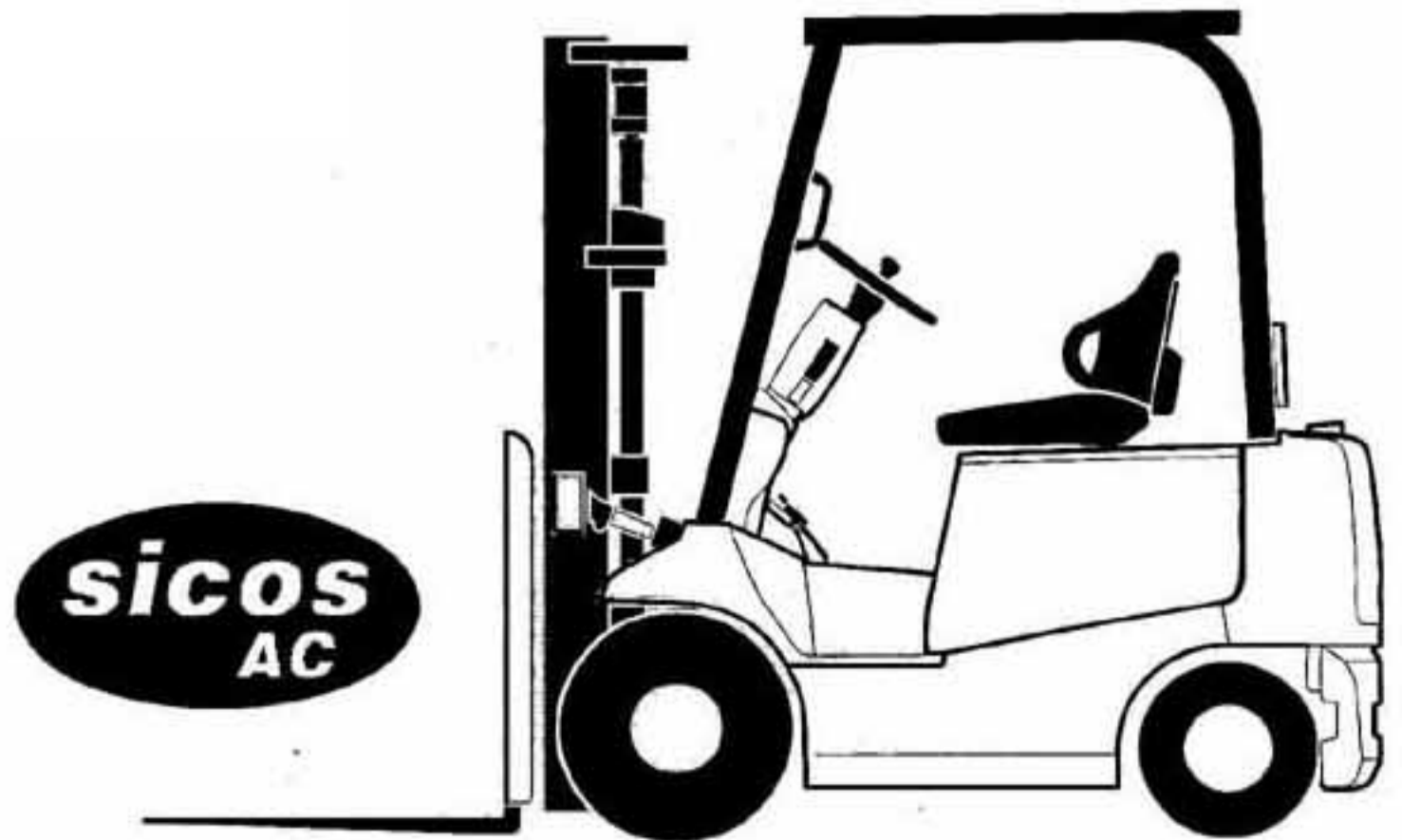


TROUBLESHOOTING MANUAL

FB-70 SERIES

FB 10P, 14P, 15P, 18P
20P, 25P, 28P, 30P



NICHYU
NIPPON YUSOKI CO.,LTD.

