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R. C. VAN SICKLE

2,467,788

CIRCUIT INTERRUPTER

Filed July 20, 1944

Fig. 1.

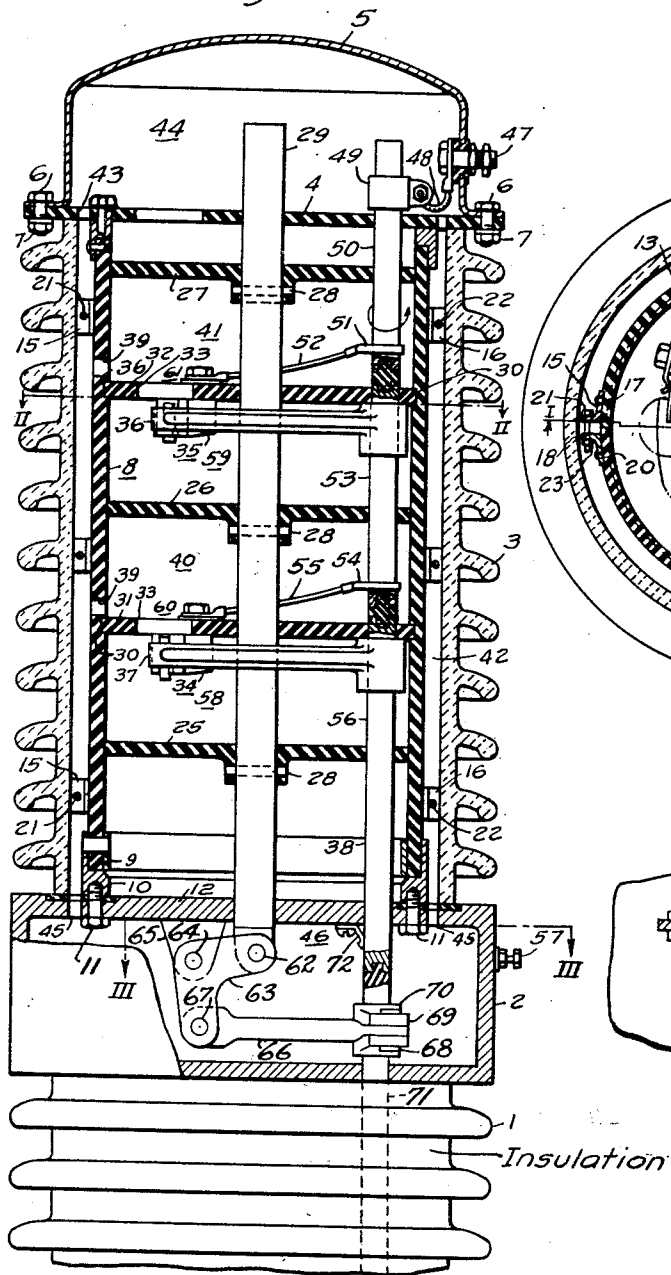


Fig. 2.

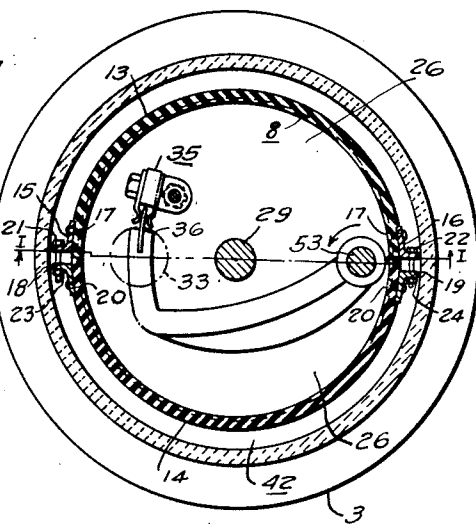
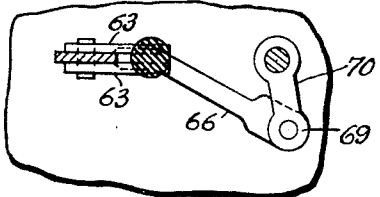


Fig. 3.



