May 5, 1970 G. GOTTSCHALL 3,509,739

STOP MOTION FOR A KNITTING MACHINE

Filed July 12, 1967 2 Sheets-Sheet 1

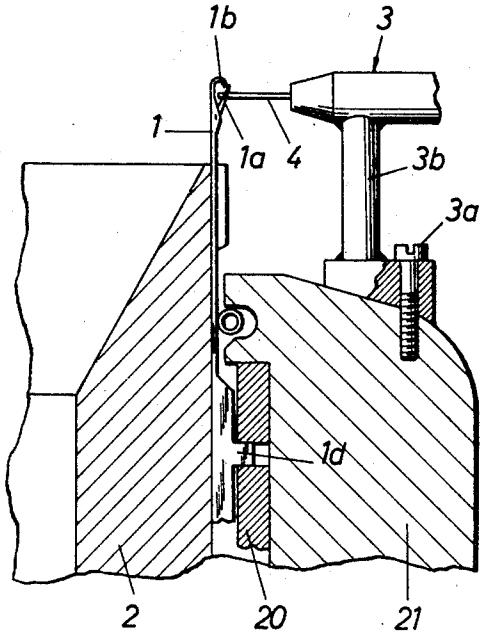

FIG. 2

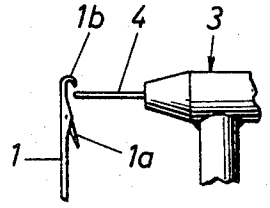

FIG. 1

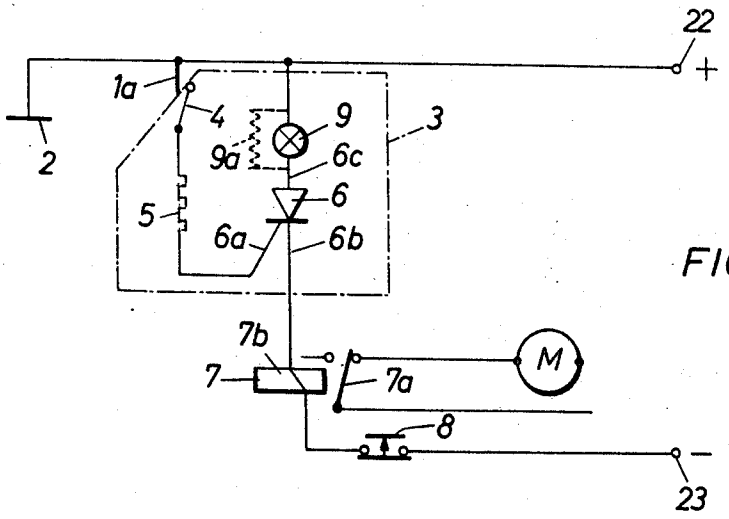

FIG. 4

Inventor:
Gerhard Gottschall
By Michael S. Striker
Attorney

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STOP MOTION FOR A KNITTING MACHINE

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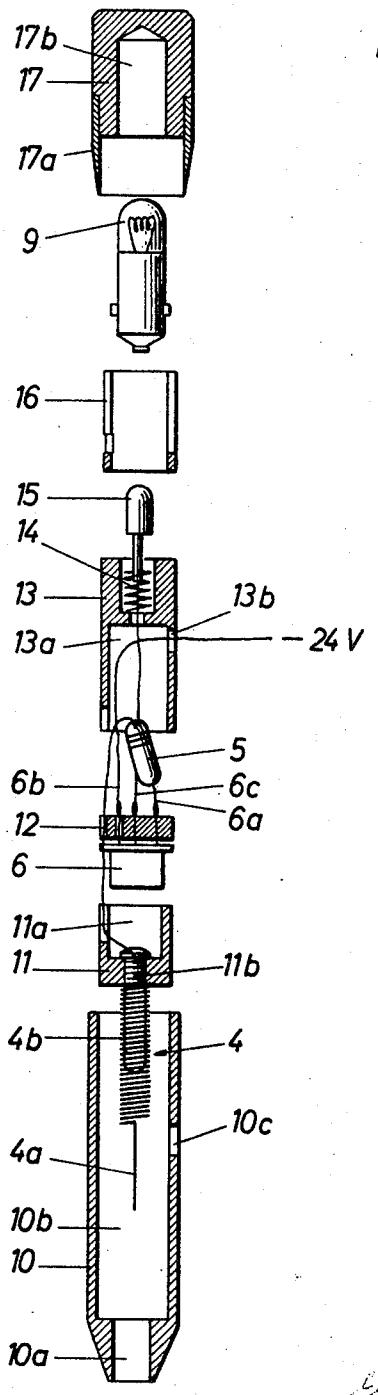

