

ON LOAD CENTER

By

Shoichi Nagase

(Switchboard Div., Design Dep't)

I. INTRODUCTION

It is generally known that the overall efficiency and rationalization of electric installations in which low tension load is centered, like that of heat power plants, steel manufacture, textile or in mines, much depend upon the form of distribution system or the type of working apparatus used. Thus we have the unit made up of the transformer by which the high tension in the center of the load is stepped down to low tension after the load is distributed into the needed capacities, and the air circuit breaker for control center and for distribution to the medium capacity low tension motor, etc. This unit simplifies multiple unit control and is easy to maintain and inspect. This low tension unit transforming facilities is known as load center.

Also when this is combined with the unit in which the breakers for low tension motor and power for electric lights are standardized according to the power and motor capacities, it is called control center. And thus the following is a brief account of the load center.

II. CHARACTERISTICS

As noted in the above paragraph the load center is mainly made up of the transformer, air circuit breaker, disconnecting switch, and the current transformer for measurement use. Fig. 1 shows the outer view of the load center and as can be seen, the following characteristics can be noted.

- 1) Both the air circuit breaker and the bus bar are constructed into units making it possible to put them on top of each other compactly and requiring small floor space.
- 2) The air circuit breaker is of draw-out type making it easy to change and maintain as well as inspect.
- 3) The live parts are all covered and the front door is equipped with both circuit breaker and mechanical interlock making it very safe.
- 4) The drive system of the breaker can be either hand drive, motor drive or compressed air drive and no matter what system employed the size of the enclosed box is the same.
- 5) For protective devices it is equipped with a

instant over current relay, voltage releaser and thermal over current relay with temperature compensation and the air circuit breaker has a very high rupturing capacity.

- 6) The smart looking standardized unit enclosed boxes are easily constructed and also easy to handle.

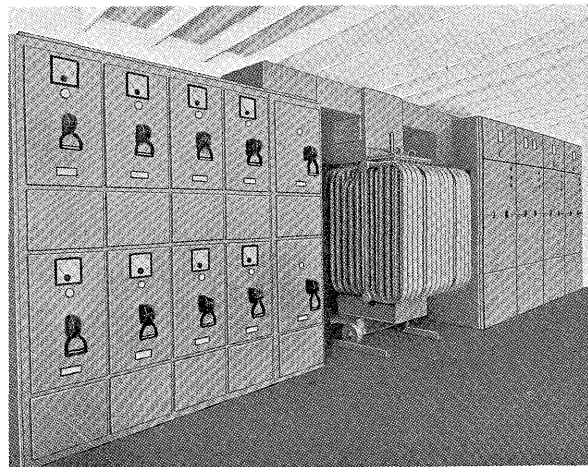


Fig. 1. Outer view of load center

III. COMPOSITION

1. Transformer

Non in-flammable oil immersed type or H class insulating dry type transformers are used, which from the angle of safety and danger of fire can be considered the most suitable for this type of transformers. Both primary and secondary bushings are covered with metal enclosed bus ducts which are so designed as to directly connected to respective enclosed box with flanges.

2. Air circuit breaker

In recent years due to the heavy increase demands in the capacity of low tension load in heat power stations or other manufacturing plants the need for breakers having large rupturing capacity has become necessary. In this regard the RF 913 type for alternating current and the RF 914 type for direct current air circuit breakers manufactured by our Company has won favor among it's users. These

breakers have a rated voltage up to 1000 V a-c or 1200 V d-c and the rated current is set in the 5 types of 1000 A, 2000 A, 3000 A 4000 A, and 6000 A, and the rupturing capacity for each rated current is as shown in Table 1. Fig. 2 shows the outer view of a 2 pole air circuit breaker for 500 V 3000 A a-c.

For further details of this breaker refer to Volume 30 Number 3 of Fuji Electric Journal.

