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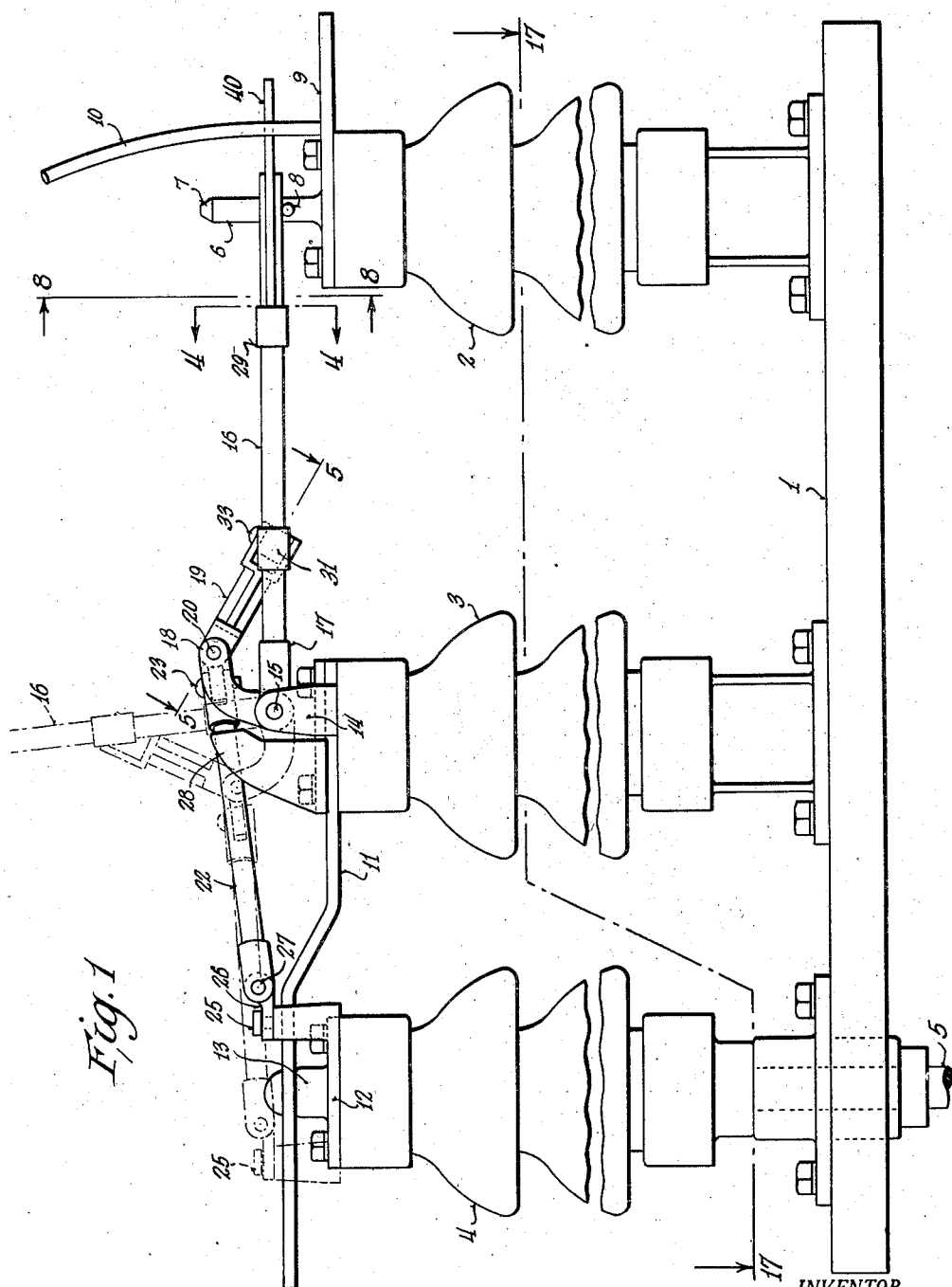
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2,431,147