FIG. 3

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STOP MOTION FOR A KNITTING MACHINE

Gernot Gottschall, Boblingen, Germany, assignor to Franz Morat G.m.b.H., Stuttgart-Vaihingen, Germany

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Int. Cl. D04b 35/18
U.S. Cl. 66—157 15 Claims

ABSTRACT OF THE DISCLOSURE

A feeler contact touches latches of the needles of a knitting machine when the same are in an undesired partly opened or closed position. In this manner the gate circuit of a thyristor is closed, and its main circuit energizes a relay winding so that a relay switch disconnects the motor driving the knitting machine.

Background of the invention

In order to produce a perfect fabric on a knitting machine, for example on a circular knitting machine, it is necessary that the latches of latch needles remain fully open during certain knitting operations. If for any reason, a latch partly closes instead of remaining open, a fault occurs in the fabric. Under such circumstances it is desired to immediately stop the knitting machine and thereby the movement of the needle, so that the needle in the undesired partly closed position is not operative during an extended time period to produce successive faulty stitches of the fabric.

In accordance with the prior art, as exemplified by the U.S. Pat. No. 2,481,632 and the German Gebrauchamuster 1,808,391 a feeler is disposed in the region of the open hooks of moving latch needles, and is engaged by latches in the undesired partly or fully closed position. The moving latch displaces the feeler angularly so that the same is released from an arresting means and mechanically effects closing of a contact located in the circuit of a relay which operates a switch to cut off the drive motor of the machine so that the movement of the needles is stopped.

In the stop motion of the prior art, the feeler must be mechanically displaced by the small latches against the action of a spring or other energy storing means and the required force must be sustained by the latch of the needle and by its pivot so that the latch needles are frequently damaged and must be exchanged.

Summary of the invention

It is one object of the invention to provide a stop motion controlled by needle latches in undesired positions, but requiring no actuating force to be transmitted by the latches.

Another object of the invention is to sense the position of a need'e latch by a yieldable, preferably resilient feeler contact which directly closes a circuit through the touched latch and the respective needle by which ultimately the stopping of the drive motor of the machine is effected.

Another object of the invention is to provide an electronic gate control device whose gate circuit is closed by the electric contact between the needle latch and the feeler contact.

With these objects in view, the present invention relates to a stop motion for a knitting machine, preferably a circular knitting machine, including a motor, a needle carrier, such as a needle cylinder or dial, driven by the motor, and latch needles mounted on the carrier for movement with the same and having latches moving

along a first path when in a desired position, for example a fully open position, and moving along a second path when in an undesired, for example partly or completely closed, position.

In accordance with the invention, a stationary electric sensing means is disposed for sensing in the second path, and is energized only when passed by a latch in the undesired position. For example, an elastic feeler contact in the second path is touched by a latch in the undesired position and establishes an electric connection with the same.

An electronic gate control device has a gate circuit electrically connected with the sensing means and a main circuit controlled by the gate circuit and connected with electric stop control means, for example a relay having a switch located in the circuit of the drive motor of the machine.

When the gate circuit is energized by a weak current flowing through the needle, latch, and feeler contact, the main circuit energizes the relay winding so that the relay switch is operated to cut off the motor.

In the preferred embodiment of the invention, the gate contolled device is a thyristor, and the gate circuit is formed by a control electrode connected with the feeler contact, preferably through a resistor, and by a cathode connected with the relay winding.

Since the feeler contact may be constructed as a very flexible thin wire, no damage can be done to the latch, and the feeler contact resiliently slides over the latch with a light pressure sufficient to permit passage of the small exciting current required for activating the thyristor.

The main circuit of the thyristor remains operative until a manually operated switch connected in series with the relay winding is operated so that the relay is deenergized and the relay switch connects the motor again to a voltage source.

Preferably, a signal lamp is connected in series with the main circuit of the thyristor so that the operative condition of the device and the stopping of the motor is indicated.

