POW-R-GEAR™ Low Voltage Distribution Switchboards

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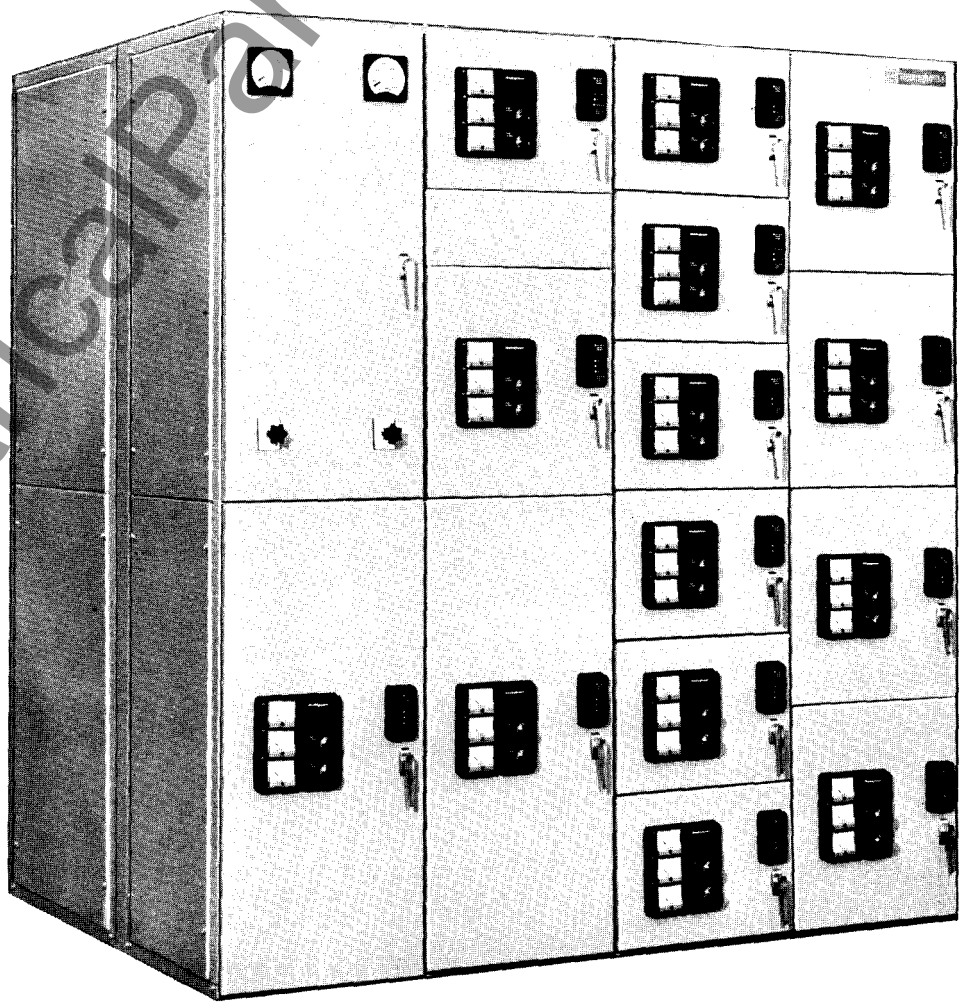


Introduction
Pow-R-Gear switchboards represent a truly modern approach in the construction and application of enclosed low voltage power distribution switchboards. They are designed to meet the ever expanding needs in every segment of the market place for safe, dependable and continuous low voltage power.

By utilizing exclusively the superior characteristics of the type SPB (Systems Pow-R Breaker) encased circuit breakers as their basic element, as well as their own advanced safety features, Pow-R-Gear switchboards provide a degree of electrical and mechanical integrity that answers the most exacting specifications.

Standard Features
Three Position Drawout All breakers are drawout-mounted and can be in the engaged, test, or dis-engaged position with the compartment door closed.

Individual Breaker Compartmentalization Each breaker is housed in a drawout-equipped cell having isolating barriers on sides, rear, top and bottom, in addition to a hinged front steel cover.

In-gear Breaker Inspection Breakers, when drawn out to the extreme ends of their self-contained rail extensions, may be rotated 180° for complete access to primary and secondary contacts.

Front Accessible Current Transformers Current transformers for instrumentation are mounted within the front cells of the respective main and feeder breakers.

Recessed Fixed Contacts Primary contacts fixed in the breaker cell rear wall are recessed behind an insulating barrier such that no live parts extend into the cell interior space with (breaker removed).

Minimum Floor Space Front cell compartments accommodate up to six-high stacking of 800 ampere drawout breakers, four-high for 1600A frames and two-high through 2500 ampere frames.

Automatic Drawout Interlock Drawout mechanism is mechanically interlocked with the breaker mechanism such that no breaker can be racked into or out of the engaged position unless its contacts are open.

Padlocking of Breakers Breakers may be padlocked in any of the three drawout positions as well as in a tripped-open position.

Welded Aluminum Bus All principal main bus connections are welded. Where connections must be bolted as at shipping splits and connections to external equipment, bus bars are silver plated. Bolted copper bus systems are available.

Door-mounted Instrumentation Feeder breaker load current can be monitored, when required, right at the breaker cell door by three-phase ammeters mounted on the door itself.

Positive Secondary Contact Engagement Secondary contact engagement uses the connector plug principle providing automatic self-alignment of mating parts and positive contact.

Removable Cable Compartment Rear cable compartment design facilitates removal and replacement of framework independent of other portions of the section. Thus, sections may be moved through smaller entrance ways during installation.

Safety Standard Compliance Pow-R-Gear switchboards are built to NEMA PB-2 and UL 891 standards for low voltage dead front switchboards, and exceeds their requirements in many important areas.

Optional Features
Drawout Cell Safety Shutter System An insulated automatic shutter system is available for all drawout cells to positively prevent inadvertent contact with line or load primary contacts while breaker is out of the cell.

Closed Door Drawout A modified version of the drawout mechanism and door interface, enables the breakers to be racked outward or inward into the three basic positions with the door remaining closed.

Bus Insulation/Isolation System Standard main and vertical busses are completely enclosed phase by phase with clip-on insulation shapes applied after assembly.

Anti-paralleling Interlock Two adjacent breakers may be mutually interlocked by means of a mechanical connection to prevent them from being in the closed position simultaneously.

Cell Mounted Auxiliary Switch An auxiliary switch is mounted in the breaker drawout cell and operated by the motion of the drawout element as it moves from "engaged" to "test" to "disengaged" positions.

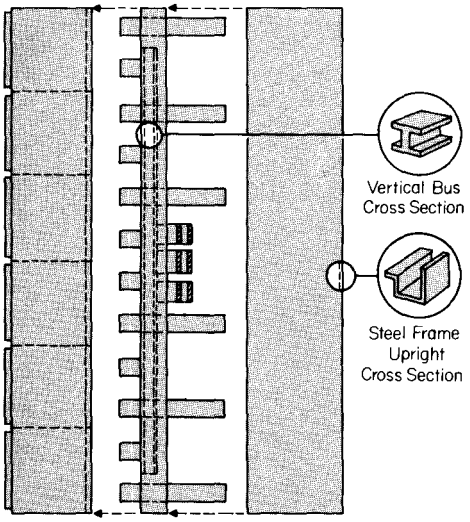
Enclosure Construction
To equip Pow-R-Gear with its many advanced safety features, the enclosure is designed in three separate parts that are bolted together in final assembly to form each vertical section of the switchboard.

