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"Magnetic-tape cassette having a cleaning element for cleaning the capstan of a magnetic-tape cassette apparatus."

The invention relates to a magnetic-tape cassette having a cleaning element for cleaning the capstan of a magnetic-tape cassette apparatus, i.e., an apparatus for recording and/or playing back signals to and/or from a magnetic tape contained in a cassette, the cassette comprising a housing having two substantially parallel major walls and containing a magnetic tape which is wound on spools in the housing and which has a straight portion extending in a plane substantially perpendicular to the planes of said major walls for cooperation with parts of the apparatus including the capstan when the cassette is mounted on the cassette apparatus, and the cleaning element being situated in the housing and comprising a wiper with a wiping edge for engaging the cylindrical surface of the capstan along an area extending longitudinally of said surface when the cassette is mounted on the apparatus.

Such a cassette is disclosed in British Patent Specification 2,103,180 A. In this known cassette a cleaning element is fixed an an area remote from its wiping edge to a wall of the cassette housing. It has been found that under certain conditions this construction can give rise to vibrations in the cleaning element, which may prevent a satisfactory engagement of the cleaning element with the capstan during operation. Moreover, the cleaning element of this known cassette is arranged so that the wiping edge of the cleaning element presses against the cylindrical surface of the capstan in a substantially tangential direction, which can give rise to stick-slip effects during operation. Under certain conditions these vibrations and stick-slip effects may adversely affect the cleaning action of the cleaning element.

It is an object of the present invention to provide a magnetic-tape cassette in which these effects

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are mitigated.

According to the invention there is provided a magnetic-tape cassette having a cleaning element for cleaning a capstan of a magnetic-tape cassette apparatus, the cassette comprising a housing having two substantially parallel major walls and containing a magnetic tape which is wound on spools in the housing and which has a straight portion extending in a plane substantially perpendicular to the planes of said major walls for cooperation with parts of the apparatus including the capstan when the cassette is mounted on the cassette apparatus, and the cleaning element being situated in the housing and comprising a wiper with a wiping edge for engaging the cylindrical surface of the capstan along an area extending longitudinally of said surface when the cassette is mounted on the apparatus, wherein the cleaning element is arranged to engage the capstan with said wiping edge at the opposite side of the capstan from that at which the tape engages the capstan when being driven thereby, and wherein the cleaning element is slidably guided between two guide surfaces in the housing so as to be movable in a direction substantially perpendicular to the plane of said straight portion of the tape, and spring means are provided for pressing the cleaning element against the capstan, the cleaning element being so disposed in the housing that the pressure of the wiping edge on the cylindrical surface of the capstan will be directed substantially radially of this surface.

In this cassette, forces exerted on the cleaning element by the capstan can be transmitted effectively to the cassette housing to be absorbed thereby and thus preclude vibration of the cleaning element due to such forces. Also, stick-slip effects are avoided due to the radial direction of the pressure exerted on the capstan by the cleaning element under the influence of the spring means. In addition, the spring means ensure that the wiping edge of the cleaning element will correctly engage, and therefore correctly clean, capstans of different diameters in

various types of magnetic-tape cassette equipment.

If the cassette is intended for use as a reversible cassette it will have two of the above cleaning elements arranged so that either of them can engage the capstan of a cassette apparatus depending upon which side of the cassette is placed against the apparatus.

Due to the guidance of the, or each, cleaning element in a direction perpendicular to the plane of the straight portion of the magnetic tape, the wiping edge of the cleaning element will engage the cylindrical surface of the capstan at a location diametrically opposite that at which the capstan is engaged by this portion of the tape. Thus, the wiping edge is situated at the maximum possible distance from the tape. This has a particular advantage in a reversible cassette since it will allow a magnetic head of a cassette apparatus to enter the cassette housing to cooperate with the tape in the region of the inoperative cleaning element without being obstructed by this element.

In a preferred embodiment of the invention the cleaning element has two elastic limbs which constitute said spring means, the limbs extending in opposite directions substantially perpendicularly to the direction in which the cleaning element is guided by said guide surfaces and parallel with the planes of the major walls of the cassette housing and being slidably guided at their free ends by guide portions which are connected to the housing and which allow movement of the free ends of the limbs in the longitudinal direction. The limbs may be moulded integrally with the remainder of the cleaning element from a plastics material.

Preferably, the cleaning element is arranged symmetrically relative to a plane which is parallel to the planes of the major walls of the cassette housing and is situated at equal distances from these walls, the wiping edge of the cleaning element extending perpendicularly to the planes of said walls, and the dimension of said limbs in a direction perpendicular to the planes of said walls is smaller than the length of the wiping edge. This allows the limbs to twist slightly so that the cleaning element

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can perform a tilting movement about an axis parallel to the plane of the straight portion of the tape and the planes of the major walls of the cassette housing, which allows the cleaning element to assume a correct position relative to the capstan when the cassette is placed on a cassette apparatus.

