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POLARIZED RELAY FOR CONTROLLING DEVICES PROVIDED WITH TO-AND-FRO MOVING ELEMENTS

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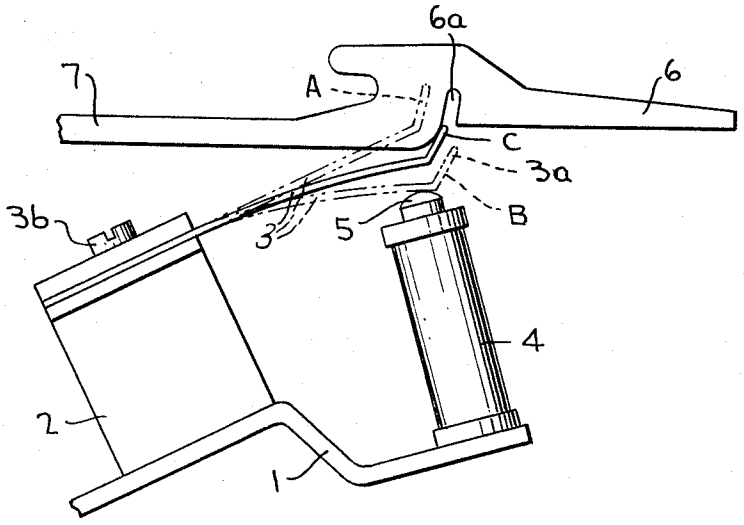

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POLARIZED RELAY FOR CONTROLLING DEVICES PROVIDED WITH TO-AND-FRO MOVING ELEMENTS

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The present invention has reference to an improved apparatus for controlling devices wherein to-and-fro moving elements must be selectively restrained or released in a predetermined position.

Examples of such devices are looms utilizing to-and-fro moving heddles, typewriters, adding machines or recording machines with key levers, or devices for carrying out punching operations, and so forth. With such and analogous devices it is of decisive importance that the holding or restraining operation of the to-and-fro moving elements proceed quickly and in synchronism with their movement and without too large an expenditure of energy.

Now, it is known to the art to use electromagnets for controlling devices wherein the armature thereof is strengthened or reinforced with respect to the part which carries it and is held by a tension spring in raised position. Furthermore, electromagnets are also known where the armature is carried by a flat or leaf spring which serves as elastic intermediate member between the actual armature and the point of anchorage, wherein the leaf spring fulfils the function of the tension spring.

As is well known, such electromagnets require relatively high expenditure of energy for attracting the armature across the air gap in order that there is obtained the required magnetic force of attraction. Apart from such, these electromagnets possess a certain inertia for which reason considerable amount of time is required until the armature is pulled across the air gap against the magnet core.

Additionally, devices are known in which a polarized relay is employed for controlling a switching operation, the magnetic armature of which in the rest condition under the action of a leaf spring and the polarized relay bears against a core, and upon excitation of the relay is released and under the action of a tension spring is moved away from the core and thereafter automatically returns to the starting position. However, such devices have the disadvantage that they react quite sluggishly since the armature during release is moved by a tension spring, so that this tension spring must overcome the stress of the leaf spring which always becomes larger with increasing air gap. Therefore, such devices are not suitable for use with electronic controlled apparatuses in which switching operations have to take place within fractions of a second. The pulses emanating from the electronic devices are so short that the inertial armature will not immediately begin to carry out its movement and, further, the existing magnet field will not be able to sufficiently break down. Moreover, with normal electromagnets the selection of the spring tension is confined to narrow limits, since with stronger pre-stress the expenditure of energy can become too great and the magnetization of the spring influences the force of attraction.

Accordingly, it is a primary object of the present invention to provide an improved apparatus for controlling devices employing to-and-fro moving or displaceable elements and which overcomes the previously mentioned disadvantages.

A further very important object of this invention is to provide an improved apparatus or mechanism which enables selective control of the movement of a displaceable element with a minimum expenditure of energy.

Generally speaking, in accordance with the teachings of the present invention a polarized relay is employed for controlling devices in which displaceable or to-and-fro moving elements must be selectively held in one position. According to one embodiment such polarized relay is constructed as a permanent magnet system and is provided with a control winding for releasing an armature of the relay constructed as a leaf or flat spring. In another possible embodiment the polarized relay incorporates an electromagnet having a core and a winding which is energized so as to hold the armature against the aforesaid core.

