June 7, 1955 M. K. PRICE 2,710,322

CIRCUIT INTERRUPTER

Filed Aug. 17, 1953 2 Sheets-Sheet 1

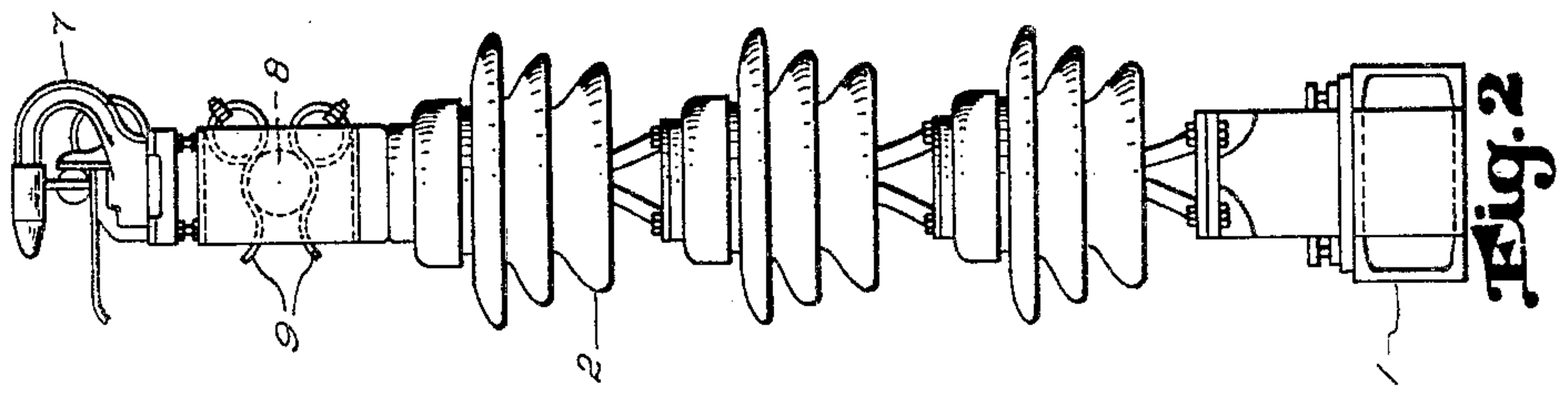

Fig. 2

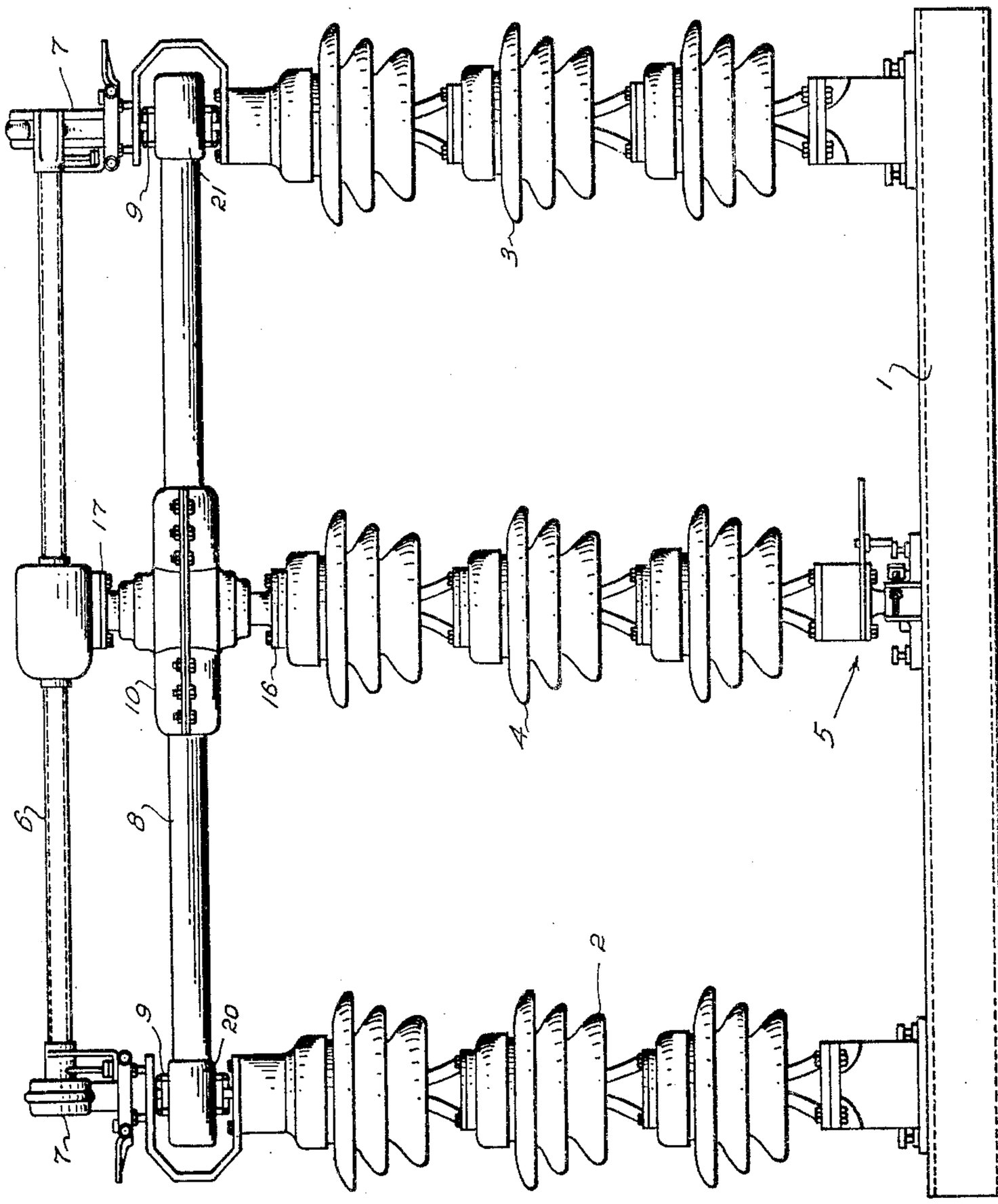

