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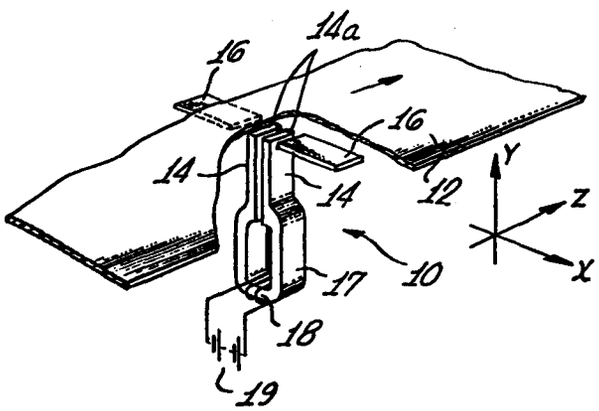
(54) Erase head for erasing single tracks of a multi-track magnetic recording tape.

(57) An erase head (10) for erasing single tracks on multi-track magnetic recording tapes (12) by means of a constant magnetic field applied in a direction perpendicular to the direction of tape travel, to avoid any asymmetrical residual magnetization with respect to the direction of a magnetizing field used for recording. A configuration of two pole pieces (14) and two corresponding shields (16), spaced out from the pole pieces and generally coplanar with the end faces thereof, ensures that the magnetic field strength is relatively uniform in a region between the shields, and falls to a relatively low value outside this region.



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Erase head for erasing single tracks of a multi-track magnetic recording tape

This invention relates to an erase head for erasing recorded signals from single tracks of a multi-track magnetic recording tape, comprising a pair of pole pieces having faces located for contacting a moving magnetic tape, magnetic circuit means providing a low reluctance path between said pole pieces, and magnetic shielding means arranged adjacent to the pole pieces.

Typically, tape recording systems include an erase head mounted in a leading position with respect to a recording transducer head, so that previously recorded material on the tape will be erased immediately before new material is recorded. There are many types of known erase heads such as those discussed below.

U.S. 3,852,812 describes a tunnel erase head for data recording purposes in particular on flexible magnetic discs. The tunnel erase head consists of two magnetic gaps arranged at a distance from one another and serves to erase the track edges in order to limit the track width. The tunnel erase head is provided with two erase coils, each of which is allocated to one of the said gaps, the

said two erase coils being energized by a direct current of opposite polarity. The magnetic fields of opposite polarity which are produced effect symmetric erasure which results in the second harmonic components of a reproduced signal being minimized.

In contrast to such a tunnel erase head, the erase head of the present invention effects accurate track erasure rather than erasure of the track edges.

U.S. 3,521,006 discloses a combined erase and record-reproduce magnetic transducer for 8-track apparatuses. A dual head is provided with two three-leg type core units and the tips of the legs extend into openings in the tape-engaging face of a magnetic shield housing for the magnetic head. The highly permeable metal shield housing is provided to prevent crosstalk between adjacent channels because the magnetic housing shorts out stray hum signals and signals from adjacent tracks. The erase coils provide high frequency bias and thereby produce the necessary erase flux.

German Laid-Open Application DOS 2,317,020 describes a very similar shielded head for use in a signal recording playback system in which several tracks are recorded in the longitudinal direction on a magnetic tape. In this publication the use of the shielded head for erasing purposes is not described.

It is well known that magnetic materials, including those used to coat magnetic recording tapes, exhibit a property known as hysteresis, wherein they will retain a degree of residual magnetism after a magnetizing or magnetomotive force is removed. Accordingly, if a constant magnetic field were to be applied in a direction generally parallel to the direction of movement of the tape, each particle of magnetic

material on the tape would be subjected to a gradually increasing magnetic field strength as it approached the constant field, and to a gradually decreasing magnetic field strength as it moved away from the field. However, because of the effect of hysteresis, each such particle of magnetic material would remain partially magnetized in the direction of the constant magnetic field.