The main advantage of the invention, prevention of damage to the latches by the operation of a mechanical device, has been pointed out above. Another advantage of the invention is that the operation of a thyristor is in no way influenced by dust, and that no mechanical wear takes place.

A very important advantage of the invention is the very high speed at which the stop motion operates to cut off the motor, which is due to the use of an electronic gate controlled device, such as a thyristor.

The mechanically operated stop motions of the prior art require at least 300 milliseconds for the operation. In this time period, the circular knitting machine having a needle cylinder of 30 inch diameter, and 1680 needles, and rotating at 18 revolutions per minute, has turned an angle of 10 degrees, so that 150 latch needles have passed the mechanical feeler before the same could effect stopping of the machine and needle cylinder. Considering further the inertia of the relay, and the further turning of the needle cylinder after the motor is de-energized, until the needle cylinder is stopped by brakes, a cylinder needle whose latch is in a wrong position, produces faulty stitches in several successive knitting systems of the circular knitting machine before the needle cylinder can be stopped. The electronic gate controlled device used in accordance with the invention, effects stopping of the needle cylinder in a far shorter time. The stop motion of the invention requires only 0.5 millisecond for stopping the machine after the sensing of a latch in a wrong position.

The novel features which are considered as charac-

teristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

Brief description of the drawing

FIG. 1 is a fragmentary side elevation of a device according to the invention sensing the position of the latch of a needle;

FIG. 2 is a fragmentary axial sectional view illustrating a device according to the invention mounted on a circular knitting machine for sensing the positions of the latches of the cylinder needles;

FIG. 3 is an exploded sectional view illustrating a preferred embodiment of the invention; and

FIG. 4 is a diagram illustrating the electric circuit used with the embodiment of FIG. 3.

Description of the preferred embodiment

Referring first to FIGS. 1 and 2, a needle cylinder **2** has on its periphery axially extending grooves in which latch needles **1** are mounted for axial movement under the control of cams **20** in a cam box **21**, cams **20** forming a cam track in which the butts **1***d* of needles **1** are guided during rotation of needle cylinder **2** relative to the stationary cam box **21**. A sensing device **3** is adjustably mounted by screws **3***a* on the cam box and has a resilient feeler contact **4** projecting into the region of the open book **1***a*. As best seen in FIG. 1, a latch **1***a* in a fully opened position desired for certain phases of the knitting operation, is spaced from feeler contact **4**. As shown in FIG. 2, latch **1***a* is in an undesired, partly closed position, and is located in the region of the feeler contact **4**.

During rotation of needle cylinder **2**, a latch **1***a* in the desired open position shown in FIG. 1 will move along a first circular path which is spaced from the stationary feeler contact **4**. A latch in the partly closed position or fully closed position, will move along a second circular path in which the feeler contact **4** is located. Consequently, latch **1***a* in the position of FIG. 2 will touch feeler contact **4**, resiliently displace the same, and continue its movement along the second path while feeler contact **4** resiliently returns to its normal straight position for sensing the position of the latch of the next following needle.

As will be described hereinafter in greater detail, feeler contact **4** is part of a circuit which is connected to one terminal of a voltage source whose other terminal is connected to the needle cylinder, or other needle carrier **2**, which is electrically connected with the conductive needle **1**, and latch **1***b*, so that a circuit is closed when feeler contact **4** touches a latch **1***a* in the position of FIG. 2, and the circuit is intermediately interrupted when latch **1***a* has passed the feeler contact and the same returns to its normal position ready to sense the position of the latch of the next following needle.

Referring now to FIG. 4, one terminal **22** of a voltage source is connected with the needle carrier **2** and the mass of the machine so that latch **1***a* which is electrically connected with carrier **2**, is also connected with the voltage source. Feeler contact **4** cooperates with latch **1***a*, as explained above, and is connected by a resistor **5** to the control electrode **6***a* of the gate circuit of a thyristor **6** whose cathode **6***b* is connected with the winding **7***b* of a relay **7** controlling a relay switch **7***a* which is connected into the circuit of the electric motor driving the knitting machine and the rotary carrier **2** of needles **1**. The main circuit of thyristor **6** is connected through a signal lamp **9** with terminal **22**, and it is preferred to connect a resistor **9***a* in parallel to signal lamp **9**.

A manually operated normally closed switch **8** is connected between relay winding **7***b* and terminal **23**. Resistor **5**, signal lamp **9**, and thyristor **6** are enveloped in a housing **3**.