The front section consists of the framing and all cell parts necessary to house the drawout breakers in a standard, modularized, vertical stacking arrangement. This fixed-depth section, independent in its construction from other sub-structures, is 90 inches high by 21 inches wide and complete with a full height insulated rear barrier which forms its rear wall. This barrier contains the mounting details for the drawout breaker stationary contacts and serves as a solid barrier isolating all front cell mounted equipment from the live bus located in the compartment immediately behind it. Horizontal and vertical steel barriers segregate each breaker cell from adjacent cells. The front compartment also contains the front formed steel doors which provide front access to each drawout module.

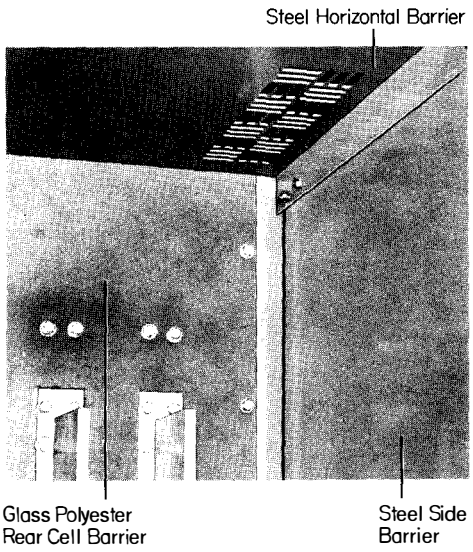
The intermediate section is also an independently constructed shallow-depth full height structure which functions as the supporting frame for the horizontal and vertical bus assembly. Its dimensions are constant for all bus ratings and it has its own front and rear flange for bolting it to the front cell structure and the rear cable compartment. The rear flange of this bus compartment provides a mounting surface for the addition of an optional full height barrier to isolate the entire bus assembly for added safety.

The rear section consists of a third independent frame whose primary purpose is to enclose and protect the rear cable space and breaker load bus extensions. Its depth varies depending on the number and size of feeder cables that have to be pulled in and terminated. The design of the rear compartment is such that it supports no internally mounted equipment and, therefore, it can be unbolted from a shipping section, if necessary, to facilitate passage through building openings.

Formed, removable covers are supplied on top, rear and sides to totally enclose the switchboard assembly.

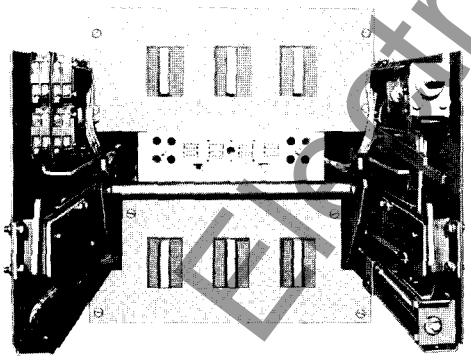


Drawout Breaker System

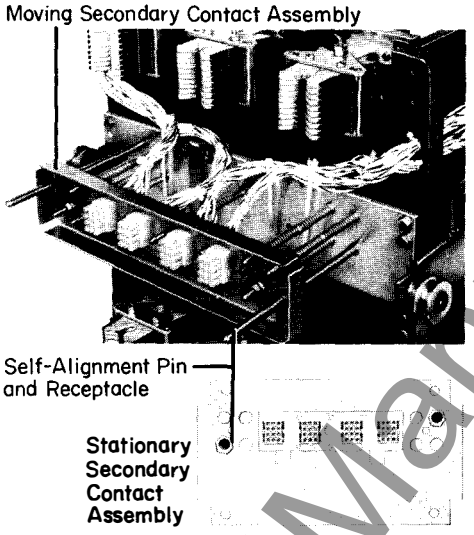


Each drawout, breaker-equipped cell is completely segregrated from other cells of the same and adjacent sections. In the rear, a double wall of glass polyester segregates the compartment from the bus assembly. On the sides, top and bottom, the cell barriers are of steel.

The fixed primary contacts are individually replaceable and accessible from the front. These contacts, both line and load, are recessed behind a glass polyester barrier so that no energized primary parts extend into the cell space when the breaker is removed. CT's, as required for feeder circuit instrumentation are front accessible.



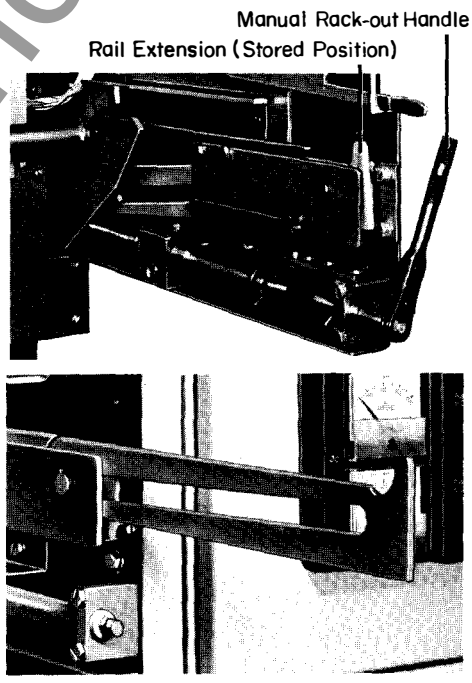
Drawout-breaker secondary contacts are full floating and precisely self-aligning. The same positive, plug contact is maintained in both the engaged and test positions as the plug contacts do not begin their opening motion until the breaker is racked out beyond the test position.



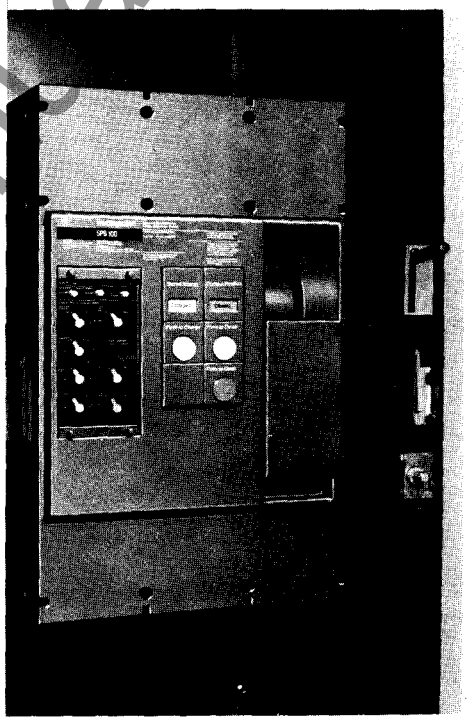
The breaker drawout mechanism is simple, yet rugged in construction. Breaker pull-in is through worm-and-lever action imparted through the rotation of a manual handle.

