Feb. 25, 1958 P. M. HASLAM 2,824,935

INTERRUPTER ATTACHMENT FOR DISCONNECT SWITCH

Filed Jan. 24, 1955 4 Sheets-Sheet 1

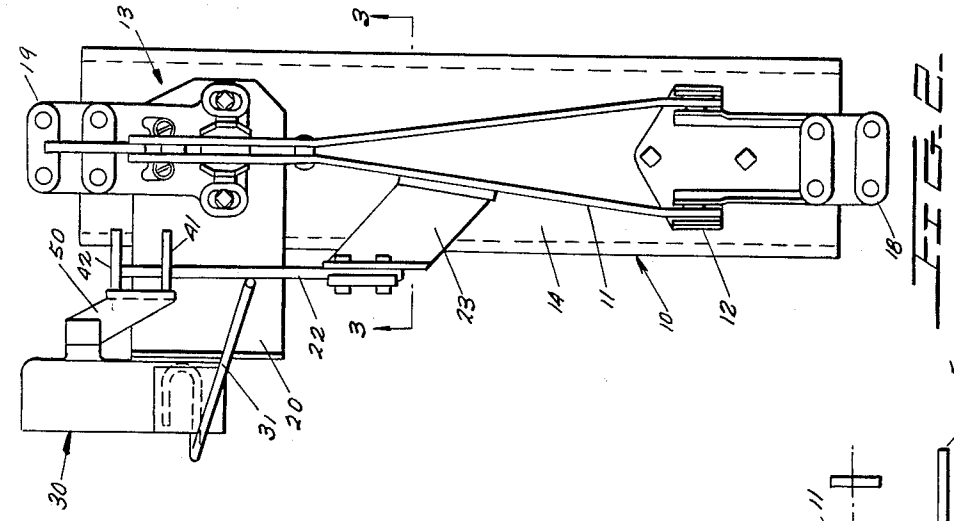


FIG. 2

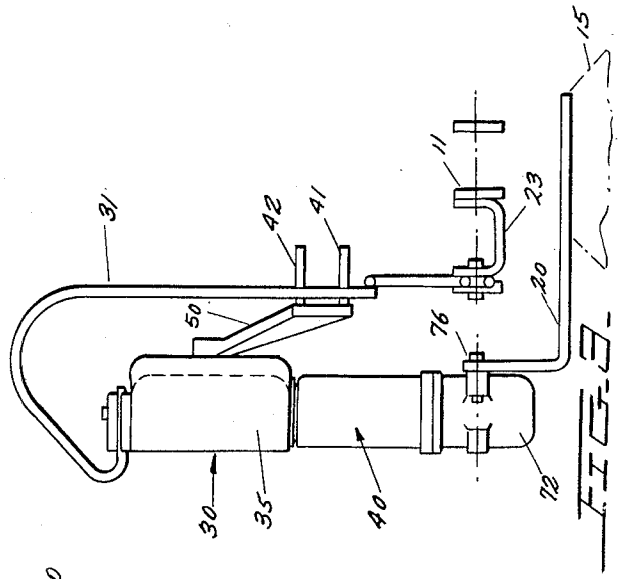


FIG. 3

FIG. 1

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Filed Jan. 24, 1955 4 Sheets-Sheet 2

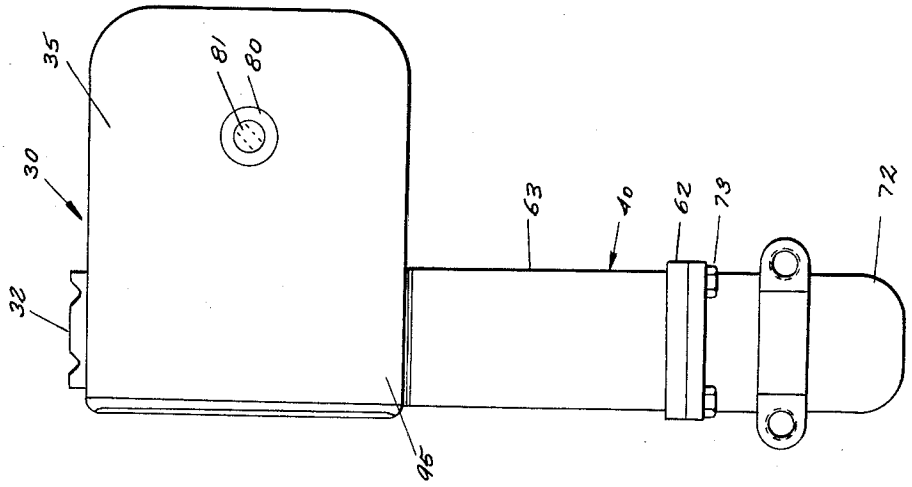


FIG. 3.

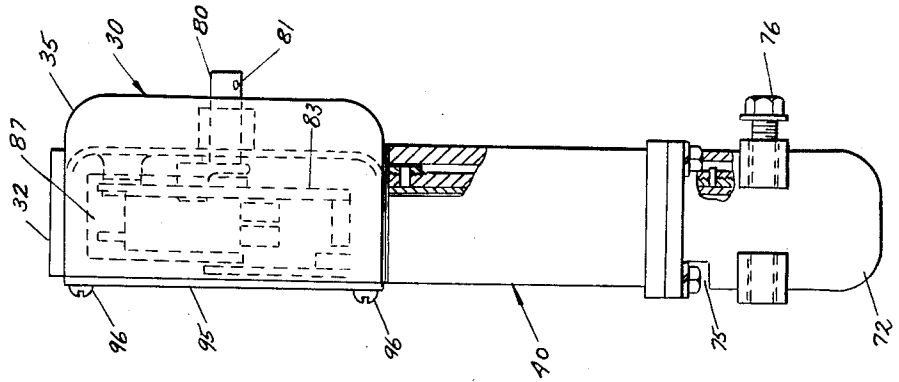


FIG. 5.

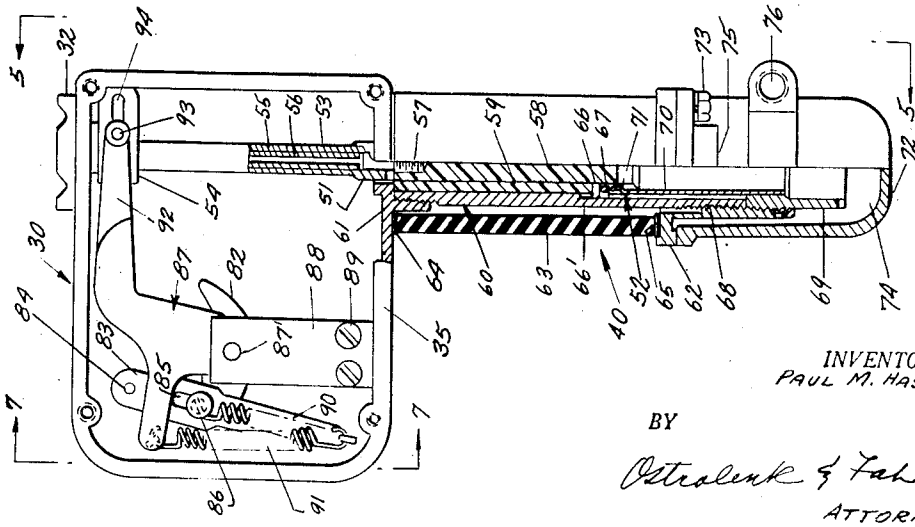


FIG. 4.

