Feb. 23, 1960 M. CAMRAS 2,926,220

ELECTROMAGNETIC HEAD CONSTRUCTION

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Fig. 1

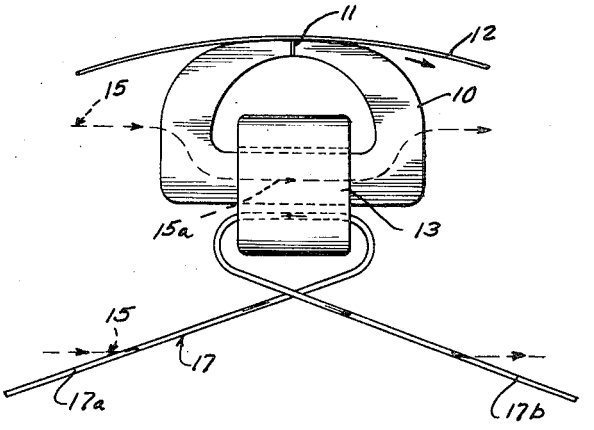


Fig. 2

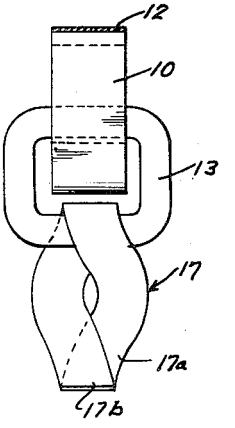


Fig. 4

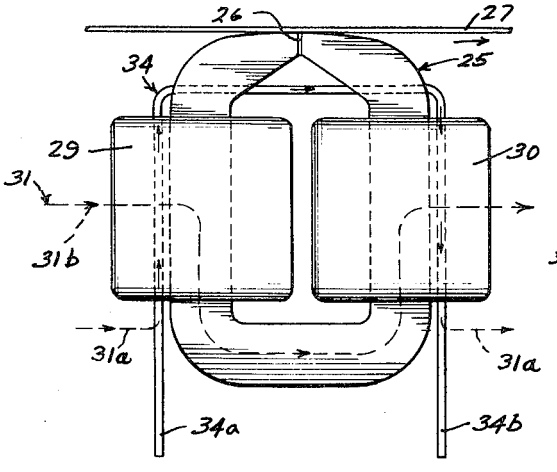


Fig. 5

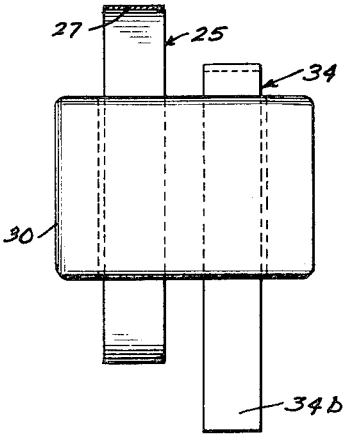
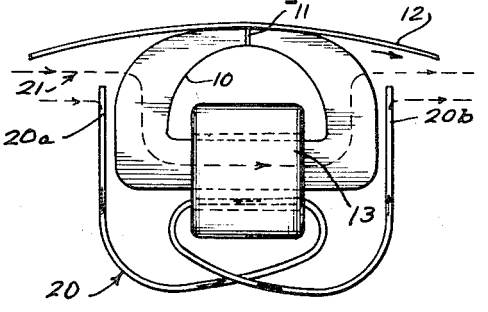


Fig. 3



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ELECTROMAGNETIC HEAD CONSTRUCTION

