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OPERATING-MECHANISM FOR LINE-SECTIONALIZERS AND THE LIKE

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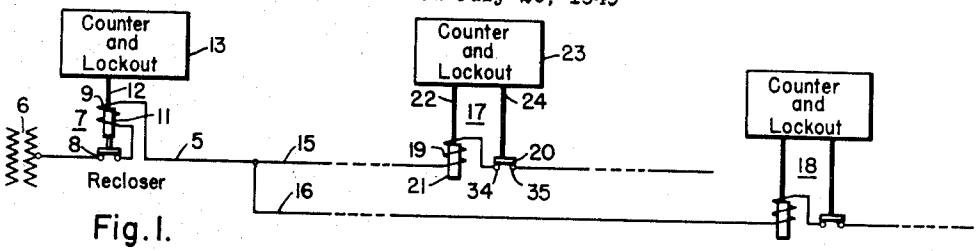


Fig. 1.

Fig. 2.

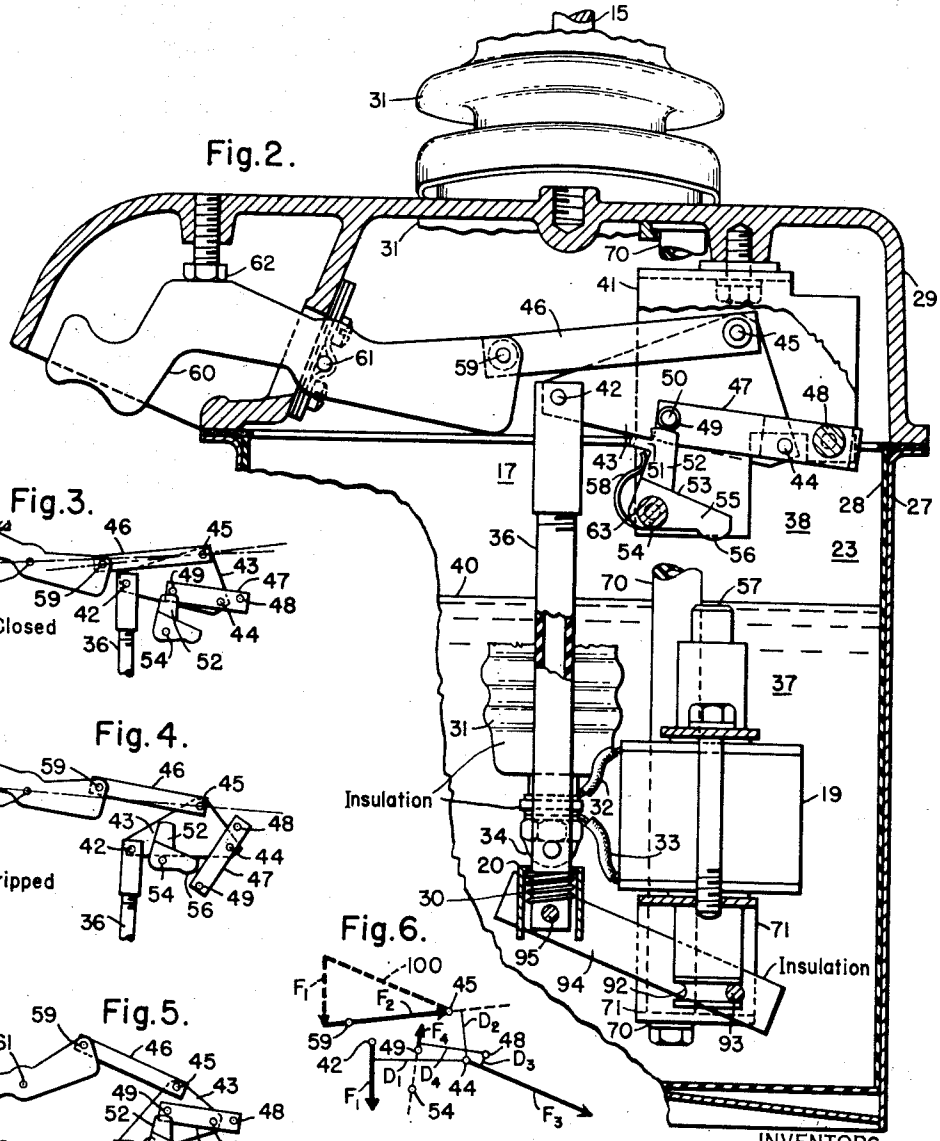


Fig. 3.

Fig. 4.

Fig. 5.

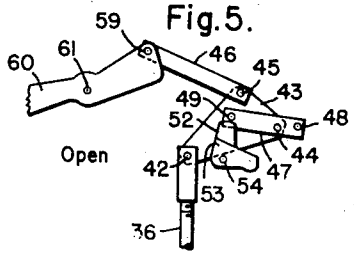


Fig. 6.

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OPERATING MECHANISM FOR LINE SECTIONALIZERS AND THE LIKE

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17 Claims. (Cl. 200—108)

Our invention relates to improvements in line-sectionalizing equipment for distribution-systems, particularly for radial-type rural power-lines of from 2.4 to 15 kilovolts. More particularly, our invention relates to a novel kind of operating-mechanism, which is designed not only for use in line-sectionalizers, but also so as to be interchangeable with reclosing circuit-breakers, which differ from sectionalizers mainly in the greater current-interrupting ratings of the breaker-contacts, and in the reclosing operation which is used with the reclosers but not with the sectionalizers.

