United States Patent

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Sunbury, Pa.

[54] ADJUSTABLE CONCAVE GUIDES FOR ROTARY HEAD MAGNETIC TAPE MACHINES

8 Claims, 21 Drawing Figs.

[52] U.S. Cl. 179/100.2, 178/6.6, 226/199

[51] Int. Cl. G11b 5/52, H04n 1/24, B65h 23/24

[50] Field of Search ..... 179/100.2 T, 100.2 C; 178/6.6 A; 226/196, 199

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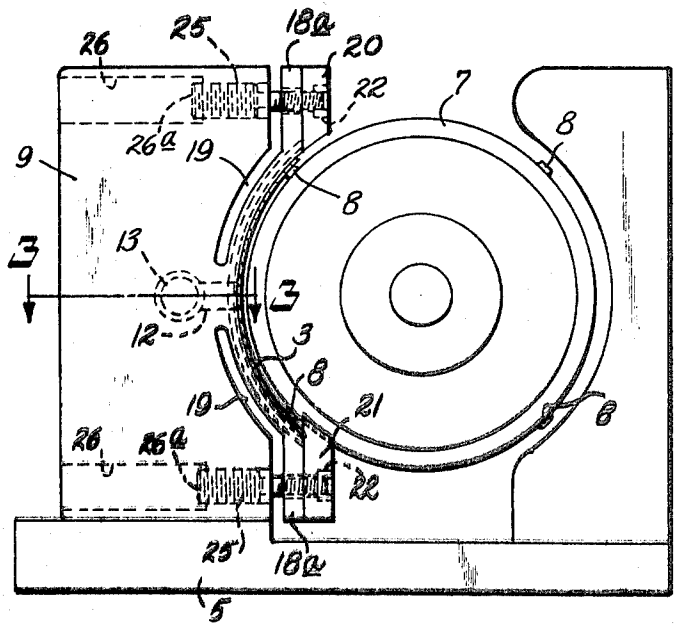
Primary Examiner—J. Russell Goudeau
Attorney—Markva, Smith & Kruger

ABSTRACT: A concave guide is so constructed that the shape of different portions of the guide can be adjusted to selectively change the shape and curvature of the guide. The arrangement is such that the guide can be adjustably deformed to an S-shaped curvature if desired. In the preferred embodiment the guide includes two arms projecting from a point of rigid connection with a body, adjusting screws at the ends of the arms can be manipulated to change the curvature of the arms, and a vacuum source communicates with the guide at the location of connection with the body.



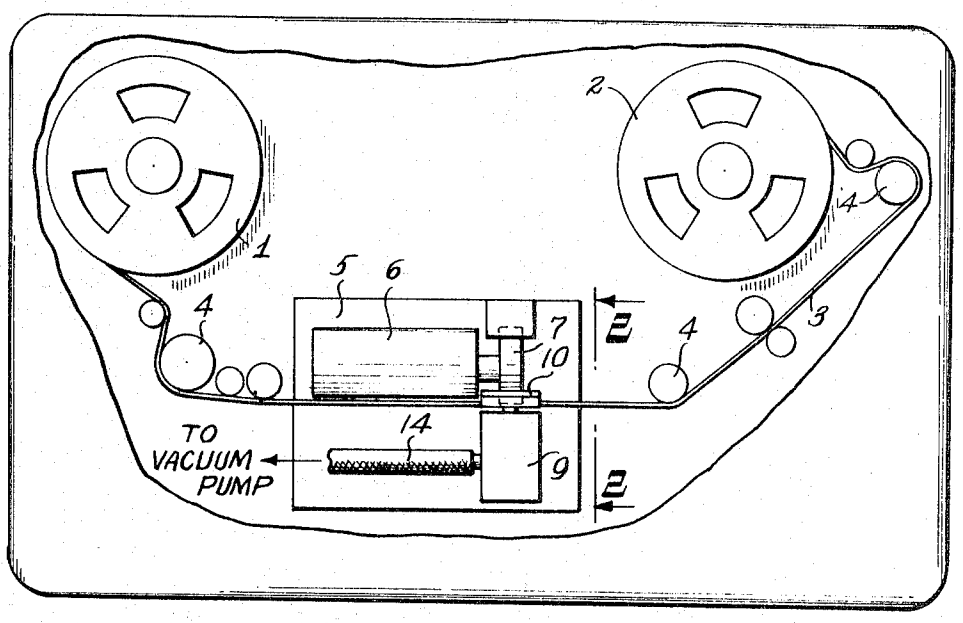


Fig. 1.