SWITCH CONSTRUCTION

Filed Sept. 4, 1943

6 Sheets-Sheet 1



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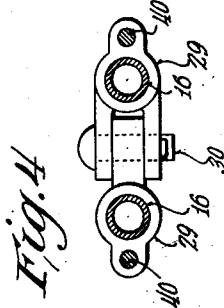
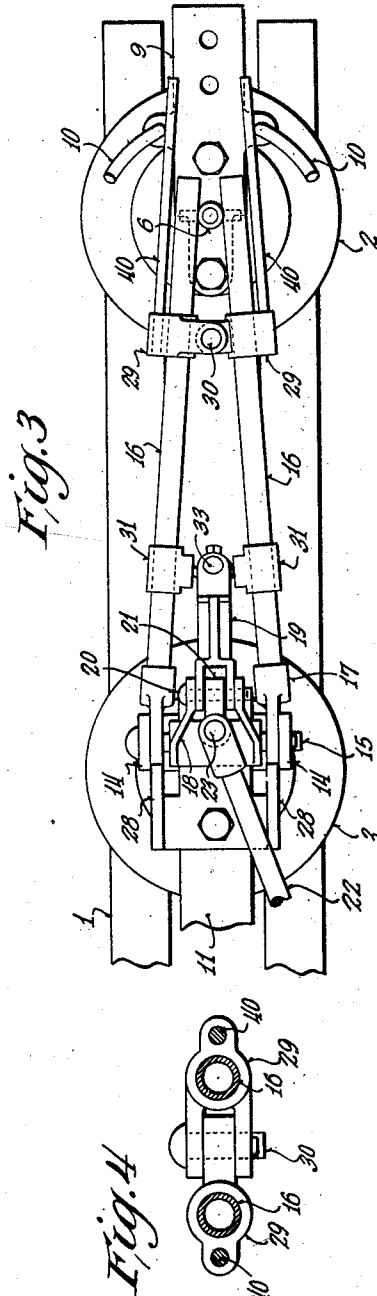
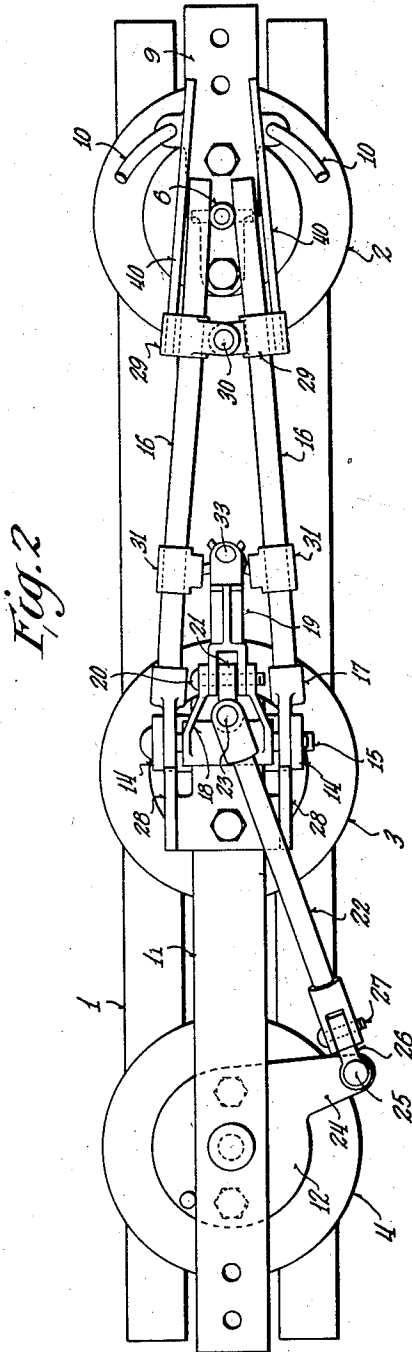
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SWITCH CONSTRUCTION

Filed Sept. 4, 1943

6 Sheets-Sheet 2



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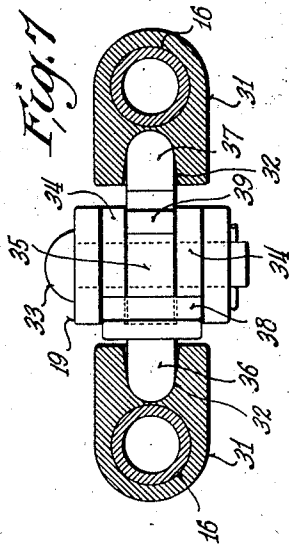
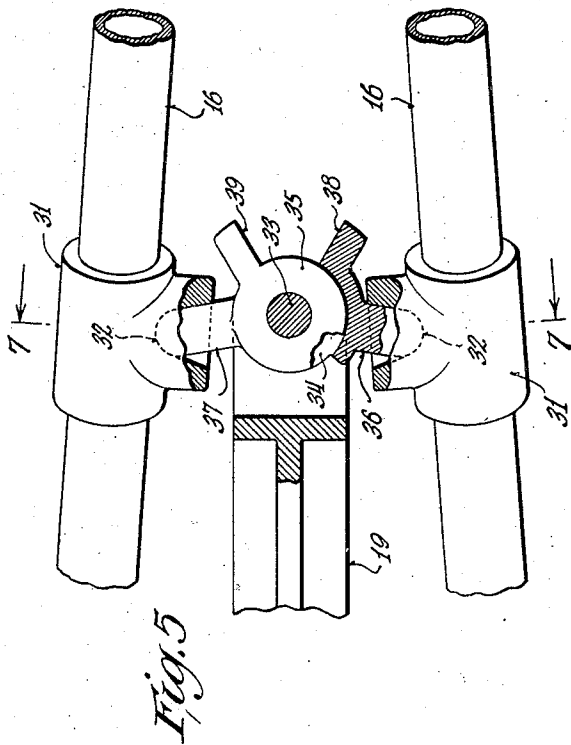
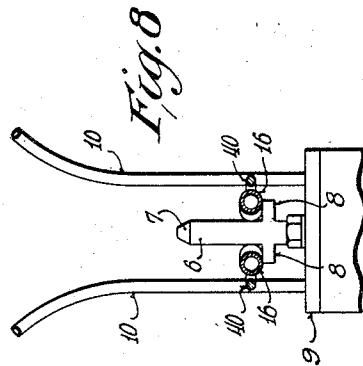
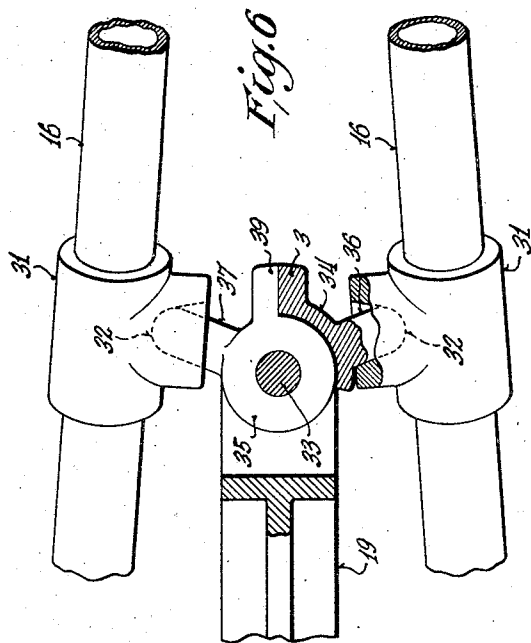
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SWITCH CONSTRUCTION