KYOTO, JAPAN

CONTENTS

1. Overview of SICOS-AC (AC control) 1

1-1. Why change to AC now?	1
1-2. Features of SICOS-AC	3
1-3. Comparison of DC and AC	4
1-4. Types of motor	12
1-5. Features of AC motors	12
1-6. Speed control of AC motor	12
1-7. Induction motors	13
1-7-1. Principles of rotation	13
1-7-2. Rotating magnetic field	16
1-8. Inverter principles and acceleration/ deceleration characteristics	18
1-8-1. Inverter construction	18
1-8-2. Inverter principles	18
1-8-3. Switching of rotation direction	22

2-3-10. Safety monitor symbol check and adjustment	50
2-3-11. Display language check and adjustment	51
2-3-12. Optional setting check and adjustment	52
2-3-13. View and brightness of display adjustment	53
2-3-14. Hour meter working check	53
2-3-15. Auto power off function working check	53
2-3-16. Battery electrolyte level working check	54
2-3-17. Turn signal lamp working check	54
2-3-18. Hydraulic oil level (optional) working check	55
2-3-19. Brake oil level working check	55
2-3-20. Overload (optional) working check	56
2-3-21. Travel inhibitor (optional) working check	56
2-3-22. Cooling fan working check	56
2-3-23. Lift interrupt (optional) working check	57
2-3-24. Turning speed reduction (optional) adjustment and working check	58
2-3-25. Seat switch (optional) working check	59
2-3-26. Built-in charger (optional) working check	60

2. Adjustment of SICOS-AC 23

2-1. Explanation of the monitor display	23
2-1-1. Indicator panel	23
2-1-2. Indication of display	24
2-1-3. Function of display	25
2-1-4. Various kinds of mode selection	30
2-2. Explanation of the MPU board	36
2-2-1. Basic control board construction	36
2-2-2. Travel/ Hydraulic board	37
2-2-3. Display board	37
2-2-4. Rotary switch on the Travel/ Hydraulic board	38
2-2-5. Rotary switch on the Display board	39
2-2-6. Adjustment Standards List for FB-70 series	40
2-3. SICOS-AC check and adjustment	41
2-3-1. Chassis insulation check	41
2-3-2. Battery voltage adjustment	42
2-3-3. Current detector check	43
2-3-4. Forklift model setting check and adjustment	45
2-3-5. Safety circuit for control (contactor tripping) check	46
2-3-6. Hydraulic setting check and adjustment	47
2-3-7. Descending regeneration check	47
2-3-8. Switch back (plugging/ regenerative) braking force adjustment	48
2-3-9. Regenerative braking force check and adjustment	49

3. Troubleshooting 61

3-1. Self diagnosis function	61
3-1-1. Display	61
3-1-2. Error messages and Display conditions	63
3-2. Error history memory	65
3-2-1. Error history memory 1	65
3-2-2. Error history memory 2	66
3-2-3. Clearing the error history memory (memory initialization)	68
3-3. I/O Check	69
3-3-1. I/O check mode display method	69
3-3-2. I/O port table	71

