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H. A. HOWELL
MAGNETIC TRANSDUCER HAVING AN
IRREGULAR NONMAGNETIC GAP
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2,469,266

Fig. 1.

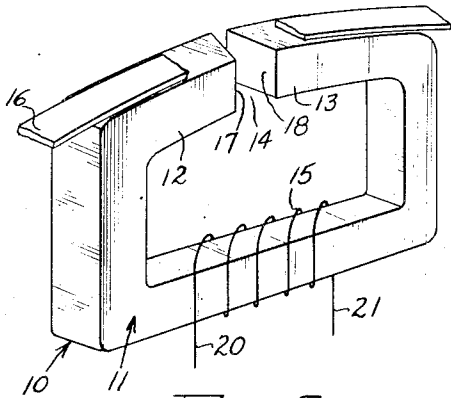


Fig. 2.

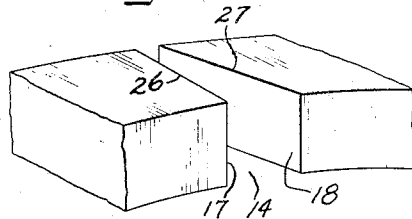


Fig. 6.

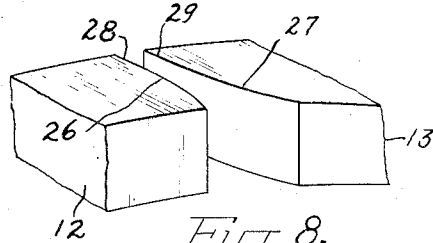


Fig. 7.

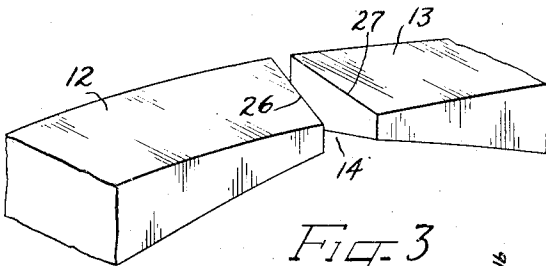


Fig. 8.

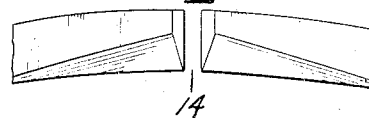


Fig. 3.

Fig. 4.

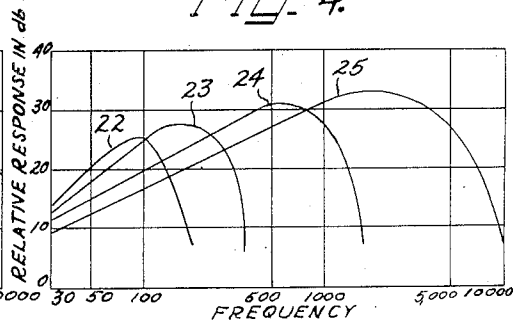
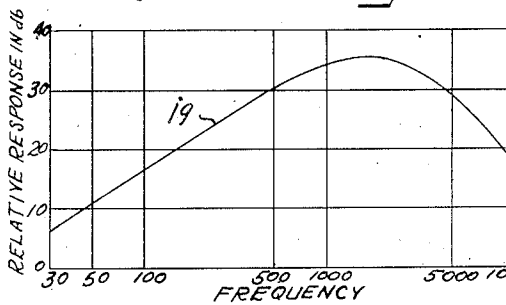
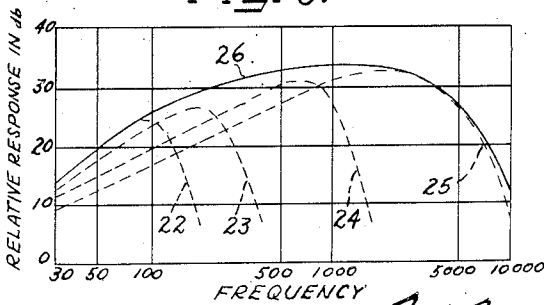


Fig. 5.



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MAGNETIC TRANSDUCER HAVING AN
IRREGULAR NONMAGNETIC GAP

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2 Claims. (Cl. 179-100.2)

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This invention relates to a new magnetic recording technique, and more particularly to a variable gap magnetic transducer head and novel method.