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Feb. 25, 1958 P. M. HASLAM 2,824,935

INTERRUPTER ATTACHMENT FOR DISCONNECT SWITCH

Filed Jan. 24, 1955 4 Sheets-Sheet 3

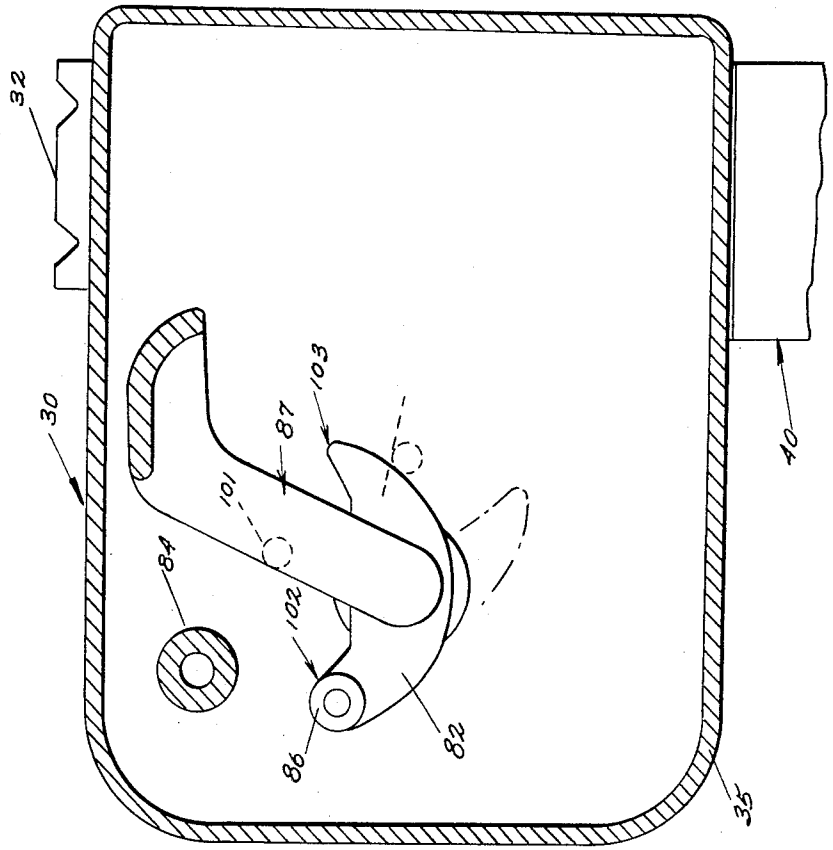


FIG. 8.

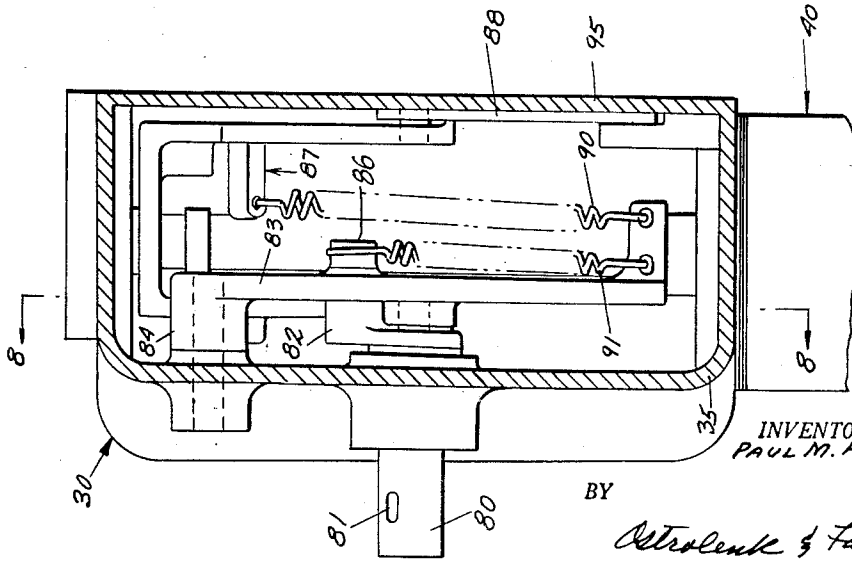


FIG. 7.

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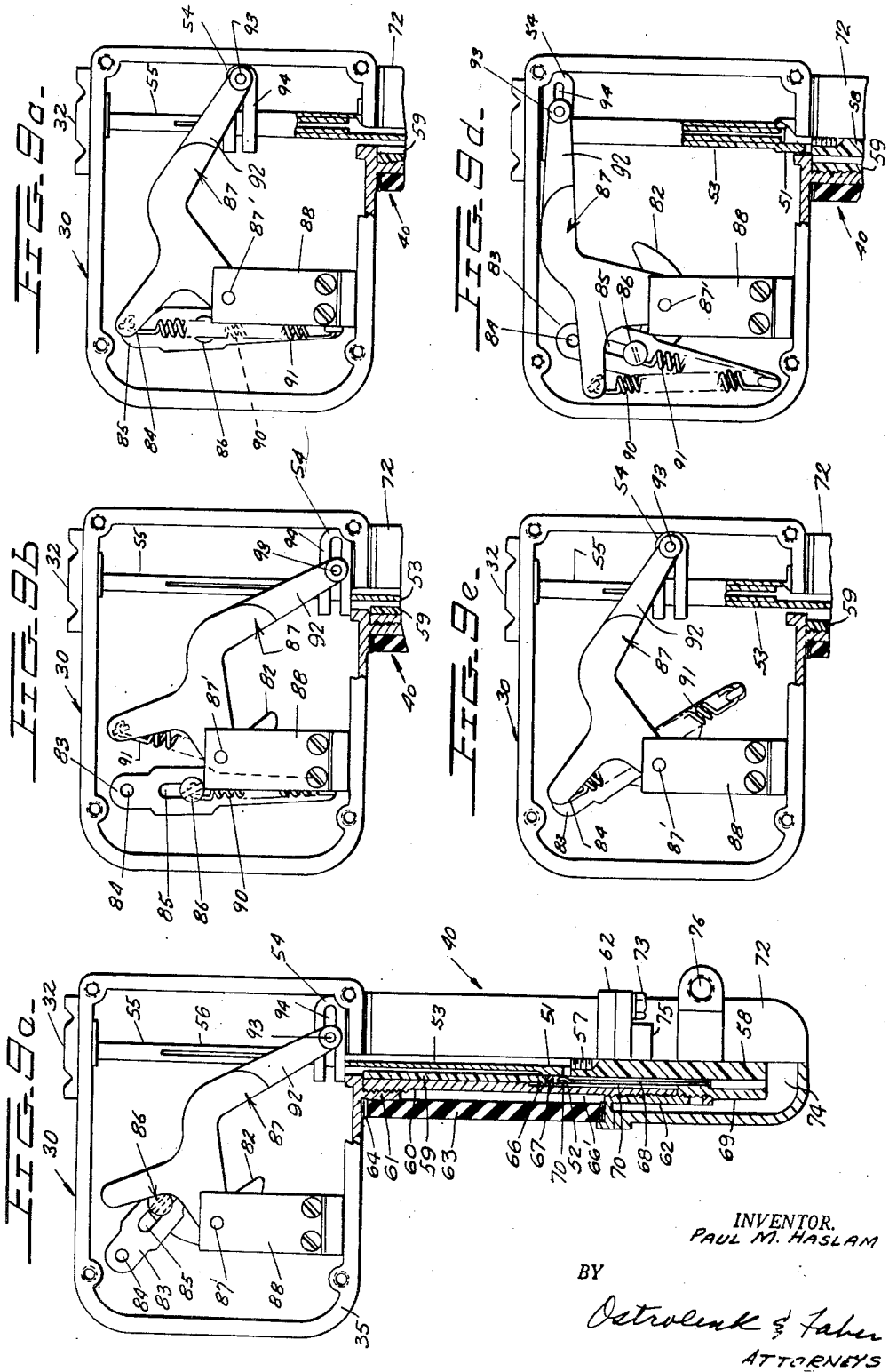
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Feb. 25, 1958 P. M. HASLAM 2,824,935

