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(54) Position switch with movable contacts having positive operation

Positionsschalter mit beweglichen Kontakten mit positivem Betrieb

Commutateur de position avec contacts mobiles ayant un fonctionnement positif

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(56) References cited:
EP-A- 0 411 331
GB-A- 765 474
GB-A- 1 033 014
GB-A- 1 113 395

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Description

Field of the invention

[0001] The present invention is generally applicable to the field of basic electric devices, and particularly relates to a position switch with movable contacts having positive operation, as described in the preamble of claim 1.

[0002] This switch is particularly useful for safe control of moving parts of machines and systems and for causing shut-down thereof upon detection of end positions.

Background of the invention

[0003] Position switches are known to be used for positioning, controlling and checking moving parts of automatic machines and systems, such as in end position detection, to cause safe automatic shut-down.

[0004] These switches have a mechanical actuator for switching from a primary shut-down circuit, which closes to cause the machine or system to start, to an auxiliary signaling circuit, which closes to cause the machine or system to stop. Switching occurs by displacing one or more movable contacts from a first position in which they are coupled with the stationary contacts of the primary circuit to a second position in which they are coupled with the stationary contacts of the auxiliary circuit.

[0005] Prior art switches use double-break movable contacts, of either simple or double-bridge type, wherein the contacts consist of pads of silver or other metals having suitable electrical conductivity properties.

[0006] In the former case there is a single pair of movable contacts which is translated to contact a pair of stationary contacts connected to the auxiliary circuit to cause closure thereof and consequent shut-down of the machine.

[0007] In the latter case, two pairs of movable contacts are provided, which are simultaneously translated to simultaneously contact respective pairs of stationary contacts of the auxiliary signaling circuit.

[0008] Nevertheless, the occasional presence of high resistance of contacts, especially caused by the presence of a thin layer of oxide, dust or other impurities of various kinds embedded in the switch during wiring, may cause switching failures.

[0009] Reiteration of this process not only depends on the switch but on the work environment in which it is situated and on the type of load under control. Effects are inversely proportional to the control voltage, as low voltage values may not be able to penetrate the oxide layers or dust.

[0010] This kind of malfunctioning is generally tolerable in manual controls, where it can be solved by repeating the operation, whereas failed detection of a limit stop position may cause considerable damages for the machine and/or for the operator working thereon.

[0011] The above switches further have high contact resistances. Particularly, in switches with single-bridge double-break movable contacts, total resistance is twice the resistance of each contact and total switching failure probability is a quadratic function of the failure probability for each break. In double-bridge, double-break movable contacts resistance is as high as in simple movable contacts and switching failure probability is lower, though not negligible.

[0012] Specific technical standards further require switches to include contacts having a positive operation, through the use of a lever or other positive opening device, whereby the movable contacts may be applied a higher opening force than the maximum expected adhesion force between movable and stationary contacts.

[0013] This need is particularly felt when high currents pass through the contacts, such as during a short circuit, in which event adhesion forces between the movable and stationary contacts reach very high values.

[0014] The above type of switch is known, amongst other, from US 5,453,590 and is composed of a bridge-like movable contact susceptible of being alternately forced against the stationary contacts of shut-down and signaling circuits by means of a pushing rod which operates on a bistable spring.

[0015] Nevertheless, this solution has such high switching failure probability and resistance values that, in case of high current passage, relatively high adhesion forces are generated between contacts. The above drawback obliges to oversize the opening mechanism, which causes an overall increase of bulkiness and costs of the whole device.

[0016] From EP-A-0411331 is known a switch having all the features of the preamble of the main claim 1.

Disclosure of the invention

[0017] The object of the present invention is to overcome the above drawbacks, by providing a position switch with movable contacts having positive operation that is highly efficient and relatively cost-effective.

[0018] A particular object is to provide a small-size and low cost position switch.

[0019] Yet another object is to provide a highly reliable position switch, while reducing switching failure probabilities.

[0020] These and other objects, as better explained hereafter, are fulfilled by a position switch with movable contacts having positive operation according to claim 1.

[0021] Thanks to this particular configuration according to the invention a double-bridge, single-break type position switch is provided, which reduces the total contact resistance between the movable contacts and the stationary contacts. Thus, the total resistance between movable and stationary contacts, upon passage of high currents, is relatively low, so that positive operation means will have to oppose lower adhesion forces than in prior art switches, and may involve lower sizes and costs.

[0022] Another important aspect is that at least one

pair of stationary and movable contacts is used, to further reduce total mutual resistance.

[0023] Also, this will lower the likelihood of switching failures thus the switch will have a higher reliability.

[0024] It was experimentally found that the total switching failure probability F_e is given by the following formula:

$$F_e = x^2$$

where x stands for the switching failure probability per break between the contacts.

[0025] Therefore, assuming that, for each break between a movable contact and a corresponding stationary contact, a switching failure occurs once every 10000 operations, there will be one switching failure every 100,000,000 operations. Experimental data showed that, in a switch with double-bridge, double-break movable contacts, assuming an identical error rate, there will be a wrong operation every 25,000,000.

[0026] Such data show that the position switch with movable contacts having positive operation of the invention is four times more reliable than prior art switches.

Brief description of drawings

[0027] Further features and advantages of the invention will be more apparent from the detailed description of a preferred, non-exclusive embodiment of a position switch according to the invention, which is described as a non-limiting example with the help of the annexed drawings, in which:

FIG. 1 is a side view of a position switch according to the invention in which the external case is partly open to make the interior of the switch visible;
FIG. 2 is a perspective view of a detail of the switch of FIG. 1 in normal operating conditions;
FIG. 3 is a front view of the detail of FIG. 2;
FIG. 4 is a side view of the detail of FIG. 2 in a first operating position with the machine or system to which the switch is connected is in function;
FIG. 5 is a side view of the detail of FIG. 2 in a second operating position;
FIG. 6 is a side view of the detail of FIG. 2 in a third operating position;
FIG. 7 is a side view of the detail of FIG. 2 in a fourth operating position with the pushbutton element in its end position.