The cleaning element may be formed at each end of its wiping edge with a surface which is inclined with respect to the planes of said walls of the cassette housing and the plane of said straight portion of the tape. When the cassette is placed on a cassette apparatus, one of these inclined surfaces engages the free end of the capstan and the resulting interaction between the capstan and the inclined surface displaces the cleaning element against the resistance of its elastic limbs or other spring means to permit a smooth engagement of the wiping edge of the cleaning element with the cylindrical surface of the capstan.

The wiping edge of the cleaning element may have a V-shaped cross-section, and the cleaning element may have flat surfaces extending along both sides of the wiping edge and adjoining the sides of this edge for collecting dirt removed from a capstan by the wiping edge.

Two embodiments of the invention will now be described in more detail, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a diagrammatic plan view of the interior of a magnetic-tape cassette in accordance with the invention;

Fig. 2 is a view, on an enlarged scale, of a cleaning element and part of the housing of the cassette shown in Fig. 1;

Fig. 3 is a perspective view of the cleaning element shown in Fig. 2, and

Fig. 4 is a view similar to Fig. 2 showing a cleaning element with an alternative form of spring means.

The magnetic-tape cassette shown in Fig. 1 comprises a housing 1 having two major walls 2 which extend

substantially parallel to each other in parallel planes and have substantially rectangular peripheries. The housing 1 also has a plurality of peripheral walls extending between the major walls and including substantially parallel side walls 3 and 4, a rear wall 5 and a front wall 6. Inside the housing 1 are two rotatable tape spools 7 on which is wound a magnetic tape 8. Near the front corners of the housing the magnetic tape 8 is guided round two guide rollers 9 so that a portion 8a of the magnetic tape extends along a straight path adjacent the front wall 6 of the housing in a direction substantially parallel to this wall and in a plane perpendicular to the planes of the major walls 2. The front wall 6 is formed with openings (not shown) through which parts of a magnetic-tape cassette apparatus, for example, magnetic heads, can enter the cassette housing to co-operate with the portion 8a of the magnetic tape. Situated behind the front wall 6 at a short distance therefrom is a partition 10 which inhibits the entry of dust and dirt through the openings in the front wall 6 into the interior of the cassette housing.

Each of the major walls 2 of the cassette housing is formed with two substantially circular openings 11 to permit the capstan or capstans of the magnetic-tape cassette apparatus to enter the housing to cooperate with the portion 8a of the tape 8. The openings 11 in each major wall are arranged coaxially with the openings in the other major wall and are disposed symmetrically relative to a plane a which is perpendicular to the planes of the major walls 2 and parallel to the side walls 3 and 4 and which lies midway between the side walls 3 and 4. Other parts of the cassette housing, including the partition 10, are also situated symmetrically relative to the plane a. This enables the cassette 1 to be placed on the magnetic-tape cassette apparatus with either of the two major walls 2 of the cassette housing facing the apparatus, so that the cassette is suitable for use as a reversible cassette. As shown in Figs. 1 and 2, adjacent each pair of coaxial openings 11 the partition 10 is provided with a pair of

part-cylindrical concave surfaces 12 and 13 which curve around the axis of the respective pair of coaxial openings 11, as shown in Fig. 2. Adjoining each pair of surfaces 12 and 13 is a pair of opposing flat guide surfaces 14 and 15 which bound an opening in the partition 10. The guide surfaces 14 and 15 lie in planes which are substantially perpendicular to the planes of the major walls 2 of the housing 1 and to the plane of the portion 8a of the tape 8. Slidably guided between each pair of opposing surfaces 14 and 15 so as to be movable substantially perpendicularly to the plane of the portion 8a of the tape is a cleaning element 16 which is shown in more detail in Fig. 3 and which comprises a wiper with a wiping edge 17 which extends perpendicularly to the planes of the major walls 2 of the housing 1. As shown in Fig. 2, the wiping edge 17 has a V-shaped cross-section, preferably with an apical angle of 70° to 90°. At its upper and lower ends the wiping edge adjoins two surfaces 18 and 19 on the cleaning element 16 which are inclined with respect to the planes of the major walls 2 of the housing 1 and the plane of the portion 8a of the tape 8 and which serve to facilitate the engagement of the cleaning element 16 with the capstan of the cassette apparatus when the cassette is being placed in position on the apparatus. Extending along both sides of the wiping edge 17 of each cleaning element 16 are flat surfaces 20 and 21 which adjoin the sides of the wiping edge and which preferably lie in a plane substantially parallel with the plane of the portion 8a of the tape 8. At the side remote from its wiping edge 17 each cleaning element 16 comprises two strip-shaped elastic limbs 22 and 23 of substantially equal length, which limbs form blade springs for urging the cleaning element towards the front wall 6 of the cassette housing, the movement of the cleaning element in this direction being limited by the limbs 22 and 23 abutting the partition 10, as shown in Fig. 2. In this way the limbs 22 and 23 ensure that the wiping edge 17 is pressed against the capstan when the cassette is in use. In the position shown in Fig. 2 the