INTERRUPTER ATTACHMENT FOR DISCONNECT SWITCH

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4 Sheets-Sheet 4



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United States Patent Office 2,824,935 Patented Feb. 25, 1958

2,824,935

INTERRUPTER ATTACHMENT FOR DISCONNECT SWITCH

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Application January 24, 1955, Serial No. 483,737

10 Claims. (Cl. 200—146)

My invention relates to an interrupter attachment for a disconnect switch and more particularly is directed to a novel attachment wherein the cooperating contacts of the interrupter attachment are moved in straight-line motion with snap action from the engaged to disengaged position, and vice versa, regardless of the speed of operation of the blade of the disconnect switch and an arrangement in which the operating mechanism for the cooperating contacts of the attachment serve only as mechanical units and do not have to conduct current to complete the circuit.

The disconnect switch is designed to isolate an electrical circuit when the blade is in the fully disengaged position with respect to its cooperating jaws. This type of switch can be opened under no load conditions to completely isolate a load and insure the safety of repairmen and other personnel during inspection and repair operations. However, a disconnect switch is designed primarily to provide electrical isolation and its cooperating contacts are not designed to open on load current. That is, the switch is primarily designed to be opened under no load conditions and, in the event an operator opens same when load current is flowing therethrough, it may result in an arc hanging on between the disengaged cooperating contacts and thus result in damage to both the switch and the circuit.

In order to extend the range of function of the disconnect switch, it is common to provide an interrupter attachment for the disconnect switch. The interrupter attachment contacts are electrically connected in parallel with the cooperating contacts of the disconnect switch at least prior to the complete disengagement of the contacts of the disconnect switch. Thus, when the disconnect switch contacts are disengaged, all of the load current will flow through the interrupter attachment contacts.

A mechanical connection between the disconnect switch blade and the interrupter attachment is operative to disengage the cooperating contacts of the interrupter attachment after the disconnect switch contacts have disengaged. That is, the mechanical interconnection between the disconnect switch and the interrupter attachment is operative to disengage the cooperating contacts of the interrupter attachment after the disconnect switch blade has established sufficient flashover clearance.

Thus, with this arrangement, all of the interrupting duty is taken by the contacts of the interrupter attachment rather than the contacts of the disconnect switch. Thereafter, one of the electrical connections between the interrupter attachment and the disconnect switch is broken so that movement of the blade of the disconnect switch to the full disengaged position will provide a sufficient airgap to prevent breakdown.

The interrupter attachment also protects the disconnect switch so that it can be closed on a line in which load current will flow. That is, during the closing operation, an electrical and mechanical connection is made between the disconnect switch blade and the interrupter attachment. Thus, prior to the engagement of the disconnect switch contacts, the movement of the disconnect switch blade effects engagement of the contacts of the interrupter attachment. Since these contacts are in parallel with the disconnect switch contacts, all of the closing duty is placed on the interrupter and not on the disconnect switch. Thereafter, the disconnect switch contacts are closed and hence, will not be damaged even though load current may be flowing in the circuit.

In the prior art construction, the interrupter attachment unit had many disadvantages which the interrupter attachment of the instant invention overcomes.

Heretofore, the interrupter attachment has been constructed with the operating arm interconnected through the operating mechanism directly to the interrupter attachment contacts. Hence, during the initial movement of the operating arm, the interrupter attachment contacts will move with respect to each other even prior to the snap action of the unit. That is, there is a teasing of the interrupter attachment contacts during the initial movement of the operating handle and operating mechanism.

In the prior art, it has been necessary to provide one of two means to overcome these disadvantages. One solution has been to provide the disconnect switch with snap action so that the motion imparted to the operating handle of the interrupter attachment by the disconnect switch blade would be a snap acting motion and thereby overcome the inherent disadvantage within the interrupter attachment unit. However, this has proved to be an undesirable solution to the problem since it requires a special construction and/or adaption on a disconnect switch.

The second alternative which has heretofore been used to overcome the above noted disadvantage is to provide a predetermined sequence in the operation of the disconnect switch and the interrupter attachment so that the disconnect switch blade does not engage the operating handle of the interrupter attachment until after the disconnect switch contacts have disengaged. Thus, by this means, any possible teasing of the cooperating contacts and the interrupter attachment will not result to destruction or damage to the main contacts of the disconnect switch. However, even this arrangement has not been wholly satisfactory since it requires a predetermined sequence of operation and may result in damage to the contacts of the interrupter attachment.

I have overcome this disadvantage in my novel interrupter attachment by providing lost motion between the operating arm and the contacts of the attachment during both opening and closing operation. That is, during the initial movement of the operating circuit, the cooperating contacts of the interrupter attachment remain either fully engaged or disengaged. It is only after a predetermined movement of the operating arm, at a time when sufficient energy is stored in a toggle spring which in turn is moved over-center, that energy is imparted to the cooperating contacts so that they will disengage or engage with snap action.

In a preferred embodiment of my invention, the operating arm moves ⅔ of its complete distance of travel before the snap action is imparted to the cooperating contacts. Furthermore, the construction is such that the speed for the full stroke of the contact plunger of the interrupter attachment is completely independent of the speed of travel of the operating arm. Thus, if the disconnect switch blade is opened slowly, the main contacts of the interrupter attachment will remain completely engaged until the operating arm has been moved to approximately ⅔ of its full distance of travel. At that time, the interrupter contacts will open with snap action at a speed which is independent of the speed of operation of the

operating arm. The same sequence will also occur during closing operation.

Thus, with my novel arrangement, it is not necessary to provide any additional or auxiliary means to the disconnect switch to open the blade with snap action nor is it necessary to provide a predetermined sequence of mechanical engagement between the disconnect blade and the operating arm of the interrupter attachment. Furthermore, by providing this novel arrangement wherein lost motion is provided between the operating arm and the contacts of the interrupter attachment, it is possible to start the opening operation of the disconnect switch, stop and reverse the movement to engagement without affecting the interrupter attachment which was not heretofore possible with the devices of the prior art.