Detailed description of a preferred embodiment

[0028] Referring to the above figures, the position switch with movable contacts having positive operation, overall designated by numeral 1, automatically switches a supply current from a primary shut-down circuit to an auxiliary signaling circuit of a machine or system.

[0029] The switch may be used for controlled shut-down of an automatic or semiautomatic machine or system, and particularly for detection of end positions.

[0030] As shown in FIG. 1, the position switch of the invention has a common input terminal 2 to be connected to a per se known voltage source, not shown in the figures one first and one second output terminals 3, 4, suitable to be connected to a primary shut-down circuit and to an auxiliary signaling circuit of a machine or system respectively, also not shown, one first pair of stationary contacts 5 and one second pair of stationary contacts 6 electrically connected respectively to the first and second output terminals 3, 4, one pair of movable contacts 7 electrically connected to the common input terminal 2 and susceptible of alternately interacting with corresponding stationary contacts 5, 6 of the first and second pairs.

[0031] While reference is being made herein to the stationary contacts 5 and 6 and the movable contacts 7 as "pairs", they may be provided in greater numbers, such as three, four, five or more, without departure from the inventive scope as defined in the annexed claims.

[0032] The movable contacts 7 are normally in contact with the first pair of stationary contacts 5 and means 8 are further provided for positive operation of the pair of movable contacts 7 to move them apart from the first pair of stationary contacts 5, thereby causing positive opening of the primary circuit and simultaneous closing of the auxiliary circuit.

[0033] The expression *"positive opening"* as used herein is in accordance with the technical standard EN 60947-5-1, which constitutes the reference document for regulating devices for use in control circuits and control elements in low voltage equipments.

[0034] According to such standard, positive operation means 8 shall have no elastic connection with the movable contacts 7, whose separation from the stationary contacts 5 of the first pair shall directly result from a specific movement of an appropriate actuator by means of non elastic members.

[0035] Thus, the movable contacts 7 will be forced to open even when contacts are stuck together due to occasional passage of a high voltage, such as during a short circuit.

[0036] Yet, appropriate arrangement of movable contacts 7 relative to stationary contacts 5, 6 can provide a double-bridge, simple-break switch. Contacts 5, 6, 7 will essentially consist of pads of silver or another metal, or anyway a material having suitable electrical conductivity properties.

[0037] In this configuration, designating R_c the contact resistance generated between each movable contact 7 and the corresponding stationary contacts of the first 5 and second pairs 6 and assuming a simplified arrangement with substantially identical contacts 5, 6, 7 made of the same material, the total resistance R will be substantially half the R_c value, equivalent to two resistances R_c in parallel.

[0038] As particularly shown in FIG. 2 and FIG. 3, the

movable contacts 7 will be electrically connected to the common input terminal 2 by articulated electrical connection means 9.

[0039] Such means 9 comprise a first elongated member 10, defining a longitudinal axis X, with a longitudinal end 11 mechanically and electrically coupled to the common input terminal 2 and the opposite longitudinal end 12 having such a shape as to define a first substantially transverse pivot axis Y_1, for a switching arm 13.

[0040] This latter will comprise in turn a pair of elongated extensions 14, 15, which are appropriately shaped and substantially parallel to the longitudinal axis X. Each of such extensions 14, 15 has one of the movable contacts 7 at its free end 16, 17 remote from the first pivot axis Y_1.

[0041] The first output terminal 3 is connected to the first pair of stationary contacts 5 through a second elongated member 18, which is appropriately shaped and substantially parallel to the longitudinal axis X, having one end 19 electrically and mechanically connected to the first output terminal 3 and the opposite end 20 bearing the first pair of stationary contacts 5.

[0042] In substantially the same manner, the second output terminal 4 is connected to the second pair of stationary contacts 6 through a third elongated member 21, which is substantially parallel to the longitudinal axis X, having one end 22 electrically and mechanically connected to the second output terminal 4 and the opposite end 23 bearing the second pair of stationary contacts 6.

[0043] Advantageously, the switching arm 13 is interposed between the second 18 and third 21 elongated members and is susceptible of pivoting in a substantially vertical plane π passing through the longitudinal axis X.

[0044] Thus, the movable contacts 7 will be also interposed between the pairs of stationary contacts 5, 6 to move, by the pivotal movement ϕ_1 of the arm 13, from the normal operating condition, in which they are coupled with the first pair of stationary contacts 5, as shown in FIG. 4, to a shut-down condition, as shown in FIG. 5, in which they are coupled with the stationary contacts 6 of the second pair.

[0045] Suitably, the positive operation means 8 include a pushbutton element 24 which is movable in a substantially vertical direction W and is operatively connected to a lever member 25 interposed between the switch arm 13 and the second elongate member 18. The lever element 25 is pivotable about a second transverse pivot axis Y_2, in the vertical plane π.

[0046] In the preferred, non exclusive configuration of the figures, the lever element 25 is a first type lever which rotates about a pivot 27, defining the axis Y_2, introduced in the side wall of the exterior case 29.

[0047] The pushbutton element 24 has two specially shaped projections 31', 31" at its bottom end 30, which are particularly shown in FIG. 3, facing towards corresponding tooth-shaped portions of the end 33 adjacent the lever element 25, one of which is only visible in the annexed figures and designated by 32, the second being placed symmetrically to the former with respect to the longitudinal axis X.

[0048] The projections 31', 31" and the tooth-shaped portions 32 mutually interact to cause a pivotal movement ϕ_2 of the lever element 25 about the second pivot axis Y_2 in response to a downward displacement w of the pushbutton element 24.