The object of our invention is to produce or provide an entirely new and redesigned operating-mechanism of the class described, having an entirely new toggle-linkage arrangement, involving various novel features and advantages, including the following: a peculiar toggle-and-linkage motion is used, which results in an extremely light latch-load, and a self-locking feature which holds the mechanism open, by gravity, once it has opened, thus avoiding dependence upon latches and springs, which may fail and let the mechanism reclose; a parallel-link guiding-means is used for the moving contacts, which is made possible by hanging the assembly from the top, with plenty of insulation, thus helping the gravity-operation, and in fact automatically providing gravity-operation; and the lever-system is completely trip-free in all positions. In addition, our novel operating-mechanism adds extreme simplicity and low cost to its other operational advantages.

With the foregoing and other objects in view, our invention consists in the systems, combinations, structures, parts, and methods of design and operation, hereinafter described and claimed, and illustrated in the accompanying drawing, wherein

Figure 1 is a diagrammatic view of circuits and apparatus illustrating the kind of system in which our invention is used,

Fig. 2 is a simplified cross-sectional view through the counting-means and through the operating-mechanism of a sectionalizer illustrative of our invention,

Figs. 3, 4 and 5 are linkage-diagrams showing the operation of the various parts, in the closed, tripped, and open positions, respectively, and

Fig. 6 is a force-diagram corresponding to Fig. 3.

In Fig. 1, we show our invention applied to a rural power-line **5** of the type described, which is fed from a power-source **6** through a diagrammatically indicated recloser **7**, having a normally closed breaker-contact **8**, and an operating-coil **9**, both connected in series with the line **5**. The recloser has an armature **11** which is mechanically connected, at **12**, to a block **13** which represents any suitable counter-and-lockout mechanism, which counts the number of rapidly repeated contact-opening-and-reclosing operations, and after a predetermined number of such operations locks out the recloser by thereafter holding the contact **8** in its open position, until the recloser is manually reset. It will be understood that the recloser-contact **8** is normally closed but opens in response to a predetermined over-current-condition in the coil **9**. The opening of the contact **8** deenergizes the coil **9**, and when the coil **9** is deenergized, the recloser-contact **8** automatically recloses itself, until the counter-mechanism **13** becomes effectively operative and holds the contact **8** in its open position. There are a number of such reclosers on the market, and their specific construction constitutes no part of our present invention, unless the mechanism **13** is designed so as to include our sectionalizer-operating mechanism which will be subsequently described. It is believed, therefore, that the diagrammatic recloser-illustration in Fig. 1 is sufficiently clear without further explanation or illustration.

The rural power-line **5** may extend out, either in a single branch, or in a plurality of branches **15** and **16**, each branch usually supplying a number of customers located at various points distributed along the line. Most of the faults which will occur on such a line are faults which will clear themselves as soon as voltage is removed from the line, although sometimes a fault may require a certain length of time, or a certain number of successive openings and reclosures of the recloser **7**, in order to burn off or clear the fault. The recloser **7** protects such a line by more or less rapidly opening and reclosing its breaker-contact **8** for a predetermined number of times, such as 4 or 5 times, after which, if the fault has not then cleared itself, the fault is considered to be a permanent fault and the recloser permanently opens its contact **8**.

Since a line **5** of the type in question, or its several branch-lines **15** and **16**, usually serve a considerable number of customers, it has been recognized as being desirable to use one or more sectionalizers for increasing the number of points, along the line, at which the circuit can be disconnected in the event of a permanent fault which will not clear itself, thus limiting the number of customers, or the amount of the circuit, affected by any permanent fault.

Fig. 1 illustrates a typical situation in which a sectionalizer **17** is inserted at some intermediate point along the length of the branch-line **15**, while a similar sectionalizer **18** is inserted at some intermediate point along the branch-line **16**. Each sectionalizer, such as **17**, comprises a series-connected operating-coil **19**, and a normally closed, series sectionalizer-contact **20**, both of which are connected in series with the associated branch-line such as **15**. The current-coil **19** operates on an armature **21** which is mechanically connected, as diagrammatically indicated at **22**, with a counter-and-lockout mechanism **23**, which is indicated by block-diagram in Fig. 1. The counter-and-lockout mechanism **23** is mechanically connected, as diagrammatically indicated at **24**, so as to trip out the sectionalizer-contact **20** after a predetermined number of "counts" of fault-current surges followed by interruptions of the current through the coil or solenoid **19**, the mechanism thereupon not only opening the contact **20** but also locking it out, or holding it open, so as to disconnect the power-service from the rest of the line, extending beyond the location of the sectionalizer (such as **17**), until the fault can be located and corrected, after which the sectionalizer will be reclosed or reset by hand.

Our invention relates to the detailed construction of the several sectionalizers, such as **17** or **18**, as shown in Fig. 2. The sectionalizer **17** is here shown as being enclosed within a metal tank **27**, which is provided with an insulating liner **28**, and which is surmounted by a top casting **29**. The incoming line **15** enters through a bushing **31** which terminates inside of the tank. The circuit then continues, through a conductor **32**, to the sectionalizer-coil **19**. From the sectionalizer-coil **19**, the circuit continues through a conductor **33** back underneath the bushing **31** for the incoming lead **15**, and thence to the terminal **34** which constitutes one of the stationary contacts of the sectionalizer. Ordinarily, the sectionalizer has two bushings, each with its lead passing through the bushing, and each bushing terminates, at its bottom, in one of the stationary contacts of the sectionalizers, but since Fig. 2 shows an approximate central section through the sectionalizer, the second stationary contact is not visible in Fig. 2, but it is indicated in Fig. 1 at **35**. The movable contact **20** is shown, in Fig. 2, as an inverted channel-shaped contact-bar or bridge which is slidably disposed on a pull-rod **36** and is so biased upwardly by means of a spring **30** which rests on a transverse pin **95** that it presses up against the underside of the stationary contacts **34** and **35**, in the closed position of the sectionalizer, and which is lowered by gravity, to operate the sectionalizer, upon the release of the pull-rod **36**, which is shown in the form of an upwardly extending insulating tube.

