

Description

This invention relates to a magnetic head unit for use in a magnetic-tape apparatus for recording and/or reproducing signals on and/or from a magnetic tape contained in a cassette which comprises a housing having an aperture in the front side, said housing further having two guide elements comprising guide surfaces and located adjacent opposite sides of the aperture, the apparatus having means for transporting the magnetic tape in a given direction past said aperture in the operation of the apparatus, the magnetic head unit comprising

- a magnetic head having a front surface, which comprises a convexly curved head face in which a head gap terminates and across which, when the head face has entered the aperture of the cassette-housing, the magnetic tape is transported in the operation of the apparatus,

- two tape guides comprising guide surfaces and disposed on opposite sides of the head gap, a plane tangential to the head face at the head gap being located forwardly with respect to a plane tangential to the guide surfaces of both tape guides,

- two height limiters each adjoining an end of the guide surface of a respective one of the tape guides and each having a height-limiting surface arranged to limit in the operation of the apparatus movement of the tape in at least one direction transverse to the direction of transport of the tape and parallel to said plane tangential to the head face,

- control means for keeping an edge of the tape constantly in contact with said height-limiting surfaces in the operation of the apparatus.

In a magnetic-tape apparatus provided with a magnetic-head unit of this kind the tape path is partly defined by elements on the apparatus and partly by tape guide elements arranged in the magnetic-tape cassette housing the tape. These tape guide elements, which are generally mass-manufactured from a plastic material, are subject to fairly large tolerances. In practice it is mainly these tolerances which give rise to so-called azimuth errors in magnetic-tape cassette apparatuses, that is errors which occur because the head-gap position deviates from a purely perpendicular position to the longitudinal edge of the magnetic tape. For example during stereo reproduction a deviation of 20 minutes may give rise to a loss of 10 dB at a frequency of 10 kHz. This is particularly undesirable when pre-recorded magnetic-tape cassettes, so-called music cassettes, are played back.

In order to solve this problem it has been proposed to utilize control systems which, for example by means of piezo-electric elements, constantly influence the position of the magnetic head so as to cancel any azimuth errors. Such control systems cause the apparatus to be very expensive and in fact do not provide a satisfactory general solution.

The article "Digital cassette and cartridge re-

corders today" of S. Davis, Computer Design, vol. 12, no. 1, January 1973, pages 59—71, Concord (USA) describes a magnetic tape apparatus provided with a magnetic-head unit of the above kind, which includes two tape guides, mounted separately at some distance from the magnetic head on the head plate on opposite sides of the head and provided with reference surfaces for holding the tape in its reference position in relation to the head. Above the tape guides control means are provided, constituted by spring loaded pressure plates, urging against the lateral edge of the tape. Although the position of the tape guides in relation to the head plate can be accurate, a special azimuth adjustment of the magnetic head is required during manufacturing of the apparatus. This adjustment is complex mechanically in view of the tolerances between the tape guides and the head plate and the magnetic head and the head plate respectively.

It is known from US—A—4.193.103 to provide the front surface of a magnetic head with two curved guide surfaces, guiding the tape at both sides of the head gap. A special pressure pad of the cassette urges the tape against the guide surfaces.

It is an object of the invention to provide a magnetic head unit which is passively capable of effectively eliminating the most frequency occurring azimuth errors in a magnetic-tape cassette apparatus and which can be mounted onto the apparatus without further adjustment.

According to the invention the two tape guides and the two height limiters are located adjacent the head face of said magnetic head unit, so as to be capable of entering the aperture of the cassette with said head face, said tape guides have convexly curved guide surfaces and are so arranged that, when entered the aperture of the cassette, the top tape guides are located between said guide elements of the cassette and said plane tangential to the guide surfaces of the tape guides lies between said plane tangential to the head face and a plane tangential to the guide surfaces of the guide elements at a position such that the tape travels along an arcuate path on the guide surfaces of the tape guides and is held taut at these guide surfaces, the magnetic head is permanently connected to said magnetic head unit, such that a plane through the head gap, which plane is perpendicular to said plane tangential to the head face, extends perpendicular to a connecting line, interconnecting the height limiting surfaces at the points adjoining the respective guide surfaces of the tape guides.

In the magnetic-head unit in accordance with the invention by means of the control means it is ensured that the lateral edge of the tape is constantly in contact with the two height limiting surfaces of the head unit, whereas the convexly curved guide surface of each tape guide of the head unit, keeping the tape taut, precludes curling of the tape edge as a result of the contact with the height limiters. As during manufacture of the magnetic head unit care is taken that the connect-

ing line between the height limiting surfaces extends perpendicularly to the plane through the head gap, a head unit with an inherently correct azimuth position is obtained. As after the adjustment the magnetic head is permanently connected to the head unit, the correct position of the head in the head unit is guaranteed. The advantage of this correct azimuth position is that during manufacture of the apparatus no further adjustment of the head unit is required. Moreover, this has the advantage that in the case of subsequent replacement of the head unit no azimuth adjustment is required, which may render such a repair substantially cheaper.

The magnetic head unit in accordance with the invention has such dimensions, that it may readily be used in cassettes of standard dimensions, such as compact cassettes, having a comparatively small aperture. The head unit corrects a tape movement between the tape guide elements, arranged in a magnetic-tape cassette, in such a way that a correct azimuth position is obtained at the location of the head gap. As a result of this the head unit in accordance with the invention may lead to an universal improvement of a magnetic-tape cassette system.

It is noted that it is known from DE-A-14 99 627 to provide a magnetic tape apparatus with two tape guides, each comprising a height limiter and a convexly curved guide surface for maintaining the tape taut at the location of the height limiter. Also these tape guides are mounted on a chassis, separate from the magnetic head, and during manufacturing of the apparatus a special azimuth adjustment of the head is necessary.

In a preferred embodiment of a magnetic-head unit in accordance with the invention the tape guides comprise cylindrical bodies which adjoin the front surface of the magnetic head and have cylinder axes substantially parallel to the axis of curvature of the head face. By means of these cylindrical bodies it is ensured that at the location of the height limiters the magnetic tape is taut, thereby precluding curling of the lateral edge of the magnetic tape and ensuring an accurate tape movement along the magnetic head.

In a further embodiment of a magnetic-head unit in accordance with the invention said bodies are integral with a portion of the magnetic head comprising the head face, and have a ground cylindrical surface having a radius of curvature less than the radius of the head face. Thus, by for example one continuous grinding operation, it is possible to obtain an accurately formed magnetic head unit suitable for use in an apparatus in accordance with the invention. This also provides the possibility of forming the tape guides by means of computer control, for which purpose the magnetic heads comprise a reference face.

In view of the foregoing a further embodiment of a magnetic head unit in accordance with the invention is characterized in that at least one of said height limiters is formed by an adjustable guide element which is axially adjustable relative

to the associated cylindrical body. In this way it is possible to ensure that the connecting line between the two height limiters extends purely perpendicularly to the plane through the head gap by adjusting the guide element.

A further preferred embodiment of a magnetic-head unit in accordance with the invention in which the apparatus has a head plate to which the head unit is to be secured, is characterized in that the magnetic head unit includes a mounting plate arranged adjacent the lower surface of the magnetic head, which surface extends substantially parallel to the direction of tape transport, by said mounting plate the magnetic head unit is capable to be secured to the head plate of the apparatus and said height limiters comprise projecting lugs formed integrally with said mounting plate. In this way the mounting plate has a double function. On the one hand it forms the height limiters and on the other hand it serves for mounting the magnetic head on the apparatus.

In yet another preferred aspect of the embodiment said adjustable guide element is formed as the end portion of a lug cut out of the mounting plate, said lug being pivotable relative to the remainder of the mounting plate for axial adjustment. This yields a simple axial adjustment of the height limiter, enabling the head gap to be adjusted to a position which is perfectly perpendicular to the connecting line in a simple yet accurate manner.

