

[54] **MODULAR GAS INSULATED CIRCUIT BREAKER SYSTEM**

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200/148 D

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[58] Field of Search 200/145, 148 B, 148 D,
200/148 R

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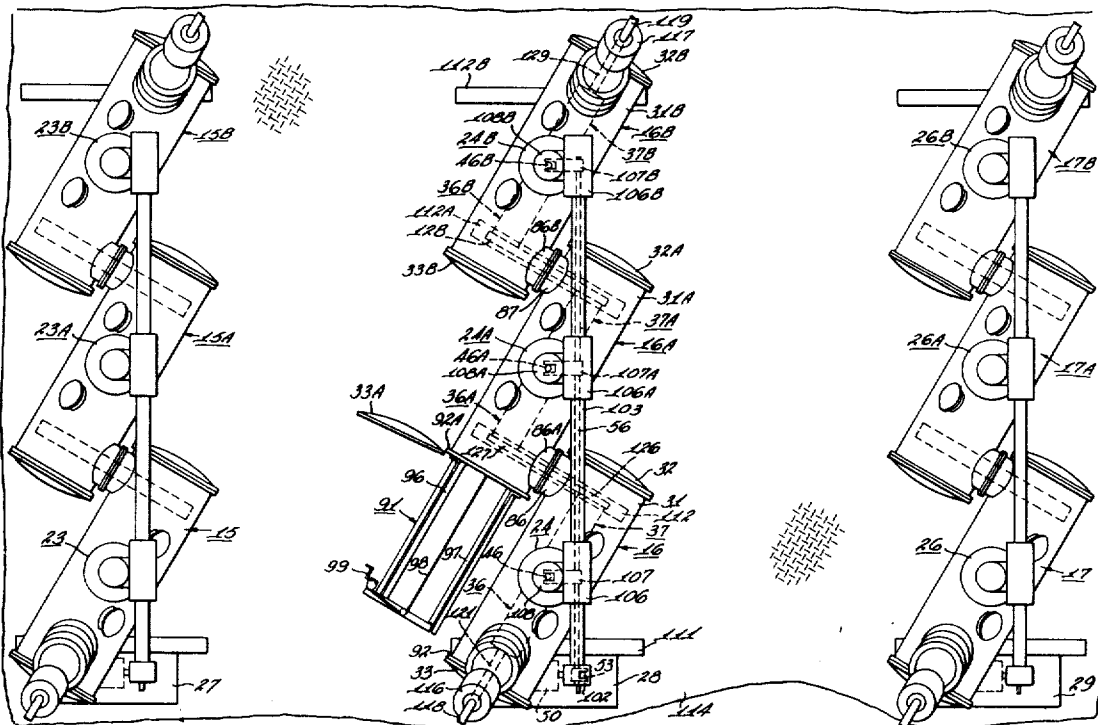
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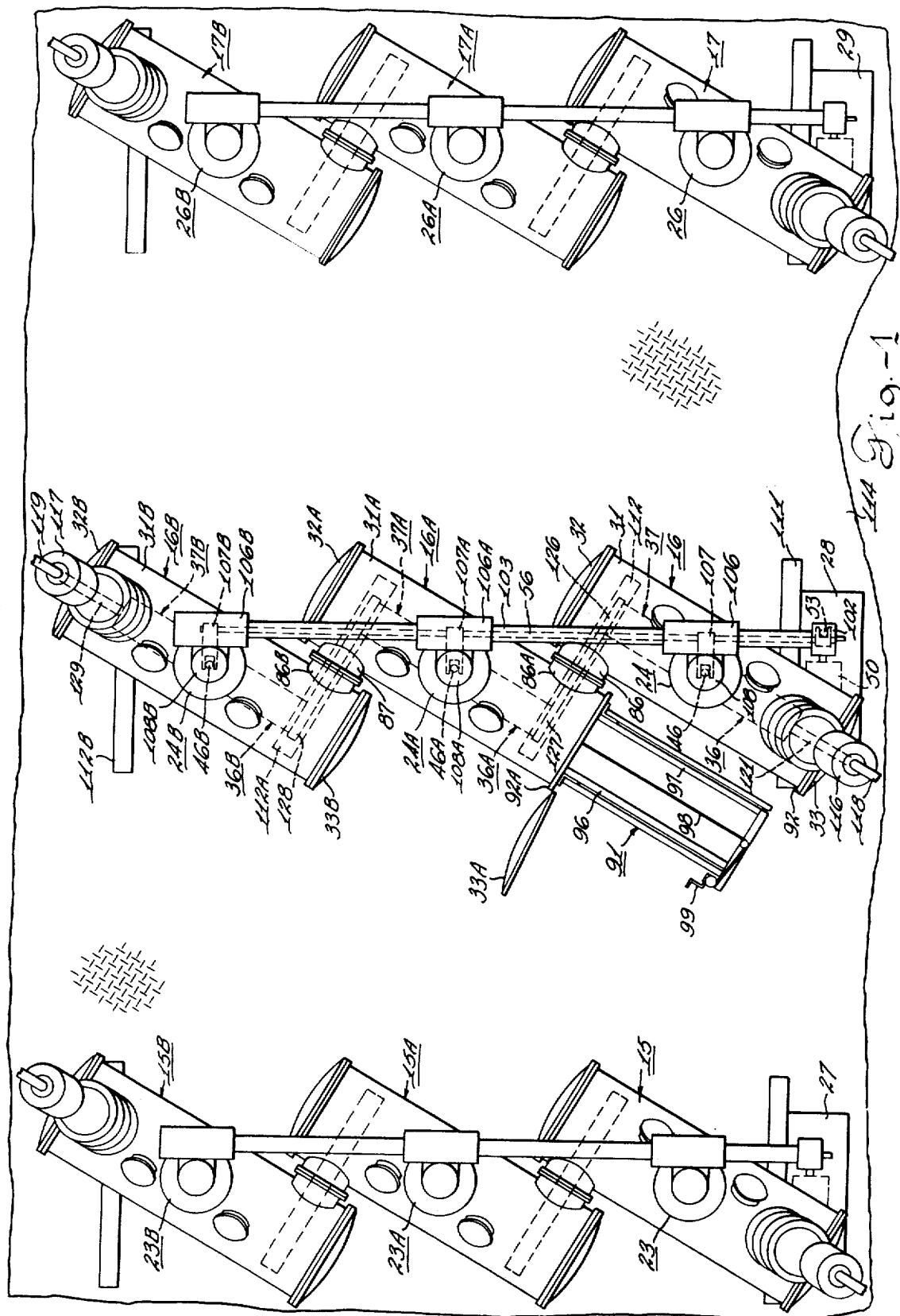
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[57] **ABSTRACT**

