

EFFECTIVE ACCESSORIES FOR TWIN BREAKERS

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1. FOREWORD

A variety of accessories for improving ease of use, safety, connections, and operation variations are installed to Fuji Auto Breakers (FAB) and Fuji Earth Leakage Breakers (ELB).

The newly developed TWIN BREAKERS can flexibly deal with increasingly complex systems as a component of low voltage distribution systems. At the same time, they also advance standardization of panels by their modularization concept.

Substantial improvements have also been made to TWIN BREAKER accessories on the same concept as the breaker itself.

The objectives of improvement of accessories are simplification of manufacture, distribution, and selection by complete standardization of FAB and ELB accessories, compatibility with other electronic control equipment demanded as FA and OA facilities power supply circuit breakers, detailed consideration of safety and man-machine interface, etc.

Typical accessories are outlined here.

2. AIM OF ACCESSORIES DEVELOPMENT

The aim of accessories development is coordination with modularization and compacting of the TWIN BREAKER and increasing the effect when the TWIN BREAKER is used.

The accessory development policy is:

- (1) Contribute to panel design and manufacture simplification and space-saving.
- (2) Improvement of ease of use while completely standardizing the accessories between FAB and ELB.
- (3) Renovation of design matched to breaker design.
- (4) Improvement of safety by abundant auxiliary insulation material.
- (5) Correspondence to combination with electronic equipment.

The aims of accessories development are shown in Fig. 1.

3. CONSTRUCTION AND FEATURES OF ACCESSORIES

The accessories installed to FAB and ELB are roughly classified into internal accessories which are housed inside the circuit breaker and external accessories which are installed outside the circuit breaker.

The kinds of accessories which are installed to FAB and ELB are shown in Fig. 2. TWIN BREAKER accessories are not discriminated as FAB or ELB like the old series and are completely standardized.

3.1 Internal accessories

Mounting of electric equipment is advancing centered about the control board field. Accompanying this is an increase in use in combination with a programmable controller (PC) and other electronic equipment. Application to the small load level of controllers is demanded. Improvement of accessory lead wire processing is also demanded because of panel space-saving, rationalization of control circuit wiring, etc. Internal accessories were improved to meet the needs above.

3.1.1 Auxiliary switch (W) and alarm switch (K)

Wiring ease and the prevention of incorrect wiring were taken into account and the lead wire color coding and terminal number marking of the auxiliary switches, which display the ON/OFF state of FAB and ELB electrically, have been clarified. To make direct connection to a PC possible, manufacture of units capable of switching a small load of 5V 1mA upon request was made possible. The ratings and specifications of the auxiliary switches and alarm switches for the TWIN BREAKERS are shown in Table 1.

3.1.2 Shunt trip device (F)

Devices that electrically trips an FAB from a distance are equipped with a burnout prevention switch as standard. Since this prevents burning of the coil even if the tripping voltage is applied continuously, control relay intervention and the use of an FAB auxiliary switch are not longer necessary.

Fig. 1 Accessories development objectives

			Internal accessories				Installation and connection system		External operating handle		Accessories terminal board	Insulation barrier	Terminal cover	Mechanical interlock	Iron box
			Symbol	W	K	F	R	X	F	P	M type handle	G type handle	Handle operation device		
Ease of use	New design														
		Correspondence to diversification of specifications													
		Installation of two alarm switches													
	Wiring rationalization	Operating voltage expansion													
		Continuous rating by built-in burning protection contacts													
		Load side wiring of lead wires													
	Space-saving	Use of vertical terminal block													
		Dense mounting lead wire wiring construction													
		Compact remote operation													
	Design and manufacture simplification	Unification of panel cutout dimension													
		Matching of center of breaker and center of matching hole													
		Assembly man-hours reduction													
	Accessories standardization	DIN rails mounted standard equipment													
		Special mount for distribution panel installation													
		FAB and ELB standardization													
Safety	Strengthening of terminal insulation	Operating power supply AC/DC standardization													
		Improvement of terminal numbers display													
		Lead wire color coding													
	Insulation barrier	Insulation barrier													
		Insulation barrier and terminal cover installation possible													
		Molding of operating handle frame													
	External operating handle interlock mechanism	External operating handle interlock mechanism													
		Switch for small loads													
		Adjustment-free													
	Unit construction	Unit construction													
	Delivery time correspondence														

The shunt trip device features a construction which compactly integrates solenoid and coil burnout prevention switch that interrupts the exciting current automatically with FAB interrupting operation. It can be installed to the FAB with one touch.

