

[54] INSTANTANEOUS SWITCH

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[51] Int. Cl. H01h 15/18

[58] Field of Search 200/76, 67 A, 67 B, 200/67 D

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[57]

ABSTRACT

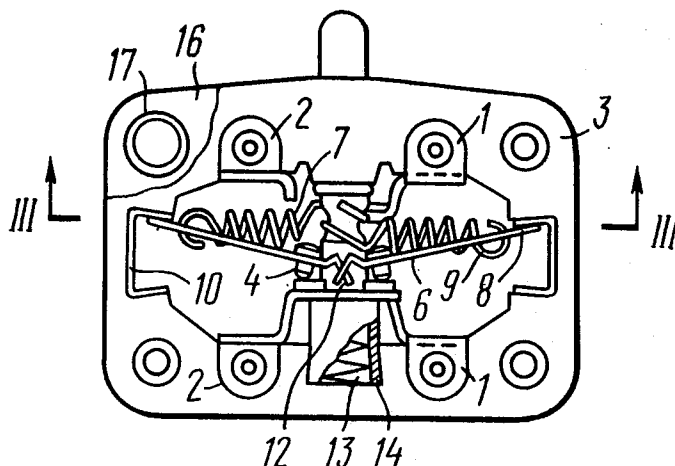
The invention relates to switches used in the automatic drive control of hoisting and conveying plant, machine-tools and other industrial equipment and, more specifically, to instantaneous switches used as limit switches.

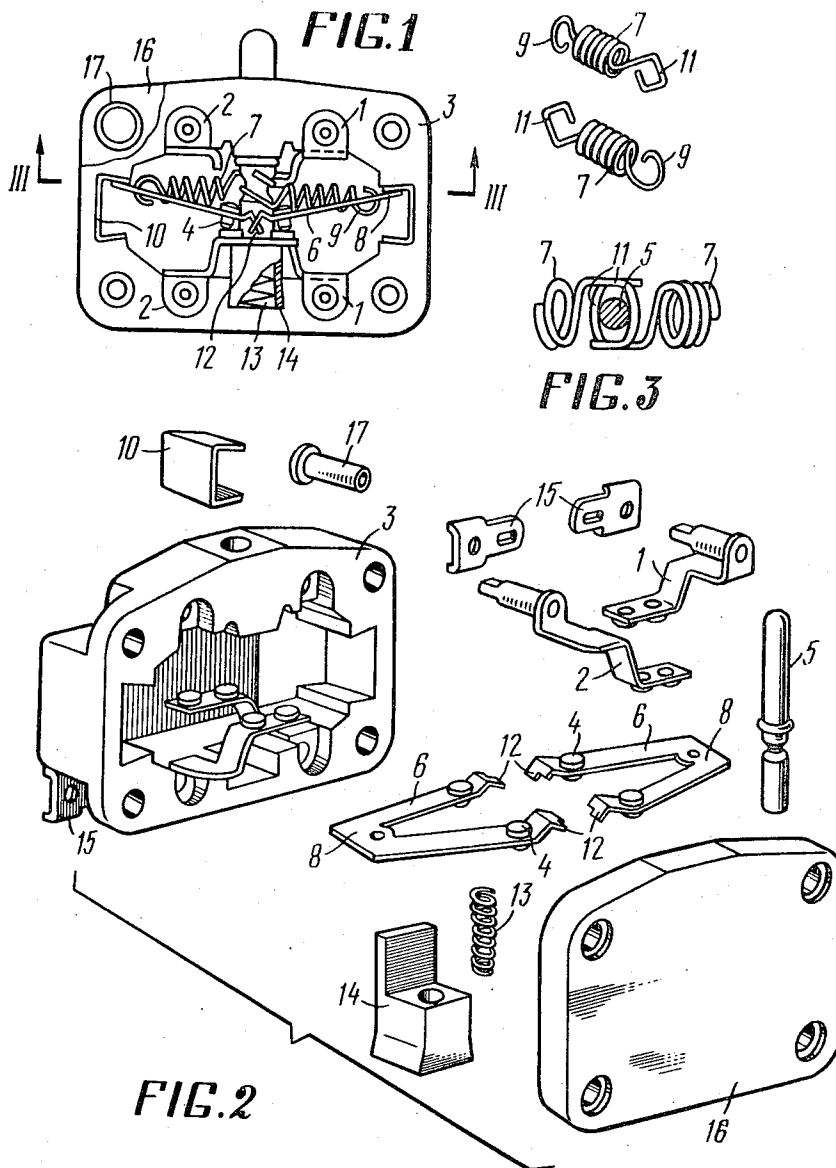
The instantaneous switch contains fixed contacts, fastened to the base, movable contacts, an operating element, two levers and two spiral springs. The ends of the levers are connected to the ends of the springs and bear against the fixed limit stops made fast to the base. The free ends of the levers are hinged and carry movable contacts.