Gas insulated substation system fully adaptable for orderly expansion for increasing the interrupting rating of an installation. A plurality of basic modular units are readily connected in series relationship in a manner to promote an efficient utilization of space and in which arrangement the servicing of each individual unit does not require any additional space over that which is required by a single unit. The operation of the interrupting contacts and blast valve for all units of a single phase of the system is accomplished by means of a single operator. The arrangement provides the required spacing between external bushings of the interrupter units in the system and between the bushings of the individual units.

6 Claims, 6 Drawing Figures





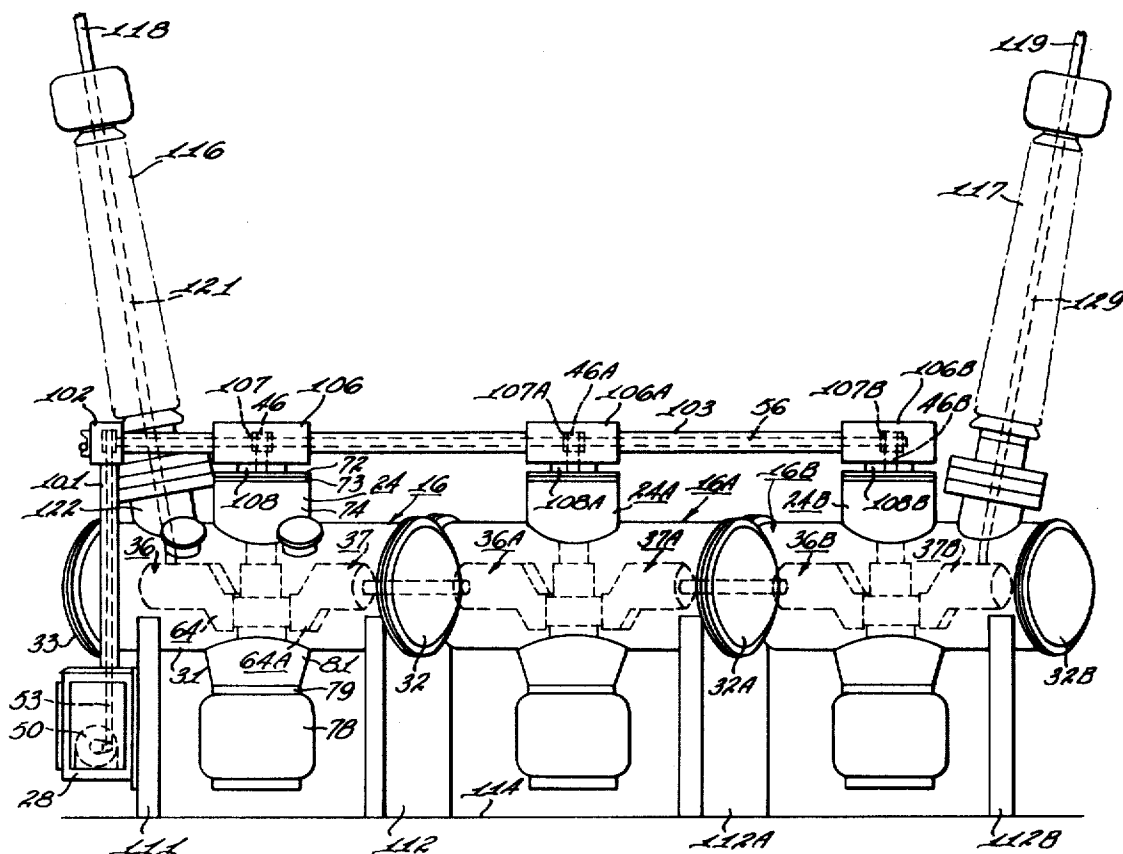


Fig. 2

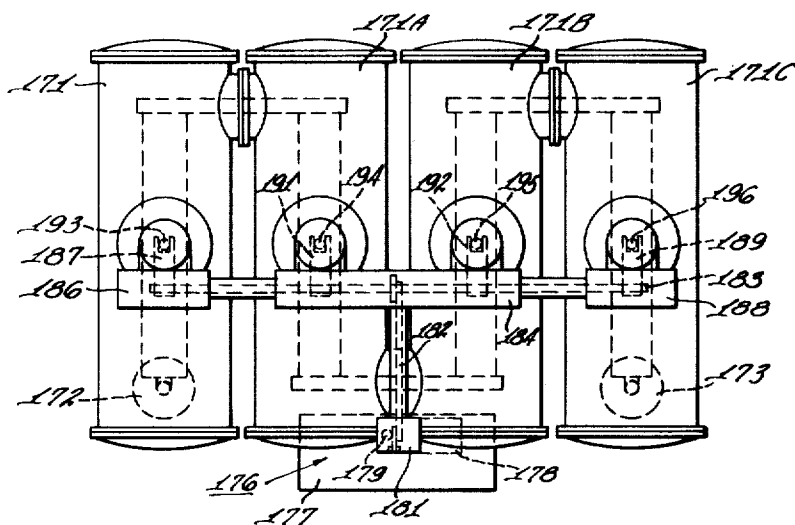
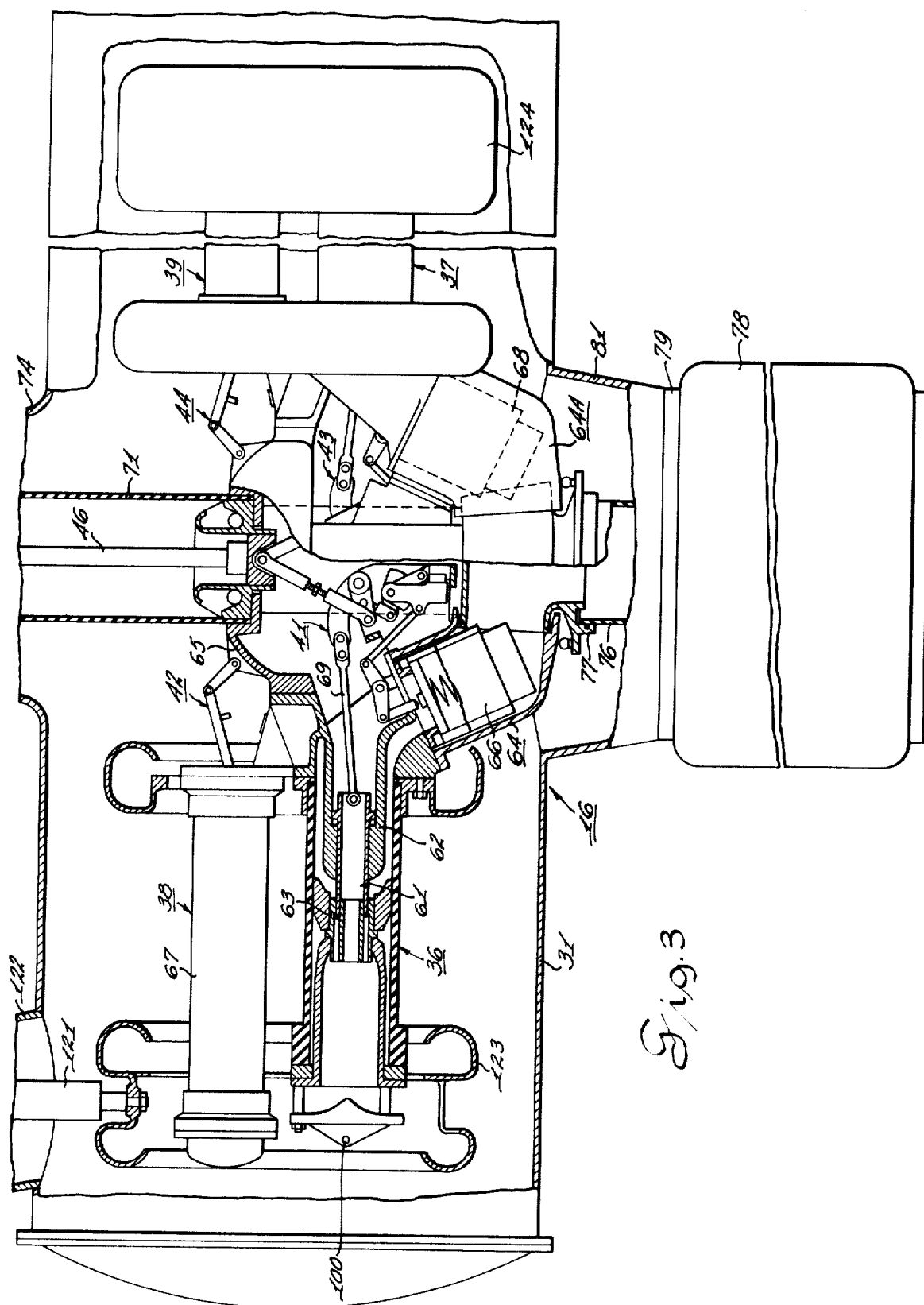