4. Wiring and control unit layout 77

4-1. FB-70 System wiring	77
4-1-1. FB10 - 28-70	77
4-1-2. FB30-70	78
4-2. FB-70 Body wiring	79
4-2-1. FB10 - 28-70	79
4-2-2. FB30-70	80
4-3. FB-70 Body harness	81
4-3-1. FB10 - 18-70(Std/CS/FCS/RP/DRP)	81
4-3-2. FB10 - 18-70(EEC)	82
4-3-3. FB20 - 28-70(Std/CS/FCS/RP/DRP)	83
4-3-4. FB20 - 28-70(EEC)	84
4-3-5. FB30-70(Std/CS/FCS/RP/DRP)	85
4-3-6. FB30-70(EEC)	86
4-4. FB-70 CU wiring	87
4-5. FB-70 CU harness	88
4-5-1. CU harness(1)	88
4-5-2. CU harness(2)	89
4-6. FB-70 Control unit	90
4-6-1. FB10 - 28-70	90
4-6-2. FB30-70	91
4-6-3. FB10 - 25-U70	92
4-7. FB-70 BC wiring	93
4-8. FB-70 Charger harness	94
4-8-1. Charger harness(1)	94
4-8-2. Charger harness(2)	95
4-9. FB-70 Wiring, revolving light	96
4-9-1. Key switch interlock	96
4-9-2. Forward/backward directional interlock	97
4-9-3. Backward directional interlock	98
4-10. FB-70 Wiring, working lamp	99
4-11. FB-70 Wiring, chime	100
4-11-1. Forward/backward chime	100
4-11-2. Forward chime	101
4-11-3. Backward chime	102
4-12. FB-70 Wiring, license	103
4-12-1. Large truck inspections, new small truck inspections	103
4-13. FB-70 Wiring, load sensor	104
4-13-1. Analog type	104
4-13-2. Digital type	105
4-14. FB-70 Wiring, lift limit	106
4-14-1. Lift limit for 1st stage	106
4-14-2. Lift limit for 2nd stages	107

4-15. FB-70 Wiring, seat heater	108
4-16. FB-70 Wiring, rear lamp	109
4-17. FB-70 Wiring, FS	110
4-18. FB-70 Wiring, wiper	111
4-18-1. Wiper	111
4-18-2. Lower wiper	112

5. Reference 113

5- 1. MPU board connectors	113
5-1-1. Pin arrangement of housing	113
5-1-2. Name of parts	113
5-1-3. Installation of terminals into housing	114
5-1-4. How to extract terminals	115
5-1-5. Crimp tools (manufactured by AMP)	116
5- 2. Water resistant connector	117
5-2-1. Water resistant connectors	117
5-2-2. Water resistant connectors (other than those described above)	117

1. Overview of SICOS-AC (AC control)

1- 1. Why change to AC now?

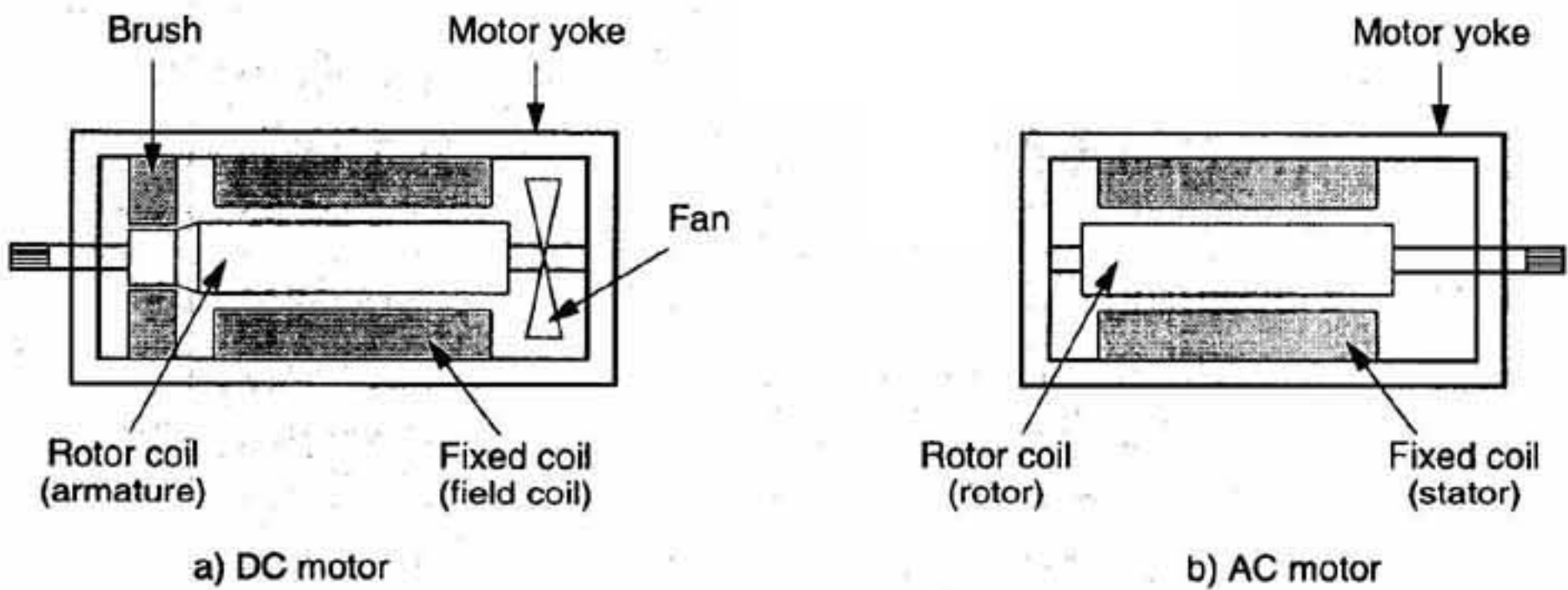
With the spectacular trend in the improvement of electrical technology beginning in the early 1970's, there were advances in new element discoveries and development, especially for controls. In the 1980's, the automation of factories advanced with the rationalization of plants with systems for mass production. Many AC systems became available for this equipment, and at the same time the change to AC power began to spread throughout mass-production industries.

