Oct. 26, 1965 H. M. PFLANZ 3,214,557

MOTION TRANSLATING MEANS

Filed Feb. 11, 1963 2 Sheets-Sheet 1

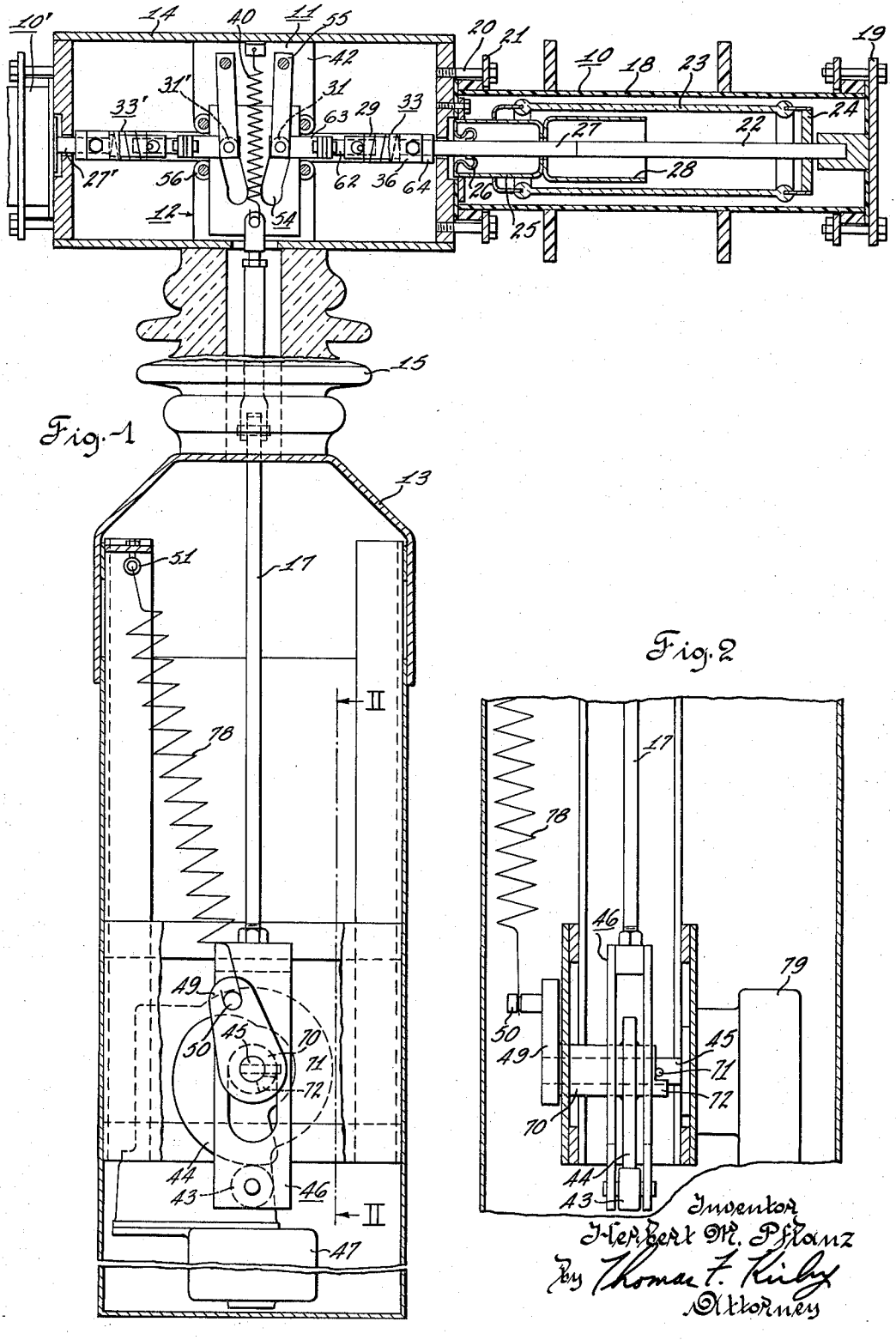


Fig. 1

Fig. 2

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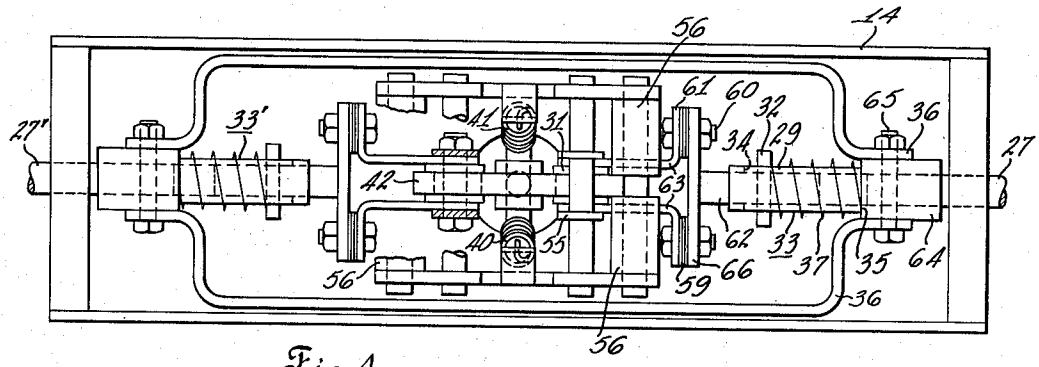


Fig. 4

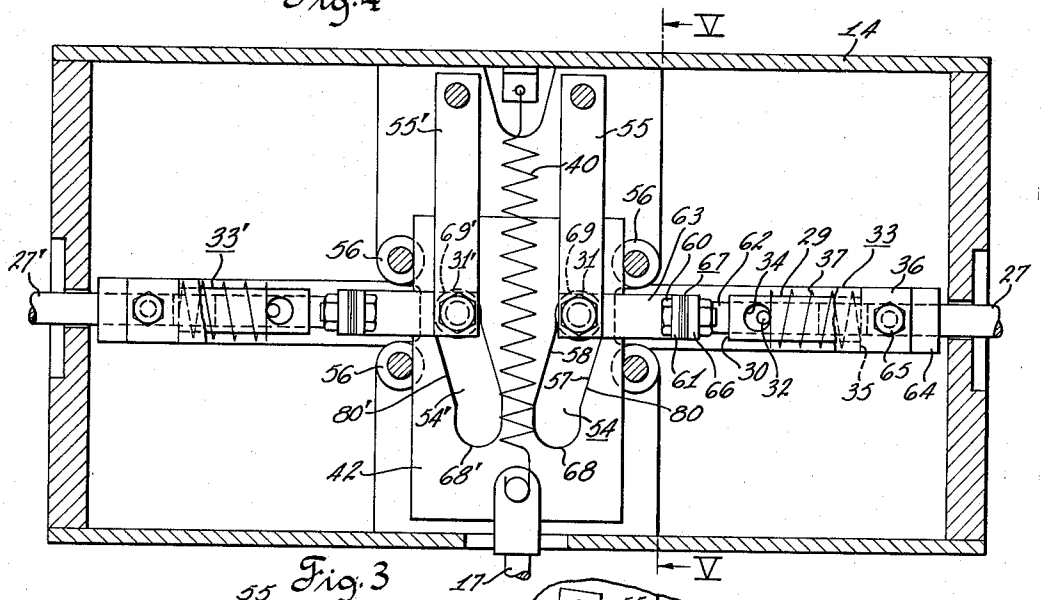


Fig. 3

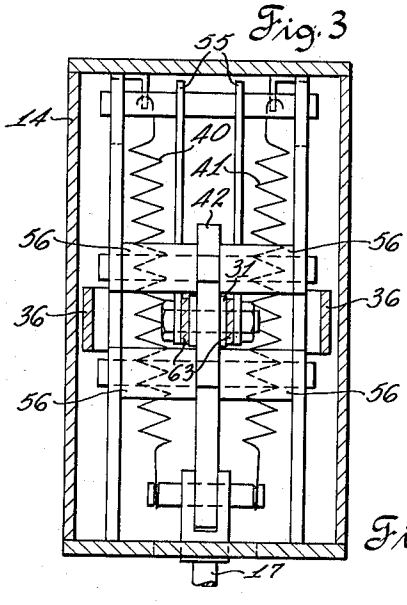


Fig. 5

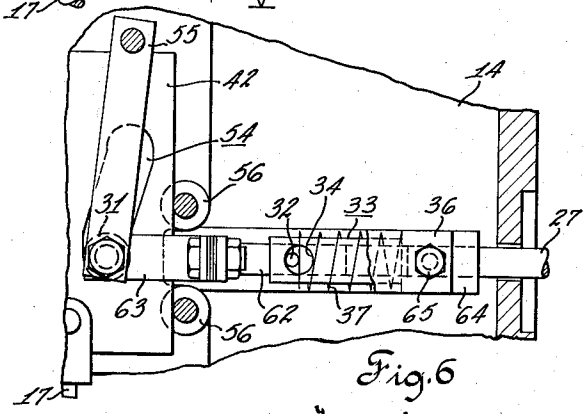


Fig. 6

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MOTION TRANSLATING MEANS

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This invention relates to means for actuating switches or the like, particularly to actuating means that reciprocally actuate the contacts of switches.