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CIRCUIT INTERRUPTER

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This invention relates to circuit interrupters in general and, more particularly, to arc extinguishing structures therefor.

In United States Patent No. 2,253,009 which issued August 19, 1941, to Benjamin P. Baker and which was assigned to the assignee of the instant application, there is shown a circuit interrupter of the "oil-poor" type in which two arc extinguishing units are disposed in superposed relation. A longitudinal member carrying two pistons with the movable contact structure moves axially of the interrupter, and in the fully open circuit position of the interrupter a disconnect member also moves longitudinally downwardly away from the aforesaid longitudinal member to effect an isolating gap into the circuit passing through the interrupter.

From an examination of the structure described in the aforesaid patent, it will be noted that since the movable parts move longitudinally of the interrupter there is consequently necessitated an insulator of considerable length. It is an object of my invention to provide an interrupter of the "oil-poor" type in which the insulator is considerably shortened by having only little longitudinal motion take place.

A general object of my invention is to provide an improved circuit interrupter which will more effectively break the circuit passing therethrough than has been achieved heretofore.

A more specific object is to provide an improved interrupting structure, the constructional details of which minimize back pressure of the gases formed during the opening operation, thus cutting down the load imposed on the operating mechanism.

Another object is to provide an improved circuit interrupter in which there is needed only a small amount of energy to actuate the moving parts.

Another object is to provide an improved circuit interrupter in which the generated gas pressures do not oppose the opening or closing of the contact structure.

Another object is to provide an improved circuit interrupter in which an arc is established and extinguished by the operation of an interrupting unit associated with the arc. I provide means forming an entrance region adjacent the unit and also an exhaust region adjacent the unit, and I provide means for simultaneously diminishing the volume of the entrance region and expanding the volume of the exhaust region to force fluid through the unit to effect extinction of the arc.

Further objects and advantages will readily

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become apparent upon a reading of the following specification, taken in conjunction with the drawing, in which:

Figure 1 is an elevational view, partly in section, taken on I—I of Fig. 2, of a circuit interrupter embodying my invention and shown in the closed circuit position;

Fig. 2 is a sectional view taken along the line II—II of Fig. 1; and

Fig. 3 is a fragmentary sectional view of the operating mechanism taken on the line III—III of Fig. 1.

Referring to the drawing, and more particularly to Figure 1 thereof, the reference numeral 1 designates an insulator, which supports a housing 2 in which is disposed suitable operating mechanism. Supported by the housing 2 is an insulator column 3 at the top of which rests an insulating plate 4. A cap 5 is secured to the plate 4 by bolts 6 and nuts 7.

Disposed centrally within the column 3 is a longitudinal insulating casing 8, the lower end of which may be slidably inserted into an annular recess 9 provided in a ring 10, the latter being secured by bolts 11 to the horizontal portion 12 of the housing 2. The casing 8 is formed by two co-operating longitudinal halves 13, 14. The longitudinal half 13 has brackets 15, 16 secured thereto by screws 17. The longitudinal half 14 has brackets 18, 19 secured thereto by screws 20. In the assembled position, bolts 21, 22 and nuts 23, 24 rigidly hold the two longitudinal halves 13, 14 together to form the casing 8.

Movable longitudinally within the casing 8 are piston members 25, 26 and 27 rigidly secured by pins 28 to an insulating operating rod 29, the latter moving axially within the casing 8 and operated by suitable operating mechanism disposed within the housing 2 and hereinafter described.

Supported in annular recesses 30 formed in the casing 8 are apertured partition means, in this instance comprising two diaphragms 31, 32, each of which is provided with an aperture 33. Disposed below each diaphragm and laterally to one side of the aperture 33 are stationary contact structures 35, 34, respectively, cooperating with movable contact structures 35, 37, the latter being rotatable and operated by rotation of an operating rod 38, the latter being actuated by the mechanism disposed within the housing 2.

