

Aug. 31, 1943.

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2,328,283

DISCONNECT SWITCH

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4 Sheets-Sheet 1

Fig. 1.

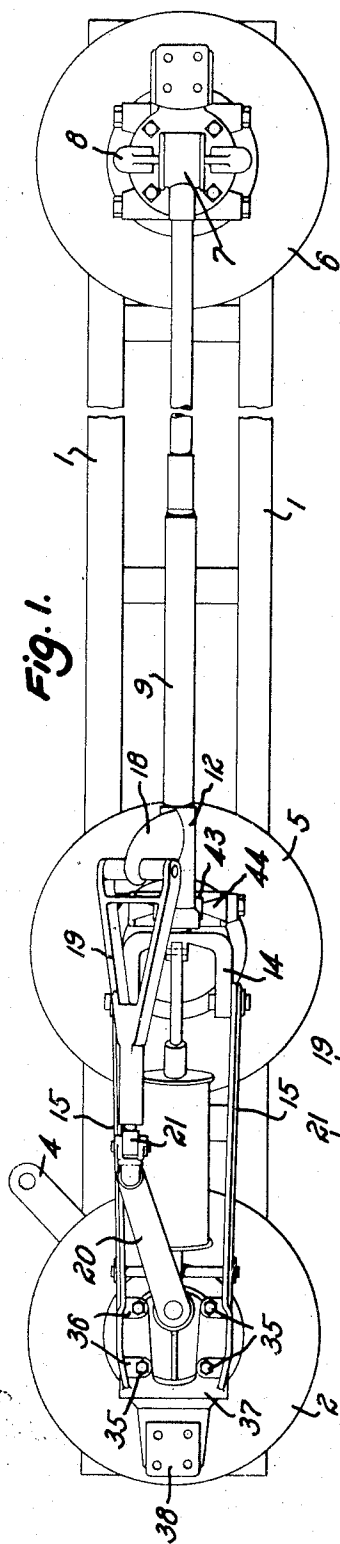
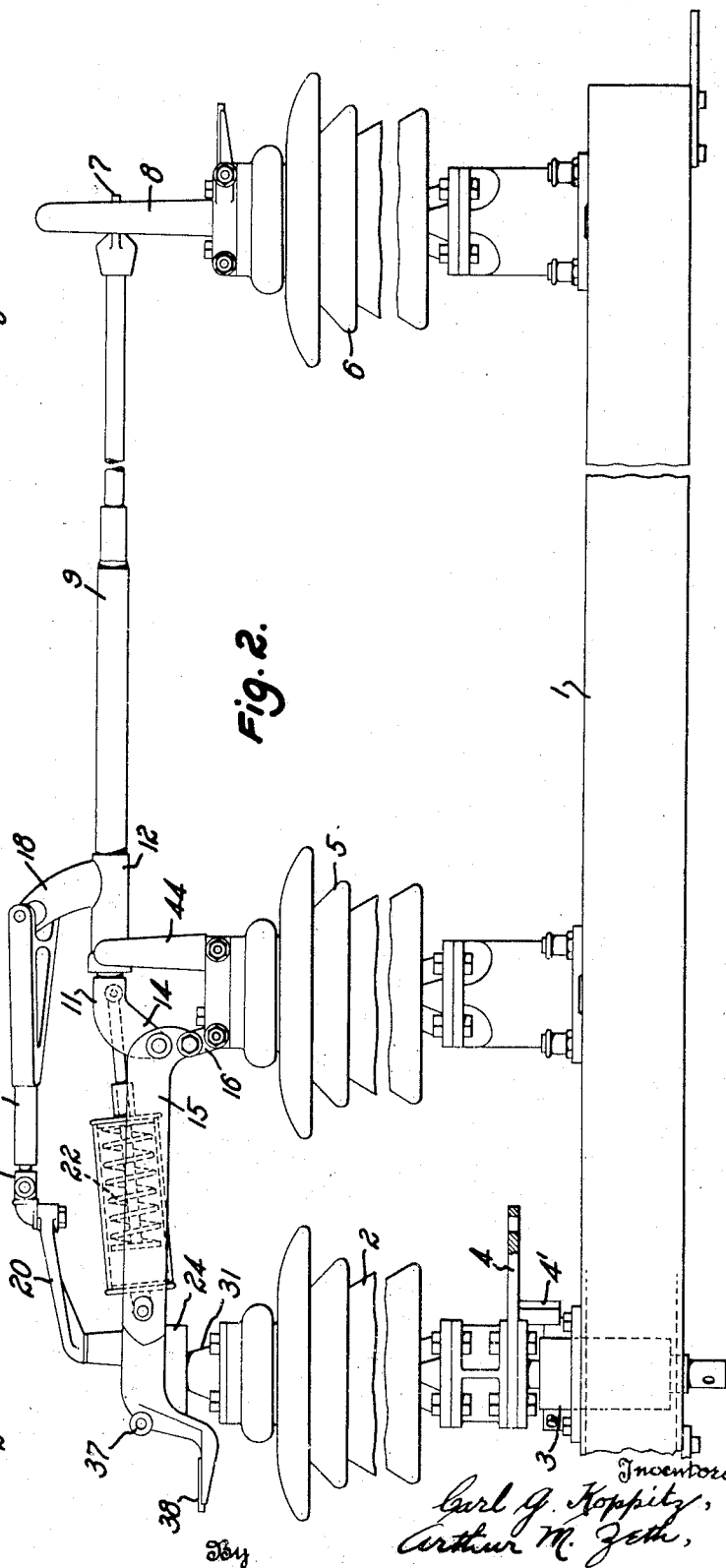