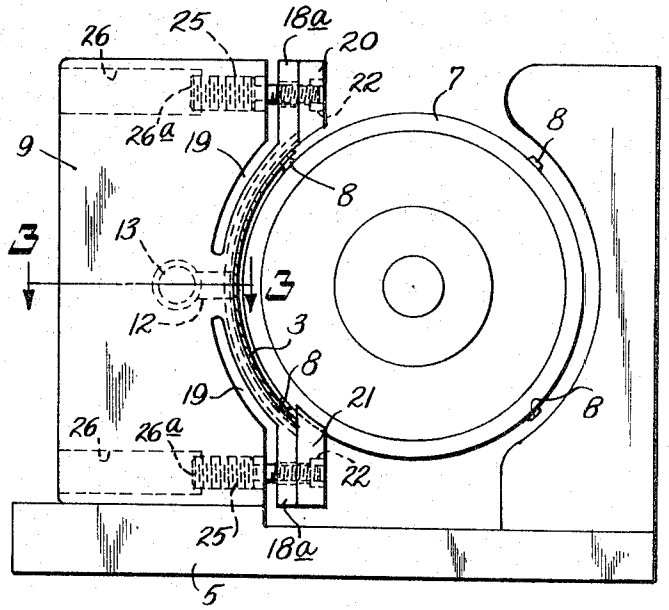
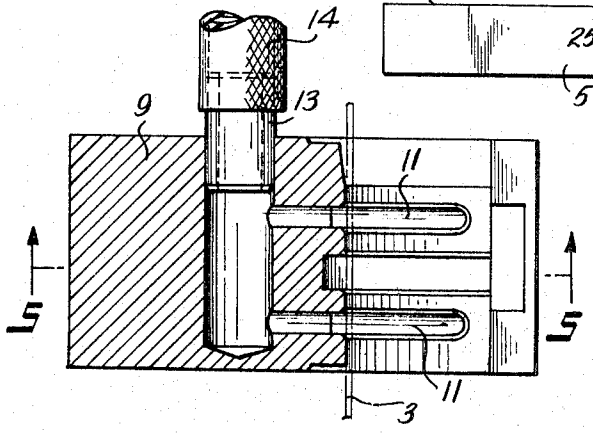


Fig. 2.

Fig. 3.



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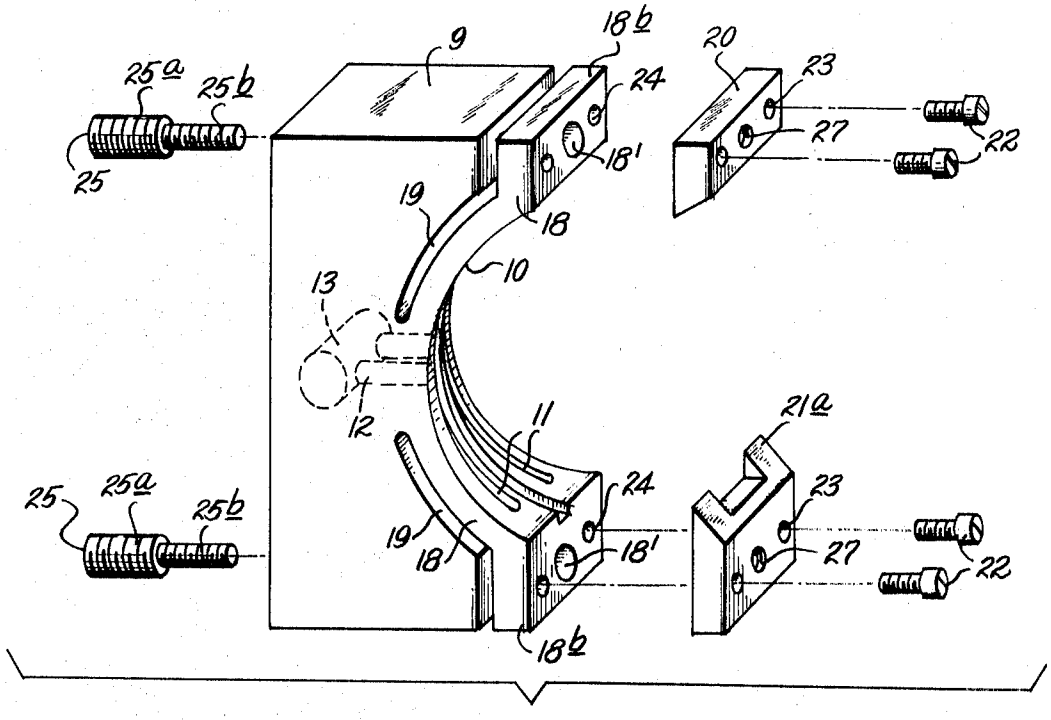

Fig. 4.