3.1.3 Improvement of accessory lead wire wiring method

Installation of internal accessories even at general distribution panels with densely mounted FAB and ELB is increasing. In this case, wiring processing of the lead wires requires the securing of space, installation pitch adjustment, and other ancillary work and also creates problems from the standpoint of distribution panel appearance. The TWIN BREAKERS allow load side wiring of the lead wires with the FAB and ELB mounted densely by providing a dense mounting unit (30A-100A frame) and combining it with internal accessories. Fig. 4 shows the construction of the dense mounting unit. The dense mounting unit consists of a flexible printed wiring board covered with insulation. This was made a case side flush mounting construction. Its current carrying capacity

Table 1 Alarm switch and auxiliary switch ratings and operation

(a) Standard

Voltage (V)	AC		Voltage (V)	DC	
	Switching current (A)			Switching current (A)	
	Resistive load	Inductive load		Resistive load	Inductive load
125	5	4	30	3	2
250	5	4	125	0.4	0.1
500	2	1	250	0.2	0.03

(b) Small loads

Rated voltage and current	DC 30V 0.1A (resistive load)
Minimum working voltage and current	DC 5V 1mA

(Note) Inductive load: Power factor 0.4 min. (AC)
Time constant 7ms max. (DC)

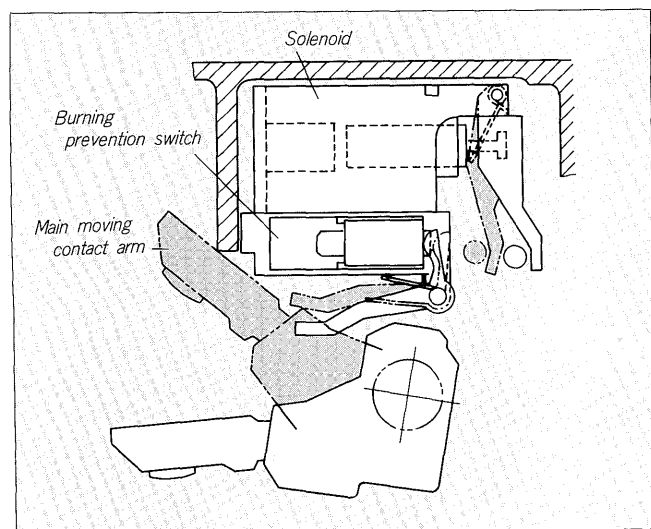
and working voltage are the same as the lead wire system. An example of densely mounted TWIN BREAKERS is

Fig. 2 Kinds of accessories

		TWIN BREAKER		Old series	
		FAB	ELB	FAB	ELB
Internal accessories	Alarm switch	○	○	○	○
	Auxiliary switch	○	○	○	○
	Shunt trip device (FAB only)	○	—	○	—
	Under voltage device (FAB only)	○	—	○	—
	Test lead wire (ELB only)	—	○	—	○
	Mechanism test switch (ELB only)	—	○	—	○
External accessories	Mechanical interlock	○	○	○	○
	Handle lock	○	○	○	○
	Terminal cover, terminal barrier	○	○	○	○
	Circuit breaker box	○	○	○	○
	Remote operator	○	○	○	○
	External operation handle	○	○	○	○
	Auxiliary handle	○	○	○	○
	Front mounting rear connection type	○	○	○	○
	Insertion mounting type	○	○	○	○
	Flush mounting type	○	○	○	○
	Drawer mounting type	—	—	—	—

○ : Dedicated accessory

Fig. 3 Construction of shunt trip device



shown in Fig. 5.

