This invention relates generally to high voltage switches and relates particularly to switches commonly known as disconnecting switches.

It is a prime consideration in the design of disconnect switches to provide a gap in the line of sufficient size when the disconnecting switch is open to assure that no arcing will occur across the gap when voltage is reapplied to the open line. The higher the voltage, the larger the gap, thus necessitating the use of longer and more massive switch blades, more complicated and massive blade counterbalancing means, stronger supports for the switch, and more powerful switch blade operating mechanisms. The longer blades may suffer greater stresses and have a greater tendency to sag and become misaligned with the contact jaws and require extremely large operating forces, particularly under severe icing conditions. Thus, it is apparent that as power systems are constructed to carry larger and larger blocks of power at higher voltages to meet rapidly increasing demand, to merely increase the relative size of known disconnect switch structures becomes impractical because of the above discussed disadvantages.

The increased voltage also requires increased spacing between the individual phases, thus requiring longer inter-phase tie connections for effecting simultaneous operation of all poles in the conventional manner. At the higher voltage ratings, these tie connections become unwieldy and impractical because of the excessive distances between phases.

Accordingly, it is an object of this invention to provide in a disconnect switch, a simple reliable structure for providing a large air gap between the line terminals when the switch is open.

More specifically, it is an object of this invention to provide in a disconnect switch a vertical break double blade for providing a large air gap between the line terminals. The double blade construction when compared to a single blade type construction minimizes inertia forces, bearing loads, sag and misalignment, and reduces operating forces, especially under severe ice conditions.

Still more specifically, it is an object of this invention to provide in a disconnect switch two vertical break blades operated simultaneously from a single operating mechanism.

It is a further object of this invention to provide in a double blade disconnect switch a single centralized rotating insulating column for operating the blades simultaneously.

It is another object of this invention to provide in a polyphase disconnect switch apparatus a plurality of motors, each individual to one phase and all subject to a common electrical control to effect simultaneous operation of all phases.

It is a further object of this invention to provide in a double blade disconnect switch, operating means responsive to the operation of a single rotator insulator column to simultaneously rotate both blades longitudinally about their respective axis to release the contact pressure, and thereafter pivot the blade vertically to the open position, the sequence of operation being reversible.

Yet another object of this invention is to provide in a disconnect switch a reduction gearing mechanism between a rotatable insulator stack and switch operating mechanism to reduce the torque on the insulator stack thus enabling the insulator stack to operate a relatively more massive operating mechanism and switch blade.

Other objects of the invention will be explained hereinafter or will be apparent to those skilled in the art.

In accordance with one embodiment of this invention, each phase of a power system includes a double break switch blade mechanism operated in response to rotation of a vertical insulator stack which is a part of the insulator assembly at the center of a switch base. From the closed position, the two blades of the double break switch blade mechanism first rotate about their longitudinal axis to completely release contact pressure before pivoting 90° from the full open vertical position. When closing, both blades pivot 90° from the vertical position, and when the blade tips are within the break jaws, the blades rotate about their longitudinal axis to reestablish high pressure wiping contacts. The blades are counterbalanced by compression springs so that they cannot fall closed from any position. The entire mechanism of each phase is supported upon an individual tubular base providing a simple, rigid mounting means.

For a better understanding of the nature and objects of the invention, reference may be had to the following detailed description, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a front elevational view of a double blade disconnect switch illustrating one embodiment of this invention; and,

FIG. 2 is a fragmentary end elevational view of the disconnect switch of FIG. 1.

Referring to the drawings, the structure shown relates to a disconnect switch for one phase of a polyphase system, and comprises three linearly spaced tripods 11, each fixedly mounted upon a single elongated base member 12 by means of brackets 13 and 14 integral with the base member 12. Each bracket 13 extends transversely of the longitudinal axis of the base member 12 to support a pair of the tripod legs positioned in straddling relationship with respect to the base member 12, while each bracket 14 supports the third tripod leg positioned in vertical relationship with respect to the base member 12. Each tripod leg comprises an insulator stack preferably composed of porcelain or similar material, being understood that the number of insulators in each stack depends upon the system voltage. The base 12 is composed of galvanized steel, preferably tubular in form, to provide maximum rigidity which, in turn, provides maximum torsional and cantilever strength for a given weight of steel. The base 12 is rigidly mounted upon the upper end of a pair of spaced base support columns 15. The rigidity of the base eliminates the need for trusses between the columns.