More specifically, in the case of the permanent magnet system the inventive apparatus is characterized by the features that an armature constructed as an elastic leaf spring of a polarized relay having a control winding for releasing the aforesaid leaf spring is provided as holding or restraining means for the to-and-fro moving element. In the case of the electromagnet of the second possible arrangement, and as just mentioned, the winding or coil is energized to hold the armature against the core. Furthermore, in both cases the leaf spring is arranged in such a manner that in its so-called held or locked position it bears under stress against the core of the polarized relay, and upon release thereof moves into its working position due to its initial or pre-stress. This working position is selected such that the leaf spring in this position has not yet reached its relaxed or unstressed condition, and furthermore, mechanical means are provided for moving the leaf spring from the working position into the locked position.

The polarized relay can comprise a permanent magnet system embodying a permanent magnet, an armature in the form of a leaf spring, a core, and a holder which magnetically couples the permanent magnet with the core. Also, the polarized relay can incorporate an armature in the form of a leaf spring and a known electromagnet with excitation or field winding encircling a core.

It will be appreciated that the use of a polarized relay effectively overcomes the mentioned disadvantages in that, first of all, upon release of the armature the prestress of the leaf spring is utilized as return force. Secondly, with a polarized relay in the form of a permanent magnet system only a small control current pulse is required for releasing the armature. Moreover, if the polarized relay is formed by a permanent magnet system there is additionally attained the considerable advantage that only a current surge is required for releasing the armature, so that current requirements can be held to a minimum.

Other features, objects and advantages of the invention will become apparent by reference to the following detailed description and single figure schematically depicting a preferred embodiment of inventive apparatus for controlling displaceable or to-and-fro moving elements.

Describing now the drawing, it will be seen that there is depicted a magnet system incorporating a polarized relay, generally designated by reference character R and comprising a permanent magnet **2** which is secured to a holder or bracket **1**. A leaf or flat spring **3** is rigidly fastened by means of screw element **3***b* or equivalent fastening means onto the upper end of this permanent magnet **2**. Moreover, a control coil or winding **4** disposed about a magnet core **5** is also mounted to the holder or bracket **1**. The leaf spring **3** is arranged in such a manner that its free upwardly flexed end **3***a* is disposed above the magnet core **5**.

Now, by further inspecting the drawing it will be seen that the leaf spring **3** is depicted in three different positions. Position A represents the rest position which the leaf spring **3** assumes when it is not influenced by external

forces in any manner. In position B this leaf spring 3 bears under stress against the core 5 of the magnet system and is restrained by such in the so-called locked or contact position. Finally, position C is the working position, that is, that position which leaf spring 3 assumes after it has been released. This working position C is intermediate the previously considered positions A and B. Moreover, working position C is determined by the stop member 6 which constitutes a portion of a displaceable element 7 moving to-and-fro and which is to be controlled.

Since the leaf spring 3 serves as restraining member for the to-and-fro moving elements of a machine, it fulfils its function in that, by way of example, after release from the magnet system it extends with its free end 3*a* into the path of movement, and specifically here into the region of recess 6*a*, of the to-and-fro moving element 7 to be controlled. As a result, element 7 is effectively restrained or held. The leaf spring 3 can, of course, carry out restraint or holding of the movable element 7 indirectly via a special holding mechanism.

It will also be understood that the leaf spring 3 possesses the same cross-section throughout its entire length, thus does not possess any reinforcement which serves as the actual armature. Moreover, the arrangement is carried out such that the leaf spring 3 is held against the core 5 when the magnetic flux of the permanent magnet 2 has a complete path via the holder 1, the magnet core 5 and the leaf spring 3—such elements defining the permanent magnet system of the polarized relay R. When such spring 3 bears against the magnet core 5 then it is stressed, so that when it is released it strives to move into its non-stressed rest position A.

It should be appreciated that if for the polarized relay only an electromagnet 4, 5 and leaf spring 3 is used it requires a current supply for excitation and for holding the leaf spring; upon interruption of the current the leaf spring is released. This results in it being necessary to continually provide a supply of energy, and indeed for such length of time as it is necessary to hold the leaf spring 3 at the core 5. When dealing with apparatus which employ a plurality of displaceable or to-and-fro moving elements which are to be controlled then such expenditure of energy becomes of considerable importance.

Now, in this last-mentioned situation there is advantageously employed a permanent magnet system as previously considered, which, on the hand, is magnetically coupled with the core 5 and, on the other hand, with the leaf spring 3. In so doing, the magnet core 5 is provided with a control winding 4 which during current flow is excited in such a manner that the prevailing magnetic flux emanating from the permanent magnet 2 is eliminated or weakened to such an extent that the leaf spring 3 previously bearing against the magnetic core 5 is released. For such release, there is only required a short current surge—a pulse—so that the expenditure of energy for release is extremely small. Thus, the control coil or winding 4 can be held very small.