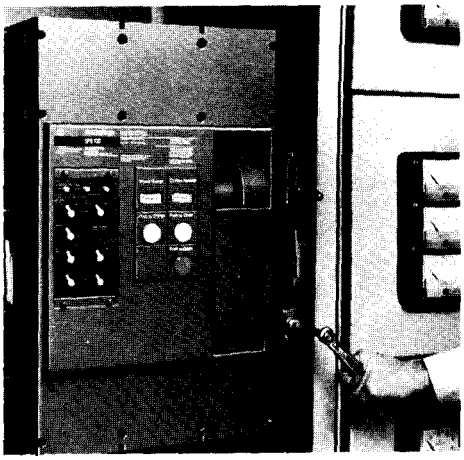
Handle shaft extends for attachment of handle when rack out is desired. It retracts into the cell when racking operation is completed.

The mechanism is identical for all breaker frame sizes. When not used for complete breaker rollout and removal, the captive rail extensions retract into the cell as integral parts of the mechanism.

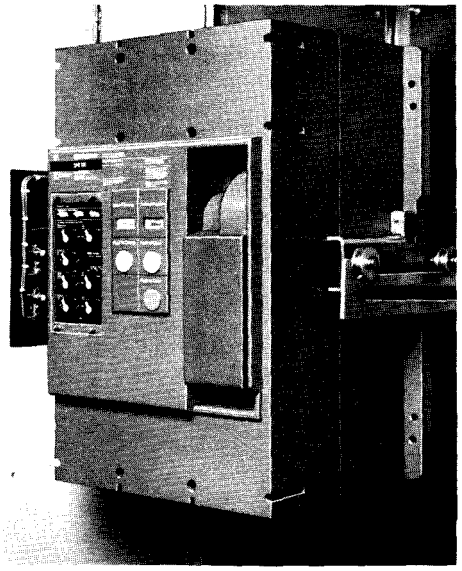


The Pow-R-Gear switchboard drawout-breaker design makes it possible to place the breaker, in "Engaged", "Test" or "Disengaged" positions without interferring with the closing and latching of the front cell door. In the engaged position, sufficient space is provided in front of the breaker to make this possible. No need for doors to be left open when breakers are being tested or stored disengaged in their cell.

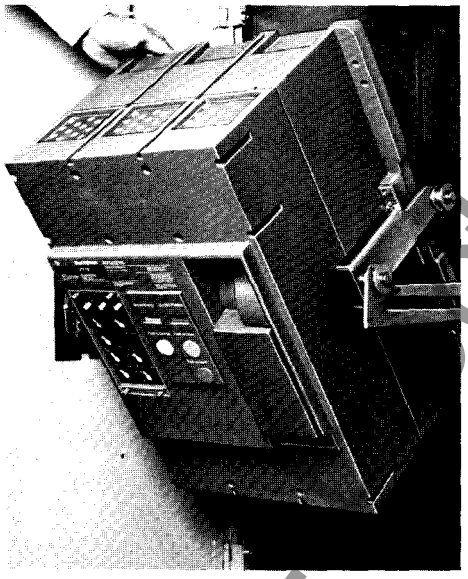




Heavy gauge steel extension rails, in combination with anti-friction rollers, permit precise roll-out and roll-in of the breaker and eliminate binding.



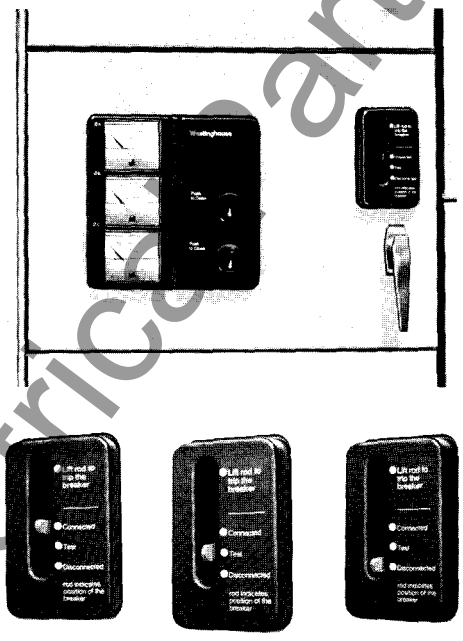
Inspection of moving primary and secondary contacts can be accomplished without removing the breaker to the workbench. The facility to rotate the breaker forward for this purpose is built into the drawout rail design.



Cell door of electrically operated breakers contains control devices necessary to close and trip the breaker, as well as to pre-charge the stored energy mechanism. On manually operated breakers, tripping can be accomplished without opening the cell door, by lifting a mechanical lever which is front accessible but protected against inadvertent operation.

The position of each breaker in a switchboard lineup can be easily determined with all doors closed. A position indicating lever and escutcheon assembly is located on each breaker door with the lever traveling in a vertical slot as the breaker is racked in and out. In addition, this indicator lever serves as the external mechanical tripping means. Lifting the lever trips the breaker regardless of the position of the breaker: "Engaged", "Test", or "Disengaged". The lever is recessed in the escutcheon to prevent its being accidently operated.

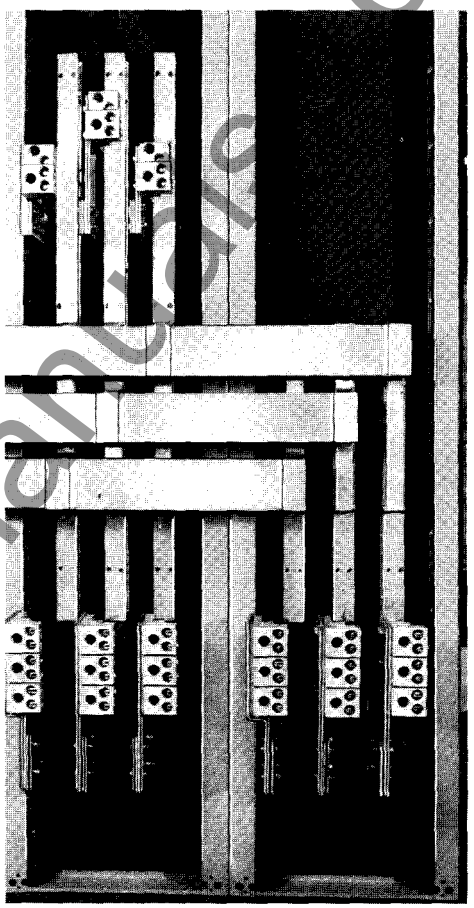
Individual feeder ammeters, when required, are door mounted.



Indicator/Trip Lever in "Connected," "Test" and "Disconnected Positions

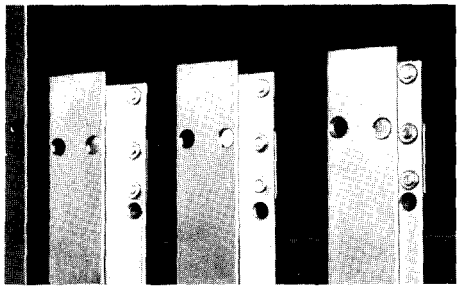
Intermediate (Bus) Section

The main bus is in a fixed location on the horizontal centerline of each section. Conventional bar-type bus is used with phases located one above the other, edge to edge, in a common plane. This configuration makes the assembly extra resistant to short circuit forces, and minimizes inadvertent bridging of uninsulated phase bars during maintenance.