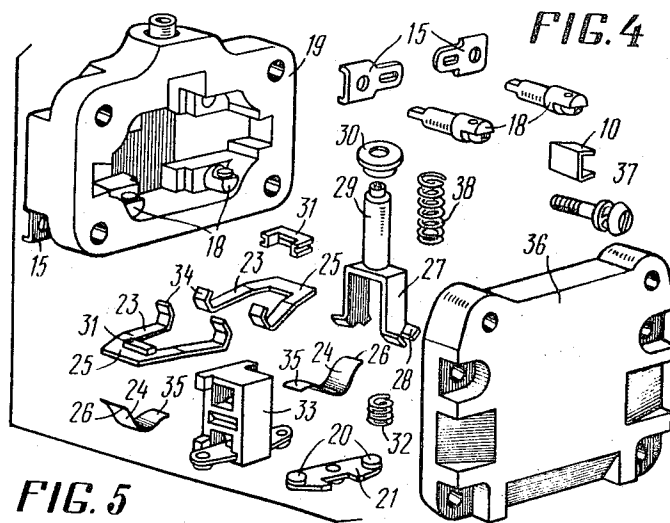
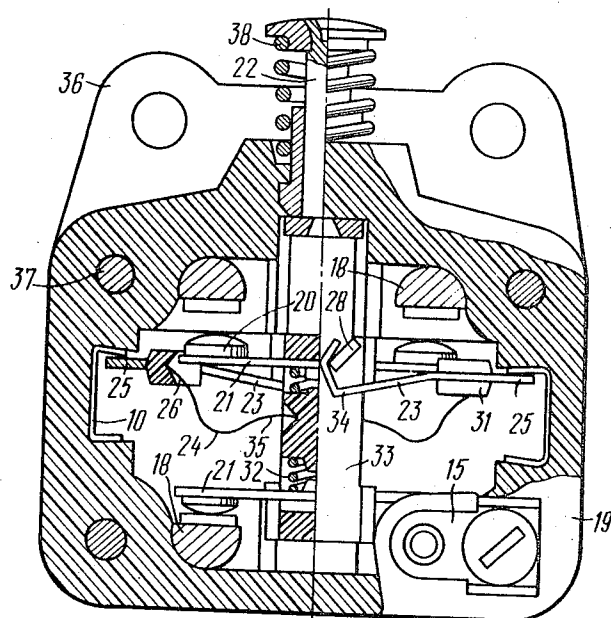
The operating element is jacked up by an opposing spring placed in a sleeve fastened to the base.

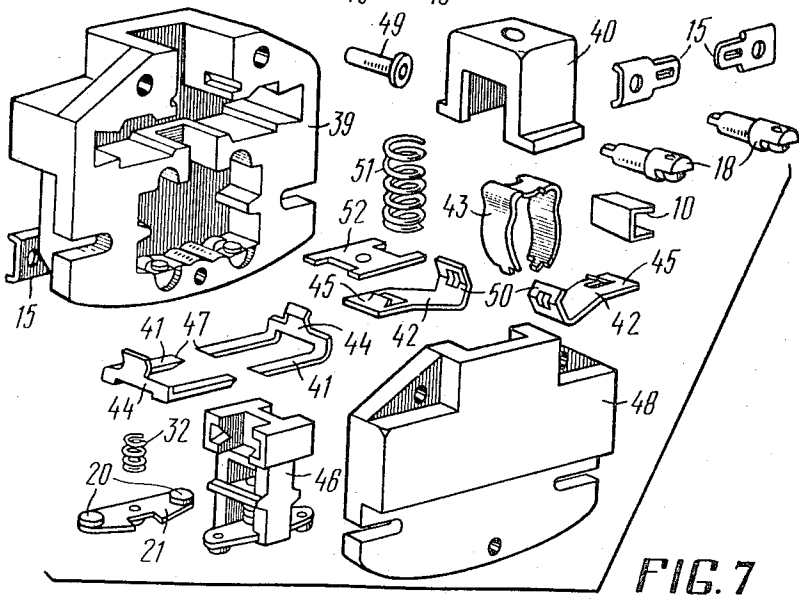
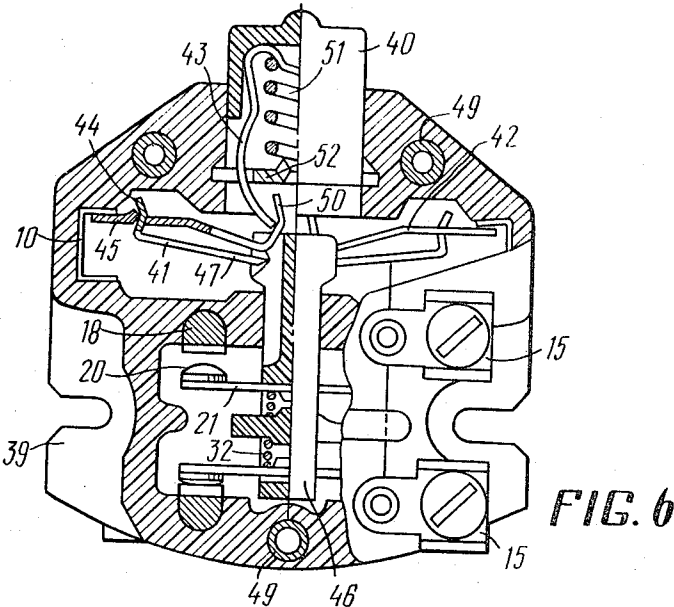
The movable contacts of the switch, built into the base, are protected by a cover fastened to the base with pipes.