The feature of AC power is that, for motors that require power, greater output can be acquired from devices of the same size. Or, putting it another way, you can get the same amount of power from a smaller device, which will result in compact equipment. Also, the range of controls that can be operated as you like is larger, the performance feeling is improved, and costs can be reduced. The primary reasons for the delay in the application of AC power to forklifts in industrial circles are the formerly high prices of elements for converting DC to AC for the low voltages used in forklifts, and the large energy loss in the conversion of a limited amount of electrical energy, as in batteries, for complex controls. However, the recent use of new elements that have the heavy insulation, high capacity, and high-speed switching of IGBT (Insulated Gate Bipolar Transistors) have allowed the conversion to AC power.

This has made possible a wide range of controls that were difficult to achieve with conventional DC systems, resulting in expectations for improvements in performance feeling in forklift operations. There are the benefits of the conversion to AC power.

- The same size motor** → **offers greater power!!**
- For various applications** → **the size can be more compact!!**
- Construction and maintenance** → **are simple, and the number of parts can be reduced!!**

2211090E



2211091

Figure 1 Comparison of DC and AC Motors

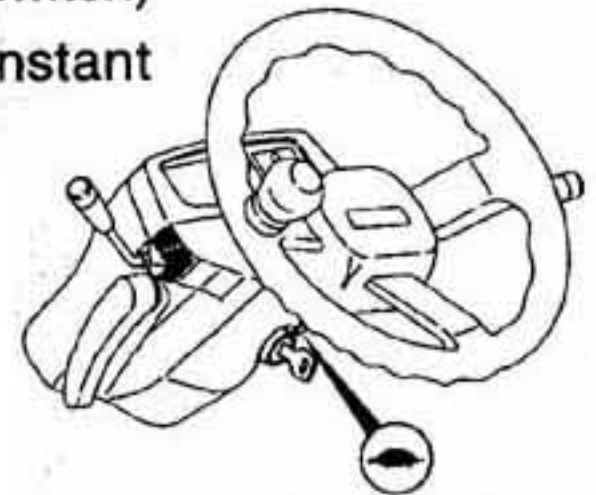
Compared to DC motors, AC motors

- have no brushes, and motor construction is simpler.
- can have smaller motor yokes since there are no brushes, resulting in a more compact design.