The operating rod 29 is pivotally connected at 62 adjacent its lower end between a pair of bell cranks 63, the latter being pivoted at 64 to a bracket 65. The bracket 65 depends from the

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horizontal portion 12 of the housing 2. A link 66 has one end pivotally connected at 67 between the bell cranks 63. The other end of the link 66 is pivotally connected at 68 to a bifurcated portion 69 of an arm 70. The arm 70 is secured to and rotatable with the insulating portion 71 of the operating rod 38. The lower insulating end 71 of the operating rod 38 extends downwardly as shown in Fig. 1 within the insulator 1. Suitable mechanism, not shown, may be employed to effect rotation of the lower end of the rod 71. Thus rotation of rod 71 simultaneously effects contact separation and upward movement of the three piston members 25, 26, 27.

The casing 8 has vents 39 formed therein which permit communication between exhaust regions 40, 41 and the annular region 42 formed between the casing 8 and the insulator 3. This annular region 42 communicates by apertures 43 provided in the plate 4 to the region 44 defined by the cap 5. The region 42 also communicates by way of apertures 45 to the region 46 defined by the housing 2.

In the closed circuit position of the interrupter, as shown in Figs. 1 and 2, the electrical circuit passing therethrough comprises terminal stud 47, connector 48, clamp 49, conducting portion 50 of rod 38, clamp 51, conductor 52, stationary contact 35, movable contact 36, conducting portion 53 of rod 38, clamp 54, conductor 55, stationary contact 34, movable contact 37, conducting portion 56 of rod 38 to a sliding contact 72 through the conducting housing 2, to the lower terminal stud 57.

To open the electrical circuit passing through the interrupter, the operating means disposed within the housing 2 effects a rotation of the rod 38 to effect thereby a separation between the movable contact structures 36, 37 from the stationary contact structures 34, 35. This draws an arc across each aperture 33.

Simultaneously or prior to rotation of the rod 38, the operating mechanism disposed within the housing 2 effects an upward motion of the operating rod 29 to thereby cause the piston members 25, 26 and 27 to move upwardly. The upward movement of the piston members 25, 26 diminishes the volume of the entrance regions 58, 59 associated with the two diaphragms 31, 32. It will be observed that not only does upward movement of the piston member 26 effect a diminishment of volume of the entrance region 59, but also it simultaneously effects an expansion of the exhaust region 40. The upward movement of the piston member 27 increases the volume of the exhaust region 41 and the upward motion of the piston member 25 diminishes the volume of the entrance region 58.

From the foregoing description, it is apparent that the upward movement of the piston members 25, 26 during the opening operation forces fluid, in this instance oil, to flow upwardly through the apertures 33 associated with the apertured partition means or diaphragms 31, 32 to effect the extinction of the arcs drawn adjacent thereto. The diminishment of the volumes of the entrance regions 58, 59 forces oil to flow through the apertures 33, and the expansion of the volumes of the exhaust regions 40, 41 facilitates this passage of fluid through the apertures 33. The vents 39 permit exhaust gases to pass out of the exhaust regions 40, 41 to the annular region 42, the latter being vented through the apertures 43 with the region 44 provided by the cap 5.

It is apparent from the foregoing description that the length of the interrupting structure is

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considerably reduced by the rotative opening movement of the movable contact structures. Also, it is apparent that the casing 8 may be removed from the insulator column 3 and by a removal of the bolts 21, 22 the longitudinal half 14 may be removed for inspection purposes without interfering with the interrupting structure which remains in a position supported by the other half 13.

Although the interrupting units 60, 61 have been assumed to be merely orifice type interrupting structures such as the apertured diaphragms 31, 32, it should be clearly understood that other interrupting structures may be substituted therefor. Merely for purposes of illustration have I shown the interrupting units 60, 61 associated with the arcs drawn to be of simple orifice type. Any interrupting structure could be used in which fluid passes. If a different interrupting structure were used, the upward movement of the piston members 25, 26 could be used to force oil through such different interrupting structures.

It will be noted that due to the large area of the piston members 25, 26 and 27 a relatively low rod velocity can produce a high oil velocity in the several interrupting units 60, 61. However, only a small amount of oil moves at high speed through the apertures 33. As the piston members 26 and 27 move upwardly, they make room for oil behind them, thereby facilitating the flow of oil through the interrupting units 60, 61.