Table 1. List of types and ratings of air circuit breakers

	A-C use	D-C use
Type	RF 913	RF 914
Rated voltage (V)	500 (can use up to 1000 V)	440 (can use up to 600 to 1200 V)
Rated current (A)	1000 2000 4000 3000 6000	1000 2000 4000 3000 6000
Rated rupturing capacity (kA) (under AC 500 V) (" DC 500 V)	40 50 70	40 50 60
Pole	2 or 3	2

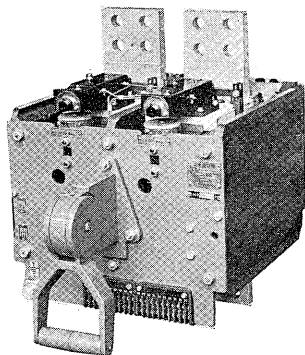


Fig. 2. 2 pole air circuit breaker for 500 V 3000 A

3. Plug type disconnecting switch

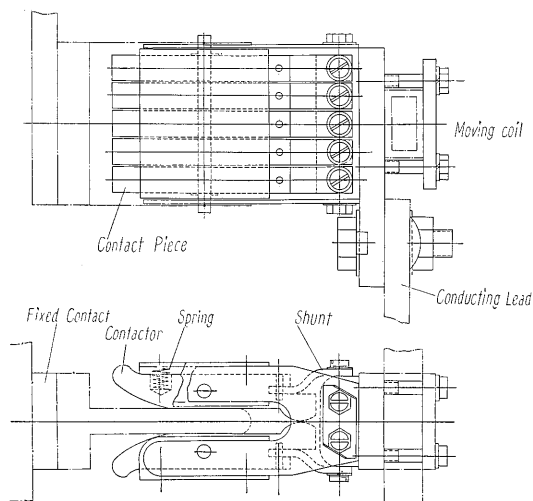


Fig. 3. Plug type disconnecting switch (rated current 1000 A)

This plug type disconnecting switch must be so constructed that it will constantly retain perfect contact conditions and the overheating and process of plug-in and plug-out should not cause mechanical trouble. Thus in the load center made by our Company due to the fact that it is used in circuits with extra large currents we are using the push type disconnecting switch found in the H type enclosed switchboard that has long proved satisfactory in actual use. Fig. 3 shows the construction of the switch.

4. Mold type current transformer

Being loaded into the enclosed box the through type is used due to its small compact size, the mold is of polyester and rated burden is 15 VA.

IV. CONSTRUCTION

The enclosed box is constructed by putting together the above mentioned parts, but here we will try to explain the construction mainly of the air circuit breaker enclosed box. Fig. 4 shows the dimensions of the entire box while Fig. 5 shows the detailed view of the enclosed box for air circuit breaker.

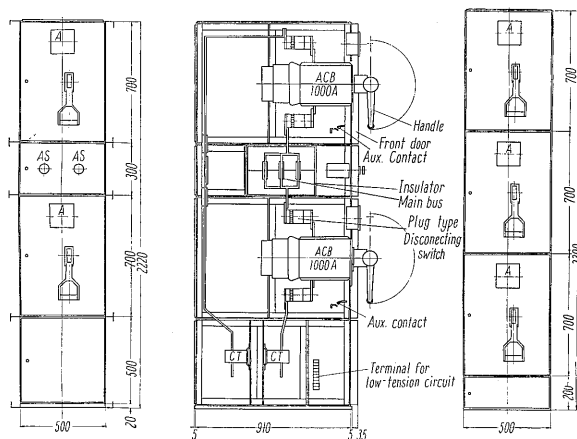


Fig. 4. Outer dimensions of enclosed box (3P 1000 A air circuit breaker)