4 Claims, 13 Drawing Figures









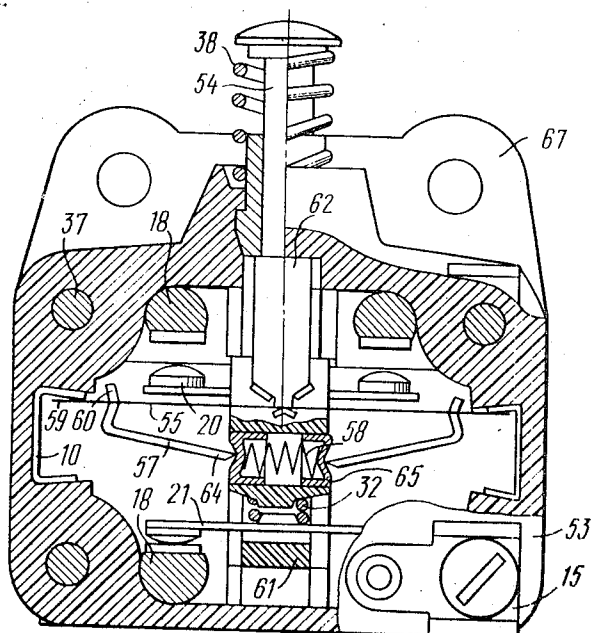


FIG. 8

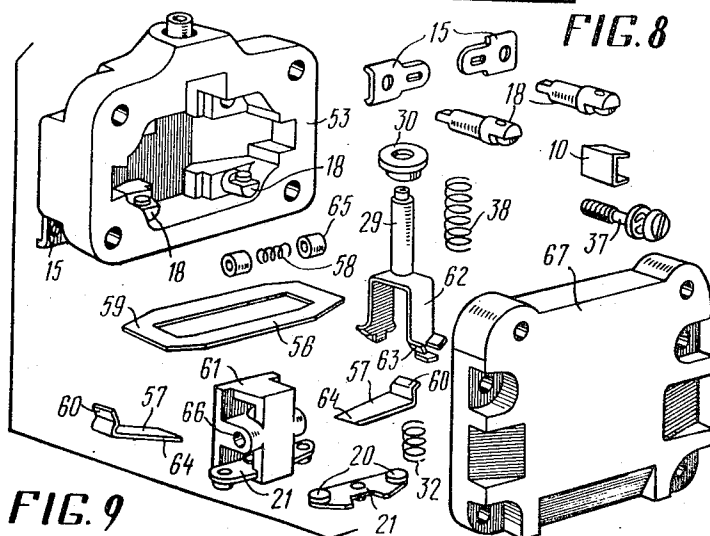
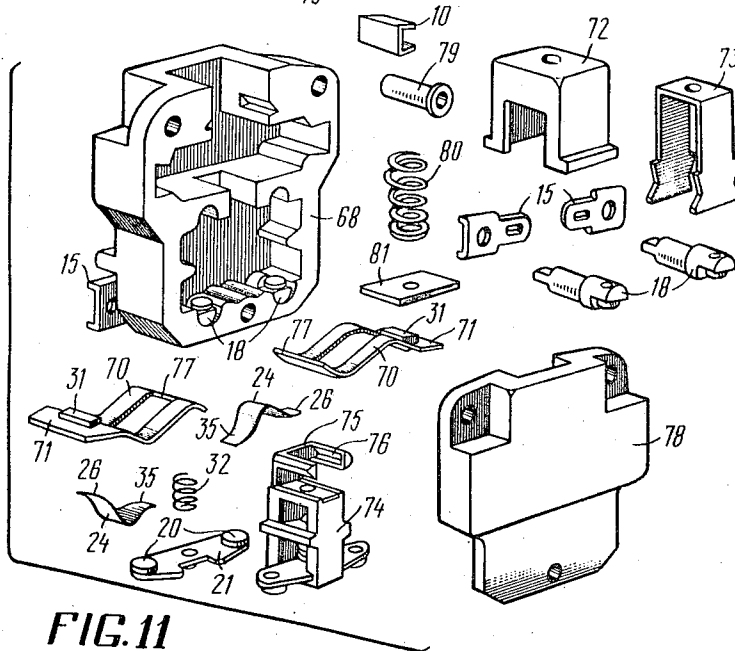
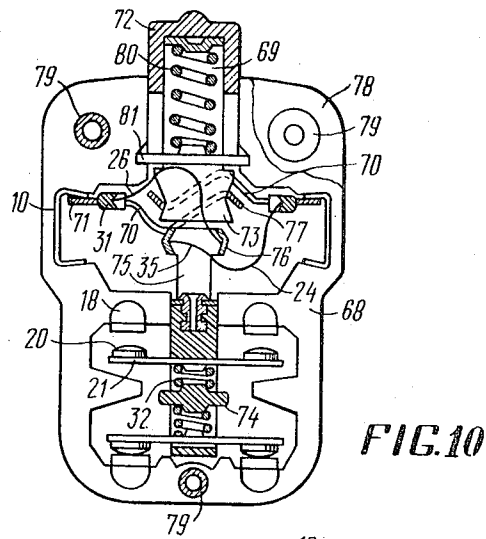


