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Kluge et al.

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[45] **July 17, 1973**

[54] **SUSPENSION SWITCH WITH GEAR SEGMENT SLIDER AND OPERATING FORCE REGULATING CONTACT OPERATING CAMS**

[75] Inventors: **Johannes Kluge; Peter Rabe,** both of Wetter; **Otto Schmidt,** Witten; **Meinlof Schleyer,** Unna, all of Germany

[73] Assignee: **Demag AG,** Duisburg, Wolfgang-Reuter-Platz, Germany

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[51] **Int. Cl.** **H01h 3/40,** H01h 3/42

[58] **Field of Search** ..... 200/153 L, 153 LB, 200/153 K, 153 P, 156, 168 K; 74/98, 104

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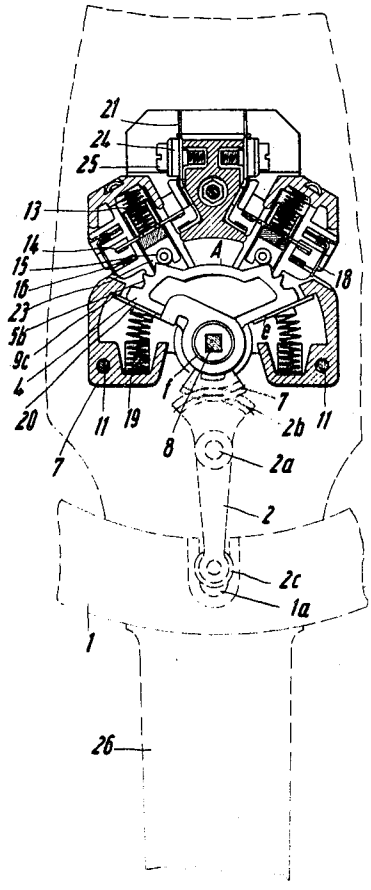
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Primary Examiner—Robert K. Schaefer
Assistant Examiner—Robert A. Vanderhye
Attorney—McGlew and Tuttle

[57] **ABSTRACT**

A suspension switch, for controlling electric motors, has plural switching positions selected by actuation of a switch slider which rotates a common carrier shaft carrying several cam disks of different cam shapes and fixed to the common shaft. Respective spring biased rollers cooperate with each cam disk and effect reciprocation of respective contact bridges controlling interconnection of respective pairs of fixed contacts. Each cam disk has a cam track formed with contact making and contact breaking surfaces engageable by the associated roller to actuate the respective contact bridges, and roller abutting surfaces, of differing slopes, interconnect the contact making and breaking surfaces.

19 Claims, 12 Drawing Figures

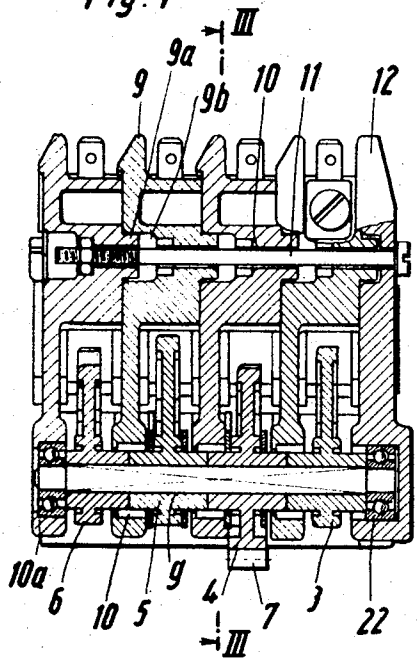


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Fig. 1



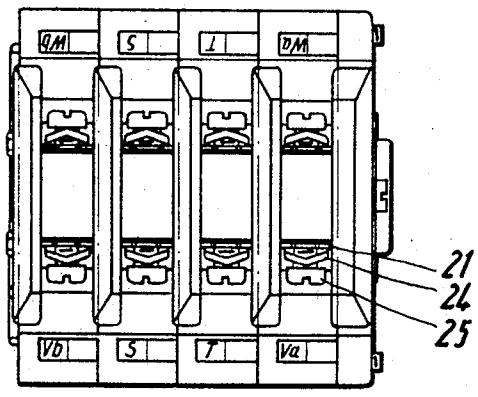
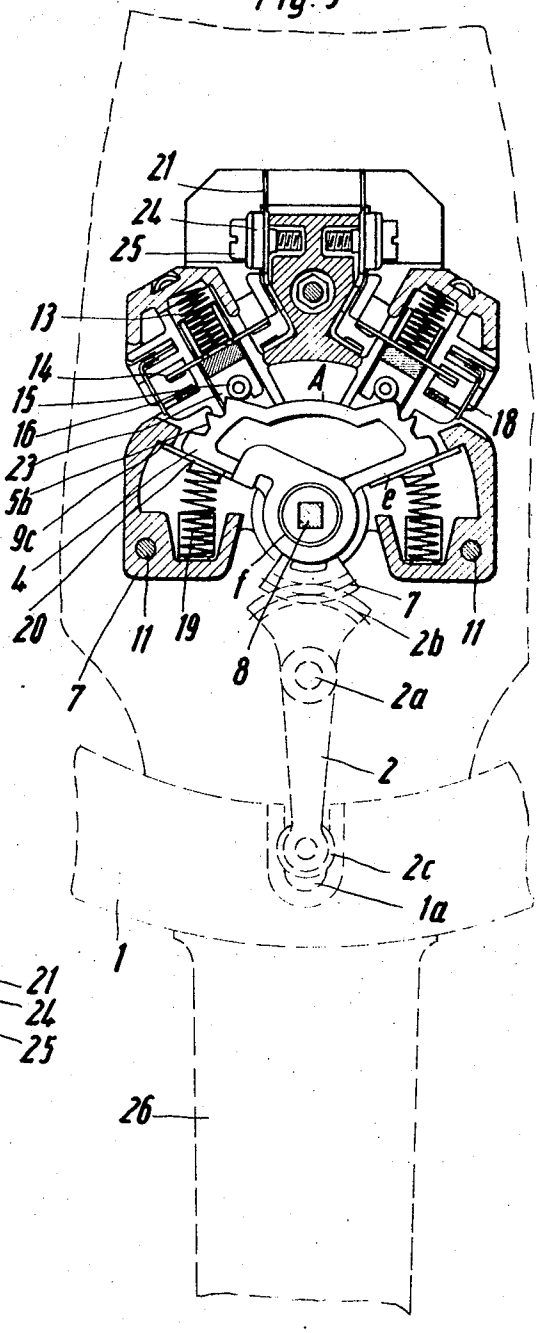