Fig. 1

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CIRCUIT INTERRUPTER

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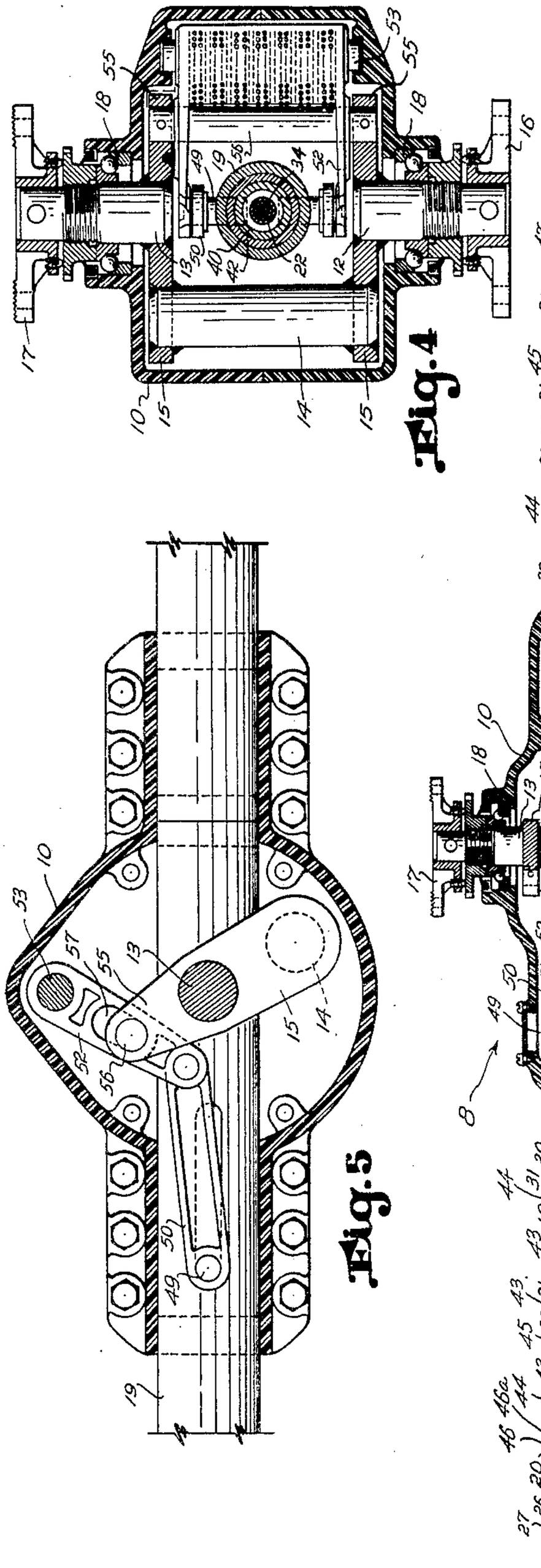