[0049] Furthermore, the lever element 25 has a catch 35 at its longitudinal end 34 opposite the tooth-shaped portions 32, which is designed to interact with the elongate extensions 14, 15 of the switching arm 13 to cause positive opening of the primary shut-down circuit and closing of the auxiliary signaling circuit.

[0050] Positive operation means 8 further include a first elastic member 36 for elastically and controllably counteracting the vertical motion of the pushbutton element 24.

[0051] The first elastic member 36 is preferably a helical spring whose modulus is calibrated to allow vertical sliding of the pushbutton 24 once a predetermined external force F is applied thereon.

[0052] In the particular configuration of the annexed figures, the pushbutton 24 substantially has a hollow cylindrical shape, having an open lower end 30 and a closed upper end 37 to at least partly receive the spring 36. Thus, the spring 36 has one end section 38 attached to the bottom wall of the case 29 and the opposite end section, not visible, facing towards the closed end 37 of the pushbutton element 24.

[0053] Also, the positive operation means 8 include a second elastic member 39 which is received in a central housing 40 in the switch arm 13 to elastically and controllably counteract the pivotal motion ϕ_1 thereof.

[0054] The second elastic member 39, which is also preferably a helical spring, is substantially parallel to the switch arm 13, when the latter is in its normal operating condition in which the main shut-down circuit is closed.

[0055] The second elastic member 39 is also in such position as to define two snap positions for the switch arm 13, i.e. a first limit stop position of the pushbutton element 24, as shown in FIG. 4, and a second position in which the pushbutton element 24 has completed its snap stroke C_s, as shown in FIG. 5.

[0056] In operation, the vertical downward displacement w of the pushbutton element 24 will involve interaction between the projections 31', 31" and the tooth-shaped portions 32, which will cause the pivotal movement ϕ_2 of the lever element 25 and the positive mechanical operation of the switch arm 13, and thence of the movable contacts 7.

[0057] The term *positive mechanical operation* as used herein is intended as the action of a mechanical component, in this case the projections 31', 31" which inevitably drives another component, i.e. the tooth-shaped portions 32, either by direct contact or through rigid elements.

[0058] FIG. 4 shows a first operating position of the inventive switch, which corresponds to the normal oper-

ating condition, in which the stationary contacts 5 are coupled to the movable contacts 7. In these conditions, the primary shut-down circuit of the machine with the switch connected thereto is closed, whereby the machine is operating.

[0059] FIG. 5 shows a second operating position of the inventive switch, in which the stroke C_s of the pushbutton element 24 has caused the arm 13 to snap into pivotal movement ϕ_1 to move the movable contacts 7 to contact engage the stationary contacts 6. In this operating position, the auxiliary signaling circuit of the machine is closed, so that the machine is in shut-down conditions. If high currents pass between the contacts 5 and 7, such as during a short-circuit, the adhesion forces between the contacts 5, 7 may be so strong that such snapping action might not occur, thereby causing serious danger for the machine and its operators.

[0060] FIG. 6 shows a third operating position of the switch of the invention, in which a stroke C_1, longer than the stroke C_s, of the pushbutton element 24 has caused interaction between the projections 31 and the tooth-shaped portions 32 to cause the lever 25 to pivot ϕ_2 In this operating position, the lever element 25 has completed its positive opening stroke C_2 and has forced the switch arm 13 to deviate thereby causing positive separation of the movable contacts 7 from the first stationary contacts 5 and contact thereof with the second stationary contacts 6. In case of short-circuit, such movement would cause the primary shut-down circuit to open, thereby resulting in a machine shut-down, any danger for the machine and the working personnel being thus prevented.

[0061] FIG. 7 shows a fourth and last operating position of the switch of the invention, in which the pushbutton element 24 reaches the limit stop position corresponding to the maximum allowed mechanical stroke C_{MAX}, longer than C_1, which is advantageously longer than the positive opening stroke C_2 to provide an adequate stroke length, given by the difference between the maximum stroke C_{MAX} and the positive opening stroke C_2, within which the switch 1 is adjusted.

[0062] The above disclosure clearly shows that the invention fulfills the intended objects and particularly meets the requirement of providing a small-size and low-cost position switch.

[0063] Thanks to this particular arrangement of the stationary and movable contacts 5, 6, 7 a double-bridge single-break position switch is provided, which reduces the overall contact resistance between the movable contacts and the stationary contacts. Thus, the total resistance between movable and stationary contacts, upon passage of high currents, is relatively low, whereby positive operation means shall have to oppose lower adhesion forces than in prior art switches, and may involve lower sizes and costs.

Claims

1. A position switch with movable contacts having positive operation for automatically switching a supply current from a primary shut-down circuit to an auxiliary signaling circuit of a machine or system, wherein said position switch comprises:

   - a common input terminal (2) connected to a voltage source;
   - one first and one second output terminals (3, 4), connectable respectively to a primary shut-down circuit and to an auxiliary signaling circuit of a machine or system;
   - at least one first (5) and at least one second (6) stationary contacts electrically connected to said first (3) and said second (4) output terminals respectively;
   - at least one pair of movable contacts (7) electrically connected to said common input terminal (2) and susceptible of alternately interacting with said at least one first (5) and one second (6) stationary contacts respectively, said at least one pair of movable contacts (7) being normally in contact engagement with said at least one first stationary contact (5);
   - means (8) for positive operation of said at least one pair of movable contacts (7) to cause them to move apart from said at least one first stationary contact (5) thereby causing positive opening of the primary circuit and simultaneous closing of the auxiliary circuit,

   wherein said movable contacts (7) and said common input terminal (2) are electrically connected by articulated electrical connection means (9),
   characterized in that said at least one first (5) and at least one second (6) stationary contacts are pairs of stationary contacts, said articulated electrical connection means (9) comprising a first elongated member (10), defining a longitudinal axis (X), said member having a longitudinal end (11) mechanically and electrically coupled to said common input terminal (2) and the opposite longitudinal end (12) so shaped as to define a first substantially transverse pivot axis (Y_1) for a switching arm (13).