Fig. 6



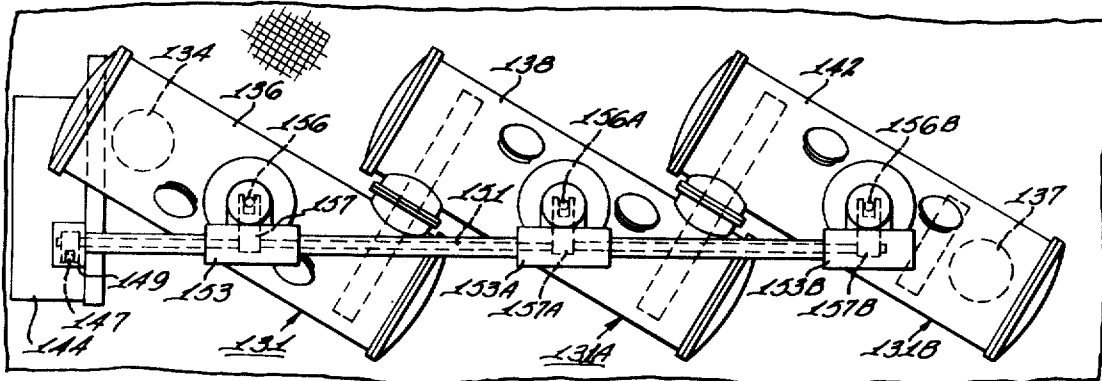


Fig. 4

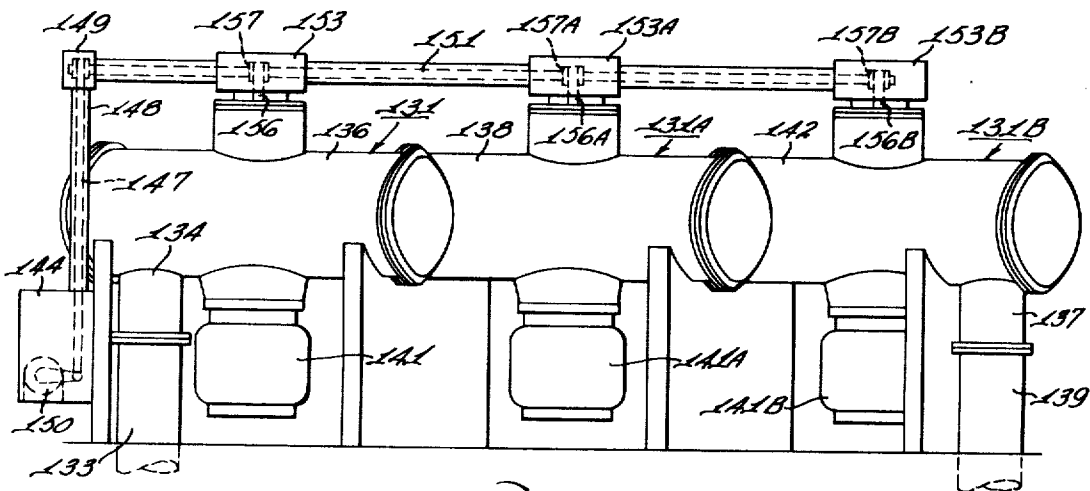


Fig. 5

MODULAR GAS INSULATED CIRCUIT BREAKER SYSTEM

SUMMARY OF THE INVENTION

This invention relates to a high voltage substation system comprising at least a pair of series related or interconnected gas insulated and gas blast circuit interrupters for each phase of the system. More particularly, the substation's system provides for economical and practical utilization of the space required for a system without excessive service area. The system arrangement provided also eliminates the necessity of providing duplicate operators for operating contacts and blast valves of each individual gas blast circuit breaker of the system.

Today's urban society has an insatiable demand for a supply of electrical energy which must be met by the electric utilities. Electric utilities are hard pressed to meet demands and are beset by the pleas of ecologists who urge reduced energy consumption for protection of the environment and conservation of natural resources. However, electric living has become an integral part of our life style; and, it is apparent that energy consumption will continue to increase even if our population is stabilized.

The pressures resulting from these conflicting needs are focused primarily on the electric utility companies. Increasing demand for energy is only one of many challenges confronting power companies. The quality of service must be improved as well. Voltage and frequency must be more closely controlled; continuity at the power supply becomes more important with each new form of electrical service.

In the face of these service oriented demands, a host of factors, internal and external to the utilities, limit the effectiveness of the traditional solutions to technical and economical problems. Some of these factors are the restrictions on rate increases; mounting cost of land, manpower and capital; difficulty in procuring land and substation sites and right-of-ways, due to restrictions on land use; restrictions on the electrical magnetic, atmospheric, thermal and audible emissions; esthetic standards resulting from statutory regulations or public pressures; vandalism and sabotage; effects of weather on system reliability and continuity of service; contamination from the environment; increased system complexity and more rigorous safety standards for protection of public and employed personnel.

The high voltage compact substation system herein depicted comprises a plurality of series interconnected metal clad gas insulated circuit breaker units arranged to provide the required interrupting capacities and electrical clearances between the external bushings of the individual units of an outdoor system and also arranged in a manner that the operation of the contacts and blast valves of the individual units of a single phase of the system can be operated by a single actuator located within a control unit compartment. The arrangement provides adequate clearance for the servicing of each unit of each phase without the need for additional costly space. The metal enclosure of each of the units while serving as a structural base for the apparatus also isolates its internal components physically and electrically from the environment. The use of the SF₆ gas as a medium for the dual function of insulation and interruption provides the advantages of the grounded metal

enclosure while overcoming many of the limitations of free air type of interrupters.

The compact substation concept herein depicted offers advantages in substation construction comparable to that which prefabricated structures offer in the building industry. The substation components are designed as a series of standard, interchangeable modules. Flexibility of the station design is preserved by the use of standard interface connections between modular components. With this substation concept the design, manufacture and preinstallation testing, as well as the shipment of all major station components as sealed, gas-tight modules is possible. Once at the field site, the modules are installed, interconnected, charged with the SF₆ insulating gas and given their final installation test.

The modular concept of the substation design which may be utilized for serving a major metropolitan area offers a number of major advantages. Real estate costs are greatly reduced, station site and right-of-way problems can be solved more readily, engineering and construction costs are greatly reduced, and the safety of personnel and equipment is greatly enhanced.

It is, therefore, the general object of the present invention to provide a compact high voltage transmission substation system having capabilities for future expansion of the system with efficient utilization of space.

Another object of the present invention is to provide a substation circuit breaker having a plurality of metal clad gas insulated modular components arranged so as to provide add-on capabilities for future expansion requirements.

Still another object of the present invention is to provide a substation system in which a plurality of interconnected series related components are automatically operated by means of a single operator.

Yet another object of the present invention is to provide a substation system including a plurality of metal clad gas insulated modules which are connected in series in a manner that servicing of any component of any module demands no greater space than that required for a single component of the system.

Still another object of the present invention is to provide a substation system having a plurality of series connected metal clad gas insulated interrupter modules that are constructed and arranged to provide the required spacing between the bushings of a single phase and also the required spacing of the external bushings between phases in a minimum area.