The aforedescribed asymmetry in the direction of magnetization of a tape erased by a constant magnetic field is of little consequence in some magnetic recording applications, such as digital recording, but is highly significant in the recording of analog signals, as in video tape recorders. In analog recording, the asymmetry can give rise to distortion in the recorded and subsequently played back video signal. This distortion manifests itself by the presence of unwanted second harmonic components, as discussed above, and is totally unacceptable for video applications.

For the foregoing reason, video and audio tape recorders typically employ high-frequency, alternating-current (ac) erase heads. As each particle of magnetic material approaches an ac erase head, it is subjected to rapid magnetization in alternating directions. Because of the hysteresis effect, the degree to which the particle is magnetized lags behind the cyclic variation in the magnetizing force, and the relationship between magnetic field strength and magnetizing force follows a well known characteristic hysteresis loop. As the particle moves away from the ac erase head, the magnitude of the magnetizing force gradually diminishes, and the hysteresis loop becomes progressively smaller and smaller, until, when the particle has escaped the influence of the field, it remains in an essentially neutral magnetic condition, without any asymmetrical magnetic bias in one direction or another.

Although ac erase heads are entirely satisfactory for most purposes, they have the disadvantage of relatively high cost as compared with a comparable dc erase head. Furthermore, an ac erase head must be provided with power from a high-frequency power source, and there is a significant problem in dealing with unwanted radiation from the source. Accordingly, appropriate shielding has to be provided, at a correpondingly higher cost.

It will be appreciated from the foregoing that there is still a significant need for a practical alternative to the more conventional ac erase head for magnetic tape recording, and such an alternative should not have the inherent disadvantage of asymmetrical magnetization, usually associated with dc erase heads, and should still be capable of erasing a single, relatively narrow recording track on a multi-track tape.

The present invention fulfills this need by an erase head for erasing recorded signals from single tracks of a multi-track magnetic recording tape, comprising a pair of pole pieces having faces located for contacting a moving magnetic tape,
magnetic circuit means providing a low reluctance path between said pole pieces, and
magnetic shielding means arranged adjacent to the pole pieces, wherein the faces of the pole pieces are arranged in a generally parallel relationship spaced across the width of the moving magnetic tape to provide a magnetic field in the plane of the moving tape and directed primarily perpendicular to the direction of tape movement,
a source of constant magnetomotive force is provided, the said magnetomotive force being applied to said magnetic circuit means to produce an unvarying magnetic field between said pole pieces, and

said magnetic shielding means are spaced outwardly from said pole pieces in a substantially coplanar relationship with said faces, whereby the resultant magnetic field strength in a plane perpendicular to the direction of movement of the tape is substantially uniform in a region inward of said shielding means but is minimized outside the region.

In summary, the present invention resides in a magnetic recording tape erase head powered by direct current and oriented to provide a constant magnetic field substantially perpendicular to the direction of tape travel. Although the tape erased by the erase head of the invention is left permanently magnetized in the perpendicular direction, there is no asymmetry in the longitudinal direction, parallel to the tape length, and hence no distortion, because the recording head utilizes a magnetizing field in the longitudinal direction. The erase head of the invention has an arrangement of pole pieces and shields which provides a substantially uniform field over a relatively narrow portion of the tape width, corresponding to the width of a single recording track on the tape.

Basically, and in general terms, the erase head of the invention comprises a pair of relatively narrow pole pieces having end faces which engage the surface of the magnetic tape, to provide a magnetic field in a direction transverse to the direction of tape movement, and a pair of flat magnetic metal plates positioned in a generally coplanar relationship with the end faces of the pole pieces and spaced apart therefrom by approximately the width of a single recording track to be erased, to minimize the effect of stray magnetic fields which would otherwise demagnetize adjacent tracks on the recording tape. The erase head device also includes a magnetic circuit coupling the two pole pieces,

and means for providing a constant magnetizing force to the magnetic circuit. The relative spacing of the pole pieces, and of the shields with respect to the pole pieces, can be optimized to provide a substantially uniform magnetic field strength in the regions between the edges of the shields. The constant magnetic field thereby provided still leaves particles of magnetic material residually magnetized in the direction across the width of the tape, but this has no adverse effect on the recording characteristics of the tape, since the recording and playback transducers utilize a magnetic field oriented in the direction of tape movement.