Fig.4

Fig.5

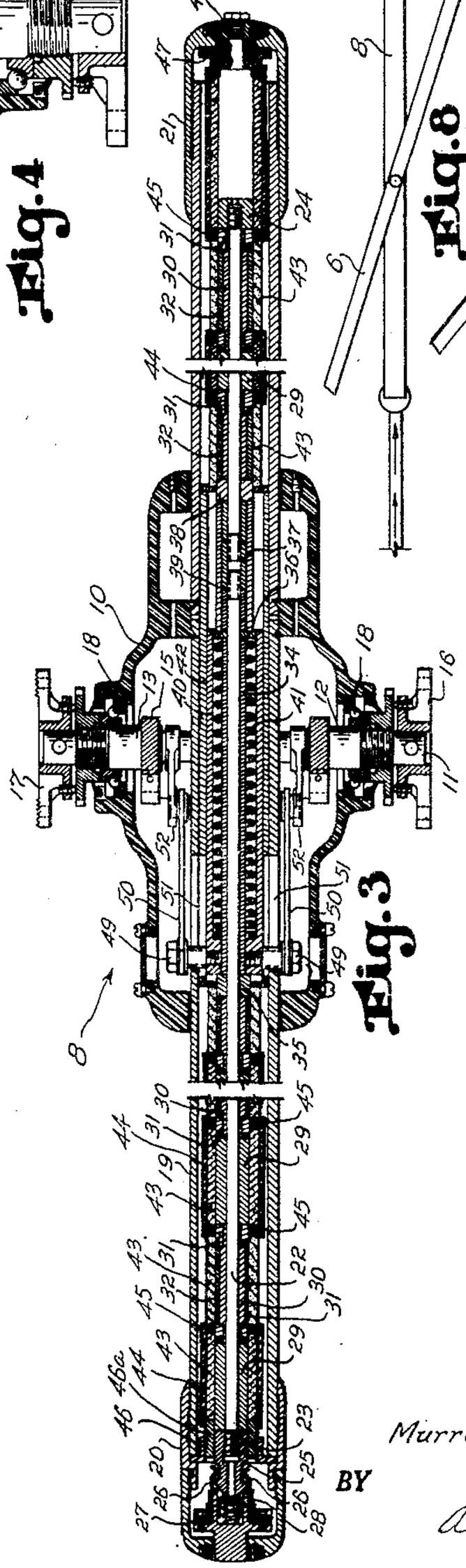

Fig.3

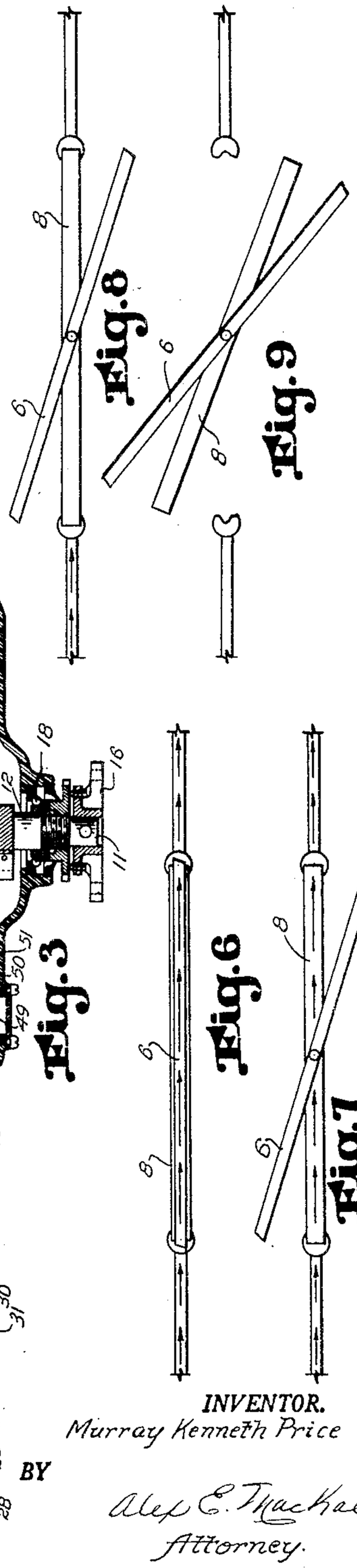

Fig.8

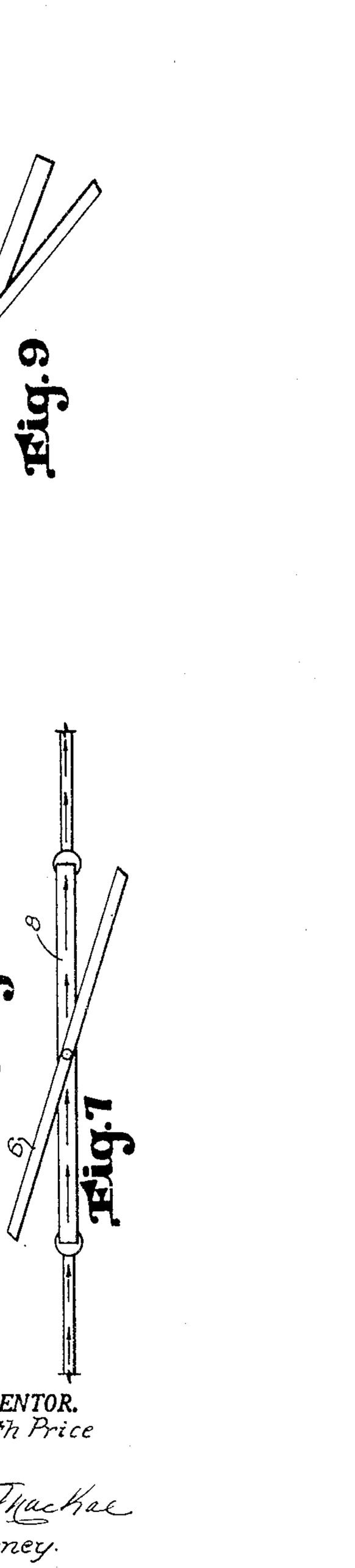

Fig.9

Fig.6

Fig.7

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CIRCUIT INTERRUPTER

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8 Claims. (Cl. 200—146)

This invention relates to circuit interrupters.

Circuit interrupters for high tension power lines are of complicated and costly construction since safety in operation and avoidance of damage to adjacent equipment due to uncontrolled arcs must be provided.

It is an object of this invention to provide a circuit interrupter which has a smoothly and positively operable actuating mechanism, which has an improved safe and effective arc controlling and quenching means, and which is subject to convenient manufacture.

The invention thus contemplates, in combination with a pair of fixed insulator columns having contact means thereon, a rotatable insulator column carrying a switch blade revolvable therewith and engageable with the contact means, an interrupter arm having a contact assembly therein carried by the rotatable column for partial rotation therewith, and contact elements on each of the fixed columns for engagement by the arm, such interrupter arm being thereby in parallel with the blade.

Other objects, details and advantages of the invention will become apparent as this description proceeds with particular reference to the accompanying drawings, in which

Figure 1 is a side elevation of a circuit interrupter assembly in accordance with the invention,

Figure 2 is an end elevation of the assembly,

Figure 3 is a sectional longitudinal elevation of the interrupter arm,

Figure 4 is a sectional transverse elevation of the interrupter arm,

Figure 5 is a partial sectional plan view of the interrupter arm, and

Figures 6, 7, 8 and 9 are diagrammatic views illustrating the sequence of operating steps of the device.