A terminal pad 18 is fixed to the apex of each one of the two end tripods, and may be adjustably mounted thereon by means of leveling screws (not shown). Contact jaws 19 are fixedly attached to the upper side of each terminal pad 18 in electrical contact with the pad to connect the line to the switch blade as will be hereinafter described. Also fixed to the upper end of each terminal pad 18 is a crown shield comprising a pair of crown members 20.

The terminal pads 18 may also serve as mounting platforms for surge suppressing resistor assemblies 16 which can be used at either or both ends of the switch as required by varying circuit parameters. The surge suppressors are used to eliminate damaging system overvoltages associated with the switching of unloaded high voltage lines and cables. The surge suppressors are preferably of the type referred to in the periodical Power Apparatus and Systems, A.I.E.E., October 1958, in an article entitled "Investigation of Switching Surges Caused by 345 kv.
Disconnecting-Switch Operation," pages 838-844. Generally stated, the surge suppressor is a porcelain enclosed resistor electrically connected to the terminal pad and normally carrying no current when the disconnect blade is closed. When the disconnect switch is opened during bus deenergization, an arc is drawn between the blade and the switch contact jaws. It may subsequently transfer to an intermediate member of the corona shield assembly. Arcing continues between these two points until the blade approaches the first or lowermost arcing ring on the porcelain enclosed resistor. At this time, the arc transfers from the stationary contact to the first resistor arcing contact ring 17 inserting one-third the total resistance in series with the disconnecting switch. Arcing continues and is progressively transferred to the second and finally the top arcing ring, at which time the total resistance has been inserted. Final interruption of the arc occurs between the blade and the top arcing ring.

The middle tripod 11 serves as a rigid support for each of a pair of switch blades 21 arranged in back-to-back relationship, each having one end rigidly fixed to a housing 26 for a switch blade operating mechanism, which housing is pivotally mounted on the middle tripod 11 for vertical movement of the other end of the blade mechanism into and out of engagement with the previously described contact jaws 19 of the outermost tripods. Motion of the arcing mechanism during 22 is fixed to the apex of the middle tripod 11 and is shown with a portion of the housing wall broken away to disclose supported therein a gear reduction mechanism 23 having an input shaft 24 extending downwardly through the housing, and having a pair of spaced parallel output shafts 25 extending upwardly through the housing.

A drive shaft 27 comprising a rigid insulator stack 28 is fixedly attached to the input shaft 24 externally of the housing 22 and extends vertically downward to the base 12 where it may be supported for rotational movement about a vertical axis. A driveshaft extension extends downwardly through the base 12 to a reversible drive mechanism 29 which may be either electrical, mechanical or electromechanical in nature and operable to rotate the extension 28, the drive shaft 27 and reduction gears 23 to rotate simultaneously the output shafts 25. The gear unit 33 serves to reduce the torque requirements on the rotating insulator stack 27 since the gear unit is disposed between the stack 27 and the operating mechanisms for the switch blades. A pair of spaced transverse pivot members 30 are fixed to the top of the housing 23, each providing a pivotal support for the pivotally supported pivot housings 26 at a pivot vertically about the pivot points in response to rotation of the corresponding output shafts 25.

The individual switch blade operating mechanisms (not shown) are each mounted internally of the housings 26 and may be of any commercially available type which operates to reduce the pressure between the switch blade 21 and the corresponding contact jaws 19 and provide vertical movement of the switch blade away from the contact jaws 19 when the output shaft 25 is operated. A preferred switch blade operating mechanism and corresponding contact jaw mechanism 19 is of the type disclosed in Patent No. 2,363,360, issued November 21, 1944 to H. L. Rawlins, and assigned to the assignee of this application, wherein, generally stated, the rotation of a shaft corresponding to the output shaft 25 of this application effects operation of a cam mechanism internally of the housing 26 to first rotate the switch blade 21 about the pivot axis 32 to disengage the flat end of the blade from the spaced contact jaws, whereafter, continued rotation of the shaft 25 pivots the blade 21 and housing 26 from the horizontal position to a substantially vertical position, and, further, wherein reverse rotation of the shaft 25 provides a reversal of the described operation to close the switch and reestablish contact pressure. A counterbalancing spring (not shown) is associated with each operating mechanism in the manner shown in the previously mentioned patent to Rawlins.