Another disadvantage which has heretofore been encountered in the prior art construction is damage or inefficiency of the interrupting chamber due to the fact that the movable contact in the interrupter attachment does not have straight-line movement. That is, the prior units provided an arrangement wherein the operating means of the housing of the interrupter attachment is connected directly to the movable contact. Hence, the arcuate movement of the operating means was imparted to the movable contact thereby forcing one end of this member to move in a substantially arcuate path. However, with my instant arrangement, I provide a sliding engagement between one unit of the operating means and the movable contact and also provide a conductive guide member. By this arrangement, the arcuate movement of the operating means is transferred through the sliding engagement and due to the conducting guide member, the movable contact moves in straightline motion thereby making most effective use of the interrupting chamber and preventing mechanical damage thereto.

Although some prior art devices do have straightline motion of the movable contact of the interrupter attachment, it is achieved by providing an extra member in the driving linkage. However, in my novel device, I provide a new and novel means to accomplish straightline motion and at the same time electrical connection to the moving contact assembly.

In addition to this advantage over the prior art arrangement, the conducting guide member provides an electrical connection directly from the movable contact of the interrupter attachment to the housing of the interrupter attachment without requiring the moving operating means to conduct current. Heretofore, the operating means and its pivotal supports have had to carry all of the load current passing through the cooperating contacts. However, with my novel arrangement, the conductive guide member electrically connects the movable contact directly to the housing so that the operating mechanism does not have to conduct current.

The prior art interrupter attachments have provided a first operating arm for disengaging the contacts and a second operating arm for engaging the contacts. Due to the direct connection between the operating means and the movable contact, it was necessary to provide this type of arrangement with the opening operating arm extending from one side of the housing and the closing operating arm extending from the opposite side of the housing. Thus, regardless of the manner in which this type of construction was mounted, at least one of the operating handles was exposed to the evil of ice formation and the possibility of water leaking into the unit. However, in my novel construction, I have provided an arrangement wherein a single operating arm is utilized to both open and close the cooperating contacts of the interrupter attachment and hence, this unit need extend from only one side of the housing. Thus, if the operating arm is positioned on the lower portion of the housing when mounted on an upright switch, ice formations will not interfere with the operation and also, since it is on the lower side, there will not be the possibility of water leaking into the unit.

In addition to the many practical and mechanical advantages which are achieved by a single opening and closing operating arm, it is also noted that this arrangement provides for an extremely economical construction and also one that is readily adapted for either a left-hand or right-hand operating unit.

Accordingly, one object of my invention is to provide an interrupter attachment for a disconnect switch in which the operating arm and operating means do not impart movement to the cooperating contacts until after they have reached a predetermined position at which time the cooperating contacts are moved to disengaged position with snap action independent of the travel of the operating arm.

Another object of my invention is to provide an arrangement in which the operating arm and operating means initially store energy in a toggle spring during which time the cooperating contacts remain in fully engaged or disengaged position. After a predetermined movement of the operating units, the energy is released from the toggle spring to thereby impart snap action to the cooperating contacts to either engage or disengage these members with snap action independent of the movement of the operating members.

Another object of my invention is to provide a lost motion connection between the operating mechanism and the cooperating contacts so that the disconnect switch blade does not have to be opened, does not require any special attachment or apparatus to be opened in snap action nor does the apparatus require any special sequence of mechanical interconnection between the disconnect switch and the interrupter attachment.

Another object of my invention is to provide an arrangement whereby a sliding connection between the operating means and the movable contact combined with a conductive guide member impart straight-line motion to the movable contact to thereby make effective use of the interrupting chamber and prevent damage thereby.

Another object of my invention is to provide an interrupter attachment with a novel interrupting guide member so that an electrical connection is made directly from the movable contact to the housing of the attachment without requiring the operating means to conduct current.

A still further object of my invention is the provision of a novel construction for an interrupter attachment wherein a single operating arm functions to both open and close the cooperating contacts so that the entire unit can be mounted with the operating arm downwardly thereby avoiding interference with the unit from ice formation and also reducing the possibility of water seeping into the unit.

These and other objects of my invention will be apparent from the following description when taken in connection with the drawings in which:

Figure 1 is a side view of a disconnect switch adapted with an interrupter attachment of my invention.

Figure 2 is a top view of the disconnect switch and interrupter attachment of Figure 1.

Figure 3 is a view taken in the direction of the arrows 3—3 of Figure 2 illustrating the mechanical and electrical relationship between the interrupter attachment and the disconnect switch.

Figure 4 is a side view of the interrupter attachment of my invention. In this view, the cover of the housing has been removed and portions of the interrupter chamber and interrupter contact are shown in sectional view.

Figure 5 is a view taken in the direction of the arrows 5—5 of Figure 4 illustrating an end view of the interrupter attachment with portions broken away.

Figure 6 is a side view of the interrupter attachment illustrating the opposite side of the view shown in Figure 4.

Figure 7 is a sectional view taken in the direction of

the arrows 7—7 of Figure 4 and illustrates an end view of the operating mechanism contained within the housing.

Figure 8 is a sectional view taken in the direction of the arrows 8—8 of Figure 7 and illustrates the side of the housing on which the operating mechanism is mounted.

Figure 9*a* is a cross-sectional view of the interrupter attachment illustrating the position of the components when the cooperating contacts are in the fully closed position prior to the rotation of the operating arm of the interrupter attachment.

Figure 9*b* is a side cross-sectional view of the interrupter attachment illustrating the position of the operating means during their initial movement but prior to the disengagement of the cooperating contacts of the interrupter attachment.

Figure 9*c* is a cross-sectional view of the interrupter attachment illustrating the position of the operating components in the partially open position. This figure is a snapshot picture taken during the opening operation.

Figure 9*d* is a cross-sectional view of the interrupter attachment illustrating the position of the various components when the interrupter attachment is in the fully open position.

Figure 9*e* illustrates a snapshot view of the components while the moving contacts are being moved to their engaged position.

Figures 1, 2 and 3 illustrate the manner in which the interrupter attachment of my invention may be applied to a disconnect switch. The disconnect switch **10** is provided with a blade **11** which is pivotally mounted at **12** for rotation into and out of engagement with jaw **13**. The entire unit may be mounted on base **14** and supported by insulators **15** and **16**. The disconnect switch blade **10** is moved into engaged and disengaged position with the jaw **13** by means of the hook ring **17** in a manner which is well known in the art and illustrated in Patent Nos. 2,738,402, 2,789,189 and 2,787,690, all assigned to the assignee of the instant application. Thus, in the arrangement illustrated, the current path is from the terminal **18**, through the hinge **12**, the blade **11** to the jaw **13** and out through the terminal **19**.

An interrupter attachment **30**, which will be hereinafter described in detail in connection with Figures 4 through 9, is mounted by means of bracket **20** on the stationary jaw base **13** of the disconnect switch **10**.

A movable shunt horn **22** is rigidly secured to the blade **11** by means of the bracket **23**. A stationary shunt horn **31** secured by means of a horn clamp **32** and bolts **33** is secured to the housing **35** of the interrupter attachment **30**. The cooperating contacts of the interrupter attachment **30** are contained within the interrupter chamber **40**.