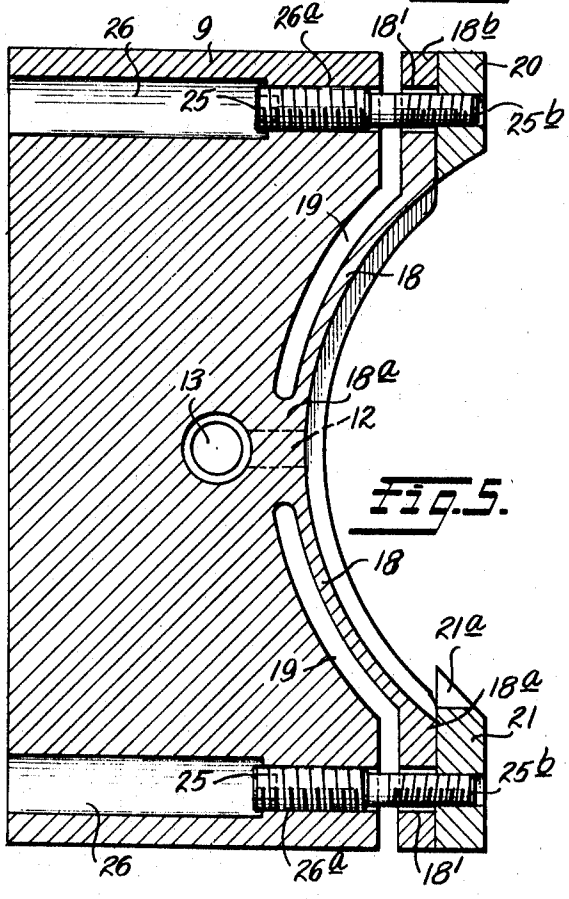

Fig. 5.

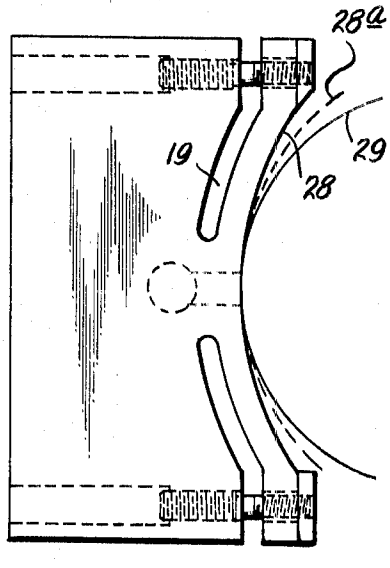

Fig. 15.

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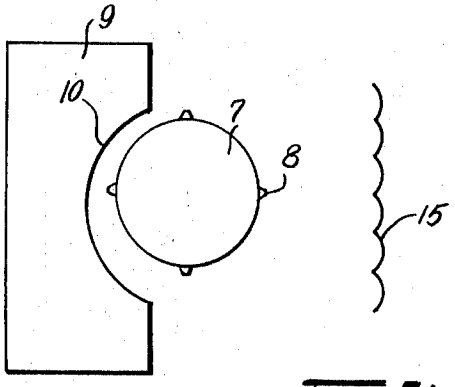

Fig. 6A.

Fig. 6.

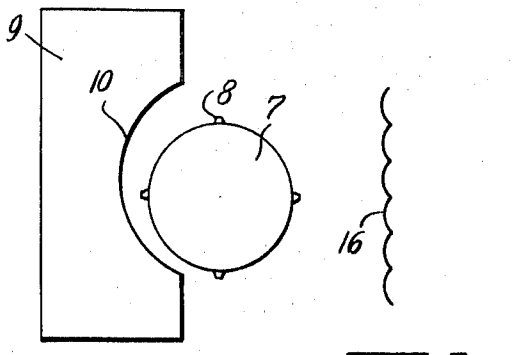

Fig. 7A.

Fig. 7.

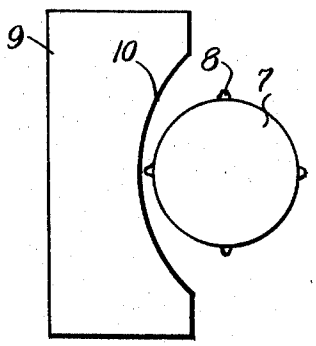

Fig. 9.