The counter-and-lockout mechanism **23** is segregated, in Fig. 2, into its component parts, consisting of the

counter or other tripping-mechanism 37, and the operating-mechanism 38.

The sectionalizer 17 can theoretically operate either in air, or in an insulating oil, or other insulating fluid. It is sometimes desirable for the counter 37 to operate in oil, as it involves dashpot or fluid-flow operation, as subsequently described, which is somewhat more difficult to obtain in air, with the necessary time-constants. It is sometimes desirable to have the contacts 34—20—35 also operating in oil. We have consequently illustrated our apparatus, by way of example, as having the counter 37 and the contacts 34—20—35 immersed in oil 40 which is contained in the tank 27.

According to our invention, the operating-mechanism 38 is mounted in a frame 41 which is bolted to the underside of the top casting 29. This operating mechanism 38 may be regarded as starting with the movable contact-member 20, and including the upwardly extending insulating pull-rod 36, the bottom end of which is connected to said movable contact-member. Pivotally connected, at 42, to the top of the pull-rod 36, is one of the two terminal pivot-points of a rocker-member or lever 43, which is shown, in its preferred form, as a triangular plate, disposed with its base-line nearly horizontal, with two terminal pivot-points 42 and 44 disposed near the ends of said base-line, and having an upwardly extending apex-portion which carries an intermediate rocker-point 45, which is pivotally connected to a first end of a normally nearly horizontal link 46, which will be subsequently described. The second terminal pivot-point 44 of the rocker-member 43 is pivotally connected to an intermediate point in a normally nearly horizontal latch 47, one end of which is connected to a stationary pivotal support 48. The intermediate pivot-point 44 of the latch 47 is closer to the pivotal support 48 for the latch than to the free end of the latch. The free end of the latch carries a roller 49 which is mounted on a horizontal pivot-pin 50.

In the normal closed position of the mechanism, the latch 47 extends in an approximately horizontal direction, and its roller 49 rests on the top of an upwardly extending arm 52 of an approximately right-angled bellcrank trigger 53, which is pivotally mounted on a stationary pivotal support 54. The trigger 53 also has a normally approximately horizontal arm 55 having a downwardly facing abutment-side 56 for engagement by an upwardly movable trip-pin 57 of the counter or other tripping-means 37. The trip-pin 57 is progressively stepped upwardly in response to movement of the armature 21 as a result of repeated energizations of the coil 19, as described in detail in the copending application Serial No. 196,508 of James M. Wallace and Andrew W. Edwards, filed November 18, 1950, and trigger 53 is normally biased to its latching position, as just described, this bias being provided either by gravity or by a spring 58, or both. A stop 51 engaging the frame 41 determines the latching position of the trigger 53.

The link 46, which is pivoted at one end 45 to the top of the triangular rocker-member 43, has a second end which is pivoted, at 59, to the inner end of an operating-handle 60. An intermediate point of the operating-handle 60 is secured to a stationary pivotal support 61, which is carried within the top casting 29. The outer end of the operating-handle 60 normally presses up against an abutment 62 which is carried by the underside of the top plate of the top casting 29.

In accordance with our invention, we also provide a reset-abutment 63 against which the lower edge of the triangular roller-member 43 is engaged in the open position of the mechanism. Conveniently, as shown, this reset-abutment is provided by a roller, or a stationary enlarged portion, 63, on the stationary pivot 54 for the trigger 53.

The operation of the operating-mechanism 38 is shown more in detail in Figs. 3, 4 and 5, which respectively show the closed, tripped, and open positions of the linkage-assembly of said operating-mechanism.

In the normal or closed position of the linkage, as shown in Fig. 3, the link 46 is in toggle-lock with respect to the operating-handle 60. In other words, the common intermediate pivotal point or overcenter toggle-point 59 of this toggle-linkage 60—46 is some $\frac{3}{32}$ of an inch below the line joining the two terminal-pivots 61 and 45 of this toggle, so that weight or other opening-bias of the movable contact-member 20 tends to rock the rocker-member 43 in a counter-clockwise direction about its second terminal pivot-point 44, so that said rocker-member presses the link 46 toward the operating-handle 60 in such direction that most of the thrust is taken by the pivotal support 61 of the operating-handle, but a small part of said thrust is transmitted to the abutment 62 for said operating-handle, in the normal closed position of the mechanism. The weight or other biasing-force of the movable contact-member 20 is borne by the latch 47, which is supported at its respective ends 49 and 48.