With the development of the vacuum switch, the trend in switch actuating mechanisms has been to smaller and lighter structures. This may appear simple to attain, but in practice many difficulties are present. For example, one problem is to provide means that will move contacts of switch modules positively to make and break the contact without an elaborate structure that will dwarf the vacuum switches themselves.

In accordance with this invention, a means is provided that positively translates reciprocal motion in both directions to open and close contacts. By utilizing such positive translation no biasing means directly controlling the movement of the contacts is required. The particular means also provides for limited movement without affecting the contact position so that minor movement or oscillations will not partially open or close the contacts. Also, with the use of this invention it is possible to individually adjust the gaps of each of the contacts without affecting the adjustment of other contacts. This adjustment may be simply made without any dismantling of complicated structure.

An object of this invention is to provide new and improved means for reciprocally moving contacts of a switch, especially a vacuum switch.

Another object is to provide means for moving contacts of a vacuum type circuit breaker or switch that is small, light, and uncomplicated.

Another object is to provide switch actuating mechanisms that are reliable in operation, simple to install, and inexpensive to manufacture.

Another object is to provide switch actuating mechanisms that are readily adaptable for operating either vacuum switches or modules of vacuum switches or circuit breakers.

Another object is to provide a switch actuating mechanism that positively moves contacts from one position to another without excessive rebound or recoil.

Another object is to provide a contact moving means and linkage that provides for simple adjustment of the gap between switch contacts.

Another object is to provide a switch actuating mechanism for modules of switches that enables independent adjustment of contact gaps.

Another object is to provide a switch moving means that has a determinable mechanical advantage between the mechanism powering the movement of the contacts and the contacts themselves.

Another object is to provide a switch moving means for switches that maintains the contact position even with spurious limited movement of the contact actuating mechanism.

Other objects and advantages of this invention will be apparent from the following detailed description.

FIG. 1 is a cross section view, including vacuum switches, of a switch actuating mechanism embodying this invention;

FIG. 2 is a partial view of the switch actuating mechanism shown in FIG. 1 taken along lines II—II of FIG. 1;

FIG. 3 is an enlarged view of the linkage mechanism shown in FIG. 1;

FIG. 4 is a top view of the linkage mechanism shown in FIG. 3 with the top cover portion removed;

FIG. 5 is a view of the linkage mechanism taken along lines V—V of FIG. 3; and

FIG. 6 is a view of a portion of the linkage mechanism shown in FIG. 3 showing the cam in another position.

FIG. 1 illustrates a circuit breaker or switch actuating mechanism having vacuum switches **10** and **10'** and a contact actuating means **12**. Vacuum switches **10** and **10'** operate similarly and like parts are provided with similar reference characters.

The vacuum switches are mounted on a linkage housing **14** which is mounted on top of a support column **15**.

One of the vacuum switches, switch **10**, is shown in FIG. 1 in cross section. Each switch may comprise a cylindrical casing **18** closed at one end by a cover **19** and secured to linkage housing **14** at the other end by suitable means such as bolts **20** and a flange **21**. Cover **19** also serves as a means for receiving and positioning one end of a stationary vacuum switch contact **22** within cylindrical casing **18** and as an electrical contact for interconnecting the vacuum switches or connecting them to a load or electrical source.

Vacuum switch **10** further comprises a cylindrical envelope **23** which may be formed, for example, of a suitable vitreous material. One end of envelope **23** is sealed to a cap **24** in vacuum tight relationship. Cap **24** supports stationary contact **22** which is arranged to extend along the longitudinal axis of envelope **23**.

At the opposite end of envelope **23** a tube or retainer **25** is sealed in a vacuum tight connection to envelope **23**. A metallic, cylindrically shaped bellows **26** is cylindrically secured in a vacuum tight connection to one end of tube **25**. The other end of bellows **26** surrounds and is fixedly attached in a vacuum tight connection to a movable contact **27** which is arranged to extend through retainer **25** into envelope **23** and to move in cooperating relationship with contact **22**.

Movable contact **27** and stationary contact **22** may be made of any suitable material such as tungsten or copper.