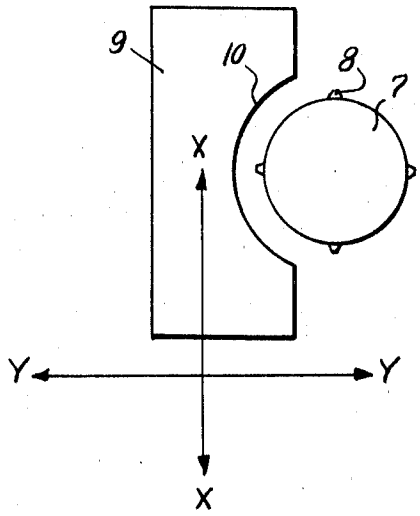

Fig. 8.

Fig. 10.

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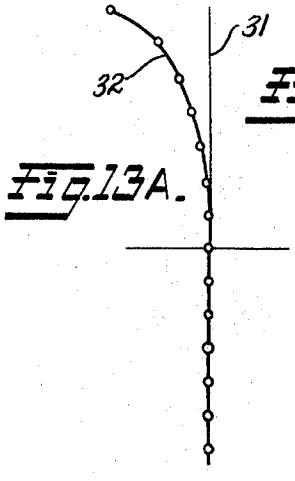

Fig. 13A.

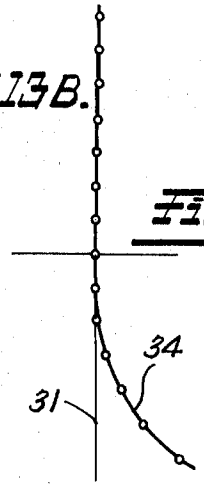

Fig. 13B.

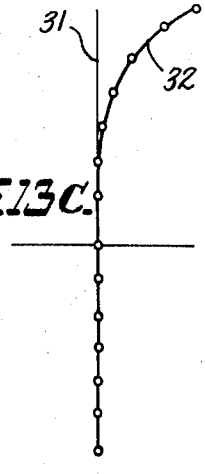

Fig. 13C.

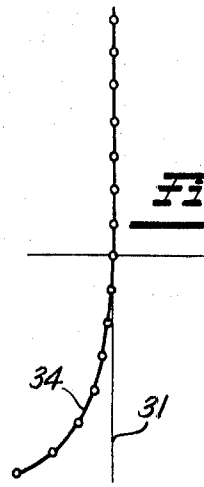

Fig. 13D.

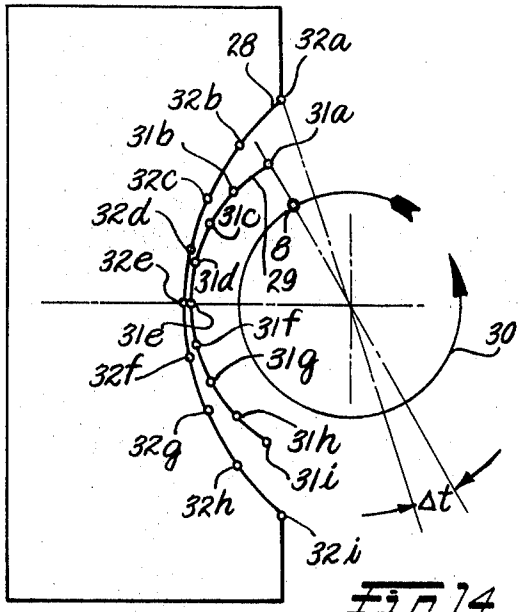

Fig. 14.

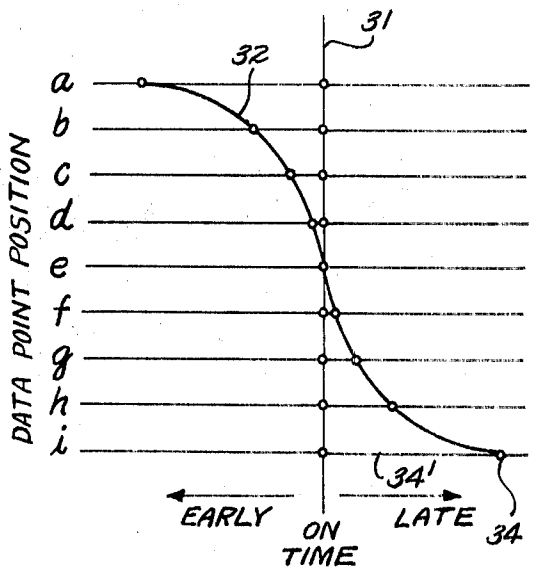

Fig. 14A.