If more than one sensing device **3** is provided on the same machine, all thyristors are connected with a single relay **7** whose relay contact **7***a* is located in the circuit of the drive motor.

During normal operation of the knitting machine, the latches have to be in the desired, fully opened position, shown in FIG. 1, at certain circumferential points of the circular cam box **21**, and the sensing devices are provided in this region. During normal operations, the needles have to have open latches in the region of the sensing devices, so that feeler contact **4** is passed by the hooks and latches of the needles without being engaged. If the latch of a needle is in the undesired partly closed or fully closed position, the latch of the needle, which moves along a circular path, touches feeler contact **4** and displaces the same resiliently until the latch has travelled far enough to release feeler contact **4** which resiliently returns to its normal position for sensing the latch of the next following needle. During the time contact was made between improperly placed latch and feeler contact **4**, a cuurent flows from terminal **22** through needle carrier **2** needle **1**, latch **1***a*, feeler contact **4**, resistor **5**, the gate circuit **6***a*, **6***b* of the thyristor **6** or other electronic gate controlled device, and through the winding **7***b* and a closed manual switch **8** to terminal **23**.

The contact between latch **1***a* and feeler contact **4** is of very short duration so that the short electric pulse passing through relay winding **7***b* is insufficient to overcome the inertia of switch **7***a* and to disconnect the motor. However, the main circuit of thyristor **6** is activated, and current flows continuously through signal lamp **9**, relay winding **7***b* and the closed manual switch **8** so that switch contact **7***a* is operated, and the motor driving the machine and rotating needle carrier **2** is disconnected and stopped, so that travel of the needle whose latch is in a wrong position is stopped, and a fault in the knitted fabric is prevented.

When the necessary corrective steps have been taken, for example, if the needle has been replaced or the reason for its partial closure found and eliminated, the operator depresses and opens the manual switch **8** so that the main circuit of the thyristor **6** is interrupted and the thyristor cut off, so that the initial position of readiness of the sensing device is again restored.

The resistor **9***a* is advantageously provided in order to maintain the device in operative condition when signal lamp **9** burns out. The resistance of resistor **9***a* is selected to be smaller than the resistance of signal lamp **9**.

However, assuming a voltage of 24 volts, and a voltage drop of 6 volts in the winding **7***b*, 18 volts remain for energizing a 24 volt signal lamp, so that its current is below the rated current and the resistor **9***a* may be omitted.

A preferred practical embodiment of the invention is illustrated in FIG. 3 which shows all parts enveloped by the housing **3** in FIG. 4. A cylindrical housing **10** has a cylindrical recess **10***b*, communicating with a bore **10***a* opening at the pointed free end of housing **10**. A cap **17**, preferably consisting of a transparent or translucent material, has a recess **17***b* and a holding ring **17***a* tightly fitting on the outer periphery of the upper end of cylindrical housing **10**. All parts shown in FIG. 3 between the cap **17** and housing **10** fit into recesses **10***b* and **17***b* when the cap is placed on the housing, FIG. 3 being an exploded view. An insulating plug **11** has a recess **11***a* into which thyristor **6** fits in the assembled condition of the device, and carries a screw **11***b* on which a coiled portion **4***b* of a sensing means **4** is mounted in such a position that the feeler contact **4***a* projects out of bore **10***a* when plug **11** abuts the shoulder between recess **10***b* and bore **10***a*.

A spacing disc **12** which has the same diameter as plug **11**, and through which the three connectors **6***a*, **6***b* and

6c of thyristor 6 are threaded, abuts the upper end of plug 11 in the assembled condition. A connecting wire secured to screw 11b passes through recesses in plug 11 and spacing disc 12 to one end of resistor 5 whose other end is connected with control electrode 6a of thyristor 6. The conductor connected with cathode 6b is guided through a bore in an insulating part 13 to the outside where it is connected through the relay winding 7b to the negative terminal 23 of a voltage source, as explained with reference to FIG. 4. Insulator part 13 has a recess 13a for receiving resistor 5, and carries a contact 15 which is resiliently supported by a spring 14 in a recess of insulator part 13. The electrode 6c of thyristor 6 is connected by a wire to resilient contact 15. Insulator part 13 has an outer diameter matching the inner diameter of recess 10b in housing 10 and fits tightly into the same.