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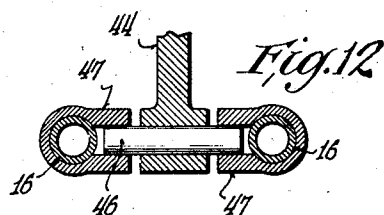
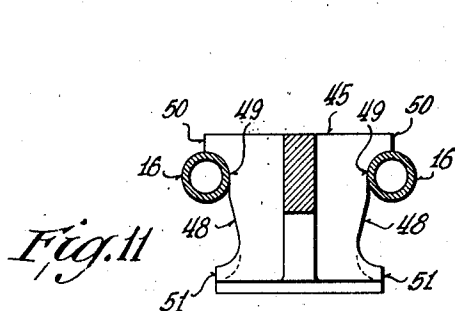
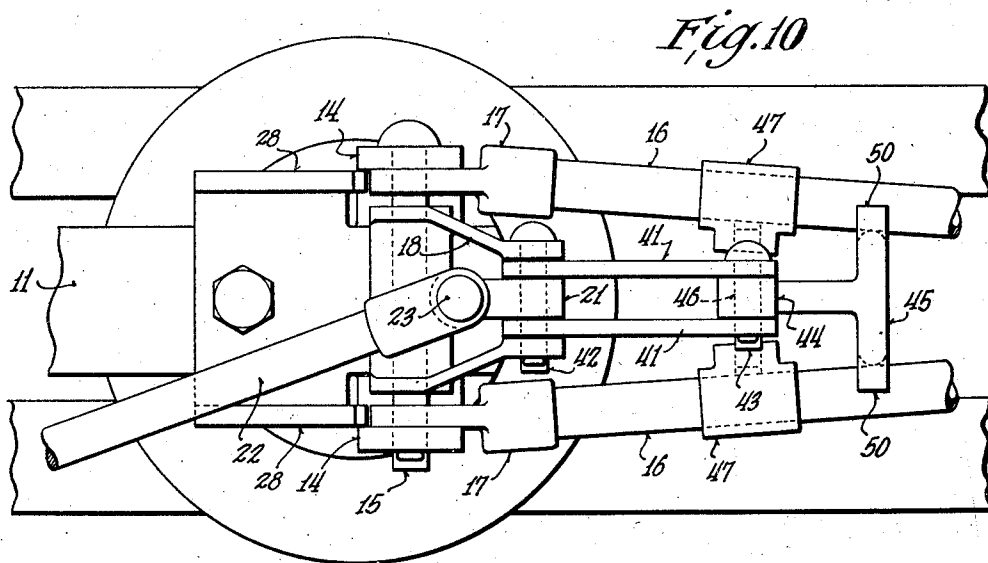
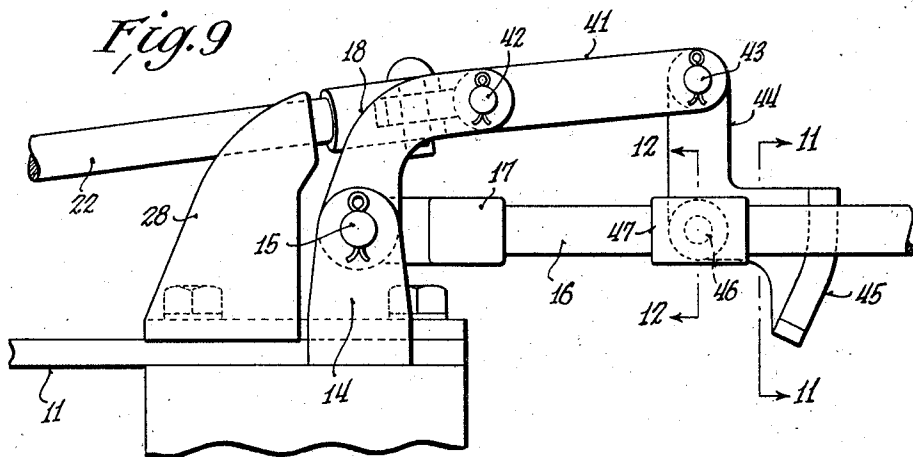
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SWITCH CONSTRUCTION