A further preferred embodiment, with two lateral members which are disposed on opposite sides of the head face in the direction of transport of the tape, end portions of said members forming the tape guide surfaces, is characterized in that said two lateral members are formed integrally with the mounting plate.

It is of advantage if said height limiters comprise hardened metal blocks disposed against one side of the lateral members. In this way the lateral members and consequently the tape guides themselves can be made of an easy-to-manufacture material, such as a plastics. Moreover, the height limiters can be made of a suitable material which is resistant to the abrasive action of the tape edge.

A further embodiment of a magnetic head unit in accordance with the invention with control means, comprising control elements, each being disposed at an end of a respective one of the guide surfaces of the tape guides, which end is remote from the respective height limiter, is characterized in that the overall height of the combination of each guide surface of said tape guides and the associated height limiter and the control element is no greater than the height of the front surface of the magnetic head so as to be capable of entering the aperture of the cassette with the head face. The advantage of this is that the magnetic head unit has such a height dimension that it may readily be used in cassettes of standard dimensions, such as Compact Cassettes. As a result of this the magnetic head unit in accordance with the invention is suitable for use

further possibility is to arrange the capstan of the apparatus, which provides the tape transport along the magnetic head, in a slightly tilted position. This may already be achieved by, for example, giving the capstan a tilt of 10 minutes. Obviously, when a plate-shaped body is arranged underneath the magnetic head 4, the relevant means should comply with the opposite requirement, namely that they tend to move the tape 8 downwards. As a result of the bent shape of the lugs 13 and 14 the contact of the tape with the lugs is minimal, so that a comparatively low wear occurs. The presence of the height limiters comprising the lugs 13 and 14 and the accurate positioning of the tape guides 9 and 10 result in a very stable movement of the tape along the magnetic head. This is of great advantage for a current contact of the magnetic tape with the magnetic heads.

By very accurately manufacturing the magnetic head unit 3 by means of computer equipment the azimuth position of the magnetic head 4 can be defined very accurately by means of the magnetic head unit. As a result of this the connecting line 16 will have the correct perpendicular position relative to the head gap 7, so that during manufacture of the apparatus no further adjustments are necessary. Moreover, this ensures that further tape guides of the apparatus or of a magnetic-tape cassette used in conjunction with the apparatus do not influence the movement of the tape along the magnetic head 4. As regards the azimuth position, this tape movement is solely determined by the position of the plugs 13 and 14. This is especially of advantage when prerecorded cassettes are used, the so-called music cassettes, in which the positioning of the tape guides in the cassette is generally subject to fairly large tolerances.

The magnetic head unit described in the foregoing further has the advantage that if after prolonged use of the apparatus the magnetic head is to be replaced the magnetic head unit can simply be replaced without any expensive adjustments. It suffices to insert the pins 5 into the sockets 2.

Figure 3 shows a second embodiment of an apparatus in accordance with the invention, in which a magnetic head unit 7 is plugged onto a head mounting plate 1 in the same way as in Figures 1 and 2. For this purpose there are again provided five pins, in a manner not shown. The magnetic head unit 17 comprises a magnetic head 18 which on both sides of a head face 19 has a slightly adapted head profile, so that space is obtained for two tape guides comprising cylindrical posts 20 and 21 whose axes extend parallel to the cylinder axis of the head face 19. At the top the post 20 adjoins a guide element and height limiter 22, which may be rigidly connected thereto. At the top the post 21 has internal screw-thread which provides axial adjustment of the guide element and height limiter 23. The height limiter 22 on the cylindrical body 20 in principle defines the track position during recording on a magnetic tape. By

means of the screw-thread the height limiter 23 is adjusted in such a way that again a connecting line between the two height limiters 22 and 23 is perfectly perpendicular to a head face 24. This construction again provides a perpendicular azimuth position. Furthermore, the present construction has the advantage that also in the case of conventional techniques, without the use of automatic computer-controlled production machines, a fixed azimuth adjustment can be obtained.

Furthermore, it is to be noted, that in this second embodiment it may be favourable to provide the magnetic head 18 with a reference face, because this enables the connecting line to be adjusted relative to the reference face.

The magnetic head unit 25 in a third embodiment of an apparatus in accordance with the invention as shown in Figures 4 and 5 comprises a magnetic head 26 arranged in an extruded casing, which casing comprises lateral members 28 and 29 arranged on opposite sides of a head face 27 of the magnetic head 26.

End portions 30 and 31 respectively of the lateral members, which end portions adjoin the head face 27, again take the form of cylindrical bodies and project from the adjacent parts of the head face 27, in the same way as in the previous embodiments, in order to obtain contact with the magnetic tape over some length (Fig. 5). In a direction transverse to the direction of transport of the magnetic tape the lateral members 28 and 29 have a height which is smaller than the height of the front surface of the magnetic head which comprises the head face 27. Thus, above and below the lateral members 28 and 29 space is available for accommodating further elements which are relevant to the invention. For example, a spring-steel plate 32 is secured to the upper surface of the magnetic head 26, for example, by gluing or welding, which plate is at least substantially U-shaped in the plan view shown in Fig. 5, the two limbs 33 and 34 of the plate 32 forming flat springs which extend from that side of the magnetic head 26 which is remote from the head face 27 up to the tape guides formed by the end portions 30 and 31. In order to obtain a suitable spring force for the springs the upper sides of the portions 30 and 31 serve as abutments for the springs 33 and 34. Thus, when lifted the springs 33 and 34 provide a force which is suitably 2 to 5 grammes. In the plan view shown in Figure 5 the flat springs 33 and 34 are provided with bent end portions 35 and 36 above the cylindrical bodies in order to obtain the correct pressure, which end portions contact the tape at the location where the magnetic tape is in contact with the end portions 30 and 31. The end portions of the spring 33 and 34 form the said control means for constantly keeping the lateral edge of the magnetic tape which is moved along the magnetic head unit in contact with the associated height limiters 37 and 38 respectively. In this respect it is of importance that the axial dimensions of the end portions 30 and 31 (designated by the reference numeral 100

in Figure 4) are such that the springs 33 and 34 constantly exert pressure on the tape edge. The height limiters and tape guide elements 37 and 38 form part of supporting plates 39 and 40, which are secured to the lateral surfaces of the lateral members 28 and 29. In the same way as in the preceding embodiments the supporting plate 39 with the height limiter 37 is first secured to the magnetic head. The height limiter 37 determines the track position on the magnetic tape. The second height limiter 38 is secured to the magnetic head 26 with the supporting plate 40 in such a way that again a connecting line between the two height limiters 36 and 38 extends perpendicularly to a plane through the head gap 41. It has been found that an accuracy of 90° plus or minus 10° is attainable. For this use may be made of a manipulator, the supporting plate 40, for example, being spot-welded to the magnetic head after the correct position has been obtained. The plate may also be secured by means of screws. It is alternatively possible to form a reference face in the magnetic head by means of computer control, so that the height limiters 37 and 38 are automatically arranged in such an accurate manner that no further adjustment is required.

In the present embodiment the cylindrical bodies 30 and 31 are again integral with the part of the magnetic head 26 which comprises the head face. The axial height of the cylindrical bodies, as already stated, is smaller than the height of the front surface of the head 26. Suitably, this axial dimension, measured between the height limiters 37 and 38 respectively and the end portions 35 and 36 respectively of the spring 33 or 34, respectively is at the most equal to the minimum width dimension of the magnetic tape. For a correct contact with the tape the cylindrical bodies 30 and 31 are preferably formed by means of a grinding operation, all the generatrices of the head face 27 and the cylindrical bodies extending accurately parallel to each other. As a result of the shape of the lateral members 28 and 29, above which the springs 33 and 34 and underneath which the height limiters 37 and 38 are disposed, a magnetic head unit construction is obtained which at the location of the lateral members has an overall height which at the most equals the height of the front surface of the magnetic head. As a result of this, the magnetic head unit in accordance with the invention is readily suitable for use in conjunction with a standard compact cassette. In the present embodiment the height limiters are arranged at the underside. Since the tracks on a compact-cassette tape are situated near the lower edge of the tape it is an advantage of this construction that an accurate track position can be obtained. It is to be noted that it is possible to arrange the head unit in accordance with the invention on a mounting plate 42 which can be secured to the head plate 1 by means of screws 43 and, if required, spacers, without the necessity of any further adjustment. This rather coarse method of fixation suffices, because the azimuth position is entirely defined by the magnetic head

unit 26. An advantage of the construction in accordance with the invention is, moreover, that in the present embodiment all provisions for obtaining the correct azimuth position are incorporated in the head unit itself. This enables head units on existing equipment to be replaced by a head unit in accordance with the invention.