2. Position switch as claimed in claim 1, **characterized in that** said switching arm (13) comprises a pair of elongated extensions (14, 15), which are substantially parallel to said longitudinal axis (X) and have said pair of movable contacts (7) proximate to their free ends (16, 17) remote from said first pivot axis (Y_1).

3. Position switch as claimed in claim 2, **characterized in that** said first output terminal (3) is connected to said first pair of stationary contacts (5) through a sec-

ond elongated member (18), which is substantially parallel to said longitudinal axis (X), and has one end (19) electrically and mechanically connected to said first output terminal (3) with the opposite end (20) bearing said first pair of stationary contacts (5).

4. Position switch as claimed in claim 3, **characterized in that** said second output terminal (4) is connected to said second pair of stationary contacts (6) through a third elongated member (21), which is substantially parallel to said longitudinal axis (X), and has one end (22) electrically and mechanically connected to said second output terminal (4) with the opposite end (23) bearing said second pair of stationary contacts (6).

5. Position switch as claimed in any preceding claim, **characterized in that** said switching arm (13) is interposed between said second (18) and said third (19) elongated members and is susceptible of pivoting in a substantially vertical plane (π) passing through said longitudinal axis (X).

6. Position switch as claimed in claim 1, **characterized in that** said positive operation means (8) include a pushbutton element (24) which is movable in a substantially vertical direction (W) and is operatively coupled to a lever element (25) pivotable about a second transverse pivot axis (Y_2) in said vertical plane (π).

7. Position switch as claimed in claim 6, **characterized in that** said lever element (25) is interposed between said switch arm (13) and said second elongated element (18).

8. Position switch as claimed in claim 7, **characterized in that** said pushbutton element (24) has at least one, preferably two specially shaped projections (31', 31") at its lower end (30), which face towards corresponding tooth-shaped portions (32) on the adjacent end (33) of said lever element (25) to cause said lever element (25) to pivot (ϕ_2) about said second pivot axis (Y_2) in response to a downward displacement (w) of said pushbutton element (24).

9. Position switch as claimed in claim 8, **characterized in that** said lever element (25) has a catch (35) at its longitudinal end (34) opposite said tooth-shaped portions (32), which is designed to interact with said elongate extensions (14, 15) of said switching arm (13) to cause positive opening of the primary shutdown circuit and closing of the auxiliary signaling circuit.

10. Position switch as claimed in any preceding claim, **characterized in that** said positive operation means (8) further include a first elastic element (36) for elastically and controllably counteracting the vertical displacement (w) of said pushbutton element (24).

11. Position switch as claimed in claim 10, **characterized in that** said positive operation means (8) further include a second elastic element (39) which is located in a central housing (40) in said switching arm (13) for elastically and controllably counteracting the pivotal motion (ϕ_1) thereof.

Patentansprüche

1. Positionsschalter mit beweglichen Kontakten mit positivem Betrieb zum automatischen Schalten eines Versorgungsstroms von einem ersten Abschaltkreis zu einem hilfsweisen Signalkreis einer Maschine oder eines Systems, wobei der Positionsschalter umfasst:

- ein gemeinsames Eingabeterminal (2), das mit einer Spannungsquelle verbunden ist,
- ein erstes und ein zweites Ausgabeterminal (3, 4), das jeweils verbunden werden kann mit einem ersten Abschaltkreis und mit einem hilfsweisen Signalkreis einer Maschine oder eines Systems,
- mindestens einem ersten (5) und mindestens einem zweiten (6) stationären Kontakt, die elektrisch verbunden sind mit jeweils dem ersten (3) und dem zweiten (4) Ausgabeterminal,
- mindestens einem Paar beweglicher Kontakte (7), die elektrisch verbunden sind mit dem gemeinsamen Eingabeterminal (2) und in der Lage sind alternativ zusammen zu wirken mit dem jeweils mindestens einen ersten (5) und einen zweiten (6) stationären Kontakt, wobei das mindestens eine Paar beweglicher Kontakte (7) normalerweise in Kontakt ist mit dem mindestens einen ersten stationären Kontakt (5),
- Einrichtungen (8) für positiven Betrieb des mindestens einen Paars beweglicher Kontakte (7), um diese zu veranlassen, sich getrennt zu bewegen von dem mindestens einen ersten stationären Kontakt (5) und dabei das positive Öffnen des primären Kreises und gleichzeitige Schließen des hilfsweisen Kreises zu bewirken,

wobei die beweglichen Kontakte (7) und das gemeinsame Eingabeterminal (2) elektrisch verbunden sind mittels gelenkiger elektrischer Verbindungseinrichtungen (9),
dadurch gekennzeichnet, dass die mindestens einen ersten (5) und mindestens einen zweiten (6) stationären Kontakte Paare sind von stationären Kontakten, die gelenkigen elektrischen Verbindungseinrichtungen (9) ein erstes längliches Element (10) umfassen, das eine longitudinale Achse (X) bestimmt, das Element ein longitudinales Ende (11) hat, das

mechanisch und elektrisch angeschlossen ist an das gemeinsame Eingabeterminal (2) und das gegenüber liegende Ende (12) so geformt ist, dass es eine erste, im wesentlichen transversale Schwenkachse (Y_1) für einen Schaltarm (13) bildet.

2. Positionsschalter gemäß Anspruch 1, **dadurch gekennzeichnet, dass** der Schaltarm (13) ein Paar länglicher Vorsprünge (14, 15) aufweist, die im wesentlichen parallel sind zu der longitudinalen Achse (X) und das Paar beweglicher Kontakte (7) nahe zu ihren freien Enden (16, 17), entfernt von der ersten Schwenkachse (Y_1) haben.