One of the principal features of the present invention is to provide an electromagnetic transducer head in which the nonmagnetic gap thereof varies from one side to another of the gap so that the flux density throughout the gap is not uniform but varies in a predetermined manner. When the electromagnetic transducer head is so arranged to provide a nonmagnetic gap in which the flux density varies in a predetermined manner or pattern, a greatly improved response characteristic is obtained. Since the current output in the pickup coil of a magnetic head varies in accordance with frequency of the signal impressed upon the record member and in accordance with the length of the gap it is necessary in order to get a level current output to have a different length gap for each frequency. By using an elongated record medium having a relatively wide dimension, such as by using a magnetic tape and by varying the length of the nonmagnetic gap from one side of the tape to the other in a longitudinal direction, the current output characteristic curve versus frequency is very greatly improved. Indeed it has been found that such an arrangement gives such a greatly improved result that a reproducing head may be connected directly into any home radio receiver without any special equalizer circuit.

It is an object of the present invention to provide a novel method and means for magnetic recording and reproducing.

Another object of the present invention is to provide a variable gap magnetic transducer head and method.

A further object of the present invention is to provide a novel transducer head in which the nonmagnetic gap is so arranged that the flux density throughout the gap varies from place to place.

A still further object of the present invention is to provide a novel magnetic transducer head in which the confronting pole faces of the polar portions thereof do not lie in spaced parallel planes but are of predetermined configuration giving a plurality of different distances between different confronting portions thereof.

Another and further object of the present invention is to provide a novel method and means for recording signals on a magnetic tape in such a manner that the so-called constant current response is more uniform and more easily corrected

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by equalization than the response hitherto possible.

The novel features which are believed to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and manner of construction, together with further objects and advantages thereof, may best be understood by reference to the following description, taken in connection with the accompanying drawing, in which:

Figure 1 is a diagrammatic isometric view of an electromagnetic transducer head embodying a novel feature and characteristic of the present invention;

Figure 2 is an enlarged fragmentary isometric view of the confronting polar portions of the electromagnetic transducer head shown in Figure 1;

Figure 3 is a graph showing a typical constant current response obtainable from an electromagnetic transducer head in which the confronting pole faces lie in spaced parallel planes;

Figure 4 is a graph showing a family of curves giving the variations in the frequency where the maximum output occurs with variations in gap lengths, each curve being for a different gap length;

Figure 5 is a graph similar to Figures 3 and 4 but giving the response characteristic when an electromagnetic transducer head is employed such as that illustrated in Figures 1 and 2 of the drawing;

Figure 6 is a fragmentary isometric view similar to Figure 2 but illustrating a modified form of the present invention;

Figure 7 is a fragmentary isometric view similar to Figures 2 and 6 illustrating a third embodiment of the present invention; and

Figure 8 is a fragmentary front elevational view of the polar portion shown in Figure 7.

The electromagnetic transducer head shown diagrammatically in Figure 1 of the drawing includes a core member 11 having a pair of symphonic core portions 12 and 13 with a nonmagnetic gap 14 lying therebetween. A signal coil 15 is wound around a portion of the core 11 and may be connected to an amplifier circuit (not shown) in any suitable and conventional manner. An elongated record medium in the form of a tape 16 passes over the top of the core member 11, it being observed that a portion of the tape 16 has been broken away at the gap 14 in order to show the configuration of the gap 14. The tape 16 may be any suitable

magnetic record member such as a paper tape coated with a permanent magnet material or a steel tape having a reasonably high coercive force.

It will be remembered that in a conventional electromagnetic transducer head in magnetic recording and reproducing devices the confronting pole faces 17 and 18 lie in spaced parallel planes. With such prior art structures the typical constant current response characteristic is illustrated in Figure 3 of the drawing. In this graph the curve 19 shows the relative E. M. F. developed across the terminals 20 and 21 of the winding 15 through the frequency range of 30 to 10,000 C. P. S., when the recording current which impressed the signal on the record member 16 is maintained constant for all frequencies throughout the indicated range during the recording operation. From the curve 19 of the graph in Figure 3 it will be noted that the output rises beginning at the lowest frequency at a rate of about 6 decibels per octave until a certain characteristic maximum has been reached. The maximum as shown in Figure 3 occurs at about 2,000 C. P. S. After the maximum is passed, the output more rapidly decreases. The rising portion of the curve 19 is due to the fact that the rate of change in flux induced in the transducer head 10 when it is acting as a reproducing head by the tape 16 determines the output. The maximum rate of change for a constant total number of lines is nearly proportional to the frequency. For example a high frequency would produce a faster rate of change than a low frequency at the same tape speed even though the remnant flux on the tape for the two frequencies were of the same value. The characteristic drop after the maximum on the curve is due to a condition imposed by the relation between the gap length and the tape velocity. The particular frequency point where the maximum output occurs increases as the tape speed is increased or as the gap is made shorter.