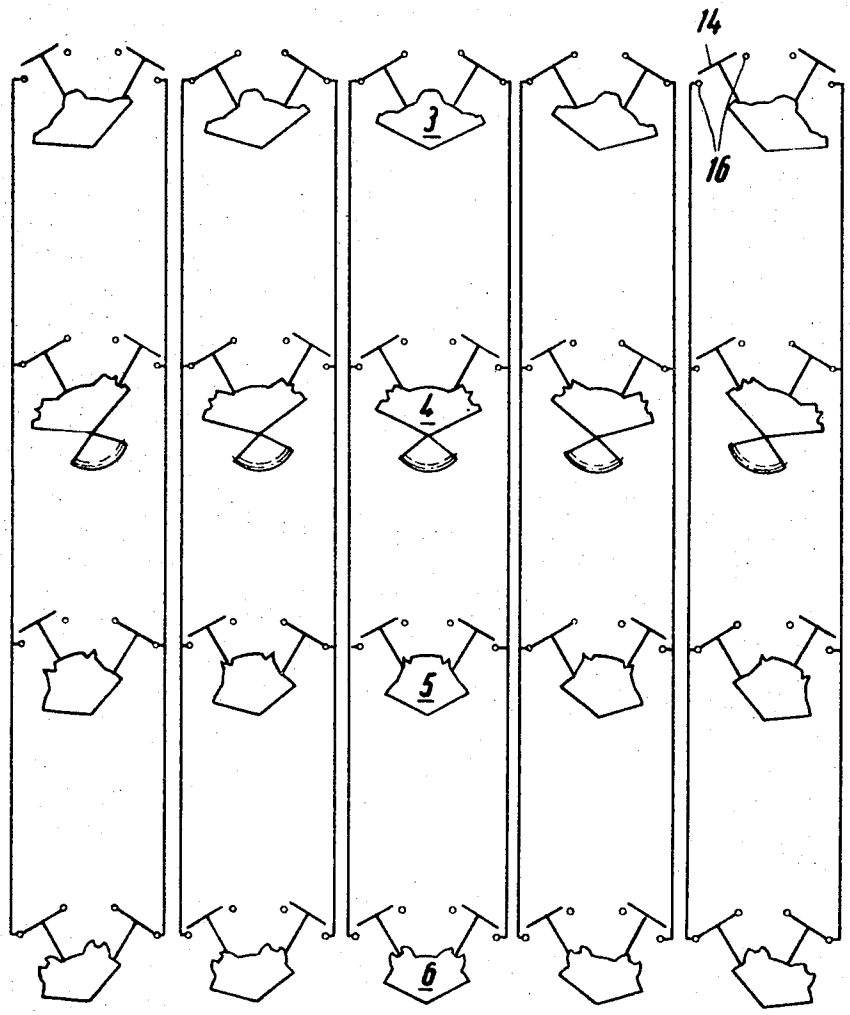
Fig. 2

Fig. 3



Inventors
JOHANNE KLUGE
PETER RABE
OTTO SCHMIDT
BY MEINOLF SCHLEYER
John J. McGlew
ATTORNEY

Fig. 4



Inventors
JOHANNE KLUGE
PETER RABE
OTTO SCHMIOT
MEINOLF SCHLEYER
BY John J. McGlew
ATTORNEY

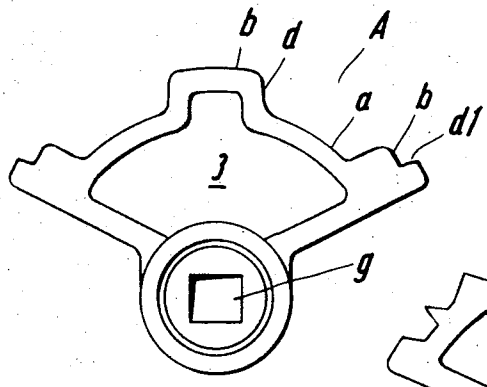


Fig. 5A

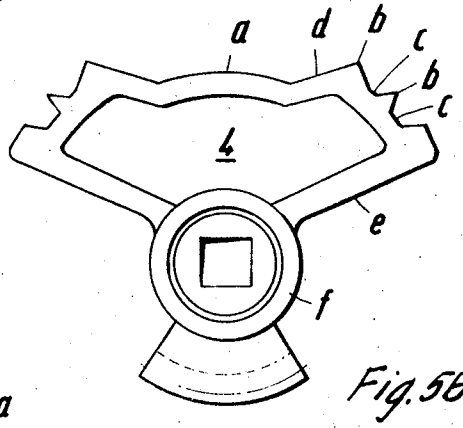


Fig. 5B

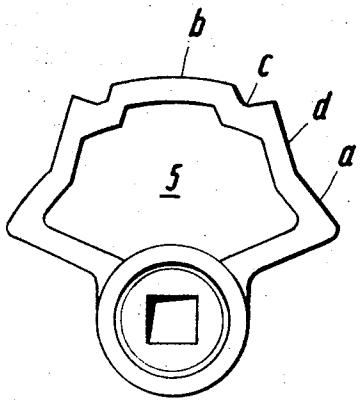


Fig. 5C

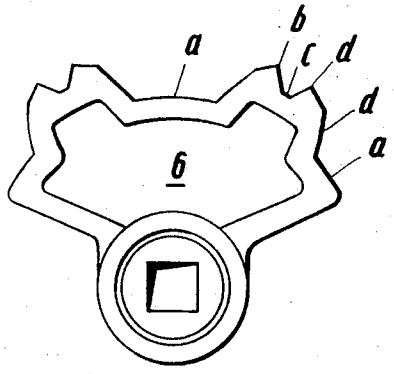


Fig. 5D

Inventors
JOHANNE KLUGE
PETER RABE
OTTO SCHMIOT
MEINOLF SCHLEYER
BY John J. McGlew
ATTORNEY

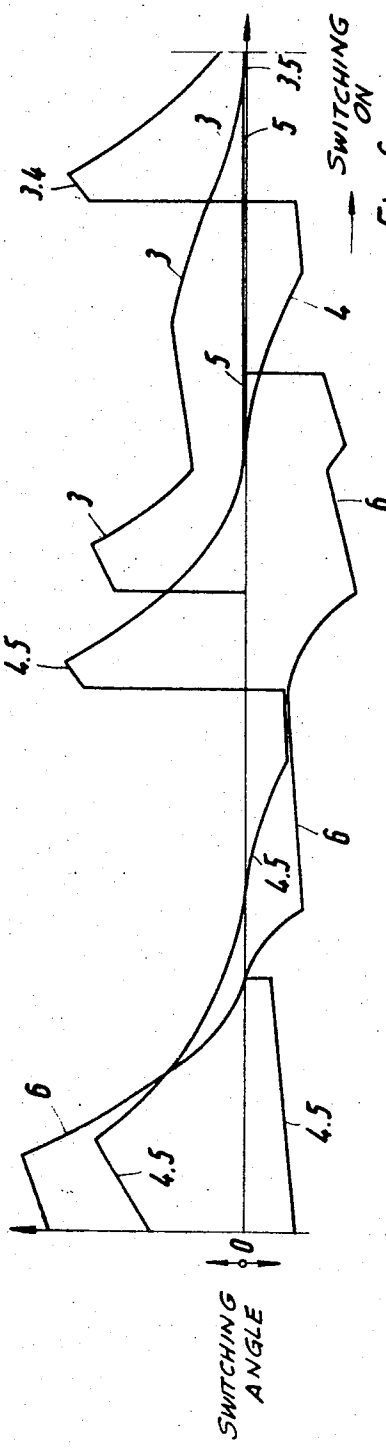


Fig. 6

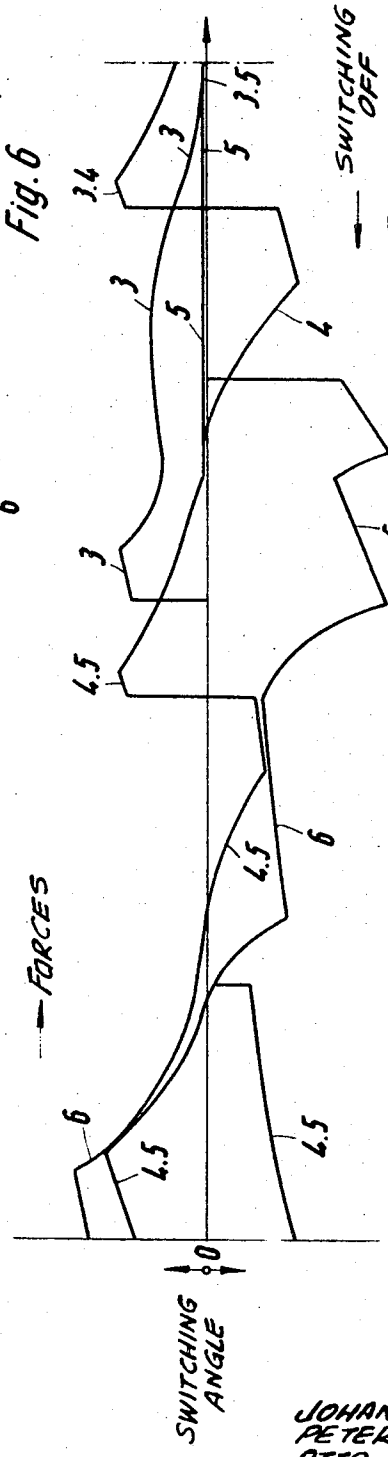


Fig. 7

Inventors
JOHANNE KLUGE
PETER RABE
OTTO SCHMIDT
MEINOLF SCHLEYER

BY John J. McGlew
ATTORNEY

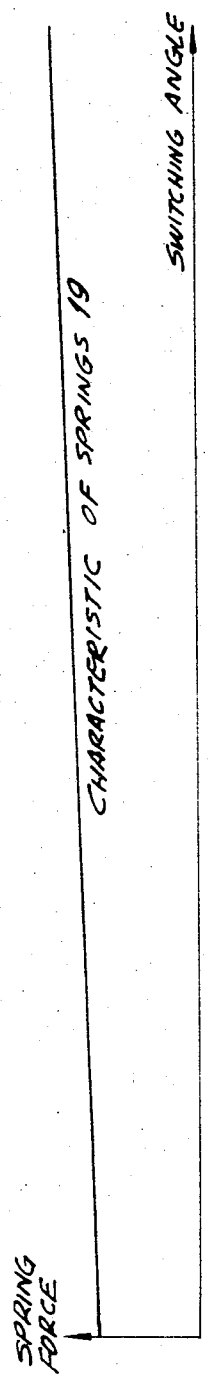


Fig. 8