Filed Sept. 4, 1943

6 Sheets-Sheet 4



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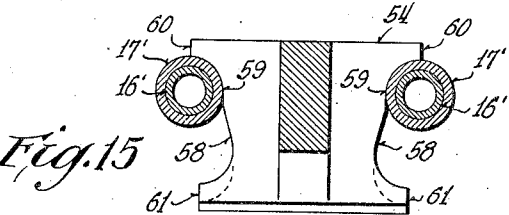
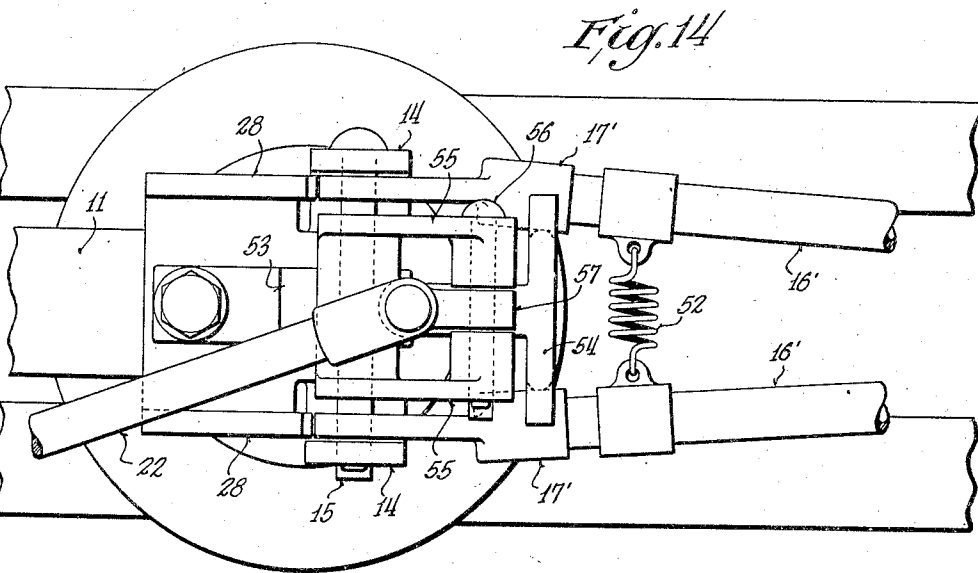
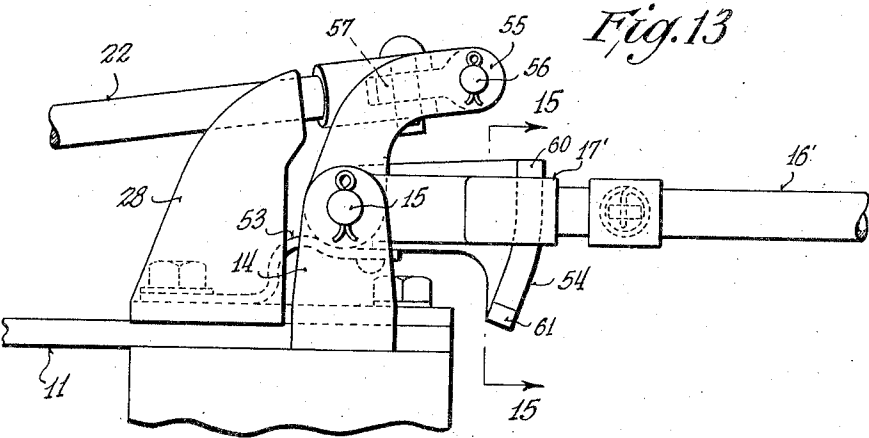
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SWITCH CONSTRUCTION

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SWITCH CONSTRUCTION

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Fig. 16

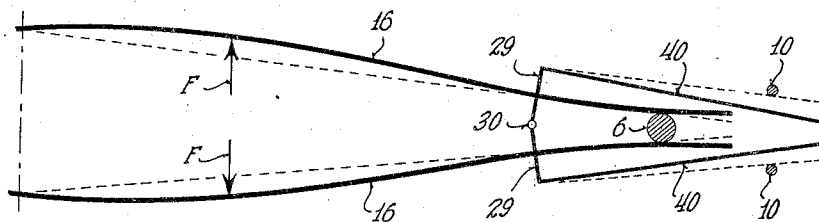
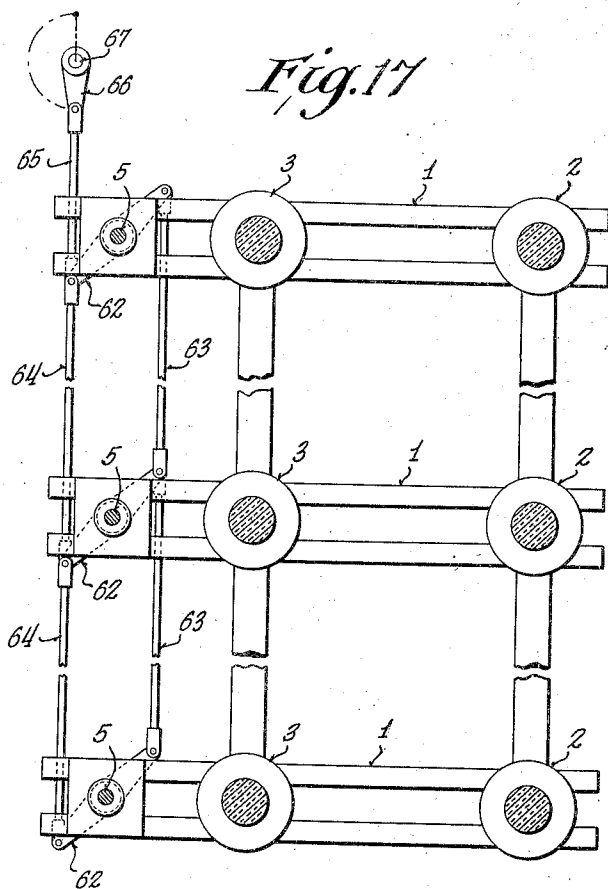


Fig. 17



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UNITED STATES PATENT OFFICE

2,431,147

SWITCH CONSTRUCTION

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Application September 4, 1943, Serial No. 501,233

6 Claims. (Cl. 200—48)

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This invention relates to a switch construction and is particularly directed to a high voltage switch such as a disconnecting switch for instance, although the invention is not limited to this type of switch.

Objects of this invention are to provide a construction which is applicable either to a single switch or to a gang type switch, in which a multiplicity of switch blades or switch members are provided and are adapted for simultaneous actuation.

Further objects are to provide a switch construction in which the parts are carried by insulator stacks, and in which the construction is such that the insulator stacks are not strained by stresses tending to draw them together or force them apart, in which the switch arm may be as long as desired and may be constructed of tubular stock, whereby its weight may be reduced, or, if desired, may be constructed from rod or other stock material, in which a high contact pressure is secured between the stationary contact means and the movable contact means when the switch is closed, in which this high pressure is relieved prior to opening of the switch, and in which the component parts of the arcing horns are kept out of contact when the switch is closed, thereby lessening the chance of the arcing horns freezing tight under sleet conditions, and in which a certain portion of the arcing horn construction is moved into contact with the remaining portion of the arcing horn construction during opening motion of the switch.