TWIN BREAKERS 100A to 225A frames are constructed by molding a groove that allows dense mounting by wiring system in the molded case.

3.1.4 Accessories terminal block

A new terminal block that allows panel space-saving with terminal block connection accessories was developed for the TWIN BREAKERS. The new terminal block is shown in Fig. 6.

This terminal block is constructed so that the direction

Fig. 4 Dense mounting unit

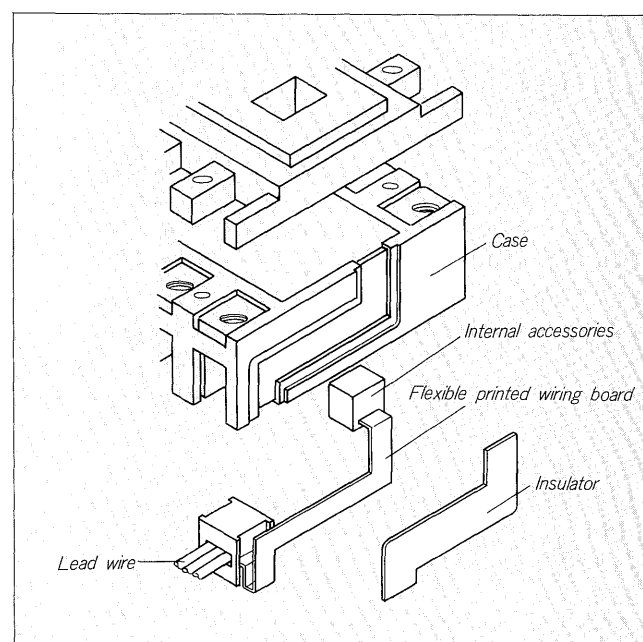
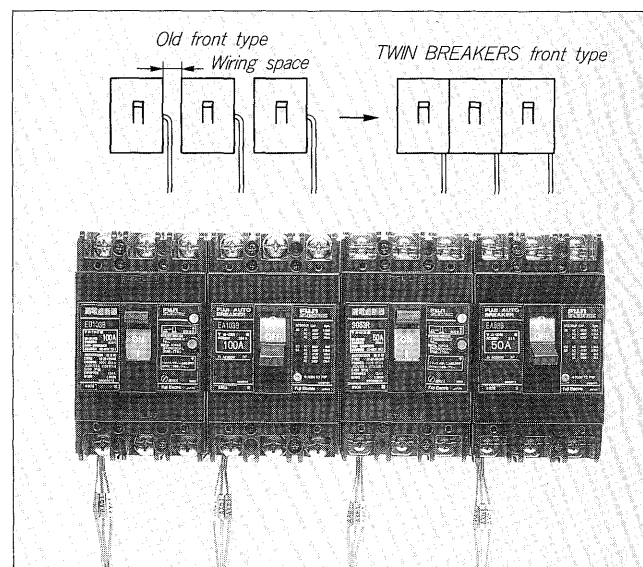


Fig. 5 Example of dense mounting with accessories



of the connection wire is parallel with the side of the TWIN BREAKER. This eliminates the need for lead wire bending space and allows dense mounting of even TWIN BREAKERS with terminal block. The mounting spacing was reduced substantially from the old minimum of about 35mm to 12.5mm. An example of a dense mounting of TWIN BREAKERS with terminal block is shown in Fig. 7.

3.2 External accessories

The externally mounted accessories of FAB and ELB can be roughly divided into those that correspond to various electric wire connection systems and those that correspond to the operating method diversification and those that correspond to protection, including insulation, etc.