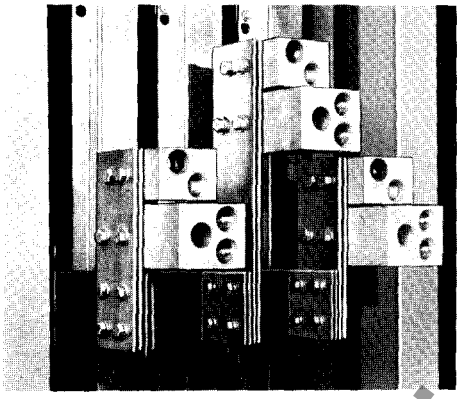


The connection of the main bus to the section bus consumes a minimum of space. UL clearances are maintained throughout the bus assembly irrespective of insulating materials applied in its construction.

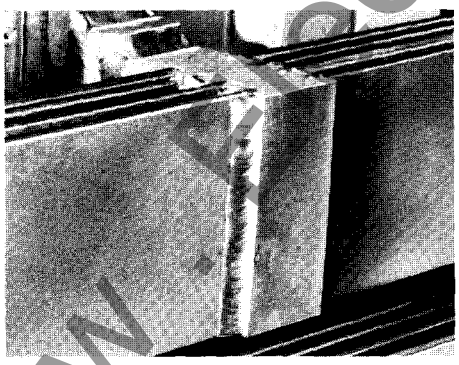
The section bus bars are secured directly to the heavy insulating barrier that isolates it from the front cell assembly. This provides a high degree of structural rigidity as well as natural short circuit bracing.



Load cable terminal points are brought rearward to safe areas behind live bus assemblies, using insulated copper runbacks.



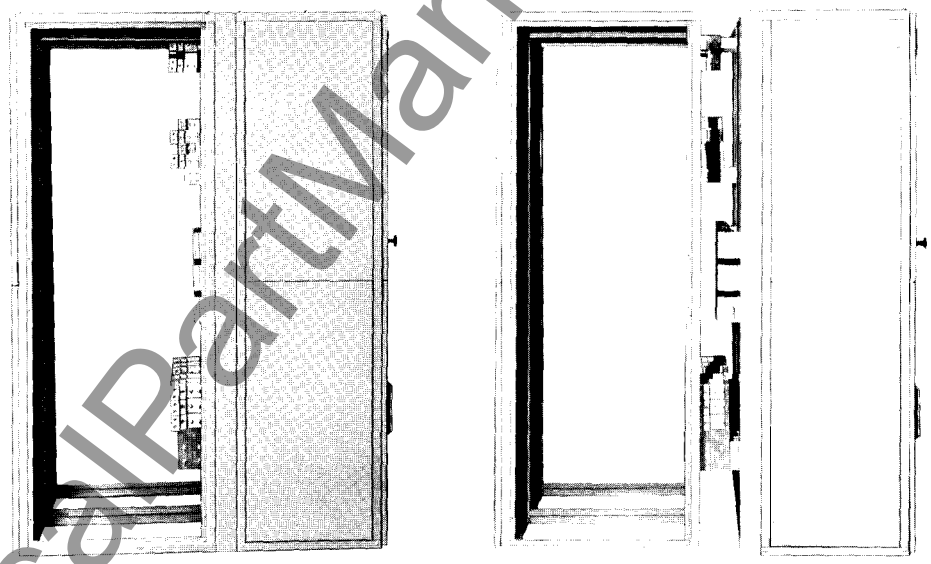
All principal main bus to section bus connections are welded aluminum in standard construction. No maintenance of these joints is ever required, and welding provides joints of maximum permanent conductivity.



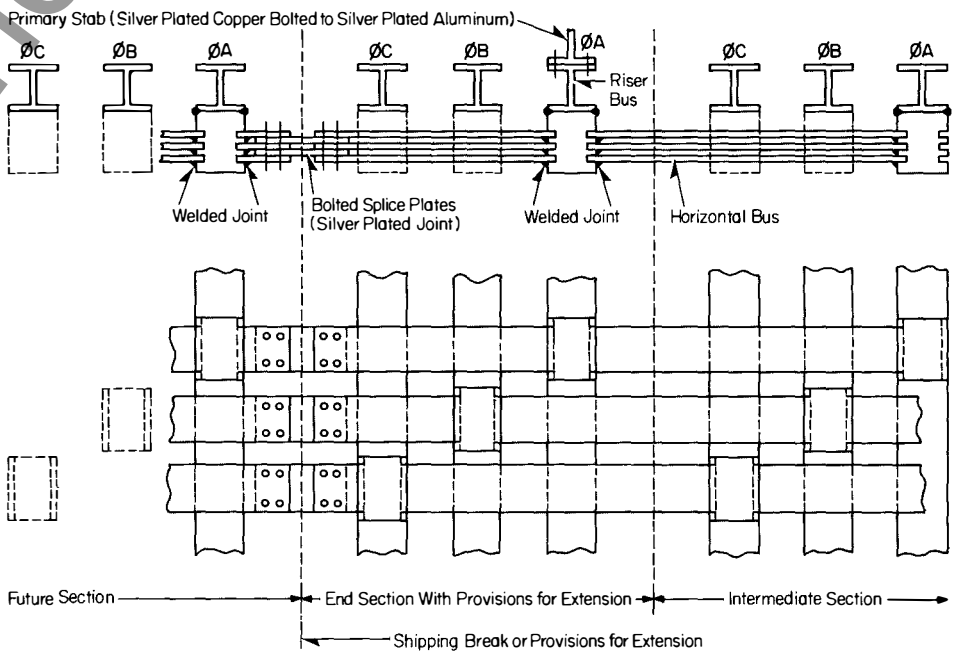
A bolted-on rear compartment encloses the extended load terminals, and provides a safe, amply sized work space for the installation and maintenance of cable connections.

The attachment of the rear compartment is such that it maybe unbolted and separated from the bus compartment if necessary to facilitate moving of the switchboard into place during initial installation.

To provide complete protection against live parts in this cable compartment, an optional full height barrier isolates it from the bus compartment.

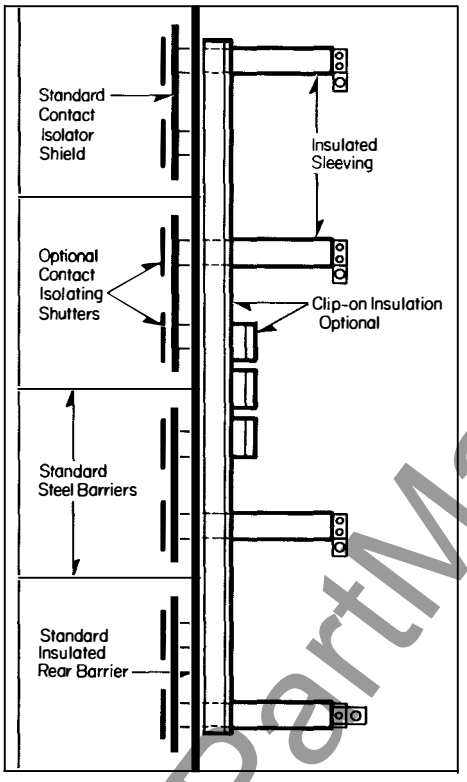


Standard Aluminum Bus Connections, 1600 Through 4000 Amp Main Bus

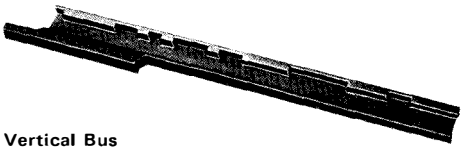


Insulation/Isolation System
A standard option in Pow-R-Gear Switchboards involves a system by which virtually all internal parts energized at bus voltage are enclosed in insulating material. This system utilizes formed insulation shapes securely clamped onto the bus bars, fitting them snuggly for their entire length. In enclosing each phase conductor, this system accomplishes phase isolation as well as individually insulating each live surface. The probability of phase to phase or phase to ground faults being initiated within the switchboard is practically eliminated.