In a further embodiment, said magnetic shielding means includes a single flat metal plate having an aperture of approximately the same width as a single recording track, to accommodate said pole pieces.

In yet another embodiment of the invention, said pole pieces are parallel bars of rectangular cross section, and the faces locatable in an operative relationship with the tape are rectangular end faces; said magnetic circuit means includes a generally U-shaped core joining the ends of said pole pieces opposite said rectangular end faces.

In a practical embodiment, the erase head according to the present invention is characterized in that the source of constant magnetomotive force is a magnetizing winding on a magnetic core energized with direct current, and magnetic shielding means having planar portions located on each side of said two pole pieces, in the same plane as its end faces, whereby the horizontal component of magnetic field strength is substantially zero in the regions adjacent to said end faces and adjacent to said shielding means, the vertical component of field strength is substantially zero except in the regions adjacent to said end faces, and the resultant

field strength is relatively great in the region between the portions of said shielding means but is essentially zero elsewhere.

In another advantageous embodiment said magnetic shielding means have an aperture for accommodating the faces of the pole pieces in such a way that said faces do not protude beyond the surface of said shielding means.

It will be apparent from the foregoing and the following description that the present invention provides a simple and less costly alternative to ac demagnetization of recording tapes. In particular, it provides a magnetic field across a relatively small width of the tape, so that recording tracks adjacent to the one that is to be demagnetized are protected from inadvertent demagnetization. Other aspects and advantages of the present invention will become apparent from the following more detailed description, taken in conjunction with the accompanying drawings in which

Figure 1 is a simplified perspective view of an erase head constructed in accordance with the present invention;

Fig. 1a is a fragmentary perspective view of an alternative form of the erase head of the invention;

Fig. 2 is a simplified graph showing the variation of manetic field strength experienced by the tape as it passes the erase head of the invention; and

Fig. 3 is a graph similar to Fig. 2, but providing a more practical example of the variation of field strength across the erase head of the invention.

In a signal recording system using magnetic tapes, each recording track may be as little as four thousandths of an inch wide, with a safety zone of an additional two thousandths of an inch between tracks.

In Fig. 1, direct-current erase head, indicated by reference numeral 10, is oriented at right angles to the direction of travel of a recording tape 12, and is provided with a configuration of pole pieces 14 and shielding elements 16 which cooperate to provide a substantially constant magnetic field across a relatively narrow width of the tape, and only a very small magnetic field outside the desired width to be demagnetized.

More specifically, the erase head 10 comprises two relatively narrow pole pieces 14 having flat, preferably rectangular end faces 14a oriented in a parallel relationship with each other and with the direction of movement of the recording tape 12. The end faces 14a are positioned in surface contact with the tape 12, or in very close proximity to it, and there is a narrow gap between parallel adjacent edges of the end faces. Thus, the magnetic field from the pole pieces 14 is oriented primarily at right-angles (x axis) to the direction of tape movement (z axis). On each side of the pair of pole pieces 14 is a flat magnetic shield 16 arranged in generally coplanar relationship with the end faces 14a of the pole pieces. Each shield 16 has its edge closest to the pole pieces spaced apart therefrom and also oriented generally parallel to the direction of tape travel. The shields 16 operate to eliminate practically all of the fringing or leakage flux paths from the pole pieces 14, and to provide a very low level of magnetic field strength in the regions of the tape immediately adjacent to the shields. Connecting the pole pieces 14 is a generally

U-shaped magnetic core 17, on which is wound a magnetizing winding 18, supplied by a dc power source, indicated at 19.

As indicated in Fig. 1, the primary direction of the magnetic field provided by the head 10 is designated as the x axis. The orthogonal directions of the y axis and z axis are defined as being perpendicular to the plane of the tape 12, and parallel to the tape movement direction, respectively.