FIG. 9



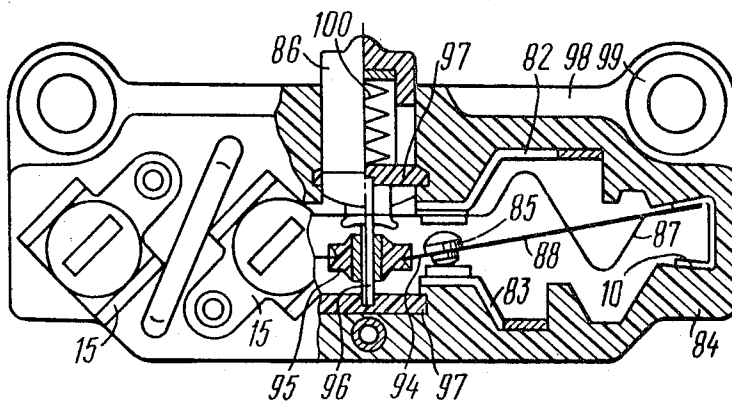


FIG. 12

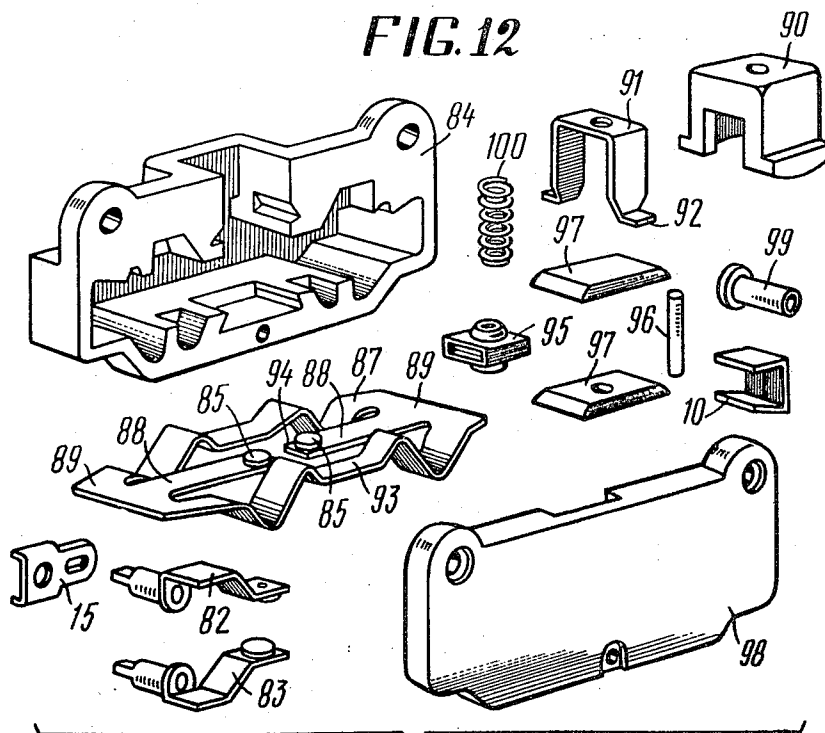


FIG. 13

INSTANTANEOUS SWITCH

The present invention relates to switches used in the automatic drive control of hoisting and conveying plant, machine-tools and other industrial equipment and, more specifically, to instantaneous switches used as limit switches.

In limit switches the contacts are thrown over when an adjustable stop (cam) of the machine actuates the operating mechanism of the switch.

When the adjustable stop of the machine moves slowly, and the speed at which the contacts are thrown over depends on that of the adjustable stop, as is the case with direct-action switches, the time interval between the instant the contacts just touch under electrical load and the instant when they build up sufficient contact pressure is relatively long.

A prolonged dwell in the closed position under electrical load coupled with insufficient pressure and slow contact throw-over may cause serious troubles such as: fusing, burning and even welding of the contacts.