Fig. 2.



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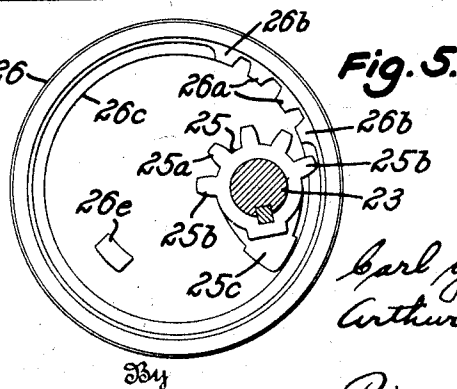
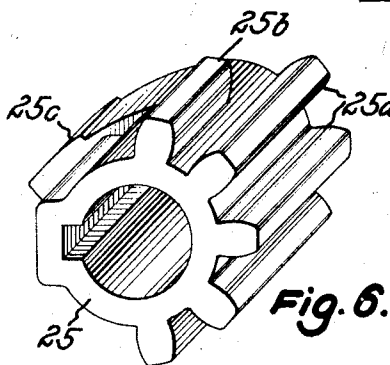
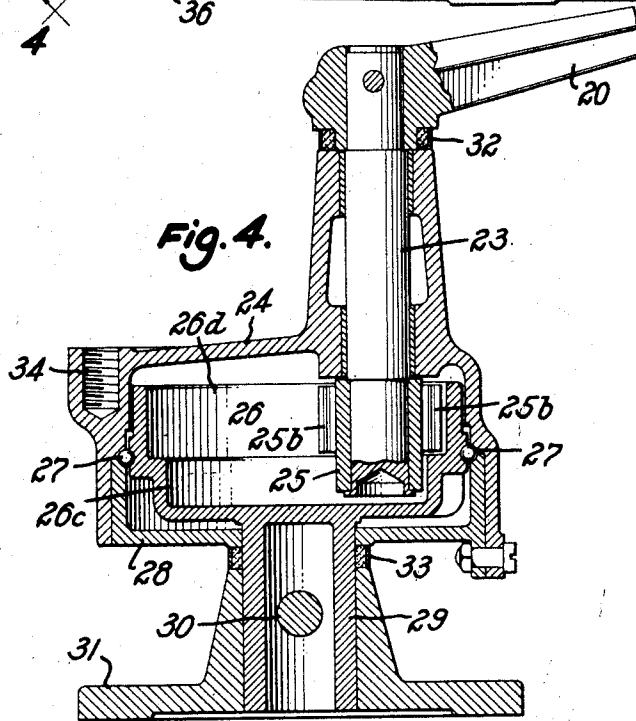
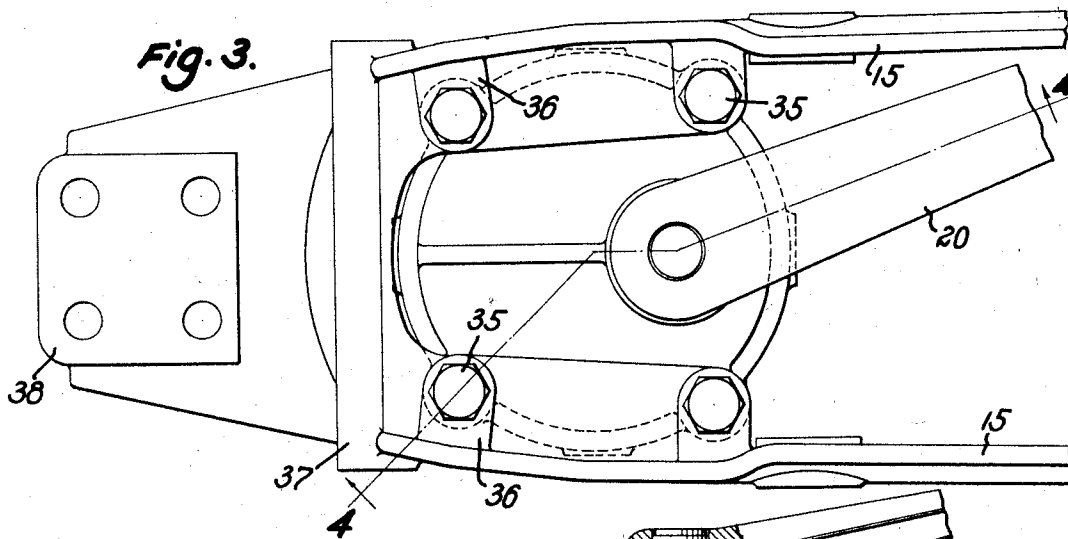
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4 Sheets-Sheet 2