The work position C is determined such that the leaf spring 3 in this position has not yet reached its relaxed state or condition, in other words, has not assumed its rest position A. This measure has the advantage that the flat or leaf spring 3 immediately after release from the magnetic core 5 moves out of its locked or contact position B into the working position C. Since leaf spring 3 has not yet reached its relaxed condition it does not rebound out of its working position C. Moreover, the time in which the open or work position C of the spring 3 has been reached is practically always the same and there is no drop in the speed of the opening movement. This is based upon the fact that upon release of the leaf spring 3 it carries out its movement as part of an oscillation with its own fundamental frequency and such is always of the same magnitude with constant elasticity.

Moreover, in each instance the working position C is determined in such a manner that the air gap between it and the locked or closing position B is so large that the continuously effective forces of attraction of the permanent magnet system 1, 2, 3, 5 or the excited electromagnet 4, 5 are not capable of bringing the armature i.e. leaf spring 3 to bear against the core 5. The force of attraction only tends to hold the flat spring type-armature at the core 5 against the pre-stress of the spring when the armature is applied to the core by an external, preferably mechanical force. This return movement takes place mechanically and, indeed, either by the to-and-fro moving element 7 itself, or by means of a special return mechanism which is actuated or controlled by such to-and-fro moving element. The first solution is simpler and with such, the flexed free end 3*a* of the leaf spring 3 moves into the path of displacement of the to-and-fro moving element 7. Thus, during each reciprocal motion of this element 7 the leaf spring 3 is pressed once onto the core 5 of the magnet system. In the event that the relevant element 7 should freely execute its to-and-fro movement, then the leaf spring 3 remains attracted against the core 5. On the other hand, if the relevant element 7 is to be restrained or held, then a current surge is delivered from any suitable non-illustrated supply source to the control winding 4 of the magnet system and thus the spring 3 moves into the path of displacement of the aforesaid element 7 and holds such fixed.

Consequently, during each to-and-fro movement of the element 7 the leaf spring 3 is applied to the core 5 of the magnet system by the movable element 7 itself, and by virtue of actuating or not actuating the control winding 4 there is determined whether the leaf spring 3 is to be released or should remain in contact with the magnet core 5. In this manner, actuation of the holding element i.e. spring 3 is synchronized with the to-and-fro movement of the element 7 in that the latter directly or indirectly itself moves the spring. Due to the selection of the internal or inherent stress of the leaf spring 3 it is possible to optionally determine within certain limits the spring movements as well as the return force into the locked position.

While there is shown and described present preferred embodiments of the invention it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims.

What is claimed is:

1. Apparatus for controlling devices having at least one to-and-fro moving element which is selectively restrained in a predetermined position, comprising a polarized relay, said polarized relay including a core and an armature constructed in the form of an elastic leaf spring, said leaf spring being mounted for movement into a locked position where it bears against the core and is in a stressed state and into a working position into which it moves upon release from said core under the action of its internal stress, said working position being selected such that said leaf spring in said working position has not yet attained its relaxed state, and mechanical means for displacing said leaf spring from said working position into said locked position.

2. Apparatus as defined in claim 1 wherein said polarized relay is a permanent magnet system incorporating said core and said leaf spring, and further incorporates a permanent magnet and a holder member coupling said permanent magnet with said core.

3. Apparatus as defined in claim 2 further including a control winding cooperating with said core for releasing said leaf spring from said core.

4. Apparatus as defined in claim 1 wherein said polarized relay comprises an electromagnet including said core, said leaf spring, and a winding surrounding said core.

5. Apparatus as defined in claim 1 wherein said leaf spring is constructed to possess the same cross-section throughout its entire length.

6. Apparatus as defined in claim 1 wherein said me-

chanical means is defined by a to-and-fro moving element.

7. Apparatus as defined in claim 6 wherein said leaf spring has a flexed free end capable of moving into the path of movement of said to-and-fro moving element for restraining the latter.

8. Apparatus for controlling devices having at least one displaceable element which is selectively restrained in a predetermined position, comprising a polarized relay, said polarized relay including a core and an armature constructed in the form of a spring, said spring being mounted for movement into a locked position where it bears against the core and is in a stressed state and into a working position into which it moves upon release from said core under

the action of its internal stress, said working position being selected such that said spring in said working position has not yet attained its relaxed state, and means for displacing said spring from said working position into said locked position.

References Cited by the Examiner

UNITED STATES PATENTS

2,811,602	10/1957	Rommel et al.	317—172 X
2,896,132	7/1959	Sauer	317—172 X

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