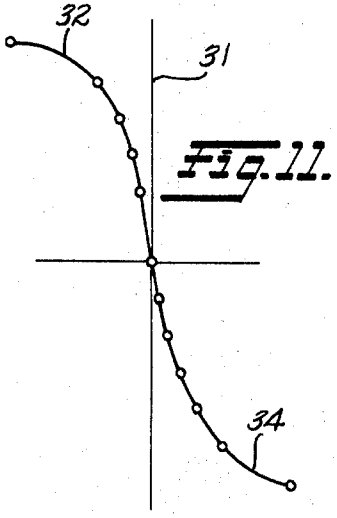

Fig. 11.

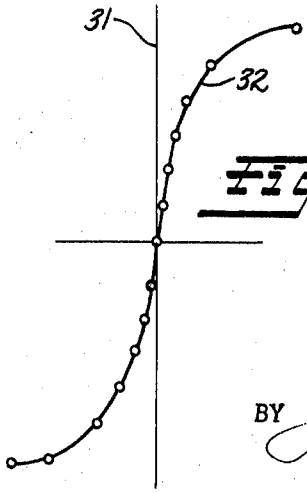

Fig. 12.

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ADJUSTABLE CONCAVE GUIDES FOR ROTARY HEAD MAGNETIC TAPE MACHINES

This invention relates to concave guides for rotary head magnetic tape recording and reproducing machines, and more particularly to television recording and reproducing apparatus.

In such machines, the tape is usually drawn longitudinally parallel to the axis of a rotating head drum or wheel on the periphery of which are mounted a series of magnetic heads, spaced angularly from each other, that successively sweep over the tape transversely. A cylindrical concave vacuum guide is used to maintain the tape in proper relation to the rotating head wheel or drum.

One of the problems encountered in the operation of such apparatus is distortion of the data being reproduced. This frequently occurs when a tape is recorded on one "panel" or machine, and reproduced or played back on another nominally identical "panel" or machine, but which may differ slightly. Distortion may also occur if the tape has suffered physical damage as a result of severe use, even if played back on the same panel on which it was recorded.

There are two distinct types of time base distortion known. One is referred to as a "scallop" distortion, and is due to the fact that the curvature of the concave guide is not precisely concentric with the cylindrical head wheel or drum because the center of rotation of the drum is displaced, on the vertical axis, from the center of curvature of the guide. Means have been developed in the prior art for adjusting the guide position in such manner as to correct or eliminate this "scallop" distortion.

The other type of distortion is known as "S" distortion. It is due to the fact that the panel assembly used to record the tape contained a vacuum guide of slightly different shape than the vacuum guide contained in the panel used to play the tape back. It can also be caused by the fact that subsequent to initial recording, the tape, and therefore the magnetic data which it contained, suffered physical distortion. In this latter case, "S" will occur even if the playback guide shape is identical to the shape of the original record guide.

So far as I am aware, no one heretofore has succeeded in correcting this "S" distortion.

The main object of the present invention therefore is to devise means for correcting this "S" distortion.

A subsidiary object is to provide means for making the necessary adjustments while the panel is playing back a test tape, so that the operator can tell by observation when the distortion has been reduced to a minimum. A second subsidiary object is to provide a means of recording "standard" test tapes having a greater level of tape-to-tape uniformity.

I accomplish this correction of the "S" distortion by forming the concave vacuum guide with a pair of movable arms arranged to embrace the head wheel or drum, and by providing means by which these arms may be individually adjusted so as to cause their inner surface to assume a curvature or shape, which may or may not be a true circular arc concentric to the center of rotation of the drum, depending upon the situation causing the distortion, but which will be the optimum or most nearly correct shape required by the existing geometrical relationships between the drum, the wheel and the data recorded on the tape.

In order that the invention may be readily understood, reference is had to the accompanying drawings, forming part of this specification, and in which:

FIG. 1 is a diagrammatic view illustrating the type of apparatus to which the invention relates;

FIG. 2 is an end elevation of a panel involving the invention;

FIG. 3 is a horizontal section substantially on the line 3–3 of FIG. 2, looking in the direction of the arrows;

FIG. 4 is an "exploded" perspective view of my improved vacuum guide by itself;

FIG. 5 is a transverse vertical section substantially sn the line 5–5 of FIG. 3, looking in the direction of the arrows;

FIG. 6 is a diagrammatic view showing the guide relatively too low with respect to the rotary drum;

FIG. 6A is a diagrammatic view showing the scalloped distortion resulting from the relative position of the parts shown in FIG. 6;

FIG. 7 is a diagrammatic view similar to FIG. 6 but showing the guide too high with respect to the rotary drum;