Fig. 5 shows the position of the tape guides 44 which form part of a compact-cassette housing. In the operating position these tape guides are disposed on opposite sides of the head unit. The construction of the head unit in accordance with the invention eliminates or mitigates the adverse effect of these tape guides on the tape transport.

The fourth embodiment of a magnetic head unit 45 as shown in Figure 6 comprises a magnetic head 46 accommodated in an extruded casing. In the same way as in the preceding embodiment the magnetic head 46 has lateral members 47 and 48 having a height which is smaller than that of the front surface of the magnetic head 46 which includes the head face. On the upper surface of the respective lateral member 47 or 48 a flat spring 49 or 50 respectively is arranged, which spring is connected to the lateral member at the side of the magnetic head which is remote from the head face. Essentially, the shape of the free end of each spring 49 or 50 corresponds to that in the preceding embodiment. The same applies to the shape of the cylindrical bodies 51 and 52 comprising the end portions of the lateral members 47 and 48. The principal difference with the preceding embodiment is the construction of the height limiters underneath the cylindrical bodies 51 and 52. These limiters form part of a mounting plate 53 of the magnetic head 46. A lug 54 of the mounting plate 53 is situated underneath the cylindrical body 51, the lug 54 preferably extending slightly upward from the major part of the mounting plate 53, so that the end portion of the lug 54 is positioned against the underside of the lateral member 47. The lug 54 constitutes a guide element or height limiter which defines the track position on the magnetic tape. The mounting plate 53 further comprises a cut-out lug 55, which also extends upward from the major part of the plate 53 towards the cylindrical body 52, the lug 55 being cut out of the mounting plate 53 in such a way that it is pivotable relative to the major part of the mounting plate. A set-screw 56 extends through the lug 55, one end of the screw bearing against the underside of the lateral member 48. In this way the free end of the lug 55, which forms a height limiter or guide element, is adjustable by screws in the height direction. This adjustment is effected, as already described, in a manipulator measuring arrangement, the screw 56 being turned until the connecting line between the two height limiters is purely perpendicular to a plane through the head gap 58. The resulting air gap between the underside of the lateral member 48 and the lug 55 may be filled with glue for locking purposes, in order to ensure that the correct setting is maintained. It is alternatively possible to lock the screw 56 itself.

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Instead of the screw for adjusting the height limiter 55 as shown in Figure 6, it is possible, as is shown in Figure 7, to use a key or wedge which is inserted in the gap between the underside of the lateral member 48 and the upper side of a lug 59, which constitutes the height limiter, as indicated by the arrow 60. By means of a manipulator, for example a wedge 61 is pushed in the direction of the arrow 60 until the connecting line between the two height limiters 54 and 55 is again perpendicular to a plane through the head gap 58. Subsequently, the head gap between the lug and the lateral member may be filled with glue for locking purposes. For an accurate adjustment it is of advantage that the lug 59 slopes gradually upward from the mounting plate 53.

The magnetic head unit 62 shown in Figures 8, 9 and 10, employs a normal commercially available magnetic head 63. In addition the magnetic head unit 62 comprises a mounting plate 64, which is integral with the lateral members 65 and 66. The members 65 and 66 again have a height which is smaller than that of the front surface of the magnetic head 63 which comprises the head face. End portions of the lateral members 65 and 66 form cylindrical bodies 67 and 68 respectively. The members 65 and 66 together with the mounting plate 64 may be manufactured from a suitable material such as a plastics. When selecting the material it is important that this material has a satisfactory dimensional stability, so that the cylindrical bodies 67 and 68 retain the correct shape during use. In the present embodiment flat springs 70 and 71 are arranged on the upper sides of the lateral members 65 and 66 for exerting a comparatively small pressure on the upper edge of the magnetic tape, so that these control means ensure that the lower edge of the magnetic tape is constantly in contact with the height limiters 72 and 73 during transport. The height limiters 72 and 73 may form part of the lateral members 65 and 66. Alternatively, as is shown in Figures 11 and 12, the height limiters may comprise hardened metal blocks 74, which each comprise a pin 75 which is clamped in an opening in the underside of the lateral member. Said blocks may for example be of a material such as tungsten carbide. It is also possible to use a wear-resistant material such as chromium steel or a ceramic material. Suitably, the block is slightly conical on its upper side and is centered relative to the axis of the pin 75. In the embodiment shown in Figure 11 the portion of the height limiter constituting a tape guide element has been turned off over approximately 5°. Each block comprises a flattened side 76, enabling the magnetic head unit to be readily inserted into a compact cassette. The mounting plate 64 comprises a knife-edge bearing 77, which is situated directly underneath the head gap 78 of the magnetic head. After the magnetic head 73 has been mounted onto the mounting plate 64 between the lateral members 65 and 66 a slight clearance exists for pivoting the magnetic head about an axis which is determined by pivoting the upper edge of the knife-edge

bearing 77 perpendicularly to the direction of transport of the magnetic tape. In this way a connecting line between the height limiters 72 and 73 can be adjusted so that it is accurately perpendicular to a plane through the head gap 78. After the magnetic head has been pivoted into the correct position by means of a manipulator, the magnetic head may also be glued in position in the present embodiment. In the present embodiment it is also possible to adjust the connecting line between the height limiters so as to extend perpendicularly to a plane through a head gap 78 with an accuracy within 10". As is illustrated by Figure 10 the construction of the magnetic head unit in accordance with the invention is of special advantage in order to eliminate the influence of the tape guides 79 and 80 in the cassette housing on the tape transport. The construction of the magnetic head unit in accordance with the invention eliminates or mitigates this undesired influence in that the head unit corrects the tape movement after a tape guide in such a way that a correct azimuth position is obtained at the location of the head gap 78.

Figure 13 shows a magnetic head unit 81, in which two separate members 83 and 84 of a strip material are secured to the side walls of a normal commercially available magnetic head. The front end of the strip material has been rounded in order to form the cylindrical bodies. By means of a technique to be described hereinafter the lateral members are connected to a magnetic head 85 in such a way that again a connecting line between the height limiters 86 and 87 extends perfectly perpendicularly to a plane through the head gap 88. The lateral members 83 and 84 again have such a height in comparison with the overall height of the front surface of the magnetic head 85 which includes the head face that a clearance of approximately 2 mm. is left at the top and bottom. Figure 13 shows how in an alternative embodiment height limiters 86 and 87 of a flat-spring material are formed underneath the lateral members. By securing these springs to the associated lateral members near the rear and front ends the height limiters will be substantially more rigid than the leaf springs 89 and 90 arranged on the upper sides of the lateral members 83 and 84. In this way said height limiters behave as substantially rigid parts relative to the magnetic tape. The lateral members are lightly urged against the side walls of the magnetic head during adjustment their lower edges being kept at the same level so that they move parallel to each other during adjustment. For the purpose of adjustment the magnetic head 85 is arranged on an alignment jig provided with a knife-edge bearing for accurately tilting the head and with supports which keep the lateral members 83 and 84 at the correct level during adjustment of the head. When the adjustment is correct the lateral members are secured to the magnetic head, for example by welding. After adjustment and fixation the magnetic head 85 is secured to a mounting plate 91. A further advantage of this embodiment is the

possibility of using comparatively cheap components.