In order to control the arcing product emitted upon separation of the engaging surfaces of contacts **22** and **27**, a cylindrically shaped, tubular shield **28** is provided around and spaced from contact **27**. Shield **28** is arranged to extend beyond the adjacent ends of the contacts so as to surround at least a part of contacts **22** and **27** when the contacts are in contact engaging position.

Movable contact **27** and its counterpart **27'** extend into linkage housing **14**. Connecting means **33** and **33'** are provided for connecting the movable contacts **27** and **27'** to cam followers **31** and **31'**, respectively. Connecting means **33** may comprise a connecting cylinder **29**, connecting rod **62**, flanges **61** and **66** held together by bolts **60**, and cam follower connector **63**. A means **67** is provided for independently adjusting the location of each contact relative to the axis of movement of cam **42** or relative to its associated cam follower. Means **67** is used to adjust the contacts to the optimum opening and closing position to insure proper closing and opening of the contacts. Washers **59** or similar elements may be inserted between flanges **61** and **66** to adjust the separation between cam follower **31** and connecting rod **62** to thereby space the contacts from the axis of movement. In this manner, each contact may be separately adjusted without dismantling any large structural components or affecting other contacts. To accomplish this it is only necessary to remove bolts **60** and insert the appropriate thickness of washer between flanges **66** and **61**.

The movable contacts are actuated through the cam followers and connecting means by the movement of cam **42** substantially simultaneously in opposite directions so

that both move inwardly and outwardly of their respective envelopes at the same time, that is, they are reciprocally actuated.

As shown more clearly in FIGS. 3, 4 and 5, particularly FIG. 3, connecting rod **62** is connected to move within an end **30** of connecting cylinder **29** and is connected to cam follower **31** at connecting flanges **61** and **66**. Another end **35** of connecting cylinder **29** is rigidly connected to movable contact **27** through a retaining sleeve **64**. A shunt **36** is electrically connected to contact **27** through retaining sleeve **64** with a bolt **65**, and in this embodiment provides an electrical path between contacts **27** and **27'** to place the contacts in series. A pin **32** is rigidly connected to connecting rod **62** and moves within a slot or hole **34** in cylinder **29**. A spring **37** is in a precompressed condition between pin **32** and sleeve **64** when the contacts are open. As cam follower **31** is moved outwardly, it moves the pin to further compress spring **37** thereby pressing with sufficient force against the sleeve to move contact **27** to the closed position and thereby further charge spring **37**. The predetermined compression of spring **37** serves to provide a given force at contact make to prevent contact rebound and overtravel. When the pin is moved in the opposite direction, pin **32** pushes against the sleeve at its slot to open the contacts, as shown in FIG. 6.

Contact actuating means **12** moves the contacts through a shaft **17** and a linkage mechanism **11**. Shaft **17** is connected to the linkage mechanism at cam **42**. As shown in FIG. 3, cam **42** has surfaces or slots **54** and **54'** each of which form a middle slot portion **80** and **80'** with extending slot end portions **68** and **68'**, respectively, at one end, and **69** and **69'**, respectively, at the other end. Cam followers **31** and **31'** ride in, and are guided by, their respective slots **54** and **54'** as shown. The cam is reciprocally movable along an axis to two positions and moves the cam followers along the axis of the contacts to move the contacts inwardly and outwardly from envelopes **23** and **23'** to open and close the contacts. Retaining bars **55** and **55'** maintain the position of the cam followers relative to the axis of the contacts. Rollers **56** retain the position of cam **42** so that it moves in the proper direction without wobbling.

Slots **54** and **54'** have geometric configurations whereby cam followers **31** and **31'** are pushed in one direction when the cam moves from one position to the other, and are pushed in another direction when the cam returns to the original position, thus making both movements mechanically positive. For example, as cam **42** moves from the position shown in FIG. 3 to the position shown in FIG. 6, a cam surface section **57** of the slot pushes against cam follower **31** to move it outwardly of the envelopes to open the contacts. As the cam moves from the position shown in FIG. 6 to the position shown in FIG. 3, a cam surface section **58** of the slot pushes against the cam follower to move it inwardly of the envelopes to close the contacts. Thus, no biasing means is relied upon to directly move the contacts in either direction. Instead, each movement is accomplished by a positive mechanical linkage between cam **42** and movable contacts **27** and **27'**.

The position of movable contact **27** is maintained by slot end portions **68** and **69** if cam **42** should move or oscillate along its axis of movement within the limits of the length of the end portions. This results because the slot end portions are elongated along a line parallel to the axis of movement of cam **42** and the open and closed position of the contact is achieved when the cam followers are in these slot end portions. Therefore, these slot end portions effectively provide a lost motion mechanism between contacts **27** and **27'** and cam **42** when the contacts are at the open and closed position.