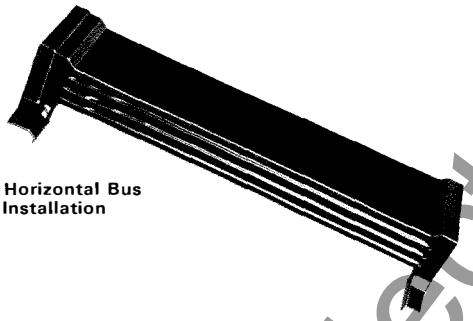
As a complementary part of the totally insulated bus, an additional option is available which protects against the danger of contacting the live primary fixed parts in the drawout cell with the breaker removed. This option is an automatic shutter system which completely closes off the line and load fixed primary contacts as the breaker is racked out of the engaged position. With this feature, the total insulation/isolation safety concept is maintained throughout the switchboard, including the breaker cells.



Cutaway View, Insulation/Isolation System



Vertical Bus Insulation



Horizontal Bus Installation

SPB Systems Pow-R-Breaker
Pow-R-Gear low voltage secondary switching equipment utilizes the SPB Systems Pow-R-Breaker exclusively in its assemblies. The SPB is an encased power breaker having operational features and tripping characteristics tailored specifically for use on higher fault capacity distribution systems, whether or not coordination is required.

The technical capabilities of the SPB Systems Pow-R-Breaker greatly exceed those of molded case breakers and enables them to safely handle many heavy duty circuits whose protection is commonly associated with the larger, open type power circuit breakers.

Standard Breaker Features
UL Listed 100% Rating All SPB frames sizes, when applied in their respective drawout cells, are UL listed at 100% of their continuous ampere rating.

Uniform Dimensions All SPB's through 3000 amps have the same width and pole spacing. Manually and electrically operated breakers are the same physical size.

Two-Step Stored Energy Closing Closing mechanism is energized by a charged spring in two steps: 1) Spring Charge, and 2) Spring Release. These are independent motions which give positive control of the closing instant. Electrically operated breakers have a motor driven spring charger and solenoid release.

Solid State Trip Devices All SPB breakers include solid state trip devices. They are front-removable, plug-in sub-assemblies. Ampere setting, long time and instantaneous trip functions are standard.

Plug-in Ampere Rating Unit Breakers are equipped with a plug-in element as part of their solid state trip assemblies which determines the continuous ampere rating when inserted.

Internal Self-Contained Ground Fault Ground fault logic components, when used, are mounted within the breaker case.

Functional Testing in Service Test points are provided on all breaker trip devices for use with portable test kit in testing the tripping device function in service.

Breaker Contacts Field Replaceable

Optional Breaker Features
Selective Override This permits short time delay tripping and in conjunction with high IC, enables these breakers to be applied in fully rated systems and provide coordination as well.

Ground Fault Protection All SPB breakers can be equipped with adjustable ground fault pick up and time delay devices as part of their solid state tripping devices.

Visual Trip Indicators The SPB Systems Pow-R-Breaker through its Pow-R-Trip 7 solid state trip device can be equipped with visual indicators which show the reason for a tripping action – "Overload", "Short circuit" or "Ground Fault".

SPB Systems Pow-R-Breaker Accessories
Undervoltage Release – Instantaneous. Refer to Application Data 29-860

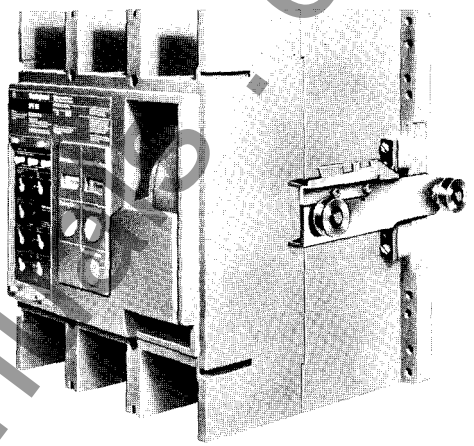
Undervoltage Release – Time delay. Refer to Application Data 29-860

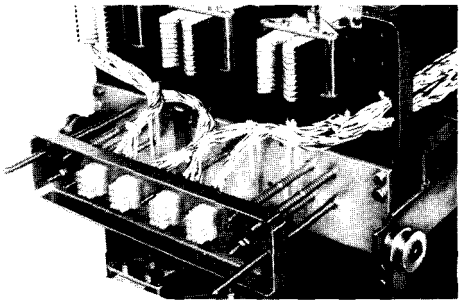
Remote Spring Release Manually operated breakers with precharged spring may be closed from a remote location through action of an unlatching solenoid.

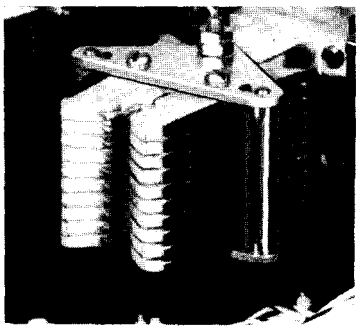
Spring Condition Auxiliary Switch. An auxiliary switch whose action is dependent upon the movement of the spring charging mechanism can be used to give remote indication of the "Spring Charged" condition.

Remote Trip Signalling. Visual trip indicators on the breaker can be wired out to remote alarm or annunciator.

Remote Ground Fault Test Panel. Refer to Application Data 29-860







The Systems Pow-R-Breaker line Note: All Systems Pow-R-Breakers with Pow-R-Trip 7

Series		SPB-50		SPB-65	SPB-100						SPB-150					
Continuous Ampere Rating		250A	800A	1600A	250A	800A	1600A	2000A	2500A	3000A	250A	800A	1600A	2000A	2500A	3000A
Short Time Rating①		25KA	25KA	35KA	25KA	25KA	35KA	35KA	35KA	35KA	25KA	25KA	35KA	51KA	51KA	51KA
Max. Short Time Delay (Cycles)		18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
U.L. Listed Interrupting Capacity RMS Symmetrical Amps @ AC Rating Volts	240	65	65	85	100	100	100	100	100	100	200	200	200	200	200	200
	480	50	50	65	100	100	100	100	100	100	150	150	150	150	150	150
	600	42	42	50	65	65	65	85	85	85	100	100	100	100	100	100

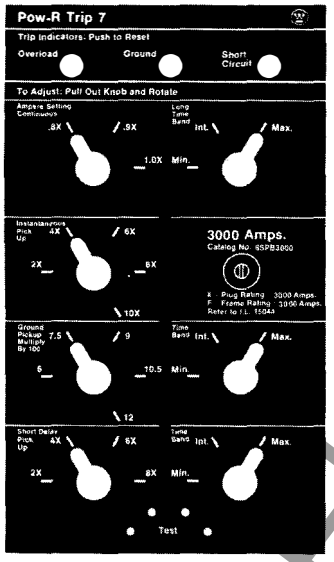
① Short Time Rating (RMS Symmetrical Amps) in 600 V., 50/60 Hz System with X/R Ratio of 6.6

Pow-R-Trip 7 Solid State Tripping System

SPB breakers are equipped with the Pow-R-Trip 7 tripping system having a complete range of tripping functions and characteristics built into its solid state module. The module itself is common to all frame sizes and is designed to plug into the breaker frame. A transparent plastic window cover is secured in place to prevent unintentional or unauthorized changes in trip settings. All adjustments are by means of rotary knobs which operate switching plugs in discreet steps. Within a given frame size, several ampere ratings are available through the use of rating plugs. When inserted in the trip module, these plugs set the breaker up for the full load rating marked on the plug.