To prevent these troubles in the contacts due to the slow movement of the adjustable stop, limit switches incorporate a means of speeding up the throw-over of the movable contacts.

Known in the prior art are semi-instantaneous switches with switch-on and throw-over times practically independent of the position and speed of the operating element. However, as the operating element shifts, contact pressure in these switches changes from the rated to the minimum value and even decreases to zero near the throw-over of the contacts.

The semi-instantaneous switches have a means for throwing over the movable contacts, actuated by the operating element and containing two springs symmetrically arranged on both sides of the axis of the operating element or two rigid levers interconnected by a spring.

Since contact pressure in semi-instantaneous switches varies as fast as the adjustable stop of the machine moves, such switches can operate trouble-free in machines in which the adjustable stop has a speed of at least 0.3 m/min.

If the controlling adjustable stop of a machine moves at a speed lower than 0.3 m/min., the limit switches use instantaneous switches with contacts whose switch-on and throw-over times and pressure are practically independent of the position of the operating element during switch-off, switch-on or throw-over and, consequently, of the speed.

Known in the prior art are instantaneous switches whose means for throwing over the movable contacts into extreme positions consists of two interconnected means of the prior art semi-instantaneous switches, namely: a first means made up of two springs interconnected by a lever, and a second means made up of two additional springs.

In these instantaneous switches, the operating element actuates the first movable-contact throw-over means, and the movable contacts are connected with the second means. The joints between the first and second means bear against limit stops.

In the prior-art instantaneous switches, the movable-contact throw-over means has two spring systems containing at least three springs. Mechanically, the prior-art instantaneous switches consist of a large number of parts, which adds to their overall dimensions, weight

and, consequently, the overall dimensions and weight of the limit switches into which they are built.

When the prior-art instantaneous switches operate under conditions of heavy impacts and vibration, the effect of external forces on their base causes a counter-movement of the masses of the operating element and the lever interconnecting the two springs and, consequently, of the lever and movable contacts. In this process, all the springs of the movable-contact throw-over means are in a position ensuring maximum contact pressure. Because of this, the prior-art instantaneous switches have low stability against vibration and impacts, just as the prior-art semi-instantaneous switches.

Also known in the prior art is an instantaneous switch disclosed in Japanese Pat. No. 59A51 39-16723 containing fixed contacts fastened to the base and mating movable contacts, a means for throwing over the movable contacts comprising an operating element, a spiral spring, two levers and two leaf springs, symmetrically arranged on both sides of the axis of the operating element. At one end, the levers are connected to the ends of the leaf springs and the ends of the spiral spring and bear against the limit stops secured to the base, while the other ends of the levers are hinged to the fixed base support. The operating element actuates the middle part of the spiral spring. The movable contacts are connected to the free ends of the leaf springs.

Thus, the means for throwing over the movable contacts of the prior-art instantaneous switch has three springs and two levers.

Many attempts have been made to develop a simple, lightweight and small-size instantaneous switch, but none has been fully successful in realizing a commercial instantaneous switch.

It is an object of the present invention to provide an instantaneous switch which is simple in design, smaller in size, lighter in weight and has fewer parts than the prior-art instantaneous switch, while its contact switch-on or throw-over time and contact pressure are practically independent of the position and, consequently, the speed of the operating element.

Another object of the present invention is to provide instantaneous switches with high mechanical and electrical wear resistance.

Still another object of the invention is to provide an instantaneous switch possessing high impact and vibration resistance and stability against linear accelerations.

With these objects in view, the invention resides in that an instantaneous switch comprising fixed contacts, secured to the base, mating movable contacts, a movable-contact throw-over means made up of at least two interconnected assemblies arranged symmetrically about the axis of the operating element and consisting each of at least one spring element and a lever, so that at one end the levers are connected to the ends of the spring elements bearing against limit stops made fast to the base, while the operating element actuates the said means at the joint between the two assemblies, according to the invention, the free and hinged ends of the assemblies are spaced closer than the limit stops and carry the movable contacts.

Also with these objects in view, in the instantaneous switch one of the assemblies of the movable-contact throw-over means is integrated with another such unit.

With the same objects in view, in the instantaneous switch the movable-contact throw-over means is made

in the form of a single elastic plate the outer parts of which are bent lengthwise and the inner parts have the shape of two tongues.

The invention will be more fully understood from the following detailed inscription when read in connection with the accompanying drawings wherein specific narrow terms are used for making the description more lucid, but the invention is not confined to the accepted narrow terminology, and it should be borne in mind that each term covers all equivalent elements operating in the same way and used for achieving objects analogous to those of the present invention.