1- 2. Features of SICOS-AC

Enhanced regenerative functions on slopes

The SICOS-AC has the traditional speed-holding regenerative functions for descending slopes, but in addition it is designed so that regenerative functions are activated simply by release of the accelerator, whether or not the slow speed mode switch (turtle switch) has been pressed. This enables descent down slopes at constant speed.



Slow speed mode switch

2211172

Enhanced acceleration force / braking force (regenerative / plugging brake)

Use of AC control gives acceleration force that is appreciably stronger than in conventional vehicles. And in the SICOS-AC, not only is basic braking performance enhanced, but the regenerative brake is activated simultaneously with release of the accelerator pedal -- unlike in conventional vehicles where the regenerative brake is activated after the brake pedal is depressed. This provides smoother braking.

Simple motor maintenance

Motor does not use brushes, so there are no brush wear problems. And the absence of brush holders and brush springs makes for simpler maintenance.

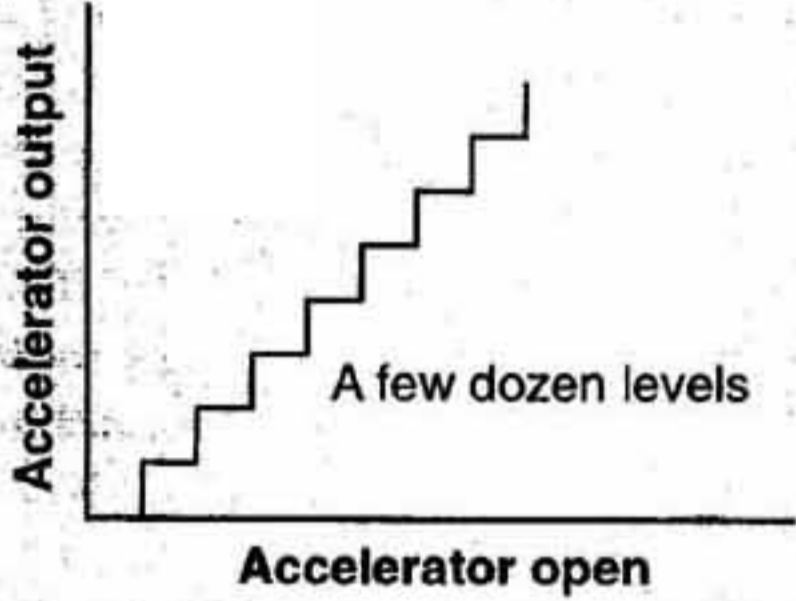
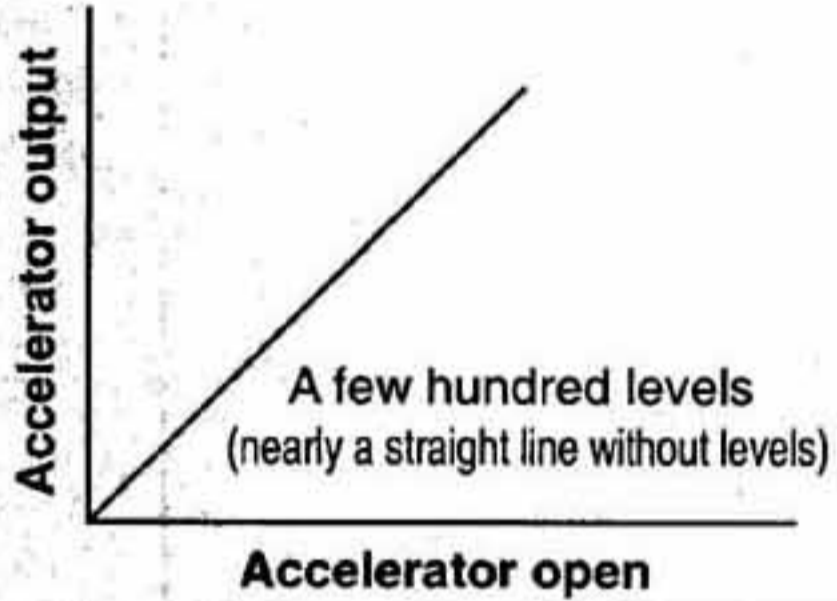
Fewer contactors

