

Recording and/or reproducing apparatus for a cassette accommodating a record carrier

The invention relates to a recording and/or reproducing apparatus for a cassette accommodating a record carrier and comprising a rectangular housing having an upper wall, a lower wall and four side walls, at least one of said side walls having at least one access opening, and a shutter for closing the access opening, which shutter is movable between a closed position and an open position, which apparatus comprises a cassette holder adapted to receive a cassette and an actuating device adapted to move the shutter of the cassette held by the cassette holder, which actuating device comprises a movable carrying member and an actuating pin which projects from the carrying member in a projection direction, which is engageable with the shutter of the cassette, and which controls the movement of the shutter during a relative movement between the actuating pin and the shutter in a direction transverse to the projection direction of said pin.

Such an apparatus of the type defined in the opening paragraph is known, for example from DE 40 33 095 A1. In this prior-art apparatus the actuating device for moving the shutter of a cassette accommodating a record carrier in the form of a magnetic tape comprises a cylindrical actuating pin having an uninterrupted smooth cylindrical surface. Since the spatial relationships at the location of the shutter of a cassette are dimensioned tightly and, consequently, only narrow tolerance limits are available for the relative positions between the actuating pin and the shutter, it is not unlikely, for example when the apparatus is subjected to vibrations or shocks, that owing to the uninterrupted smooth cylindrical surface of the actuating pin this pin performs a relative movement with respect to the shutter parallel to the direction in which said pin projects and thus moves away from the shutter, in which case the actuating pin may become disengaged from the shutter of the cassette, thereby inadvertently

interrupting the operative connection between the actuating pin and the shutter. Such an undesired interruption of the operative connection between the actuating pin and the shutter constitutes an operational fault which may lead to damage to the cassette or to parts of the apparatus which cooperate with the cassette, which is obviously undesirable.

It is an object of the invention to preclude the above problems and to ensure that the actuating pin in an apparatus of the type defined in the opening paragraph remains in engagement with the shutter after the actuating pin has established an operative connection with the shutter. To this end the invention is characterised in that the actuating pin has at least one stepped portion which extends substantially transversely of the projection direction of said pin and, when the shutter has been moved to its open position by the actuating pin, a portion of said shutter engages behind the stepped portion of the actuating pin and positively blocks a movement of the actuating pin parallel to the projection direction of said pin. This ensures in a particularly simple manner that the actuating pin cannot perform any undesired relative movement with respect to the shutter parallel to the direction of projection of the pin as long as the actuating pin is operatively connected to the shutter, thereby ensuring that an operational fault as possible in the known apparatus is avoided.

The actuating pin may be of, for example, triangular or quadrangular cross-section and have an offset portion which extends transversely of its direction of projection and having one bounding wall constituting the stepped portion of the actuating pin. However, in the case of an apparatus in which the actuating pin is cylindrical it is found to be particularly advantageous if the stepped portion is constituted by an axial bounding surface of a recess formed in the cylindrical actuating pin. This is advantageous for a reliable low-friction cooperation of the actuating pin with the shutter and also for a simple manufacture of the stepped portion of the actuating pin because this can be formed in a simple turning operation.

The invention will now be described in more detail on the basis of some embodiments given by way of example but to which the invention is not limited. Fig. 1 is a diagrammatic oblique view of a recording and reproducing

