

Switching device ¹ *for auto reverse mode* in a magnetic tape apparatus ~~for auto reverse operation~~.

The invention relates to a switching device in a magnetic-tape apparatus for the auto-reverse operation, comprising a drive mechanism which is pivotable between two turntables to drive a first turntable in a first position and a second turntable in a second position, which pivotal drive mechanism, when it is pivoted between the first and the second position in the case of a reversal of the direction of tape transport, actuates a change-over device for pressure rollers which device by means of a slide lifts a first or a second pressure roller carried by a lever off an associated capstan against spring force.

A magnetic-tape apparatus of the type defined in the opening paragraph is described in EP-A-47 552. This known magnetic-tape apparatus of the auto-reverse type comprises a pivotal drive mechanism for switching the drive from one turntable of the apparatus to the other turntable, for example, when at the end of the tape. Simultaneously with the change-over of the drive from one turntable to the other the pressure rollers must be switched over in such a way that a pressure roller which is initially positioned against one capstan is lifted off this capstan and that another pressure roller is applied to another capstan. During the change-over from one turntable to the other turntable the pivotal drive mechanism can only deliver the power needed for the change-over of the pressure rollers in a specific central change-over range. This is because the turntables should be coupled correctly and the transmission of power should not be disturbed or loaded by other parts. This means that for changing over only a comparatively small part of the pivoting range of the pivotal drive mechanism is available. This, in its turn, complicates the disengagement of the pivotal drive mechanism from the pressure rollers. Therefore, the construction of the apparatus must be very accurate and is subject to close tolerances.

It is the object of the invention to provide a switching device as defined in the opening part of Claim 1, in which the pressure rollers can be actuated over the entire pivoting range of the pivotal drive mechanism but which enables the change-over of the pressure rollers to be completed by means of parts which are independent of the

pivotal drive mechanism.

According to the invention said object is achieved in that each of the pressure-roller levers is actuated *via* a first and a second cam lever respectively, which are pivotable about a pivotal axis, and *via* the pivotal drive mechanism and the slide, and the cam levers comprise cam surfaces which are followed by the pressure-roller levers and, when the pivotal drive mechanism approaches the first or the second turntable, always one of the cam levers is pivoted further, *via* a pressure portion of the cam surface, by the spring force acting on the associated pressure-roller lever, in such a way that the slide is urged into an end position by the pressure-roller lever, in which end position the pivotal drive mechanism is disengaged from the change-over device.

This construction has the advantage that the change-over of the pressure rollers in the end range of the change-over is effected by means of the spring load of the pressure-roller levers. Since the spring load is available anyway, this means that no additional parts for the change-over in the end range are needed. Thus, the pivotal drive mechanism is only involved in changing over the pressure rollers in its central range and in fact merely initiates the change-over of the pressure rollers. Changing over is effected and completed *via* each time one pressure-roller lever and with the aid of each time one cam lever. The advantage of this construction is that in operation the pivotal drive mechanism is disengaged from the switching device, thereby enabling the pivotal drive mechanism to cooperate with the turntables only.

In a further embodiment of the invention the cam lever comprises a pin which interlocks with the slide, so that the cam lever is actuated by movements of the slide, or the slide is actuated by movements of one of the pressure-roller levers *via* the associated cam lever. This means that the switching movement of the pressure rollers or the pressure-roller levers is always initiated by the slide and is subsequently taken over by the pressure-roller levers.

In a further embodiment of the invention the cam surface comprises a sliding portion which is concentric with the pivotal axis and which adjoins the pressure portion, which is spaced at a smaller distance from the pivotal axis. These two different portions of the cam surface are necessary because always one of the pressure rollers is applied to a capstan and the other pressure roller must be lifted. The pressure roller which is lifted from its associated capstan is always kept in its lifted position *via* the sliding portion. The other pressure roller ensures that, *via* the pressure portion, the cam

lever moves the slide into one of the end positions.