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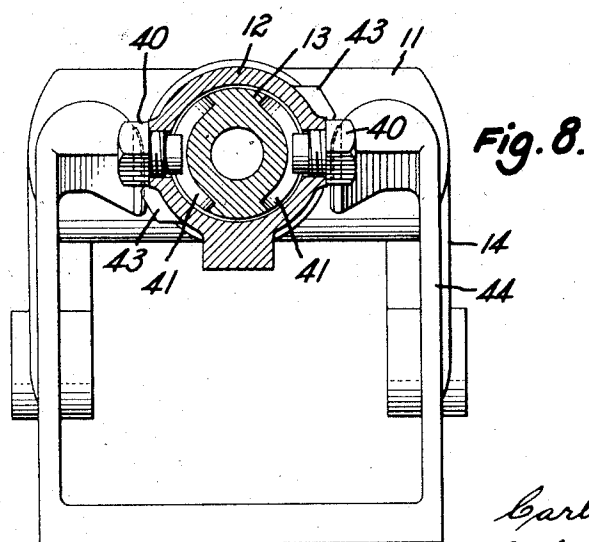
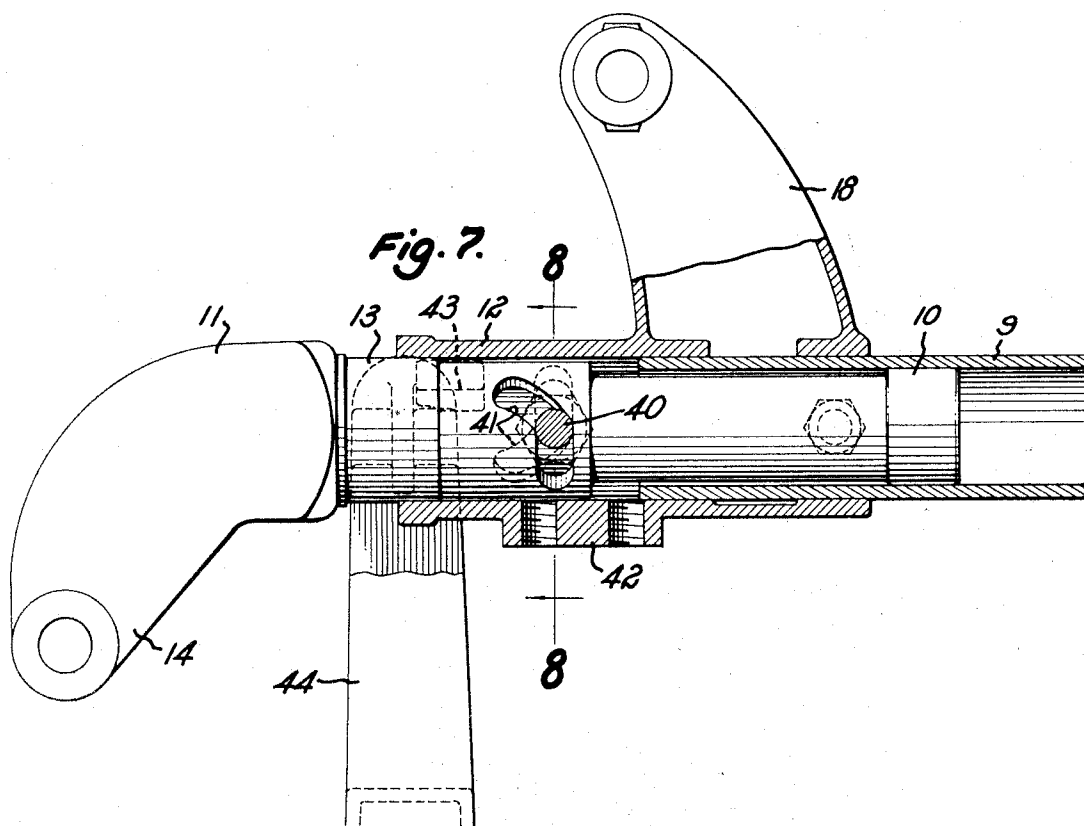
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DISCONNECT SWITCH