apparatus for a cassette accommodating a record carrier in the form of a magnetic tape, which apparatus comprises a cassette holder for receiving the cassette, which holder has been provided on a drawer which can be slid into and out of the apparatus. Fig. 2 is a diagrammatic oblique view of a cassette which can be loaded into the apparatus shown in Fig. 1 and which comprises a shutter which is movable between a closed position and an open position and which is shown in its closed in Fig. 2. Fig. 3 shows the cassette of Fig. 2 in the same way as in Fig. 2, the cassette being partly cut-away and the shutter being shown in its open position. Fig. 4 shows a part of the cassette of Figs. 2 and 3 in the same way as in Fig. 3 but to an larger scale than in Fig. 3, and a relevant part of an actuating device for moving the shutter of the cassette, which device comprises a simple cylindrical actuating pin in accordance with the prior art. Fig. 5 shows a part of the cassette of Figs. 2 to 4 to a substantially larger scale than Fig. 4, to illustrate the cooperation of the actuating pin of the actuating device shown in Fig. 4 with wall portions and with the shutter of the cassette. Fig. 6 shows, in a sectional view taken on the line VI-VI in Fig. 5, the actuating pin of the actuating device of Fig. 4 together with the parts of the cassette of Figs. 2 to 5 which cooperate with said actuating pin when the shutter has been moved into its open position. Fig. 7 shows, in the same way as Fig. 6, an actuating pin of an actuating device of a recording and reproducing apparatus in accordance with the invention, the actuating pin also being cylindrical but having a recess for cooperation with the shutter of a cassette. Fig. 8 shows, in the same way as Figs. 6 and 7, an actuating pin of an actuating device of a further recording and reproducing apparatus in accordance with the invention, the actuating pin also being cylindrical but having an end portion of larger diameter than the remainder of the actuating pin. Fig. 9 shows, in the same way as Figs. 6, 7 and 8, an actuating pin of an actuating device of a further recording and reproducing apparatus in accordance with the invention, the actuating pin being of rectangular or square cross-section and having a laterally offset portion at the location of its free end.

Fig. 1 shows diagrammatically a recording and reproducing apparatus 1 constructed for recording and reproducing information signals, for

example speech signals or music signals, on/from a magnetic tape. The magnetic tape is accommodated in a cassette 2, which is at least partly shown diagrammatically in Figs. 2, 3, 4, 5 and 6.

5 The cassette 2 has a rectangular housing 3 having an upper wall 4, a lower wall 5, not shown in Figs. 2, 3, 4 and 5, and four side walls 6, 7, 8 and 9, the two side walls 8 and 9 neither being shown in Figs. 2, 3 and 4. The long front-side wall 6 of the housing 3 of the cassette 2 has three access openings 10, 11 and 12. The access opening 10 also extends into the upper wall 4 and into the bottom wall 5 of the housing 3 of the cassette 2. The access opening 12 also
10 extends into the lower wall 5 of the housing 3 of the cassette 2. The access openings 10, 11, and 12 provide access to the magnetic tape 13, which is accommodated in the cassette 2 and extends between two rotatable reel hubs, not shown, for at least one magnetic head, which can pass through the access opening 11, and for two pressure rollers, which can cooperate with the magnetic
15 tape 13 through the access openings 10 and 12 and thereby press the magnetic tape 13 against the capstans, which are engageable behind the magnetic tape 13 through the parts of the openings 10 and 12 in the cassette 2 which are situated in the lower wall 5. The shape of the access opening 10 in the upper wall 4 will be described in more detail with reference to Figs. 4 and 5.

20 The cassette 2 has a shutter 14 for closing the access openings 10, 11 and 12. The shutter 14 is formed by a sheet-metal part of substantially U-shaped cross-section and comprises a plate-shaped first flange portion 15 extending parallel to the upper wall 4, a plate-shaped second flange portion 16 extending parallel to the lower wall 5, and a plate-shaped connecting portion
25 extending parallel to the long side wall 6 at the front. The connecting portion 18 and 19 has two windows 18 and 19, the window 17 also extending into the second flange portion 16. The U-shaped shutter 14 is movable between a closed position shown in Fig. 2 and an open position shown in Fig. 3, the shutter 14 being guided to be slidable in both directions between these two positions but this
30 will not be described in further detail here. At the location of the second flange portion 16 a return spring, which is not shown and which is arranged between

the second flange portion 16 and the lower wall 5, acts upon the shutter 14 and thus urges the shutter 14 into its closed position.

As can be seen in Fig. 1, the apparatus 1 has a cassette holder 20 for receiving a cassette 2, which holder is situated on a drawer 21 which can be slid into and out of the apparatus 1. The cassette holder 20 is substantially trough-shaped and has a bottom wall 22 and side walls, Fig. 1 showing only a side wall 23 and a further side wall 24. The side wall 24 has an opening 25 at whose location the side wall 6 with the openings 10, 11 and 12 of a cassette 2 is situated when the cassette 2 has been loaded into the cassette holder 20. Through the opening 25 in the side wall 24 of the cassette holder 20 said magnetic head and the pressure rollers can cooperate with the magnetic tape 13 in the cassette 2. Moreover, the opening 25 in the side wall 24 enables an actuating device 26, provided the cassette holder 20 for the actuation of the U-shaped shutter 14 of the cassette 2, to cooperate with the shutter 14, which will be described in detail with reference to Figs. 4 and 5.