FIG. 7A is a diagrammatic view similar to FIG. 6A but showing the scalloped distortion resulting from the relative position of the parts shown in FIG. 7;

FIG. 8 is a diagrammatic view generally similar to FIGS. 6 and 7 but indicating how the relative position of the parts can be changed to correct or eliminate the scalloped distortion;

FIG. 9 is a diagrammatic view similar to FIG. 8 but showing the guide to be out-of-round, i.e., ellipsoidal with major axis vertical;

FIG. 10 is a diagrammatic view similar to FIGS. 6A and 7A but showing the species of "S" distortion resulting from the out-of-round condition shown in FIG. 9;

FIG. 11 is an enlarged diagrammatic representation of the "S" distortion produced during a single transverse sweep of a single magnetic head across the tape during playback when the guide radius is too small and/or too far away from the wheel in the horizontal direction, and/or when the guide is elliptical with major axis vertical, as in FIG. 9;

FIG. 12 is an enlarged diagrammatic representation of the "S" distortion produced during a single transverse sweep of a single magnetic head across the tape during playback when the guide radius is too large and/or too close to the wheel in the horizontal direction and/or when the guide is elliptical with the major axis horizontal;

FIGS. 13A, 13B, 13C and 13D are diagrammatic representations of the general shapes of "S" distortions produced by various types of unsymmetrical out-of-round conditions of the vacuum guide during playback, as compared with symmetrical conditions during record.

FIGS. 14 and 14A together constitute a single diagram explaining the geometrical causes for "S" distortion using the case of an out-of-round guide whose shape approaches that of an ellipse with major axis vertical; and

FIG. 15 is a diagram showing how my improved vacuum guide can be adjusted to eliminate or reduce to an acceptable minimum, the "S" distortion resulting, for example, from an elliptical guide with major axis vertical.

Referring to the drawings in detail and first more particularly to FIG. 1, the tape 3 is wound on a reel 1 from which it passes around guide pulleys 4 to a takeup reel 2.

During its travel from one reel to the other it passes through a panel 5 on which is mounted a motor 6 driving the head wheel or drum 7 on the periphery of which are mounted a series of angularly spaced magnetic heads 8 which, as the wheel or drum rotates sweep transversely over the concave surface of the tape 3 (see FIG. 2).

Also forming a part of the panel 5 is a vacuum guide 9 having a concave face 10 (see FIG. 4) which partially embraces the rotary head wheel or drum one one side, and maintains the tape in the proper shape.

Extending lengthwise of the concave surface of the vacuum guide 9 are one or more grooves 11 (two being shown), and these grooves are connected by conduits 12 with a passageway 13 formed in the guide 9 and connected with a source of vacuum by suitable conduit as is perhaps best shown in FIGS. 1 and 3.

Referring now to FIGS. 6 to 8, the scalloped distortion is indicated in FIG. 6A at 15 and in FIG. 7A at 16. FIG. 8 indicates diagrammatically that the prior art teaches that the guide can be adjusted vertically and horizontally along the axes X–X and Y–Y so that the guide can be brought into true concentric relation with the rotary wheel or drum, and in this way the scallop distortions 15 and 16 can be corrected or eliminated.

The most serious distortion which, so far as I am aware, no one has heretofore succeeded in eliminating, is the so-called "S" distortion indicated diagrammatically at 17 in FIG. 10, and different forms on an enlarged scale in FIGS. 11, 12, 13A, 13B, 13C and 13D.

FIG. 14A is an enlarged view of one of the distorted lines shown at 17 in FIG. 10, and it will be noted that this particular form of "S" distortion consists in the fact that the impulses making up the picture, instead of lying in a straight line 31 as they should, come too early, as indicated at 32, at the upper part of the line and too late as indicated at 34 at the lower part of the line, thus producing a reversely curved line of impulses which gives rise to observable distortion of the picture. Other forms of distortion of either the upper part 32 of the line or the lower part 34, or both, are also shown in FIGS. 12 and 13A to 13D.