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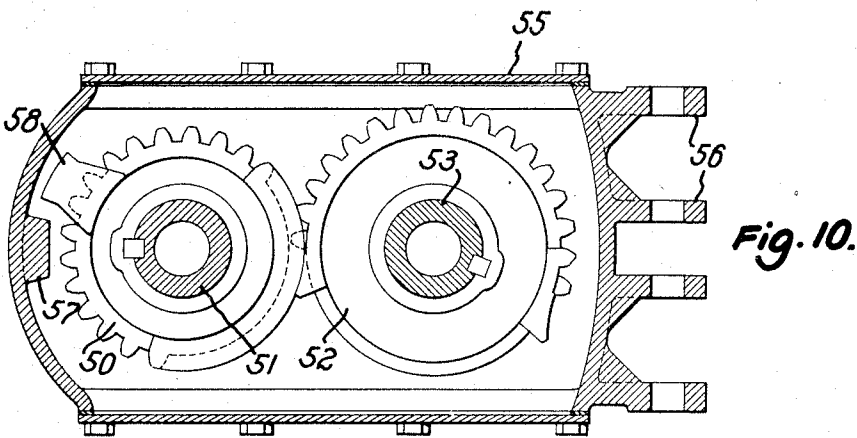
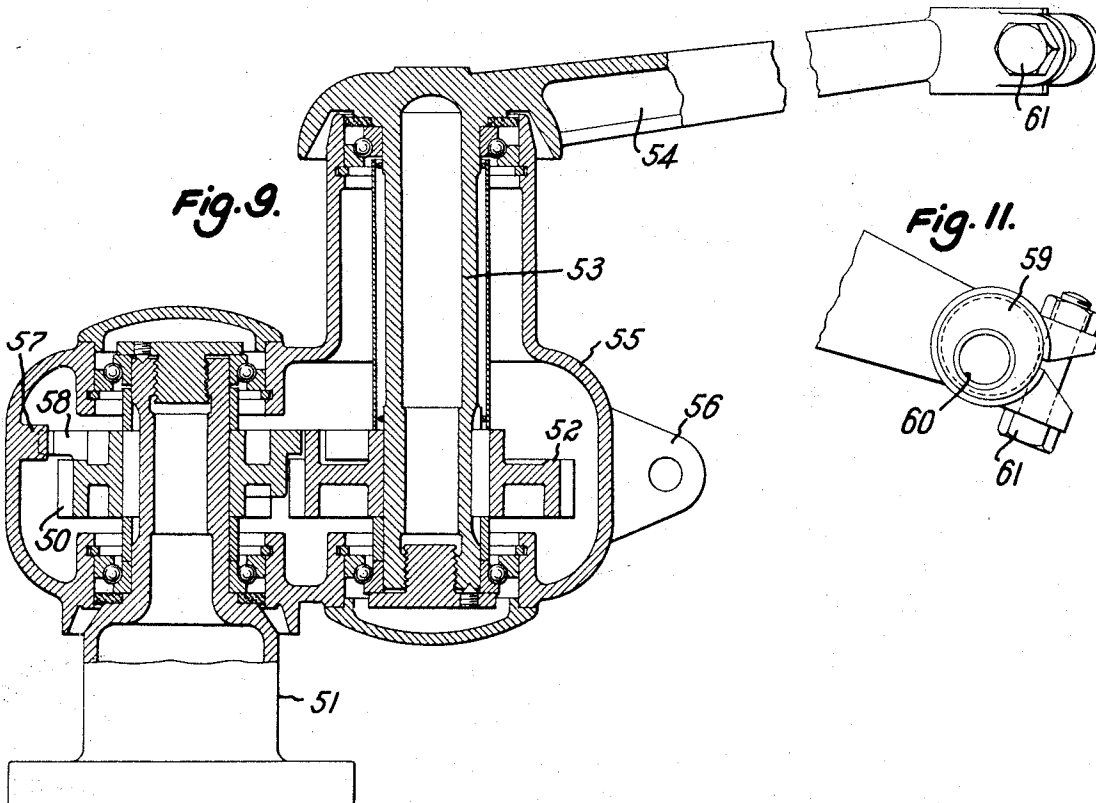
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DISCONNECT SWITCH