In the figures illustrated, the disconnect switch **10** and the interrupter attachment **30** are both in the fully closed position. The supporting bracket **20** of the interrupter attachment **30** is a conductive member so that the stationary contact of the interrupter attachment **30** is electrically connected to the jaw end of the disconnect switch **10**.

As will hereinafter be more fully explained, the movable contact of the interrupter attachment **30** within the arcing chamber **40** is electrically connected to the housing **35**. Since the arcing horn **31** is rigidly secured to the housing **35**, an electrical connection is made from the moving contact of the interrupter attachment **30** through the stationary arcing horn **31**, the movable arcing horn **32** and the blade **11** of the switch **10**. Thus, in the position illustrated in the figures, the cooperating contacts of the interrupter attachment **30** are connected in electrical parallel with the main contacts of the disconnect switch **10**.

It will be noted that the electrical connection between the blade **11** and the movable contact of the interrupter attachment **30**, which is made between the movable arcing horn **22** and the stationary arcing horn **31**, may be made while the cooperating contacts **11** and **13** of the disconnect switch are in the fully engaged position or, in some applications, it may be desirable not to have electrical engagement between the moving arcing horn **22** and the stationary arcing horn **31** until after opening operation of the disconnect switch **10** is started but of course prior to the disengagement of the disconnect switch cooperating contacts.

The interrupter attachment **30** is provided with an operating lever **50** which extends from one side of the housing **35**. Rotation of the operating lever **50** in a counterclockwise direction, as illustrated in Figure 1, will result in the disengagement of the cooperating contacts of the interrupter attachment **30** and rotation of the same operating lever **50** in the clockwise direction will result in the engagement of the cooperating contact.

The manner in which the interrupter attachment **30** coordinates with the disconnect switch **10** is as follows.

When the switch is in the fully closed position, a major portion of the load current will flow through the relatively low resistance path provided by the blade **11** and the jaw **13** thereby effectively bypassing the parallel path provided through the arcing horns **22**, **31** and the interrupter attachment **30** mounted on conductive break **20**.

When it is desired to open the disconnect switch blade **11**, the pull ring **30** is pulled toward the open position so that the blade **11** will disengage the jaw **13** of the disconnect switch **10**. However, these cooperating contacts will not be called upon to interrupt any current since there is an alternate electrical path through the interrupter attachment **30** due to the electrical engagement of the movable and stationary arcing horns **22—31**.

The continued movement of the blade **11** of the disconnect switch **10** will bring the movable arcing horn **22** into mechanical engagement with the operating lever **50** of the interrupter attachment **30** to thereby rotate this lever in a counterclockwise direction. It will be noted that during this period of time, electrical engagement is still maintained between the blade **11** and the interrupter attachment **30** due to the continued electrical engagement of the arcing horns **22—31**.

After the operating lever **50** has been rotated a predetermined number of degrees, as for example 65° as will hereinafter be more fully explained, the operating mechanism within the interrupter attachment **30** will result in snap action opening operation of the contacts of the interrupter attachment. Thus, all of the interrupting duty will be taken by the cooperating contacts of the interrupter attachment **30** so that no damage will occur to the cooperating contacts of the switch **10**.

It will be noted that the arrangement is designed so that the disconnect switch blade **11** establishes a sufficient flashover clearance to the jaw **13** before the cooperating contacts of the interrupter attachment **30** separate. After the load current has been fully interrupted, by the interrupter attachment **30**, the operator will continue to move the switch blade **11** toward its disengaged position until it is approximately 90° from the position illustrated in Figure 1. At this point, there is no longer any mechanical or electrical engagement between the interrupter attachment **30** and the blade **11** since the movable arcing horn **22** will have disengaged both the stationary arcing horn **31** and the operating lever **50**.

Thus, the disconnect switch **10** is moved from the fully engaged position to the fully disengaged position and even though load current was flowing in the circuit, there is no interrupting duty placed upon the disconnect switch since interrupter attachment contacts perform the interruption of the current. Hence during the opening operation, the interrupter attachment permits the combined unit to function as a load break switch. However, as noted, when the disconnect switch **10** is in the fully open position, it is mechanically and electrically disengaged from the interrupter attachment **30** and hence,

provides the full airgap distance to provide sufficient isolation for the electrical circuit.

During the closing operation, the interrupter attachment 30 also functions to protect the disconnect switch 10 from any damages which might result to the switch in the event it is closed on a hot line. This is achieved in the following manner.

During the closing operation, the movable arcing horn 22 of the blade 11 engages both the stationary arcing horn 31 and the operating lever 50. The rotation of the blade 11 toward the closed position rocks the operating lever 50 in a direction to charge a toggle spring, as will hereinafter be more fully explained, so that after it has moved a predetermined distance the contacts in the interrupter attachment 30 will close with snap action. Thus, an electrical circuit will be completed during the portion of the closing operation from the terminal 18, through the hinge 12, the blade 11, the moving arcing horn 22, the stationary arcing horn 31, the interrupter attachment 30, the jaw 13 then to the terminal 19.

Upon continued movement of the blade 11 toward the closed position, there will be no damage to the cooperating contacts of the disconnect switch 10 since the closed contacts of the interrupter attachment 30 are connected in parallel therewith and hence, will conduct all of the current during the closing operation. Thus, the disconnect switch 10 can be moved to the fully engaged position without damage to the cooperating contacts.

In the illustration and description in connection with Figures 1 to 3, I have explained the manner in which the interrupter attachment electrically and mechanically coordinate with a disconnect switch.

Figures 4 through 9 illustrate the detailed construction of the interrupter attachment and the manner in which the operating mechanism and cooperating contacts thereof operate.

The details of the interrupter unit are best illustrated in Figures 4, 5, 6, 7 and 8.

As has heretofore been noted, the interrupter attachment 30 is comprised of the housing 35 and the interrupting chamber 40. Referring first to the interrupting chamber 40, the device comprises a main movable contact 51 and a main stationary contact 52. In the position illustrated in Figure 4, the interrupter attachment is in the completely disengaged position. The movable contact 51 is an integral part of the hollow cylindrical conducting member 53 which has a slotted member 54 rigidly secured to the upper end thereof.

A conductive guide member 55 is rigidly secured at its upper end to the housing 35 to thereby make electrical and mechanical engagement therewith. The lower end of the conductive guide member 55 is slit as indicated by the slot 56 and positioned within the hollow cylindrical conducting member 53. The slot 56 in the conductive guide member 55 extends for a substantial distance along the length of the member 55 and serves to bias the guide member 55 toward the inner surface of the hollow cylindrical moving contact 53 to make electrical and mechanical engagement therewith.

The lower end of the hollow cylindrical movable contact 53 is provided with an extending screw 57. A follower 58 of insulated material such as nylon is threadably engaged with the extension screw 57 so that the follower 58, the hollow cylindrical movable contact 53 and the slotted member 54 move together as a single unit.

The cylindrical follower 58 has an external diameter which is slightly less than the internal diameter of the hollow cylindrical arc chamber liner 59 which may be made of an insulating material such as nylon or a material which will emit arc extinguishing gases. The arc chamber liner 59 is initially slidably positioned within the arc chamber tube 60 and thereafter securely held in position in a manner hereinafter described.