In a further embodiment of the invention the slide comprises a fork and during actuation the fork tines are coupled to the pivotal drive mechanism until one of the pressure-roller levers begins to urge the slide towards one of its end positions in which the slide is disengaged from the pivotal drive mechanism. Thus, the pivotal drive
5 mechanism always acts on the slide *via* one of the fork tines to move said slide in the desired switching direction. Since the further slide movement is taken over by a cam lever the pivotal drive mechanism is then brought out of engagement with the fork tines.

In a further embodiment of the invention the slide comprises two slide
10 sections which are movable relative to one another, a first slide section being adapted to cooperate with one pressure roller lever and a second slide section being adapted to cooperate with the other pressure roller lever, the first slide section is provided with a first armature plate and the second slide section with a second armature plate, and the slide sections are moved alternately into end positions by the pivotal drive mechanism,
15 in which end positions the pressure rollers are disengaged from the associated capstans and in which the armature plates and hence the slide sections are retained electromagnetically. Once the two slide sections have been moved to their end positions the two pressure rollers can be lifted. In this way fast winding is possible. This can be achieved, for example, in that the electromagnet is a pulling magnet and is capable of
20 attracting the armature plates to move the slide sections relative to one another.

In a modification of this embodiment the armature plates are retained by means of an electromagnet device comprising magnet coils and coil formers, the coil former being traversed by limbs of two U-shaped iron yokes, which limbs are magnetically isolated from one another and whose free ends function as polepieces, the
25 iron yokes being arranged opposite one another in such a way that each time two polepieces are situated at the location of the two axial coil ends to cooperate with the first and the second armature plate respectively. This embodiment requires only one electromagnet to influence both armature plates and to move them in opposite directions. Such an arrangement provides a substantial saving of energy.

In a further embodiment of the invention the limbs of the iron yokes extend parallel to the slide sections. This results in a very efficient movement of the
30 slide sections.

For lifting both pressure rollers, in a further embodiment of the invention,

alternately one of the pressure rollers is lifted by one of the cam levers and the other pressure roller is lifted by one of the slide sections. Thus, in the final stages of the movement a combination is obtained between a purely mechanical change-over of the pressure-rollers and an electromagnetic disengagement of the pressure rollers.

- 5 Moreover, this embodiment enables the electromagnet to be constructed as a holding magnet, which reduces the current consumption and makes the magnet arrangement cheaper.

In a further embodiment of the invention the slide and the slide sections are movable parallel to one another and are moved together by the pivotal drive
10 mechanism *via* an actuating lever. Such a construction saves space, depending on whether this space is needed in the plane or in the depth or is to be saved.

The invention will now be described in more detail reference to the drawings. In the drawings:

- Fig. 1 shows a switching device in a magnetic tape apparatus of the auto-
15 reverse type, comprising a drive mechanism which is pivotable between two turntables and a change-over device for pressure rollers which are engageable with capstans,

Fig. 2 shows a part of the change-over device of Fig. 1 to an enlarged scale,

- Fig. 3 shows the switching device during change-over of the pivotal drive
20 mechanism,

Fig. 4 shows the change-over device in an end position situated opposite the end position shown in Fig. 1, and

Fig. 5 shows the lower part of Fig. 1, both pressure rollers being lifted off the capstans.

- 25 Figs. 1, 3 and 4 diagrammatically show a turntable drive 3 of a magnetic tap apparatus. The turntable drive 3 comprises a reversible motor 4, which drives a reduction gear wheel 6 *via* a worm shaft 5. The reduction gear wheel 6 is mesh with a central gear wheel 7. A pivotal drive mechanism 9 is pivotable about the central shaft 8 of the central gear wheel 7 and comprises a pivotal arm 10 and a transmission gear wheel 11 mounted for rotation on said arm. The transmission gear wheel 11 can
30 transmit rotations of the central gear wheel 7 to a first turntable wheel 12 or a second turntable wheel 13. For this purpose the transmission gear wheel 11 is movable in the directions indicated by a double arrow 14. The pivotal arm 10 is articulated to an

actuating lever 16 via an articulation 15 and can pivot about a fulcrum 17.

