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ELECTRIC CIRCUIT BREAKER

1,965,551

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2 Sheets-Sheet 1

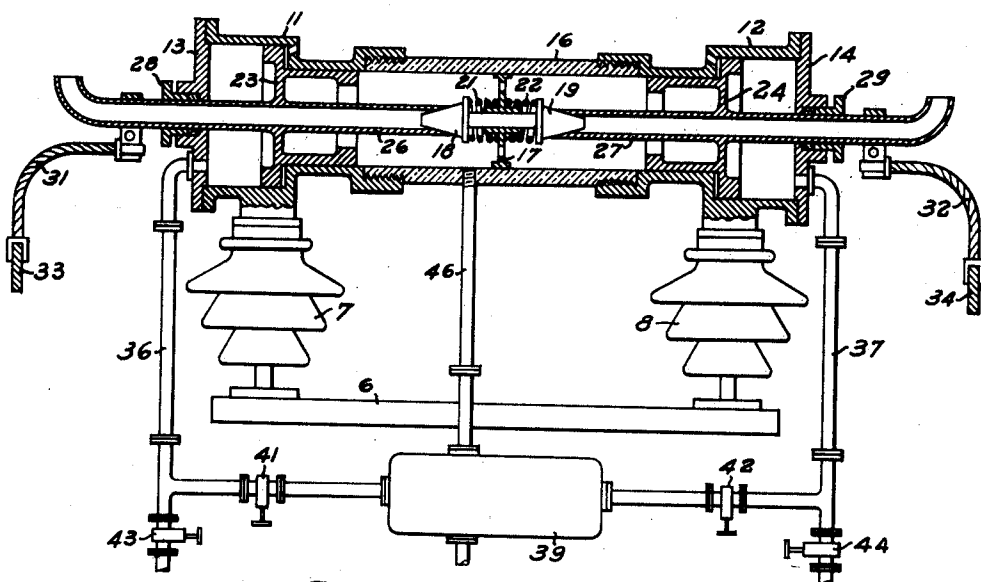


Fig. 1

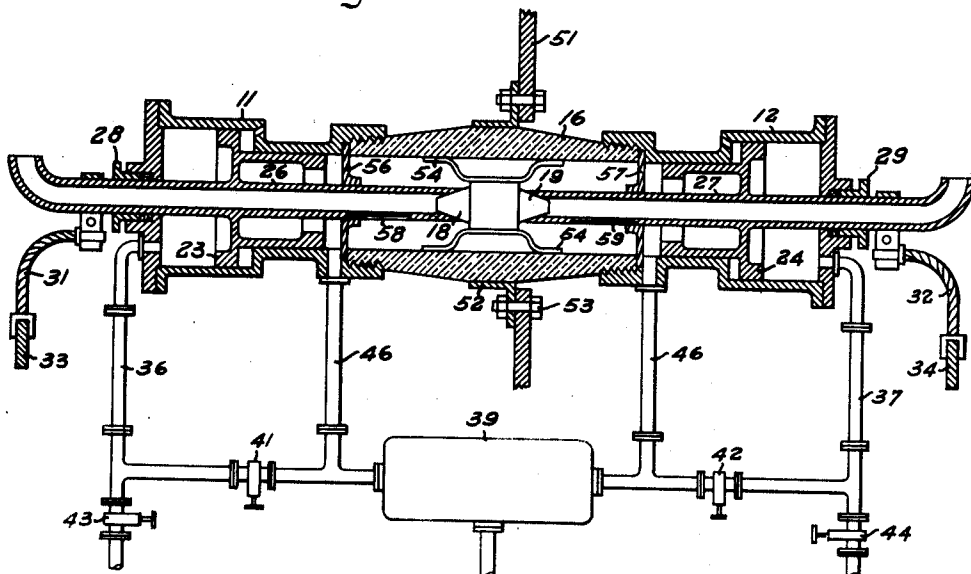


Fig. 2

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2 Sheets-Sheet 2

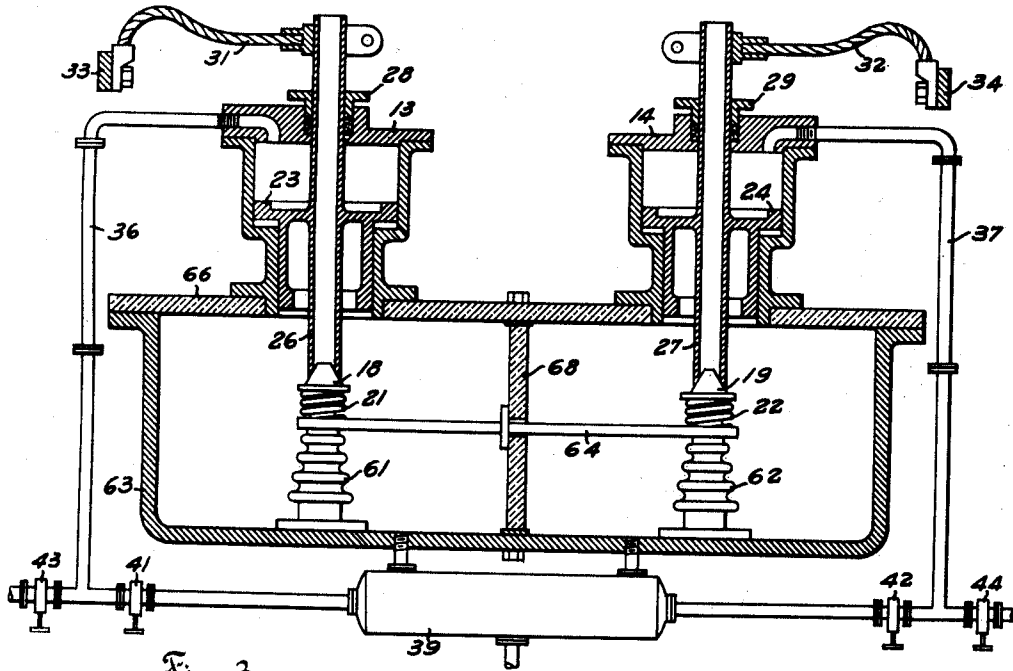


Fig. 3

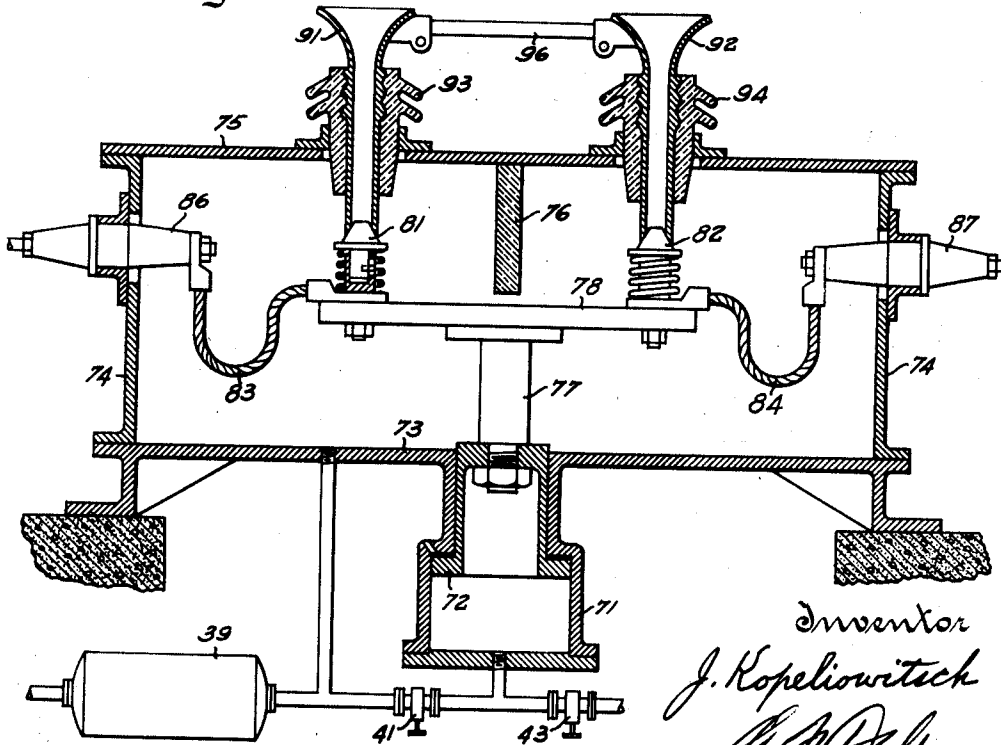


Fig. 4

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UNITED STATES PATENT OFFICE

1,965,551

ELECTRIC CIRCUIT BREAKER

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10 Claims. (Cl. 200—148)

This invention relates to improvements in electric circuit breakers and more particularly to circuit breakers producing an interruption of an electric circuit at a plurality of points within a chamber retaining an insulating fluid under pressure.