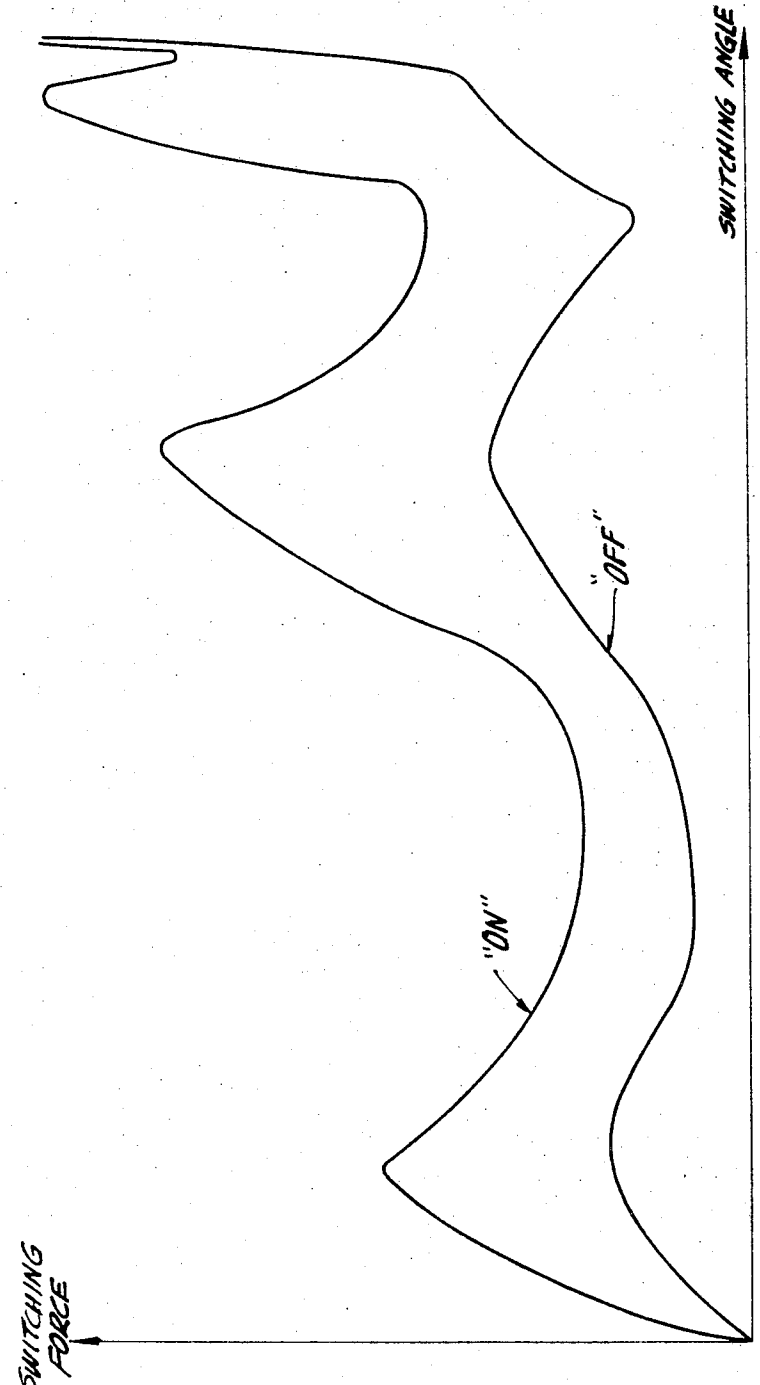


Fig. 9

Inventors
JOHANNE KLUGE
PETER RABE
OTTO SCHMIDT
MEINOLF SCHLEYER
BY John J. McGlew
ATTORNEY

SUSPENSION SWITCH WITH GEAR SEGMENT SLIDER AND OPERATING FORCE REGULATING CONTACT OPERATING CAMS

FIELD OF THE INVENTION

This invention relates to suspension switches, with several switching positions, for controlling hoisting gear electric motors, with the switching positions being selected by actuation of a switch slider. More particularly, the present invention is directed to such a suspension switch which is easy to operate and wherein wrong connections, due to carelessness or fatique of an operator, or due to contacts being welded together, are eliminated to a large extent.

BACKGROUND OF THE INVENTION

Such suspension switches, in which the lower part is designed as a handle in which is mounted the switch slider, are not always recommended for controlling a hoisting gear motor. Depending upon the desired direction of rotation of the motor, the switch slider is pressed with the thumb or a finger of the operator. A suspension switch of this type is easy to operate if not more than two switching positions are required, for example, a raising position and a lowering position, and wrong connections are impossible with some care, because the operator does not have to change the position of his hand embracing the suspension switch. By increasing the pressure on the switch slider, the electric motor can be switched from precision hoisting to normal hoisting. However, holding the switch slider in the switching stages requires considerable force, which leads to fatigue of the operator.