Both ends of the arc chamber tubes 60 are threaded with the upper end in threaded engagement with an extension 61 of the housing 35. The lower end is in threaded engagement with the clamping sleeve 62. However, prior to the time that the clamping sleeve 62 is brought into complete threaded engagement with the arc chamber tube 60, a hollow cylindrical housing 63 is made of material such as porcelain and is positioned concentric with respect to the cooperating contacts. The upper end of the porcelain housing 63 is sealed against the lower surface of the housing 35 with a gasket 64 positioned therebetween. The clamping sleeve 62 is then brought into threaded engagement with the arc chamber tube 60 and a gasket 65 is positioned between the porcelain tube 63 and the clamping sleeve 62.

As clearly illustrated in Figure 4, the lower end of the arc chamber tube 60 is provided with a step section 66'. This step section serves as a guide for insulating ring 66 and the stationary arcing contact ring 67. These two ring members are initially loosely fitted in concentric alignment with the follower 58 and have an external diameter which is slightly less than the internal diameter of the step portion 66' of the arc chamber tube 60. Thereafter, a hollow cylindrical conducting sleeve 68, having substantially the same external diameter as the ring member 66 and 67, is positioned within the arc chamber tube 60.

Thus, the upper end of the metal spacing sleeve 68 engages the lower surface of the stationary arcing contact ring 67 and the lower end of the spacing sleeve 68 engages the member 69 which forms one portion of the main stationary contact.

The operative portion of the stationary contact 69 is comprised of a hollow cylindrical conducting member 70 which has a plurality of longitudinal slots thereof curved inwardly as illustrated in Figure 4. Thus, with this arrangement, the lower end of the stationary contact 70 is in tight fit electrical and mechanical engagement with the upper internal portion of the stationary contacts 69 and the upper portion of the stationary conducting member 70 will engage the main movable contact 51 when the interrupter attachment 30 is in the closed position.

It will be noted that the internal diameter of the stationary contact 70 is less than the external diameter of the movable contact 51 and hence, due to the slotted arrangement of the stationary contact 70, the stationary contact will be biased toward the movable contact.

By providing the curved section 71 at the upper end of the stationary member 70 so that its extreme upper end flanges outwardly, the follower 58 and movable contact 51 can move easily into the internal portion of the stationary contact 70 when the interrupter is moved to the closed position and thereafter, the stationary contact 70 will be biased radially inward toward the movable contact 51. By rotating the stationary contact 69 into threaded engagement with the clamping sleeve 62, the spacing sleeve 68 urges the arcing contact ring 67, the insulating ring 66 and the arc chamber liner tube 59 upwardly until they are all securely positioned by a tight fit arrangement.

Thereafter, the mounting base muffler 72 is positioned over the lower portion of the arcing chamber 40 and secured by means of bolts 73 to the clamping sleeve 62. The mounting base muffler 72 provides a chamber 74 into which hot gases and ionized air can expand when the cooperating contacts of the interrupter attachment interrupt load current.

An opening 75 is provided in the side of the mounting base muffler 72 to exhaust hot gases and ionized air.

It will be noted that the mounting base is also provided with mounting lugs 76 so that the interrupter attachment can be secured to the conductive mounting plate 20, as heretofore described in connection with Figures 1, 2 and 3.

When the interrupter attachment 30 is in the fully

closed position, a current path will be provided from the jaw base 13 of the disconnect switch through the mounting plate 20, through the mounting bolt 76, the base 72, the clamping sleeve 62, the base 69, the stationary contact 70, the main movable contact 51, through the hollow cylindrical sleeve 53 of the movable contact to the conductive guide member 55, to the housing 35, the arc horn clamping member 32 to the stationary arcing horn 31 and back to the blade 11 of the disconnect switch 10 by means of the movable arcing horn 22. Thus, the interrupter attachment cooperating contacts will be in parallel with the main contacts 11, 13 of the disconnect switch 10.

The operating mechanism by which the cooperating contacts of the interrupter attachment move from the engaged to the disengaged position and vice versa will now be described.

As heretofore noted, the interrupter attachment is controlled by means of the operating lever 50 which, in turn, is controlled by the movement of the blade 11 of the disconnect switch 10. That is, during the opening operation of the disconnect switch, the movable arcing horn 22 engages the protruding pin 41 of the operating lever 50 and during the closing operation, engages the protruding pin 42 of the operating lever 50.

The operating lever 50, mounted on the outside of the housing 35, is rigidly secured to the operating shaft 80 in any desirable manner as for example by a key and keyway 81 interlocked therebetween.

The operating shaft 80 extends through the one side of the housing 35 and has a first lever 82 rigidly mounted thereon in any desirable manner. The lever 82, therefore, has the same degree of rotation that the operating lever 50 will have since they are both rigidly secured to the operating shaft 80.

An L-shaped lever 83 is pivotally mounted at pivot 84. The lever 83 is provided with a slot 85 which contains a pin 86 rigidly secured and extending perpendicular to the first lever 82. Thus, a clockwise rotation of the first lever 82, due to the rotation of the operating lever 50 will cause counterclockwise rotation of the second lever 83 due to the sliding engagement by slide 85 and pin 86.

A trip lever 87 has a U-shaped base with one side pivotally mounted on the operating shaft 80 and the other side pivotally mounted at the pivot point 87'. The pivot point 87' is on the bearing plate 88 which is rigidly secured to the base of the housing 35 by means of the screws 89.

One end of a toggle spring 90 is secured to one extension of the trip lever 87 and the other end of the toggle spring 90 is secured to the base of the second lever 83. It will be noted that a second spring 91 may be provided with one end secured to the second lever 83 and the opposite end secured to the pin 86 of the first lever 82.

As will hereinafter be more fully explained, the toggle spring 90 serves to store energy during the initial movement of the first and second lever 82 and 83 and thereafter, transfer this energy to the trip lever 87 after the toggle spring 90 has been moved over center so that the trip lever 87 will move with snap action independent of the movement of the first and second lever 82 and 83. The spring 91 serves as a biasing means to maintain the first and second levers 82 and 83 in either their open or closed position.

The third or trip lever 87 is provided with extension arms 92 which have a guide pin 93 extending therethrough. The guide pin 93 also extends through the slot 94 and hence is in sliding engagement with member 54 which, as heretofore noted, is rigidly secured to the hollow cylindrical movable contact 53.

In Figure 8, there is a circular projection 101 shown dotted on the far side of trip lever 87. The purpose of this projection is to engage alternately faces marked 102 and 103 of the first lever 82 during the opening or closing operations, respectively. The engagement of 101 with 102 or 103 is to urge the trip lever to pass dead center and thereby to not wholly depend on the toggle spring 90 to urge the trip lever over dead center. This is a semi-positive backup for the spring 90.

A flat cover plate 95 may be positioned on one side of the housing 35 and secured thereto by means of the screws 96.

The manner in which the operating mechanism of Figures 4, 5, 6, 7 and 8 functions will now be described in connection with the sequence of diagrams illustrated in Figures 9*a*, 9*b*, 9*c* and 9*d*.

