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(54) MAGNETIC TRANSDUCER HEAD

(71) We, RCA CORPORATION, formerly known as Radio Corporation of America, a corporation organized under the laws of the State of Delaware, United States of America, of 30 Rockefeller Plaza, City and State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a magnetic transducer head capable of a high efficiency of operation.

Single turn transducer heads have been known in the art for some time but have had limited use because of severe problems of fabrication and operation. In the typical prior art heads a conductor usually consisting of metal foil forms the single turn which is mounted between the pole tips in the same place occupied by a gap spacer in a conventional ring head. However at video frequencies the gap dimensions must be kept small to insure proper frequency response. This permits only a very small cross-sectional area of the single turn which limits its current carrying capability and therefore reduces transducer efficiency. To remedy this problem attempts have been made to couple the single turn to a remote transformer. However the leads required introduce intolerable amounts of stray inductance which degrade performance especially at high frequencies. Alternatively the transformer has been brought in closer proximity by utilizing a portion of one of the magnetic legs of the head core as the core for the transformer. While this reduces the inductance, it introduces interference problems in magnetic circuits of the head.

A transducer head according to the invention comprises a pair of discrete pole pieces having adjacent surfaces with a gap therebetween; insulating means in said gap; a pair of clamping members holding said pole pieces in said adjacent relationship and having portions which co-operate with each

other to form an internal space adjacent said pole pieces; a core member of magnetically permeable material situated within said internal space; an electrical winding wound about said core member; and a single turn closed loop unitary electrical conductor passing about said core and through said gap.

With such a construction it is possible to provide a very short magnetic flux path, thereby requiring less drive current. This path comprises the proximate portions of the juxtapositioned pole pieces with the intervening single turn disposed therebetween in part, and the portion of the recording medium adjacent to the gap formed by the pole pieces. This compactness of the magnetic circuit is due to the skin effect in the magnetically separated pole pieces at high frequencies which sets up eddy currents in the extremes of the pole pieces thereby containing the magnetic lines to the gap vicinity. The resultant efficiency of the magnetic circuit permits the use of a pole piece material which is less efficient magnetically but more resistant to wear. The single turn also links a toroid of high efficiency magnetic material having an independent multiple turn secondary winding to form a transformer which provides the required signal transfer characteristics. The mounting of the toroid in close proximity to the pole pieces but magnetically independent of them except for the coupling afforded by the single turn, eliminates magnetic circuit interference and reduces lead inductance. Secondary gap effect which is caused by the grain boundaries in the pole tip material is virtually eliminated by providing a hole in the pole pieces for the single turn which is small.

Figure 1 is a view of a magnetic head according to one embodiment of this invention.

Figure 2a—b are views of a magnetic head according to another embodiment of this invention.

Figure 3 is an expanded view of one portion of the head of Figure 2.

Figure 4 is an expanded sectional view of another portion of the head of Figure 2.

Figure 1 shows a magnetic transducer comprising a pair of separate magnetic pole pieces 3 and 4 mounted in a pair of "C" shaped non-magnetic clamping blocks 1 and 2. The pole pieces 3 and 4 are preferably constructed from a material such as the magnetic alloy of approximately 85.3% iron, 9.5% silicon, and 5.2% aluminium (by weight) sold under the Trade Name Alfecon whose characteristics are a compromise between high magnetic efficiency and good wear resistance. However, the pole pieces 3 and 4 may also be formed from a ferrite material. Clamping blocks 1 and 2 are preferably made of a hard non-magnetic material such as brass and contain slots 17 and 18 respectively in which are mounted the pole pieces 3 and 4. Each of the pole pieces 3 and 4 contains a groove there-through in the confronting pole faces which together form the aperture 12 having a diameter of approximately .005 inches. An insulating layer of Silicon Monoxide of approximate thickness of 50 micro inches is disposed between the faces of pole pieces 3 and 4 to form the working gap 13. The surfaces 14 and 16 of the pole pieces and the plane of joinder 15 of the clamping blocks are similarly covered with a layer of Silicon Monoxide. A single closed turn 6 of electrically conductive material such as copper, silver or gold passes through aperture 12 formed at the gap 13 between pole pieces 3 and 4. The single turn 6 further couples to a toroidal core 5 of high magnetic permeability such as ferrite, which is disposed within the opening of the "C" shaped clamping blocks 1 and 2. A multiple turn winding 7 of the material used for single turn 6 is also wound about toroid core 5 to provide proper signal transformation to and from the working gap 13 of the head. A channel 9 is provided in clamping block 2 through which the leads of winding 7 are coupled to terminals 11 of the recessed terminal board 10. For structural integrity and proper insulation, a potting compound 8 such as Hysol (Registered Trade Mark) cement is provided which fills the open spaces between clamping blocks 1 and 2, the channel 9 and covers recessed terminal board 10.