A fully equipped Pow-R-Trip 7 trip module consists of the following adjustable tripping functions affecting the breakers overall time/current characteristic:

- Ampere Setting (O.C. Pickup)
- Long time delay
- Short time pickup
- Short time delay
- Instantaneous pickup
- Ground Fault pickup
- Ground Fault delay

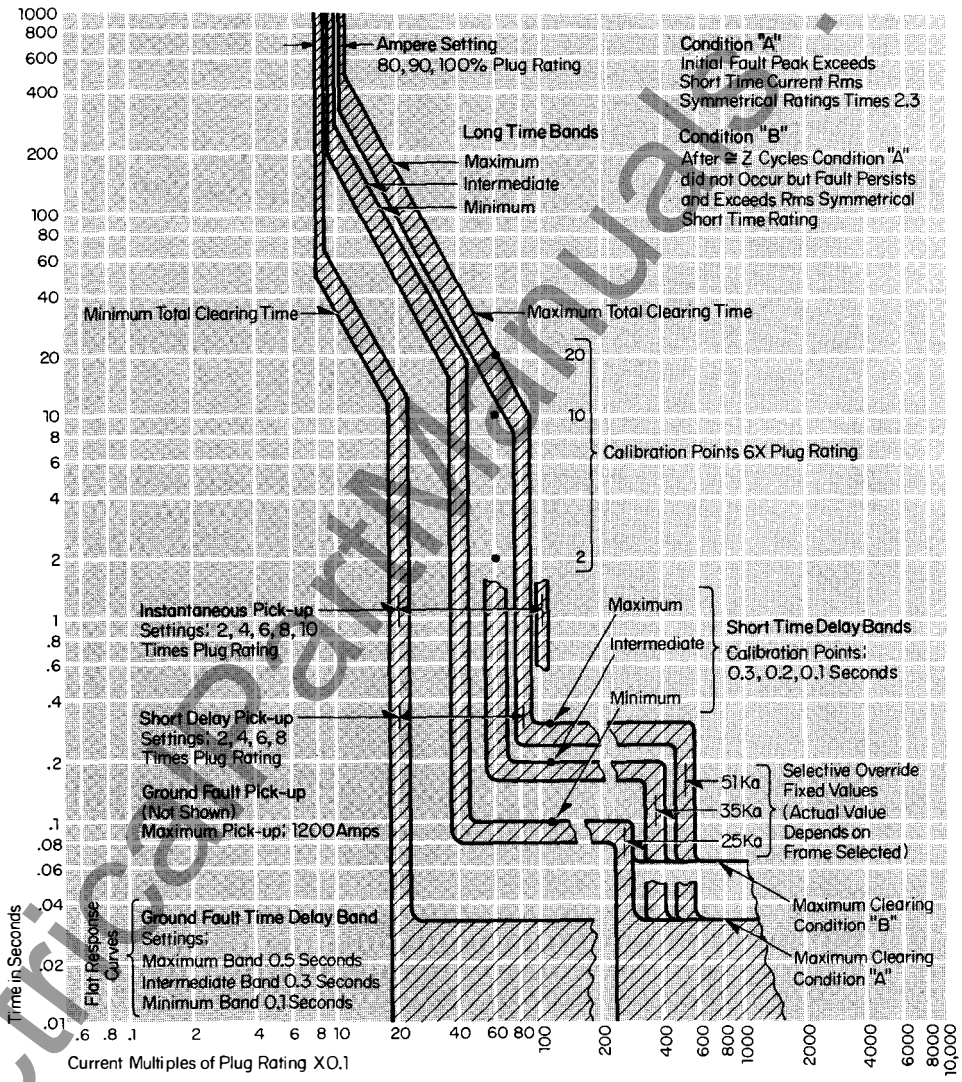


①Other standard or optional features of Pow-R-Trip 7 equipped breakers are:

- Ground fault zone interlocking
- Remote G.F. test panel
- Ground fault memory
- Built-in trip indicators
- Functional test provisions (built-in)
- Selective override circuit for trip systems that do not include adj. instantaneous trip function.

① See feature matrix, at right.

Pow-R-Trip 7 Time-Current Curve

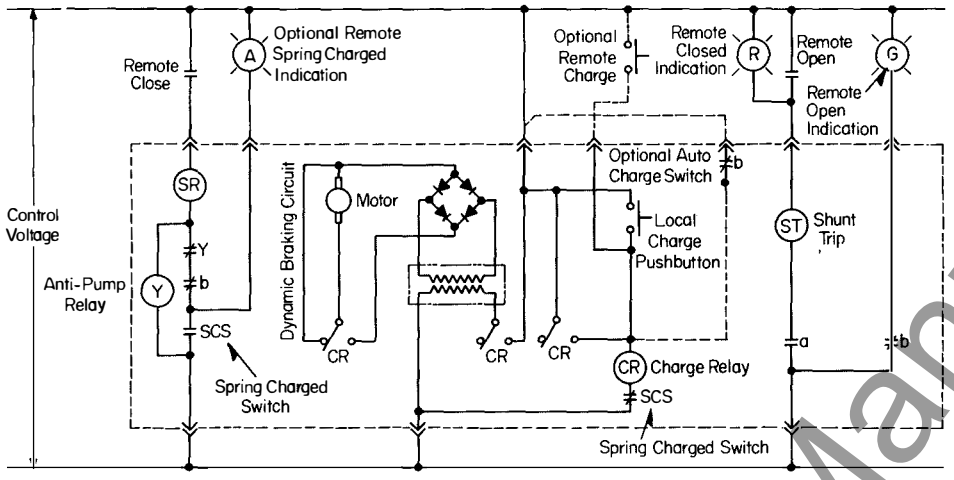


SPB Feature Combinations

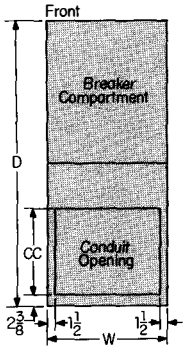
Combination No. →	10	11	12	20	21	22	23	24	25	30	31	32	33	34	35	36	37
Individual and Group Functions																	
Adjustable Long Time Delay and Ampere Setting	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Adjustable Short Time Delay and Pick-up		X	X			X	X	X	X	X	X			X	X	X	X
Adjustable Instantaneous Trip②	X	X		X	X		X	X	X	X		X	X			X	X
Fixed Instantaneous Trip			X			X	X				X			X	X		
Ground Fault Functions Adj. Pick-up and Delay, Interlocking and Remote Test Panel provisions				X	X	X	X	X	X			X	X	X	X	X	X
Ground Fault Fourth Wire CT					X		X		X				X		X		X
Short Circuit Indicator (Built-in)										X	X	X	X	X	X	X	X
Overload Trip Indicator (Built-in)										X	X	X	X	X	X	X	X
Ground Fault Indicator (Built-in)												X	X	X	X	X	X

② Selective override not included when this operation selected.