Figure 9*a* illustrates the position of the various components when the interrupter attachment is in the fully closed position. In this position, the toggle spring 90 maintains the trip lever 87 in its extreme clockwise position so that the cooperating contacts 51—70 remain in the fully engaged position.

When the disconnect switch is moved toward the open position, the movable arcing horn 22 will engage the pin 41 of the operating lever 50 thereby tending to rock this member in a counterclockwise direction. The counterclockwise rotation of the operating lever 50 will be transmitted through the operating shaft 80 to the first lever 82 so that this member will also rock in a clockwise direction. The rotational motion of the first lever 82 will be transmitted by the sliding engagement of pin 86 and slot 85 to the second lever 83.

The second lever will thus rotate in a clockwise direction about its pivot point 84. During this initial period of rotation, energy will be stored in both the toggle spring 90 and the spring 91. It will also be noted that since the lower base of the second lever 83 is being rotated about the pivot point 84, the lower end of the toggle spring 90 and the spring 91 will also be rotated about this pivot point since they are both secured to the second lever 83. Spring 91 is the operating lever spring which acts only to hold the first lever 82 and its attached lever 50 in the extreme position.

As best seen in Figure 9*b*, the initial movement of both the first and second lever 82 and 83, although effective to move and store energy in the springs 90 and 91, will not move the trip lever 87. In the event the operator recloses the disconnect switch before the toggle spring 90 has been moved over center, both toggle spring 90 and 91 will force the first and second toggles 82 and 83 back to their original position as illustrated in Figure 9*a*.

It will be noted that in the event this sequence of operation should occur that the cooperating contacts 51—70 of the interrupter attachment 30 will remain in full contact engagement all during this period of time. That is, since the trip lever 87 has not been moved, lost motion of the operating mechanism will insure that the cooperating contacts 51—70 will not be teased.

However, if the operator does continue to open the disconnect switch 10, a point will be reached at approximately 50° rotation of the operating lever 50, operating shaft 80 and a first lever 82 when the toggle spring 90 will be in alignment on the left side of the pivot point 80—87 of the trip lever 87. Hence, all of the stored energy in the toggle springs 90 will be released and transmitted to the trip lever 87 and, therefore, this unit will rotate in a counterclockwise direction about its pivot point 80—87.

Due to the sliding engagement between the trip lever 87 and the movable contact 53, this energy and motion will be transmitted to the movable contact of the interrupter attachment 30 and hence, the sleeve 53 with its contact 51 and follower 58 will all be moved upwardly.

It will be noted that the sliding engagement due to the pin 93 and slot 94 will permit the movable contact 51 to have straightline motion as determined by the conductive guide member 55 even though the trip lever 87

travels through an arcuate path. Thus, with this arrangement, maximum use of the interrupting chamber is obtained without the possibility of damage thereto.

Figure 9*c* illustrates a snap-shot view of the operating means as the moving contacts are being moved toward the open position. It will be noted also that the stored energy of the springs **90** which is transferred to the trip lever **87** is also transmitted to the movable contact and hence, the opening movement of the movable contact **53—51** is now independent of the movement of the first and second levers **82** and **83**. The operating mechanism will then come to rest in the position illustrated in Figure 9*d* when the contacts will be in the fully disengaged position.

As has heretofore been noted, the cooperating contacts of the interrupter attachment disengage after the main contacts **11—13** of the disconnect switch have separated a sufficient distance to prevent flashover therebetween. However, there is an electrical engagement due to the moving arcing horn **22** and the stationary arcing horn **31** prior to the time that the cooperating contacts of the interrupter attachment are disengaged.

Following disengagement of the cooperating contacts of the interrupter attachment, the blade **11** of the disconnect switch **10** is rotated a sufficient distance so that the arcing horn **22** will disengage the stationary arcing horn **31** and hence, there will be no electrical connection between the blade **11** and the interrupter attachment **30**.

The closing operation for the interrupter attachment is a reverse sequence of that above noted. That is, the blade **11** is moved toward the closed position and hence, the moving arcing horn **22** is brought into electrical engagement with the spark arcing horn **31**. Thereafter, the moving arcing horn **22** engages the operating lever **50** of the interrupter attachment **30** to rotate this unit in a clockwise direction.

As has heretofore been noted, since the operating lever **50** is rigidly secured to the operating shaft **80**, the first lever **82** will also be rotated in a clockwise direction. Due to the sliding engagement between the first and second levers **82** and **83** and due to the pin **86** and slot **85**, the second lever **83** will be rocked in a counterclockwise direction about its fixed pivot **84**. During the initial rotation of these two components, energy will be stored in the springs **90** and **91**.

It will be noted that during this initial movement of the first and second levers **82** and **83**, no motion is imparted to the trip lever **87** and hence, the cooperating contacts **51—70** will remain completely disengaged. However, after the toggle spring **90** is moved over center, that is, to the right of the pivot point **80—87**, the energy therein will be released to the trip lever **87** and hence, the cooperating contacts will be moved to the engaged position with snap-action.

Figure 9*e* illustrates a snapshot view of the position of the components of the operating means as the contacts are being moved with snap-action toward their closed position and Figure 9*a* illustrates the position of the components when the interrupter attachment is in the fully closed position.

It will be noted that the closing operation of the cooperating contacts **51—70** occurs independent of the movement of the first and second lever **82** and **83**. Thereafter, as blade **11** is continuously moved toward its disengaged position, the main contacts **11—13** of the disconnect switch **10** will be brought into engagement. However, since the parallel contacts of the interrupter attachment have already been brought into engagement, there will be no arcing on the main contacts of the disconnect switch.

Thus, in summary, I have provided a novel interrupter attachment for a disconnect switch wherein a single operating lever **50** extends from one side of the housing **35** and controls both the opening and closing operating of the contacts. Thus, the interrupter attachment can be mounted on an upright mounted switch so that the cover plate **95** extends upwardly. Since the operating lever is on the lower side and also since there need be no openings in the cover plate **95**, interference with the operation of the unit due to ice formation will be reduced and the possibility of leakage into the housings of the unit is reduced.

Furthermore, the arrangement of providing lost motion within the operating mechanism so that the cooperating contacts do not move during the initial operation of the operating lever **50** prevents teasing of the operating contacts, insures that they will open and close with snap-action which is independent of the movement of the operating levers, will not require special snap-action operation of the blade of the disconnect switch nor require a predetermined sequence of coordination with the disconnect switch.

Furthermore, the novel interrupter attachment provides a conductive guide member **55** so that an electrical connection can be made directly from the movable contact **51—53** to the housing **35** without going through the operating mechanism **87, 82, 83** and the operating shaft **80**. Also, the slide engagement between the trip lever **87** and the movable contact member **53** combined with the guide member **55** permits straightline motion of the movable contact so that most effective use of the interrupting chamber is utilized without the possibility of damage thereto.

In the foregoing, I have described my invention only in connection with preferred embodiments thereof. Many variations and modifications of the principles of my invention within the scope of the description herein are obvious. Accordingly, I prefer to be bound not by the specific disclosure herein but only by the appending claims.