5 A change-over device 18a comprises a slide 18 and fork tines 19 between which a coupling portion 20 of the actuating lever 16 engages. The slide has slots 21 which extend perpendicularly to the direction of movement of the slide 18 as indicated by the double arrow 22. The slots 21 are engaged by pins 23 of cam levers 24, which are pivotable about cam-lever pivots 25. Instead of slots 21 and pins 23 it is possible to use interengaging coupling elements of a different type, for example gear racks and gear segments. The cam levers 24 comprise a sliding portion 26 and a pressure portion 27, the pressure portion being situated at a smaller distance from the axis 28 of the cam-lever pivot 25.

10 The magnetic-tape apparatus comprises capstans 30, 31 by means of which a magnetic tape, not shown, can be moved past a magnetic head, not shown, when the pressure rollers 32, 33 are applied. The pressure rollers 32, 33 are mounted for rotation on pressure-roller levers 34, 35. The pressure-roller levers themselves are pivotable about fulcrums 36, 37, and tension springs 38, 39 tend to urge the pressure rollers 32, 33 against the associated capstans 30, 31. Each pressure-roller lever 34, 35 carries an arm 40, 41 with a follower 42, 43 to follow the cam surfaces formed by the sliding portions 26 and the pressure portions 27.

20 The arms 40 and 41 comprise actuating limbs 44, 45 which are adapted to cooperate with pins 46, 47 of a combined slide 48. The combined slide 48 comprises two slide sections 49, 50. The pin 46 forms part of the slide section 49 and the pin 47 forms part of the slide section 50. The slide section 49 has a stop 51 and the slide section 50 has a stop 52. Both slide sections 49 and 50 are guided in a common slide guide 53 and extend towards an electromagnet device 54. Near the electromagnet device 25 54 the slide section 49 carries an armature plate 55 and the slide section 50 carries an armature plate 56. The electromagnet device 54 carries a magnet coil 57 in a coil former 54a. The magnet coil 57 is traversed by limbs 58a of a U-shaped iron yoke 58, which limbs are magnetically isolated from one another. The iron yokes 58 are arranged opposite one another in such a way that two pole pieces 58b are situated at the location 30 of both axial coil ends 57a to cooperate with the armature plates 55 and 56 respectively. The limbs 58a, which extend through the coil 57, and the outer limbs 58c of the iron yoke 58 extend parallel to the slide sections 49, 50. The electromagnet device 54 is described comprehensively in DE-A-37 14 704 (PHD 87-084, filed on 2 May 1987).

The polepiece pairs 58 cooperate with the armature plates 55, 56. The two slide sections 49, 50 are movable parallel to the sliding direction 22 of the slide 18 in the direction indicated by a double arrow 59a.

5 It is to be noted that the total pivoting range of the pivotal drive mechanism 9, as is indicated by an arrow 14, is bounded by end positions 59. Between these end positions 59 there is a range indicated by a double arrow 60, in which range the pivotal drive mechanism is changed over by mechanical coupling either *via* friction or non-positively *via* a toothed wheel. In the end ranges 61 the non-positive movement ceases and the transmission wheel 11 is pivoted by means of the slide 18 in a manner to
10 be described hereinafter.

It is assumed that in the situation shown in Fig. 1 the transmission wheel 11 has been pivoted towards the turntable wheel 12. This pivotal movement is obtained in that by means of the central toothed wheel 7 the transmission wheel 11 is moved towards the turntable wheel 12 within the pivotal range 60 until the line 62 bounding
15 this range 60 is reached. The direction of the pivotal movement depends on the direction of rotation of the motor. During this pivotal movement the coupling portion 20 abuts against the right-hand fork tine 19, thereby moving the slide 18 to the right. Before the line 62 is reached the follower 62 has already moved from the sliding portion 26 onto the pressure portion 27 of the cam lever 24. This is because the slide 18
20 moves the pin 23 to the right in the slot 21 and the follower 42, which previously followed the sliding portion 26, has now run onto the pressure portion 27 *via* a transition 63 (Fig. 2). The tension spring 38, which urges the follower 42 against the pressure portion 27, then exerts such a pressure on the cam lever 24 that it is pivoted anti-clockwise. This anti-clockwise pivotal movement of the cam lever 24 produced by
25 the tension spring 38 ensures that the pin 23 of the cam lever 24 moves the slide 18 further to the right *via* the slot 21 until the transmission wheel 11 has reached the end position 59 in a friction-dependent manner and the central toothed wheel 7 thus drives the turntable wheel 12.