Arcs will produce pressure due to gas generation. Due to the location of the interrupting units 60, 61, the pressure should be transmitted almost equally to both adjacent oil chambers, the one above and the other below the interrupting unit. This gas will act on both pistons and the pressure will be neutralized so that no heavy extra burden is imposed on the opening mechanism when the arc produces heavy pressure. The vents 39 are provided for the escape of gases during and after the interruption process. They destroy part of the neutralizing action, but by proper adjustment of their size the gases can be permitted to escape and the forces balanced adequately.

The advantages of my invention are as follows:

(1) There is low energy of the moving parts. Little energy goes into kinetic energy because the oil pistons move upwardly relatively slowly; consequently most of the oil and the operating rod 29 move relatively slowly. The contact operating rod operates in torsion and requires relatively little energy. The contacts on the ends of the arms are the only high speed parts except for the oil passing through the interrupting units 60, 61. Therefore, little energy goes into the kinetic energy of the moving parts.

(2) The circuit interrupter requires only a low amount of energy to be operated. The forces supplied by the mechanism are not required to overcome large unbalanced back pressures due to the arc. Gas pressures are substantially balanced.

(3) Gas pressures do not oppose closing or opening since the contact moves in but not into the entrance chambers 58, 59. Thus there is no piston action tending to blow the contacts apart or together.

(4) The contacts and interrupting units 60, 61 are assembled and adjusted on one-half of the casing. The other half is then employed to close the casing, which is then inserted in the insulator column 3. The lower end of the casing then fits into the guide 10 and the upper end of the casing is secured to the cap 5 supplying the mechanism.

cal strength of the complete assembly. The breaker is, therefore, easily assembled and disassembled for inspection, maintenance and adjustment.

(5) This circuit breaker may use various types of interrupting units 60, 61. Thus the arcs may be blown into relatively simple interrupting units such as apertures provided in diaphragms or against splitters, or into interrupting units of the type which move the arc laterally by magnetic means into a restricted slot containing oil pockets and having venting passages at the end of the said restricted slot, or the interrupting unit may be of the form shown in the aforesaid Baker patent, with the oil blast being supplied by the piston members 25, 26 and the contact movement furnished by the rotating shaft 38. Such a design would have the advantage that the two movements were independently adjustable and the oil flow could be started before the contact separates.

It will, of course, be apparent that rotative separating motion of the movable contact structure is not necessary to eliminate the piston action prevalent in commercial breakers tending to oppose the opening and closing movements. That is, instead of the rod 38 being rotated it could be arranged to move axially of the interrupter, thereby producing separation of the contact structure, but not increasing or decreasing the volume of the entrance chambers 58, 59.

Although I have shown and described a specific structure, it is to be clearly understood that the same was merely for the purpose of illustration and that changes and modifications may readily be made by those skilled in the art without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. In a circuit interrupter, a longitudinal casing, means for establishing an arc, an interrupting unit including apertured partition means associated with the arc and fixed to the casing, means forming an entrance region adjacent the unit on one side of the partition means, means forming an exhaust region adjacent the unit on the other side of the partition means, and means including a pair of simultaneously longitudinally movable piston members disposed on opposite sides of the partition means for simultaneously diminishing the volume of the entrance region and expanding the volume of the exhaust region to force fluid through the unit to effect extinction of the arc.

2. In a circuit interrupter, means defining a longitudinal casing, means for establishing a first arc, a first interrupting unit associated with the first arc and fixed to the casing, means for establishing a second arc, a second interrupting unit associated with the second arc and also fixed to the casing, means forming a first entrance region adjacent the first unit, means forming a first exhaust region adjacent the first unit, means forming a second entrance region adjacent the second unit, means forming a second exhaust region adjacent the second unit, and longitudinally movable means including common wall means separating the first exhaust region and the second entrance region for simultaneously diminishing the volume of both entrance regions and expanding the volume of both exhaust regions to force fluid through both units to effect the extinction of both arcs.