Further objects are to provide a switch having a pivoted switch arm construction, certain forms of the invention being provided with resilient switch arms and with mechanism which not only secures high contact pressure between the movable and stationary contacts, but also secures high contact pressure at the pivoted portions of the switch, thereby avoiding the necessity of using a flexible leader when flexible switch arms are used, the invention, however, permitting the use of rigid switch arms and a flexible jumper or leader at the pivoted end of the switch when rigid switch arms are used.

Further objects are to provide a switch construction in which cylindrical switch members preferably of tubular form are employed and in which a high contact pressure on a stationary contact is obtained at opposed points on the stationary contact so that the pressures are balanced and no external stresses are imparted to any other portions of the mechanism.

In greater detail, objects of this invention are

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to provide tubular main switch members which grip between them a cylindrical stationary contact member, thereby obtaining small area, high pressure contacting portions, the movable contacts extending transversely across the stationary contact when the switch is closed.

Further objects are to provide a construction in which it is not necessary to employ any latches to insure the correct sequence of operation of the parts, but in which very simple mechanisms are provided for insuring the correct sequence of operations of the switch parts, and in which in certain forms of the invention the inherent resiliency of the switch arms is utilized and in another form of the invention in which relatively rigid switch arms are used while still obtaining the desired heavy contact pressure between the stationary and movable contacts and the correct sequence of operations.

Further objects are to provide a construction in which the switch arm portion is so made that it is laterally braced, in which the parts cooperate to insure correct centering or positioning of the movable contacts when the switch arm is rocked to closed position and to provide a construction which is very simple, which is highly reliable in operation, and which is economical to manufacture.

Embodiments of the invention are shown in the accompanying drawings, in which:

Figure 1 is a side elevation, partly broken away, showing one form of switch construction, the switch being shown in full lines in closed position and in dotted lines in open position.

Figure 2 is a plan view of the structure shown in Figure 1, showing the switch in closed position with heavy contact pressure applied.

Figure 3 is a view corresponding to Figure 1, partly broken away, showing the switch closed but without the heavy contact pressure applied.

Figure 4 is a sectional view on the line 4—4 of Figure 1.

Figure 5 is an enlarged fragmentary view, partly in section, taken along the line 5—5 of Figure 1.

Figure 6 is a view corresponding to Figure 5 showing the position of the parts when the heavy contact pressure is relieved.

Figure 7 is a sectional view on the line 7—7 of Figure 5.

Figure 8 is a sectional view on the line 8—8 of Figure 1.

Figure 9 is a fragmentary view showing a further form of the invention.

Figure 10 is a fragmentary plan view of the structure shown in Figure 9.

Figure 11 is a sectional view on the line 11—11 of Figure 9.

Figure 12 is a sectional view on the line 12—12 of Figure 9.

Figure 13 is a fragmentary view of a further form of the invention.

Figure 14 is a fragmentary plan view of the structure shown in Figure 13.

Figure 15 is a sectional view on the line 15—15 of Figure 13.

Figure 16 is a diagrammatic view very much exaggerated showing the lines of flexure of the switch arms.

Figure 17 is a sectional view showing a gang switch, such section corresponding to a section on the line 17—17 of Figure 1.

Referring to Figures 1 to 8, it will be seen that the switch comprises a base 1 which supports three stacks of insulators indicated by the reference characters 2, 3 and 4. The stack 4 is revolvably mounted and is rotated by means of a shaft 5 or in any other suitable manner. The switch is shown as a single switch but, as will appear hereinafter, it is the usual practice to mount a plurality of switches and operate them as a gang switch.

The insulator 2 carries a stationary contact which may be in the form of an upstanding cylindrical pin 6 which has a tapered upper portion 7 and a pair of outwardly projecting stop pins 8 to arrest the downward motion of the movable contacts of the switch as will appear hereinafter. The pin 6 is rigidly mounted on a terminal 9 and the terminal carries a pair of flaring arc horns 10. The insulator stack 3 rigidly carries a terminal 11. The terminal 11 is also supported from the insulator stack 4, such stack having an upper member 12 provided with an upstanding portion 13 which is revolvable within the terminal 11, the terminal 11 thereby forming a brace between the insular stacks 3 and 4.

A pair of pivot supports 14 are rigid with the terminal 11 and are supported from the insulator stack 3. These pivot supports carry the pivot pin 15 about which the switch arms 16 rock when the switch is opened and closed. The inner faces of the pivot support means constitute contact faces as will hereinafter appear.

The switch arms 16 are tubular and are preferably formed of copper or other good conducting material. They may be flattened at their pivoted ends or may, as shown in the drawings, be provided with end portions 17 which are directly pivoted on the pin 15. An idler link 18 is pivotally mounted on the pin 15 and is pivoted to a connecting link 19 by means of a pivot pin 20, the link 19 being operatively connected to the switch arms 16 for raising and lowering the switch arms as will hereinafter appear. An intermediate link 21 is also pivoted on the pin 20 and is pivoted to the connecting link 22 by means of a pivot pin 23. It is to be noted that the pivot pins 20 and 23 are at right angles to each other and that the construction thus provides a universal joint.

An operating crank 24 forms a rigid part of the upper member 12 of the insulator stack 4 and is provided with a crank pin 25 which carries an intermediate link 26. The intermediate link 26 is pivoted to the connecting rod 22 by means of the pivot pin 27, it being noted that the pivot pin 27 is at right angles to the crank pin 25 and the construction thus forms a universal joint. It is apparent, therefore, that when the insulator

stack 4 is rotated in a clockwise direction as viewed in Figure 2, the switch arms will be raised to the dotted line position shown in Figure 1. It is to be noted from Figure 1 that a pair of stops 28 are rigidly supported from the insulator stack 3 and provide means for arresting the switch arms in a slightly over center position when they are fully raised.