It is also known to arrange several pressure operated or pushbutton switches in a common housing of a suspension switch, but such a suspension switch is not always recommended for controlling a hoisting gear motor. This is because the operator mostly observes the load suspended on a hoisting gear, and actuates the pushbutton switches only by feel. Pressing a wrong pushbutton switch is not impossible, and leads to a wrong connection which can cause accidents. The last-mentioned type of suspension switch is also so large that the operator must hold it, during the switching, with one hand while using the other hand to operate the pushbutton switches. The operator thus does not have a hand free for guiding the load suspended on the hoisting cable or rope.

In all known switches, the requirement for a separating velocity of the contacts which is independent of the operating speed of the switch operator has been met by providing an instanteous circuit controlling operation in such a way that a spring is prestressed over a certain actuating path which effects the separation or reversal of the contacts abruptly when a "tipping" or "tilting" point is passed. Switches of this type have the disadvantage that very high contact velocities appear in the moving contacts, and these high velocities cause a high energy dissipation with the relatively great mass of the contacts, which has an adverse affect on chattering of the contacts. Contact chatter reduces the life of the contacts and increases the contact wear.

In the control of hoisting gears, the loads to be handled mostly are heavy loads or mixtures of heavy loads and normal loads. In heavy load operation, the starting current of the motor is supplied and interrupted, for example, in tipping operations. At normal load, the starting current is supplied and the rated current of the motor is interrupted by the switch. If wear appears on the contacts, due to long chatter times, it is not possible, in known suspension switches, or is possible only to a limited extent, to reopen the contacts by introducing additional external forces. An increased accident hazard results when an accidently given control order can no longer be cancelled or can be cancelled only with delay.

An additional wear hazard, and thus an additional accident hazard, is represented by the course of the actuating force along the actuating path. The known suspension switches have the characteristics of a helical spring in the force-travel course, that is, of a steady force increase up to the switching points. Through the actuating path, there is also effected the prestressing of a spring up to the "tipping" point, at which the contacts are abruptly separated or reversed. The "tipping" point is almost identical with the switching point. The prestressing of the spring results in the sinusoidal decrease of the contact force until it becomes zero at the "tipping" point.

SUMMARY OF THE INVENTION

In accordance with the invention, the switch slider is connected to several cam disks of different shape arranged on a common carrier shaft, and whose cam tracks are formed with contact making and contact breaking surfaces for spring-loaded rollers actuating contact bridges, and further formed with roller abutting surfaces, of different shapes, interconnecting the contact making and contact breaking surfaces. Due to the different forms and arrangements of the contact making and contact breaking surfaces, the rollers are forced back, against the spring bias, by roller abutting surfaces of varying slope and pressed, by the springs, into depressions of the cam track to effect closing of the contacts.

In accordance with another feature of the invention, the contact making surfaces are located at a shorter distance from the carrier shaft than are the contact breaking surfaces. The number of cam disks is determined by the number of desired switching positions. The carrier shaft can have a polygonal cross-section, and is preferably a rectangular bar which transmits the movement, initiated by the switch slide, to all the cam switches, which latter are symmetrical with respect to angular displacement from a zero position in either direction.

The roller abutting surfaces are so arranged, in the various cam disks, that, when the switch slide is actuated, generally only one spring is tensioned and the opposing spring is relaxed, which assures an easy actuation of the switch slide. The roller abutting surfaces can be so steep ahead of and behind the last switching stage that even an unskilled operator notices very quickly when the last switching stage is reached. The abutting surfaces also can be designed so that the switching positions can be held without effort or with very little effort. To this end, some or all of the cam disks can be provided, on both symmetrical sides, with notches, apart from the contact making and contact breaking surfaces.

If a suspension switch embodying the invention is placed in use, wrong connections due to carelessness or fatigue of the operator are eliminated to a great extent,

due to the physiologically favorable force-travel course of the switch slide.

In accordance with another feature of the invention, one of the cam disks, arranged on the carrier shaft, is provided with a gear segment for connection to the switch slide, and the switch slide has a recess for engaging one end of a two-arm operating lever whose opposite end has a gear segment, on the other side of the axis of rotaton of the lever, meshing with the gear segment of the cam disk. The operating lever is rotatably and displaceably mounted in the recess of the switch slide. Due to this arrangement, the displacement curve of the switch slide can be selected from the viewpoint of easy operability, independent of the transmission ratio of the operating lever.

The cam disks, in accordance with another feature of the invention, are circular segments with an included angle of about 90° to 180°. Each cam disk is arranged in a respective switch housing, and the cam disks can thus be produced as a unit including several cam disks arranged side-by-side as required. To this end, each switch housing has, on one side, at least one recess and, on the other side, at least one projection fitting into the recess of an adjacent switch housing. In addition, each switch housing has one or more through-bores to receive one or several screws and to receive the carrier shaft. With suspension switches of different sizes and capacities, only the screws and the carrier shafts have to be adapted, as to length, to the number of cam disks. The through-bore for the carrier shaft can have a bearing stop, which is necessary only, however, in the switch housing arranged at one end of the group of housings constituting a suspension switch. Consequently, all switch housings can be identical. The switch housing arranged at an end of a suspension switch can be provided with a cover which has the same through-bores as the switch housings to receive the screws and the carrier shaft.

In accordance with still another feature of the invention, the outer switch housing and the cover have arranged therein bearings for the carrier shaft. The support of the carrier shaft is thus statically determined, and the shaft causes only minor frictional resistances. The carrier shaft is so thick that it does not sag in the case of the simultaneous appearance of several shocks caused during the switching and even in a suspension switch including a large number of cam disks. Each suspension switch, in accordance with an additional feature of the invention, has a contact strip extending over all the switch housings, for the contact bridges arranged on both sides of the switch housing and pressed by the spring for producing roller contact against the cam track. This spring is connected to the roller which rolls along the cam track of the associated cam disk. On the undersides of the generally radial segment boundary surfaces of the cam disks there can be arranged springs bearing on the respective switch housings, and which are guided on the strips mounted on the hubs of the cam disks for rotation therewith. These ledges bear, in the zero position of the suspension switch, on a stop of the associated switch housing, and thus limit the travel of the return spring. Each return spring counteracts the opposite return spring only until the zero position is attained.