A bayonet holder ring 16 abuts insulating part 13 in the assembled condition, and fits into recess 10. Signal lamp 9 is normally held by bayonet holder ring 16 in a position electrically connected with contact 15. When all parts are assembled in housing 10, signal lamp 9 projects into recess 17b of the translucent cap 17 which is placed on the upper end of housing 10 to close the same. Instead of the tightly fitting holding ring 17a, screw threads may be provided to connect cap 17 with housing 10. The attached cap 17 prevents any relative axial movement of the assembled parts of the device. In the assembled condition, the wire passing through bore 13b of insulating part 13 also passes through bore 10c of housing 10. Housing 10 may be conductive to connect the bayonet holder ring and the second terminal of signal lamp 9 through the supporting bracket 3b of sensing device 3 with cam box 21 and the mass of the machine including needle carrier 2.

The coil portion 4b renders feeler contact 4 particularly flexible so that the force exerted by feeler contact on the latch during displacement of the feeler contact is very small.

In a modified embodiment, the sensing means for sensing the latches comprises a very thin wire core, partly enveloped by an elastic rubber cylinder and having a feeler contact portion freely projecting from the rubber and the core, for sensing the latches, as explained above.

The invention can be applied to all kinds of knitting machines, although it has been described in combination with a circular knitting machine. If the sensing device is used with flat bed knitting machines, it is advantageous that the feeler contact is yieldable and flexible in all directions. Feeler wires as described above, will suit this purpose. It is possible to mount the bracket 3b of the sensing device 3 adjustably on the knitting machine so that the device can be retracted or turned to an inoperative position in which the feeler contact is not located in the path of movement of the latches.

If several sensing devices 3 are provided on a circular knitting machine at spaced circumferential points, the connection with terminal 23 is advantageously constructed as a circular conductor to which a plurality of manual switches 8 and devices 3 is connected.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of stop motions for knitting machines differing from the types described above.

While the invention has been illustrated and described as embodied in a feeler contact sensing wrong positions of needle latches and connected with an electronic gate controlled device by which a relay of an electric stop control means is energized, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge readily adapt it for various applications without omitting features that from the standpoint of prior art fairly constitute essential characteristics of the generic and specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. Stop motion for a machine including a motor, and conductive parts driven by said motor and moving along a first path when in a desired position and moving along a second path when in an undesired position; a stationary electric sensing means including an elastic feeler contact disposed for sensing in said second path and being energized only when sensing a conductive part in said undesired position; a voltage source connected to said conductive parts and said sensing means; electric stop control means energizable to stop said motor; and an electronic gate controlled device having a gate circuit electrically connected with said sensing means and a main circuit controlled by said gate circuit and connected with said electric stop control means so that said gate circuit is energized when said sensing means senses a part in said undesired position whereby current flows through said main circuit and energizes said stop control means to stop said motor.

2. Stop motion as claimed in claim 1, wherein said motor is an electric motor; and wherein said stop control means includes a relay having a winding connected with said main circuit, and a relay switch in the circuit of said motor for cutting off the same when said sensing means senses a part in said undesired position so that current flows through said main circuit.

3. Stop control motion as claimed in claim 1, wherein said gate controlled device is a thyristor having a control electrode and a cathode forming said gate circuit and being connected with said electric sensing means and said electric stop control means respectively.

4. Stop motion for a knitting machine including an electric motor, a needle carrier driven by said motor, and conductive latch needles mounted on said carrier for movement with the same and having latches moving along a first path when in a desired fully opened position and moving along a second path when in an undersired not fully opened position; a voltage source having one terminal connected with said carrier and latch needles; a stationary sensing means having a resilient feeler contact disposed in said second path and connected with one terminal of said voltage source when touching a latch in said undesired position; relay means including a winding, and a relay switch in the circuit of said motor operable to effect de-energizing of said motor, said winding being connected with the other terminal of said source; and a gate controlled device having a gate circuit electrically connected between said feeler contact and the other terminal of said source, and a main circuit controlled by said gate circuit for connecting said winding with said one terminal so that said gate circuit is energized when said feeler contact touches a latch in said undesired position whereby current flows through said main circuit and winding, and actuates said relay switch to cut off said motor.

5. Stop motion as claimed in claim 4, wherein said gate controlled device is a thyristor having a control electrode electrically connected with said feeler contact and a cathode electrically connected through said winding with said other terminal of said source.