When the drawer 21 of the apparatus 1 has been slid out of the apparatus 1 a cassette 2 can be inserted into the cassette holder 20, as a result of which the side wall 6 of the housing 3 of the cassette 2 faces the side wall 24 of the cassette holder 20. Subsequently, the drawer 21 is moved into the apparatus 1 in a manner not shown and not described. During this inward movement the actuating device 26, shown diagrammatically in Fig. 4, engages with the U-shaped shutter 14 of the cassette 2.

The actuating device 26 basically comprises a lever 28 which is pivotally supported on the bottom wall 22 of the cassette holder 20 by means of a spindle 27 and which constitutes a member carrying an actuating pin 29 of the actuating device 26. The actuating pin 29 projects from one end of the lever 28 in a direction perpendicular to the lever 28, *i.e.* oriented parallel to the axis of the spindle 27 and perpendicularly to the upper wall 4 of the housing 3 of the cassette 2. The actuating pin 29 is engageable with the U-shaped shutter 14 of the cassette 2 and during a relative movement between the actuating pin 29 and the U-shaped shutter 14 in a direction perpendicular to the direction in which the pin projects this pin controls the movement of the shutter between its closed

position and its open position, as will be described in more detail hereinafter. As is shown in Figs. 4 and 5, the actuating pin 29 is simply cylindrical with an uninterrupted smooth cylindrical surface, which is in accordance with the prior art.

5 At its end which is remote from the actuating pin 29 the actuating device 26 further comprises a control pin 30 projecting in a direction opposite to that of the actuating pin 29. By means of this control pin 30 the actuating device 26 can be controlled to bring the actuating device 26, *i.e.* its actuating pin 29, into engagement with the shutter 14 of the cassette 2 when the drawer 21 is
10 moved from its position outside the apparatus 1 into its position inside the apparatus 1. An actuating spring, not shown, acts upon the control pin 30, which thus tends to bring the actuating pin 29 into engagement with the cassette 2, *i.e.* with the shutter 14 of the cassette 2. Moreover, a mechanical control device, not shown, provided in the apparatus 1 acts upon the control pin 30 to control the
15 action of actuating spring which also acts upon the control pin 30. However, these details are not shown because they are not relevant in the present context.

 During the above-mentioned movement of the drawer 21 from its position outside the apparatus 1 into its position inside the apparatus 1 the mechanical control device, as described above, allows the actuating pin 29 to
20 cooperate with the cassette 2, *i.e.* with the shutter 14 of the cassette 2, under the influence of the force exerted by the actuating spring. By means of the actuating spring acting upon the control pin 30 the actuating pin 29 is first positioned against a wall portion 31 of the side wall 6, which wall portion adjoins the upper wall 4. Subsequently, the actuating pin 29 slides along a wall portion 32 having a
25 comparatively steep inclination relative to the side wall 6 and bounding the access opening 10 in the side wall 6 and the upper wall 4. As the actuating pin 29 slides along the wall portion 32 it engages with the first flange portion 15 of the shutter 14 in that the actuating pin 29 abuts against the first flange portion 15 of the shutter 15. Subsequently, the actuating pin 29 slides along a wall portion
30 33 having a comparatively moderate inclination relative to the side wall 6 and also bounding the access opening 10 in the side wall 6 and the upper wall 4. As the actuating pin 29 slides along the wall portion 33 it moves the first flange