Fig. 4 shows the tripped position of the operating linkage, in an intermediate stage of the opening-operating of the movable contact-member 20. The tripping-operation is initiated by an upward pressure of the trip-pin 57 (Fig. 2) against the horizontal arm 55 of the trigger 53. The tripping-movement of the trigger 53 in a counter-clockwise direction removes the support from the free end 49 of the latch 47, so that the weight of the movable contact-member 20, pulling on the pull-rod 36, is transmitted by the rocker-member 43 to the latch 47, and causes the latter to swing down about its fixed pivot 48, as shown in Fig. 4. This downward movement of the latch is accompanied by a downward movement of the intermediate rocker-point 45 of the rocker-member 43, so as to break the toggle-lock with the operating-handle 60 at the pivot-point 59, as is shown in Fig. 4, wherein it is seen that the point 59 is now above the line drawn between the two terminal-pivots 61 and 45 of this toggle.

At one point during the opening movement of the movable contact-member 20, the rocker-member 43 moves down far enough to have its lower edge come into contact with the reset-abutment 54 or 63, as shown in Fig. 4, whereafter the still further continuing opening-movement rocks said rocker-plate in a counterclockwise direction about said reset-abutment and thus causes the intermediate rocker-point 45 of the rocker-member 43 to press on the link 46 and thus open the operating handle, as shown in Fig. 5, which shows the final opening position of the mechanism. During this counterclockwise tilting of the rocker-member, the second terminal pivot-point 44 of the rocker-member lifts the latch 47 up to a position above the upright arm 52 of the trigger 53. Thus, when the trip-pin 57 falls back out of engagement with the trigger 53, the gravity or other biasing means of the trigger 53 causes the trigger to fall back into its normal position, with the upright arm 52 in position to receive the downward thrust of the free end of the latch 47, when weight is again placed on said latch.

To close the breaker, the outer end or handle-portion of the operating-handle 60 must be elevated, and this movement of the handle depresses the inner end 59 thereof and causes the link 46 to rock the rocker-member 43 in a clockwise direction about its second terminal pivot 44, which promptly puts a downward thrust on the latch 47, bringing the latch-roller 49 against the top of the upright arm 52 of the trigger 53, and causing the parts to return to the closed position shown in Fig. 3.

If the sectionalizer-contact 20 is manually opened, not by a tripping action as just described, but by a manual opening-movement of the operating-handle 60, the first beginning of said movement elevates the inner pivot-point 59 of the operating handle and breaks the toggle at this place, which is shown in Fig. 1, after which the weight of the contact 20 causes the operating-handle to continue to move into its fully open position which is shown in Fig. 5.

The forces which are effective on the rocker-member 43 and the latch 47 in the normal closed position of the mechanism are indicated in Fig. 6, in which the position of the parts is the same as in Fig. 3. The contact-opening bias is indicated as a force F, pulling downward on the first terminal pivot-point 42 of the rocker-member 43 in line with the pull-rod 36. This force F, produces a positive or counterclockwise moment $+F, D$, tending to rotate the rocker-member 43 about its second terminal pivot-point 44. This positive moment $+F, D$, is exactly opposed by the link 46 which applies a force F_2 operating on the intermediate rocker-point 45 in line with said link 46, and producing a negative or clockwise moment $-F_2D_2$ tending to rotate the rocker-member 43 about its aforesaid second terminal pivot-point 44. In Fig. 6, the first moment-arm D, is substantially twice as long as the second moment-arm D_2, and hence the second force F_2 is substantially twice as large as the contact-bias F_1. Constructing a force-triangle of the forces F_1 and F_2, as indicated at 100, we can find the direction and the magnitude of the

resultant force F_3, which we can draw in, at the second terminal pivot-point **44**, as shown in Fig. 3. This completes the force-diagram for the triangular rocker-member **43** in Fig. 6.

The resultant-force F_3 acts on the latch **47** to produce a positive or counterclockwise moment $+F_3D_3$ tending to rotate the latch **47** about its stationary or fixed pivot **48** as shown in Fig. 6. This positive moment $+F_3D_3$ is exactly opposed by the upright trigger-arm **52** which applies a force F_4 operating upwardly on the free end **49** of said latch **47** in a line which passes through the trigger-pivot **54**, and producing a negative or clockwise moment $-F_4D_4$ tending to rotate the latch **47** about its pivot **48**. It is a desirable feature of our invention that the resultant-force F_3 should be in such a direction that its moment-arm D_3 will be quite small as compared with the effective length D_4 of the latch **47**. In Fig. 6, the resultant moment-arm D_3 is about one-seventh of the latch-length D_4 (or even considerably less), and hence the latch-pressure F_4 is small, only about one-seventh of the resultant force F_3.

The precise counter or tripping-means **37** is an improved form of counter which constitutes the subject-matter of a companion application of J. M. Wallace and A. W. Edwards, Serial No. 196,508, filed November 8, 1950. It is an essential feature of our invention, however, that this counting or tripping-mechanism **37**, whatever its details, is suspended on long tubular insulators **70** which depend from the top of the top casting **29**, so as to provide adequate insulation between the bottom **71** of the counter-mechanism **37**, and the tank of our sectionalizer-mechanism. The lower end **71** of the counter-mechanism **37** is provided with a groove **92**, which serves as a means for receiving a pivot-pin **93** which is thus positively located in a vertical direction with respect to the counter-mechanism **37**. The pin **93** is used as a stationary pivot for pivotally supporting one end of each of a pair of insulating guide-links **94**, the other ends of which are pivoted to the lower end of the pull-rod **36**, as shown at **95**. This link-guiding or suspension of the lower end of the pull-rod **36** guides the substantially vertical movement of the moving contact-member **20** during its opening movement, and at the same time insulates the contact-member **20** from the lower end **71** of the counter-mechanism **37**, which is in turn insulated from the top casting **29** by the long vertical insulators **70**. The vertical insulators **70** provide adequate insulation for the pivoted ends **93** of the guide-link insulators **94**, and hence the guide-link insulators constitute a particularly desirable guiding-means for a mechanism which is gravity-operated, as in our preferred construction as illustrated. The top end of the insulating pull-rod **36** is held by pin **42** with freedom of substantially vertical movement by the rocker-member **43** of the operating-mechanism **38**, which serves as a guide-link for that end of the pull-rod, in a known manner.