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UNITED STATES PATENT OFFICE

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DISCONNECT SWITCH

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12 Claims. (Cl. 200—48)

This invention to disconnect switches and more particularly to switches of the type in which two distinct movements are imparted to the switch members to move the blade into proximity to the jaw and then to effect a high pressure contact engagement of the blade and jaw.

Various mechanisms have been devised to produce the two distinctive movements of the switch elements from the angular movement of a single switch operating member and, when properly adjusted, the prior switch operating mechanisms have proved quite satisfactory. Considerable time and care have been required to adjust the mechanisms to insure the full range of movement of the switch members between their end positions, and the ganging of the disconnect switches of a three-phase power line has increased the difficulties in assembly and adjustment of the mechanical linkages of the several disconnect switches.

An object of the present invention is to provide a disconnect switch in which the operating mechanism has a range of overtravel, in one or both of its directions of movement, that insures a full range movement of the switch members to effect the intended opening and closing movements of the disconnect switch. An object is to provide a disconnect switch in which the movable linkage of the switch is coupled to its rotatable operating member through an interrupted gear that permits an appreciable angular displacement of the operating member after the movable linkage has reached its end positions corresponding to an open or alternatively a closed condition of the disconnect switch. More specifically, objects of the invention are to provide disconnect switches of the stated interrupted gear type in which the gear system is supported at the high potential end of an insulator column or pillar that is rotated to open and to close the switch; the insulator column or pillar having the driving gear secured thereto, and the gear system being either of the internal or the spur gear type and housed within a casing that is supported, in part, by the rotatable insulator column or pillar. A further object of the invention is to provide a disconnect switch of the type in which a blade is first turned angularly to locate its contact end within a switch jaw and, thereafter, a portion of the blade is rotated about the blade axis for wedging engagement in the switch jaw, the rotatable portion of the switch blade having contact sections at its hinge end for engagement with parts of the blade supporting element to produce a low resistance connection that eliminates the need of

the conventional flexible jumper connection between the hinged blade and its supporting element. Another object is to provide a disconnect switch of the type in which the switch blade comprises telescoped and relatively rotatable members, one blade member being pivotally supported for angular movement of the blade and the other blade member being pivotally connected with substantially no lost motion to a crank arm having an axis spaced from the pivotal axis of the blade, whereby angular movement of the crank arm imparts an axial movement to the rotatable member of the switch blade when the latter is moved angularly by the crank arm.

These and other objects and advantages will be apparent from the following specification when taken with the accompanying drawings in which:

Figs. 1 and 2 are fragmentary plan and side elevation views, respectively, of a disconnect switch embodying the invention;

Fig. 3 is a fragmentary plan view, on a larger scale, of the mechanism at the top of the rotating insulator column;

Fig. 4 is a sectional view of the same as seen on the vertical planes of the section line 4—4 of Fig. 3;

Fig. 5 is a plan view of the interrupted gear system;

Fig. 6 is a perspective view of the driven gear member;

Fig. 7 is an enlarged side elevation, with parts shown in section, of the hinge end of the switch blade and its associated current conducting jaw;

Fig. 8 is a transverse section through the same on the plane of the section line 8—8 of Fig. 7;

Fig. 9 is a fragmentary vertical section through a switch operating mechanism including an interrupted gear drive of the spur gear type;

Fig. 10 is a transverse section through the gear box; and

Fig. 11 is a fragmentary plan view of the adjustable connector at the outer end of the crank arm.