An object of the invention is to provide an improved suspension switch for controlling hoisting gear electric motors.

Another object of the invention is to provide such a suspension switch which is easy to operate, has a long life, and has several switching positions.

A further object of the invention is to provide such a suspension switch with which wrong circuit connections, due to carelessness or fatigue of an operator, or due to welded contacts, are eliminated to a large extent.

Another object of the invention is to provide such a suspension switch formed of a plurality of substantially identical switch housings each mounting a respective switch operating cam controlled by a single switch slider.

A further object of the invention is to provide such a suspension switch which can be readily and easily adapted to any desired number of switching positions by joining together the required number of substantially identical switch housings.

For an understanding of the principles of the invention, reference is made to the following description of a typical embodiment thereof as illustrated in the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. **1** is a longitudinal or axial sectional view through a suspension switch embodying the invention;

FIG. **2** is a top plan view corresponding to FIG. **1**;

FIG. **3** is a sectional view taken on the line III—III of FIG. **1**, with the switch slider, the operating lever and the protective housing being indicated by broken lines;

FIG. **4** is a schematic illustration of several cam disks in the various switching positions for two motor speeds;

FIGS. **5A – 5D** are elevation views, on an enlarged scale, of the four cam disks shown in FIG. **1**;

FIG. **6** is a graphic illustration of the calculated force-switching angle "ON" for the four cam disks;

FIG. **7** is a view similar to FIG. **6** but related to "OFF" for the four cam disks;

FIG. **8** is a graphical illustration of the characteristic of one of the return springs; and

FIG. **9** is a graphic illustration of the measured switching force-resultant from the four cam disks when added to the characteristic of the return spring shown in FIG. **8**, in the "ON" and "OFF" directions.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. **1**, four identical disk-shaped switch housings **9** are formed, in their upper regions, with a through-bore **10** for screw **11** which connects the switch housings **9** with a cover **12**. Each switch housing **9** has, on one side surface, a projection **9*a*** and, on the opposite side surface, a recess **9*b***, whereby the switch housings **9** can be interfitted with each other by engaging projections **9*a*** into the substantially mating recesses **9*b***. As can be seen from FIG. **3**, the suspension switch also is held together at both sides of the bottom portion by additional screws **11**. FIG. **3** also illustrates the square carrier shaft **8** which is mounted, as shown in FIG. **1**, at its ends in bearings **22**, in the form of ball-bearings, in the outermost switch housing **9** and in cover **12**. Bearing **22** in outermost switch housing **9** engages a bearing stop **10*a*** of through-bore **10**. Carrier shaft **8** is guided, with a sliding fit, through recesses or apertures *g* of cam disks **3**, **4**, **5** and **6**.

The application of the external force for actuating the suspension switch is effected by a switch slide **1** which is mounted in a protective housing **26** as indicated by broken lines. Switch slide **1** has a recess **1***a* for receiving a roller **2***c* on one end of an operating lever **2** which is oscillatable about an axis of rotation or pivot **2***a*, and whose opposite end has a gear segment **2***b* meshing with a gear segment or rim **7** which is a part of cam disk **4**. Each of cam disks **3, 4, 5** and **6** has a cam track A engaged by a respective pair of rollers **15**, one on each side of a vertical plane, and each mounted in a sliding element **23**. Each sliding element **23** has guiding engagement, at its opposite side edges, in the respective switch housing **9**, and carries a respective contact bridge **14** biased in one direction of movement by a respective spring **13** to engage and interconnect a respective pair of contacts **16** extending throughout the entire length of the suspension switch. FIG. **3** illustrates that a satisfactory forced opening and closing of the contacts is attained by rollers **15**, carrying contact strips **14**, rolling along cam tracks A of the respective cams.

Terminal contacts **21** extend parallel to contact strips **16**, and are bent so that they extend parallel to each other in the upper portion of the suspension switch. The upper end or parallel portion of each terminal contact is engaged by a respective connecting disk **24** secured by means of a respective cylinder screw **25**. The upper ends of terminal contacts **21** are so designed that commercial plugs can be used for connection. The closely arranged terminal contacts have the advantage that the arrangement is clear and that they permit the easy and proper mounting of the supply lines. Due to the continuous contact strip **16**, additional connecting lines or conductors to the terminal contacts **21** are not required in many suspension switches and are only partly required in other suspension switches, embodying the invention.

For cooling the arcs formed during switching between contact strip **16** and the associated contact bridges **14**, cooling plates **18** are provided, so that the life of the suspension switch is thus extended. The cooling plates **18** are resiliently clamped in position, and can be assembled later or can be disassembled repeatedly for inspection of the contact bridges **14** and the contact strips **16**.

For the purpose of varying the actuating force, return springs **19** are interposed between the radial segment boundary surfaces of cam disks **3, 4, 5** and **9** and the associated switch housings **9**. The upper ends of springs **19** are retained by strips **20** which bear, in the "OFF" or "REST" position of the switch, on stop surfaces **9***c* of the respective switching housings **9**, and which are mounted, for rotation, on the hubs of the respective cam disks **3, 4, 5** and **6**. In the illustrated suspension switch, each cam disk has a strip **20** and a return spring **19** on each side. Strips **20** can extend over all the cam disks and be engaged by one or several return springs **19**.