As will be apparent from Fig. 2, the component of magnetic field strength measured in the horizontal or x-axis direction is relatively high in the region between the pole pieces 14, falls to zero in the areas across the pole pieces and shields 16, and is also relatively high in the regions between the pole pieces and shields. The broken line 20 (Fig. 2) indicates the approximate magnitude, designated H_x, of the horizontal component of the magnetic field strength. Similarly, the solid line 22 indicates the corresponding variation in the vertical component of magnetic field strength, designated H_y, measured across the same region. It will be apparent that the magnitude of the vertical component field strength H_y rises from close to zero outside the pole pieces 10 to a maximum value across the faces 16a of the pole pieces, but is substantially zero between the pole pieces.

The resultant field strength, H, is, of course, determined as the square root of the sum of the squares of the horizontal and vertical components. The value of H is separately plotted as the solid line 24 in Fig. 2. It will be seen that the field strength, H, between the edges of the shields 16 is substantially constant. As already mentioned, Fig. 2 is only an approximate illustration of the actual field strengths involved. In practice, the field strengths may

vary as shown by way of example in Fig. 3, wherein the magnitude of the horizontal component of field strength, H_x, is indicated at 30, the magnitude of the vertical component of field strength, H_y, is indicated at 32 and the resultant, H, of the horizontal and vertical components is indicated at 34. The absolute spacing of the pole pieces 14 and the shields 16 will depend upon a variety of factors, such as the recording track width, the width of guard bands or safety zones between tracks, the desired field strength, and so forth. In general, however, it is a matter of relatively simple design technique to optimize the spacings between the pole pieces 14, and between the pole pieces and the shields 16, to obtain a relatively constant field strength across a desired tape width. Variations in field strength across the width the recording track are of little consequence, so long as the resultant field strength remains above a minimum level, which should be several times the value of the maximum field strength measured outside the recording track width.

The shields 16 may, in a variation of the embodiment of Figure 1, be formed as a single continuous shield 16', shown in Fig, 1a, having a single aperture 40 therein to receive the two pole pieces 14. The continuous shield 16' eliminates the possibility of stray paths, through the air, between the two separate shields 16.

It will be appreciated from the foregoing that the present invention represents a significant advance in the field of magnetic recording. In particular, it provides a less costly alternative to demagnetization of recording tapes by alternating current means, and does so by obviating the disadvantages previously thought to be inherent in the use of direct current erase heads. It will also be appreciated that, although a particular embodiment of the invention has

been described in detail for purposes of illustration, various modifications may be made without departing from the spirit and scope of the invention. Accordingly, the invention is not to be limited except as by the appended claims.

Claims

1. An erase head for erasing recorded signals from single tracks of a multi-track magnetic recording tape, comprising a pair of pole pieces having faces located for contacting a moving magnetic tape,
magnetic circuit means providing a low reluctance path between said pole pieces, and
magnetic shielding means arranged adjacent to the pole pieces, characterized in that the faces (14a) of the pole pieces (14) are arranged in a generally parallel relationship spaced across the width of the moving magnetic tape (12) to provide a magnetic field in the plane (z axis) of the moving tape (12) and directed primarily perpendicular (x axis) to the direction of tape movement and a source (18, 19) of constant magnetomotive force is provided, the said magnetomotive force being applied to said magnetic circuit means (17) to produce an unvarying magnetic field between said pole pieces (14), and
said magnetic shielding means (16, 16') are spaced outwardly from said pole pieces (14) in a substantially coplanar relationship with said faces (14a), whereby the resultant magnetic field strength in a plane perpendicular to the direction of movement of the tape is substantially uniform in a region inward of said shielding means (16, 16') but is minimized outside the region (Fig. 2, Fig. 3).

2. An erase head as set forth in claim 1, characterized in that said magnetic shielding means includes a pair of flat metal plates (16) spaced apart from said pole pieces (14) by approximately the width of a single recording track to be erased.