These external accessories are directly connected

Fig. 6 Accessories terminal block

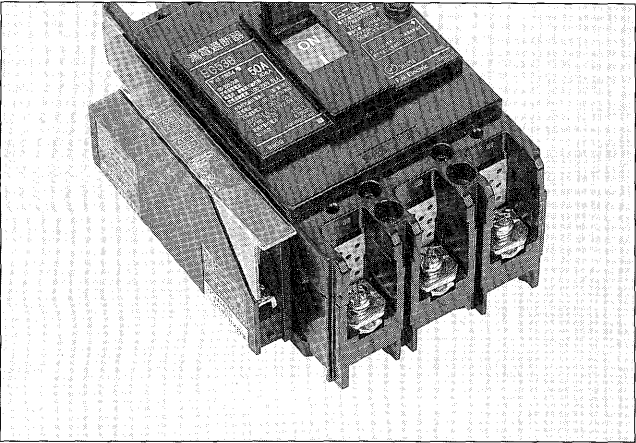
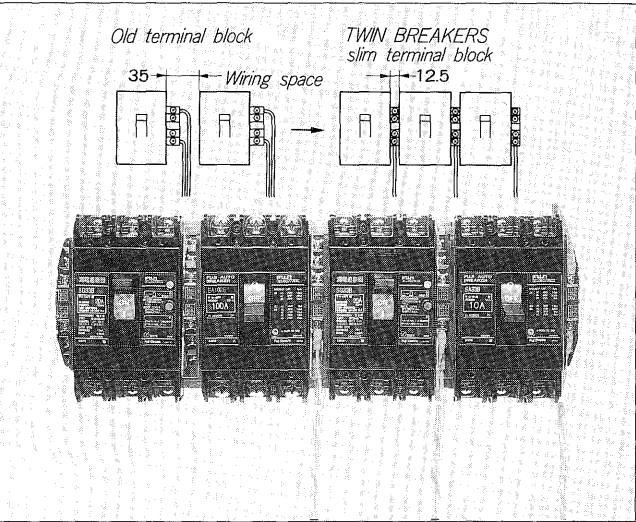


Fig. 7 Example of dense mounting of accessories terminal block



to ease of use by the customer and ease of installation to the panel. Therefore, improvement of external operating devices must be able to contribute to rationalization and improvement of maintainability from the standpoints of panel design, manufacture, and operation.

For TWIN BREAKERS external accessories, improvement of safety centered about protection of charged parts, reduction of the panel cutout pattern corresponding to design by CAD, remote operation, and other improvements were stressed. The features of the external accessories are outlined below.

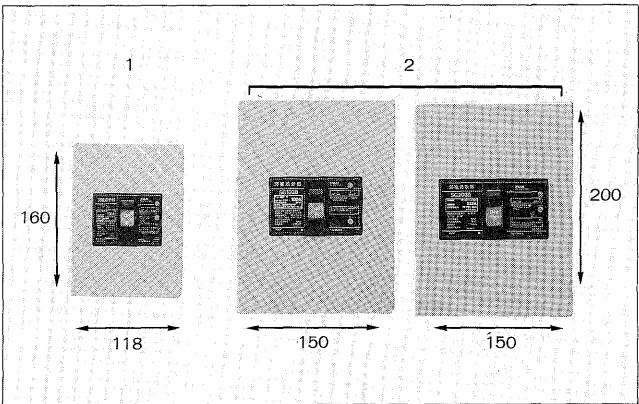
3.2.1 Front mounting rear connection type (X), flush mounting type (E)

The number of panel cutouts of the old series and TWIN BREAKERS series is compared in Fig. 8. The number of mounting panel cutout patterns for the front mounting rear connection type and flush mounting type was reduced substantially by taking advantage of standardization of the outside dimensions of the FAB and ELB body. The shape of the flush mounting flush plate was also reduced to two kinds of shown in Fig. 9. The improvements above make it possible to simplify panel design and reduce the number of mounting plate machining management points.

Fig. 8 Panel cutout patterns

	Old	TWIN BREAKER
Flush mounting panel cutout	 8 patterns	 2 patterns
Front mounting rear connection panel cutout	 11 pattern	 3 patterns

Fig. 9 Flush plate shape



3.2.2 Insulation system

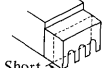

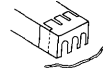

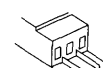
Besides miniaturizing the FAB and ELB and advancing miniaturization of the panel, ample consideration must also be given to securing insulation reliability. With the TWIN BREAKERS, a terminal barrier is made standard (50A frame and larger) and the kinds of terminal cover and barriers matched to each wiring system was enhanced as shown in Table 2. For example, a new earth barrier was added to strengthen the insulation with the mounting surface at two crimp terminals installation.