I claim:

1. An interrupter attachment for disconnect switch comprising a housing and interrupting chamber; a pair of cooperating contacts positioned within said interrupting chamber; said pair of cooperating contacts being comprised of a stationary contact and a movable contact, operating means associated with said housing to control the operation of said movable contact; a stationary guide means for said movable contact; said movable contact being in electrical and mechanical engagement with said guide means; said operating means operatively connected to said movable contact to move said movable contact with respect to said guide means; said guide means operative to guide said movable contacts in straight-line motion.

2. An interrupter attachment for a disconnect switch comprised of an interrupting chamber and a housing; a stationary and movable contact positioned within said interrupting chamber; operating means mounted in and on said housing to effect engagement and disengagement of said stationary and movable contacts; said movable contact member being comprised of a hollow conducting member; a conductive guide means positioned within said movable contact; one end of said conductive guide means biased toward said movable contact to effect electrical and mechanical engagement therewith; the other end of said conductive guide means electrically and mechanically connected to said housing.

3. An interrupter attachment for a disconnect switch comprised of a conductive housing and an interrupting chamber; a pair of cooperative contacts positioned within said interrupting chamber; operating means to effect movement of one of said cooperating contacts with respect to said other cooperating contact; a conductive guide member for said one cooperating contact to guide said contact in straight-line motion; said conductive guide means operatively connected to complete electrical engagement between said last mentioned contact and said housing.

4. An interrupter attachment for a disconnect switch

comprised of a conductive housing and an interrupting chamber; a pair of cooperating contacts positioned within said interrupting chamber; operating means to effect movement of one of said cooperating contacts with respect to said other cooperating contact; a conductive guide member for said one cooperating contact to guide said contact in straight-line motion; one end of said guide means mechanically and electrically connected to said housing; the other end of said conductive guide means biased into mechanical and electrical engagement with said one contact.

5. An interrupter attachment for disconnect switch being comprised of a housing and an interrupting chamber; a pair of cooperating contacts positioned within said interrupting chamber; operating means supported by said housing for moving said cooperating contacts to engaged and disengaged position; said operating means being comprised of a first, second and third member; said first member being connected to said second member by a first toggle spring; said second member being connected to said third member by a second toggle spring; said third member being slidably connected to one of said cooperating contacts to enable straight-line motion between said cooperating contacts.

6. An interrupter attachment for disconnect switch being comprised of a housing and an interrupting chamber; a pair of cooperating contacts positioned within said interrupting chamber; operating means supported by said housing for moving said cooperating contacts to engaged and disengaged position; said operating means being comprised of a first, second and third member: said first member being connected to said second member by a first toggle spring; said second member being connected to said third member by a second toggle spring; said third member operatively connected to one of said cooperating contacts; said first toggle spring operatively connected between said first member and said second member to impart clockwise rotation to said second member when said first member is rotated in a clockwise direction; said second toggle spring ineffective to transmit motion from said second member to said third member during the initial movement of said first and second member.

7. An interrupter attachment for disconnect switch being comprised of a housing and an interrupting chamber; a pair of cooperating contacts positioned within said interrupting chamber; operating means supported by said housing for moving said cooperating contacts to engaged and disengaged position; said operating means being comprised of a first, second and third member; said first member being connected to said second member by a first toggle spring; said second member being connected to said third member by a second toggle spring; said third member operatively connected to one of said cooperating contacts; said first toggle spring operatively connected between said first member and said second member to impart clockwise rotation to said second member when said first member is rotated in a clockwise direction; said second toggle spring ineffective to transmit motion from said second member to said third member during the initial movement of said first and second member; a first fixed pivot on said housing for said first and third member; a second fixed pivot on said housing for said second member.

8. An interrupter attachment for disconnect switch being comprised of a housing and an interrupting chamber; a pair of cooperating contacts positioned within said interrupting chamber; operating means supported by said housing for moving said cooperating contacts to engaged and disengaged position; said operating means being comprised of a first, second and third member; said first member being connected to said second member by a first toggle spring; said second member being connected to said third member by a second toggle spring; said third member operatively connected to one of said cooperating contacts; said first toggle spring operatively connected between said first member and said second member to impart clockwise rotation to said second member when said first member is rotated in a clockwise direction; said second toggle spring ineffective to transmit motion from said second member to said third member during the initial movement of said first and second member; an operating shaft extending through one side of said housing; said first member rigidly secured to said operating shaft and operated thereby; said third member pivotally mounted on said operating shaft; a fixed pivot on said housing removed from said operating shaft for pivotally supporting said second member; one end of said first toggle spring secured to said first member and the other end of said first toggle spring secured to said second member; said first toggle spring effective to impart movement to said second member in a second direction when said first member is moved in a first direction; said second toggle spring ineffective to impart movement to said third member during the initial movement of said first and second member; said first and second member operatively connected to move said second toggle spring over the center line of said third member following initial movement of said first and second member to thereby impart snap action to said third member independent of the movement of said first and second member.

9. In an interrupter attachment comprised of a housing and an interrupting chamber; a pair of cooperating contacts maintained within said interrupting chamber and having an engaged and disengaged position; operating means for moving said cooperating contacts into said engaged and disengaged position with snap action; said operating means being comprised of an operating shaft extending through one side of said housing; a first member secured to said operating shaft; a third member pivotally mounted on said operating shaft; a second member pivotally mounted on said one side of said housing; said first and second member slidably interconnected; said second member interconnected with said third member by a toggle spring; said slidable interconnection between said first and second member effective to impart clockwise rotation to said second member when said first member is rotated in a counterclockwise direction; said toggle spring ineffective to impart motion from said second member to said third member during the initial movement of said first and second member; movement of said toggle spring to overcenter position by said first and second member operative to cause rotation of said third member about said operating shaft; said third member operatively connected to one of said cooperating contacts to impart snap action to said cooperating contacts.

10. An interrupter attachment for disconnect switch comprising a housing and an interrupter chamber; a pair of cooperating contacts contained within said interrupter chamber having an engaged and disengaged position; operating means to control the position of said cooperating contacts with respect to each other; said operating means being comprised of a shaft extending through one side of said housing; a first member rigidly secured to said first operating shaft; a second member pivoted on said operating shaft; said first operating shaft pivotally mounted on said one side of said housing; said first and second member slidably interconnected; a toggle spring for said third member; said first and second member operative to store energy in said toggle spring during the initial movement of said first and second member; said toggle spring ineffective to release said stored energy to said third member during the initial movement of said first and second member; said third member operatively connected to one of said pair of said cooperating contacts; said pair of cooperating contacts remaining in full engaged position while said first and second member are storing energy in said toggle spring; movement of said first and second member to a predetermined position effective to transfer the stored energy in said toggle spring to said third mem-

ber to thereby effect snap action of said third member and said cooperating contacts.

References Cited in the file of this patent

UNITED STATES PATENTS

1,963,418	Pittman et al.	June 19, 1934
2,172,225	Schofield et al.	Sept. 5, 1939
2,351,826	Lindell et al.	June 20, 1944
2,365,509	Baker	Dec. 19, 1944
2,434,315	Froland	Jan. 13, 1948
2,601,138	Hart	June 17, 1952
2,621,271	Lindell	Dec. 9, 1952
2,697,153	Owens et al.	Dec. 14, 1954
2,769,063	Lingal	Oct. 30, 1956