3. An erase head as set forth in claim 1, characterized in that said magnetic shielding means includes a single flat metal plate (16') having an aperture (40) of approximately the same width as a single recording track, to accommodate said pole pieces (14).

4. An erase head as set forth in claims 1 and/or 2, characterized in that said pole pieces (14) are parallel bars of rectangular cross section, and the faces located for contacting the moving tape are rectangular end faces (14a); and said magnetic circuit means includes a generally U-shaped core (17) joining the ends of said pole pieces (14) opposite said rectangular end faces (14a).

5. An erase head as set forth in claim 1 and one or more of claims 2 to 4, characterized in that the source of constant magnetomotive force is a magnetizing winding (18) on a magnetic core (17) energized with direct current (19) and magnetic shielding means (16, 16') having planar portions located on each side of said two pole pieces, in the same plane as its end faces, whereby the horizontal component of magnetic field strength is substantially zero in the regions adjacent to said end faces and adjacent to said shielding means, the vertical component of field strength is substantially zero except in the regions adjacent to said end faces, and the resultant field strength is relatively great in the region between the portions of said shielding means but is essentially zero elsewhere (Fig. 2, Fig. 3).

6. An erase head as set forth in one or more of claims 1 to 5, characterized in that said magnetic shielding means (16') have an aperture (40) for accommodating the

faces (14a) of the pole pieces (14) in such a way that said faces (14a) do not protrude beyond the surface of said shielding means (16').

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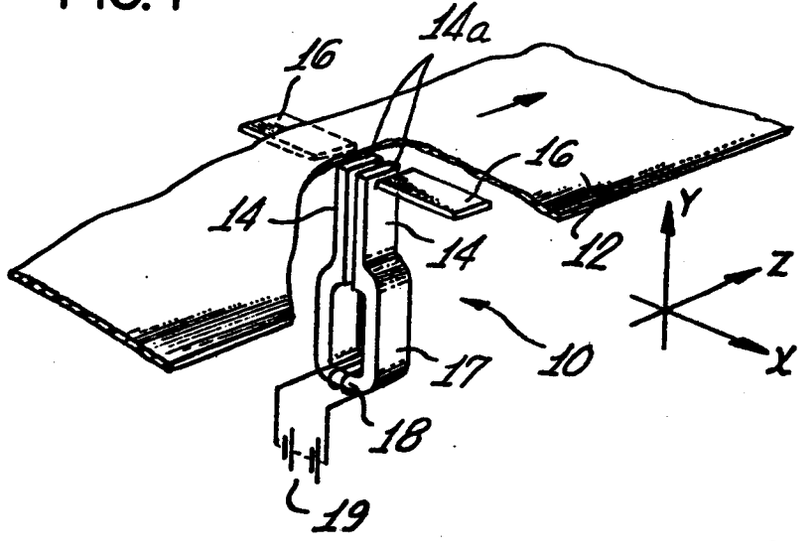
FIG. 1