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Fig. 6

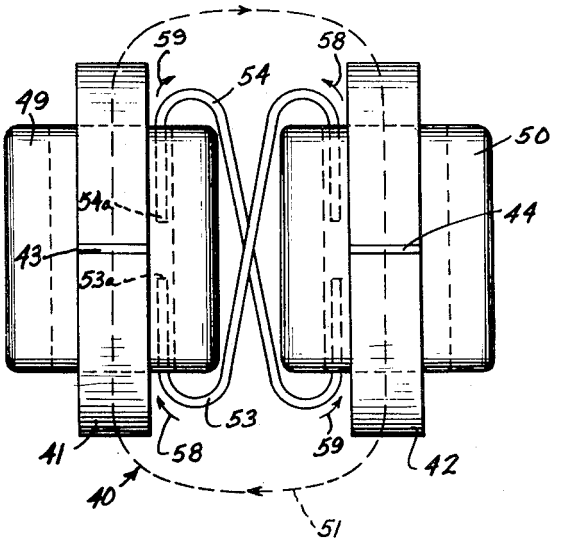


Fig. 7

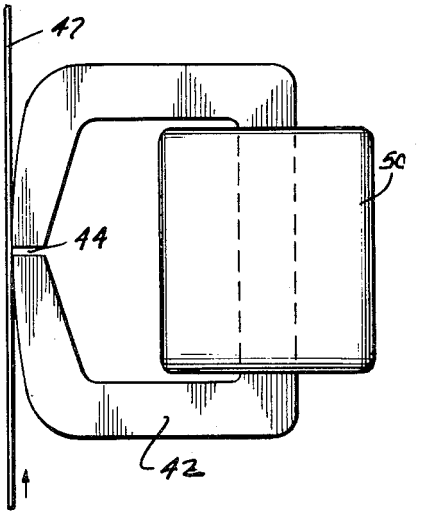


Fig. 8

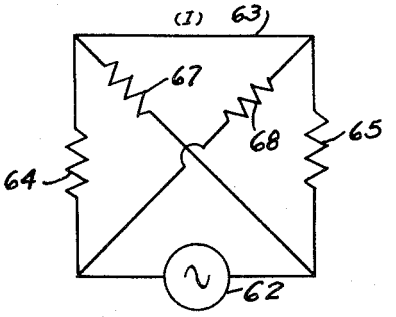


Fig. 9

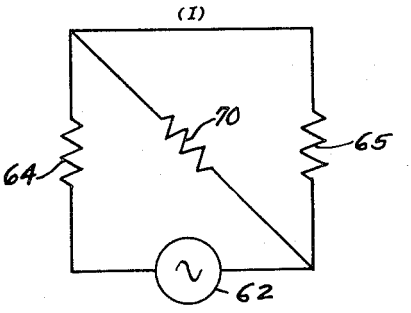
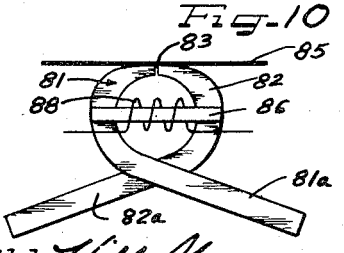


Fig. 10



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United States Patent Office 2,926,220 Patented Feb. 23, 1960

2,926,220

ELECTROMAGNETIC HEAD CONSTRUCTION

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Application September 7, 1955, Serial No. 532,834

8 Claims. (Cl. 179—100.2)

This invention relates to a novel magnetic transducer head construction and particularly to such a structure having novel means for balancing stray flux.

It is an object of the present invention to provide a novel method and means for balancing stray flux in magnetic transducer heads.

It is a further object of the present invention to provide a novel hum balancing structure for magnetic transducer heads.

Still another object of the present invention is to provide a novel structure for reducing cross talk between adjacent cores of a multi-channel head.

A further object of the present invention resides in controlling the coupling of a magnetic head with respect to external fields while maintaining close coupling with a magnetic record.

Other objects, features and advantages of the present invention will be more fully apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

Figure 1 is a diagrammatic side elevational view of a first transducer head in accordance with the present invention;

Figure 2 is a side elevational view of the structure of Figure 1;

Figure 3 is a diagrammatic illustration of a modified head construction;

Figure 4 is a diagrammatic illustration of a further modified form of head construction in accordance with the present invention;

Figure 5 is an end elevational view of the structure of Figure 4;

Figure 6 is a diagrammatic plan view of a multi-channel head having means for preventing cross talk;

Figure 7 is an elevational view of the structure of Figure 6;

Figure 8 illustrates an electrical equivalent to the magnetic circuit involved in Figure 6;

Figure 9 is a view similar to Figure 8 but illustrating the situation with only a single magnetic piece between the adjacent cores of the multi-channel head; and

Figure 10 shows a further modified head construction.