FIG. **4** illustrates that, in the zero or "OFF" position, only the contacts actuated by cam disk **3** are closed by interconnecting contact strips **16** by the respective contact strips **14**. In the first stage "hoisting," the right contact bridge **14** of cam disk **4** and the left contact bridge **14** of cam disk **5** are closed against the associated contact strips **16**, in addition to the contact strips closed by the contact bridges of cam disk **3**. Accidental turning of the cam disks is prevented by cam disks **4** and **5**, whose notches are engaged by the rollers, which have not been shown in FIG. **4**. In the second stage "hoisting," the contacts of cam disk **3** are opened or disconnected, as compared to the first stage, and those of cam disk **6** are interconnected or closed. Rollers **15** then engage the outer left notch of cam disk **4**. In addition, the roller abutting surfaces *d* of cam disk **6** act as stop means against accidental turning in the direction of the zero or "OFF" position.

As the cams **3, 4, 5** and **6** are symmetrical, with respect to the bisector of each cam segment, the operation is identical when going to first stage "lowering" and from there to second stage "lowering." This is clearly apparent from the center and two left hand sequences shown in FIG. **4**.

FIGS. 5A – 5D, which illustrate the cams **3, 4, 5** and **6**, respectively, drawn to a much larger scale than in FIGS. **3** and **4**, clearly illustrate the different cam tracks A respective to each cam disk. All of the contact making surfaces *a* are at the same radial distance from the axis or center line of the square openings *g* receiving carrier shaft **8**. The contact "break" surfaces *b* also having the same radial spacing from the axis or longitudinal center line of the respective openings *g* for receiving shaft **8**. The roller abutting surfaces *d* of cam disk **6** are flatter, in their outer portions, than they are in their inner portions. Cam disks **4, 5** and **6** have pronounced notches *c*. Since cam disk **3** effects disengagement of contacts in tne second stage, it is advisable if a greater resistance has to be overcome when starting the second stage than when starting the first stage, of motor operation. For this reason, the roller abutting surfaces *d* of cam disk **3** are steep and are formed, to act prior to the terminal stage, as one-sided stops *d*1.

Due to the differing designs of the cam tracks A, it is possible to vary the switching program and to design the operating force and operating path, for operation of the switch slide, so that a simple and non-tiring, and thus accident-proof, control of an electric motor is possible.

FIGS. **6** and **7** graphically illustrate the calculated force-switching angle characteristics for the four cam disks, with the forces being plotted as ordinates and the switching angles as abscissae. From these figures, it can be seen that additional large forces have to be overcome, for example, for turning cam disk **6** in the direction of the first stage "hoisting," because of the steep roller abutting surfaces *d* serving as limitations of the notches *c*. The rotation of cam disks **4** and **5** results in lower resistances for displacing rollers **15** upwardly or outwardly, with these resistances being reduced by the rollers running down or inwardly toward the contact making surfaces *a*. In turning cam disk **3**, only rolling resistances have to be overcome initially. For overcoming the resistances in the recesses, the switching force increases, at first, theoretically abruptly, without any change in the switching angle.

A force characteristic, with respect to the switching angle, for return springs **19**, is graphically illustrated in FIG. **8**. FIG. **9** graphically illustrates the measured switching force-resultant of the combined cam disks **3, 4, 5** and **6** when the characteristic of FIG. **8** is added to the individual forces on the cams. From FIG. **9**, it will be observed that the switching force decreases as soon as rollers **15** have overcome the roller abutting surfaces *d* of the cam disks **4** and **5** and roll down into

the notches *c* and on the roller abutting surfaces *d*, respectively, to the contact making surfaces *a*. At the same time, cam disks **6** causes lower resistances because of the flatter outermost courses of its roller abutting surfaces *d*.

For switching into the second stage "hoisting" two steep roller abutting surfaces *d* have to be overcome in cam disk **3**, and one flat roller abutting surface *d* in each of cam disks **4** and **5**. This second stage is retained, in particular, by the left hand notch *c* of cam disk **4**, as shown in FIG. **5B**. The outer left roller abutting surfaces *d*1 of cam disk **3** makes the advance from the second stage "hoisting" difficult, and the roller abutting surfaces *d* of cam disk **6** make the return of the cam disks to the zero position difficult.

FIG. **9** also graphically illustrates that the course of the force during disengagement of the contacts is similar to that during engagement of the contacts. The switching force necessary to be extended by the switch operator, however, is decreased, because it is augmented by return springs **19**.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A suspension switch, for controlling electric motors driving hoisting gear, having an "OFF" switching position and plural sucessive "ON" switching positions, selected by actuation of a switch slider, said switch comprising, in combination, a rotatably mounted carrier shaft; a switch slider operable to rotate said shaft; plural cam discs of different cam shapes, fixed to said shaft for angular displacement as a unit therewith; respective spring-biased rollers cooperable with each cam disc; each cam disc having a respective cam track formed with at least one pair of symmetrically located substantially arcuate contact making surfaces and at least one pair of symmetrically located contact breaking surfaces engageable by said rollers to actuate circuit closers, all the contact making surfaces being at the same first spacing from the axis of said shaft and all the contact breaking surfaces being at the same different second spacing from the axis of said shaft and each cam track having roller abutting surfaces, of selected degrees of slope, interconnecting adjacent contact making and contact breaking surfaces and regulating the force required to operate the switch between contact making and contact breaking positions; and respective circuit closers operable by each roller to open and close motor energizing circuits in accordance with movement of said switch slider; the contact breaking surfaces of at least one cam being joined to the contact making surfaces thereof by abrupt roller abutting surfaces extending steeply in a nearly radial direction; the cam tracks of at least certain of the cams having symmetrically located relatively deep and narrow roller engaging notches between adjacent contact breaking surfaces releasably restraining movement of the switch between two successive operating positions.