3. Positionsschalter gemäß Anspruch 2, **dadurch gekennzeichnet, dass** das erste Ausgabeterminal (3) verbunden ist mit dem ersten Paar stationärer Kontakte (5) durch ein zweites längliches Element (18), das im wesentlichen parallel ist zu der longitudinalen Achse (X) und ein Ende (19) hat, das elektrisch und mechanisch verbunden ist mit dem ersten Ausgabeterminal (3), wobei das gegenüber liegende Ende (20) das erste Paar stationärer Kontakte (5) trägt.

4. Positionsschalter gemäß Anspruch 3, **dadurch gekennzeichnet, dass** das zweite Ausgabeterminal (4) verbunden ist mit dem zweiten Paar stationärer Kontakte (6) durch ein drittes längliches Element (21), das im wesentlichen parallel ist zu der longitudinalen Achse (X) und ein Ende (22) hat, das elektrisch und mechanisch verbunden ist mit dem zweiten Ausgabeterminal (4), wobei das gegenüber liegende Ende (23) das zweite Paar stationärer Kontakte (6) trägt.

5. Positionsschalter gemäß einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Schaltarm (13) zwischen den zweiten (18) und den dritten länglichen Elementen (19) angeordnet ist und in der Lage ist in einer im wesentlichen vertikalen Ebene (Π) zu schwenken, die durch die longitudinale Achse (X) verläuft.

6. Positionsschalter gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die Einrichtungen (8) für positiven Betrieb ein Druckknopf-Element (24) umfassen, das beweglich ist in einer im wesentlichen vertikalen Richtung (W) und funktionell verbunden ist mit einem Hebelelement (25), das schwenkbar ist um eine zweite transversale Schwenkachse (Y_2) in der vertikalen Ebene (Π).

7. Positionsschalter gemäß Anspruch 6, **dadurch gekennzeichnet, dass** das Hebelelement (25) zwischen dem Schaltarm (13) und dem zweiten länglichen Element (18) angeordnet ist.

8. Positionsschalter gemäß Anspruch 7, **dadurch gekennzeichnet, dass** das Druckknopf-Element (24) mindestens ein, vorzugsweise zwei besonders geformte Vorsprünge (31', 31") an seinem unteren Ende (30) aufweist, die ausgerichtet sind auf entsprechend zahnförmige Bereiche (32) auf dem anliegenden Ende (33) des Hebelelements (25), um das Hebelelement (25) zu veranlassen, um (Φ_2) zu schwenken um die zweite Schwenkachse (Y_2) als Reaktion auf eine Verschiebung (w) des Druckknopf-Elements (24) nach unten.

9. Positionsschalter gemäß Anspruch 8, **dadurch gekennzeichnet, dass** das Hebelelement (25) einen Eingriff (35) an seinem longitudinalen Ende (34) gegenüber den zahnförmigen Bereichen (32) aufweist, der so ausgelegt ist, dass er zusammen wirkt mit den länglichen Vorsprüngen (14, 15) des Schwenkarms (13), um positives Öffnen des ersten Abschaltkreises und Schließen des hilfsweisen Signalkreises zu bewirken.

10. Positionsschalter gemäß einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Einrichtungen (8) für positiven Betrieb zudem ein erstes elastisches Element (36) umfassen, um der vertikalen Bewegung (W) des Druckknopf-Elements (24) elastisch und steuerbar entgegen zu wirken.

11. Positionsschalter gemäß Anspruch 10, **dadurch gekennzeichnet, dass** die Einrichtungen (8) für positiven Betrieb zudem ein zweites elastisches Element (39) umfassen, das in einem zentralen Gehäuse (40) angeordnet ist in dem Schwenkarm (13), um dessen Schwenkbewegung (Φ_1) elastisch und steuerbar entgegen zu wirken.

Revendications

1. Commutateur de position possédant des contacts mobiles ayant une commande positive pour commuter automatiquement un courant d'alimentation d'un circuit principal d'arrêt à un circuit auxiliaire de signalisation d'une machine ou d'un système, dans lequel ledit commutateur de position comprend :

- une borne d'entrée commune (2) connectée à une source de tension ;
- des première et deuxième bornes de sortie (3, 4) qui peuvent être connectées respectivement à un circuit principal d'arrêt et à un circuit auxiliaire de signalisation d'une machine ou d'un système ;
- au moins un premier contact fixe (5) et au moins un second contact fixe (6) respectivement connectés électriquement à ladite première borne de sortie (3) et à ladite seconde borne de sortie (4) ;

- au moins une paire de contacts mobiles (7) connectés électriquement à ladite borne d'entrée commune (2) et susceptibles de coopérer alternativement avec ledit au moins un premier contact fixe (5) et avec ledit au moins un second contact fixe (6) respectivement, ladite au moins une paire de contacts mobiles (7) étant normalement en position de contact avec ledit au moins un premier contact fixe (5) ;
- des moyens (8) pour commander positivement ladite au moins une paire de contacts mobiles (7) pour les amener à s'écarter dudit au moins un premier contact fixe (5), en provoquant par ce moyen l'ouverture positive du circuit principal et la fermeture simultanée du circuit auxiliaire,

dans lequel lesdits contacts mobiles (7) et ladite borne d'entrée commune (2) sont connectés électriquement par des moyens de connexion électrique articulés (9),
caractérisé en ce que ledit au moins un premier contact fixe (5) et ledit au moins un second contact fixe (6) sont des paires de contacts fixes, lesdits moyens de connexion électrique articulés (9) comprenant un premier élément allongé (10) définissant un axe longitudinal (X), ledit élément ayant une extrémité longitudinale (11) couplée mécaniquement et électriquement à ladite borne d'entrée commune (2) et l'extrémité longitudinale opposée (12) étant conformée de manière à définir un premier axe formant pivot (Y_1) sensiblement transversal pour un bras de commutation (13).