FIG. 14 represents a vacuum guide having an out-of-round condition such that its concave surface 28 is more accurately described as a vertical ellipse than as a true circular arc. The vacuum guide illustrated is considered, for the present purpose, to be in the process of playing back a tape upon which has been recorded a straight vertical line, as shown at 31. The tape was previously record using a truly circular vacuum guide concentrically arranged to the center of rotation of the wheel as suggested by the dashed circular arc 29 shown in FIG. 14. In the figure, the path of the magnetic head 8 is represented by means of a counterclockwise vector 30. The points 31*a* through 31*a* on the circular arc 29 indicate the position of the magnetic data on the tape relative to the path of the head 30 at initial recording. The points 32*a* through 32*l* on the elliptical concave surface 28 indicate the positions of the magnetic data on the tape relative to the path 30 of the head 8 at "playback." The difference between the relative positions of magnetic data and head path at initial record and the relative positions of magnetic data and head path at playback arises because, at record, the tape is positioned with respect to the head path by a circular and concentric guide while at playback the same tape is positioned by means of an elliptically shaped guide. To further explain how "S" distortion occurs, consider the magnetic head 8 at FIG. 14 to be playing back the tape while it is being held in position by the circular and concentric vacuum guide represented by the circular arc 29. It will be noted that the head 8 first comes into radial alignment with data point 31*a* on 29 and then into radial alignment with 31*b* and so on through 31*i*. It will be further noted that, in this case, radial alignment of head and magnetic data point occur at the same angular position of the head as when the data point was initially recorded and, since the head rotates with constant angular velocity, it may be said that radial alignment occurs at the "same time" during playback as during record. In other words, during "playback" the head arrives at each data point exactly "on time" with reference to record. Refer now to FIG. 14A. Let the vertical axis 31 contain the distribution of signal impulses produced by the magnetic data points on the tape and let the horizontal axis 34' represent the "time" at which the data is played back relative to the "time" at which it was recorded. In the case of playback using the same vacuum guide 29 as was used for record, the impulses are seen to occur "on time" and therefore fall upon the vertical or "on time" axis 31.

With reference again to FIG. 14: consider the magnetic head 8 to be playing back the same tape as in the foregoing case. In this case, however, the tape is being held in position by the elliptically out-of-round vacuum guide surface 28. It will be noted that the head 8 first comes into radial alignment with magnetic data point 32*a* on 28 and then into radial alignment with 32*b* and so on through 32*i*. It will be further noted that the radial alignment of head and magnetic data point does not occur at the same angular position of the head as when the data point was initially recorded. Rather, the head 8 aligns with data point 32*a* on 28 at some time "ealier" than it aligned with 31*a* which is the same date point as 32*a* except that it is in a different position. As the head continues to rotate, it next aligns itself with 32*b;* again, this occurs some time "earlier" than alignment with 31*b*. However, alignment with 32*b* is not quite as early as was head alignment with 32*a*. Head to magnetic data point alignment grows less early as the head approaches alignment with 32*e* at which point the head is "on-time." The head next aligns itself radially with magnetic data point 32*f* at some small time "later" than it aligned with 31*f* which is the position of the same data point when the tape was being held by the truly circular guide 29. The head grows more and more "late" as it continues to rotate until it reaches data point 32*i* at which point is is "late" by the same amount of time that it was "early" in arriving at data point 32*a*.

Referring to FIG. 14A, it will be noted that the signal impulses produced at alignment of the head 8 with data points 32*a* through 32*i* give rise to the reversely curved or "distorted" line 32.

It may be pointed out that if the tape in foregoing discussion had been initially recorded using the elliptically out-of-round vacuum guide shown in FIG. 9 and/or FIG. 14, then "S" distortion would have occurred as a result of "playing back" using the circular and concentric guide or any other guide which is not shaped precisely the same as the guide used for recording.

The variation of the series of impulses, i.e., so-called "S" distortion, is due to the fact that the shape of the concave inner surface of the vacuum guide used for initial recording of the tape is not the same as the shape of the concave inner surface of the vacuum guide used for playing back the tape and therefore, adjusting the guide position along the axis x–x and y–y as shown in FIG. 8, will not eliminate nor minimize the "S" distortion.

I have found that this "S" distortion can be eliminated or reduced to an acceptable minimum by adjusting the shape of the concave inner surface of the vacuum guide by means of a construction shown in FIGS. 4 and 5.

By reference to these FIGS. it will be seen that I make up the inner concave surface of the guide by means of a pair of flexible arms 18, arranged end-to-end, and these meeting ends, being rigidly joined to the body of the guide by means of an integral portion 18*a* as best shown in FIG. 5. Other than this integral portion the arms are spaced from the body substantially throughout their length as indicated at 19 so that the arms are free to flex and move relative to the body.

At the upper end of the guide is a nut 20 and at the lower end a nut 21, both nuts being secured firmly to the ends of the arms 18 by means of screws 22 passing through openings 23 in the nuts 20 and 21 and engaging threaded openings 24 in the end portions 18*b* of the arms 18.