The configuration of the middle slot portion can be selected to obtain the preferable mechanical advantage between the operating mechanism and the contacts. That is, if a desired mechanical advantage is necessary to properly operate the contacts as to speed and force, the angle of the slots to the axis of movement of the cam **42** may be calculated and appropriately determined for the mechanism. The slots are formed by be elongated along lines parallel to one line or, for example, with one slot being elongated parallel to one line and the other slot parallel to another line. These lines may be appropriately curved or straight (as shown) and are positioned to form an acute angle with the axis of movement of cam **42**. The size of this acute angle, particularly when the elongation is along straight lines, determines the mechanical advantage between the operating mechanism and the contact. The movement of the cam is preferably as shown, i.e., along a line bisecting the angle between the lines and in the plane of the lines so that the resulting movement of the contacts are equal.

A means for reciprocally moving shaft **17** and thereby cam **42** is provided and comprises a motor **47** for rotating a drive shaft **45** through a gear box **79**, a sleeve **70** mounted around shaft **45** and rotatable thereon, an eccentric cam **44** rigidly connected to sleeve **70**, a tension spring **78** connected to rotate cam **44** and biasing springs **40** and **41** (FIG. 5) connected to bias a cam roller or follower **43** against the surface of cam **44**. Shaft **17** is connected to transfer the reciprocal motion from cam follower **43** to cam **42** and to transmit the tension from biasing springs **40** and **41** to the cam follower to maintain it against the surface of cam **44**.

Referring to FIGS. 1 and 2, to close the contacts in the vacuum switches, shaft **17** is actuated downwardly by cam **44** and biased upwardly by biasing springs **40** and **41**. Shaft **17** extends through column **15** into housing **13** where it is connected to cam follower **43** through a cam follower structure **46**.

Cam **44** is mounted on sleeve **70** and is rotated clockwise to where a pin **71**, which extends radially outward from drive shaft **45**, engages a pawl **72** extending axially outward from sleeve **70**. Upon such engagement, starting with the position shown in FIG. 1, cam **44** is rotated clockwise and cam roller **43** rolls off the high portion of the surface of cam **44** and is pulled upward by biasing springs **40** and **41**. This moves cam **42** to its upper position, as shown in FIG. 6, to open the contacts. The motor may be automatically turned off by any known means (not shown) in response to the opening of the switches.

To close the switches, the motor turns the shaft, sleeve, and cam **44** further clockwise to the point where an arm **49** is just slightly more than 180° from the position shown in FIG. 1. At this point, tension spring **78**, which is connected to arm **49** at a pin **50** and to housing **13** at an ear **51**, compresses to pull the arm to rotate the sleeve (which will rotate freely in this direction because of the pin **71** and pawl **72** arrangement) and stop cam **44** at the position shown. This position, shown in FIGS. 1, 3, 4 and 5, closes the contacts. Any known means (not shown) may be provided for automatically stopping the motor when the switches are closed.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. Motion translating means for moving a pair of movable contacts to a contact open and a contact closed position, said means comprising: a cam movable along an axis and having two slots each having a middle portion elongated in a direction along a first and second line, respectively, said lines positioned to each form an acute angle to said axis and said slots having end portions at each end elongated along a line parallel to the axis; means for reciprocally moving the cam along said axis; two cam followers each supported to ride in cooperative relationship with a different slot; means for connecting one of the cam followers to one of the movable contacts and the other cam follower to the other of the movable contacts; and said slots having a configuration adapted to move

the contacts through the cam followers to the contact open position and to the contact closed position in response to movement of the cam, and means for moving the cam.

2. Motion translating means for moving a pair of contacts along a first axis to a contact open and a contact closed position, said means comprising: a cam reciprocally movable along a second axis substantially perpendicular to the first axis and having one slot having a center portion elongated in a direction parallel to a first line and an end portion at each end elongated in a direction parallel to the second axis and another slot having a center portion elongated in a direction parallel to a second line and an end portion at each end elongated in a direction parallel to the second axis; said lines positioned to form equal and opposite acute angles to said second axis; a pair of cam followers each supported to ride within and in cooperative relationship with a different slot and to

be movable only in a direction parallel to the first axis; and means for connecting each of the cam followers to a different one of the movable contacts, and means for reciprocally moving the cam along said first axis to place each of the cam followers in one end portion of its respective slot at contact open position and to place each of the cam followers in the other end portion of its respective slot at contact closed position.

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