2. Commutateur de position selon la revendication 1, **caractérisé en ce que** ledit bras de commutation (13) comprend une paire de prolongements allongés (14, 15) qui sont sensiblement parallèles audit axe longitudinal (X) et ont ladite paire de contacts mobiles (7) à proximité de leurs extrémités libres (16, 17) éloignées dudit premier axe formant pivot (Y_1).

3. Commutateur de position selon la revendication 2, **caractérisé en ce que** ladite première borne de sortie (3) est connectée à ladite première paire de contacts fixes (5) par l'intermédiaire d'un second élément allongé (18) qui est sensiblement parallèle audit axe longitudinal (X) et a une extrémité (19) connectée électriquement et mécaniquement à ladite première borne de sortie (3), l'extrémité opposée (20) portant ladite première paire de contacts fixes (5).

4. Commutateur de position selon la revendication 3, **caractérisé en ce que** ladite seconde borne de sortie (4) est connectée à ladite seconde paire de contacts fixes (6) par l'intermédiaire d'un troisième élément allongé (21) qui est sensiblement parallèle audit axe longitudinal (X) et a une extrémité (22) connectée électriquement et mécaniquement à ladite seconde borne de sortie (4), l'extrémité opposée (23) portant ladite seconde paire de contacts fixes (6).

5. Commutateur de position selon une quelconque des revendications précédentes, **caractérisé en ce que** ledit bras de commutation (13) est interposé entre ledit second élément allongé (18) et ledit troisième élément allongé (19) et est susceptible de pivoter dans un plan sensiblement vertical (π) qui passe par ledit axe longitudinal (X).

6. Commutateur de position selon la revendication 1, **caractérisé en ce que** lesdits moyens de commande positive (8) comprennent un élément à bouton-poussoir (24) qui est mobile dans une direction sensiblement verticale (W) et est couplé fonctionnellement à un élément formant levier (25) qui peut pivoter dans ledit plan vertical (π) autour d'un second axe formant pivot transversal (Y_2).

7. Commutateur de position selon la revendication 6, **caractérisé en ce que** ledit élément formant levier (25) est interposé entre ledit bras de commutation (13) et ledit second élément allongé (18).

8. Commutateur de position selon la revendication 7, **caractérisé en ce que** ledit élément à bouton-poussoir (24) a, à son extrémité inférieure (30), au moins une, de préférence deux, saillie(s) spécialement conformées (31', 31") qui font face vers des parties correspondantes (32) en forme de dent prévues sur l'extrémité adjacente (33) dudit élément formant levier (25) pour amener ledit élément formant levier (25) à pivoter ($\Phi 2$) autour dudit second axe formant pivot (Y_2) en réponse à un déplacement descendant (w) dudit élément à bouton-poussoir (24).

9. Commutateur de position selon la revendication 8, **caractérisé en ce que** ledit élément formant levier (25) a, à son extrémité longitudinale (34) située à l'opposé desdites parties en forme de dent (32), un taquet (35) qui est conçu pour coopérer avec lesdits prolongements allongés (14, 15) dudit bras de commutation (13) pour provoquer l'ouverture positive du circuit principal d'arrêt et la fermeture du circuit auxiliaire de signalisation.

10. Commutateur de position selon une quelconque des revendications précédentes, **caractérisé en ce que** lesdits moyens de commande positive (8) comprennent en outre un premier élément élastique (36) pour contrecarrer élastiquement et de façon contrôlable le déplacement vertical (w) dudit élément formant bouton-poussoir (24).

11. Commutateur de position selon la revendication 10, **caractérisé en ce que** lesdits moyens de comman-

de positive (8) comprennent en outre un second élément élastique (39) qui est placé dans un logement central (40) ménagé dans ledit bras de commutation (13) pour contrecarrer élastiquement et de façon contrôlable le mouvement de pivotement (Φ_1) de ce bras.