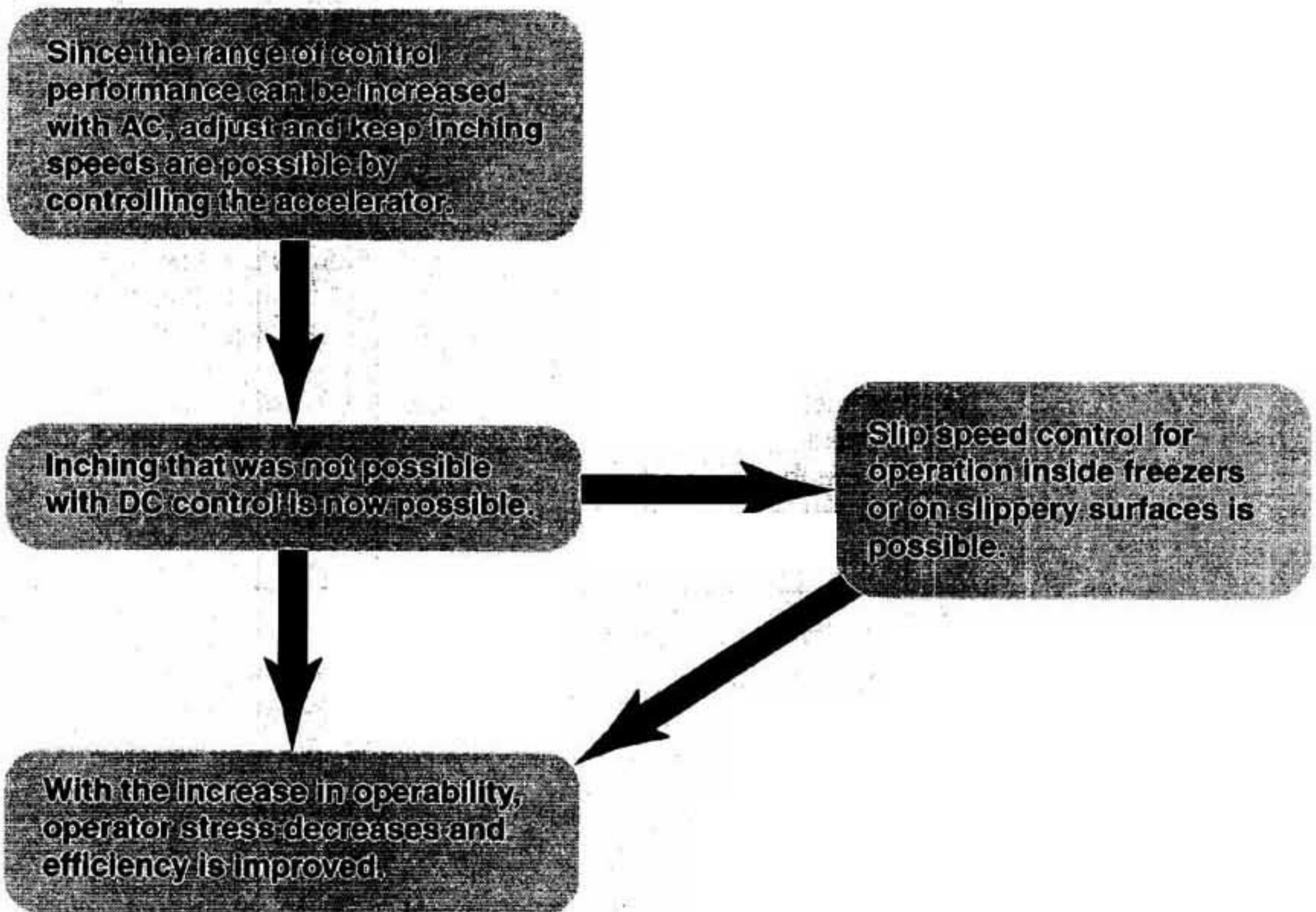
Use of 3-phase inverter control renders contactors for travel (forward/backward/bypass) unnecessary. The only one contactor is used for emergency sake in the control circuits.