Horizontally and transversely of the guide body 9 adjacent to its upper and lower end are openings 26 through which pass a specially constructed bolt member 25 which I will describe as a "differential screw." It is clearly shown in FIGS. 4 and 5 and comprises a relatively large threaded portion 25*a* engaging a threaded portion 26*a* of the opening 26.

The bolt or screw 25 has a threaded extension 25*b* of smaller diameter, and this engages a threaded opening 27 in the nuts 20 and 21. This portion of smaller diameter passes freely through an unthreaded opening 18' in the ends 18*b* the arms 18.

Both portions of these special bolts are threaded in the same direction but each portion has a slightly different lead; thus, when the bolt 25 is rotated one turn clockwise the nut 20 will advance to the right (see FIG. 5) for a distance equal to the differential between the leads of bolt portions 25*a* and 25*b*. This motion will cause the upper flexible arm to move clockwise with respect to a flexure point located in the integral body portion 18*a*. This movement of the flexible arm is shown best in FIG. 15. By virtue of the differential action of the bolt, extremely fine adjustments of the ends of the arms 18 can be made. The lower nut 21 preferably has tape guiding lugs 21*a* projecting from the upper surface thereof.

It will thus be seen that by turning the screws 25 the ends of the arms 18 may be moved inwardly or outwardly relative to the body of the vacuum guide, thus altering the radius of curvature of the concave surface 10 of the arms, and changing the shape of the concave surface defined by these arms. In FIG. 15, the initial shape of the concave surface of the playback guide is indicated at 28, while 29 shows the shape of the concave surface at initial recording. The shape of the concave sur-

face as partially adjusted, is shown by a broken line at 28*a*. By continuing the adjustment in the same direction, the line 28*a* can be made to coincide more or less exactly with 29. In this way, the shape of the concave surface of the vacuum guide being used to play back a prerecorded tape can be adjusted to conform exactly to or closely approach the shape of the concave surface of the vacuum guide initially used to record the tape as is best shown in FIG. 15. Thus, "S" distortion at playback is either eliminated or reduced to an acceptable minimum.

It will also be particularly noted that the adjustment of these arms can take place while a test tape is being run so that the operator can tell by observation exactly when the optimum correction has been made.

What I claim is:

1. A concave vacuum guide to hold a magnetic tape in relation to a cylindrical rotating head drum comprising a body, a pair of curved arms disposed in end to end relation and together providing a continuous concave surface conforming in general with the cylindrical surface of said drum, said arms being integrally united at their meeting ends, the junction of such meeting ends being rigidly secured to said body, said arms being otherwise spaced from said body throughout their length, said arms being flexible, and means for independently adjusting the free ends of said arms relative to said body to alter their radius of curvature as desired.

2. A concave guide in accordance with claim 1 in which said body is provided with a passageway communicating with a source of vacuum, and the continuous concave surface of said two arms being formed with at least one groove connected with said passageway, said groove lying in a plane at substantial right angles to the axis of the head drum,

3. A concave vacuum guide in accordance with claim 1 in which said adjusting means comprises a screw threaded in an opening in each end of said body and having an extension connected with the free end of the arm, whereby turning said screw will move the free end of said arm toward or away from said body.

4. A concave vacuum guide in accordance with claim 3 in which a nut is secured to the free end of each arm, and said extension is threaded and passes freely through an opening in the arm but threadedly engages said nut.

5. A concave vacuum guide in accordance with claim 4 in which the extension of the screw which engages said nut is of smaller diameter than the main portion of the screw which engages said body, but threaded in the same direction, thus providing a differential screw capable of making extremely fine adjustments.

6. A panel for recording and reproducing television pictures by means of magnetic tape, said panel comprising a cylindrical rotary head drum carrying on its periphery a series of magnetic heads, a concave vacuum guide for said tape having a continuous concave surface embracing said drum at one side, and means for selectively changing the curvature of different portions of the continuous concave surface of said guide.

7. A panel for recording and reproducing television pictures by means of magnetic tape, said panel comprising a cylindrical rotary head drum carrying on its periphery a series of magnetic meads, a concave vacuum guide for said tape having a continuous concave surface embracing said drum at one side, and means for changing the shape of the continuous concave surface of said guide.

8. A concave vacuum guide to hold a magnetic tape in relation to a cylindrical rotating head drum comprising a body, curved arm providing a continuous concave surface conforming in general with the cylindrical surface of said drum, said arm being rigidly secured to said body at a location spaced from a free end of the arm, said arm being otherwise spaced from said body throughout its length, said arm being flexible, and means for adjusting at least the free end of said arm relative to said body to alter the radius of curvature of the arm.