Referring to Figures 1 and 2, 1 is an elongated base member of any suitable form having two stationary insulator columns 2 and 3 fixed thereto adjacent a respective end thereof, and a rotatable insulator column 4 rotatably mounted on the base by means of suitable bearing means 5 substantially midway between the insulators 2 and 3.

Fixed to the upper end of rotatable insulator 4 and rotatable therewith is a disconnecting switch blade 6 the ends of which are adapted to engage cooperating contact means 7 on each of the stationary insulators 2 and 3. Also mounted on insulator 4 is an interrupter arm 8, the ends of which are arranged to engage cooperating spring contact jaws 9 on each of the stationary contact columns.

The interrupter arm assembly will now be described in detail with particular reference to Figures 3, 4 and 5 of the drawings. The arm comprises a centrally disposed housing 10 of suitable material, which preferably is that known under the trade name "Bakelite." The housing is carried by a shaft 11 having vertically disposed and aligned lower and upper portions 12 and 13 and an intermediate offset portion or crank 14 fixed to portions 12 and 13 by its arms 15. Portion 12 is fixed to the column

4 by means of a flanged connection 16. Switch blade 6 is fixed to shaft portion 13 by means of a flanged connection 17. The housing 10 is supported on the shaft 11 by means of upper and lower bearings 18 which permit relative rotation of the shaft with respect to the housing.

The interrupter arm further comprises an elongated tube 19 carried by the housing and extending longitudinally therethrough. The ends of the tube are provided with closure caps 20 and 21 of conducting material, such caps being arranged for engagement by the jaws 9. Reciprocally and axially mounted within the tube is a rod 22 having enlarged end portions 23 and 24. Portion 23 has an annular groove 25 therein to receive a plurality of spring fingers 26 carried by a bracket 27 on the end of cap 20. Thus, fingers 26 releasably hold rod 22 with one end located in adjacent relation to the complementary end of tube 19. Resilient shock-absorbing and positioning means 28 carried by bracket 27 are preferably provided for engagement by the end of portion 23 as shown.

Rod 22 carries thereon a plurality of movable contacts and to this end has sleeved upon the portions thereof which are generally externally of the housing 10, for reciprocal movement therewith, a plurality of tubular sleeves 29 of insulating material alternating with a plurality of tubular sleeves 30 of conducting material. It will be observed that the sleeves 29 and 30 are retained on the rod by the end portions 23 and 24, a sleeve 29 being in contact with portion 23 and a sleeve 30 being in contact with portion 24. Each of sleeves 30 carries an annular contact 31 at each end thereof. A sleeve 32 of non-conductive material surrounds each sleeve 30 and extends between the pair of contacts 31 thereon.

Mounted on the rod for reciprocation therewith within the housing is a tube 34 of conducting material separated at one end from a sleeve 30 by a collar 35 of conducting material and spaced from a sleeve 30 at its other end by a disc 36, sleeve 37 and collar 38, all of conducting material. Sleeve 37 is provided with an external liner 39 of insulating material. An annular housing 40 of conducting material surrounds tube 34 and contains a spring 41. One end of housing 40 engages tube 34 for sliding movement with respect thereto, such end of the housing providing a reciprocal seat for one end of spring 41. The other end of the housing 40 engages disc 36 and is slidable with respect thereto, disc 36 providing a temporarily fixed seat for the other end of spring 41. Housing 40 is arranged to slide within a tube 42 which is in fixed relation within tube 19.

Tube 19 also carries therein a plurality of fixed contacts for cooperation with the movable contacts carried by rod 22. To this end, a plurality of liner sleeves 43 of non-conducting material are sleeved upon sleeves 29 and 32. The liners 43 are preferably of organic material such as sodium fluoride and hardwood powder or similar material which emits gas when arcs are struck to quench the latter. A tube 44 of conducting material carries at one or both ends an annular contact 45 which extends between the adjacent ends of sleeves 43 for engagement with a complementary annular contact 31. It will be observed that all of the tubes 44 except the end tubes carry an annular contact 45 at each end. However, the outer end of each end tube 44 is supported in contacting relation to caps 20 and 21 by means of flanged ring 46 and collar 46*a*, and flanged ring 47 and tubular member 48 respectively.