6. Stop motion as claimed in claim 4, wherein said feeler contact is a resilient wire flexible in all directions.

7. A stop motion as claimed in claim 4, wherein said feeler contact comprises a flexible conductor and an elastic insulating material partly enveloping said conductor.

8. Stop motion as claimed in claim 4, wherein said feeler contact is a thin flexible resilient conductive wire having a coil portion and a feeler portion projecting from one end of said coil portion.

9. A stop motion as claimed in claim 4, wherein said

gate controlled device is a thyristor; and comprising a manually operated normally closed switch connected in series with said main circuit of said thyristor and with said winding so that manual opening of said switch cuts off the energized thyristor.

10. A stop motion as claimed in claim **4**, and comprising at least one signal lamp connected in series with said main circuit to indicate the energized condition of said gate controlled device and also the sensing of a latch in an undesired position by said feeler contact.

11. A stop motion as claimed in claim **10**, wherein said gate controlled device is a thyristor, and comprising a resistor connected between said feeler contact and said gate circuit of said thyristor; and a casing enveloping said resistor, said thyristor and said signal lamp and having an opening through which said feeler contact projects to the outside.

12. A stop motion as claimed in claim **11**, wherein said casing comprises a cylindrical housing portion, and a light permeable cap portion attached to said housing portion and covering said signal lamp so that light passes from said signal lamp through said light permeable cap portion; said housing portion and cap portion defining a confined space for non-movably holding the parts assembled in said housing.

13. A stop motion as claimed in claim **10** and comprising a resistor whose resistance is smaller than the resistance of said signal lamp and connected in parallel with the same and in series with said main circuit.

14. Stop motion for a knitting machine including an electric motor, a needle carrier driven by said motor, and conductive latch needles mounted on said carrier for movement with the same and having latches for moving along a first path when in a desired fully opened position and moving along a second path when in an undesired not fully opened position; a voltage source having one terminal connected with said carrier and latch needles; a plurality of sensing devices, each of which includes a stationary sensing means having a resilient feeler contact disposed in said second path and connected with one terminal of said voltage source when touching a latch in said undesired position; relay means including a winding and a relay switch in the circuit of said motor operable to effect deenergizing of said motor; an annular conductor connected with said other terminal and with said relay winding; each sensing device including a gate controlled device having a gate circuit electrically connected between said feeler contact and the other terminal of said source, and a main circuit controlled by said gate circuit for connecting said winding with said one terminal so that said gate circuit is energized when said feeler contact touches a latch in said undesired position whereby current flows through said main circuit and winding, and actuates said relay switch to cut off said motor; and a plurality of manually operated switches respectively connected between said annular conductor and said sensing devices.

15. Stop motion for a knitting machine including an electric motor, a needle carrier driven by said motor, and conductive latch needles mounted on said carrier for movement with the same and having latches moving along a first path when in a desired fully opened position and moving along a second path when in an undesired not fully opened position; a voltage source having one terminal connected with said carrier and latch needles; a stationary sensing means having a resilient feeler contact disposed in said second path and connected with one terminal of said voltage source when touching a latch in said undesired position; relay means including a winding, and a relay switch in the circuit of said motor operable to effect de-energizing of said motor, said winding being connected with the other terminal of said source; a thyristor having a gate circuit electrically connected between said feeler contact and the other terminal of said source, a resistor connected between said feeler contact and said gate circuit of said thyristor, and a main circuit controlled by said gate circuit for connecting said winding with one terminal so that said gate circuit is energized when said feeler contact touches a latch in said undesired position whereby current flows through said main circuit and winding, and actuates said relay switch to cut off said motor; and a casing enveloping said resistor and said thyristor and having an opening through which said feeler contact projects to the outside.

References Cited

UNITED STATES PATENTS

2,760,363	8/1956	Van Alen et al.	66—157
2,804,761	9/1957	Lebocey	66—163
2,880,381	3/1959	Antonevich	66—163 X
2,963,890	12/1960	Hoots	66—157
3,258,612	6/1966	Rubelmann	307—252 X
3,378,733	4/1968	Jensen	307—305 X

OTHER REFERENCES

Moll, J. L. et al.: P-N-P-N Transistor Switches, Proceedings of The IRE, September 1956, page 1181.

MERVIN STEIN, Primary Examiner

U.S. Cl. X.R.

66—163