If reference is made to Figure 2a there is shown a view of a magnetic transducer according to another embodiment of the invention. The structure, material and mode of operation of this transducer are identical to that of Figure 1 with the exception of the single turn 20. The single turn 20 of Figure 2a is passed about core 5 and through aperture 12 in the form of a figure eight as contrasted with the elliptical shape of the single turn 6 of Figure 1. This figure eight con-

figuration affords increased inductive coupling in the magnetic circuit of the transducer. Figure 2a also shows more clearly the details of the transducer structure including pressure screw 21 which engages the threaded aperture 22 of clamping block 1 to hold the head assembly together.

Figure 2b is an end view of the transducer of Figure 2a showing the disposition of the toroid 5, pole piece 3, terminal board 10 and threaded aperture 22.

Figure 3 is an expanded view of the working gap area of the transducer of Figure 2 showing the structural interrelation of the pole pieces 3 and 4 with the single turn 20, toroid 5 and its multiple winding 7.

Figure 4 is an enlarged sectional view along the section line 4-4 of Figure 2a which more clearly shows how the figure eight single turn winding 20 is disposed about toroid 5 and through the aperture 12 at the gap face of pole piece 4.

WHAT WE CLAIM IS:—

1. A magnetic transducer head comprising a pair of discrete pole pieces having adjacent surfaces with a gap therebetween; insulating means in said gap; a pair of clamping members holding said pole pieces in said adjacent relationship and having portions which co-operate with each other to form an internal space adjacent said pole pieces; a core member of magnetically permeable material situated within said internal space; an electrical winding wound about said core member; and a single turn closed loop unitary electrical conductor passing about said core and through said gap.

2. A magnetic transducer head according to Claim 1 wherein said pole pieces are composed of Alfecon material as hereinbefore identified.

3. A magnetic transducer head according to Claim 1 wherein said pole pieces are composed of ferrite material.

4. A magnetic transducer head according to any preceding claim wherein said insulating means comprises a layer of silicon monoxide material.

5. A magnetic transducer head according to any preceding Claim wherein said clamping blocks are C-shaped and face each other to define by their C-shapes said internal space in which said core is accommodated.

6. A magnetic transducer head according to any preceding Claim wherein said closed loop electrical conductor is generally in the form of an ellipse.

7. A magnetic transducer head according to any of claims 1-5 wherein said closed loop electrical conductor is generally in the form of a figure eight.

8. A magnetic transducer according to any preceding claim wherein each of said

Figure 4 is an expanded sectional view of another portion of the head of Figure 2.