In the known constructions of circuit breakers of the character above indicated, insulating fluid is continuously retained about the contacts or is supplied to a chamber enclosing the contacts during the period in which the circuit is to be interrupted by separation of the contacts by mechanically or electrically operated means. If the fluid is supplied under pressure, it has been found that the double function of cooling the arc and of deionizing the gases conducting the arc will be intensified. Circuit breakers are also known in which a fluid under pressure causes operation of the circuit breaker by causing movement of the movable contacts out of engagement with the fixed contacts. The use of the same insulating fluid for operation of the circuit breaker however has numerous advantages which will become apparent hereinafter.

It is one object of the present invention to provide an electric circuit breaker of the type having the contacts immersed within an insulating fluid in which the fluid serves the double purpose of causing operation of the circuit breaker by causing movement of the movable contacts and of aiding in quenching the arc.

Another object of the invention is to provide an electric circuit breaker of the insulating fluid immersed contact type in which the fluid under pressure employed to quench the arc and to operate the circuit breaker may be either a liquid or a gas.

Objects and advantages other than those above set forth will be apparent from the following description when read in connection with the accompanying drawings in which:

Fig. 1 illustrates one embodiment of the present invention shown partially in elevation and partially in vertical section in which the movable contacts move in opposite directions to cause multiple interruption of the circuit connected therewith;

Fig. 2 is a view similar to that shown in Fig. 1 but illustrating a modified embodiment of the invention in which the circuit breaker is adapted for use in a bushing-like structure;

Fig. 3 is a view partially in elevation and partially in section of one embodiment of the invention in which the movable contacts are arranged to move in parallel and in the same

direction by use of separate operating means; and

Fig. 4 is a view similar to that shown in Fig. 3 with the exception that the movable contacts are moved by a single operating means.

Referring more particularly to the various figures of the drawings by characters of reference, the reference numeral 6 (in Fig. 1) designates a suitable base on which are mounted insulators 7 and 8. The insulators support cylinders 11 and 12 open at one end and closed at the other end by suitable end or head plates 13 and 14. It will be seen that the cylinders are of different diameters at different portions of the length thereof. A tube 16 of insulating material is arranged between the open ends of the cylinders and is sealed into such cylinders in fluid-tight relation. A perforated partition 17 (in Fig. 1) is arranged across tube 16 at substantially the center portion thereof and supports a fixed contact or bridging member having both ends 18 and 19 thereof conically shaped. The spacing of the ends of the fixed contact from the partition 17 is maintained by springs 21 and 22 which take up any shock occurring upon closing of the circuit by movement of movable contacts into engagement with the fixed contact or bridging member.

Differential pistons 23 and 24 are arranged in the cylinders 11 and 12 respectively and severally support tubular members 26 and 27 extending therethrough. The tubular members are arranged to extend into engagement with the fixed contacts and extend through sealing glands 28 and 29 arranged in the heads of the respective cylinders. The ends of the tubular contact members 26 and 27 extending exteriorly of the cylinders 11 and 12 are connected by means of flexible conductors 31 and 32 with terminals 33 and 34 respectively of an electric circuit (not shown). Conduits each having an insulating section 36 or 37 are connected with a reservoir 39 having an insulating fluid retained therein under pressure. The connection of the reservoir 39 with the cylinders 11 or 12 is controlled by valves 41 and 42 respectively and discharge from the cylinders is controlled by valves 43 or 44. The reservoir is also connected with the tube 16 by a conduit having an insulating section 46. It will be understood that, although manually operated valves have been shown in the drawings, the valves controlling the flow of fluid from the reservoir 39 to the cylinders and discharge of the fluid therefrom are preferably of the magnetically operated type controlled by suitable means re-

sponsive to one or more electrical conditions of the circuit to be interrupted.