portion 15 and hence the U-shaped shutter 14. Subsequently, the actuating pin 29 reaches the end of the wall portion 33, after which the actuating pin 29, under the influence of the actuating spring acting upon the control pin 30, slides along a wall portion 34 which extends perpendicularly to the side wall 6 and which bounds the access opening 10. This movement of the actuating pin 29 proceeds until the actuating pin 29 abuts against the wall portion 35 which extends parallel to the side wall 6 and which bounds the access opening 10. The actuating pin 29 remains in this position and under the influence of the return spring acting upon the U-shaped shutter 14 the pin 29 is pressed against the wall portion 34, which extends perpendicularly to the side wall 6, by the first flange portion 15 of the U-shaped shutter 14, as is shown in Figs. 4 and 5 but also in Fig. 6. If the actuating pin 29 has a diameter d the end of the shutter 14, *i.e.* of the first flange portion 15 thereof, is consequently held at a distance d , equal to the diameter d of the actuating pin 29, from the wall portion 34, as is clearly illustrated in Fig. 6. Thus, the position of the shutter 14 relative to the wall portion 34 in the open position of the shutter can be defined by a suitable choice of the diameter d of the actuating pin 29.

With a prior-art construction of the actuating pin as described with reference to Figs. 4 and 5 it has been found, for example when the apparatus 1 is subjected to vibrations or shocks, that owing to the uninterrupted smooth cylindrical surface of the cylindrical actuating pin 29 this pin 29 performs a relative movement with respect to the shutter 14, *i.e.* the first flange portion 15 thereof, parallel to the direction in which said pin projects and thus moves away from the first flange portion 15 in the direction of projection, in which case the actuating pin 29 may become disengaged from the shutter 14 of the cassette 2, which may result in the operative connection between the actuating pin 29 and the shutter 14 being interrupted inadvertently. Such an undesired interruption of the operative connection between the actuating pin 29 and the shutter 14 constitutes an operational fault, which may lead to damage to the cassette 2 or to parts of the apparatus which cooperate with the magnetic tape 13 accommodated in the cassette 2, such as a magnetic head or pressure rollers, which is obviously undesirable.

In order to preclude the above problems as occurring with an actuating pin of an actuating device of a construction as shown in Figs. 4, 5 and 6 the actuating pin 29 of the actuating device 26 in a first embodiment of a recording and reproducing apparatus 1 in accordance with the invention, as shown in Fig. 7, is provided with two stepped portions 37 and 37 extending substantially transversely of the direction in which said pin projects. As is also shown in Fig. 7, a portion of the shutter 14, *i.e.* the first flange portion 15, engages behind the stepped portions 36 and 37 of the actuating pin 29 when the shutter 14 has been moved to its open position by the actuating pin 29. In this way the first flange portion 15 of the shutter 14 positively blocks a movement of the actuating pin 29 parallel to the direction in which it projects. With the construction shown in Fig. 7, where the actuating pin 29 is in principle cylindrical, the stepped portions 37 and 37 are each formed by an axial bounding surface of a recess 38 formed in the cylindrical actuating pin 29. The actuating pin 29 now has a diameter D and the depth of the recess 38 has been selected in such a manner that the distance d between the tangential generatrix of the actuating pin 29 at the location of the wall portion 34 and the generatrix of the bottom of the recess 38 diametrically opposite said tangential generatrix, with which the free end of the first flange portion 15 of the shutter 14 is in contact, is equal to the diameter d of the actuating pin 29 of the actuating device 26 of the apparatus shown in Figs. 1, 4, 5 and 6. In this way it is achieved that in the apparatus shown in Fig. 7 the shutter 14 of the cassette 2, when open, occupies the same position relative to the wall portion 34 as in the apparatus shown in Figs. 1, 4, 5 and 6.

The provision of the recess in the cylindrical actuating pin of the apparatus shown in Fig. 7 ensures in a particularly simple way that the actuating pin cannot perform an undesired relative movement with respect to the shutter parallel to the projection direction of this pin as long as the actuating pin engages with the shutter, thereby ensuring that an undesired disengagement of the actuating pin and the shutter is not possible and consequently an operational fault as a result of such an undesired disengagement is precluded. The actuating pin of the actuating device can be formed with such a recess in a simple turning

operation and involves only minimal additional cost, nevertheless yielding a very high reliability of the actuating device.