A terminal cover for rear wiring to the TWIN BREAKER is also available. One-touch mounting and dismounting of these terminal covers and barriers after wiring is possible even when an external operation handle, remote operator, mechanical interlock, etc. is installed.

3.2.3 External operation handle

From the standpoint of safety, standards mandate that an external operation handle have various interlock functions.

Table 2 Insulation system

Type	Application & features	Appearance
Terminal cover (short type) BZ-TS	<ul style="list-style-type: none"> Bar connection use charging exposure prevention Transparent, sealing possible 	 <ul style="list-style-type: none"> One-touch insertion from top
Terminal cover (long type) BZ-TB	<ul style="list-style-type: none"> Amp connection use Transparent, sealing possible 	 <ul style="list-style-type: none"> One-touch insertion from top
Rear connection terminals cover BZ-TY	<ul style="list-style-type: none"> Charging exposure prevention at rear connection wiring Transparent 	 <ul style="list-style-type: none"> One-touch insertion from top
Interphase barrier BZ-B	<ul style="list-style-type: none"> Amp and bus bar connection section interphase insulation strengthening Black, flexible 	 <ul style="list-style-type: none"> One-touch insertion from top
Ground barrier BZ-BL	<ul style="list-style-type: none"> Tow crip terminals wiring ground insulation strengthening Black, combinable with terminal cover (long type) 	 <ul style="list-style-type: none"> One-touch insertion at bottom

Two kinds of external operation handles are available: G type door mounting type that also serves as a door switch and N type that mounts to the FAB and ELB body. The N type external operation handle is shown in Fig. 10 and the G type external operation handle is shown in Fig. 11. Their features are described below. (See Fig. 12.)

- (1) Improved display and new design
 - (a) The handle on and off operating angle was made 90° and the on and off states are displayed clearly.
 - (b) The handle on operation direction was standardized at clockwise to match IEC and JIS standards.

- (2) Improved safety
 - (a) The mounting frame was changed from a plate metal part to a molded part.

Since the TWIN BREAKERS were substantially miniaturized, this was done to eliminate miniaturized, this was done to eliminate the cause of ground faults by the detector touching the frame at mechanism inspection, for example,

- (b) Enhancement of lock functions

A distribution panel door lock function is provided in the FAB and ELB switching, interrupting, and tripping states. The door can be unlocked by handle open operation or release device release operation. (Conforms to JIS B 6015, IEC 204-1, etc.) To make door operation easy at distribution panel inspection, a release operation self-hold function is also provided as standard.

This self-hold function has a foolproof construction which releases it automatically when the door is closed.

- (3) Rationalization of panel design and manufacture

The center of the panel cutout and the center of the FAB and ELB are matched. This eliminates troublesome deviation of the mounting position that was necessary