Still another object of the present invention is to provide a substation system having a plurality of series connected metal clad gas insulated interrupter modules that can be combined in a large number of configurations to most advantageously fit the space available.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a three phase outdoor substation showing the modular arrangement of the gas insulated circuit breaker units;

FIG. 2 is a view in side elevation of the modular components associated with the middle phase of FIG. 1;

FIG. 3 is an enlarged fragmentary view partly in vertical section and partly in elevation showing the interior and one interrupter of a modular circuit breaker;

FIG. 4 is a plan view of a plurality of circuit breaker modules arranged for indoor application;

FIG. 5 is a side elevation view of the modified circuit breaker modules of FIG. 4; and

FIG. 6 is a plan view of a plurality of circuit breaker modules in a modified configuration arrangement.

DESCRIPTION OF THE INVENTION

Referring to FIG. 1, there is depicted a high voltage transmission substation comprised of a series of modular components which are operatively installed as integral units. These components include, for each phase, a plurality of circuit breaker modules 15, 15A, 15B, 16, 16A, 16B, 17, 17A and 17B, and in addition, current transformers as required. All components except the transformers (transformers are external of housing) are supported and contained in electrically interconnected metallic housings which are solidly connected to the frame of the substation structure. The live parts of the components are insulated from their metal housings by suitable insulating material and by SF₆ gas. Each circuit breaker employs a two pressure system which is sealed and may be separated from all of the other components of the system. Thus, a gas loss from one unit will not affect any other unit. In addition, the operating sequence of the contacts of each circuit interrupter module as well as the operation of associated high pressure gas blast valves are controlled by actuating means mounted in top structures 23, 24 and 26. Each phase is provided with its individual control cabinet 27, 28 and 29 which houses the gas controls (not shown), gauges (not shown), hydraulic motors as well as the power sources for the associated hydraulic motors.

The circuit breaker module, such as the circuit breaker module 16, includes a gas filled metallic enclosure 31 of tubular form. Each end of the enclosure 31 is provided with a hinged access door 32 and 33 for providing entry into the enclosure. Within the enclosure 31, there are disposed, in this particular illustration, two series connected identical circuit interrupters 36 and 37 which are operated simultaneously to contact closed or contact open positions. Closing resistors and/or capacitors 38 and 39 may be connected in parallel with interrupters 36 and 37. The contacts of the interrupters 36 and 37 and the contacts (not shown) of the resistors 38 and 39 are moved in proper sequence to open or closed positions by operating linkage 41, 42, 43 and 44 actuated by a common rod 46. The rod 46 is operatively connected to a source such as a hydraulic motor 50 located within the control cabinet 28 via a vertical motion transmitting rod 53 and horizontally disposed rod 56.

The contacts within each unit are the same and the description of the contact structure 36 will apply to all. As shown in FIG. 3, a tubular axially movable contact 61 is slidably supported in a conductive metallic housing 62 so as to move relative to a fixed contact 63. The housing 62 and the gas blast valve housing 64 in which an associated displaceable gas valve 66 is located is carried by a centrally disposed housing 65. Resistor 38 has somewhat the same arrangement having an axially movable contact (not shown) engageable with a fixed contact (not shown) located within a housing 67. The interrupter 37 and the associated resistor 39 are identical to the interrupter 36 and its associated resistor 38. It is to be understood that the gas valve housing 64A is also provided with another displaceable gas valve 68. The contact housing 62 is secured to the gas valve housing 64 in a manner such that the rod 69 for the movable contact 61 passes through the casting 62 to operatively connect with the drive linkage 41. In a simi-

lar manner, the housing 67 of the resistor 38 is carried by the housing 62 so that actuating linkage 42 associated with the movable resistor contact (not shown) is functionally accessible to the drive linkage 41.

Support for the gas valve housing 64 is provided by its attachment to housing 62, which in turn attaches to support 65 that is secured to tubular sleeve 71. Tubular sleeve 71, in turn, is secured in depending relationship from a closure sealing plate 72 shown in FIG. 2. The sealing plate 72 is affixed to a flange 73 of a vertical circular housing 74 that extends upwardly from the top of the enclosure 31. The depending end of the sleeve 71 is secured as aforementioned to the gas valve housing 64 and carries substantially the entire weight of the housings 65, 64 and 64A, contacts 36 and 37 and the resistors 38 and 39. To counteract the blast effect encountered during operation, a stabilizing effect is afforded to the header 77 by means of a high pressure gas conducting tube 76. The gas conducting tube 76 is connected in sealed relationship within a bell-shaped inlet port of header 77. At its opposite end, the conducting tube 76 has communication with a high pressure gas tank 78 through a sealing plate 79 which operates to seal the open end of an enclosure extension 81.

For the purpose of connecting modular circuit breaker units, for example, units 16, 16A and 16B, together in electrical series relationship for increasing breaker capacity; to provide the most advantageous configuration arrangement for minimizing space requirement; for ease of servicing individual modules; and, also, to facilitate transportation of the modules, a connecting side port 86 is provided. The port 86 is constructed on the longitudinal centerline of the housing 31 and extended laterally therefrom. Since the valve housing 64 and the contacts 36 and 37 and resistors 38 and 39 therein are symmetrically arranged within the enclosures with respect to a vertical centerline, the construction of the enclosure can be standardized to facilitate manufacturing. Thus, if it is desired to utilize three modules, such as the modules 16, 16A and 16B, associated with a single phase of a three phase transmission line so as to triple the breaker capacity, the one module is simply turned 180° with respect to the other so that the ports 86 of each module are adjacent to one another, as shown. In the three unit module arrangement shown, the middle circuit breaker unit 16A requires an additional lateral port 87 to mate with the port 86B associated with the unit 16B. With the port 86 of two modules 16 and 16A aligned, a suitable seal is interposed between the flanges of the ports and the ports bolted or otherwise fastened together to provide a rigid gas tight connection therebetween. A similar arrangement is effected between the modules 16A and 16B wherein their ports 87 and 86B are aligned and a gas seal interposed between the flanges of the ports and the ports thereafter bolted together to form a gas tight seal. It can be seen that the parallel staggered arrangement of three modules, as depicted, provides a more convenient and space saving arrangement than that which could be obtained from a single tank enclosure structure. Not only does the module concept result in a reduction of the space required, but it also facilitates the removal of the interrupters and associated actuating means for servicing.