Means for sharply and simultaneously breaking contact between the movable contacts 31 and fixed contacts 45 comprises means for compressing the spring 41 for subsequent release to permit it to propel the rod 22 and movable contact assembly carried thereby very rapidly in one direction within the tube 19 (to the right as viewed in Figure 3). To this end, the closed end of

the housing 40 is pivotally connected by means of a pair of pins 49 to a pair of links 50, pins 49 having sliding movement with respect to tubes 19 and 42 by means of longitudinal slots 51 therein. Each link 50 is pivotally connected to the extremity of a respective arm 52 of a crank 53 rotatably mounted in the housing 10. The arms 15 of crank 14, which is disposed on one side of the tube 19, have portions 55 projecting beyond the other side of tube 19, such portions being connected by a pin 56 extending through slots 57 in arms 52.

The normal closed position of the interrupter is as illustrated in the drawing, switch blade 6 and arm 8 being in contact with columns 2 and 3 and contacts 31 and 45 within the arm being in engagement. Current flows through the blade 6, as shown in Figure 6. When it is desired to actuate the device to open the power circuit, rotative movement is applied to insulator column 4. Blade 6 is fixed to column 4 and therefore revolves therewith. However, due to the pivotal connection of arm 8 with column 4 and the provision of crank 14, initial opening movement of column 4 does not impart revolving movement to arm 8. Since arm 8 is in parallel connection with blade 6, current now flows through the arm, as shown in Figure 7.

During such initial rotation of column 4, crank 14 is rotated in a clockwise direction as viewed in Figure 5. Such rotation of crank 14 in turn rotates crank 53 in a counterclockwise direction, thus pulling links 50, pins 49 and housing 40 to the right. Such movement compresses the spring 41 against disc 36. Just prior to termination of the reciprocal stroke of housing 40 as determined by the revolving movement of crank 14, spring 41 is arranged to become fully compressed, at which time further revolution of crank 14 moves the entire movable contact assembly with rod 22 a sufficient distance to the right to release the rod 22 from the retainer fingers 26. The movable contact assembly with rod 22 are now shot very rapidly to the left under the influence of spring 41. This movement moves each contact 31 out of engagement with a contact 45 and into engagement with an insulating sleeve 43. The resulting plurality of gaps breaks up the voltage per break into safe proportions. The voltage break is illustrated diagrammatically in Figure 8. It occurs preferably when blade 6 has swung through an opening movement of approximately a 30° arc. In other words, current flows through arm 8 only during approximately the first 30° movement of blade 6.

The resulting arcs at each break are quenched by gas emitted by the liners 43.

It will be appreciated that since each of the stationary contact carrying tubes 44 is provided with a liner 43 of non-conducting material extending between the contacts carried thereby, two openings are formed when the break occurs instead of the usual one as would be provided by a simple tubular contact. This creates twice the gap length in the same time as that formed by unlined contacts. Furthermore, the reversal of direction that the current must take at the additional gaps, places those segments of arcs between two oppositely flowing parallel currents. This configuration creates electromagnetic forces which elongate the arc for better cooling and, hence, arc quenching effect.

When the spring-propulsed movement of the movable contact assembly occurs, the pin 56 of crank 14 has reached the end of slots 57 in arms 52 of crank 53 and thereafter further rotation of crank 53 is transmitted directly to the arm 8 as a unit. The rotative force applied to arm 8 then disengages its extremities from jaws 9 and swings the arm open creating a visible gap, as shown in Figure 9. It should be understood that such swinging movement of the arm 8 does not occur until the arcs therein have been extinguished and thus no external arc is drawn.

During the operational steps just described, the blade

6 has been swinging open continuously. As previously indicated, the first movement of the blade 6 transfers the current to the arm 8 and at the moment of contact separation, as described above, the blade 6 is open sufficiently to prevent reestablishment of an arc across it.

I claim:

1. A circuit interrupter comprising a base, a pair of insulator columns stationarily fixed to the base, a third insulator column rotatably mounted on the base between said first two columns, a switch blade carried by the rotatable column for constant rotation therewith, contact means on each of said fixed columns engageable by said blade, an interrupter arm carried by the rotatable column, and contact jaws on each fixed column for engagement by a respective end of said arm, said arm being rotatable with said rotatable column only after said blade has been moved by said rotatable column a predetermined distance from said contact means on the fixed columns.