The switch arms 16 are resilient and this resiliency is utilized in securing a binding engagement or heavy contact pressure between the outer ends of the switch arms 16 and the stationary contact or pin 6 and also in securing a heavy contact pressure between the pivoted end portions 17 of the switch arms and the ears or pivot supports 14. A pair of members 29 are rigidly secured to the switch arms at a point spaced inwardly from their outer ends and are pivotally joined by means of the pin 30. These members 29 constitute tie members and tie the switch arms together at this point. These tie members, therefore, constitute means for maintaining substantially constant spacing of the arms at a point spaced inwardly from their outer ends. In addition to this, these tie members constitute means for preventing relative longitudinal motion of the arms. It is also to be noted that the main pivot 15 also prevents relative longitudinal shifting of the arms. In addition to this, the main pivot and the tie means coacting with the arms produces a laterally braced truss like structure.

The arms are also provided with a pair of socket members 31 which are rigidly attached thereto at points spaced outwardly from the inner or pivot ends of the switch arms 16. These socket members are shown in greater detail in Figures 5, 6 and 7. They are each provided with inwardly directed sockets 32 which have rounded inner ends. The link 19 is bifurcated at its outer end and carries a pivot pin 23 upon which are pivoted a pair of members 34 and 35, the member 34 being bifurcated and receiving the member 35 between its two arms, as shown most clearly in Figure 7. The members 34 and 35 are respectively provided with outwardly projecting toggle members 36 and 37 which have rounded outer ends seating within the sockets 32. The members 34 and 35 also have stop projections 33 and 39 respectively which when the toggle mechanism is in its final expanded position as shown in Figure 5 are spaced apart, but which are arranged to contact when the toggle is in its most collapsed position as shown in Figure 6.

It is to be noted that when the toggle mechanism is in its most collapsed position as shown in Figures 3 and 6, the outer ends of the switch arms 16 do not have a heavy pressure engagement with the stationary contact 6. However, when the toggle link mechanism is in its expanded position as shown in Figures 2 and 5, the arms 16 are forced apart at the members 31 and in view of the fact that they are pivoted at 30, it will be seen that their outer ends engage the stationary contact 6 with a very heavy contact pressure. Also it will be seen that the members 17 are forced apart into heavy binding engagement with the pivot supports or ears 14.

It is to be noted from reference to Figures 5 and 6 that the outer sides of the sockets 32, that is to say, the walls of the sockets located towards the free end of the switch arms, are less steep than the rear walls of the sockets 32. This construction allows the toggle members 36 and 37 to be rocked slightly past dead center when the

switch is closed, as shown in Figures 2 and 5, to thus lock the switch in closed position with heavy binding pressure at the contacts. However, when the toggle is collapsed the rear walls of the sockets 32 are sufficiently angularly disposed to allow the toggle to collapse to a considerable extent to the position shown in Figure 6, thus allowing the members 31 to move inwardly and allowing the switch arms 16 to straighten themselves out due to their inherent resiliency.

It is to be noted from Figures 2 and 3 that the members 29 carry the movable elements 40 of the arcing horns. When the toggle mechanism is in its most expanded position, it will be seen that the movable arcing horns 40 are out of engagement with the stationary arcing horns 10. This is particularly desirable as under sleet conditions it prevents the arcing horns from freezing together. However, when it is desired to open the switch, the crank 24 is rocked in a clockwise direction and the first effect is to collapse the toggle mechanism and allow the switch arms 16 to straighten out to the position shown in Figure 3. When this occurs, the movable arcing horns 40 move outwardly into engagement with the stationary arcing horns 10 and this occurs prior to any raising motion of the switch arms 16. When the switch arms 16 straighten out, the heavy contact pressure against such pin is relieved and also the heavy contact pressure at the pivoted ends of the switch arms is relieved. It is thus a relatively easy matter to raise the switch by rotating the crank 24 in a clockwise direction.

When the switch is being lowered to close position, there is no chance of the parts jamming or operating in the wrong sequence. The weight of the switch arms pulls downwardly against the connecting link 19 and thus keeps the toggle mechanism in its most collapsed condition. As the switch is lowered, the arcing horns 40 first engage the outwardly flaring arcing horns 10 and serve to roughly guide the switch arms 16 into position on opposite sides of the stationary contact 6. They are additionally accurately guided into position by the tapered upper end 7 of the stationary contact 6, see Figure 1. The switch arms continue to descend until they rest upon the stop pins 8. Thereafter continued motion of the crank 24 in a counterclockwise direction as viewed in Figure 2 causes the toggle mechanism to expand and causes heavy contact pressure between the switch arms and the stationary contact 6 and also heavy contact pressure at the pivoted ends of the switch arms.

The diagrammatic view of Figure 16 shows in a very exaggerated manner the deflection of the switch arms 16 when the toggle link mechanism is fully expanded. The forces indicated by the arrows at F are directed outwardly and it will be seen that the switch arms 16 bow outwardly between the pivoted inner ends and the members 29 with the radius of curvature located inwardly of the arms. However, past the members 29 the switch arms bow in the reverse direction, that is to say, with the center of curvature on the outer side of the switch arms.

The toggle members 36 and 37 and the members 31 are made sufficiently heavy or strong so that the weight of the switch arms 16 when they are raised and lowered will be easily carried by such members while the link 19 raises or lowers the switch arms.