It is to be noted that the magnetic head units in the preceding embodiments may lead to a universal improvement of a magnetic-tape cassette system. This makes it possible to continue existing cassette systems, such as the so-called compact cassette and microcassette, as a result of which the construction in accordance with the invention may eliminate the necessity of developing new cassette systems. The proposed magnetic-head units may, moreover, provide an improvement for the recording of signals in a tape transport mode opposite to the normal direction of transport, the so-called auto reverse system, in which the direction of transport of the magnetic tape is automatically reversed when the end is reached. In both directions of transport it is ensured that the azimuth position of the magnetic head relative to the magnetic tape is accurately perpendicular. The construction of a magnetic head unit in accordance with the invention furthermore has the advantage that it provides an accurate height stability of the tape transport within a cassette provided with a tape-guide, such as the compact cassette. Thus, the construction in accordance with the invention may be used in order to adapt the well-known compact cassette for digital recording purposes, when very narrow track widths are used.

It is to be noted that the invention is not only favourable for the construction of the magnetic-tape cassette apparatus itself but also for a suitable construction of the magnetic head units described which, as a result of their inherently accurate azimuth position, may be used for service purposes.

Furthermore, it is to be noted that it is also possible to combine different details of the various embodiments. For example, the plate 32 shown in Figure 4 may be replaced by the flat springs 49 and 50 in Figure 6.

Figures 14 to 19 represent a number of measurements results in order to illustrate the advantages of the accurate tape transport obtained by a magnetic head unit in accordance with the invention. Except for Figure 19 all the graphs show the azimuth error (A) plotted as a function of time (T).

Figure 14 represents the azimuth-error tolerances, Figure 14a relating to a standard 10 kHz azimuth test cassette with an accurately constructed housing (metal frame and tape guides), containing a ferro magnetic-tape. This magnetic tape has been recorded on a standard high-quality magnetic-tape apparatus, outside the cassette, which test tape will be referred to hereinafter as the "standard test tape". Figure 14a shows that despite the accurate tape guidance during recording the azimuth-error tolerances may increase to $\pm 0.5'$ when the cassette is played back on a hifi magnetic-tape cassette apparatus provided with a magnetic head unit in accordance with the invention, which tolerances (as will appear from the following measurements)

are too large for precision measurements. Therefore, a special azimuth test cassette has been made with a magnetic tape recorded on a high-quality magnetic-tape apparatus but now provided with a magnetic head unit in accordance with the invention, which magnetic tape will be referred to hereinafter as "special magnetic tape". Figure 14b shows that now during playback of the special azimuth test cassette on a hifi cassette apparatus provided with a magnetic head unit in accordance with the invention the azimuth errors are maximum $\pm 0.1'$. This demonstrates that by means of a magnetic-tape apparatus incorporating a head unit in accordance with the invention azimuth test cassettes can be made with an accuracy which is a factor 5 higher than the usual test cassettes.

Figure 15 represents a comparison of results between a normally commercially available hifi magnetic tape cassette apparatus (Figure 15a) and the same cassette apparatus but now equipped with a magnetic head unit in accordance with the invention (Figure 15b) using the aforementioned special azimuth test cassette. The maximum tolerance in Figure 15a is approximately $\pm 0.5'$ and in Figure 15b $\pm 0.1'$. Again this demonstrates that azimuth errors are reduced by a factor 5.

Figure 16 shows a comparison of the results starting from the normal ferro C60 cassette, on which a 10 kHz signal has been recorded by means of a commercially available hifi magnetic-tape cassette apparatus (Figure 16a) and by means of a similar apparatus using a head unit in accordance with the invention (Figure 16b). Again it is found that an improvement of the azimuth errors by approximately a factor 5 is obtained. This comparison demonstrated that in the case of recordings made on a normal hifi magnetic tape cassette apparatus equipped with a head unit in accordance with the invention, the azimuth tolerances may be reduced by approximately a factor 5.

Figure 17 shows a comparison of the results measured by means of the aforementioned special magnetic tape, which is now accommodated in the housings of three comparatively cheap, commercially available plastics cassettes having tape guides which exhibit the usual tolerances. Such housings are made by injection-moulding techniques in quantities of millions a year. Figures 17d, e and f show that in a hifi cassette apparatus equipped with a magnetic head unit in accordance with the invention, when the housing corresponding to Figures 17a, b and c is used, the azimuth errors are limited to $\pm 0.3'$. Figures 17a, b and c show that in a hifi cassette apparatus without the special magnetic head unit the tolerances vary from $\pm 4'$ (Figure 15d) to $\pm 1.5'$ (Figure 15f). The conclusion to be drawn is that when the head unit in accordance with the invention is used errors in the tape guidance of the cassette housing can be eliminated almost completely. This demonstrates that when magnetic tapes which have been modulated outside

the cassette housing, as is frequently done for so-called music cassettes, are played back a substantial improvement in playback quality can be obtained by means of the magnetic head units in accordance with the invention.

Figure 18 shows the variation of the azimuth tolerances between the beginning and end of the magnetic tape when using the normal test tape. During transport from the beginning to the end of the magnetic tape variations in tape tension occur, which variations are mainly the result of the changing tape-roll diameter. Between the beginning and the end the tape tension may vary by approximately a factor $2\frac{1}{2}$. For the measurements a standard test-cassette housing is used, one of the winding hubs having an eccentric shape with a radius of minimum 10 mm and maximum 25 mm relative to the axis of rotation. Thus, during one revolution of the eccentric winding hub the same tape-tension variations occur as in a normal cassette between the beginning and the end of the magnetic tape. Figures 18a, b and c show that when the three such cassettes are used on a normal hifi cassette apparatus, starting from initial zero positions, tolerances of $\pm 2'$ may occur. Figures 18d, e and f show that when the cassettes of Figures 18a, b and c respectively are used on a hifi cassette apparatus equipped with a magnetic head unit in accordance with the invention azimuth tolerances of $\pm 0.5'$ occur, which is a result which may be compared with that of the measurement in accordance with Figure 14b. Consequently, when the construction in accordance with the invention is used variations in tape tension have hardly any or no effect and the azimuth tolerances do not vary between the beginning of the end.

Figure 19 represents results of measurements of the height stability of the magnetic tape. In general, when a magnetic tape runs along a magnetic head *via* guides which deviate for example $1'$ relative to the horizontal, for example because a first guide occupies a position which is $3\frac{1}{2}$ micrometre higher than a second guide, the tape edge has a height position which is accurate within 2 micrometres near the head gap. The measurements represented by Figure 19 have been carried out by means of a measuring instrument comprising a photodiode and a photo-transistor in order to sense the lower tape edge. Use has been made of a C60 cassette with chromium-dioxide tape. The tests have been carried out on a hifi cassette recorder whose magnetic head has been replaced by this measuring instrument, on which measuring instrument the tape-guide construction of the magnetic head unit in accordance with the invention is used or not used respectively. This means that the tape guides, the height limiters and the control means for keeping the tape edge in contact with the height limiters are arranged on the measurement instrument. The graphs of Figure 19 show the height deviation (H) plotted as a function of time (T). Figure 19a shows that in the case of a normal hifi cassette apparatus without the tape guide

construction in accordance with the invention height deviations up to 20 micrometres occur, because comparatively large variations in height occur in the case of tape-transport interruptions such as for example in the case of stop-art. The last-mentioned effect may be explained by the fact that each time during starting (playback) the tape requires some time to reach the correct height. Figure 19b shows that in a hifi cassette apparatus with the tape guide construction in accordance with the invention the maximum height deviations are 1 micrometre, that is an improvement by a factor 10. Figure 19b represents the situation with the same tape-transport interruptions as in Figure 19a. This demonstrates that after the interruptions the lace-up is restored to the correct position at a substantially faster rate.