As shown on the drawings:

Figures 1 and 2 illustrate a first form of the invention wherein a conventional magnetic transducer core **10** has a non-magnetic gap **11** for coupling the core to a record member **12**. The core has a recording or pickup coil **13** linking the core **11** which is subject to hum pickup due to a stray field illustrated for example by the dash lines **15** which thread the coil **13** as indicated at **15***a*. In accordance with the present invention an auxiliary magnetic strip **17** preferably of high permeability material as "Mumetal" having a composition of 5% copper, 2% chromium, 77% nickel and the remainder iron and minor constituents, or "Supermalloy" composed of 5% molybdenum, 79% nickel and the remainder iron and minor constituents, is provided having oppositely directed spaced free ends **17***a* and **17***b*, connected by a loop portion in such a manner that flux picked up by the leg **17***a* is threaded through the coil **13** in a direction opposite to the flux picked up by the coil directly, which is indicated at **15***a*, to balance out or cancel the effect of the flux **15***a*. Legs **17***a* and **17***b* should be separated where they cross each other. To simplify assembly, legs **17***a* and **17***b* may be separate pieces, joined by lapping the ends thereof inside the coil **13**.

Figure 3 illustrates a modified construction having a core **10** and gap **11** similar to that of Figure 1 and a coil **13** which is also similar to that of Figure 1. However, in this case the magnetic hum balancing piece **20** has its end portions **20***a* and **20***b* bent to intersect more of the hum flux indicated at **21** which tends to link the main core **10**. Further, the end portions **20***a* and **20***b* may be of increased area as compared to the remainder of the magnetic piece **20** so as to intercept more of the flux at the critical region.

Figures 4 and 5 illustrate a modified construction wherein a magnetic core **25** having a non-magnetic gap **26** for receiving a record medium **27** thereacross has a pair of pickup coils **29** and **30** subject to stray pickup due to a hum flux indicated by the dash lines **31**. In this case, a U-shaped core member **34** is threaded through the coils **29** and **30** in such a manner that the air gap between the legs **34***a* and **34***b* of the auxiliary core is on the opposite side of the coil from the gap **26**. In this manner, hum flux as indicated at **31***a* which is picked up by the auxiliary core **34** tends to thread the coils **29** and **30** in the opposite direction from the flux **31***b* which threads the main core **25**.

In Figures 6 and 7, a multi-channel head **40** is illustrated having a pair of cores **41** and **42** with non-magnetic gaps **43** and **44** respectively for receiving laterally adjacent channels of a magnetic record medium **47**. Record or playback windings **49** and **50** respectively, are provided for establishing recording flux at the gaps **43** and **44**, or for producing a voltage due to the threading of a signal flux in the respective cores. For example, in recording, the winding **49** may be energized and this causes a desired recording field across the gap **43** but also sets up a stray flux as indicated at **51** linking the coil **50**. To oppose this stray flux **51**, a pair of auxiliary magnetic pieces **53** and **54** are provided having end portions **53***a* and **54***a* in the respective coils **49** and **50** and connecting opposite ends of the coils so as to produce fluxes as indicated by the arrows **58** and **59** opposing the stray flux **51** in the winding **50**.

The electrical analogy for this situation is illustrated in Figure 8 wherein the voltage source **62** corresponds to the magnetomotive force from the energized head, for example due to the energization of winding **49**, the branch **63** has a current corresponding to the stray flux in the second head along the path represented by electrical resistances **64** and **65**, the stray flux being reduced to zero by proper adjustment of the path through the balancing auxiliary pieces **53** and **54** represented by the resistances **67** and **68**. The network of Figure 8 corresponds to a Wheatstone bridge arrangement so that it will be understood that the current in the branch **63** may be reduced to zero by proper adjustment of the resistances **67** and **68**. Figure 9 illustrates the corresponding situation where there is only a single auxiliary magnetic path between the two windings represented by resistance **70**. In this case, current (I) can be reduced by resistance **70** but not perfectly balanced out as with the circuit of Figure 8 corresponding to the embodiment of Figures 6 and 7.

It will be understood that the auxiliary pieces in Figs. 1 to 7 may be adjustable in size or position to provide the desired cancellation of the stray flux, or alternatively the adjustment or size of the auxiliary pieces may be predetermined for satisfactory reduction of unwanted pickup.

Adjustment of the length or area of the ends such as 17*a*, 20*a*, or 34*a* protruding from the coils is particularly effective in securing a balance.

Experimental results indicate that for the head of Figures 1 and 2 with a single core oriented in a standard field for maximum hum pickup, without the auxiliary piece 17 the relative hum voltage output was about 35 db, while with the auxiliary piece 17 in place adjusted for best balance, the hum voltage pickup in the same field when the head was oriented for maximum hum pickup was 16½ db.