Referring to Figures 9 to 12 which show a further form of the invention, it is to be noted that the switch arms 16 are as previously described

and are provided with the end members 17 pivoted on the pivot pin 15 and supported by the pivot supports 14. The idler link 18 is pivotally connected to intermediate links 41 by means of the pivot pin 42. The outer end of the links 41 are pivoted by means of the pivot pin 43 to the upstanding arm 44 of a cam member indicated generally at 45. The cam member is pivotally mounted on a pivot pin 46 which is slidable and loosely received within socket members 47, see Figure 12, rigidly carried by the resilient switch arms 16. The cam member 45 is provided with upwardly and outwardly flaring or tapered portions 48 which are adapted to force the switch arms 16 apart when the cam member 45 is rocked downwardly to the position shown in Figures 9 and 11. It is preferable to provide flat portions or parallel portions 49 at the upper portion of the cam surface so as to tend to lock the switch arms 16 in their outwardly pressed position as shown in Figures 9 and 11. The cam member 45 is provided with upper and lower stops or outwardly projecting portions 50 and 51 respectively. When the switch is opened, it is apparent that when the crank 12 is rotating, link 22 will be drawn to the left as viewed in Figures 9 and 10 and will draw the links 41 to the left and thus rock the cam member 45 in a counterclockwise direction. The cam will continue to move upwardly, thus allowing the switch arms 16 to resume their original straight shape until the lower stops 51 of the cam member 45, see Figure 11, come into engagement with the switch arms 16. The switch arms are now fully collapsed and are lifted by the cam member upon continued operation of the crank.

There is no chance of jamming when the switch is being closed as there is no danger of the sequence of operations hereinbefore described occurring out of order as the weight of the switch arms holds the switch arms downwardly with reference to the cam 45 until the switch arms are brought to rest at the stationary contact. Thereafter further operation of the main crank rocks the cam member 45 downwardly to the position shown in Figures 9 and 11, thus locking the switch closed with heavy contact pressure both at the stationary contact and at the pivoted ends of the switch arms.

In the forms of the invention heretofore described resilient switch arms have been employed. However, it is possible to employ rigid switch arms and one form of the invention in which rigid switch arms are employed is illustrated in Figures 13, 14 and 15. These rigid switch arms are indicated at 16' and are provided with pivoted end portions 17' pivoted on the pivot pin 15 as hereinbefore described. The inner or pivoted ends of the rigid switch arms 16' are biased inwardly towards each other by means of the spring 52. Means are provided for forcing the inner ends of the switch arms 16' outwardly in opposition to the action of the spring 52. This causes the switch arms 16' to pivot about the outer pivot pin 30 hereinbefore described, see Figure 2, and causes the front or outer ends of the switch arms to bind against the stationary contact with heavy contact pressure.

It is preferable to leave a clearance between the pivoted portions 17' and the ears 14 and to provide a flexible jumper or connector 53, see Figure 13, between the cam member 54 and the terminal 11. The cam member 54 is pivoted on the main pivot pin 15 and is provided with a pair of integral arms 55 which are shaped somewhat like the connecting link 18 of the first forms of

the invention. The arms 55 of the cam member carry a pivot pin 56 which pivotally supports the connecting link 57, the connecting link 57 being in turn pivoted to the connecting rod 22 in the manner hereinbefore described.

It is obvious from the description thus far given that when the connecting rod 22 is drawn to the left as viewed in Figures 13 and 14, the cam will be rocked upwardly and when driven to the right, the cam will be pressed downwardly.

The cam 54 is shown in detail in Figure 15 and it will be seen that it has upwardly and outwardly slanting cam faces 58 and flat or parallel faces 59 at the upper ends of the cam faces. The cam is adapted to cooperate with the pivoted portions 17' of the switch arms 16'. It is provided with upper and lower stops 60 and 61.

It is obvious that when the switch is closed and the connecting rod 22 is driven further to the right through operation of the crank hereinbefore described, the inner or pivoted ends of the switch arms will be spread apart and the outer ends of these rigid switch arms will tightly grip the stationary contact, thus providing high contact pressure. When the switch is to be opened, the crank is rotated to draw the connecting rod 22 to the left as viewed in Figures 13 and 14 and the cam 54 is rocked upwardly from the position shown in Figures 13 and 15. This allows the spring 52 to draw the pivoted ends of the switch arms 16' inwardly and thus relieve the heavy contact pressure at the stationary contact.

In the forms of the invention shown in Figures 9 to 12 and in Figures 13 to 15 it is intended that the outer ends of the switch arms be tied together in the same manner as described for the first form of the invention.

In all forms of the invention, when the switch is closed but before the switch arms are deflected by the deflecting mechanism, it is optional whether or not the outer portions of the switch arms 16 will have a light contact pressure on the stationary contact 6. It is, however, preferable to have no contact pressure so that, with even a slight coating of ice, there will be no resistance offered the switch arms which might cause the deflecting mechanism to operate and thereby cause the blades to assume their deflected position. When the switch arms are deflected, there is a slight relative motion between the outer portions of the switch arms and the stationary contact 6 sufficient to scrape off any scale or oxide that may have formed.

In all forms of the invention the movable arcing horns are out of contact with the stationary arcing horns when there is heavy contact pressure and are in contact with the stationary arcing horns when this heavy contact pressure is relieved.

In all forms of the invention the pivoted ends of the switch arms have a relatively loose fit with the pivot pin to allow them to freely slide on the pivot pin during operation of the switch.

The switches in all forms of the invention are usually mounted as gang switches, that is to say, a plurality of switch units are employed as shown in Figure 17. In this case the shafts 5 are provided with rock arms 62 rigid therewith which are connected by means of a series of connecting links 63 and 64. One of the rock arms is connected by means of connecting link 65 with a master crank 66 carried by the rock shaft 67 and adapted to rock through at least 180° so as to lock the switches both in closed and in open positions. If desired, the master crank arm 66

could swing slightly past dead center at each end of its stroke to insure locking.