Servicing of the interrupters of each module is accomplished from the ends of the module. As depicted in FIG. 1, a servicing unit 91 is positioned for servicing

the interrupter in the enclosure 16A. To 31A purpose, the insulating gas is evacuated from the enclosure 31a and conserved for future use. With this accomplished, the enclosure door 33A is unbolted and either removed or swung to full open position to permit free access to the interior. The service unit 91 is secured to the enclosure flange 92A and suitable associated track ways (not shown), which are in effect continuation of the tracks 96 and 97 of the external service unit 91, are inserted into the interior of the enclosure for receiving the interrupter unit 36A. A cable 98 is attached to bracket 100 of the interrupter 36 or 36A (FIG. 3), and by operation of a winch 99, the entire interrupter unit 36A is withdrawn from the enclosure 31A to a position where it can be easily serviced.

As previously mentioned, operation of the interrupters and associated resistors in each of the breaker modules associated with a single phase is accomplished by a single operator. For example, the circuit breaker modules 16, 16A and 16B that are operatively connected to provide increased breaker capacity for a single phase of a three phase transmission line have their associated interrupters all connected to be operated by the single power source 50. To this end, the vertical operating rod 53 is operatively disposed within a tubular vertically extending housing 101 that extends upwardly from the control cabinet 28 into a motion directional change box 102. The lower end of the disposed drive rod 53 is operatively connected to the drive motor 50 which is operative to effect axial movement of the rod 53 on a signal received from a control section (not shown). The upper end of the drive rod 53 within the motion directional change box 102 is operatively connected by suitable linkage to the horizontally disposed rod system 56 that is housed within a horizontal tubular housing 103 extending across the top of the three circuit breaker modules 16, 16A and 16B. Associated with each module circuit breaker adjacent to the housings 24, 24A and 24B associated therewith is an external motion directional change mechanism 106, 106A and 106B. The tubular housings 103 extend between each unit 106, 106A and 106B so that the rods 56 housed with the housings 103 extend through the units 106 and 106A and into the unit 106B. Within the units the rods 56 have operative connection with laterally extending horizontal levers 107, 107A and 107B that are pivotally supported in vertical dome portion 108, 108A and 108B of the housings 24, 24A and 24B. Internally the levers 107, 107A and 107B are operatively connected by a suitable linkage mechanism (not shown) to the associated vertical actuating rods 46, 46A and 46B that extend downwardly into the circuit breakers. Thus, upon a signal the power source 50 within the cabinet 28 will be caused to operate in a contact opening operation wherein the rod 53 moved vertically upward to effect movement of the rod 56 as viewed in FIGS. 2, 4 and 5, thereby moving the contacts to open position. In a similar manner, to effect a closing of the interrupter contacts, the power source 50, upon receiving the proper signals, will effect a movement of the rods 53 and 56 to effect downward movement of the rods 46, 46A and 46B thereby moving the contacts to closed positions.

As best illustrated in FIGS. 1 and 2, each modular circuit breaker unit is supported by its individual base members 111 and 112 so that each modular unit with its associated supporting members 111 and 112 forms

a complete unit in itself. To provide easy access to the interior of each modular unit and for purposes of visual inspection of the upper reaches of the units, a grate platform 114 may be provided which extends below the enclosures of the modules and below the control cabinet 28 so that personnel may walk thereupon to facilitate inspection.

As previously mentioned, each modular unit such as the units 16, 16A and 16B are electrically connected in series so that a continuous electrical path may be established from an external bushing 116 to the opposite external bushing 117 to which an external incoming line 118 and an outgoing line 119 are connected. Thus, the line 118 is electrically connected to a suitable conductor means 121 disposed within the bushing 116. Bushing 116 is supported by an inlet port 122. The inner end of the conductor 121 is electrically connected to the left end of the interrupter unit 36 as viewed in FIG. 3. The electrical conductive path continues from the inner end of the conductor 121 to the shield structure 123 which surrounds the free end of the interrupter 36 and is electrically connected to the stationary contact 62 by means of the movable contact 61. The electrical circuit is established through the casting 62 and support 65 and similarly to the movable (not shown) of the interrupter 37. The conductive path continues therefrom through the fixed contact (not shown) of the interrupter 37 to the shield structure 124 which is secured and electrically connected to the extending right hand end of the interrupter 37 as viewed in FIG. 3. The right hand end of the interrupter 37 is electrically connected to the left hand end of the interrupter structure 36A of the module 16A by means of a laterally extending horizontal conductor 126 that extends from the shield 124 through the connecting ports 86 into the enclosure of the circuit breaker module 16A where it is electrically connected to a shield structure 127 associated with the left end of the interrupter 36A within the unit 16A. Electrical continuity is continued through the contacts of the interrupter 36A associated with the unit module 16A, the support 65, the contacts of the interrupter 37A, and transferred laterally from the interrupter 16A to the interrupter 16B by means of a conductor 128. The conductor 128 is connected to the left end of the interrupter 36B and the electrical circuit continues in the same manner as described for 16A. From the right hand or upper end of the interrupter 37B, as viewed in FIG. 1, the circuit continues to a conductor 129 in the bushing 117 and is connected to the distribution line 119. A similar arrangement is provided for the other phases so that each phase is identical.