While we have illustrated our invention in but a single exemplary form of embodiment, which is now preferred, we wish it to be understood that our invention is susceptible of considerable modification, by way of additions, omissions and the substitution of various equivalents, without departing from the essential spirit of our invention, particularly in its broader aspects. We desire, therefore, that the appended claims shall be accorded the broadest construction consistent with their language.

We claim as our invention:

1. A latch-operated contact-separating mechanism, comprising the combination, with a movable contact-member which is normally closed but biased toward its open position, of a pull-rod connected at its first end to said movable contact-member, a rocker-member having two terminal pivot-points and an intermediate rocker-point, a first one of said terminal pivot-points of said rocker-member being pivotally connected to the second end of said pull-rod, a link having a first end pivotally connected to said intermediate rocker-point of said rocker-member, a latch, a stationary pivotal-supoprt for one end of said latch, the second terminal pivot-point of said rocker-member being pivotally connected to an intermediate point in the latch, closer to said stationary pivotal support for the latch than to the free end of the latch, a trigger having an arm normally abutting against the free end of the latch to hold said mechanism in its normal closed position, a stationary pivotal support for said trigger, said trigger having an abutment-side for engagement by a trip-pin to disengage said latch-holding arm of the trigger from said latch, an operating-handle, a stationary pivotal support for said operating-handle, the inner end of said operating-handle being pivotally connected to the second end of said link, means for providing an abutment to be engaged by said operating-handle in the closed position of the mechanism, and means for providing a reset-abutment to be engaged by an intermediate point of said rocker-member, intermediate between the two terminal pivot-points thereof, in the open position of the mechanism; said link being normally in toggle-lock with respect to said operating-handle, so that the bias-action of said normally closed movable contact-member tends to rock said rocker-member about its second terminal pivot-point, so that said rocker-member presses said link toward said operating-handle in such direction that most of the thrust is taken by the pivotal support of the operating-handle but a small part of said thrust is transmitted to the abutment for said operating-handle, in the normal closed position of said mechanism; said toggle-lock, with respect to the operating-handle, which is existent in the normal position of the mechanism, being broken in the tripped position wherein the trigger is disengaged from the latch, and the bias-action of the movable contact-member, which causes said movable contact-member to move in its opening direction, thereby assisting in causing said pull-rod to pull said rocker-member and hence said latch and the first end of said link in such direction as to break said toggle-lock, the continued opening movement of said movable contact-member causing said intermediate portion of said rocker-member to engage its aforesaid reset-abutment, whereafter the still further continuing opening movement rocks said rocker-member about said reset-abutment and thus opens the operating-handle and causes the latch to swing back past said latch-holding arm of the trigger.

2. A normally closed circuit-make-and-break device, comprising: stationary contact-means; a movable contact-member which is normally closed against said stationary contact-means, said movable contact-member being biased, however, toward its open position; an insulatedly supported tripping-means having a trip-pin; a pair of insulating guide-links, pivoted at one end to said tripping-means and pivoted at the other end to said movable contact-member to guide the same in its opening-movement; and an operating-mechanism comprising a pull-rod connected at its first end to said movable contact-member, a rocker-member having two terminal pivot-points and an intermediate rocker-point, a first one of said terminal pivot-points of said rocker-member being pivotally connected to the second end of said pull-rod, a link having a first end pivotally connected to said intermediate rocker-point of said rocker-member, a latch, a stationary pivotal support for one end of said latch, the second terminal pivot-point of said rocker-member being pivotally connected to an intermediate point in the latch, closer to said stationary pivotal support for the latch than to the free end of the latch, a trigger having an arm normally abutting against the free end of the latch to hold said mechanism in its normal closed position, a stationary pivotal support for said trigger, said trigger having an abutment-side for engagement by said trip-pin to disengage said latch-holding arm of the trigger from said latch, an operating-handle, a stationary pivotal support for said operating-handle, the inner end of said operating-handle being pivotally connected to the second end of said link, means for providing an abutment to be engaged by said operating-handle in the closed position of the mechanism, and means for providing a reset-abutment to be engaged by an intermediate point of said rocker-member, intermediate between the two terminal pivot-points thereof, in the open position of the mechanism; said link being normally in toggle-lock with respect to said operating-handle, so that the bias action of said normally closed movable contact-member tends to rock said rocker-member about its second terminal pivot-point, so that said rocker-member presses said link toward said operating-handle in such direction that most of the thrust is taken by the pivotal support of the operating-handle but a small part of said thrust is transmitted to the abutment for said operating-handle, in the normal closed position of said mechanism; said toggle-lock, with respect to the operating-handle, which is existent in the normal position of the mechanism, being broken in the tripped position wherein the trigger is disengaged from the latch, and the bias action of the movable contact-member, which causes said movable contact-member to move in its opening direction, thereby assisting in causing said pull-rod to pull said rocker-member and hence said latch and the

first end of said link in such direction as to break said toggle-lock, the continued opening movement of said movable contact-member causing said intermediate portion of said rocker-member to engage its aforesaid reset-abutment, whereafter the still further continuing opening movement rocks said rocker-member about said reset-abutment and thus opens the operating-handle and causes the latch to swing back past said latch-holding arm of the trigger.