Since the slide 18 is moved from the end of the pivotal range 60 into one
30 of its two end positions by the tension springs 38 and 39 *via* the cam lever 24 without intervention of the drive mechanism, the pivotal drive mechanism 9 is not coupled to the change-over device 18a if one of the pressure rollers 32, 33 is in engagement with the associated capstan 30, 31. Thus, in the playing modes the pivotal drive mechanism

is completely disengaged from and not loaded by the change-over device 18a.

Fig. 2 shows to an enlarged scale how the cam levers 24 cooperate with the slide 18 and the follower 42 of the arm 40. At the rear of the slide 18 the pin 23, which extends through the slot 21, is secured to a cam portion 23a which forms part of the cam lever 24, with which it is pivotable about the axis 28.

Fig. 3 shows how after a reversal of the direction of rotation of the motor 4 the central gear wheel 7 has disengaged the transmission wheel 11 from the turntable wheel 12 and has moved it towards the other turntable wheel 13, the pivotal arm 10 being pivoted anti-clockwise. At the same time the pivotal arm 10 has pivoted the actuating lever 16 about the fulcrum 17 and the coupling portion 20 has abutted against the left-hand fork tine 19. The actuating lever 16 then moves the slide 18 to the left in the direction indicated by an arrow 65. This movement to the left of the slide 18 results in the follower 42 of the arm 40 moving over the pressure portion 27 towards the transition 63. Since the pivotal range of the pivotal arm 10 is situated within the non-positive coupling range of the central toothed wheel 7, the follower 32 overcomes the apparent inclination on the left-hand cam lever 24, opposed by the force of the tension spring 38. At the right-hand cam lever 24 the follower 43 has just reached the transition 63 and is about to run onto the pressure portion 27. When the pressure portion 27 is reached the pivotal drive mechanism with the pivotal arm 10 will shortly afterwards reach the end of the range of non-positive coupling indicated by the line 62. When the non-positive coupling between the central gear wheel 7 and the transmission gear wheel 11 has ceased, the tension spring 39 provides the continued pivotal movement of the pivotal arm 10 to the right, in that the follower 43 moves the slide 18 further to the left via the right-hand cam lever 24 until its end position 18a is reached, in which the transmission wheel 11 has reached the turntable wheel 13, to establish the non-positive coupling between the central toothed wheel 7 and the turntable 13 via the intermediate toothed wheel 11.

This end position is shown in Fig. 4. However, to illustrate the cooperation between the pressure rollers 32, 33 and the capstans 30, 31 reference is made to Fig. 3.

In Fig. 1 the pressure roller 32 is in engagement with the capstan 30 and the pressure roller 33 is disengaged from the capstan 31. Since the follower 42 has run onto the pressure portion 27 of the left-hand cam lever 24 towards the transition 63, the

arm 40 tends to lift the pressure roller 32 off the capstan 30. In the situation illustrated in Fig. 3 the pressure roller 32 is still in engagement with the associated capstan 30.

In the situation shown in Fig. 4 the pivotal arm 10 has reached its right-hand end position, indicated by the line 59. In this end position 59 the clearance of the coupling portion 20 of the actuating lever 16 relative to the fork tines 19 corresponds to the range 61. Under the influence of the tension spring 39 the arm 41 has pivoted the right-hand cam lever 24 so far clockwise *via* the follower 43 that the arm 41 is now situated closer to the cam-lever pivot. As a result of this, the spring 39 has applied the pressure roller 33 to the capstan 31 *via* the pressure-roller lever 35, which is pivoted clockwise. Now playing in the opposite direction can begin, because the capstan 31 and the pressure roller 33 can move the tape past the magnetic head, not shown, in a direction opposite to that illustrated in Fig. 1. In the position shown in Fig. 4 the pressure roller 32 is disengaged from the capstan 30.