The conclusion from Figure 19 is that the head unit in accordance with the invention is particularly suitable for digital recordings, for which the track position in the height direction should be maintained very accurately. As a result of this very narrow tracks may be selected, the number of tracks on the tape may be increased and consequently, the tape speed may be reduced.

Claims

1. A magnetic-head unit (3; 17; 25; 45; 62; 81) for use in a magnetic-tape apparatus for recording and/or reproducing signals on and/or from a magnetic tape (8) contained in a cassette which comprises a housing having an aperture in the front side, said housing further having two guide elements (44; 79, 80) comprising guide surfaces and located adjacent opposite sides of the aperture, the apparatus having means for transporting the magnetic tape (8) in a given direction past said aperture in the operation of the apparatus, the magnetic head unit (3; 17; 25; 45; 62; 81) comprising

— a magnetic head (4; 18; 26; 46; 63; 85) having a front surface, which comprises a convexly curved head face (6; 19; 27) in which a head gap (7; 24; 41; 58; 78; 88) terminates and across which, when the head face (6; 19; 27) has entered the aperture of the cassette-housing, the magnetic tape (8) is transported in the operation of the apparatus,

— two tape guides (9, 10; 20, 21; 30, 31; 51, 52; 67, 68) comprising guide surfaces and disposed on opposite sides of the head gap (7; 24; 41; 58; 78; 88), a plane tangential to the head face (6; 19; 27) at the head gap (7; 24; 41; 58; 78; 88) being located forwardly with respect to a plane tangential to the guide surfaces of both tape guides (9, 10; 20, 21; 30, 31; 51, 52; 67, 68),

— two height limiters (13, 14; 22, 23; 37, 38; 54, 55; 72, 73; 74; 86, 87) each adjoining an end of the guide surface of a respective one of the tape guides (9, 10; 20, 21; 30, 31; 51, 52; 67, 68) and each having a height-limiting surface arranged to limit in the operation of the apparatus movement of the tape (8) in at least one direction transverse

the cassette housing, as is frequently done for so-called music cassettes, are played back a substantial improvement in playback quality can be obtained by means of the magnetic head units in accordance with the invention.

Figure 18 shows the variation of the azimuth tolerances between the beginning and end of the magnetic tape when using the normal test tape. During transport from the beginning to the end of the magnetic tape variations in tape tension occur, which variations are mainly the result of the changing tape-roll diameter. Between the beginning and the end the tape tension may vary by approximately a factor $2\frac{1}{2}$. For the measurements a standard test-cassette housing is used, one of the winding hubs having an eccentric shape with a radius of minimum 10 mm and maximum 25 mm relative to the axis of rotation. Thus, during one revolution of the eccentric winding hub the same tape-tension variations occur as in a normal cassette between the beginning and the end of the magnetic tape. Figures 18a, b and c show that when the three such cassettes are used on a normal hifi cassette apparatus, starting from initial zero positions, tolerances of $\pm 2^\circ$ may occur. Figures 18d, e and f show that when the cassettes of Figures 18a, b and c respectively are used on a hifi cassette apparatus equipped with a magnetic head unit in accordance with the invention azimuth tolerances of $\pm 0.5^\circ$ occur, which is a result which may be compared with that of the measurement in accordance with Figure 14b. Consequently, when the construction in accordance with the invention is used variations in tape tension have hardly any or no effect and the azimuth tolerances do not vary between the beginning of the end.

Figure 19 represents results of measurements of the height stability of the magnetic tape. In general, when a magnetic tape runs along a magnetic head via guides which deviate for example 1° relative to the horizontal, for example because a first guide occupies a position which is $3\frac{1}{2}$ micrometre higher than a second guide, the tape edge has a height position which is accurate within 2 micrometres near the head gap. The measurements represented by Figure 19 have been carried out by means of a measuring instrument comprising a photodiode and a phototransistor in order to sense the lower tape edge. Use has been made of a C60 cassette with chromium-dioxide tape. The tests have been carried out on a hifi cassette recorder whose magnetic head has been replaced by this measuring instrument, on which measuring instrument the tape-guide construction of the magnetic head unit in accordance with the invention is used or not used respectively. This means that the tape guides, the height limiters and the control means for keeping the tape edge in contact with the height limiters are arranged on the measurement instrument. The graphs of Figure 19 show the height deviation (H) plotted as a function of time (T). Figure 19a shows that in the case of a normal hifi cassette apparatus without the tape guide

construction in accordance with the invention height deviations up to 20 micrometres occur, because comparatively large variations in height occur in the case of tape-transport interruptions such as for example in the case of stop-art. The last-mentioned effect may be explained by the fact that each time during starting (playback) the tape requires some time to reach the correct height. Figure 19b shows that in a hifi cassette apparatus with the tape guide construction in accordance with the invention the maximum height deviations are 1 micrometre, that is an improvement by a factor 10. Figure 19b represents the situation with the same tape-transport interruptions as in Figure 19a. This demonstrates that after the interruptions the tape is restored to the correct position at a substantially faster rate.

The conclusion from Figure 19 is that the head unit in accordance with the invention is particularly suitable for digital recordings, for which the track position in the height direction should be maintained very accurately. As a result of this very narrow tracks may be selected, the number of tracks on the tape may be increased and consequently, the tape speed may be reduced.

Claims

1. A magnetic-head unit (3; 17; 25; 45; 62; 81) for use in a magnetic-tape apparatus for recording and/or reproducing signals on and/or from a magnetic tape (8) contained in a cassette which comprises a housing having an aperture in the front side, said housing further having two guide elements (44; 79, 80) comprising guide surfaces and located adjacent opposite sides of the aperture, the apparatus having means for transporting the magnetic tape (8) in a given direction past said aperture in the operation of the apparatus, the magnetic head unit (3; 17; 25; 45; 62; 81) comprising

— a magnetic head (4; 18; 26; 46; 63; 85) having a front surface, which comprises a convexly curved head face (6; 19; 27) in which a head gap (7; 24; 41; 58; 78; 88) terminates and across which, when the head face (6; 19; 27) has entered the aperture of the cassette-housing, the magnetic tape (8) is transported in the operation of the apparatus,

— two tape guides (9, 10; 20, 21; 30, 31; 51, 52; 67, 68) comprising guide surfaces and disposed on opposite sides of the head gap (7; 24; 41; 58; 78; 88), a plane tangential to the head face (6; 19; 27) at the head gap (7; 24; 41; 58; 78; 88) being located forwardly with respect to a plane tangential to the guide surfaces of both tape guides (9, 10; 20, 21; 30, 31; 51, 52; 67, 68),

— two height limiters (13, 14; 22, 23; 37, 38; 54, 55; 72, 73; 74; 86, 87) each adjoining an end of the guide surface of a respective one of the tape guides (9, 10; 20, 21; 30, 31; 51, 52; 67, 68) and each having a height-limiting surface arranged to limit in the operation of the apparatus movement of the tape (8) in at least one direction transverse



to the direction of transport of the tape and parallel to said plane tangential to the head face (6; 19; 27),

— control means (35, 36; 49, 50; 70, 71; 89, 90) for keeping an edge (15) of the tape (8) constantly in contact with said height-limiting surfaces in the operation of the apparatus, characterized in that,

— the two tape guides (9, 10; 20, 21; 30, 31; 51, 52; 67, 68) and the two height limiters (13, 14; 22, 23; 37, 38; 54, 55; 72, 73; 74; 86, 87) are located adjacent the head face (6; 19; 27) of said magnetic head unit (3; 17; 25; 45; 62; 81), so as to be capable of entering the aperture of the cassette with said head face,

— said tape guides (9, 10; 20, 21; 30, 31; 51, 52; 67, 68) have convexly curved guide surfaces and are so arranged that, when entered the aperture of the cassette, the two tape guides are located between said guide elements (44; 79, 80) of the cassette and said plane tangential to the guide surfaces of the tape guides lies between said plane tangential to the head face (6; 19; 27) and a plane tangential to the guide surfaces of the guide elements (44; 79, 80) at a position such that the tape (8) travels along an arcuate path on the guide surfaces of the tape guides and is held taut at these guide surfaces,

— the magnetic head (4; 18; 26; 46; 63; 85) is permanently connected to said magnetic head unit (3; 17; 25; 45; 62; 81), such that a plane through the head gap (7; 24; 41; 58; 78; 88), which plane is perpendicular to said plane tangential to the head face (6; 19; 27), extends perpendicular to a connecting line (16), interconnecting the height limiting surfaces at points adjoining the respective guide surfaces of the tape guides (9, 10; 20, 21; 30, 31; 51, 52; 67, 68).