In the drawings, the reference numeral 1 identifies the grounded steel frame upon which the insulator column 2 is supported, by a bearing 3, for rotation by a crank arm 4 through a preselected angle that is determined by a stop 4' on the crank arm and the usual adjustable stops, not shown, on the frame 1 or the bearing 3. Insulator columns 5, 6 are rigidly mounted upon the frame 1 and carry, respectively, the pivoted switch blade that terminates in a flattened contact 7, and the switch jaw 8. The inner tubular

end of the elongated blade member 9 is telescoped over the reduced diameter outer end 10 of the stem of the hinge member 11 of the blade (see Fig. 7), and a trunnion member 12 is secured to the member 9 and supported for rotary and axial movement on the enlarged diameter intermediate section 13 of the hinge member. The forked inner end 14 of the hinge member is pivotally mounted on the side bars 15 of a bifurcated casting that is bolted to the cap 16 at the top of the fixed insulator column 5. A T-shaped lateral extension 18 of the trunnion 12 is pivotally connected to the yoke end of a link 19 that, in turn, is pivotally connected to the crank 20 by a universal joint 21. A compression spring 22 is connected between the hinge member 11 of the blade and the arms 15 to reduce the force that must be applied to the crank 20 to lift the switch blade into open circuit position.

The prior practice has been to secure the crank 20 rigidly to the insulator column 2 but, in accordance with this invention, the crank 20 is connected to the rotatable insulator column 2 through an interrupted gear system that permits overtravel of the insulator column after the switch blade has reached one or both of its end positions. As shown in Fig. 4, the crank 20 is mounted on shaft 23 that is journaled in the cover section 24 of a gear box and that carries, at its lower end, the driven member 25 of an internal, interrupted gear system. The outer, driver gear member 26 is rotatably mounted on ball bearings 27 in a race formed at the upper edge of the lower gear box section 28 that telescopes within the cover section 24. The tubular drive stem 29 of the crown gear 26 is secured, by a pin 30, within the bore of a casting 31 that is bolted to the top of the insulator column 2. Washers or gaskets 32, 33 are arranged at the upper and lower faces of the gear box to seal the openings through which the driven shaft 23 and the drive stem 29 extend. The upper gear box section 24 has threaded openings 34 to receive studs 35 that secure the gear box to, and beneath, the lugs 36 of the side bars 15 that, as described above, are bolted to the cap 16 of the fixed insulator column 5. The ends of the side bars 15 are joined by an integral section 37 that terminates in an apertured flange 38 to which a line conductor may be secured.

The drive member 26 of the interrupted gear system has a limited number of full length driving teeth 26a between a pair of shorter guide teeth 26b that extend above the lower section 26c which has an internal diameter equal to the addendum circle diameter of the teeth 26a, 26b. The upper section 26d of the driving gear 26 has an internal diameter equal to the root circle diameter of the teeth. The driven gear 25 has full length teeth 25a, in number equal to the spaces between the full length teeth 26a of the driver gear, between a pair of shorter guide teeth 25b that align transversely with the larger diameter section 26d of the driver gear. The driven gear also has a lower guide section 25c with opposite sides of the same curvature as the reduced diameter section 26c of the driver gear, for engagement with the driver gear section 26c when the driver gear is rotated in either direction beyond the range of driving engagement of the gear members 25, 26. A stop lug 26e preferably extends above the transverse wall of the driver gear 26 to limit the relative angular movement of the gear members before the operating mechanism is

assembled with the disconnect switch on the frame 1. The stop 4' on the crank arm 4 prevents an inadvertent excess rotation of the gear members after the switch mechanism is assembled.

The interrupted gear system may be designed for a desired degree of overtravel of the primary switch operator, i. e. the crank arm 4 and insulator column 2, to compensate for those variations in size and relative locations that are to be expected in the manufacture and assembly of a disconnect switch. The overtravel is particularly helpful in the ganging of several switches for actuation of the crank arms 4 from a single manually or motor operated linkage. The overtravel of the primary switch operator at the end of a switch-closing operation has the further advantage of reducing the power required for the opening of the switch. The insulating column can be set in motion by the application of a relatively small force to the crank arm 4, and the kinetic energy of the rotating insulator column is available to impart a sharp blow to the crank 20 upon the initial meshing of the interrupted gear members.