SPB Breaker Standard Control Diagram (Basic)

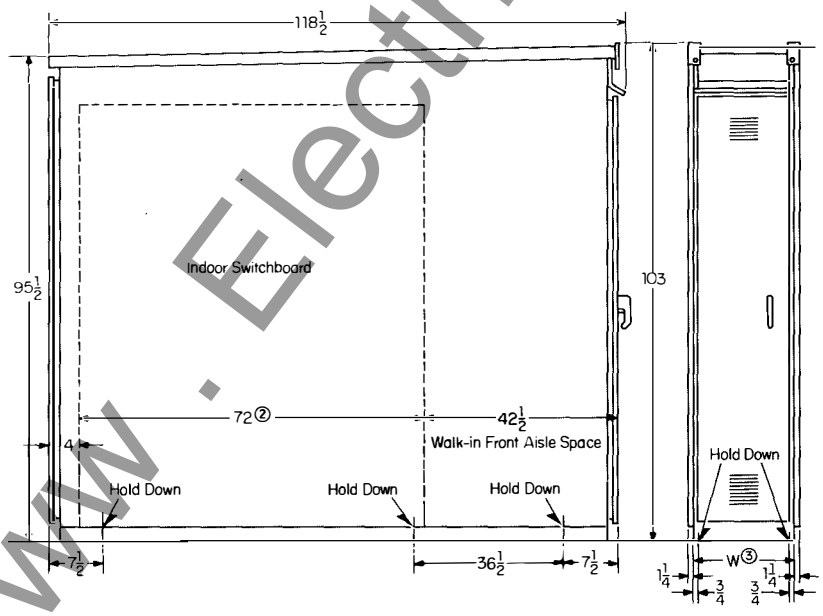


Pow-R-Gear Floor Plan and Cable Space Dimensions-Indoor Sections



Breaker Frame, Amps	Mix of Breakers in Vertical Section				
800	3 – – 1	4 – 2 1	5 3 1 2 –	6 – – 4 3 1 3 – 1	
1600	– 1 – 1	– 2 1 –	– 1 2 – 1	– 3 – 1 2 3 – 2 1	4
3000	– – 1 –	– – – 1	– – – 1 1	– – 2 – – – 1 1 1	
Structure Depth-D	48	54	60	66	72
Structure Weight Less Breakers (Approx.)	1125	1200	1275	1350	1450
Dim. CC-Conduit Opening	7¾	13¾	19¾	25¾	31¾

Pow-R-Gear Outdoor Enclosure



② When outdoor walk-in enclosure is used, all internal frames are 72 inches deep.
③ W=width of internal structure

Pow-R-Gear Typical Dimensions Standard Physical Arrangements

Main Breaker Sections

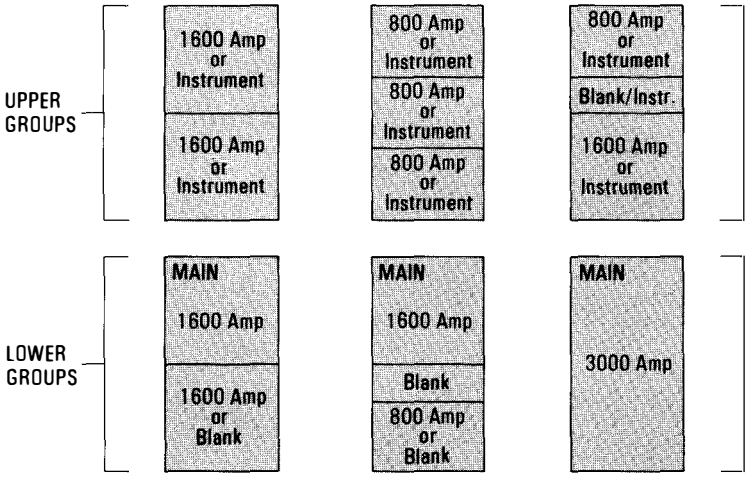


Figure 1 (2)

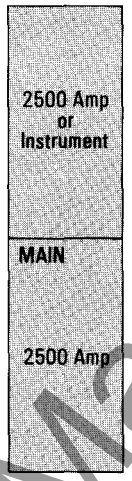


Figure 2

(2) In Figures 1 and 3, Any Upper Group May be Stacked With any Lower Group.

(3) Unless Otherwise Shown, All Sections are 21 Inches Wide by 90 Inches High.

Feeder Breaker Sections

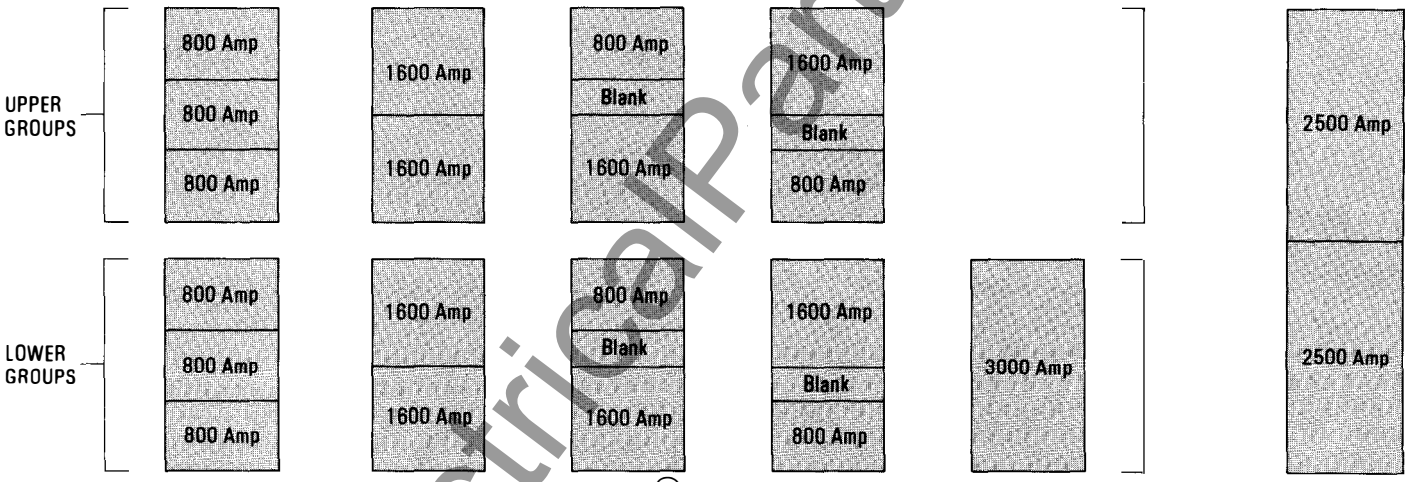


Figure 3 (2)