2. A suspension switch, as claimed in claim **1**, wherein each circuit closer comprises a contact bridge operable to interconnect a pair of circuit contacts, and movable into and out of engagement with its associated contacts by the associated spring-biased roller.

3. A suspension switch, as claimed in claim **2**, in which each cam disk is arranged in a separate switch housing.

4. A suspension switch, as claimed in claim **3**, in which each switch housing has, on one side, at least one recess and, on the other side, at least one projection; each switch housing projection fitting into a respective switch housing recess of an adjacent switch housing.

5. A suspension switch, as claimed in claim **4**, in which each switch housing is formed with a through-bore receiving said common carrier shaft, and with at least one additional through-bore for receiving screws joining plural switch housings to form a suspension switch.

6. A suspension switch, as claimed in claim **5**, in which the through-bore for said common carrier shaft is formed with a bearing shoulder.

7. A suspension switch, as claimed in claim **3**, in which the switch housing at one end of the suspension switch is provided with a cover.

8. A suspension switch, as claimed in claim **7**, comprising bearings for said common carrier shaft arranged in the switch housing at the opposite end of said suspension switch and in said cover.

9. A suspension switch, as claimed in claim **2**, in which each cam disk is arranged in a separate switch housing; said switch housings being juxtaposed to form said suspension switch; the cam track of each cam disk being cooperable with a pair of spring-biased rollers mounted in the associated switch housing symmetrically on each side of the zero position of the respective cam disk; respective springs engaging the contact bridge operable by each roller and biasing the associated roller into pressing engagement with the cam track of the respective cam disk; said suspension switch having two pairs of contact strips extending through all the switch housings with each pair of contact strips forming said contacts engageable with said contact bridges.

10. A suspension switch, as claimed in claim **1**, in which the spacing of said contact making surfaces from the axis of said carrier shaft is less than the spacing of said contact breaking surfaces from the axis of said shaft.

11. A suspension switch, as claimed in claim **1**, in which said carrier shaft has a polygonal cross section.

12. A suspension switch, as claimed in claim **1**, in which said cam disks are symmetrical with respect to each direction of operation of said suspension switch by said switch slider.

13. A suspension switch, as claimed in claim **1**, including a gear segment on one cam disk cooperable with said switch slider to rotate said common carrier shaft.

14. A suspension switch, as claimed in claim **1**, in which said cam disks are segments of a circle and have angular extents of from 90° to 180°.

15. A suspension switch, for controlling electric motors driving hoisting gear, having plural switching positions selected by actuation of a switch slider, said switch comprising, in combination, a rotatably mounted carrier shaft; a switch slider operable to rotate said shaft; plural cam discs of different cam shapes, fixed to said shaft for angular displacement as a unit therewith; respective spring-biased rollers cooperable with each cam disc; each cam disc having a respective cam track formed with at least one pair of symmetrically located contact making surfaces and at least one

pair of symmetrically located contact breaking surfaces engageable by said rollers to actuate circuit closers, and each cam track having roller abutting surfaces, of selected degrees of slope, interconnecting adjacent contact making and contact breaking surfaces and regulating the force required to operate the switch between contact making and contact breaking positions; respective circuit closers operable by each roller to open and close motor energizing circuits in accordance with movement of said switch slider; the cam tracks of at least certain cams having symmetrically located roller engaging notches releasably restraining movement of the switch between two sucessive operating positions; a gear segment on one cam disk cooperable with said switch slider to rotate said common carrier shaft; said switch slider being formed with a recess; a two-arm lever having one end engaged in said recess; means pivotally mounting said lever intermediate its ends for oscillation; and a gear segment on the opposite end of said lever meshing with said gear segment on said one of said cam disks.

16. A suspension switch, as claimed in claim **15,** in which said lever is mounted for rotation and displacement in said recess in said switch slider.

17. A suspension switch, for controlling electric motors driving hoisting gear, having plural switching positions selected by actuation of a switch slider, said switch comprising, in combination, a rotatably mounted carrier shaft; a switch slider operable to rotate said shaft; plural cam discs of different cam shapes, fixed to said shaft for angular displacement as a unit therewith; respective spring-biased rollers cooperable with each cam disc; each cam disc having a respective cam track formed with at least one pair of symmetrically located contact making surfaces and at least one pair of symmetrically located contact breaking surfaces engageable by said rollers to actuate circuit closers, and each cam track having roller abutting surfaces, of selected degrees of slope, interconnecting adjacent contact making and contact breaking surfaces and regulating the force required to operate the switch between contact making and contact breaking positions; respective circuit closers operable by each roller to open and close motor energizing circuits in accordance with movement of said switch slider; the cam tracks of at least certain cams having symmetrically located roller engaging notches releasably restraining movement of the switch between two successive operating positions; said cam discs being segments of a circle and having angular extents of from 90° to 180°; and a pair of return springs operatively associated with each cam disc and seated in the associated switch housing; each return spring being engageable with a respective segment bounding radial surface of the associated cam disc.

18. A suspension switch, as claimed in claim **17,** in which each return spring is seated on a respective strip mounted on the hub of the associated cam disk for rotation with said hub.

19. A suspension switch, as claimed in claim **18,** in which each of said last-named strips bears, in the zero or "OFF" position of said suspension switch, on a stop formed in the associated switch housing.

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