It should also be borne in mind that other objects and advantages of the present invention, besides those indicated above, will be revealed below in the description when read in connection with the following drawings wherein:

FIG. 1 shows a front view, with the cover partially removed, of a preferred embodiment of an instantaneous switch;

FIG. 2 shows details of the switch of FIG. 1;

FIG. 3 shows a section taken on line III—III of FIG. 1;

FIG. 4 shows a front view, with the base wall partially removed, of a second embodiment of the instantaneous switch;

FIG. 5 shows a detail of the switch of FIG. 4;

FIG. 6 shows a front view, with the base wall partially removed, of a third embodiment of the instantaneous switch;

FIG. 7 shows details of the switch of FIG. 6;

FIG. 8 shows a front view, with the base wall partially removed, of a fourth embodiment of the instantaneous switch;

FIG. 9 shows details of the switch of FIG. 8;

FIG. 10 shows a front view, with the cover partially removed, of a fifth embodiment of the instantaneous switch;

FIG. 11 shows details of the switch of FIG. 10;

FIG. 12 shows a front view, with the base wall partially removed, of a sixth embodiment of the instantaneous switch;

FIG. 13 shows details of the switch of FIG. 12

According to the invention, the instantaneous switch contains fixed contacts 1 and 2 (FIGS. 1 and 2), fastened to a base 3, made of an insulating material, mating movable contacts 4, an operating or actuating element 5 and a movable-contact throw-over means, made up of two assemblies arranged symmetrically about the axis of the operating element 5, each assembly consisting of a lever 6 and a spring element in the shape of a spiral spring 7. Ends 8 of the levers 6 are connected to ends 9 of the springs 7 and bear against limit stops 10, made fast to the base 3 and in the shape of metal clamps. The operating element 5 actuates the movable-contact throw-over means at the joint of the two assemblies, namely, at the contact points of the other ends 11 of the springs 7 (FIG. 3).

Free ends 12 of the levers 6, opposite to ends 8 bearing against the limit stops 10, and to ends 11 of the springs 7, i.e., to the parts actuated by the operating element 5, are hinged together and carry the movable contacts 4. The free ends 12 are closer to the said axis of the operating element 5 than the limit stops 10.

The operating element 5 is jacked up by an opposing spring 13 placed in a sleeve 14 fastened to the base 3.

The fixed contacts 1 and 2 are connected to clamps 15 to which control circuit wires are connected when-

ever necessary. The movable parts of the switch, built into the base 3, are protected by a cover 16 fastened to the base 3 with pipes 17.

When an external force influences the operating element 5, the ends 11 of the springs 7 move downwards, and when they cross the lines drawn through the ends 8 and 12 of the levers 6, the movable contacts 4 are thrown over.

When the external force ceases to influence the operating element 5, all the movable parts of the switch are returned to their initial position by the spring 13.

A second, explosion-proof, embodiment of the instantaneous switch contains the fixed contacts 18 (FIGS. 4 and 5), fastened to a base 19, made of insulation material, mating movable contacts 20, connected to contact bridges 21, an operating element 22 and a movable-contact throw-over means made up of two assemblies arranged symmetrically about the axis of the operating element 22, each assembly consisting of a lever 23 and a spring element made in the shape of a leaf spring 24. Ends 25 of the levers 23 are connected to ends 26 of the springs 24 and bear against the limit stops 10 fastened to the base 19.

The operating element 22 consists of a clamp 27 with catches 28, a roller 29 and a hood 30.

Fastened to the levers 23 are brackets 31 against which the ends 26 of the springs 24 bear.

The contact bridges 21 are secured by the springs 32 to a contact holder 33 made of an insulating material.

The operating element 22 actuates the movable-contact throw-over means at the joints between the two assemblies and, namely, in the points of contact between the catches 28 and other ends 34 of the levers 23.

The free ends 35 of the springs 24, opposite to the ends 26 bearing against the limit stops 10, and to ends 34 of the levers 23, i.e., to the parts actuated by the operating element 22, are hinged and carry the movable contacts 20. The free ends 35 are closer to the said axis of the operating element 22 than the limit stops 10.

The fixed contacts 18 are connected to the clamps 15 to which control circuit wires are connected whenever necessary.

The movable parts of the switch, built into the base 19, are protected by a cover 36 fastened to the base 19 with screws 37.

When an external force influences the operating element 22, ends 34 of the levers 23 move downwards, and when they cross the lines drawn through the ends 26 and 35 of the springs 24, the movable contacts 20 are thrown over.

When the external force ceases to influence the operating element 22, all the movable parts of the switch are returned to their initial position by the spring 38.

The third embodiment of the instantaneous switch contains fixed contacts 18 (FIGS. 6 and 7), fastened to a base 39 made of an insulating material, mating movable contacts 20, connected to the contact bridges 21, operating element 40, in the shape of a hood, and movable-contact throw-over means made up of two assemblies arranged symmetrically about the axis of the operating element 40, each assembly consisting of a lever 41 and a spring element made in the shape of a link 42 connected to another such link by a spring 43. Ends 44 of the levers 41 are connected to ends 45 of the links 42 and bear against the limit stops 10 fastened to the base.