From the foregoing description, it can be seen that the modular circuit breaker arrangement as herein described provides for an economy of space requirements, ease of servicing each modular unit without the need of additional room for the servicing unit; also, it provides adequate electrical clearance between the bushings of each phase and between the bushings between phases so that the electrical safety standards are maintained. It is also apparent that with the configuration and arrangement of the modular units described, additions may be readily made at any time without any undue remodeling. For example, the required interrupting capacity for a substation at the time of construction may require that only one circuit breaker module per phase is necessary. However, the capacity of the substation may be calculated to eventually reach

a point where the substation will require three circuit breaker modules per phase. However, before reaching the maximum size calculated, an intermediate capacity may be required and which necessitates only one additional circuit breaker module per phase so that two circuit breakers per phase would suffice. This can easily be done by adding just one circuit breaker module per phase to the original installation. At a later time, the maximum load interrupting capacity will be reached, and it would be only necessary to add a third circuit breaker unit to the two breaker units per phase already installed, and this may be readily accomplished without disturbing the associated electrical circuits of the other units. With this occasion arising, the bushing that would be associated with the far end of the second modular unit 16A would be removed and placed into the far end of the third circuit breaker modular unit 16B and the port on the unit 16A from which it has been removed would be capped by means of a plate (not shown). It can also be seen that with the constructional arrangement provided herein that the interrupter actuating means can be expanded as the modular units are added. Thus, a single control cabinet associated with a singular modular unit would be adequate to operate three circuit breaker units merely by the addition or the extension of the horizontal actuating rod and the associated control mechanism. This arrangement provides for economy of operation, of installation, of manufacturing, and is well adapted to modern ecology requirements.

In FIGS. 4 and 5 there is shown a modification of a plurality of circuit breaker modules arranged for indoor application. As there shown, the circuit breakers 131, 131A and 131B are arranged in electrical series relationship in a manner set forth for the circuit breakers 16, 16A and 16B. Since the circuit breakers 131, 131A and 131B will be confined within a building, the incoming line and the connected lines will normally be arranged to enter the building via underground piping which may or may not be insulated by an insulating gas. However, these lines, once within the building, will enter via a gas insulated bus enclosure 133 which is secured to a depending enclosure entrance housing 134. Exit from the circuit breaker module arrangement is via a housing 137 to which a gas insulated bus 139 is secured. Each circuit breaker module 131, 131A and 131B is provided with its own high pressure gas tank 141, 141A and 141B, respectively, which contains insulating gas at a relatively higher pressure than the insulating gas which is contained within the enclosures 136, 138 and 142. Operation of the contacts and the gas blast valves associated with each of the circuit breaker units 131, 131A and 131B is accomplished through operation of a single power source 150 which is similar to the single power source associated with the circuit breaker modules 16, 16A and 16B. Thus, a control cabinet 144 accommodates the power source such as a hydraulic motor 150 which is operatively connected to effect vertical actuation of the vertical rod 147 that is housed within the tubular housing 148 and which extends between the cabinet 144 and a motion directional change box 149. Within the box 149 the upper end of the vertical rod 147 is operatively connected to horizontally disposed rotational rods 151. The rods 151 extend through motion change boxes 153, 153A and into the change box mechanism 153B associated with the circuit breaker unit. The rotational

movement of the rod 151 to effect vertical movement of actuating rods 156, 156A and 156B that are operatively connected to effect the opening and closing movement of the circuit breaker contacts and the associated gas blast valves of the individual circuit breaker units is accomplished through horizontally disposed transfer levers 157, 157A and 157B which are operatively connected to the horizontal shaft 151 and the operating shafts 156, 156A and 156B.

From the brief description herein given of the indoor application of the modular circuit breaker units, it can be seen that with very little manufacturing changes the circuit breaker modules described for an outdoor substation application can be modified to accommodate an environmental location which necessitates the enclosure of the circuit breaker modules within the confines of a building. It is quite obvious that since the substation circuit breaker modules would be utilized indoors and in a confined space, the necessary precautions of the incoming bus and the outgoing lines must be protected by insulated gas environment as indicated which provides the necessary safety standards. Other than these minor precautions, it is apparent that the parallel series relationship of the circuit breaker modules, as set forth herein, is well adapted for utilization within the confines of a building. The parallel staggered relationship of these individual circuit breaker units minimizes the space requirement that must be provided for an indoor substation installation. It should be apparent that the plurality of circuit breaker modules herein set forth provides a greater interrupting capacity, requires less space, facilitates assembly on site, greatly reduces the shipping problems between the manufacturing point and the assembly point and also reduces manufacturing costs.

To further illustrate the novel versatility and practical aspects of the modular circuit breaker concept, a further modification of the invention arranged for indoor application is shown in FIG. 6. As there shown, the circuit breakers 171, 171A, 171B and 171C are arranged in electrical series relationship in a manner set forth for the circuit breakers 16, 16A and 16B. Since the circuit breakers 171, 171A, 171B and 171C are intended to be utilized in a building, the incoming line and the connected lines will normally be arranged to enter the building via underground piping. These lines, once within the building, will enter the circuit breaker 171 via a gas insulated bus enclosure (not shown) which is secured in gas tight relationship to a depending enclosure breaker entrance housing 172. Exit from the circuit breaker module arrangement is via a housing 173 to which a gas insulated bus (not shown) is secured. Each circuit breaker module 171, 171A, 171B and 171C is provided with its own high pressure gas tank (not shown) which depends from the bottom of an associated module 171, 171A, 171B and 171C and is centrally located with respect to the end of the module. Operation of the contacts and blast valves associated with each of the circuit breakers 171, 171A, 171B and 171C is accomplished through operation of a single operating mechanism 176 which is similar to the mechanism associated with the circuit breaker modules 16, 16A and 16B. Thus, a control cabinet 177 accommodates the power source such as a hydraulic motor 178 which is operatively connected to effect vertical actuation of a vertical rod 179 that extends between the cabinet 177 and a motion directional change box 181.