3. A normally closed, gravity-operated, circuit-make-and-break device, comprising: stationary contact-means; a movable contact-member which is normally closed against the bottom of said stationary contact-means, the weight of said movable contact-member and of its connected parts constituting a gravity-bias tending to open said movable contact-member; a tripping-means having an upwardly movable trip-pin; downwardly extending insulating supports for suspending said tripping-means from the top of the circuit-make-and-break device; a pair of insulating guide-link, pivoted at one end to said tripping-means and pivoted at the other end to said movable contact-member to guide the same in its opening-movement; and an operating-mechanism comprising an upwardly extending insulating pull-rod connected at its bottom to said movable contact-member, a rocker-member having two terminal pivot-points and an intermediate rocker-point, a first one of said terminal pivot-points of said rocker-member being pivotally connected to the upper end of said pull-rod, a normally approximately horizontal link having a first end pivotally connected to said intermediate rocker-point of said rocker-member, a normally approximately horizontal latch, a stationary pivotal support for one end of said latch, the second terminal pivot-point of said rocker-member being pivotally connected to an intermediate point in the latch, closer to said stationary pivotal support for the latch than to the free end of the latch, a trigger having an upwardly extending arm normally abutting against the free end of the latch to hold said mechanism in its normal closed position, a stationary pivotal support for said trigger, said trigger having an abutment-side for engagement by said trip-pin to disengage said upwardly extending arm of the trigger from said latch, a normally approximately horizontal operating-handle, a stationary pivotal support for said operating-handle, the inner end of said operating-handle being pivotally connected to the second end of said link, means for providing an abutment to be engaged by said operating-handle in the closed position of the mechanism, and means for providing a reset-abutment to be engaged by an intermediate point of a lower edge of said rocker-member, intermediate between the two terminal pivot-points thereof, in the open position of the mechanism; said link being normally in toggle-lock with respect to said operating-handle, so that the bias-action of said normally closed movable contact-member tends to rock said rocker-member about its second terminal pivot-point, so that said rocker-member presses said link toward said operating-handle in such direction that most of the thrust is taken by the pivotal support of the operating-handle but a small part of said thrust is transmitted to the abutment for said operating-handle, in the normal closed position of said mechanism; said toggle-lock, with respect to the operating-handle, which is existent in the normal position of the mechanism, being broken in the tripped position wherein the trigger is disengaged from the latch, and the bias-action of the movable contact-member, which causes said movable contact-member to move downwardly in its opening direction, thereby assisting in causing said pull-rod to pull said rocker-member and hence said latch and the first end of said link downwardly so as to break said toggle-lock, the continued opening movement of said movable contact-member causing said intermediate portion of said rocker-member to engage its aforesaid reset-abutment, whereafter the still further continuing opening movement rocks said rocker-member about said reset-abutment and thus opens the operating-handle and causes the latch to swing back upwardly past the upwardly extending arm of the trigger.

4. The invention as defined in claim 1, characterized by said intermediate rocker-point being offset out of alignment with two terminal pivot-points of said rocker-member.

5. The invention as defined in claim 2, characterized by said intermediate rocker-point being offset out of alignment with two terminal pivot-points of said rocker-member.

6. The invention as defined in claim 3, characterized by said intermediate rocker-point being offset above the line joining the two terminal pivot-points of the rocker-member.

7. A latch-operated contact-separating mechanism, comprising the combination, with a movable contact-member which is normally closed but biased toward its open position, of a pull-rod connected at its first end to said movable contact-member, a rocker-member having two terminal pivot-points and an offset intermediate rocker-point, out of alignment with the two terminal pivot-points, a first one of said terminal pivot-points of said rocker-member being pivotally connected to the second end of said pull-rod, a link having a first end pivotally connected to said offset intermediate rocker-point of said rocker-member, a latch, a stationary pivotal support for one end of said latch, the second terminal pivot-point of said rocker-member being pivotally connected to the latch at such a point that the resultant of the pull-rod force and the link force, applied to the latch at said point, has a latch-operating moment-arm which is short as compared to the effective length of the latch, a trigger having an arm normally abutting against the free end of the latch to hold said mechanism in its normal closed position, a stationary pivotal support for said trigger, said trigger having an abutment-side for engagement by a trip-pin to disengage said latch-holding arm of the trigger from said latch, an operating-handle, a stationary pivotal support for said operating-handle, the inner end of said operating-handle being pivotally connected to the second end of said link, means for providing an abutment to be engaged by said operating-handle in the closed position of the mechanism, and means for providing a reset-abutment to be engaged by an intermediate point of said rocker-member, intermediate between the two terminal pivot-points thereof, in the open position of the mechanism; said link being normally in toggle-lock with respect to said operating-handle, so that the bias-action of said normally closed movable contact-member tends to rock said rocker-member about its second terminal pivot-point, so that said rocker-member presses said link toward said operating-handle in such direction that most of the thrust is taken by the pivotal support of the operating-handle but a small part of said thrust is transmitted to the abutment for said operating-handle, in the normal closed position of said mechanism; said toggle-lock, with respect to the operating-handle, which is existent in the normal position of the mechanism, being broken in the tripped position wherein the trigger is disengaged from the latch, and the bias-action of the movable contact-member, which causes said movable contact-member to move in its opening direction, thereby assisting in causing said pull-rod to pull said rocker-member and hence said latch and the first end of said link in such direction as to break said toggle-lock, the continued opening movement of said movable contact-member causing said intermediate portion of said rocker-member to engage its aforesaid reset-abutment, whereafter the still further continuing opening movement rocks said rocker-member about said reset-abutment and thus opens the operating-handle and causes the latch to swing back past said latch-holding arm of the trigger.

