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Actuating Mechanism for a Control Switch

The invention relates to an actuating mechanism for a control switch which delivers different control signals as a function of the position of a switch member.

Actuating mechanisms of this type are used particularly in regulating and control drives for sewing machines, such as are known from the Journal "BEKLEIDUNG UND WÄSCHE" ("Clothingand Underwear") No. 7/1970, Pages 466 to 470. Such regulating and control drives are likewise known from German Gebrauchsmuster (Utility Model) 75 39 310 (corresponding to United States of America Patent 4 100 868). The actuating mechanism is this case is actuating through a pedal operable by the machinist with her foot. The transmission of movement from the pedal to the actuating mechanism occurs through the linkage. Upon movement of an operating member of the control switch out of the rest position in one direction, various speeds of the drive increasing with the degree of deflection out of the rest position are regulated, whereas in the case of a pivoting of the operating member out of the rest position in the opposite direction, other functions, such as the actuation of a thread cutter are operated.

Control switches of this type are known; they can operate in individual switching steps or steplessly. They can further operate by means of sets of contact or be of contactless construction.

In a known mechanism, the free members of a single torsion spring are mutually cranked and abut the station-

ary stop arranged between them. A driver coupled to an actuating arm is further arranged between them, whereby the rest position of the actuating arm is defined. Upon the movement of the actuating arm in the one or other direction, one spring member in each case is deflected, generating a corresponding return force. A limitation of the path of travel is achieved in that the driver is simultaneously guided in a stationary slot of a housing, the ends of which respectively constitute the limit stops for the driver. A so-called pressure point, i.e., a sensible increase in the necessary adjusting force before the commencement of the actual switching processes is achieved by a complicated spring-loaded lever linkage which is connected to the actuating arm by cam connections.

The underlying aim of the invention is to produce an actuating mechanism which is particularly simple in its construction and which especially permits a particularly simple pressure point generation.

According to the invention there is provided an actuating mechanism for a control switch which produces control signals in dependence on the position of a switch operating member, comprising an actuating arm adapted to be connected to the switch operating member, said arm being pivotable about an axis against the restoring force of a torsion spring out of a rest position, said spring having projecting members engageable with fixed abutments by which the initial rest position is determined, the actuating arm having at least one drive member which co-operates with the spring members such that one member of the torsion spring is moved when the actuating arm is moved in one direction and the other member of the spring is moved when the actuating arm is moved in the opposite direction, the mechanism also comprising a second fixed abutment or end stop which determines the travel of the actuating arm in each direction and a second torsion spring, disposed co-axially with the first mentioned spring, also having projecting members supported against fixed abutments in the rest

position of the actuating arm and one of which is movable when the actuating arm is moved in one direction and the other member of the spring is moved when the actuating arm is moved in the opposite direction a free clearance being provided in the rest position between at least one member of the second torsion spring and a drive member of the actuating arm.

Because the members of the torsion springs are used to determine not only the commencement of the control movement and hence the rest position of the actuating arm, they can also be used to set the end of the control movement all the measures otherwise necessary for this purpose are eliminated.

In one embodiment of the invention the drivers of the operating arm first deform one member of one torsion spring and then, at the commencement of the actual switching operation of the control switch, come into connection with a first member of the second spring which is likewise pretensioned, so that this pretensioning force also has to be overcome only at one point, i.e., without movement of the driver. By this means a so-called pressure point is generated which is respectively associated with both or with only one of the two switching or control directions. These constructions permit an extremely simple structural solution for the stops in which the initial stop and limit stop associated with each spring member is constituted in each case by a respective slot in a guide element.

In a further embodiment of the invention, the second fixed abutment or end stop limiting the travel of each spring member is constituted in each case by a projection on the guide element in the path of a drive member. As a result of this arrangement, the actuating mechanism is further developed so that even for powerful switching forces, damage to the members of the torsion springs in the region of the limit or end stops is excluded. In this embodiment the limitation of the paths of travel or the torsion spring is effected by the relevant driver; the drivers themselves and also the projections on the guide element, against which the respective driver comes into abutment, can of course be of very much more robust construction than the end of the relevant member of the torsion spring. Otherwise, the same advantages can also be achieved with this embodiment as with the first-mentioned embodiment.