2. A magnetic head unit as claimed in Claim 1, characterized in that the tape guides comprise cylindrical bodies (9, 10; 20, 21; 30, 31; 51, 52; 67, 68) which adjoin the front surface of the magnetic head (4; 18; 26; 46; 63; 85) and have cylinder axes substantially parallel to the axis of curvature of the head face (6; 19; 27). Figs. 1—13.

3. A magnetic head unit as claimed in Claim 2, characterized in that said bodies (9, 10; 30, 31) are integral with a portion of the magnetic head (4; 26; 46) comprising the head face (6; 27), and have a ground cylindrical surface having a radius of curvature less than the radius of the head face. Figs. 1—7.

4. A magnetic head unit as claimed in Claim 2 or 3, characterized in that at least one of said height limiters is formed by an adjustable guide element (23; 55; 59) which is axially adjustable relative to the associated cylindrical body (21; 52). Figs. 3, 6, 7.

5. A magnetic head unit as claimed in any one of the preceding claims, the apparatus having a head plate (1) to which the head unit (45; 62) is to be secured, characterized in that the magnetic head unit (45; 62) includes a mounting plate (53; 64) arranged adjacent the lower surface of the magnetic head (46; 63), which surface extends substantially parallel to the direction of tape

transport, by said mounting plate the magnetic head unit is capable to be secured to the head plate (1) of the apparatus and said height limiters comprise projecting lugs (54, 55; 72, 73) formed integrally with said mounting plate. Figs. 6—12.

6. A magnetic head unit as claimed in Claim 4 and 5, characterized in that said adjustable guide element is formed as the end portion of a plug cut out (55; 59) of the mounting plate (53), said lug being pivotable relative to the remainder of the mounting plate for axial adjustment. Figs. 6, 7.

7. A magnetic head unit as claimed in Claim 5 with two lateral members (65, 66; 83, 84) disposed on opposite sides of the head face in the direction of transport of the tape, end portions (67, 68) of said members forming the tape guide surfaces, characterized in that said two lateral members (65, 66; 83, 84) are formed integrally with the mounting plate (64). Figs. 8—12.

8. A magnetic head unit as claimed in Claim 7, characterized in that said height limiters (74) comprise hardened metal blocks disposed against one side of the lateral members (65). Figs. 11 and 12.

9. A magnetic head unit as claimed in any one of the preceding claims, said control means comprise control elements (35, 36; 49, 50; 70, 71; 89, 90) each being disposed at an end of a respective one of the guide surfaces of the tape guides (30, 31; 51, 52; 67, 68), which end is remote from the respective height limiter (37, 38; 54, 55; 72, 73; 86, 87), characterized in that the overall height of the combination of each guide surface of said tape guides (30, 31; 51, 52; 67, 68) and the associated height limiter (37, 38; 54, 55; 72, 73; 86, 87) and the control element (35, 36; 49, 50; 70, 71; 89, 90) is no greater than the height of the front surface of the magnetic head (26; 46; 63; 85) so as to be capable of entering the aperture of the cassette with the head face. Figs. 4—13.

10. A magnetic head unit as claimed in any one of the Claims 7—9, characterized by comprising means for pivoting the magnetic head (63) about an axis perpendicular to said plane tangential to the head face, in order to position said plane through the head gap (78) perpendicular to said connecting line (16) before permanently connecting the head (63) to the head unit (62), said means for pivoting including a knife-edge bearing (77) arranged on the mounting plate (64) between the lateral members (65, 66) and situated directly underneath the head gap (78) of the magnetic head. Figs. 8—10.

11. A magnetic tape apparatus, characterized in that the apparatus comprises the magnetic head unit (13; 17; 25; 45; 62; 81) as claimed in Claim 1.

Patentsprüche

1. Magnetkopfeinheit (3; 17; 25; 45; 62; 81) zum Gebrauch in einem Magnetbandgerät zum Aufnehmen und/oder Wiedergeben von Signalen auf und/oder von einem Magnetband (8), das in einer Kassette vorgesehen ist, die ein Gehäuse aufweist mit einer Öffnung auf der Vorderseite, wobei



dieses Gehäuses weiterhin zwei Führungselemente (44; 79, 80) aufweist, die Führungsflächen haben und an einander gegenüberliegenden Seiten neben der Öffnung liegen, wobei das Gerät Mittel aufweist zum im Betrieb des Gerätes in einer bestimmten Richtung Transportieren des Magnetbandes (8) an der genannten Öffnung entlang, wobei die Magnetkopfeinheit (3; 17; 25; 45; 62; 81) die folgenden Elemente aufweist:

— einem Magnetkopf (4; 18; 26; 46; 63; 85) mit einer Vorderfläche, die einen konvex gekrümmten Kopfspiegel (6; 19; 27) aufweist, in den ein Kopfspalt (7; 24; 41; 58; 78; 88) mündet und über den, wenn der Kopfspiegel (6; 19; 27) in die Öffnung des Kassettengehäuses eingeführt ist, im Betrieb des Gerätes des Magnetband (8) transportiert wird,

— zwei Bandführungselemente (9, 10; 20, 21; 30, 31; 51, 52; 67, 68) mit Führungsflächen, wobei die Elemente an einander gegenüberliegenden Seiten neben dem Kopfspalt (7; 24; 41; 58; 78; 88) vorgesehen sind, wobei eine Ebene tangential zu dem Kopfspiegel (6; 19; 27) am Kopfspalt (7; 24; 41; 58; 78; 88) in bezug auf eine Ebene tangential zu den Führungsflächen der beiden Bandführungselemente (9, 10; 20, 21; 30, 31; 51, 52; 67, 68) vorne liegt,

— zwei Höhenbegrenzer (13, 14; 22, 23; 37, 38; 54, 55; 72, 73; 74, 86, 86) die je an ein Ende der Führungsflächen jedes der Bandführungselemente (9, 10; 20, 21; 30, 31; 51, 52; 67, 68) grenzen und je eine Höhenbegrenzungsfläche aufweisen um im Betrieb des Gerätes die Bewegung des Bandes (8) in wenigstens einer Richtung quer zu der Transportrichtung des Bandes und parallel zu der genannten Ebene tangential zu dem Kopfspiegel (6; 19; 27) zu begrenzen,

— Steuermittel (35, 36; 49, 50; 70, 71; 89, 90) um einen Rand (15) des Bandes (8) im Betrieb des Gerätes ständig mit den Höhenbegrenzungsflächen in Kontakt zu halten, dadurch gekennzeichnet, dass

— die zwei Bandführungselemente (9, 10; 20, 21; 30, 31; 51, 52; 67, 68) und die zwei Höhenbegrenzer (13, 14; 22, 23; 37, 38; 54, 55; 71, 73; 74; 86, 87) neben dem Kopfspiegel (6; 19; 27) der genannten Magnetkopfeinheit (3; 17; 25; 45; 62; 81) liegen, so dass sie mit dem Kopfspiegel in die Öffnung der Kassette eindringen können,