Figure 4

Tie Breaker Sections

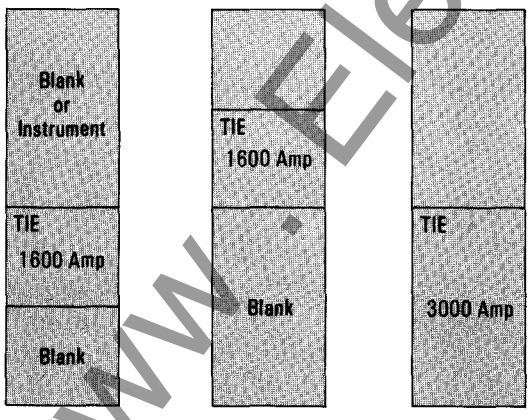
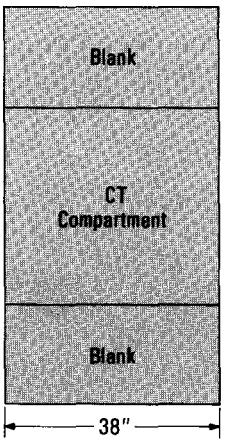


Figure 5

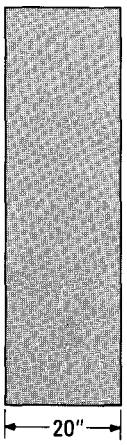
Figure 6

Figure 7

Utility Metering Section



Auxiliary or Transition Section



Typical Specifications

General
The Low Voltage Secondary Switching Equipment shall be Westinghouse (Indoor) (Outdoor) metal enclosed Pow-R-Gear™ consisting of a stationary structure assembly, and one or more Westinghouse drawout mounted Systems Pow-R-Breakers fitted with disconnecting devices and other necessary equipment. The power assembly is to be suitable for 600 volts maximum Ac service and shall be tested for that voltage class in accordance with applicable NEMA standards. The complete assembly including steel framing and covers, the bus system and the breaker drawout cell details, as a minimum requirement, shall satisfy all applicable provisions of UL 891 and NEMA PB-2 for Low Voltage, Distribution Switchboards and, in addition, shall embody the added safety features as are hereinafter described.

Stationary Structure
Each vertical steel unit forming part of the switchboard line up shall be a self-contained housing having one or more individual breaker or instrument compartments, a centralized bus compartment, and a rear cabling compartment. Each individual circuit breaker compartment, or cell, shall be completely segrated from adjacent compartments or sections by means of barriers at rear, top, bottom and sides. It shall be equipped with drawout rails, levering out mechanism, primary and secondary contacts. Current transformers for feeder instrumentation, where shown on the plans, shall be located within the appropriate breaker cells.

Option Number 1
As a safety precaution to prevent accidental contact with live parts during maintenance procedures, the centralized bus subassembly containing the section bus and the through bus, shall be segregated from the rear cabling section by means of removable solid insulating barriers.

A formed steel door with adequate ventilating openings shall be provided for each circuit breaker cell. Each door shall have concealed hinges and shall mount the required devices for local breaker control as well as a circuit ammeter, in a grouped subassembly visible and operable from the front with the door closed.

The top and rear of each vertical unit shall be enclosed with removabie steel sheets having the necessary ventilated openings.

The structure shall be so designed that future additions may readily be made. The steel structure shall be thoroughly cleaned prior to the application of phosphatizing coat and a baked on enamel finish. The finish color shall be ANSI 61.

Busses and Connections
Each circuit shall include the necessary 3 phase bus connections between the section bus and the breaker line side studs. Load studs shall be equipped with load extension busses terminating in solderless type terminals in the rear cable compartment of each structure. Bus extensions shall be silver plated where outgoing terminals are attached.

All busses and connections shall consist of high conductivity (aluminum) (copper) bars mounted on heavy duty glass polyester supports. (All principal bus joints of aluminum shall be welded.) (Copper bus joints shall be bolted.) Shipping breaks and bus provisions for extending the switchboard line-up shall have silver plated bolted connection points.

The bus assembly shall be constructed so as to maintain the minimum UL electrical clearances without reliance on the use of insulating material.

Option Number 2
For added safety during maintenance and to inhibit ground faults or phase faults within the bus assembly, all section (vertical) and through (horizontal) bus bars shall be isolated phase from phase and phase from grounded dead metal through the use of insulating material properly applied in a complete insulation/isolation system.

This system shall be in addition to the minimum UL clearances established in the basic bus design. It shall be totally independent of the bus support system so that it may be removed and replaced for inspection and maintenance without affecting the structural rigidity of the assembly.

Moldarta terminal blocks with integral type barriers between terminals shall be provided for all outgoing secondary control circuits. The terminal blocks shall be accessible by removing the vertical section rear covers.

Disconnecting Devices
The stationary part of the primary disconnecting devices for each circuit breaker shall consist of a set of silver plated copper contacts extending through a glass polyester insulating base. The line busses and load bus extensions shall be directly connected to them. The corresponding moving contacts shall consist of a set of contact finger clusters suitably fitted to the breaker line and load studs. In the "Connected" position, these contact fingers shall engage the stationary contacts forming a current carrying bridge. The assembly shall provide multiple silver-to-silver high pressure point contacts. High uniform pressure on each finger is to be provided by spring action. The entire assembly shall be full floating in order to provide ample flexibility between the stationary and moving elements. Contact engagement shall be maintained only in the "Connected" position.

Stationary primary contacts shall be totally recessed behind an auxiliary rear cell insulating barrier to prevent accidental contact with live parts when the breaker is out of its cell.

Option Number 3
As a positive safeguard against any accidental contact with live parts in a cell while the breaker is removed, an automatically operated shutter system shall be provided for each drawout breaker in the assembly. The shutter shall be directly actuated by the motion of the breaker drawout element in such a way as to isolate all live primary contacts from the cell interior as the breaker is moved out of the "Connected" position.

The secondary disconnecting devices shall consist of floating contact assemblies mounted on the removable unit and engaging with mating assemblies located at the rear of the compartment. The secondary disconnecting devices shall be silver plated to insure permanence of contact. Secondary contact engagement shall be maintained in the "Connected" and "Test" positions.

Removable Element and Drawout System
The removable element shall consist of an encased System Pow-R-Breaker equipped with the necessary disconnecting contacts, wheels, and interlocks for drawout operation. The removable element shall be of the three position drawout design in which it shall be possible to close the compartment door with the breaker in the "Connected", "Test" and "Disconnected" positions. A positive mechanical interlock shall prevent the breaker from being racked in or out while in the closed position either by tripping it or, if it is already tripped, by blocking its closing. A manual latch shall positively position the removable unit in the "Test" and "Disconnected" positions and provisions for padlocking in all positions shall be made. A limit stop shall be provided in the fully withdrawn position and in this position it shall be possible to rotate the unit 180 degrees for inspection and maintenance.

Breakers shall be (manually) (electrically) operated with stored energy mechanisms. Manually operated breakers shall have a charging handle whose operating force is constant throughout its travel. Any number of partial charging strokes may be used, if desired, in lieu of full strokes to accomplish charging. All breakers shall have solid state trip devices with fully adjustable characteristics necessary to protect and coordinate the system on which they are to be applied.

Factory Assembly and Tests
The switchboard shall be completely assembled, wired, adjusted and tested at the factory. After assembly, the complete switchboard will be tested for operation under simulated service conditions to assure the accuracy of the wiring and the functioning of all equipment.

The main circuits will be given a dielectric test of 1500 volts for one minute between live parts and ground.

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