3. In a circuit interrupter, means defining a longitudinal casing, means for establishing an

arc, an interrupting unit including an apertured diaphragm associated with the arc and fixed to the casing, means forming an entrance region adjacent the unit on one side of the diaphragm, means forming an exhaust region adjacent the unit on the other side of the diaphragm, and piston means including a pair of simultaneously longitudinally movable piston members disposed on opposite sides of the diaphragm for simultaneously diminishing the volume of the entrance region and expanding the volume of the exhaust region to force fluid through the unit to effect extinction of the arc.

4. In a circuit interrupter, means defining a longitudinal casing, means for establishing a first arc, a first interrupting unit including apertured partition means associated with the first arc and fixed to the casing, means for establishing a second arc, a second interrupting unit including apertured partition means associated with the second arc and also fixed to the casing, means forming a first entrance region adjacent the first unit, means forming a first exhaust region adjacent the first unit, means forming a second entrance region adjacent the second unit, means forming a second exhaust region adjacent the second unit, and longitudinally movable piston means including common wall means separating the first exhaust region and the second entrance region for simultaneously diminishing the volume of both entrance regions and expanding the volume of both exhaust regions to force fluid through both units to effect the extinction of both arcs.

5. In a circuit interrupter, means defining a longitudinal casing, means for establishing a first arc, a first interrupting unit associated with the first arc and fixed to the casing, means for establishing a second arc, a second interrupting unit associated with the second arc and also fixed to the casing, means forming a first entrance region adjacent the first unit, means forming a first exhaust region adjacent the first unit, means forming a second entrance region adjacent the second unit, means forming a second exhaust region adjacent the second unit, and means comprising three longitudinally movable piston members at least one of which constitutes common wall means for simultaneously diminishing the volume of both entrance regions and expanding the volume of both exhaust regions to force fluid through both units to effect the extinction of both arcs.

6. In a circuit interrupter, rotatable means for establishing an arc, apertured partition means, an interrupting unit including the apertured partition means associated with the arc, means forming an entrance region adjacent the unit on one side of the partition means, means forming an exhaust region adjacent the unit on the other side of the partition means, and means for simultaneously diminishing the volume of the entrance region and expanding the volume of the exhaust region to force fluid through the unit to effect extinction of the arc.

7. In a circuit interrupter, means defining a longitudinal casing, first rotatable means for establishing a first arc, a first interrupting unit associated with the first arc and fixed to the casing, a second rotatable means for establishing a second arc, a second interrupting unit associated with the second arc and also fixed to the casing, means forming a first entrance region adjacent the first unit, means forming a first exhaust re-

gion adjacent the first unit, means forming a second entrance region adjacent the second unit, means forming a second exhaust region adjacent the second unit, and longitudinally movable means including common wall means separating the first exhaust region and the second entrance region for simultaneously diminishing the volume of both entrance regions and expanding the volume of both exhaust regions to force fluid through both units to effect the extinction of both arcs.

8. In a circuit interrupter, means defining a longitudinal casing, first rotatable means for establishing a first arc, a first interrupting unit including apertured partition means associated with the first arc and fixed to the casing, a second rotatable means for establishing a second arc, a second interrupting unit including apertured partition means associated with the second arc and also fixed to the casing, means forming a first entrance region adjacent the first unit, means forming a first exhaust region adjacent the first unit, means forming a second entrance region adjacent the second unit, means forming a second exhaust region adjacent the second unit, longitudinally movable means including common wall means between the first exhaust region and the second entrance region for simultaneously diminishing the volume of both entrance regions and expanding the volume of both exhaust regions to force fluid through both units to effect the extinction of both arcs, and operating means for simultaneously causing the actuation of both the first and second rotatable means.

9. In a circuit interrupter, means forming a casing, a diaphragm fixed to the casing and having an aperture therethrough, means for establishing an arc adjacent the aperture, a first piston member movable within the casing and cooperable with the diaphragm to form an entrance region, a second piston member movable within the casing and cooperable with the diaphragm to form an exhaust region, and means for simultaneously moving both the first and second piston members to simultaneously effect a diminishment of the volume of the entrance region and an expansion of the volume of the exhaust region to force fluid through the aperture to effect extinction of the arc.