— die genannten Bandführungselemente (9, 10; 20, 21; 30, 31; 51, 52; 67, 68) konvex gekrümmte Führungsflächen aufweisen und derart vorgesehen sind, dass wenn die zwei Bandführungselemente sich innerhalb der Öffnung der Kassette befinden, sie zwischen den genannten Führungselementen der Kassette (44; 79; 80) liegen und wobei die genannte Ebene tangential zu den Führungsflächen der Bandführungselemente zwischen der genannten Ebene tangential zu dem Kopfspiegel (6; 19; 27) und einer Ebene tangential zu den Führungsflächen der Führungselemente (44; 79, 80) in einer solchen Lage liegt, dass das Band (8) über eine genaue Spur über die Führungsflächen der Bandführungselemente läuft und an diesen Führungsflächen angedrückt gehalten wird,

— der Magnetkopf (4; 18; 26; 46; 63; 85) ständig mit der genannten Magnetkopfeinheit (3; 17; 25; 45; 62; 81) verbunden ist, so dass eine Ebene durch den Kopfspalt (7; 24; 41; 58; 78; 88), die senkrecht auf der genannten Ebene tangential zu den Kopfspiegel (6; 19; 27) steht, sich senkrecht zu der Verbindungslinie (16) erstreckt, welche die Höhenbegrenzungsflächen miteinander verbindet an Stellen, die an die betreffenden Führungsflächen der Bandführungselemente (9, 10; 20, 21; 30, 31; 51, 52; 67, 68) grenzen.

2. Magnetkopfeinheit nach Anspruch 1, dadurch gekennzeichnet, dass die Bandführungselemente zylinderförmige Körper (9, 10; 20, 21; 30, 31; 51, 52; 67, 68) aufweisen, die an die Vorderfläche des Magnetkopfes (4; 18; 26; 46; 63; 85) grenzen und eine Zylinderachse aufweisen, die sich parallel zu der Krümmung des Kopfspiegels (6; 19; 27) erstreckt.

3. Magnetkopfeinheit nach Anspruch 1, dadurch gekennzeichnet, dass die genannten Körper (9, 10; 30, 31) mit einem Teil des Magnetkopfes (4; 26; 46), der den Kopfspiegel (6; 27) aufweist, einen integralen Teil bilden und eine geschliffene zylinderförmige Oberfläche aufweisen mit einem Krümmungsradius, der kleiner ist als der Radius der Kopfspiegels.

4. Magnetkopfeinheit nach Anspruch 2 oder 3, dadurch gekennzeichnet, dass wenigstens einer der Höhenbegrenzer durch ein einstellbares Führungselement (25; 55; 59) gebildet wird, das gegenüber dem zugeordneten zylinderförmigen Körper (21; 52) axial einstellbar ist.

5. Magnetkopfeinheit nach einem der vorstehenden Ansprüche, wobei das Gerät eine Kopfplatte (1) aufweist, auf der die Kopfeinheit (45; 62) befestigt werden muss, dadurch gekennzeichnet, dass die Magnetkopfeinheit (45; 62) eine Montageplatte (53; 64) aufweist, die an die untere Fläche des Magnetkopfes (43, 63) grenzt, wobei diese Fläche sich im wesentlichen parallel zu der Richtung des Bandtransportes erstreckt, wobei durch die genannte Montageplatte die Magnetkopfeinheit auf der Kopfplatte (1) des Gerätes befestigt werden kann und wobei die genannten Höhenbegrenzer vorspringende Zungen (54, 55; 72, 73) aufweisen, die einen integralen Teil der genannten Montageplatte bilden.

6. Magnetkopfeinheit nach den Ansprüchen 4 und 5, dadurch gekennzeichnet, dass das genannte einstellbare Führungselement als der Endteil eines Zungenausschnittes (55; 59) der Montageplatte (53) gebildet ist, wobei die genannte Zunge gegenüber dem restlichen Teil der Montageplatte zur axialen Einstellung drehbar ist. Fig. 6, 7.

7. Magnetkopfeinheit nach Anspruch 5, mit zwei Seitenelementen (65, 66; 83, 84) die an einander gegenüberliegenden Seiten des Kopfspiegels in der Richtung des Bandtransportes vorgesehen sind, wobei Endteile (67, 68) der genannten Elemente die Bandführungsflächen bilden, dadurch gekennzeichnet, dass die zwei Seitenelemente (65, 66; 83, 84) mit der Montageplatte (64) einen integralen Teil bilden. Fig. 8—12:



8. Magnetkopfeinheit nach Anspruch 7, dadurch gekennzeichnet, dass die genannten Höhenbegrenzer (74) gehärtete Metallblöcke aufweisen, die an nur einer Seite der Seitenelemente (65) angeordnet sind. Fig. 11, 12.

9. Magnetkopfeinheit nach einem der vorstehenden Ansprüche, wobei die genannten Steuerelemente (35, 36; 49, 59; 70, 71; 89, 90) aufweisen, die je an einem Ende jeder der Führungsflächen der Bandführungselemente (30, 31; 51, 52; 67, 68) vorgesehen sind, wobei dieses Ende in einem Abstand von dem betreffenden Höhenbegrenzer (37, 38; 54, 55; 72, 73; 86, 87) liegt, dadurch gekennzeichnet, dass die Gesamthöhe der aus jeder Führungsfläche der genannten Bandführungselemente (30, 31; 51, 52; 67, 68) und dem zugeordneten Höhenbegrenzer (37, 38; 49, 50; 70, 71; 89, 90) und dem Steuerelement (35, 36; 49, 50; 70, 71; 89, 90) gebildeten Kombination nicht grösser ist als die Höhe der Vorderfläche des Magnetkopfes (26; 46; 63, 85), so dass der Kopfspiegel in die Öffnung der Kassette eingeführt werden kann. Fig. 4—13.

10. Magnetkopfeinheit nach einem der Ansprüche 7—9, dadurch gekennzeichnet, dass sie Mittel aufweist, zum Kippen des Magnetkopfes (63) um eine Achse senkrecht zu der genannten Ebene tangential zu dem Kopfspiegel um die Ebene durch den Kopfspalt (78) senkrecht zu der genannten Verbindungslinie (16) auszurichten bevor der Kopf (63) endgültig auf der Kopfeinheit (62) befestigt wird, wobei die genannten Kippmittel eine Schneidenlagerung (77) aufweisen, die auf der Montageplatte (64) zwischen den Seitenelementen (65, 66) unmittelbar unter dem Kopfspalt (78) des Magnetkopfes angeordnet ist. Fig. 8—10.

11. Magnetbandgerät, dadurch gekennzeichnet, dass das Gerät eine Magnetkopfeinheit (13; 17; 25; 45; 62; 81) nach Anspruch 1 aufweist.

Revendications

1. Unité de tête magnétique (3; 17; 25; 45; 62; 81) à utiliser dans un appareil à cassette de bande magnétique pour enregistrer des signaux sur une bande magnétique et/ou reproduire des signaux depuis une bande magnétique (8) contenue dans une cassette qui comprend un boîtier dont la face frontale comporte une ouverture, ce boîtier ayant en outre deux éléments de guidage (44; 79; 80) munis de surfaces de guidage et situés près de deux côtés opposés de l'ouverture, alors que ledit appareil est équipé de moyens pour transporter la bande magnétique (8) dans une direction déterminée derrière ladite ouverture au cours du fonctionnement de cet appareil, l'unité de tête magnétique (3; 17; 25; 45; 62; 81) comportant:

— une tête magnétique (4; 18; 26; 46; 63; 85) ayant une surface frontale qui comprend une face de tête convexe (6; 19; 27) dans laquelle se termine en entrefer de tête (7; 24; 41; 58; 78; 88), alors que ladite face de tête convexe (6; 19; 27) étant entrée dans l'ouverture du boîtier de la

cassette, la bande magnétique (8) est transportée le long de cette face convexe au cours du fonctionnement de l'appareil,