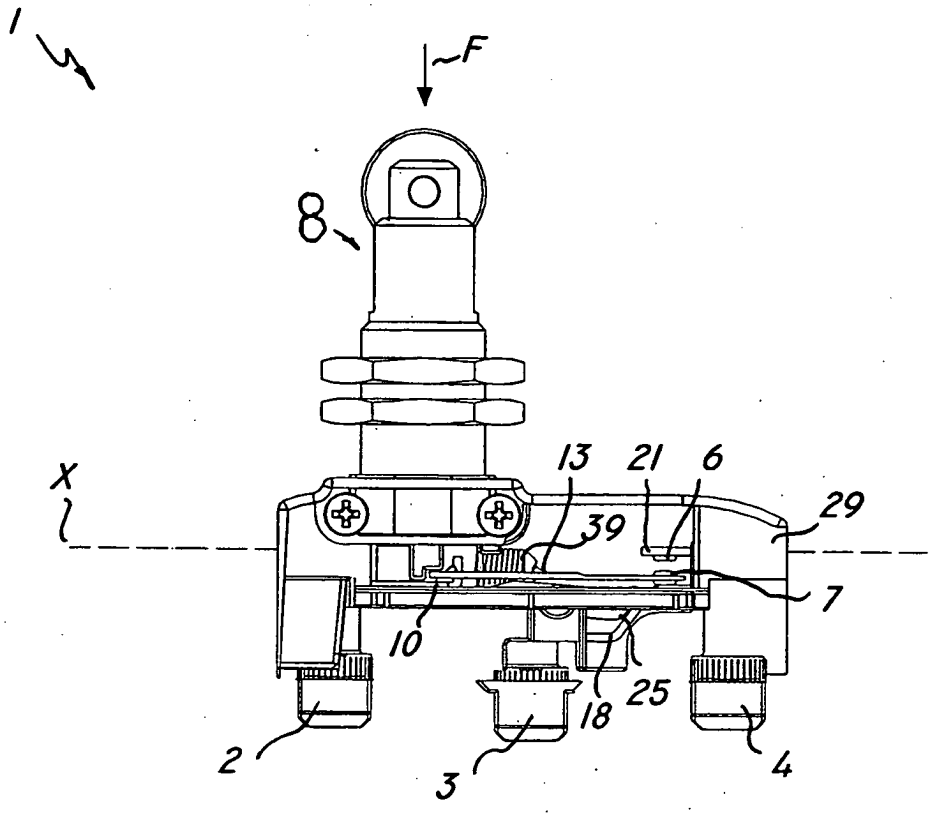
1
F
8
X
13
21
6
29
39
7
10
25
18
2
3
4

FIG. 1

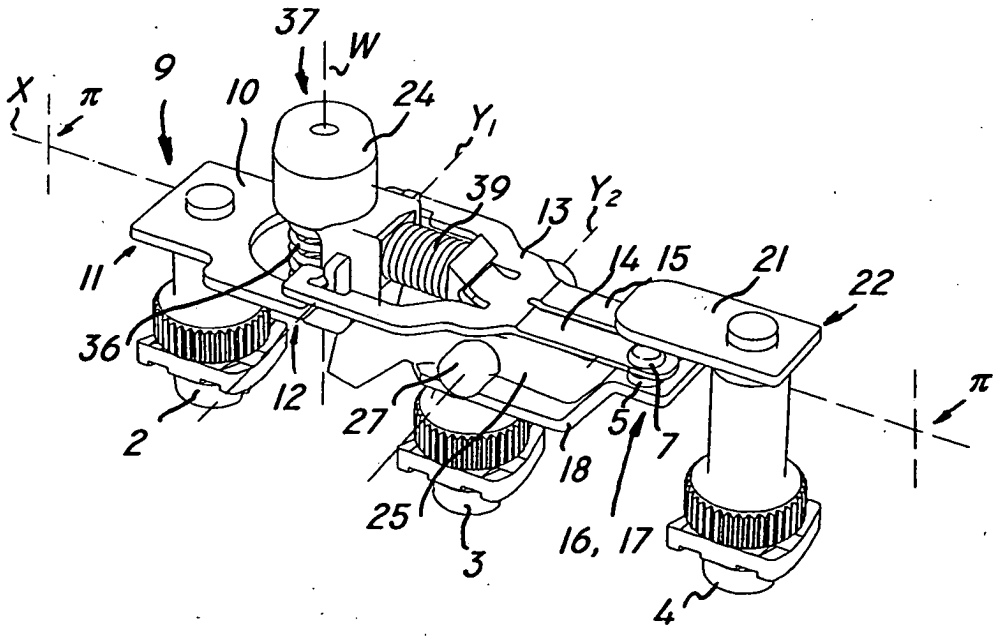
37
W
X
π
9
10
24
Y1
39
13
Y2
11
14
15
21
22
36
12
27
5
7
18
25
3
16, 17
4
π

FIG. 2

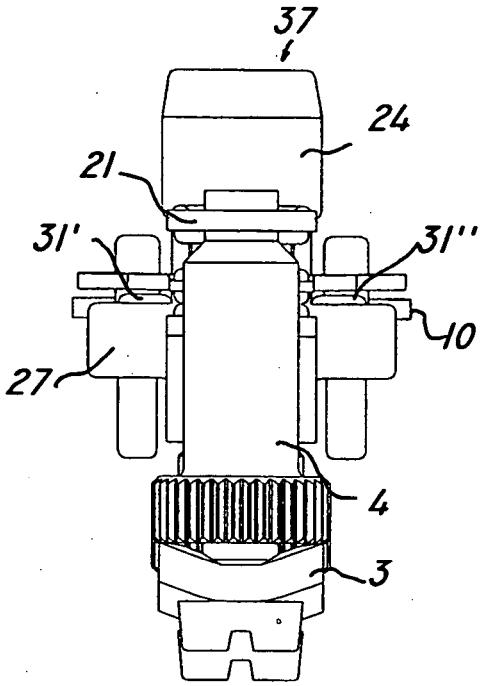
37
24
21
31'
31''
10
27
4
3

FIG. 3

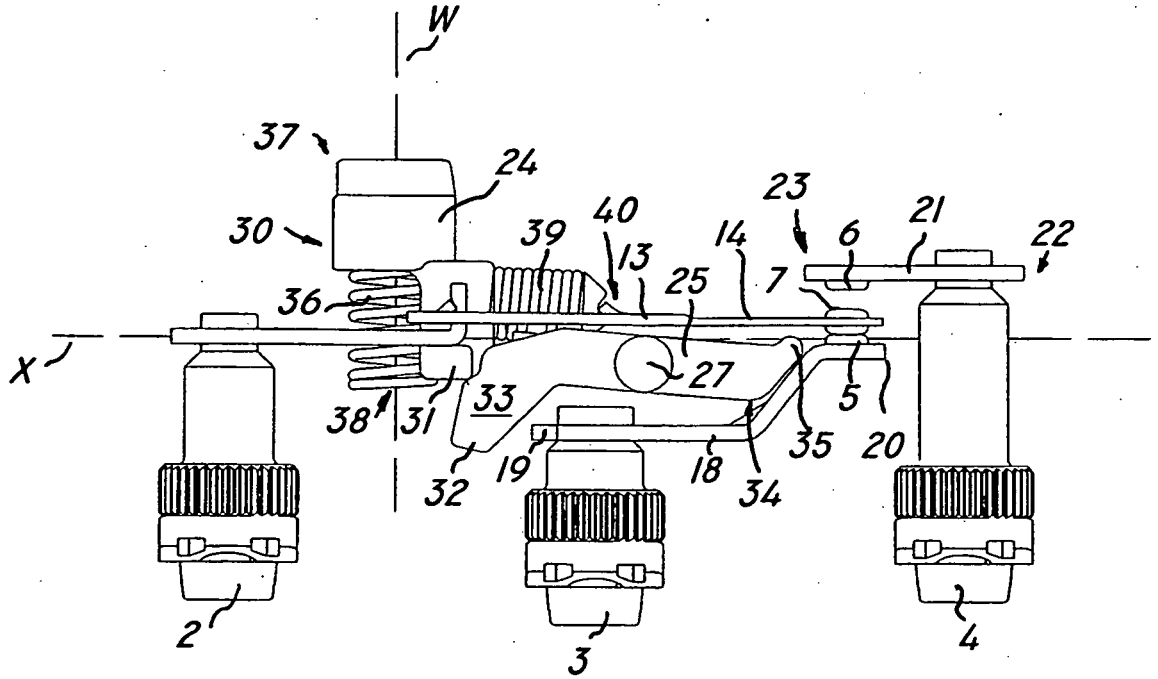
W
37
24
30
39
40
13
14
23
6
21
22
36
25
7
X
27
5
38
31
33
35
20
32
19
18
34
2
3
4