When the circuit is to be interrupted, valves 43 and 44 are opened and valves 41 and 42 are closed. The fluid under pressure in reservoir 39 then flows through conduit 46 into tube 16 and into the portions thereof on both sides of partition 17. The fluid pressure acts on the smaller surfaces of the differential pistons 23 and 24 and moves contacts 26 and 27 away from the fixed contacts 18 and 19. Any fluid in cylinders 11 and 12 is discharged through conduits 36 and 37 by way of valves 43 and 44 respectively. As soon as the contacts 18, 26, and 19, 27 separate the fluid within the tube 16 flows through the arc produced between each pair of such contacts, from all sides, into the tubular contacts 26 and 27 and discharges therefrom from the outer ends thereof extending beyond the heads of the cylinders. The circuit is thus interrupted at two points and the arc is drawn out in opposite directions. The fluid flows through the movable contacts in opposite directions. Multiple interruption of the circuit, rapid extension of the arcs produced upon interruption of the circuit and the opposite flow of cooling and deionizing fluid accelerates the interruption of the circuit by accelerating quenching of the arcs.

The closing operation of the apparatus shown in Figs. 1, 2 and 3 is accomplished by closing valves 43 and 44 and opening valves 41 and 42, thereby causing the pressure per unit of area on each side of the differential pistons 23 and 24 to become equal, however, since the total force on the larger face of each piston is greater than the total force on the smaller face of each piston, the tubular contacts 26 and 27 will be moved to their circuit closing positions.

If the circuit breaker is to be mounted in a wall as indicated at 51 in Fig. 2 the tube 16 is preferably made in the form of an insulating bushing and the base 6 and supports 7 and 8 shown in Fig. 1 are omitted. The tube is then fixed in a flanged ring 52 which is secured to the wall 51 by any suitable means such as the bolts 53 shown. The fixed contacts 18 and 19 may be formed from a single cylindrical member which is supported resiliently and in spaced relation with the walls of the tube 16 by springs 54. If difficulty is experienced in preventing leakage through the joint between the fixed contacts 18 and 19 and the movable contacts 26 and 27 respectively when the reservoir 39 is in communication with the tube 16, partitions 56 and 57 are located in the tube 16 adjacent the smaller surfaces of the pistons 23 and 24. Apertures are provided in such partitions through which the movable contacts 26 and 27 extend in fluid-tight relation, sealing being secured by a close fit or by a suitable sealing gland as may be desired depending on the pressure of the fluid in the reservoir 39. The spaces between the smaller surfaces of the pistons and the partitions are connected with the fluid pressure reservoir 39. Grooves 58 and 59 are then cut into the tubular contacts at such locations that the partitions 56 and 57 shut the spaces under fluid pressure off from the spaces about the joints between the contacts when the electric circuit is completed upon engagement of the movable contacts with the fixed contacts or bridging member.

When the circuit is to be interrupted by the apparatus shown in Fig. 2, opening of valves 43 and 44 and closing of valves 41 and 42 will permit the pressure to be discharged from the larger sur-

faces of the pistons and the pistons will move outwardly under the action of the fluid pressure from reservoir 39 on the smaller surfaces of the pistons. As soon as the pistons have moved a sufficient distance to allow grooves 58 and 59 to extend on both sides of partitions 56 and 57, communication is provided between the high pressure spaces between the partitions and the smaller surfaces of the pistons with the space about the contacts. The fluid under pressure will flow into the latter space from which the fluid will discharge through the movable contacts as described above.