It is apparent that a group of three of the previously described individual pole units may be ganged to provide either individual operation or simultaneous three-phase operation by merely energizing the drive mechanisms 29 either individually or simultaneously from a centralized control station. For example, an electrical system or a hydraulic system could connect all drive mechanisms for individual or simultaneous operation.

It is apparent that the provision of a double break disconnect switch shortens the length of the individual switch blade by substantially one-half for any given gap size between line terminals to thus greatly minimize inertia forces and bearing loads on the blade and its actuating mechanism, and reduce operating forces especially under severe ice conditions. The blades moving in a vertical direction during operation of the switch minimizes the effect of sag on the alignment of the contact jaws with the blade as compared with a side operated switch. Further, the vertical movement of the blades minimizes the phase spacing required as compared to a horizontal break switch and with the double vertical break type switch the height above ground of overhead electrical members can be minimized thereby minimizing structural steel costs.

While there is shown and described a certain specific embodiment of our invention, many modifications thereof are possible within the spirit and scope of the invention. Accordingly, the foregoing specification is intended to be illustrative and not in a limiting sense.

We claim as our invention:

1. In a high voltage disconnect switch: a base, a pair of spaced insulator support means secured to the base; a stationary contact secured to each insulator support means; an additional insulator support means on the base intermediate said spaced insulator support means; a gear housing supported by said additional insulator support means; a pair of spaced pivot means on said gear housing; a switch blade supported by each one of said pivot means; reduction gear means in said housing for simultaneously actuating the switch blades about a transverse axis through the corresponding pivot means to effect engagement and disengagement between each blade and the corresponding stationary contact, and means for driving said reduction gear means.

2. In a high voltage disconnect switch: a base; a pair of spaced insulator support means secured to the base; a set of contact jaws secured to each insulator support means; a switch blade corresponding to each set of jaws; an additional insulator support means on the base intermediate said pair of spaced insulator support means; a pair of spaced pivot means on said additional insulator support means, each pivot means supporting one of said pair of switch blades for rotation about a transverse axis through the corresponding pivot; reduction gearing operable to simultaneously actuate said pair of blades about their respective pivots to effect engagement and disengagement between each blade and the corresponding set of jaws; and a single rotatable insulator stack for operating the reduction gearing.

3. In a high voltage disconnect switch: a base, a pair of insulator support means secured to the base; contact jaw means secured to each of said pair of insulator support means; a pair of switch blade means; additional insulator support means on the base; a gear housing supported by said additional insulator support means; a pair of spaced pivot means on said gear housing; each said pivot means supporting one of said said switch blade means; gear means in said housing for simultaneously operating both said switch blades about said pivot means to effect engagement and disengagement between each blade means and the corresponding contact jaw means and including means for actuating said blade in a direction other than about said pivot means at the beginning of each contact.
separation operation and at the end of each contact closing operation, respectively, to respectively initially break and finally make contact between each blade and the corresponding contact jaws, and means for driving said gear means.

4. In a high voltage disconnect switch: a base, a pair of insulator support means secured to the base; contact jaw means secured to each of said pair of insulator support means; a pair of switch blade means; additional insulator support means on the base; a gear housing supported by said additional insulator support means; a pair of spaced pivot means on said gear housing, each said pivot means supporting one of said switch blade means; reduction gear means in said housing for simultaneously operating both said switch blades about said pivot means to effect engagement and disengagement between each blade means and the corresponding contact jaw means and including means for actuating said blade in a direction other than above said pivot means at the beginning of each contact separation operation and at the end of each contact closing operation, respectively, to respectively initially break and finally make contact between each blade and the corresponding contact jaws; and, a single rotatable insulator stack for driving the reduction gear means.

5. In a high voltage disconnect switch; a base, a pair of insulator support means secured to the base; contact jaw means secured to each of said pair of insulator support means; a pair of switch blade means; additional insulator support means on the base; a gear housing supported by said additional insulator support means; a pair of spaced pivot means on said gear housing, each said pivot means supporting one of said switch blade means; gear means in said housing for simultaneously operating both said switch blades about said pivot means to effect engagement and disengagement between said blade means and the corresponding contact jaw means and including means for rotating said blades about their longitudinal axes at the beginning of each contact separation operation and at the end of each contact closing operation, respectively, to respectively initially break and finally make contact between each blade and the corresponding contact jaws; and a single rotatable insulator stack for driving the gear means.

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