Embodiments of the invention will now be described by way of examples and with reference to the accompanying

drawings in which:-

Figure 1 shows a section through an actuating mechanism according to the invention,

Figure 2 shows a view of the actuating mechanism viewed in the direction of the arrow II in Figure 1,

Figure 3 shows a view of the actuating mechanism, seen in the direction of the arrow III in Figures 1 and 2, with the cover removed and the conductor plate disassembled,

Figure 4 shows a section through another embodiment of an actuating mechanism according to the invention,

Figure 5 shows a view of the actuating mechanism, seen in the direction of the arrov V in Figure 4, and

Figure 6 shows a view of the actuating mechanism in the direction of the arrow VI in Figures 4 and 5 with the cover removed and the conductor plate disassembled.

Figure 1 indicates a lateral section of a control box 1 which is connected by flanges to a drive, as described in detail in the Journal "BEKLEIDUNG UND WÄSCHE", (Clothing and Underwear) No. 7/1970 Pages 466 to 470. The control box 1 is closable by means of a cover 2 and in a side wall 3 of the control box 1 there is constructed a bearing bushing 4 which is cast integrally if the control box is produced by the pressure-casting process in customary manner. Retained in the bearing bushing 4 as a force-fit is a bearing 5, e.g., a plain bearing in which a bearing shaft 6 is rotatably mounted. A lever 7 is attached integrally for rotation and axially immovably to that part of the bearing shaft 6 protruding from the control box 1. For this purpose the lever 7 is assembled

to the bearing shaft 6 by a corresponding bore 8. The rotational integrity is obtained by a key 9. The lever 7 is secured against being pulled off the bearing shaft 6 by a screw 10. On the side wall 3 confronting the plain bearing 5, the lever abuts against a locking ring 12 anchored in a groove 11 of the shaft. This ring is braced in turn against an annular washer 13 covering the end face of the plain bearing 5.

A hub 14 of an actuating arm 15 is mounted upon that part of the bearing shaft 6 projecting into the control box 1 and is anchored integrally for rotation with the shaft by means of a key 16. Th hub, and hence the actuating arm, is secured against being pulled off the bearing shaft into the control box by a circlip 17.

Due to the mode of connection described it will be evident that the actuating arm 15 is connected integrally for rotation with the lever 7.

The free end of the lever 7 has a ball spigot 18 which is screwed into a corresponding screw-threaded bore 18'. Said ball spigot 18 is part of a customary angle joint, by which e.g., a bar is attached which leads to a pedal, so that the lever and hence the actuating arm can be pivoted by means of such a pedal.

The actuating arm 15 is connected directly to the hub 14 near the associated side of the bearing bushing 4 and tapers somewhat towards the side wall 3 of the control box 1. The actuating arm 15 is provided at its free end with a recess 19 which is approximately Y-shaped as can be seen in Figure 2. In the lower leg of the Y, which is constructed after the manner of a slot 20, a driving pin 21 of the operating member 22 of

a control switch 23 is arranged. The control switch 23 is screwed onto a circuit board 24 by means of screws 25. The Y-shaped enlargement of the recess 19 serves to permit the driving pin 21 to be introduced into the slot 20 as easily as possible when the preassembled circuit board 24 is inserted. The circuit board 24 is screwed to the control box by screws 26, whereby a fixed mutual association of control switch 23 and actuating arm 15 is then also ensured. The control switch 23 is constructed in known manner as a switch with contact sets, whilst specific contact pairs are closed in conformity with a specific switching position by virtue of corresponding movements of the actuating arm 15 and hence of the operating member 22 in conformity with the movement direction arrow 27. Obviously, such a switch may also be constructed as a contactlessly operating switch, and also as a steplessly or stepped operating switch. Such switches are commercially available.

Mounted on the hub 14 is a first torsion spring 28, which is constituted by a plurality of tightly coiled turns 29 of a spring wire, the two ends of which project radially upwards as free members 30, 31 towards the control switch 23. Beside said first torsion spring, a second torsion spring 32 is arranged on the hub 14. Both these torsion springs 28, 32 are secured to the hub 14 by a washer 33 and a circlip 34 attached to the hub 14. The second torsion spring 32 likewise has two free members 35, 36.

In proximity to the circuit board 24 and arranged between the board and the hub 14 there is a plate serving as a guide element 37, which is therefore oriented substantially

at right angles to the longitudinal direction of the actuating arm 15 in the central, rest position of the arm, visible in Figure 2. The guide element 37 is screwed to the control box 1 by screws 38. A first pair of slots 39, 40, which are associated with the first torsion spring 28, is arranged in the guide element 37. Also arranged in the guide element 37 is a second pair of slots 41, 42, which are associated with the second torsion spring 32 is guided in a respective one of the slots 39, 40, 41, or 42. The slots 39, 40, 41 and 42 extend at right angles to the axis 43 of the bearing shaft 6 which is of course simultaneously also the rotary axis for the members 30, 31 and 35, 36 of the torsion springs 28 and 32 respectively.