10. In a circuit interrupter, means forming a casing, a first diaphragm fixed to the casing and having a first aperture therethrough, means for establishing a first arc adjacent to the first aperture, a second diaphragm fixed to the casing and having a second aperture therethrough, means for establishing a second arc adjacent to the second aperture, a first piston member cooperable with the first diaphragm to form a first entrance region adjacent the first arc, a second piston member movable between the first and second diaphragms, and a third piston member cooperable with the second diaphragm to form a second exhaust region for the second arc.

11. In a circuit interrupter, means forming a casing, a first diaphragm fixed to the casing and having a first aperture therethrough, means for establishing a first arc adjacent to the first aperture, a second diaphragm fixed to the casing and having a second aperture therethrough, means for establishing a second arc adjacent to the second aperture, a first piston member cooperable with the first diaphragm to form a first entrance region adjacent the first arc, a second piston member movable between the first and second diaphragms, a third piston member cooper-

able with the second diaphragm to form a second exhaust region for the second arc, and means for simultaneously causing the motion of all three piston members.

12. In a circuit interrupter, means forming a casing, a diaphragm fixed to the casing and having an aperture therethrough, rotatable means for establishing an arc adjacent the aperture, a first piston member longitudinally movable within the casing and cooperable with the diaphragm to form an entrance region, a second piston member longitudinally movable within the casing and cooperable with the diaphragm to form an exhaust region, and means for simultaneously moving both the first and second piston members longitudinally within the casing to simultaneously effect a diminishment of the volume of the entrance region and an expansion of the volume of the exhaust region to force fluid through the aperture to effect extinction of the arc.

13. In a circuit interrupter, means forming a casing, a first diaphragm fixed to the casing and having a first aperture therethrough, a first rotatable means for establishing a first arc adjacent to the first aperture, a second diaphragm fixed to the casing and having a second aperture therethrough, a second rotatable means for establishing a second arc adjacent to the second aperture, a first piston member cooperable with the first diaphragm to form a first entrance region adjacent the first arc, a second piston member movable between the first and second diaphragms, and a third piston member cooperable with the second diaphragm to form a second exhaust region for the second arc.

14. In a circuit interrupter, means forming a casing, a first diaphragm fixed to the casing and having a first aperture therethrough, a first rotatable means for establishing a first arc adjacent to the first aperture, a second diaphragm fixed to the casing and having a second aperture therethrough, a second rotatable means for establishing a second arc adjacent to the second aperture, a first piston member cooperable with the first diaphragm to form a first entrance region adjacent the first arc, a second piston member movable between the first and second diaphragms, a third piston member cooperable with the second diaphragm to form a second exhaust region for the second arc, and operating means for simultaneously causing the actuation of both the first and second rotatable means.

15. In a circuit interrupter, means forming a casing, a first diaphragm fixed to the casing and having a first aperture therethrough, a first rotatable means for establishing a first arc adjacent to the first aperture, a second diaphragm fixed to the casing and having a second aperture therethrough, a second rotatable means for establishing a second arc adjacent to the second aperture, a first piston member cooperable with the first diaphragm to form a first entrance region adjacent the first arc, a second piston member movable between the first and second diaphragms, a third piston member cooperable with the second diaphragm to form a second exhaust region for the second arc, operating means for simultaneously causing the actuation of both the first and second rotatable means, and means for simultaneously causing the motion of all three piston members.

16. In a circuit interrupter, a casing, a plurality of apertured partition members, a plurality of piston members, the partition members and

piston members being spaced and staggered within the casing to form a plurality of separate chambers, contact means disposed in at least one chamber to establish an arc adjacent one apertured partition member, an operating rod extending through the chambers, means for rotating the operating rod, means operatively relating rotation of the operating rod with opening of the contact means, another operating rod extending through the chambers and secured to the piston members to cause their simultaneous motion, and means for moving the said other operating rod longitudinally of the casing.

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