FIG. 4

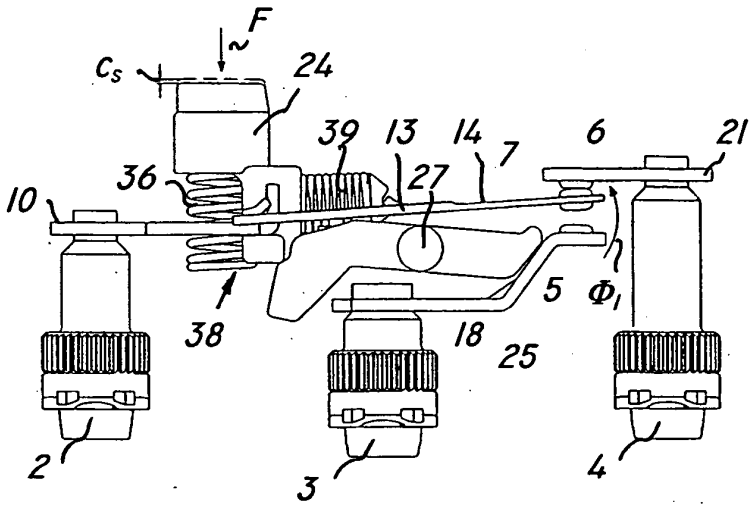

FIG. 5

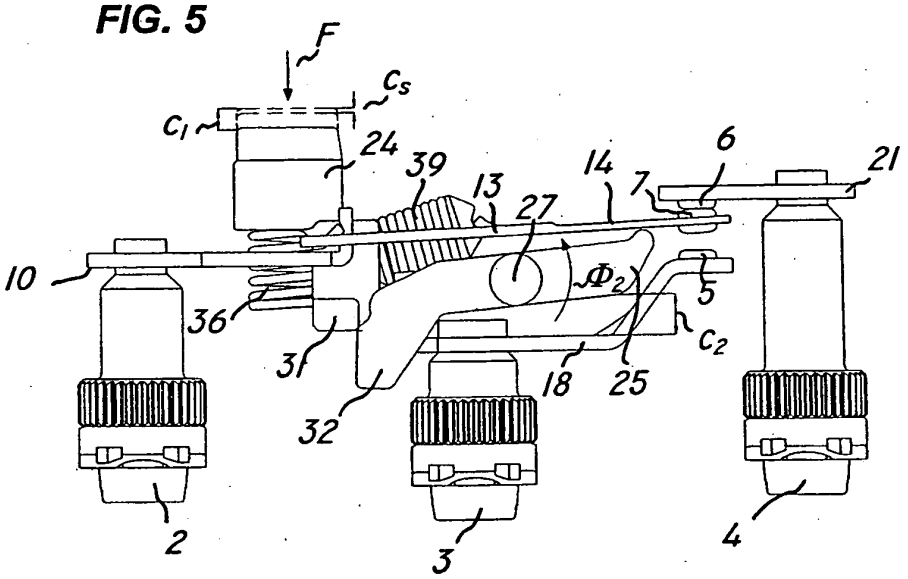

FIG. 6

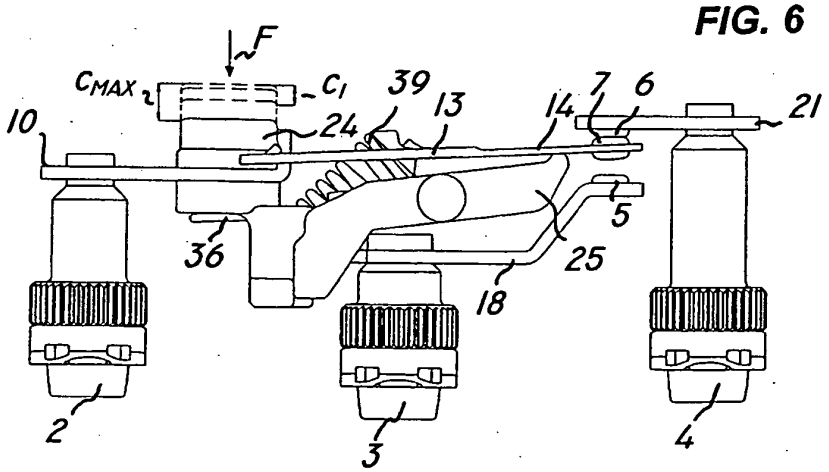

FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5453590 A **[0014]**
- EP 0411331 A **[0016]**