Two drivers 44, 45 are fitted on the actuating arm 15, adjacently to the guide element 37, between the latter and the hub 14. The entire actuating arm 15 with the hub 14 and with the drivers 44, 45 and with the recess 19 can be produced integrally of synthetic plastics or by pressure casting, such as die casting.

As Figure 3 shows particularly, the drivers 44, 45 overhang the members 30, 35 on the one hand and 31, 36 on the other hand from the outside. In the rest position illustrated in Figure 3, all the members 30, 31, 36 abut, due to their pretension, respectively against the mutually remote, i.e., the outer, ends of the slots 39 to 42 constructed in the manner of elongate holes. Said ends therefore serve as initial stops 46, 47 and 48, 49 with reference to a deflection of the members 30, 31 and 35, 36, respectively. In this position of the two members 30, 31 of the first torsion spring 28 on the associated initial stops 46, 47, the two drivers 44, 45 rest with their driver surfaces 50, 51 confronting the members against the outside of said two members 30, 31, whereby the actuating arm 15 with the lever 7 is simultaneously maintained without play in said rest position. The control switch 23 and its operating member 22

with drive pin 21 is arranged so that the zero position is also adjusted in the control switch 23 in the case of this thus defined position of the actuating arm 15.

The slots 41, 42 associated with the second torsion spring 32 are arranged so that in this rest position the members 35, 36 abutting against the corresponding initial stops 48 and 49 respectively exhibit a short interval a or a' from the corresponding driver surface 50 or 51. By this means it is achieved that in the case of a pivoting of the lever 7 with the actuating arm 15 in one of the directions of the movement direction arrow 27, either only the member 30 of the first torsion spring 28 will be entrained at first by the driver surface 50 of the driver 44 counter to a corresponding counterforce, before the driver surface 50 comes into abutment against the member 35 of the second torsion spring 32 and then also has to overcome its counterforce, or else, in the case of an opposite pivoting movement, the member 31 of the first torsion spring 28 is at first entrained by the driver surface 51 of the driver 45, until after travelling over path a', the dirver surface 51 comes into abutment against the corresponding member 36 of the second torsion spring 32. In each case after the path a or a' has been travelled

a so-called pressure point therefore occurs, at which an additional force must again be exerted in order to trip a corresponding switch movement.

The slots 40, 42 and 39, 41 respectively associated with a driver 44 or 45 terminate at such a height that both members 30, 35 or 31, 36 arrive simultaneously at these ends of the slots 39 to 42 serving as limit stops 52, 53, 54, 55.

It is, of course, possible and also advantageous depending upon particular applications to provide the torsion springs 28, 32 with different spring characteristics, i.e. to make them of differnet stiffnesses. Therefore, if the second torsion spring 32 is constructed so as to be comparitively soft in comparison to the first torsion spring 28, then no appreciable increase in the force to actuate the lever 7 with actuating arm 15 will occur when overcoming the pressure point, i.e., with the second torsion spring 32 becoming additionally operative. On the other hand, if the first torsion spring 28 is relatively soft in comparison to the second torsion spring 32 then the actual increase in force, i.e., increase in the counterforce, will occur only upon the engagement of the second torsion spring 32.

There is also the respective degree of pre-tension of the individual springs. In the case of the second torsion spring 32, of course, the total pretensioning force has to be overcome only after the relevant driver 44 or 45 abuts against the corresponding member 35 or 36 of the second torsion spring 32, before a further deflection of the corresponding driver with the actuating arm 15 occurs. It will therefore generally be convenient to construct the second torsion spring 32 so that it is relatively weak in comparison to the first torsion spring 28, and conversely to pretention the second torsion spring 32 correspondingly to such an extent that the desired counter-force occurs at the pressure point. Then, after this force is overcome at the pressure point no further appreciable increase in the counterforce occurs along the pivotal path of the corresponding members 35 and 36 of the second torsion spring 32.