Fig. 10 N type external operation handle

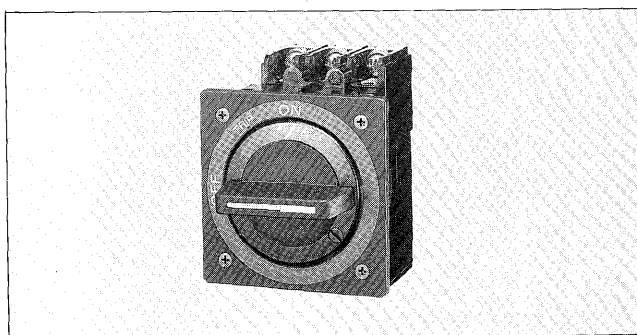


Fig. 11 G type external operation handle

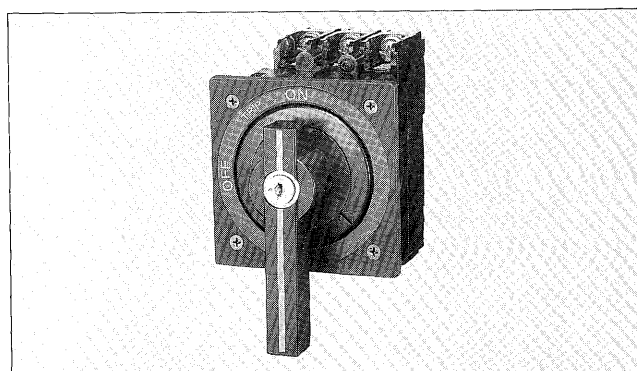
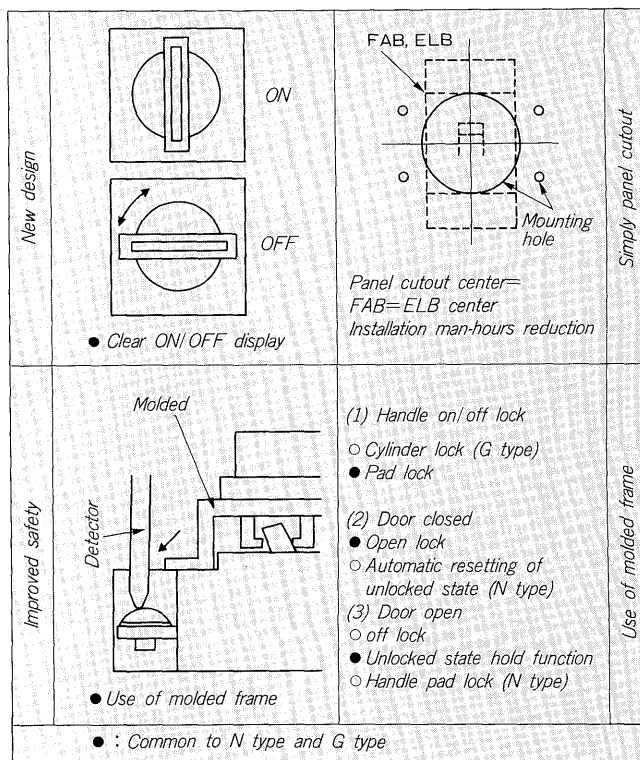


Fig. 12 Features of external operation handle



with the old G type handle and ELB. Machining is only simple drilling of a round hole.

3.2.4 Remote operator

The demand for remote operation of FAB and ELB for efficient operation of FA, power saving, central super-

Fig. 13 Remote operator

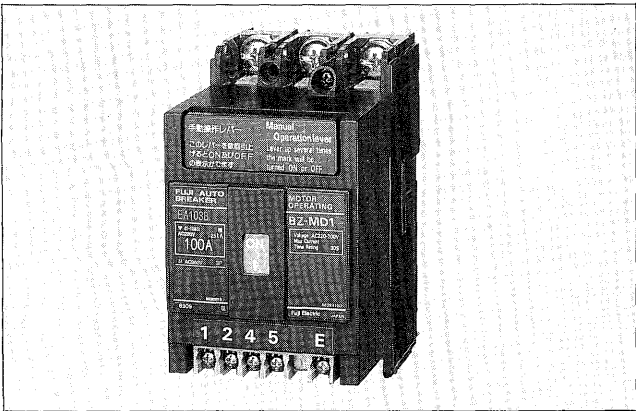
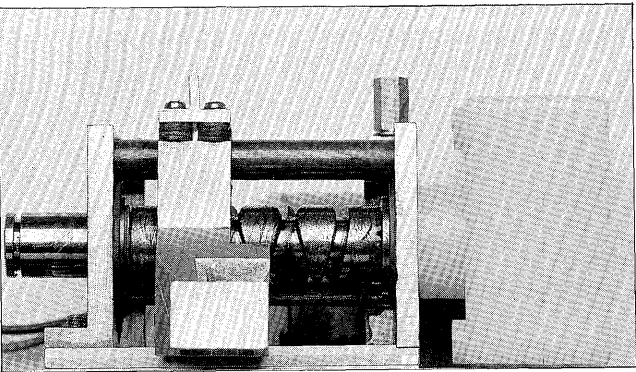


Fig. 14 Remote operator construction



visory and control system, and other facilities is rising. The remote operator was substantially improved to meet this demand. The features of this device are its compact size matched to the TWIN BREAKER and easy-to-use head-on type construction. It is shown in Fig. 13.