Contactors actuation noise eliminated

Because of no contactors for travel and hydraulic circuits, the actuation noise is also eliminated.

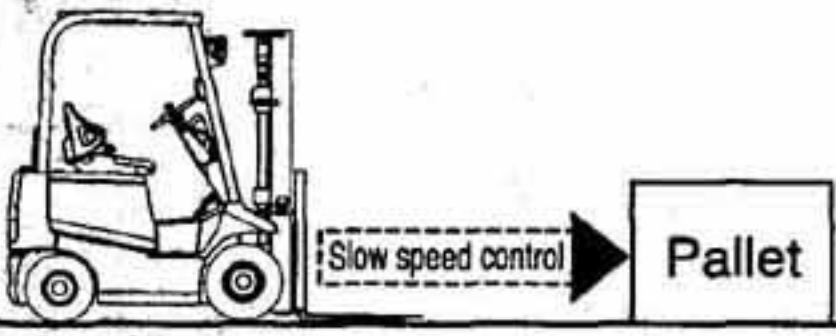
1- 3. Comparison of DC and AC

Method Performance	DC (Direct Current)	AC (Alternating Current)
Forward and Backward Controls and Operability	<ul style="list-style-type: none"> • A contactor is used to switch between forward and backward. (There is a switching sound.) • Controls are relatively simple. • The control range is limited to a few dozen levels. 	<ul style="list-style-type: none"> • Operated with an inverter (IGBT device). (Very little sound since a contactor is not used.) • Controls are more complicated. • The control range is larger, and the performance feeling is increased with a few hundred levels (more than 30 times DC). 



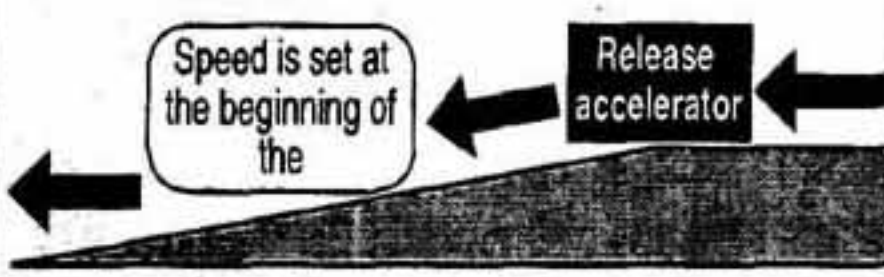
Note IGBT device

Insulated Gate Bipolar Transistor (IGBT) is the device that have the high voltage insulation and high capacity of bipolar transistors and the high-speed switching of Field Effect Transistors (FET). This low-loss device is compact and highly reliable. Nichiyu uses it and has had good results with all models of the A-SICOS since the FBR-60 series.

Method Performance	DC (Direct Current)	AC (Alternating Current)
Acceleration	<ul style="list-style-type: none"> ● There are several dozen control levels, and the inching speed control is relatively rough. ● Acceleration is controlled by microcomputer, but somewhat rough. ● Little acceleration during high-speed travel 	<ul style="list-style-type: none"> ● There are several hundred control levels (30 times those for DC control), and the inching speed control is high-performance to allow for very slow travel speed and a good feeling. <p>Inching speed control</p>  <p>1. Insert the fork into the pallet. 2. Operate at 3 - 0 km/h. (approach) 3. No chopper sound during start or travel, and low amount of noise. 4. Outstanding inching performance has been achieved. Its resolution is approximately 30 times of current forklifts.</p> <ul style="list-style-type: none"> ● Acceleration is possible even in high-speed travel areas.