Under some circumstances it may be desirable that the fluid flowing through the movable contacts discharge therefrom in the same direction. In such case the fixed contacts 18 and 19 are mounted on springs 21, 22 which are supported on insulators 61, 62 arranged within the chamber or tank 63 as shown in Fig. 3. The fixed contacts are conductively connected by means of a bar 64 mounted on the insulators 61, 62. The tank 63 is provided with a cover preferably of insulating material having apertures therethrough over the fixed contacts and the cover is sealed in fluid-tight relation with the lower portion of the tank structure. The tank 63 is then preferably divided into two compartments by an insulating partition 68. The cylinders 11 and 12 containing the differential pistons 23 and 24 carrying the movable contacts 26 and 27 are mounted on the insulating cover 66 over the apertures therethrough in fluid-tight relation. Opening of valves 43 and 44 and closing of valves 41 and 42 causes movement of the pistons 23 and 24 due to the fluid pressure from the reservoir 39 on the smaller surfaces of the pistons communicating with tank 63 and, therefore, causes movement of contacts 26 and 27 out of engagement with fixed contacts 18 and 19 whereupon the electric circuit is interrupted as above described.

If the use of separate operating means for each of the movable contacts is objectionable for any reasons, such operating means may be replaced by a single operating means as illustrated in Fig. 4. A single cylinder 71 arranged to retain a differential piston 72 is formed as an extension from a plate 73 which forms the bottom of a chamber having side walls 74 and a cover 75. The bottom, side walls and top of the chamber are sealed to each other in fluid-tight relation by suitable means. If the chamber is formed of conductive material, a wall 76 of insulating material is preferably arranged therein to divide the chamber into substantially two compartments. The piston 72 carries a rod 77 and a cross bar 78 of insulating material on which contacts having conical contact members 81 and 82 are resiliently supported. The contacts are each arranged for connection with a portion of an electric circuit exteriorly of the chamber by means of a conductor 83 or 84 each extending through an insulator 86 or 87 sealed in gas-tight relation with the wall of the chamber. The movable contacts 81 and 82 engage with the ends of tubular contacts 91 and 92 respectively extending through the cover 75 through insulators 93 and 94 respectively. The fixed contacts are conductively connected by a bridge member 96. The movement of cross bar 78 by means of differential piston 72, which is controlled by valves 41 and 43, is substantially the same as hereinbefore described in connection with Figs. 1, 2 and 3.

Although but a few embodiments of the present invention have been illustrated and de-

scribed, it will be apparent to those skilled in the art that various modifications and changes may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. In an electric circuit breaker, a fluid tight chamber comprising a section of metal and a section of insulation, a unitary differential piston arranged for movement within said metal section of said chamber, a tubular contact connected with said piston for movement axially through said chamber, a fixed contact arranged within said insulation section of said chamber to close the end of said movable contact upon engagement therewith, said tubular contact having a discharge passageway therethrough in communication with atmosphere after said tubular contact disengages from said fixed contact, means connecting said movable contact with an electric circuit, a fluid pressure reservoir continually connected with said chamber on both sides of said piston to hold said tubular contact in engagement with said fixed contact, and means for reducing the pressure on one side of said differential piston to cause movement of said piston so that said tubular contact disengages with said fixed contact and thereby opens said discharge passageway.

2. In an electric circuit breaker, a single fluid-tight chamber, two differential pistons arranged for movement within said chamber, two tubular contacts extending into said chamber and arranged for movement by said pistons, conductively connected fixed contacts arranged to bridge said movable contacts within said chamber, means connecting said movable contacts with an electric circuit, a fluid pressure reservoir normally connected with said chamber on both sides of each of said pistons to hold said movable contacts in engagement with said fixed contacts, and means for reducing the pressure on only one side of each of said pistons to cause said tubular contacts to disengage with said fixed contacts and thereby cause fluid under pressure to discharge through said tubular contacts.

3. In an electric circuit breaker, a single fluid-tight chamber, two differential pistons arranged for movement within said chamber, two tubular contacts extending into said chamber through said pistons for movement thereby, a single fixed contact member arranged within said chamber for bridging said tubular contacts, means for connecting said movable contacts with an electric circuit, a fluid pressure reservoir connected with said chamber on both sides of each of said pistons, and means for reducing the pressure on only one side of each of said pistons to cause movement of said pistons.

4. In an electric circuit breaker, a fluid-tight chamber formed of insulating material and metal, a plurality of differential pistons arranged for movement within said metal part of said chamber, a plurality of tubular contacts severally extending into said chamber through said pistons and connected therewith, means for connecting said contacts with an electric circuit exteriorly of said chamber, a conductive member arranged within said insulation part of said chamber to close the ends of said tubular contacts upon engagement therewith, springs resiliently supporting said conductive member, a fluid pressure reservoir connected with said chamber on both sides of each of said pistons, and means for reducing

the pressure on one side of each of said pistons to cause movement of said pistons.