This device is installed as a unit at the front of the FAB or ELB. Since the on and off display section is at the center of the unit and the control terminals are at the bottom, dense mounting just like a manual TWIN BREAKER is possible. Wiring and terminal cover and barriers can be installed to the FAB and ELB terminals as is. Improvement of the wiring work that was a disadvantage of devices of this type in the past was planned. Manual operation is also possible by operating a manual handle embedded in the unit.

This unit contains a cylindrical cam, which converts the rotary motion of the drive motor directly to reciprocating motion as shown in Fig. 14. A cam follower moves along the groove in this cylindrical cam and reciprocating motion is obtained directly from the fixed direction rotation of the motor. This eliminated the need for forward/reverse control of the motor and substantially simplified the construction and control circuit. Together with the use of a high torque DC motor, a volume of approximately 1/8th that of the old type was realized and a large volume reduction was planned. (See Fig. 15.)

The specifications of the TWIN BREAKER remote operator and the old FAB remote operator are, shown in Table 3.

Fig. 15 Comparison of remote operators

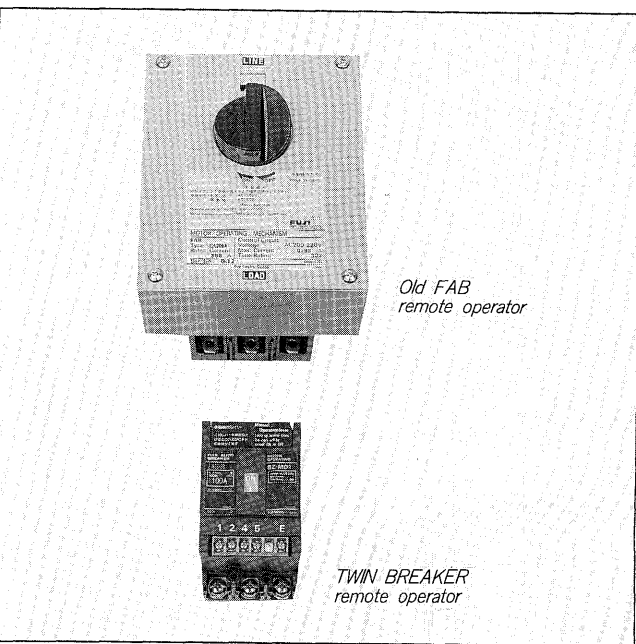


Table 3 Remote operator ratings and specifications

Breaker			TWIN BREAKER	Old
			EA50B~100B SA50B・60B EG30B~100B SG50B・60B	SA53H SA103H SA103A EA225A EA225H SA225A
Operating voltage (V)	AC	100/110	○	○
		200/220	○	○
	DC	100/110	○	○
		200/220	○	○
Maximum starting current (A)			0.5	1.5
Operating time (secs)			1.5	1.5
Allowable continuous operation time (secs)			30	30
Power consumption (VA)	100/110V	20	100	
	200/220V	40	200	
Combination with accessories	Front mounting rear connection type	○	○	
	Flush mounting type	○	○	
	Plug-in type	○	○	
Weight (remote operator only) (kg)			1.0	4.5

4. CONCLUSION

The main accessories mounted to the new TWIN BREAKERS were introduced. We are confident that these accessories meet the diverse needs of today's users and can amply contribute to improvement of cost/performance. With the progress toward advanced molded case circuit breakers and earth-leakage circuit breakers which correspond to improvement of reliability, improvement of safety, and more complex loads, farther enhancement of the corresponding accessories will be necessary. Fuji Electric is proceeding with product improvements with the guidance of customers.