensor	Check with the microcomputer that the AD value is 1.8 V ± 0.15.	12
15	AD (Analog and digital conversion)	water temp sensor	Check with the microcomputer that the AD value is 2.5 V ± 0.15.	
16	AD (Analog and digital conversion)	motor potention sensor	Check with the microcomputer that the AD value is 3.75 V ± 0.15.	
17	AD (Analog and digital conversion)	accel potention sensor	Check with the microcomputer that the AD value is 2.5 V ± 0.15.	
18	AD (Analog and digital conversion)	AUX potention sensor	Check with the microcomputer that the AD value is 1.25 V ± 0.15.	