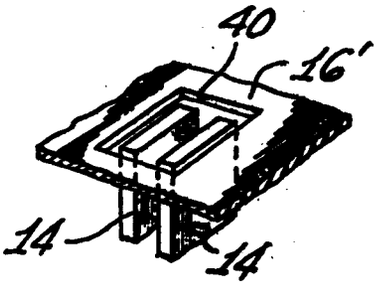


FIG. 1a

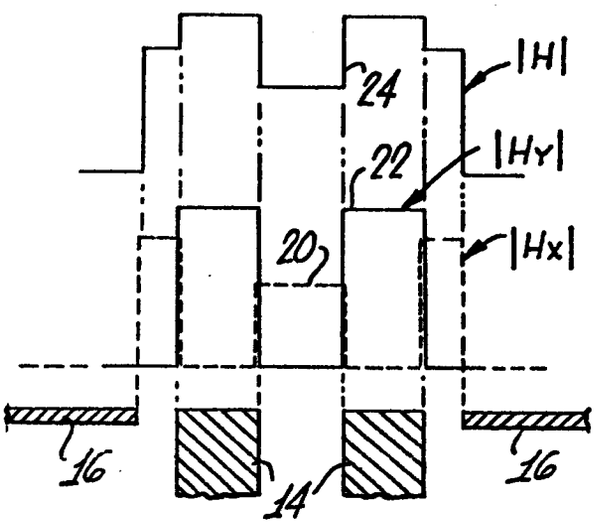
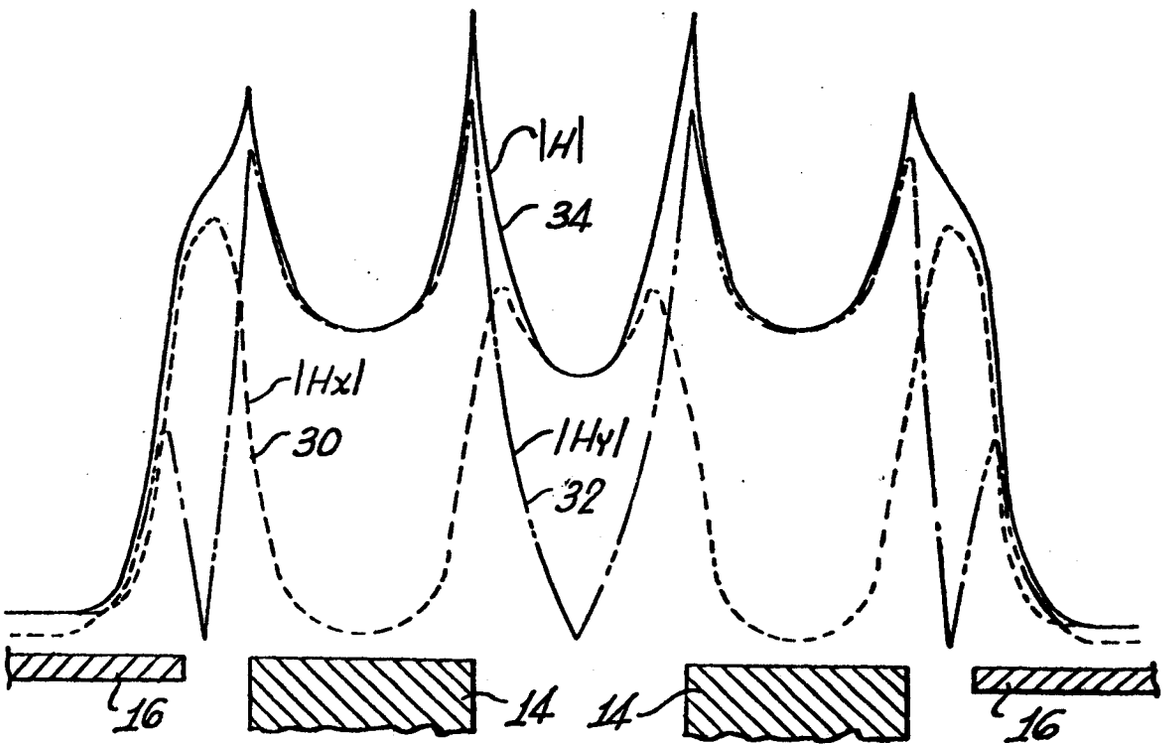


FIG. 2

FIG. 3



European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 79 101 312.1

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	DE - C - 1 136 841 (ELECTRIC & MUSICAL INDUSTRIES LIMITED) * claim 2, column 1, line 51 to column 2, line 29; fig. 1 *	4
	US - A - 4 071 868 (MATSUSHITA ELECTRIC INDUSTRIAL CO. LTD.) * claims 1 to 3; fig. 2 *	2
	US - A - 3 194 894 (BSR LIMITED) * claim 1; fig. 4 *	4
A	US - A - 3 610 838 (SONY CORPORATION) * complete document *	

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

G 11 B 5/22
G 11 B 5/12

TECHNICAL FIELDS SEARCHED (Int.Cl.³)

G 11 B 5/00

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	24-07-1979	LEITHÄUSER

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