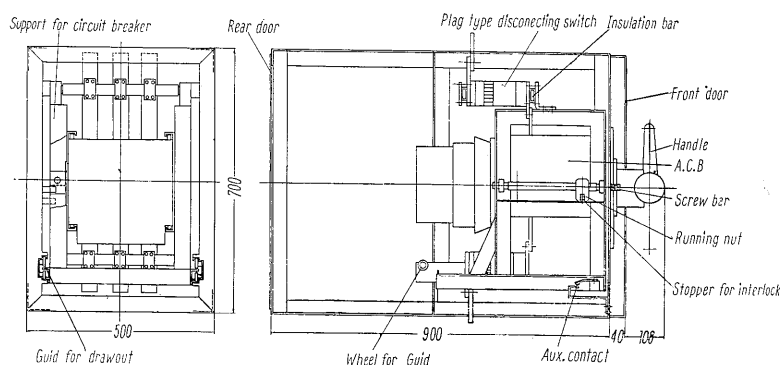


Fig. 5. Detailed view of enclosed box for air circuit breaker (3P 1000 A)

1. Arrangement of parts

As can be seen in Fig. 4 the air circuit breakers are placed on top of each other making for the use of the smallest space. When two are placed on top of each other, cable unit, current transformer and low tension control circuit are placed on the bottom box and a bus bar chamber is placed between the air circuit breaker enclosed boxes. This is the standard procedure for the placing of the boxes on top of each other.

Also on the front door of the box it is possible to place a control switch and in the case of a pneumatic drive type in the inside an operation valve can be placed. The front and rear of the bus bar are isolated off with insulating materials making for safety in the opening and closing of the door. And because of the low tension circuit the bus bar support does not depend upon the supporting porcelain but upon the other insulating materials.

In case of very limited floor space three breaker units can be placed upon each other. However in this case, to facilitate the operation, maintenance and inspection of the breakers, it should be like the open type circuit breaker not higher than 2300 mm.

The outer dimensions of these units will slightly differ according to the rated current of the inside breaker but the same measurements are taken for the height of the boxes, i.e., the breaker box, the bus bar box and the cable box, and the difference in size according to the rating of circuit breaker is made in the width of the box. In other words this means that it is possible to assemble units in every way.

Table 2. List of outer dimensions of unit enclosed box for load center

Rating of air circuit breaker	double placement of breaker			triple placement of breaker		
	height	width	depth	height	width	depth
2 Pole 1,000 A	2,220	450	900	2,300	450	1,200
2 Pole 2,000 A	2,220	550	900	2,300	550	1,200
2 Pole 3,000 A	2,220	600	900	2,300	600	1,200
2 Pole 4,000 A	2,700	1,000	900	2,700	1,000	1,200
2 Pole 6,000 A	2,700	1,000	900	2,700	1,000	1,200
3 Pole 1,000 A	2,220	500	900	2,300	500	1,200
3 Pole 2,000 A	2,220	650	900	2,300	650	1,200
3 Pole 3,000 A	2,220	750	900	2,300	750	1,200
3 Pole 4,000 A	2,700	1,000	900	2,700	1,200	1,200
3 Pole 6,000 A	2,700	1,200	900	2,700	1,200	1,200

The above table 2 shows the outer dimensions of units as assembled.

2. Mechanism parts

The air circuit breaker enclosed box is composed of plug type disconnecting switch, the draw-out apparatus, the interlocking device and the sliding contacts for auxiliary circuits.

1) Draw-out apparatus

The breaker at the operating position is fixed to the draw-out apparatus, and it is so interlocked that unless the breaker is opened the draw-out or plug-in operation cannot be worked. In the draw-out apparatus the screw bar is inserted in the handle and so made it can be turned to either the left or the right and the running nut moves horizontally from the running position to the draw-out position. On the door there is a hole to insert the handle. On the lever attached to the breaker operating shaft a red and green colored closed plate is attached and so made that it indicates at the center of the insert hole with the inter-operation of opening or closing of the breaker inside the door. The interlock of the breaker draw-out is operated by this closed plate. In other words when the breaker makes some fault breaking such as an over load or a short-circuit, the green closed plate comes out, and when the breaker is to be drawn out, the handle is set back to the open position. And unless the green closed plate comes out, the handle cannot be inserted into the screw bar.