Figs. 1 and 4 show the slide sections 49, 50 and the electromagnet devices 54 below the slide 18. In principle, the switching device cooperates with the electromagnet device 54 without the additional slide sections 49, 50. However, it is alternatively possible to dispense with the slide 18 with the cam levers 24 and to use only the slide sections 49, 50 and the electromagnet device 54.

In the case that the slide 18 is dispensed with it is assumed that the electromagnet device is constructed in such a way that it is capable of attracting the armature plates 55, 56 over a distance corresponding to the end ranges 61. When it is assumed that the pressure roller 32 has been applied to the capstan 30, the arm 40 will have moved the slide section 40 so far to the right *via* the actuating limb 44 and the pin 46 that the armature plate 56 is situated far enough from the polepieces 58. The slide section 49 then cannot be moved to the left in the lifting direction by magnetic force alone. However, for the slide section 50 and the armature plate 56 the situation is different. The actuating lever 16 has moved the slide section 50 to the left *via* the stop 52 into the end range 62 of the coupled pivotal drive mechanism 9. As a result of this, the distance between the armature plate 56 and the associated polepieces 58b has decreased so far that the armature plate 56 can now be attracted, and the slide section 50 has electromagnetically traversed the end range 61. The pin 47 has then withdrawn the pressure roller 33 from the capstan 31 *via* the actuating limb 45 and the arm 41.

Fig. 4 illustrates the opposite position. The slide section 50 has been

moved so far to the left by the actuating limb 45 with the aid of the tension spring 39, that the attractive force of the polepieces 58b is no longer adequate to attract the armature plate 56. However, since the actuating lever 16 has abutted against the stop 51 it has moved the slide section 49 so far to the left that the armature plate 55 is now
5 situated close enough to the associated polepieces 58b for said plate to be magnetically attracted against the right-hand polepieces 58b. The pin 46 has then lifted the pressure roller 32 off the capstan 30 *via* the actuating limb 44.

If the switching device is employed in a deck of a car radio its heat dissipation must be minimal. In the switching device the heat dissipation can be reduced
10 if the electromagnet device 54 is constructed as a holding magnet device. This means that the device is not actively involved in the actuation; in conjunction with the change-over device 18a with the slide 18 this additional device, comprising the slide sections 49, 50 and the electromagnet device 54, can then be used for lifting the two pressure rollers 32, 33 off the associated capstans 30 and 31. For this reference is made to Fig.
15 4, in which the pressure roller 32 is lifted and the armature plate 55 is positioned against the associated polepieces 58b. If the magnet coil 57 is energised at this instant, the armature plate 55 will stick to the polepieces 58b and the pin 46 will subsequently urge the pressure roller 32 away from the capstan 30 *via* the actuating limb 44.

If the pivotal arm 10 now pivots the transmission wheel 11 clockwise
20 towards the turntable wheel 12 as a result of a reversal of the direction of rotation of the motor 4, the actuating lever 16 will be urged against the stop 52, as can be seen in Fig. 1, so that the slide section 50 is moved to the right and the armature plate 56 comes closer to the associated polepieces 58b. When it is close enough the armature plate 56 is positioned against the polepieces 58b, covering a distance 61, and the
25 pressure roller 33 is lifted off the associated capstan 31 by the pin 47 *via* the actuating limb 45. This means that both pressure rollers 32, 33 are now clear of their associated capstans 30, 31. This enables, for example, fast winding. This position is illustrated in Fig. 5.