The above-mentioned effect can be realised in a particularly simple manner in that the second torsion spring 32 is on the one hand wound from a thinner, i.e., softer, spring wire than the first torsion spring 28, but that on the other hand, the second torsion spring 32 has a few more turns than the first torsion spring 28. This is indicated in Figure 1. This embodiment is, of course, not very satisfying aesthetically; this is however immediately feasible due to the arrangement of the actuating mechanism in the interior of the control box.

It is obviously also possible to stagger the initial stops 48 or 49 of the members 35, 36 of the second

torsion spring 32 on one side only, i.e., only at the slot 41 or 42, by the distance a or a' with reference to the associated initial-limit stop 46 or 47 so that a pressure point is generated after the corresponding short distance a or a' in the case of a pivoting of the actuating arm 15 out of a rest position in only one of the two possible directions. Furthermore, a single guide element 37 may obviously be equipped with corresponding combinations of slots for the members 30, 31 and 35, 36, so that all the three above-stated combinations are selectively possible.

In the embodiment illustrated in Figures 4 to 6 the drivers 44, 45 constructed on the actuating arm 15 are provided with extensions 56, 57 which project beyond the edge 58 of the guide element 37 associated with their free ends. In the region of the edge, limit stops 59, 60 in the form of tongues, tabs or projections, against which either the extension 56 of the driver 44 or the extension 57 of the driver 45 comes into abutment as travel limitation, are bent downwards, i.e., towards the bearing shaft 6, out of the respective guide element 37 consisting of a sheet metal plate. In order not to modify the length of the control paths of travel the slots 39, 40, 41, 42 are provided, in comparison with the embodiment described above, with a small slot elongation 61 at their end opposite to the initial stops 46, 47, 48, 49 so that it is ensured that when the extension 56 or 57 of the driver 44 or 45 strikes against the associated tongue-like or projection-like limit stop 59 or 60, the members 30, 31 or 35, 36 do not strike against the other ends

of the associated slots in the guide element 37.

When the extension 56 of the driver 44 strikes against the limit stop 59 this constitutes the limit stop for deflection of the members 31 or 36 of the torsion springs 28, 32 in each case. Conversely, the limit stop 60, in co-operation with the extension 57 of the driver 45, is the limit stop for the deflection of the members 30, 35 of both the torsion springs 28, 32.

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1. An actuating mechanism for a control switch which produces control signals in dependence on the position of a switch operating member, comprising an actuating arm adapted to be connected to the switch operating member, said arm being pivotable about an axis against the restoring force of a torsion spring out of a rest position, said spring having projecting members engageable with fixed abutments by which the initial rest position is determined, the actuating arm having at least one drive member which co-operates with the spring members such that one member of the torsion spring is moved when the actuating arm is moved in one direction and the other member of the spring is moved when the actuating arm is moved in the opposite direction, the mechanism also comprising a second fixed abutment or end stop which determines the travel of the actuating arm in each direction and a second torsion spring, disposed co-axially with the first mentioned spring, also having projecting members supported against fixed abutments in the rest position of the actuating arm and one of which is movable when the actuating arm is moved in one direction and the other member of the spring is moved when the actuating arm is moved in the opposite direction a free clearance being provided in the rest position between at least one member of the second torsion spring and a drive member of the actuating arm.

2. A mechanism according to Claim 1 wherein the first and second fixed abutments associated with each spring limb are constituted in each case by a respective slot in a guide element.

3. A mechanism according to Claim 1 or Claim 2 wherein the actuating arm is provided with two driver members which are spaced from each other and each of which abuts a limb of the first torsion spring in the rest position.

4. A mechanism according to any one of Claims 1 to 3, wherein the two projecting members of each of the two torsion springs respectively associated with a drive member abut the associated abutments or end stops in the corresponding position of the actuating arm deflected from the rest position.

5. A mechanism according to Claim 1, wherein the two torsion springs have different spring characteristics.

6. A mechanism according to Claim 5, wherein the second torsion spring is weaker than the first torsion spring.

7. A mechanism according to Claim 5 or Claim 6 wherein the second torsion spring has a flatter spring characteristic than the first torsion spring.

8. A mechanism according to Claim 1 wherein the second fixed abutment or end stop associated with each projecting spring member is constituted in each case by a projection on a guide element arranged in the path of a drive member.

9. A mechanism according to Claim 1, wherein the respective abutments or end stops are shaped integrally with a guide element.

10. A mechanism according to Claim 9 wherein each respective abutment or end stop is constituted by a bent-over part on the guide element.

11. An actuating mechanism for a control switch substantially as hereinbefore described with reference to the accompanying drawings.

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