When the handle is just used to open the breaker, the green closed plate will not indicate.

When the breaker is closed, it is indicated by the red closed plate. This draw-out apparatus is set to the circuit breaker support and the operation is simplified by the use of ball bearings for movement. Also the plug type disconnecting switch is closed in the running position and main circuit opened in the draw-out position on which it is so maintained to stop at a set insulation distance.

2) Interlocking device

Alongside with the above mentioned draw-out apparatus, the enclosed box is equipped with a interlocking lever. When the breaker needs to be taken out of the box after the breaker is moved to the draw-out position, it is only necessary to draw up the interlocking lever which will make movable the running nut stopper. This will unlock the breaker and the enclosed box making it simple to take out. Again when inserting into the draw-out position, push down the interlocking lever and in which the stopper will lock with the

running nut. After that the breaker can be inserted by means of draw-out apparatus handle.

This stopper can only be operated in the draw-out position and through it the breaker is made stationary. Thus unless the draw-out apparatus is operated, the breaker cannot be moved from its stationary position, even in the cases of vibration upon the opening and closing or in the process of running or stopping.

3. Outer construction

The whole is composed of the enclosed box filled with various equipments, the covers of both sides and the channel base.

The enclosed box and covers are made of high grade steel sheets and the inner iron frame works. The front door of the breaker unit is attached to the frame of the breaker unit box. For hand driven operations the door is of the fixed type with manual operating device and for motor or compressed air operations it is of the hinged type. The rear door is of the hooked method or simply screwed-on making the maintenance and inspection simple. The enclosed box units are bolted to connecting adjacent units and easy to connect or disconnect.

4. Auxiliary circuit

Such terminals of slide type aux. contacts are fitted to circuit breaker track, that driving device circuit and standardized 4a+4b aux. contacts circuit for low tension control are leaded to the above slide type aux. contacts. This type of contact is not only compact with a wide contact range but the wipers are large, easy to change and can be easily assembled.

The wiring materials ordinary used are chlorinated vinyl wires of 2mm², and vinyl thickness of 0.8mm. The cleat wiring system using this chlorinated vinyl originated by our Company is used, and this has crased faults such as grounding or short-circuit, so common in this type of equipment.

V. TROLLEY LIFTER

A trolley lifter to facilitate the taking out of the breaker from the box for inspection or maintenance is provided. Because the compartments are placed on top of each other in two or three, and the lifted units must remain stationary, this calls for a trolley that is light and yet able to move up and down at every angle. The trolley lifter developed by our Company as shown in Fig. 6 can be operated up and down and the level can be set by the handle at the bottom. The trolley is provided with a movable wheel in the front and stationary wheels in the back and can be driven easy. For indoor use, trolley has rubber wheels.

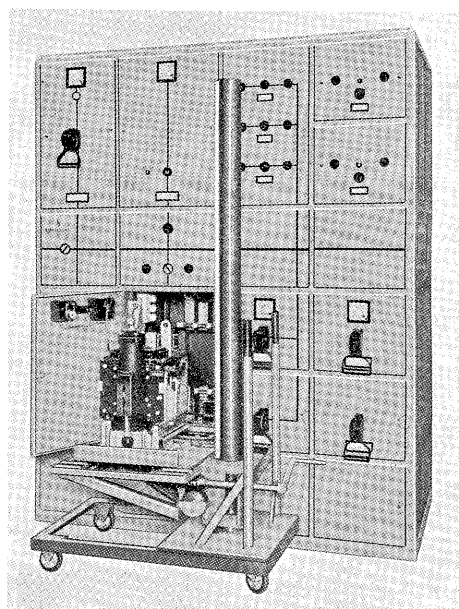


Fig. 6. Trolley lifter for removing the compartments

VI. CONCLUSION

The above is the brief explanation of the load center as made by our Company. Realizing the importance of this type of equipment we have endeavored to produce one matching our country's need. And to this end we would like to call upon the advice of its users.