8. A normally closed circuit-make-and-break device, comprising: stationary contact-means; a movable contact-member which is normally closed against said stationary contact-means, said movable contact-member being biased, however, toward its open position; an insulated supported tripping-means having a trip-pin; a pair of insulating guide-links, pivoted at one end to said tripping-means and pivoted at the other end to said movable contact-member to guide the same in its opening-movement; and an operating-mechanism comprising a pull-rod connected at its first end to said movable contact-member, a rocker-member having two terminal pivot-points and an offset intermediate rocker-point, out of alignment with the two terminal pivot-points, a first one of said terminal pivot-points of said rocker-member being pivotally connected to the second end of said pull-rod, a link having a first end pivotally connected to said offset intermediate rocker-point of said rocker-member, a latch, a stationary pivotal support for one end of said latch, the second terminal pivot-point of said rocker-member being pivotally connected to the latch at such a point that the resultant of the pull-rod force and the link force, applied to the latch at said point, has a latch-operating moment-arm which is short as compared to the effective length of the latch, a trigger having an arm

normally abutting against the free end of the latch to hold said mechanism in its normal closed position, a stationary pivotal support for said trigger, said trigger having an abutment-side for engagement by said trip-pin to disengage said latch-holding arm of the trigger from said latch, an operating-handle, a stationary pivotal support for said operating-handle, the inner end of said operating-handle being pivotally connected to the second end of said link, means for providing an abutment to be engaged by said operating-handle in the closed position of the mechanism, and means for providing a reset-abutment to be engaged by an intermediate point of said rocker-member, intermediate between the two terminal pivot-points thereof, in the open position of the mechanism; said link being normally in toggle-lock with respect to said operating-handle, so that the bias-action of said normally closed movable contact-member tends to rock said rocker-member about its second terminal pivot-point, so that said rocker-member presses said link toward said operating-handle in such direction that most of the thrust is taken by the pivotal support of the operating-handle but a small part of said thrust is transmitted to the abutment for said operating-handle, in the normal closed position of said mechanism; said toggle-lock, with respect to the operating-handle, which is existent in the normal position of the mechanism, being broken in the tripped position wherein the trigger is disengaged from the latch, and the bias-action of the movable contact-member, which causes said movable-contact-member to move in its opening direction, thereby assisting in causing said pull-rod to pull said rocker-member and hence said latch and the first end of said link in such direction as to break said toggle-lock, the continued opening movement of said movable contact-member causing said intermediate portion of said rocker-member to engage its aforesaid reset-abutment, whereafter the still further continuing opening movement rocks said rocker-member about said reset-abutment and thus opens the operating-handle and causes the latch to swing back past said latch-holding arm of the trigger.

9. A normally closed, gravity-operated, circuit-make-and-break device, comprising: a stationary contact means: a movable contact-member which is normally closed against the bottom of said stationary contact-means, the weight of said movable contact-member and of its connected parts constituting a gravity-bias tending to open said movable contact-member; a tripping-means having an upwardly movable trip-pin; downwardly extending insulating supports for suspending said tripping-means from the top of the circuit-make-and-break device; a pair of insulating guide-links, pivoted at one end to said tripping means and pivoted at the other end to said movable contact-member to guide the same in its opening-movement; and an operating-mechanism comprising an upwardly extending insulating pull-rod connected at its bottom to said movable contact-member, a rocker-member having two terminal pivot-points and an offset intermediate rocker-point, out of alignment with the two terminal pivot-points, a first one of said terminal pivot-points of said rocker-member being pivotally connected to the upper end of said pull-rod, a normally approximately horizontal link having a first end pivotally connected to said offset intermediate rocker-point of said rocker-member, a normally approximately horizontal latch, a stationary pivotal support for one end of said latch, the second terminal pivot-point of said rocker-member being pivotally connected to the latch at such a point that the resultant of the pull-rod force and the link force, applied to the latch at said point, has a latch-operating moment-arm which is short as compared to the effective length of the latch, a trigger having an upwardly extending arm normally abutting against the free end of the latch to hold said mechanism in its normal closed position, a stationary pivotal support for said trigger, said trigger having an abutment-side for engagement by said trip-pin to disengage said upwardly extending arm of the trigger from said latch, a normally approximately horizontal operating-handle, a stationary pivotal support for said operating-handle, the inner end of said operating-handle being pivotally connected to the second end of said link, means for providing an abutment to be engaged by said operating-handle in the closed position of the mechanism, and means for providing a reset-abutment to be engaged by an intermediate point of a lower edge of said rocker-member, intermediate between the two terminal pivot-points thereof, in the open position of the mechanism; said link being normally in toggle-lock with respect to said operating-handle, so that the bias-action of said normally closed movable contact-member tends to rock said rocker-member about its second terminal pivot-point, so that said rocker-member presses said link toward said operating-handle in such direction that most of the thrust is taken by the pivotal support of the operating-handle but a small part of said thrust is transmitted to the abutment for said operating-handle, in the normal closed position of said mechanism; said toggle-lock, with respect to the operating-handle, which is existent in the normal position of the mechanism, being broken in the tripped position wherein the trigger is disengaged from the latch, and the bias-action of the movable contact-member, which causes said movable contact-member to move downwardly in its opening direction, thereby assisting in causing said pull-rod to pull said rocker-member and hence said latch and the first end of said link downwardly so as to break said toggle-lock, the continued opening movement of said movable contact-member causing said intermediate portion of said rocker-member to engage its aforesaid reset-abutment, whereafter the still further continuing opening movement rocks said rocker-member about said reset-abutment and thus opens the operating-handle and causes the latch to swing back upwardly past the upwardly extending arm of the trigger.