Angular movement of the crank 20 during a switch closing operation imparts a swinging movement to the switch blade until the contact element 7 enters the switch jaw 8, and then rotates the blade section 9 about the blade axis to wedge the contact element 7 across the switch jaw. The final closed position of the disconnect switch is illustrated in Figs. 1 to 5 inclusive. The blade section 9 is positively guided for movement axially of the hinge blade section 11 by studs 40 on the trunnion 12 that extend into slots 41 of the intermediate section 13 of the hinge member. The switch blade elements are illustrated in Figs. 7 and 8 in the positions corresponding to an axial alignment of the link 19 and the crank 20, i. e. after a partial rotation of the blade section 9 and its contact 7 during a switch closing or switch opening operation. Assuming that the switch is being closed, the further angular movement of the insulator column 2 will effect a counterclockwise movement of the trunnion 12, Fig. 8. The earlier angular movement of the trunnion 12 did not effect an axial movement of the blade section 9 since the initial portion of the guide groove 41 lies in a plane normal to the axis of the hinge element 11. The further movement of the operating mechanism carries the studs 40 into the helical sections of the guide grooves 41, and thus results in an axial movement of the blade section 9 towards the hinge section 11. This axial movement may be employed to advantage to eliminate the customary flexible shunts that are connected between the threaded extensions 42 of the trunnion and the hinge insulator cap 16. Diametrically opposed contact lugs 43 are formed on the trunnion 12 for engagement with a jaw member 44 that is bolted to the insulator cap 16.

The method of operation of the described apparatus is, in general, similar to that of prior disconnect switches in which the crank was fixed to the rotatable insulator column 2. Angular motion imparted to the column 2 by the crank arm 4 operates, through the interrupted gear system, to rotate the crank 20 to impart the desired switch closing or switch opening movements to the switch blade. The interrupted gear system permits an overtravel of the insulator column after the switch blade has reached its alternative final positions, and thereby eliminates

the necessity for a close adjustment of the travel of the switch operating column 2. This overtravel facilitates the ganging of the several disconnect switches of a three-phase transmission line as any variations in the alinement of the movements of the switch blades may be compensated by corresponding variations in the extent of overtravel of the operating mechanisms of the several switches.

The interrupted gears for obtaining an overtravel of the operating mechanism may be of the spur gear type, as shown in Figs. 9 and 10, in which the driver gear 50 is mounted on a shaft member 51 that is fixed to the rotatable insulator column 2, and meshes with a driven gear 52 on a shaft 53 that is integral with or carries a crank arm 54. The gear box 55 is supported, in part, by the shaft member 51 and has lugs 56 for connection by links, not shown, to the cap of the insulator column that provides the hinge support for the switch blade. The gear casing preferably has an internal lug 57 for co-operation with a stop projection 58 on the driver gear 50 to limit the rotation of the gear 50 before the gear system is incorporated in the disconnect switch.

As shown in Figs. 9 and 11, the crank arm 54 preferably terminates in a bifurcated socket for receiving a coupling member 59 with an eccentrically arranged opening 60 for receiving an end member of the universal joint that is connected at its opposite end to the link 19. The coupling member 59 may be adjusted angularly to alter the effective length of the crank arm 54, and may be clamped in adjusted position by the bolt 61.

It is to be understood that the described constructions are illustrative of the invention, and that various changes may be made in the elements of the operating mechanism without departure from the spirit of our invention as set forth in the following claims.

We claim:

1. In a single-pole disconnecting switch adapted to be ganged with similar switches for use on a multi-phase power line, a frame structure, an insulator column mounted on said structure for rotation about its axis, a stationary insulator column secured to said structure and parallel to said first column, hinge terminal means mounted on said insulator columns, a switch blade, means pivotally supporting said blade on said hinge terminal means for angular movement about an axis normal to the axis of said rotatable insulator column, and means including said rotatable insulator column for operating said blade; said operating means comprising a crank rotatable on an axis parallel to the axis of said rotatable insulator column, means connecting said blade to said crank for actuation thereby, an interrupted gear system mechanically connecting said rotatable insulator column to said crank, and an operator arm secured to said rotatable insulator column for imparting rotation thereto to actuate said blade; said interrupted gear system permitting overtravel of said rotatable insulator column at the completion of a blade-operating movement of said crank, thereby to facilitate the mechanical connection of the operating arms of associated switches for gang operation.

2. In a disconnecting switch, the invention as recited in claim 1 wherein said gear system includes a driver gear secured to said rotatable insulator column, a driven gear on a shaft carrying said crank, and a gear box enclosing said gears and supported by said insulator columns.