5. In an electric circuit breaker, a fluid-tight chamber partially formed of insulating material, a plurality of differential pistons arranged for movement within said chamber, a plurality of tubular contacts severally extending into said chamber through said pistons and connected therewith, means for connecting said contacts with an electric circuit exteriorly of said chamber, a conductive member arranged within said chamber to close the ends of said tubular contacts upon engagement therewith, springs resiliently supporting said conductive member, a fluid pressure reservoir connected with said chamber on both sides of each of said pistons, means within said chamber controlling the flow of fluid from said reservoir into said chamber about said contacts, said means being operated upon movement of said tubular contacts, and means controlling the discharge of fluid from said reservoir to cause movement of said pistons.

6. In an electric circuit breaker, a fluid-tight chamber formed of insulating material and metal, a plurality of differential pistons arranged for movement in opposite directions within said metal portion of said chamber along the longitudinal axis thereof, a plurality of tubular contacts severally extending into said chamber through said pistons and connected therewith, means for connecting said contacts with an electric circuit exteriorly of said chamber, a conductive member arranged within the insulating portion of said chamber to close the ends of said tubular contacts upon engagement therewith, springs resiliently supporting said conductive member, a fluid pressure reservoir connected with said chamber on both sides of each of said pistons, and means controlling the discharge of fluid from said reservoir to cause movement of said pistons.

7. In an electric circuit breaker, a pressure chamber, a piston slidable within said chamber, a fixed contact mounted within said chamber, a tubular contact slidably extending through said chamber into engagement with said fixed contact, said tubular contact being connected to said piston, a fluid pressure reservoir for supplying fluid to operate said piston and to cause a blast of fluid through said tubular contact, and means in said chamber controlled by the movement of said tubular contact for initiating said blast of fluid shortly after said tubular contact disengages from said fixed contact and for stopping said blast of fluid after said tubular contact has moved away from said fixed contact a predetermined distance.

8. In an electric circuit breaker, a pressure cylinder, a fixed contact mounted within said cylinder, a tubular contact axially slidable through a wall of said cylinder to engage and disengage with said fixed contact, a piston slidable within said cylinder and operatively connected with said tubular contact, means for supplying fluid under pressure to operate said piston so as to engage and disengage said tubular contact with said fixed contact and to supply fluid under pressure for discharging through said tubular contact, and means in said cylinder controlled by the movement of said tubular contact for initiating the discharging of said fluid through said tubular contact during the initial disengagement of said contacts and for stopping the discharge of said fluid through said tubular contact upon further predetermined disengagement of said contacts.

9. In an electric circuit breaker, a pressure cylinder, a fixed contact mounted within said cylinder, a piston slidable within said cylinder, a partition member between said fixed contact and
5 said piston, a tubular contact slidable through a wall of said cylinder and through said partition member to engage and disengage with said fixed contact, said tubular contact being operatively connected with said piston, and means
10 for supplying operating fluid under pressure to the space between said partition member and said piston to cause disengaging movement of said tubular contact, said tubular contact having means cooperating with said partition member
15 for causing a blast of said operating fluid to discharge from said cylinder through said tubular contact only during an intermediate portion of the movement of said tubular member.
10. In an electric circuit breaker, a pressure
20 cylinder having a head member and concentric bores of different diameters, a fixed contact mounted within said cylinder, a differential piston slidable within said cylinder and having faces
of relatively large and small diameters, a partition member within said cylinder arranged between the smaller face of said piston and said fixed contact, said partition member having an
opening therethrough, a tubular contact slidable through the head member of said cylinder
and through said opening in said partition member to engage and disengage with said fixed contact, said tubular contact being operatively connected with said differential piston, a fluid pressure reservoir continually in communication with the space in said cylinder between said piston and said partition member, means for selectively connecting the space between said head member and the larger face of said differential piston
with atmosphere and with said reservoir to actuate said piston, and means associated with
said tubular contact for causing fluid under pressure to flow from said space between said piston and said partition member through said tubular contact only during a portion of the movement of said tubular contact.
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