In a second embodiment of a recording and reproducing apparatus 1 in accordance with the invention shown in Fig. 8 the actuating pin 29 of the actuating device 26 has only one stepped portion 36 which extends substantially transversely of the projection direction of this pin and which is now formed by an axial bounding surface of a cylindrical end portion 39 of the actuating pin 29 whose diameter is larger than that of the remainder of the actuating pin 29. The end portion 39 has a diameter D and the remainder of the actuating pin 29 has a diameter a , the diameters D and a being selected in such a manner that the distance d between the tangential generatrix of the end portion 39 at the location of the wall portion 34 and the generatrix of the actuating pin 29 opposite said tangential generatrix at the location where the first flange portion 15 of the shutter 14 is equal to the diameter d of the actuating pin 29 of the actuating device 26 of the apparatus as shown in Figs. 1, 4, 5 and 6. In this way it is achieved that in the apparatus as shown in Fig. 8 the shutter 14 of the cassette 2, when open, occupies the same position relative to the wall portion 34 as in the two apparatuses shown in Figs. 1, 4, 5 and 6 and in Fig. 7.

In a third embodiment of a recording and reproducing apparatus 1 in accordance with the invention shown in Fig. 9 the actuating pin 29 of the actuating device 26 has a rectangular or square cross-section in relation to the projection direction of this pin, the side walls of the actuating pin 29 which extend between the wall portion 34 and the end of the first flange portion 15 of the shutter 14 having a length d equal to the diameter d of the actuating pin 29 of the actuating device 26 of the apparatus as shown in Figs. 1, 4, 5 and 6. Thus, it is achieved that in the apparatus as shown in Fig. 9 the shutter 14 of the cassette 2, when open, occupies the same position relative to the wall portion 34 as in the three apparatuses shown in Figs. 1, 4, 5 and 6, in Fig. 7 and in Fig. 8.

In the apparatus shown in Fig. 9 the actuating pin 29 has a laterally offset portion 41 at the location of its side wall 40 facing the shutter 14, the bounding wall 42 of said portion, which bounding wall faces the first flange portion 15 of the shutter 14, forming a stepped portion of the actuating pin 29,

which stepped portion engages the first flange portion 15 of the shutter 14 when the shutter 14 has been moved to its open position by the actuating pin 29. As is shown in Fig. 9, the bounding wall 42 of the offset portion 41 of the actuating pin 29 extends parallel to the plate-shaped first flange portion 15 of the shutter 14. However, alternatively this bounding wall may be slightly inclined relative to the first flange portion 15 of the shutter 14.

The two embodiments of the apparatus as shown in Figs. 8 and 9 in principle have the same advantages as obtained by means of the embodiment of the apparatus as shown in Fig. 7.

The invention has been described on the basis of apparatuses for magnetic-tape cassettes. However, the invention can also be used with apparatuses for other cassettes, for example cassettes accommodating an optically or magnetically scanned disc-shaped record carrier. Moreover, the invention can be used with apparatuses comprising an actuating device of different construction, for example with apparatuses as disclosed in EP 0,438,144 A2 or in EP 0,248,908 A1.

CLAIMS:

1. A recording and/or reproducing apparatus (1) for a cassette (2) accommodating a record carrier (13) and comprising a rectangular housing (3) having an upper wall (4), a lower wall (5) and four side walls (6, 7, 8, 9), at least one (6) of said side walls having at least one access opening (10, 11, 12), and a shutter (14) for closing the access opening (10, 11, 12), which shutter is movable between a closed position and an open position, which apparatus comprises a cassette holder (20) adapted to receive a cassette (2) and an actuating device (26) adapted to move the shutter (14) of the cassette (2) held by the cassette holder (20), which actuating device comprises a movable carrying member (28) and an actuating pin (29) which projects from the carrying member (26) in a projection direction, which is engageable with the shutter (14) of the cassette (2), and which controls the movement of the shutter (14) during a relative movement between the actuating pin and the shutter in a direction transverse to the projection direction of said pin, characterised in that the actuating pin (29) has at least one stepped portion (36, 37; 42) which extends substantially transversely of the projection direction of said pin and, when the shutter (14) has been moved to its open position by the actuating pin (29), a portion (15) of said shutter engages behind the stepped portion (36, 37; 42) of the actuating pin (29) and positively blocks a movement of the actuating pin parallel to the projection direction of said pin.
2. An apparatus as claimed in Claim 1, in which the actuating pin (29) is cylindrical, characterised in that the stepped portion (36, 37) is constituted by an axial bounding surface of a recess (38) formed in the cylindrical actuating pin (29). (Fig. 7)