The characteristic rise in output from the lowest frequency to the maximum will be the range of most interest since it is in this range that the greatest amount of correction is required to get a relatively flat response. It will be noted in Figure 3 that the output at 30 C. P. S. is about 28 db. lower than at the maximum. This means that in order to make the proper correction an overall boost in the base response must be produced in the recording and playback amplifier. A 14 db. boost in the base response of the amplifier would record a higher level in the base region and during playback there would be an equivalent 14 db. boost. It will be here noted that when the proper low frequency boost is used to flatten out the range immediately below the maximum, the response at the extreme low end is still down a few db. and the base response suffers.

In Figure 4 there is a graph giving a family of curves showing the variations in the frequency where the maximum output occurs with variations in gap length, all other conditions being considered constant. More particularly the graph in Figure 4 gives four curves 22, 23, 24, 25. The curve 22 is for the longest gap and the curve 25 is for the shortest gap. By way of an example and not by way of limitation, the longest gap may be .1" while the shortest gap may be .0015".

In accordance with the teachings of the present invention, a gap is employed which varies in the length across the width of tape and as a

result thereof substantially the envelope of the family of curves shown in Figure 4 is obtained, as is shown by the full line 26 in Figure 5. The dotted lines in Figure 5 illustrate the same family of curves as shown in Figure 4. In this manner the maximum output is spread out or flattened over a substantial portion of the operating range. The curve 26 of Figure 5 is obtained from an electromagnetic transducer head having a variable nonmagnetic gap as illustrated in Figure 1 of the drawing. This particular head is shown more clearly in the fragmentary view of Figure 2. More particularly the gap 14 is in the form of a wedge. The pole faces 17 and 18 lie in vertical planes which diverge from the back side of the core 11 to the front side of the core 11. This may be seen clearly by the diverging lines 23 and 27 which are the top edges of the nonmagnetic gap.

Since the length of the nonmagnetic gap from one pole portion to the other, as shown in Figure 2, varies across the width of the tape it will be seen that in effect we have the summation of an infinite number of curves making up a family (of which a few are shown in Figure 4). The overall effect is that the current response is the summation of the family of curves and thus a current response characteristic like 25 is obtained rather than a response characteristic like 19.

The particular shape of the final response characteristic 26 as shown in Figure 5 of the drawing may be controlled by the manner in which the gap length varies from one side of the core to the other. Thus instead of using a wedge shaped gap which is not shown in Figures 1 and 2, a gap may be employed in which the upper lines 26 and 27 of the pole pieces 12 and 13 are curves which gradually flare apart. As shown particularly in Figure 6, the initial portions may be parallel as at 28 and 29 before they start to gradually flare out, depending upon the shape of the final response characteristic desired.

A third embodiment of the present invention is illustrated in Figures 7 and 8 of the drawing wherein the top edges 26 and 27 not only diverge as in Figure 2 of the drawing but the thickness of the pole pieces 12 and 13 vary from one side to the other. This, when carried out in the manner shown in Figures 7 and 8 of the drawing, produces a much more rapid change in flux density in the gap 14 than is obtained with Figure 2.

While I have shown some particular embodiments of my invention, it will, of course, be understood that I do not wish to be limited thereto, since many modifications may be made, and I, therefore, contemplate by the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

I claim as my invention:

1. A magnetic transducer head comprising a paramagnetic core having a pair of confronting pole portions with a nonmagnetic gap therebetween over which a traveling magnetizable tapelike record member is arranged to pass, the confronting faces of said pole portions being shaped to diverge from each other from one side edge of said gap to the other and said pole portions also being decreased in thickness from said first side edge to said second side edge, and a signal coil on said core for establishing a fluctuating magnetic field across said gap.

2. A magnetic transducer head comprising a paramagnetic core having a pair of confronting

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pole portions with a non-magnetic gap therebetween over which a traveling magnetizable tape-like record member is arranged to pass, the confronting faces of said pole portions being shaped so that at least a portion of the span therebetween from one side of the path of travel of the tape-like record member to the other progressively increases, the depth of said pole faces decreasing in thickness over the region where the span progressively increases, and a signal coil 10 on said core for establishing a fluctuating magnetic field across said gap.

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REFERENCES CITED

The following references are of record in the file of this patent:

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