The contact bridges 21 are made fast to the contact-holder 46, made of an insulating material, by means of the springs 32. The operating element 40 actuates the movable-contact throw-over means at the joints between the assemblies, namely, the spring 43.

The free ends 47 of the levers 41, opposite to the ends 44 bearing against the limit stops 10, are hinged and carry the movable contacts 20. The fixed contacts 18 are connected to the clamps 15 to which control circuit wires are connected whenever necessary.

The free ends 47 of the levers 41 are closer to the said axis of the operating element 40 than the limit stops 10.

The movable parts of the switch, built into the base 39, are protected by the cover 48 secured to the base 39 by the pipes 49.

When an external force influences the operating element 40, ends 50 of the links 42 move downwards, and when they cross the lines drawn through the ends 44 and 47 of the levers 41, the movable contacts 20 are thrown over.

When the external force ceases to influence the operating element 40, all the movable parts of the switch are returned to their initial position by the opposing spring 51 which bears against a plate 52 made fast to the base 39.

The fourth embodiment of the instantaneous switch contains fixed contacts 18 (FIGS. 8 and 9), fastened to the base 53 made of an insulating material, mating movable contacts 20, secured to contact bridges 21, the operating element 54 and movable-contact throw-over means made up of two assemblies arranged symmetrically about the axis of the operating element 54, each assembly consisting of the levers 55 made integral of a thin elastic material in the shape of a frame 56 and a spring element in the shape of a link 57 connected to another such link by a spring 58. The ends 59 of the levers 55 are connected to the ends 60 of the links 57 and bear against the limit stops 10 fastened to the base. The contact bridges 21 are fastened by the springs 32 to the contact holder 61 made of an insulating material.

The operating element 54 consists of a clamp 62 with catches 63, a roller 29 and a hood 30.

By its catches 63, the operating element 54 actuates the movable-contact throw-over means at the joints between the two assemblies, namely, the middle parts of the frame 56.

The free ends 64 of the links 57, opposite to the ends 60 that bear against the limit stops 10, are hinged by means of contact holders 65 placed in an aperture 66 of the contact holder 61 and carry the movable contacts 20. The free ends 64 of the links 57 are closer to the said axis of the operating element 54 than the limit stops 10.

The movable parts of the switch built into the base 53 are protected by the cover 67 fastened to the base 53 by the screws 37.

When an external force influences the operating element 54, the catches 63 bend in the middle part of the frame 56 and, when the levers 55 are aligned with the links 57, the movable contacts 20 are thrown over.

When the external force ceases to influence the operating element 54, the movable parts of the switch are returned to their initial position by the spring 38.

The fifth embodiment of the instantaneous switch contains the fixed contacts 18 (FIGS. 10 and 11), fastened to the base 68 made of an insulating material, the

mating movable contacts 20 fastened to the contact bridges 21, the operating element 69 and the movable-contact throw-over means made up of two assemblies arranged symmetrically about the axis of the operating element 69, each assembly consisting of the lever 70 and a spring element in the shape of a leaf spring 24.

The levers 70 are of wave shape, aligned and turned 180° relative to each other about an axis perpendicular to the axis of the operating element 69. Ends 71 of the levers 70 are connected to the ends 26 of the springs 24 and bear against the limit stops 10 fastened to the base 68. The operating element 69 consists of a hood 72 and a clamp 73.

The contact bridges 21 are fastened by the springs 32 to the contact holder 74 made of an insulating material. Fastened to the levers 70 are the brackets 31 against which the ends 26 of the spring 24 bear.

Fastened to the contact holder 74 is a clamp 75 with brackets 76. The operating element 69 actuates the movable-contact throw-over means at the joints between the two assemblies, and namely in the points of contact between the clamps 73 and other ends 77 of the levers 70.

The free ends 35 of the springs 24, opposite to the ends 26 that bear against the limit stops 10 and to the ends 77 of the levers 70, are hinged and bear against the brackets 76. The ends 35 carry the movable contacts 20.

The free ends 35 of the springs 24 are closer to the said axis of the operating element 69 than the limit stops 10.

The fixed contacts 18 are linked with the clamps 15 to which control circuit wires may be connected, if necessary. The movable parts of the switch, built into the base 68, are protected by the cover 78 fastened to the base 68 by the pipes 79.

When an external force influences the operating element 69, the ends 77 of the levers 70 move downwards, and when they cross the lines drawn through the ends 26 and 35 of the springs 24, the movable contacts 20 are thrown over.

When the external force ceases to influence the operating element 69, all the movable parts of the switch are returned to the original position by a spring 80. The spring 80 bears against a plate 81 made fast to the base 68.

The sixth embodiment of the instantaneous switch contains fixed contacts 82 and 83 (FIGS. 12, 13) fastened to a base 84 made of an insulating material, mating movable contacts 85, an operating element 86 and a movable-contact throw-over means made as a whole plate 87 the outer parts of which are bent lengthwise, and the inner parts are made in the shape of two tongues 88.