Within the box 181 the upper end of the vertical rod 179 is operatively connected to a horizontally disposed reciprocal rod 182. At its opposite end the rod 182 has operative connection with another transversely extending horizontal rotatable rod 183. The rod 183 extends outwardly from both ends of a motion change box 184 that is associated with the circuit breaker modules 171A and 171B. The rod 183 extends leftwardly into another motion change box 186 and has operative connection with a lever 187. The opposite end of the rod 183 extends rightwardly into another motion change box 188 associated with the module 171C and has an operative connection with an actuating lever 189. Within the centrally located motion change box 184, the rod 183 is also operatively connected to levers 191 and 192. The levers 187, 189, 191 and 192 are each operatively connected to effect vertical movement of associated actuating rods 193, 194, 195 and 196 that are operatively connected to effect the opening and closing movement of associated contacts and related gas blast valves of the associated circuit breaker modules.

Thus, the modified arrangement of circuit breaker modules as herein described require no manufacturing changes and only minor adaptation of the contact and blast valve operating mechanism. The arrangement provides all the advantages of compactness and is eminently suitable for installation in buildings. The arrangement also retains the single contact and blast valve operating mechanism, thereby insuring synchronization in the operation of the contacts and of the blast valves associated with each module.

From the foregoing description of a modular circuit breaker unit substation it can be seen that a novel arrangement is provided from which benefits not heretofore experienced can be obtained and which go a long way to meet today's ecology problems. Now, not only is a more compact substation assembly provided, but the costs of manufacturing, assembling and shipping are greatly reduced by the modular concept herein described.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a modular substation;
 - a plurality of gas insulated circuit breaker units arranged in axial parallelism wherein each circuit breaker unit includes;
 - an enclosure containing an insulating gas at a first pressure;
 - a pair of series connected contacts;
 - a separate tank carried by said enclosure exteriorly thereof and containing an insulating gas at a relatively higher second pressure;
 - blast valve means carried by said enclosure and operatively arranged to interconnect said high pressure gas tank to the interior of said enclosure;
 - contact and blast valve actuating means carried by said enclosure and operably connected to be operated simultaneously to effect substantially simultaneous opening of said contacts and said blast valve means;
 - port means operatively interconnecting said enclosures of said circuit breaker units in communicating relationship to provide an electrical passageway between adjacent enclosures;
 - sealing means within said interconnecting means to isolate one circuit breaker unit from another to

maintain the gas tight integrity of each enclosure; means extending between said circuit breaker units within said enclosures through said port means and said sealing means to establish an electrical series relationship between the contacts of said circuit breaker units; and,

a single mechanical operating means external of said circuit breaker unit enclosures and operably connected to effect the simultaneous operation of each of said circuit breaker contact and blast valve actuating means.

2. A modular substation according to claim 1 wherein said enclosure of each circuit breaker unit is an elongated tubular member having removable sealing axial end doors.

3. A modular substation according to claim 2 wherein said enclosures of said circuit breaker units are disposed adjacent each other in axial parallelism and said port means operate to provide a close coupled enclosed passageway between adjacent enclosures; and, the enclosures most remote from each other are each provided with a single terminal bushing, said terminal bushings being arranged to provide electrical isolation therebetween, said terminal bushings being electrically connected in series internally through all of said enclosures.

4. A modular substation according to claim 3 wherein said enclosure of each circuit breaker unit is disposed at an angle relative to a plane that includes lines which are transverse to the axis of each of said enclosures and that pass through the axis of the enclosure substantially midway of the ends of the enclosures.

5. A modular substation according to claim 1 wherein the end of one of said enclosure furthest removed from an associated enclosure is provided with an external housing adapted to provide a sealed entry for the high voltage entrance means into said enclosure; and,

said another of said enclosures at its end furthest removed from the end of the said one enclosure having the external housing being provided with an external housing adapted to provide a sealed housing for the high voltage exit means out of said enclosure.

6. In a modular substation;
 - a plurality of gas insulated circuit breaker units wherein each circuit breaker unit includes;
 - an enclosure containing an insulating gas at a first pressure and having a centrally located upwardly extending housing;
 - a pair of series connected contacts;
 - a separate tank carried by said enclosure and containing an insulating gas at a relatively higher second pressure;
 - blast valve means carried by said enclosure and operatively arranged to interconnect said high pressure gas tank to the interior of said enclosure;
 - contact and blast valve actuating means carried by said enclosure and operably connected to effect substantially simultaneous opening of said pair of series connected contacts and associated blast valves, said contact and blast valve actuating means extending upwardly from its operative connection with said contacts and associated blast valves into said upwardly extending housing;
 - drive means operatively connected to said actuating means within said upwardly extending housing and

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extending outwardly in sealed engagement through the wall of said housing;
a single operating means external of said enclosure and operably connected to the external portion of said drive means that extends outwardly of said housing through the wall thereof;
a control cabinet at one end of said plurality of gas insulated circuit breaker units;
power means within said cabinet;
connecting drive means operatively connected to said power means within said cabinet and extending outwardly from said cabinet to operably connect with said single operating means;
port means provided on each of said enclosures and

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disposed in adjacent relationship to provide enclosed passageways between adjacent enclosures; sealing means in said passageways channels to isolate said adjacent enclosures in a manner that each enclosure is a separate gas sealed unit so that gas loss in any one enclosure will not effect any other enclosure; and,

means extending between said circuit breaker units within said enclosures and through said communicating channels and said sealing means to establish an electrical series relationship between the contacts of said circuit breaker units.

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