With the head of Figures 4 and 5, without the auxiliary piece 34, the maximum relative hum voltage pickup in a standard field was 26 db while with the auxiliary piece the maximum relative pickup was 6 db.

In the head of Figures 1 and 2, the coil 13 was 3000 turns ½ inch long while the core 10 was 3/16 inch wide by .010 inch thick. In the head of Figures 4 and 5, the pole pieces were 3/32 of an inch wide by .014 inch thick, and the coils each had 3000 turns and were ½ inch long.

In Figure 10, the head has a pair of core legs 81 and 82 with a gap 83 between one pair of free ends of the legs coupling the head to a magnetic record member 85. A bridge member 86 overlaps intermediate portions of legs 81 and 82 and completes a loop magnetic circuit including gap 83. Pickup winding 88 is wound on bridge 86 and stray flux linking winding 88 directly is opposed by stray flux picked up by end 82*a* of leg 82 and channeled through bridge 86 and then through end 81*a* of leg 81. Ends 81*a* and 82*a* are spaced where they cross as in Figure 1.

It will be apparent that many modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

I claim as my invention:

1. A magnetic transducer head comprising a core having a non-magnetic gap for receiving a magnetic record medium thereacross, and a coil linking said core, the improvement characterized by auxiliary magnetic means forming a magnetic circuit linking said coil and channeling stray flux through said coil in the opposite direction from stray flux linking said coil by means of a path separate from said auxiliary magnetic circuit.

2. A magnetic transducer head comprising a core having a non-magnetic gap for receiving a magnetic record medium thereacross, and a coil linking said core, the improvement characterized by an auxiliary magnetic piece forming a magnetic circuit linking said coil and disposed to channel stray flux through said coil in the opposite direction from flux linking said coil by means of a path separate from said auxiliary magnetic circuit, said auxiliary piece comprising an elongated member extending through said coil and having opposite free ends crossing in spaced relation and extending in opposite directions generally along the axis of said coil.

3. A magnetic transducer head comprising a core having a non-magnetic gap for receiving a magnetic record medium thereacross, and a coil linking said core, the improvement characterized by an auxiliary magnetic piece forming a magnetic circuit linking said coil and disposed to channel stray flux through said coil in the opposite direction from flux linking said coil by a path separate from said auxiliary magnetic circuit, said auxiliary piece being of generally U-shape and having legs extending through a pair of coils on said core and terminating at the opposite side of said core from said gap therein.

4. A magnetic head construction comprising a magnetic core having a non-magnetic gap, winding means linking said core, an auxiliary magnetic piece having a portion thereof extending within said winding means and having a further portion thereof joining with said first portion on a reverse bend and extending generally parallel with said first portion and channeling stray flux through said winding means in the opposite direction from stray flux linking said winding means by a path spaced from said auxiliary magnetic piece.

5. A multi-channel head comprising a pair of adjacent cores having non-magnetic gaps and having winding means linking the respective cores, and a pair of auxiliary magnetic members having end portions extending into the respective windings and crossing so as to produce magnetic fluxes in one of the windings due to energization of the other opposing the fluxes linking between said winding means along paths separate from said auxiliary magnetic members.

6. A multi-channel head assembly comprising a first core having a flux sensitive element associated therewith responsive to flux linking said first core, a second core adjacent said first core and having a flux sensitive element associated therewith responsive to flux linking said second core, and auxiliary magnetic members in spaced crossed relation between said first and second cores and having an effect on the flux sensitive elements when linked by a stray flux opposite to the effect on the flux sensitive elements of the stray flux linking said cores by paths separate from said auxiliary magnetic members.

7. A magnetic transducer head comprising a core having a non-magnetic gap for receiving a magnetic record medium thereacross, and a flux sensitive element coupled to said core, the improvement characterized by an auxiliary magnetic means forming a magnetic circuit linking said flux sensitive element channeling stray flux through said flux sensitive element in the opposite direction from stray flux linking said flux sensitive element along a path disposed in spaced relation to said auxiliary magnetic circuit.

8. A multi-channel head comprising a pair of adjacent cores having non-magnetic gaps and having flux sensitive means in proximity to the respective cores, and a pair of auxiliary magnetic members having portions extending between the respective flux sensitive means and crossing so as to produce magnetic fluxes in one of the flux sensitive means associated with one of the cores due to energization of the other core opposing the flux linking between said other core and said one flux sensitive means along paths separate from said auxiliary magnetic members.

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