It is to be understood that the switch arms 16 or 16' may be made as long as desired depending on the voltage of the circuit in which the switches are to be used. They are ordinarily used in the well known manner as disconnecting switches.

It is to be noted that the switch arm 16 or 16' are not mounted one above the other, as has often been done in the prior practice, but are mounted opposite each other in the same plane. It is also to be noted that toggle link mechanism or cam mechanisms are employed to expand the switch arms laterally, that is to say, in a horizontal plane, in order to get the high contact pressure. Decided advantages result from this arrangement in that the switch arms form a laterally braced movable structure and also particularly in that no catches are required to insure the correct sequence of operations of the parts. Instead the weight of the switch arms contacting with the toggle link mechanism or with the cam mechanism forcibly holds the switch arms in their relaxed condition and precludes the possibility of the switch arms being moved to their clamping or high pressure position until after the switch arms have been brought to rest in engagement with the stationary contact.

It will be seen further that at the stationary contact and the free end of the switch arms a small area high pressure contact is obtained and also in at least the first two forms of the invention a heavy contact pressure is obtained at the pivoted ends of the switch arms. It is preferable, as previously described, to depend upon a flexible leader for the electrical connection at the pivoted ends of that form of the invention having the rigid switch arms.

It will be seen that the mechanism of the switches is very simple and that the parts may be made sturdy and that the switches will be reliable in operation.

In all forms of the invention the correct sequence of operations is not dependent on any latches, catches, or other devices of this nature and, at least in the first two forms of the invention, is not dependent upon the action of any springs whatsoever as the weight of the switch arms while the switch is being raised or lowered always holds the toggle or cam members in a position so that the switch arms are relaxed.

Although this invention has been described in considerable detail, it is to be understood that such description is intended as illustrative rather than limiting, as the invention may be variously embodied and is to be interpreted as claimed.

I claim:

1. A switch construction comprising a pair of spaced arms, movable arcing horns carried by said arms, a stationary contact adapted to be engaged by the outer ends of said spaced arms, stationary arcing horns, pivot means pivotally supporting said arms, operating means for rocking said arms about said pivot means, tie means for tying said arms together at a point spaced inwardly from the outer ends of said arms, and deflecting means for varying the spacing between said arms at a point spaced inwardly from said tie means to thereby deflect said arms to cause the outer ends of said arms to engage said stationary contact at spaced points with a heavy contact pressure and to cause said movable arcing horns to move away from said stationary arcing horns, said movable arcing horns engaging

said stationary arcing horns when said arms are moved to closed position and are undeflected.

2. A switch construction comprising a pair of spaced arms, movable arcing horns carried by said spaced arms, a stationary contact adapted to be engaged by the outer ends of said spaced arms, stationary arcing horns, pivot means pivotally supporting said arms at a point spaced from said stationary contact and preventing relative longitudinal shifting of said arms, operating means for rocking said arms about said pivot means, means for maintaining substantially constant spacing of portions of said arms, and deflecting means for varying the spacing between said arms at a point spaced inwardly from the means for maintaining substantially constant spacing to cause the outer portions of said arms to engage said stationary contact at spaced points with a heavy contact pressure, said deflecting means being operatively connected to said operating means and being operated by said operating means, said movable arcing horns being adapted to engage said stationary arcing horns when said arms are moved to closed position and are undeflected and said movable arcing horns being arranged to move away from said stationary arcing horns when said arms are deflected.

3. A switch construction comprising a pair of spaced switch arms, movable arcing horn means carried by said switch arms, a stationary contact, stationary arcing horn means, pivot means pivotally supporting said arms, operating means for moving said arms towards and from said stationary contact, and mechanism for causing the outer portion of said arms to engage said stationary contact at spaced points with a heavy contact pressure and for relieving said pressure, said mechanism moving said movable arcing horn means away from said stationary arcing horn means when said heavy contact pressure exists and moving said movable arcing horn means into engagement with said stationary arcing horn means when said heavy contact pressure is relieved.

4. A switch construction comprising a pair of spaced arms, a stationary contact adapted to be engaged by the outer ends of said spaced arms, pivot means pivotally supporting said arms at a point spaced from said stationary contact, operating means for rocking said arms about said pivot means, tie means for tying portions of said arms together, and toggle means located between said arms for varying the spacing between said arms at a point spaced inwardly from said tie means to cause the outer portions of said arms to engage said stationary contact at spaced points with a heavy contact pressure, said toggle means

being operatively connected to said operating means and comprising a pair of pivotally joined lever members having rounded outer ends, said arms having socket members receiving the rounded outer ends of the lever members of said toggle means.

5. A switch construction comprising a pair of spaced arms, a stationary contact adapted to be engaged by the outer ends of said spaced arms, pivot means pivotally supporting said arms at a point spaced from said stationary contact, operating means for rocking said arms about said pivot means, tie means for tying portions of said arms together, a pivoted cam member located between said arms and having oppositely slanting side portions for varying the spacing between said arms at a point spaced inwardly from said tie means to cause the outer portions of said arms to engage said stationary contact at spaced points with a heavy contact pressure, said cam means being operatively connected to said operating means, and pivot means slidably supported from said arms and pivotally supporting said cam member.

6. A switch construction comprising a pair of spaced arms, a stationary contact adapted to be engaged by the outer ends of said spaced arms, pivot means pivotally supporting said arms at a point spaced from said stationary contact, operating means for rocking said arms about said pivot means, tie means for tying portions of said arms together, and a pivoted cam member located between said arms and having oppositely slanting side portions for varying the spacing between said arms at a point spaced inwardly from said tie means to cause the outer portions of said arms to engage said stationary contact at spaced points with a heavy contact pressure, said cam means being operatively connected to said operating means, said side portions having flat portions adjacent the end of said slanting portions to hold said arms in their heavy contact pressure position.

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