10. A circuit-interrupter comprising fixed contact-means, a movable contact-member adapted to be moved into and out of engagement with said fixed contact-means, an insulating operating-rod movable longitudinally to actuate said movable contact-member, two sets of pivoted-link mechanisms connected to the operating rod on opposite sides of the movable contact-member and longitudinally spaced along the rod for separately guiding the respective ends of said operating-rod during the movement of said movable contact-member, and means comprising a manually operable toggle linkage connected to the link mechanism more remote from the contact-member for actuating the contact-member into and out of engagement with said fixed contact-means.

11. A circuit-interrupter comprising fixed contact-means, a movable contact-member adapted to be moved substantially upwardly into engagement with said fixed contact-means and substantially downwardly out of engagement therewith, a substantially vertically extending insulating pull-rod having its lower end secured to said movable contact-member, a gravity-operated operating-mechanism comprising a pivoted member which serves as a guide-link for holding the top end of said pull-rod with freedom of substantially vertical movement, manual operating means connected to said member, an electrically controlled tripping-mechanism having a frame and having an advanceable member adapted to trip said operating-mechanism in response to repeated overcurrents only, insulating supporting-means for the frame of said tripping-mechanism, and an insulating guide-link connected between the lower end of said pull-rod and said frame of the tripping-mechanism for holding said lower end with freedom of substantially vertical movement.

12. In a circuit interrupter, a pair of spaced stationary contacts, a movable contact disposed to bridge the stationary contacts, an operating mechanism including a lever having two terminal points and an intermediate point of connection, an insulating rod having a yieldable connection with the movable contact connected to one of said terminal points, releasable means including a support lever pivotally supported and pivotally connected to the aforesaid lever at the other terminal point disposed to support said other terminal point, and manually operable means connected to said intermediate point of connection for operating the lever to move the movable contact into and out of engagement with said stationary contacts.

13. A circuit interrupter comprising, a pair of spaced stationary contacts, a lever mechanism including a lever having a pair of spaced terminal points, an insulating pull rod pivotally connected to one of the terminal points, a channel-shaped bridging contact slidably disposed on the pull rod and having spring means to bias it toward the stationary contacts, releasable means including a support lever and a latch therefor disposed to support said other terminal point, and manual operating means connected to said lever intermediate said terminal points.

14. A circuit interrupter comprising, stationary contact means, a lever mechanism including a lever having two terminal points and an intermediate point of connection, an insulating rod connected to one of said terminal points,

an inverted channel-shaped contact member slidably disposed on the rod to engage said stationary contact means, a spring disposed on the rod within the channel-shaped contact means, releasable means including a support pivotally supporting the other terminal point of the lever and a latch therefor, and a manually operable toggle mechanism connected to said intermediate point of connection for actuating said lever to effect separation and engagement of said channel-shaped contact member and said stationary contact means.

15. A circuit interrupter comprising, separable contact means, an operating mechanism for said contact means comprising, a toggle means having a first undercenter position when said contact means are closed and movable to another overcenter position when said contact means are opened, said toggle means having two links each with two terminal points and an intermediate pivot point, a terminal point of one link and the intermediate point of the other comprising a common pivot point, electroresponsive trip means having a movable trip member for displacing one of said terminal points to move said toggle means from its first undercenter position to its other overcenter position, and a handle connected to one of said links for moving it to effect relative displacement of said common pivot point and thereby moving said toggle means to its other overcenter position.

16. A circuit interrupter comprising, separable contact means biased to the open position, an operating mechanism for said contact means comprising a toggle means of two links, one having a terminal pivot point, releasable means normally holding said pivot point stationary, a common intermediate pivot point for said links having a first overcenter position when said contact means are closed and movable to its other overcenter position when said contact means are opened, electromagnetically controlled tripping means having a movable trip pin disposed to displace said releasably held terminal point and thereby move said intermediate pivot point from its first overcenter position to said other overcenter position, and an extension on one of said links for manually displacing said intermediate pivot point to either of its overcenter positions.

17. A circuit interrupter comprising, separable contact means, an operating mechanism for said contact means comprising a toggle means of two links each having two terminal points and a common intermediate pivot point which has a first overcenter position when said contact means are closed and another overcenter position when they are opened, releasable means operable to support one of said terminal pivot points, electromagnetically controlled tripping means having a movable trip member operable to actuate said releasable means and displace said one terminal point to move the intermediate pivot point from its first overcenter position to its other overcenter position, means for resetting said releasable means during opening of said contact means to restore it to its terminal point supporting condition, and manually operable means for displacing said common intermediate pivot point from its first overcenter position to its other overcenter position.

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