Figure 1 shows a magnetic transducer comprising a pair of separate magnetic pole pieces 3 and 4 mounted in a pair of "C" shaped non-magnetic clamping blocks 1 and 2. The pole pieces 3 and 4 are preferably constructed from a material such as the magnetic alloy of approximately 85.3% iron, 9.5% silicon, and 5.2% aluminium (by weight) sold under the Trade Name Alfecon whose characteristics are a compromise between high magnetic efficiency and good wear resistance. However, the pole pieces 3 and 4 may also be formed from a ferrite material. Clamping blocks 1 and 2 are preferably made of a hard non-magnetic material such as brass and contain slots 17 and 18 respectively in which are mounted the pole pieces 3 and 4. Each of the pole pieces 3 and 4 contains a groove there-through in the confronting pole faces which together form the aperture 12 having a diameter of approximately .005 inches. An insulating layer of Silicon Monoxide of approximate thickness of 50 micro inches is disposed between the faces of pole pieces 3 and 4 to form the working gap 13. The surfaces 14 and 16 of the pole pieces and the plane of joinder 15 of the clamping blocks are similarly covered with a layer of Silicon Monoxide. A single closed turn 6 of electrically conductive material such as copper, silver or gold passes through aperture 12 formed at the gap 13 between pole pieces 3 and 4. The single turn 6 further couples to a toroidal core 5 of high magnetic permeability such as ferrite, which is disposed within the opening of the "C" shaped clamping blocks 1 and 2. A multiple turn winding 7 of the material used for single turn 6 is also wound about toroid core 5 to provide proper signal transformation to and from the working gap 13 of the head. A channel 9 is provided in clamping block 2 through which the leads of winding 7 are coupled to terminals 11 of the recessed terminal board 10. For structural integrity and proper insulation, a potting compound 8 such as Hysol (Registered Trade Mark) cement is provided which fills the open spaces between clamping blocks 1 and 2, the channel 9 and covers recessed terminal board 10.

If reference is made to Figure 2a there is shown a view of a magnetic transducer according to another embodiment of the invention. The structure, material and mode of operation of this transducer are identical to that of Figure 1 with the exception of the single turn 20. The single turn 20 of Figure 2a is passed about core 5 and through aperture 12 in the form of a figure eight as contrasted with the elliptical shape of the single turn 6 of Figure 1. This figure eight con-

figuration affords increased inductive coupling in the magnetic circuit of the transducer. Figure 2a also shows more clearly the details of the transducer structure including pressure screw 21 which engages the threaded aperture 22 of clamping block 1 to hold the head assembly together.

Figure 2b is an end view of the transducer of Figure 2a showing the disposition of the toroid 5, pole piece 3, terminal board 10 and threaded aperture 22.

Figure 3 is an expanded view of the working gap area of the transducer of Figure 2 showing the structural interrelation of the pole pieces 3 and 4 with the single turn 20, toroid 5 and its multiple winding 7.

Figure 4 is an enlarged sectional view along the section line 4-4 of Figure 2a which more clearly shows how the figure eight single turn winding 20 is disposed about toroid 5 and through the aperture 12 at the gap face of pole piece 4.

WHAT WE CLAIM IS:—

1. A magnetic transducer head comprising a pair of discrete pole pieces having adjacent surfaces with a gap therebetween; insulating means in said gap; a pair of clamping members holding said pole pieces in said adjacent relationship and having portions which co-operate with each other to form an internal space adjacent said pole pieces; a core member of magnetically permeable material situated within said internal space; an electrical winding wound about said core member; and a single turn closed loop unitary electrical conductor passing about said core and through said gap.

2. A magnetic transducer head according to Claim 1 wherein said pole pieces are composed of Alfecon material as hereinbefore identified.

3. A magnetic transducer head according to Claim 1 wherein said pole pieces are composed of ferrite material.

4. A magnetic transducer head according to any preceding claim wherein said insulating means comprises a layer of silicon monoxide material.

5. A magnetic transducer head according to any preceding Claim wherein said clamping blocks are C-shaped and face each other to define by their C-shapes said internal space in which said core is accommodated.

6. A magnetic transducer head according to any preceding Claim wherein said closed loop electrical conductor is generally in the form of an ellipse.

7. A magnetic transducer head according to any of claims 1-5 wherein said closed loop electrical conductor is generally in the form of a figure eight.

8. A magnetic transducer according to any preceding claim wherein each of said



- pole piece surfaces has a groove extending across the width thereof so as to form an aperture through the pole piece assembly at said gap, the center axis of said aperture being parallel to the transducing gap surface formed by said pole pieces; said insulating means comprises a layer of insulating material disposed in said gap on the adjacent surfaces of said pole pieces including said grooves; and each of said clamping members comprises a block having a slot therein for holding a respective one of said pole pieces while also defining said internal space within the assembled clamping blocks.
9. A single turn magnetic transducer head substantially as described herein with reference to Figure 1 of the accompanying drawing.
10. A single turn magnetic transducer head substantially as described herein with reference to Figures 2a, 2b, 3 and 4 of the accompanying drawing.

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