limbs 22 and 23, which are integral with the body of the cleaning element and may be made of a plastics material, preferably polyacetal, extend substantially perpendicularly to the planes containing the respective guide surfaces 14 and 15. The limbs are reduced in thickness slightly towards their free ends to obtain the necessary elasticity. Near their free ends the limbs 22 and 23 bear slidably against guide portions 24 and 25 which form parts of the partition 10, and which allow movement of the free ends of the limbs in the longitudinal direction. As can be seen in Fig. 3, the width of the limbs 22 and 23 is smaller than the length of the wiping edge 17. In the present embodiment the limbs have a width which is about 40% of the length of the wiping edge 17. Moreover, the cleaning element is arranged symmetrically between the two major walls 2 relative to a plane which is parallel to the planes of the major walls and is situated at equal distances from these walls, the intersection of this plane with the limbs being indicated by the broken line 26 in Fig. 3.

The operation of the cleaning element 16 is as follows. If the cassette is intended for use as a reversible cassette, when the cassette is placed in position on a magnetic-tape cassette apparatus the capstan of the apparatus enters the cassette housing through one of the openings 11 in the major wall of the housing which faces the apparatus. In the case of an auto-reverse apparatus the two capstans of the apparatus enter the cassette housing through the two openings 11 in the relevant major wall, as shown in Fig. 1. As the capstans enter the cassette housing their upper ends cooperate with the lower inclined surfaces 19 of the cleaning elements and displace these elements rearwardly against the resilience of the limbs 22 and 23 of the cleaning elements to allow the wiping edges 17 of these elements to engage the cylindrical surfaces of the capstans. If the cassette apparatus has a pivotable cassette holder, as the cassette is swung down onto the apparatus the limbs 22 and 23, due to their small width in relation to the length of the wiping edges 17 of

the cleaning elements, can also twist to allow the cleaning elements to tilt about an axis parallel with the longitudinal direction of the portion 8a of the tape 8 as they slide down the capstans. By means of the guide surfaces 14 and 15, the cleaning elements 16 are maintained in positions such that the median plane b of the wiping edge 17 of each cleaning element, i.e. the plane which bisects the apical angle of the wiping edge, is perpendicular to the plane of the portion 8a of the tape 8 and coincides with the axis of the associated pair of openings 11 in the major walls 2 of the cassette housing. Consequently, when the cassette is in position on the cassette apparatus, since the capstans extend concentrically through the relevant openings 11 and perpendicularly to the major walls of the cassette housing, the median planes of the wiping edges 17 will also coincide with the axes of the capstans. As a result of this, the pressure of each wiping edge on the cylindrical surface of the respective capstan will always be directed substantially radially of this surface. The guidance of the cleaning elements 16 by the guide surfaces 14 and 15 also allows each cleaning element to adapt itself to the diameter of the capstan. The broken circles 27 and 28 in Fig. 2 represent capstans having the largest and smallest conventional diameters respectively. Thus, when the cassette is in position on the cassette apparatus, the apex of the wiping edge 17 of each cleaning element will be situated somewhere between the respective circles 27 and 28. It is also important that, due to the arrangement of the guide surfaces 14 and 15 in planes perpendicular to the plane of the portion 8a of the tape 8, the wiping edge 17 of each cleaning element engages the cylindrical surface of the respective capstan at a location diametrically opposite that at which the capstan is engaged by this portion of the tape, so that when the cassette is used on a cassette apparatus having only one capstan, the inoperative cleaning element 16 will not obstruct a magnetic head, such as an erase head, which might enter the cassette housing in the region of this