3. In a disconnecting switch, the invention as

recited in claim 1 wherein said gear system includes a crown gear secured to said rotatable insulator column, a driven gear within said crown gear and on a shaft carrying said crank, and a gear box enclosing said gears and supported by said insulator columns.

4. In a disconnecting switch, the invention as recited in claim 1 wherein said gear system includes a spur driver gear secured to said rotatable insulator column, a spur driven gear on a shaft carrying said crank, and a gear box enclosing said gears and supported by said insulator columns.

5. In a disconnecting switch, an insulator column, a switch jaw terminal mounted on said insulator column, hinge terminal means, insulating means supporting said hinge terminal means and including a stationary and a rotatable insulator column spaced laterally from and parallel to said first insulator column, a switch blade assembly pivotally mounted on said hinge terminal assembly, a crank rotatable on an axis normal to the pivotal axis of said blade assembly, means connecting said blade assembly to said crank for operation thereby, and an interrupted gear system mechanically coupling said rotatable insulator column to said crank to impart angular motion thereto; said gear system including a driver gear secured to the rotatable insulator column, a driven gear on a shaft carrying said crank, and a gear box enclosing said gears and supported on said hinge terminal means.

6. In a disconnect switch, a switch jaw, a switch blade, means including a crank and a rotatable insulator column for moving said blade between its end positions upon a predetermined angular movement of said crank, means including said rotatable insulator column and a plurality of fixed insulator columns supporting said switch jaw and switch blade, a grounded support carrying said insulator columns, said rotatable insulator column being mounted for rotation through an angle greater than the angular movement of said crank, and an interrupted gear mechanism mounted on said supporting means and coupling said rotatable insulator column to said crank whereby said rotatable insulator column may rotate after said crank has reached one of its end positions corresponding to an end position of said switch blade.

7. In a disconnect switch, a plurality of parallel insulator columns, cooperating terminal means mounted on spaced insulator columns and each including a jaw member, a blade assembly pivotally supported on one terminal means for angular movement into engagement with or alternatively into a position spaced from said jaw members, said blade assembly including a hinge section pivoted upon the associated terminal means and a blade section supported on said hinge section for a rotary movement about its axis, operating means for imparting angular movement to said blade assembly and rotary movement to said blade section at the end of a switch closing movement and at the beginning of a switch opening movement of said blade assembly, and contact means on said blade section for engagement with the respective jaw members when said switch is closed.

8. A disconnect switch of the type including cooperating terminal means, a blade assembly pivotally supported on one terminal means, operating means for imparting angular movement to said blade assembly and rotary motion to a blade section thereof at the end of a switch closing

ing movement and at the beginning of a switch opening movement, and a jaw member on the other terminal means for engagement by said blade section; characterized by the fact that said first terminal means includes a jaw member positioned to receive said blade section at the end of the angular movement of said blade assembly into switch closing position, and said blade section has a contact portion for engagement with the jaw member of the terminal means on which said blade assembly is pivotally supported, thereby to render unnecessary a jumper connection from said blade section to the terminal means supporting said blade assembly.

9. In a disconnect switch, a fixed and a rotatable insulator column in spaced parallel relation, terminal means mounted on said insulator columns, a blade assembly pivotally mounted on said terminal means, said blade assembly including a hinge section and a blade section mounted thereon for rotary movement on its own axis, operating means including said rotatable insulator column for imparting angular movement to said blade assembly and rotary movement to the blade section thereof, contact means on said blade assembly for engagement with a cooperating switch jaw, a jaw member on said terminal means, and contact means on said blade section for engagement with said jaw member upon a switch closing operation.

10. In a disconnect switch, a pivoted switch blade comprising a hinge section and a contact section telescoped over said hinge section for rotation about and displacement along the axis of the blade section, operating means for imparting pivotal movement to said switch blade and rotary movement to said contact section, and cooperating guide means carried by said blade sections for imparting axial movement to said contact section upon rotation thereof.

11. In a disconnect switch, the invention as set forth in claim 10, wherein said contact section has contact means for engagement with a stationary contact adjacent the pivot of said blade upon axial movement of the contact section during a switch-closing movement of said operating means.

12. In a disconnect switch, a switch blade comprising a contact section telescoped over the stem of a hinge section, said stem having a guide groove including a helically arranged portion, a stud on said contact section and extending into said guide groove, and operating means for imparting pivotal movement to the blade as a whole and rotary movement about the axis of said stem to said contact section, whereby axial movement of said contact section on said stem is effected by said guide groove and stud.

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