The plate 87 and the tongues 88 are made integral of an elastic material, such as beryllium bronze. Ends 89 of the plate 87 bear against the limit stops 10.

The operating element 86 consists of a hood 90 and a clamp 91 with catches 92.

The operating element 86 actuates the movable-contact throw-over means in part symmetrical to the limit stops 10, namely, in the points of contact between the catches 92 and the medium outer parts 93 of the plate 87.

Free ends 94 of the tongues 88, opposite to the ends 89, are hinged by means of a bracket 95 and carry movable contacts 85.

The movable bracket 95 slides along a guide 96 fastened to the base 84 by means of plates 97. The free ends 94 of the tongues 88 are closer to the said axis of the operating element 86 than the limit stops 10.

The fixed contacts 82 and 83 are linked with the clamps 15 to which control circuit wires may be connected, if necessary.

The movable parts of the switch, built into the base 84, are protected by a cover 98 fastened to the base 84 by pipes 99.

When an external force influences the operating element 86, parts 93 of the plate 87 move downwards, and when they cross the lines of the ends 94 drawn through the tongues 88, the movable contacts 85 are thrown over.

When the external force ceases to influence the operating element 86, all the movable parts of the switch are returned to the initial position by a spring 100.

As is seen from the description of the invention and the drawings, the desired objects are achieved as follows. In the instantaneous switch disclosed herein, the movable-contact throw-over means practically does not differ, in the number of its components, from the prior-art means used in semi-instantaneous switches. Thus, the movable-contact throw-over means of the instantaneous switch disclosed herein may comprise at least one spring instead of three in the prior-art instantaneous switches.

The small number of components of the switch disclosed herein permits simplification of its design, reduction of its overall size and weight and, consequently, reduction of the size and weight of the limit switches in which it is built into.

In the switch disclosed herein, the joint connection of the free ends of the movable-contact throw-over means, opposite to the ends that bear against the limit stops and to the parts influenced by the operating element, make it possible to ensure a rather high mechanical wear resistance.

The instant an external force begins to influence the base of the switch described herein, the levers or springs of its movable-contact throw-over means are in positions ensuring considerable contact pressure even in case of a counter-movement of the masses of the operating element and movable contacts. As a result, the switch disclosed herein has a relatively high electrical wear resistance and stability against vibration, impacts and linear accelerations.

The invention described above makes it possible to realize commercially and in quantity a switch with the switch-on and throw-over times and contact pressure practically independent of the position of the operating element and, consequently, of its speed, that is, an instantaneous switch whose number of parts, overall dimensions and weight are equal to those of the prior-art semi-instantaneous switches and identical or slightly superior to the prior-art instantaneous switches in mechanical and electrical wear resistance and in stability against vibration, impacts and linear accelerations.

It should be borne in mind that the present description and drawings relate only to a few preferred em-

bodiments of the switch disclosed herein. Its modifications may differ as regard the shape, size and the arrangement of individual elements. For instance, the parts described above and shown in the drawings may be replaced by their equivalents, the position of individual parts may be changed, certain elements of the invention may be used independently of others if it is within the scope and meaning of the invention as set forth in the claims. The switches made according to this invention may be also used at button control posts or as retaining contacts in electromagnetic devices like relays, contactors and electromagnets.

What is claimed is:

1. An instantaneous switch comprising

a base,

fixed contacts secured to said base,

mating movable contacts for selective contact with the fixed contacts,

an actuator means for effecting selective contact of the movable contacts with the fixed contacts and means for throwing over the movable contacts to end positions in which they make selective contact with the fixed contacts, said means including at least two units symmetrically located with respect to said actuator and operatively coupled therewith, each unit including

at least one spring member having opposite ends, a lever having opposite ends, the levers and the spring members of the units being symmetrically disposed with respect to the actuator, the levers and spring members having respective ends remote from the actuator which are coupled together, and fixed limiters secured to the base, said levers bearing against the limiters at the ends thereof where the levers are connected to the spring members, the other ends of the spring members and levers constituting free ends of the units,

some of said free ends being connected to the actuator, the other of said free ends being located at a distance from each other which is less than the distance between said limiters and being hinged together and carrying said movable contacts.

2. An instantaneous switch as claimed in claim 1 wherein the levers and spring members have inner ends closer to the actuator and outer ends further away from the actuator, the other of said free ends being the inner ends of the levers, the free ends connected to the actuator being the inner ends of the spring members.

3. An instantaneous switch as claimed in claim 1 wherein:

said units are aligned with one another.

4. An instantaneous switch as claimed in claim 1

wherein each said unit is in the form of a single elastic plate the outer portions of which are bent lengthwise and the inner portions have the shape of two tongues, the other portions being the spring members, the inner portions being said tongues. The movable parts of the switch, built into the base 68, are protected by the cover 78 fastened to the base 68 by the pipes 79.

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