2. A circuit interrupter as defined in claim 1, said arm having therein more than two spaced fixed contacts, a plurality of movable contacts each normally engaging one of said fixed contacts to permit current flow through the arm, and means responsive to a predetermined degree of rotation of said rotatable column for moving said movable contacts out of contact with said fixed contacts.

3. A circuit interrupter as defined in claim 1, said arm having a contact assembly fixed therein, a second contact assembly reciprocally mounted in the arm, means holding said second assembly in position to normally provide current passage with said first assembly, a spring engaging said second assembly, means for compressing said spring in response to rotative movement of said rotatable column, and means responsive to further rotative movement of said rotatable column to release said holding means to permit reciprocal movement of said second assembly under the influence of said spring.

4. A circuit interrupter as defined in claim 1, said predetermined distance being an arc of approximately 30°.

5. A circuit interrupter comprising a base, a pair of insulator columns stationarily fixed to said base, a third insulator column rotatably mounted on the base between said first two columns, a switch blade fixed to the rotatable column for constant rotation therewith, contact means on each of said fixed columns engageable by said blade, an interrupter arm pivotally mounted on the rotatable column, contact jaws on each fixed column for engagement by a respective end of said arm, crank means connecting said arm to said rotatable column for partial rotation therewith, a contact assembly having a plurality of contacts fixed within the arm, a second contact assembly having a plurality of contacts cooperating with the first contacts reciprocally mounted in the arm, and means responsive to rotative movement of the rotatable column with respect to said arm for reciprocating said second contact assembly to disconnect its contacts from the first contacts, said last-mentioned means comprising a spring acting on said second assembly, a cylindrical housing for the spring reciprocally mounted in the arm, a pin fixed to the housing for reciprocating the latter, a link pivoted to the pin, and means connecting said link to said crank means to exert a pulling movement on said link.

6. A circuit interrupter comprising a base, a pair of insulator columns stationarily fixed to said base, a third insulator column rotatably mounted on the base between said first two columns, a switch blade fixed to the rotatable column for constant rotation therewith, contact means on each of said fixed columns engageable by said blade, an interrupter arm pivotally mounted on the rotatable column, contact jaws on each fixed column for engagement by a respective end of said arm, crank means connecting said arm to said rotatable column for partial rotation therewith, a contact assembly having a plurality of contacts fixed within the arm, a second contact as-

sembly having a plurality of contacts cooperating with the first contacts reciprocally mounted in the arm, and means responsive to rotative movement of the rotatable column with respect to said arm for reciprocating said second contact assembly to disconnect its contacts from the first contacts, said last-mentioned means comprising a spring acting on said second assembly, a supporting tube having a longitudinal slot therein, a cylindrical housing for the spring reciprocally mounted in the tube and having a pin extending through said slot, a link pivoted to the pin, and a crank arm pivotally mounted in said arm and pivoted to said link, said crank arm having a slot therein, said crank means including a crank having a pin extending through said crank arm slot.

7. An interrupter arm comprising a tubular member, a housing centrally supporting said member, said member and housing being of non-conducting material, a closure cap of conducting material on each end of said member, a rod axially and reciprocally supported within said tubular member, a tubular contact assembly having more than two spaced annular contacts carried by said rod for reciprocation therewith, a second tubular contact assembly surrounding said first assembly and in fixed relation to said tubular member, said second assembly having a plurality of annular contacts corresponding in number to and for engagement by said first contacts, means holding said rod and first assembly in fixed relation to said

second assembly, a spring acting on said first assembly to reciprocate the same, a housing for the spring reciprocally mounted in said member, a shaft journalled in the housing and having its axis normal to that of said rod, and crank mechanism connecting said shaft with said spring housing to reciprocate said housing to compress the spring, said first contact assembly being reciprocable by said crank mechanism following compression of said spring to release said holding means.

8. An interrupter arm as defined in claim 7, said second contact assembly comprising a plurality of longitudinally aligned sleeves of non-conducting material, a tube of conducting material disposed between each adjacent pair of said sleeves, a sleeve of non-conducting material surrounding each said tube, and an annular ring of arc resistant contact material at each end of said last-mentioned sleeve and in contact with said conducting tube.

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