cleaning element. During operation the forces exerted on each cleaning element 16 by the respective capstan are effectively transmitted to the cassette housing via the respective guide surfaces 14 and 15 and to the cassette apparatus via the housing. This effectively precludes the occurrence of vibrations in the cleaning elements. Moreover, the occurrence of stick-slip effects is precluded by the radial position of the median plane b of each wiping edge 17 with respect to the cylindrical surface of the respective capstan. This ensures that during operation the wiping edge constantly cleans the capstan. Depending on the direction of rotation of the capstan, the dirt removed from the capstan is transferred via the wiping edge 17 to one or the other of the surfaces 20 and 21 which adjoin the wiping edge, which surfaces have an adequate capacity for collecting the dirt removed by the wiping edge. It has been found in practice that with this construction the dirt removed from the capstans during use of the cassette can be collected effectively. Excessive amounts of collected dirt can escape through the openings 11 in the major walls of the cassette housing or the openings in the front wall 6. Moreover, it has been found that by preventing dirt from building up on the capstans the cleaning elements 16 preserve the desired circular-cylindrical shape of the capstans and thus avoid a tendency for the tape to drift up or down the capstans due to the presence of dirt on the cylindrical surfaces of the capstans. Such drifting of the tape gives rise to azimuth errors of the tape transport past the magnetic head, which leads to loss of treble tones both during playback and recording. In this way, the cleaning action of the cleaning elements 16 ensures that there can be no azimuth errors due to dirt on a capstan. In practice, the conical surface which can be formed on a capstan by such dirt not only gives rise to azimuth errors but also to faults in the tape transport near the guide rollers 9 and jamming of the magnetic tape 8 on the spools 7. The tape edges may then become creased and damaged. The cleaning action of the cleaning elements 16 inhibits the

occurrence of such effects.

Fig. 4 shows a cleaning element 31 which has a wiping edge 32 and is similar to the cleaning elements 16 described above except that instead of the spring limbs 22 and 23, spring means in the form of a compression spring 30 bearing against an abutment 29 at the back of the partition 10 are provided for urging the cleaning element against the capstan when the cassette is in use.

If a cassette according to the invention is to be used as a non-reversible cassette on a cassette apparatus having a single capstan, since the capstan will always enter the cassette housing through the same hole in the relevant major wall of the housing, only one cleaning element is required. Furthermore, this element would not require an inclined surface at both ends of its wiping edge.

CLAIMS:

1. A magnetic-tape cassette having a cleaning element for cleaning a capstan of a magnetic-tape cassette apparatus, the cassette comprising a housing having two substantially parallel major walls and containing a magnetic tape which is wound on spools in the housing and which has a straight portion extending in a plane substantially perpendicular to the planes of said major walls for cooperation with parts of the apparatus including the capstan when the cassette is mounted on the cassette apparatus, and the cleaning element being situated in the housing and comprising a wiper with a wiping edge for engaging the cylindrical surface of the capstan along an area extending longitudinally of said surface when the cassette is mounted on the apparatus, wherein the cleaning element is arranged to engage the capstan with said wiping edge at the opposite side of the capstan from that at which the tape engages the capstan when being driven thereby, and wherein the cleaning element is slidably guided between two guide surfaces in the housing so as to be movable in a direction substantially perpendicular to the plane of said straight portion of the tape, and spring means are provided for pressing the cleaning element against the capstan, the cleaning element being so disposed in the housing that the pressure of the wiping edge on the cylindrical surface of the capstan will be directed substantially radially of this surface.

2. A magnetic-tape cassette as claimed in Claim 1, wherein the cleaning element has two elastic limbs which constitute said spring means, the limbs extending in opposite directions substantially perpendicularly to the direction in which the cleaning element is guided by said guide surfaces and parallel with the planes of the major walls of the cassette housing and being slidably guided at their free ends by

guide portions which are connected to the housing and which allow movement of the free ends of the limbs in the longitudinal direction.

3. A magnetic-tape cassette as claimed in Claim 2, wherein the cleaning element is arranged symmetrically relative to a plane which is parallel to the planes of the major walls of the cassette housing and is situated at equal distances from these walls, the wiping edge of the cleaning element extending perpendicularly to the planes of said walls, and wherein the dimension of said limbs in a direction perpendicular to the planes of said walls is smaller than the length of the wiping edge.

4. A magnetic-tape cassette as claimed in Claim 3, wherein the cleaning element is formed at each end of its wiping edge with a surface which is inclined with respect to the planes of said walls of the cassette housing and the plane of said straight portion of the tape.

5. A magnetic-tape cassette as claimed in Claim 1, 2, 3 or 4, wherein the wiping edge of the cleaning element has a V-shaped cross-section, and wherein the cleaning element has flat surfaces extending along both sides of the wiping edge and adjoining the sides of this edge for collecting dirt removed from a capstan by the wiping edge.

6. A magnetic-tape cassette substantially as herein described with reference to Figures 1, 2 and 3 or Figure 4 of the accompanying drawings.