Method Performance	DC (Direct Current)	AC (Alternating Current)
Travel speed	<ul style="list-style-type: none"> ● 13.0/15.0km/h (loaded/unloaded) for both the 1.5 ton and 2.0 ton models of 65 series <p>Low speed setting</p> <ul style="list-style-type: none"> ● 65 series has 8 levels from 5 to 12km/h. Settings below 5km/h are not possible. 	<ul style="list-style-type: none"> ● Improved travel speed of 14.0/16.0km/h (loaded/unloaded) for both the 1.5 ton and 2.0 ton models of 70 series. <p>Low speed setting</p> <ul style="list-style-type: none"> ● 70 series has 5 levels from 2 to 6km/h, and 3 levels of 8, 10, and 12km/h, for a total of 8 levels. <p>Feature: Settings below 5km/h are possible for operators who want to keep low-speed travel.</p>
Gradeability	<ul style="list-style-type: none"> ● The accelerator pedal should be depressed fully when climbing a grade. ● When climbing, speed adjustments with the accelerator are difficult. ● Inching is impossible when climbing. 	<ul style="list-style-type: none"> ● Speed adjustments can be made easily with the accelerator, even when climbing. ● Inching is possible while climbing.

Overview of S100S AC (AC control)

Method Performance	DC (Direct Current)	AC (Alternating Current)											
<p>Descending and Regenerative Breaking</p>	<ul style="list-style-type: none"> When descending, travel speed is regenerated by activating the slow speed mode switch (turtle switch). The regenerative force increases in the high speed range, and decreases by lowering the speed. (Regeneration is not possible at speeds of 3km/h or lower.) Descending speed is the preset speed plus 1km/h. 	<ul style="list-style-type: none"> The slow speed mode switch (turtle switch) is not required to turn on while descending. When descending, the speed when the accelerator is released plus 1km/h is maintained throughout the descent. Feature: This function is not available on competitor's forklifts or engine forklifts. Regenerative Breaking when Descending 											
	<p>Regeneration Function when Descending</p> <table border="1" data-bbox="664 1236 1952 1541"> <thead> <tr> <th></th> <th>65 series</th> <th>70 series</th> <th>Toyota 7FB</th> </tr> </thead> <tbody> <tr> <td></td> <td>Available</td> <td>Available</td> <td></td> </tr> <tr> <td>Setting</td> <td>Descent is at the set speed plus 1km/h</td> <td>Descent is at the speed when the accelerator is released plus 1km/h.</td> <td>Not available</td> </tr> </tbody> </table>			65 series	70 series	Toyota 7FB		Available	Available		Setting	Descent is at the set speed plus 1km/h	Descent is at the speed when the accelerator is released plus 1km/h.
	65 series	70 series	Toyota 7FB										
	Available	Available											
Setting	Descent is at the set speed plus 1km/h	Descent is at the speed when the accelerator is released plus 1km/h.	Not available										
<p>Starting on a slope / Creeping back</p>	<ul style="list-style-type: none"> When stopping mid-grade with a normal load, creeping back will occur when starting again. After stopping mid-grade, the parking brake must be aligned when starting again. When stopping mid-grade, releasing the accelerator and brake pedals will cause the forklift to descend and accelerate dangerously. A chopper sound is emitted when starting mid-grade. 	<ul style="list-style-type: none"> Even after stopping mid-grade, the parking brake alignment is not necessary and creeping back will be minimized for starting. Even after stopping mid-grade and releasing the brake and accelerator, the forklift will descend at a safe speed of 1km/h. No chopper sound is emitted. Feature: To warn to the operator to apply the parking brake, the forklift will descend with very slow speed if both accelerator and brake pedals are released on a grade. This function is not available on competitor's forklifts or engine forklifts. Starting Mid-Grade 