CLAIMS:

1. A switching device in a magnetic-tape apparatus for the auto-reverse operation, comprising a drive mechanism (9) which is pivotable between two turntables (12, 13) to drive a first turntable (12) in a first position and a second turntable (13) in a second position, which pivotal drive mechanism, when it is pivoted between the first
5 and the second position in the case of a reversal of the direction of tape transport, actuates a change-over device (18a) for pressure rollers (32, 33,) which device by means of a slide (18) lifts a first or a second pressure roller (32, 33) carried by a lever (34, 35) off an associated capstan (30, 31) against spring force,
characterised in that each of the pressure-roller levers (34, 35) is actuated *via* a first and
10 a second cam lever (24) respectively, which are pivotable about a pivotal axis (28), and *via* the pivotal drive mechanism (9) and the slide (18), and the cam levers (24) comprise cam surfaces (26, 27) which are followed by the pressure-roller levers (34, 35) and, when the pivotal drive mechanism (9) approaches the first or the second turntable (12, 13), always one of the cam levers (24) is pivoted further, *via* a pressure portion of the
15 cam surface, by the spring force acting on the associated pressure-roller lever (34, 35), in such a way that the slide (18) is urged into an end position (59) by the pressure-roller lever (34, 35), in which end position the pivotal drive mechanism (9) is disengaged from the change-over device (18a).
2. A switching device as claimed in Claim 1, characterised in that the cam
20 lever (25) comprises a pin (23) which interlocks with the slide (18), so that the cam lever (24) is actuated by movements of the slide (18), or the slide is actuated by movements of one of the pressure-roller levers (34, 35) *via* the associated cam lever.
3. A switching device as claimed in Claim 2, characterised in that the cam
25 surface comprises a sliding portion (26) which is concentric with the pivotal axis (28) and which adjoins the pressure portion (27), which is spaced at a smaller distance from the pivotal axis (28).
4. A switching device as claimed in any one of the Claims 1 to 3,
characterised in that the slide (18) comprises a fork and during actuation the fork tines



(19) are coupled to the pivotal drive mechanism (9) until one of the pressure-roller levers (34, 35) begins to urge the slide (18) towards one of its end positions in which the slide (18) is disengaged from the pivotal drive mechanism (9).

5. A switching device in a magnetic-tape apparatus for the auto-reverse operation, comprising a drive mechanism (9) which is pivotable between two turntables (12, 13) to drive a first turntable (12) in a first position and a second turntable (13) in a second position, which pivotal drive mechanism when it is pivoted between the first and the second position in the case of a reversal of the direction of tape transport actuates a change-over device (18a) for pressure rollers (32, 33), which device by means of a slide (18) alternately lifts a first or a second pressure roller (32, 33) carried by a lever (34, 35) off an associated capstan (30, 31) against spring force,
10 characterised in that the slide (48) comprises two slide sections (49, 50) which are movable relative to one another, a first slide section (49) being adapted to cooperate with one pressure roller lever (34) and a second slide section (50) being adapted to
15 cooperate with the other pressure roller lever (35), the first slide section (49) is provided with a first armature plate (55) and the second slide section (50) with a second armature plate (56), and the slide sections (49, 50) are moved alternately into end positions by the pivotal drive mechanism (9), in which end positions the pressure rollers (32, 33) are disengaged from the associated capstans (30, 31) and in which the armature
20 plates (55, 56) and hence the slide sections (49, 50) are retained electromagnetically.

6. A switching device as claimed in Claim 5, characterised in that the armature plates (55, 56) are retained by means of an electromagnet device (54) comprising magnet coils (57) and coil formers (54a), the coil former (54a) being traversed by limbs (58a) of two U-shaped iron yokes (58), which limbs are magnetically
25 isolated from one another and whose free ends function as polepieces (58b), the iron yokes being arranged opposite one another in such a way that each time two polepieces (58a) are situated at the location of the two axial coil ends (57a) to cooperate with the first and the second armature plate respectively.

7. A switching device as claimed in Claim 6, characterised in that the limbs (58a) of the iron yokes (58) extend parallel to the slide sections (49, 50).
30

8. A switching device as claimed in Claims 1 and 5, characterised in that for lifting both pressure rollers (32, 33) alternately one of the pressure rollers (32, 33) is lifted by one of the cam levers (24) and the other pressure roller (32, 33) is lifted by



one of the slide sections (49, 50).

9. A switching device as claimed in Claim 8, characterised in that the slide (18) and the slide sections (49, 50) are movable parallel to one another and are moved together by the pivotal drive mechanism (9) *via* an actuating lever (16).



* C L M S *