— deux guides de bande (9; 10; 20; 21; 30; 31; 51; 52; 67; 68) munis de surfaces de guidage et située de part et d'autre de l'entrefer de tête (7; 24; 41; 58; 78; 88), alors qu'un plan, tangentiel à la face de tête convexe (6; 19; 27) à l'endroit de l'entrefer de tête (7; 24; 41; 58; 78; 88) est situé vers l'avant par rapport à un plan qui est tangentiel aux surfaces de guidage des deux guides de bande (9; 10; 20; 21; 30; 31; 51; 52; 67; 68),

— deux limiteurs de hauteur (13; 14; 22; 23; 37; 38; 54; 55; 72; 73; 74; 86; 87) dont chacun se trouve près d'une extrémité de la surface de guidage d'un des deux guides de bande (9; 10; 20; 21; 30; 31; 51; 52; 67; 68) et comporte une surface limiteuse de hauteur conçue pour limiter, au cours du fonctionnement de l'appareil, le mouvement de la bande magnétique (8) dans au moins une direction qui est transversale à la direction de transport de la bande et parallèle audit plan tangentiel à la face de tête convexe (6; 19; 27), ainsi que

— des moyens de commande (35; 36; 49; 50; 70; 71; 89; 90) pour maintenir, au cours du fonctionnement de l'appareil, un contact permanent entre un bord (15) de la bande magnétique (8) et lesdites surfaces limiteuses de hauteur, caractérisé en ce que

— les deux guides de bande (9; 10; 20; 21; 30; 31; 51; 52; 67; 68) et les deux limiteurs de hauteur (13; 14; 22; 23; 37; 38; 54; 55; 72; 73; 74; 86; 87) avoisinent la face de tête convexe (6; 19; 27) de ladite unité de tête magnétique (3; 17; 25; 45; 62; 81) de façon à permettre à ladite face de tête convexe son entrée dans l'ouverture de la cassette;

— lesdits guides de bande (9; 10; 20; 21; 30; 31; 51; 52; 67; 68) ont des surfaces de guidage convexes et sont aménagés de façon que, la face de tête convexe étant entrée dans l'ouverture de la cassette, les deux guides de bande sont situés entre lesdits éléments de guidage (44; 79; 80) de la cassette et ledit plan tangentiel aux surfaces de guidage des guides de bande se trouve entre d'une part ledit plan tangentiel à la face de tête convexe (6; 19; 27) et d'autre part le plan tangentiel aux surfaces de guidage des éléments de guidage (44; 79; 80) dans une position telle que la bande (8) se déplace le long d'une voie arquée sur les surfaces de guidage des guides de bande et est maintenue tendue à cet endroit, et

— la tête magnétique (4; 18; 26; 46; 63; 85) est liée en permanence à ladite unité de tête magnétique (3; 17; 25; 45; 62; 81), de sorte qu'un plan passant par l'entrefer de tête (7; 24; 41; 58; 78; 88) et perpendiculaire audit plan tangentiel à la face de tête convexe (6; 19; 27) est perpendiculaire à une ligne de liaison (16) qui relie les surfaces limiteuses de hauteur en des points qui avoisinent les surfaces de guidage respectives des guides de bande (9; 10; 20; 21; 30; 31; 51; 52; 67; 68).

2. Unité de tête magnétique selon la revendica-



tion 1, caractérisée en ce que les guides de bande sont formés par des corps cylindriques (9; 10; 20; 21; 30; 31; 51; 52; 67; 68) qui sont situés près de la surface frontale de la tête magnétique (4; 18; 26; 46; 63; 85) et dont les axes sont pratiquement parallèles à l'axe de courbure de la face de tête convexe (6; 19; 27). Figures 1 à 13.

3. Unité de tête magnétique selon la revendication 2, caractérisée en ce que lesdits corps cylindriques (9; 10; 30; 31) forment corps avec une partie de la tête magnétique (4; 26; 46), cette partie comportant la face de tête convexe (6; 27), et ont une surface cylindrique de base dont le rayon de courbure est inférieur au rayon de courbure de la face de tête convexe. Figures 1 à 7.

4. Unité de tête magnétique selon la revendication 2 ou 3, caractérisée en ce qu'au moins un desdits limiteurs de hauteur est formé par un élément de guidage (23; 55; 59) dont il est possible de régler dans la direction axiale la position par rapport au corps cylindrique correspondant (21; 52). Figures 3, 6 et 7.

5. Unité de tête magnétique selon l'une quelconque des revendications précédentes, utilisée dans un appareil comportant une plaque de têtes (1) à laquelle il y a lieu de fixer l'unité de tête (45; 62), caractérisée en ce que l'unité de tête magnétique (45; 62) comporte une plaque de montage (53, 64) située près de la surface inférieure de la tête magnétique (46; 63), cette surface étant pratiquement parallèle à la direction de transport de la bande, alors que ladite plaque de montage (53; 64) permet à l'unité de tête magnétique d'être fixée à la plaque de têtes (1) de l'appareil, et que lesdits limiteurs de hauteur comportent des languettes en saillie (54; 55; 72; 73) qui forment corps avec ladite plaque de montage. Figures 6 à 12.

6. Unité de tête magnétique selon les revendications 4 et 5, caractérisée en ce que ledit élément de guidage (55; 59), réglable en ce que concerne sa position axiale, est formé par la partie terminale d'une languette obtenue par entaillage de la plaque de montage (53), cette languette pouvant pivoter par rapport au reste de ladite plaque pour pouvoir régler axialement ladite position. Figures 6 et 7.

7. Unité de tête magnétique selon la revendication 5, cette unité comportant deux organes latéraux (65; 66; 83; 84) situés de part et d'autre de la

face de tête convexe dans la direction de transport de la bande magnétique alors que des parties terminales (67, 68) desdits organes constituent les surfaces de guidage de bande, caractérisée en ce que les deux organes latéraux (65; 66; 83; 84) forment corps avec la plaque de montage (64).

8. Unité de tête magnétique selon la revendication 7, caractérisée en ce que lesdits limiteurs de hauteur (74) sont formés par des blocs en métal trempé, placés contre une face des organes latéraux (65). Figures 11 et 12.

9. Unité de tête magnétique selon l'une quelconque des revendications précédentes, alors que lesdits moyens de commande comprennent des éléments de commande (35; 36; 49; 50; 70; 71; 89; 90) dont chacun est aménagé à une extrémité d'une des surfaces de guidage des guides de bande magnétique (30; 31; 51; 52; 67; 68), ladite extrémité étant située à l'opposé du limiteur de hauteur correspondant (37; 38; 54; 55; 72; 73; 86; 87); caractérisée en ce que la hauteur totale de l'ensemble que forment chaque surface de guidage desdits guides de bande (30; 31; 51; 52; 67; 68), le limiteur de hauteur correspondant (37; 38; 54; 55; 72; 73; 86; 87) et l'élément de commande (35; 36; 49; 50; 70; 71; 89; 90) ne dépasse pas la hauteur de la surface frontale de la tête magnétique (26; 46; 63; 85) pour permettre ainsi à la face de tête convexe son entrée dans l'ouverture de la cassette. Figures 4 à 13.

10. Unité de tête magnétique selon l'une quelconque des revendications 7 à 9, caractérisée en ce que cette unité de tête magnétique comporte des moyens pour faire pivoter la tête magnétique (63) sur un axe perpendiculaire audit plan tangentiel à la face de tête convexe, pour positionner ledit plan passant par l'entrefer de tête (78) perpendiculairement à ladite ligne de liaison (16) avant de lier définitivement la tête (63) à l'unité de tête magnétique (62), lesdits moyens de pivotement comportant un palier en lame de couteau (77) aménagé sur la plaque de montage (64) entre les organes latéraux (65; 66) et situé directement au-dessous de l'entrefer de tête (78) de la tête magnétique. Figures 8 à 10.

11. Appareil à bande magnétique, caractérisé en ce que cet appareil est muni de l'unité de tête magnétique (13; 17; 25; 45; 62; 81) revendiquée dans la revendication 1.

