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METHOD OF ADJUSTING A MAGNETIC HEAD

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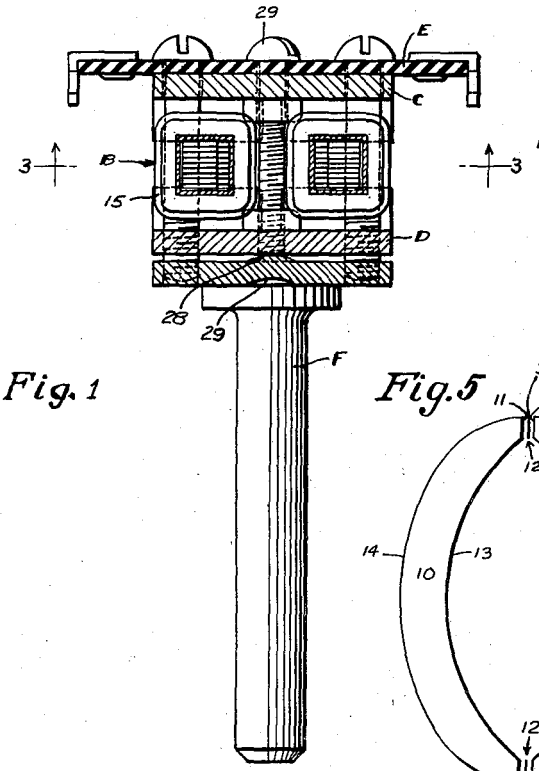


Fig. 1

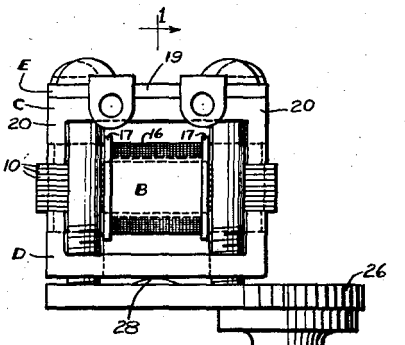


Fig. 2

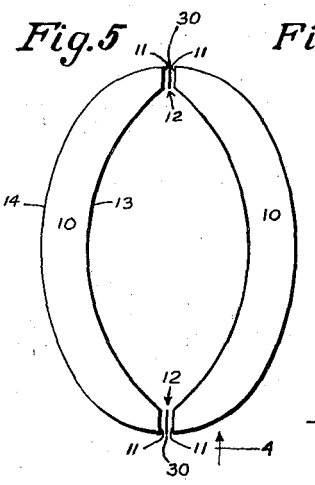


Fig. 5

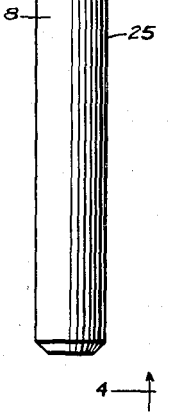


Fig. 4

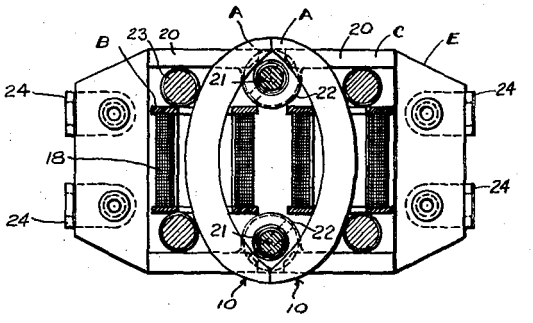
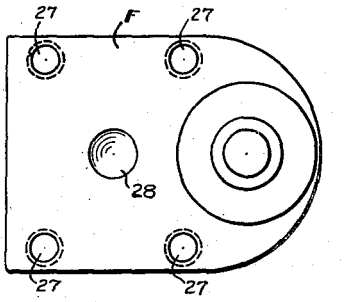


Fig. 3



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METHOD OF ADJUSTING A MAGNETIC HEAD

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Original application Jan. 14, 1949, Ser. No. 70,837, now Patent No. 2,745,905, dated May 15, 1956. Divided and this application May 14, 1956, Ser. No. 584,795

3 Claims. (Cl. 29—155.5)

This invention relates to magnetic head assemblies for use in magnetic recording and reproducing apparatus.

The invention is particularly concerned with magnetic recording, reproducing and erasing head assemblies, for example, of the general type disclosed in my copending application, Serial No. 777,677, now Patent No. 2,555,-110, issued May 29, 1951, that is to say, heads which are assembled from identical laminae to form a lamination symmetrical about a translating flux gap.

The present application is a division of my copending application, Serial No. 70,837, filed January 14, 1949, entitled Magnetic Head Assembly, which issued May 15, 1956, as Patent No. 2,745,905.

I have found that the pole pieces of magnetic heads which scan a magnetic record while in actual physical contact therewith are subject, over a period of time, to considerable wear. As the metal of the pole pieces wears away, the magnetic characteristics of the gap undergo changes as compared with the characteristics of a new head, and, if such wear continues, the characteristics of the gap may change so completely as to require the substitution of a new head for the worn head.

I have also found that in recording or reproducing heads comprising laminations which are asymmetrical about even one plane, and which therefore necessarily involve the asymmetrical location of the head windings with respect to at least one plane, difficulties are occasionally encountered in balancing the susceptibility of the windings to the influence of external electromagnetic fields, with the result that a hum or noise voltage representing the unbalance may appear at the terminals of the head and be amplified along with the signal being reproduced. The same condition can lead to the recording of hum and related disturbances when such a head is being used for recording.

Beyond the foregoing, I have found that for optimum operation of magnetic recording and reproducing equipment, particularly where magnetic records recorded on one apparatus are intended to be reproduced by another apparatus, it is essential to provide for extremely accurate orientation of the head relative to a record being scanned thereby, both as regards the alignment of the recording pole pieces with the record track and with regard to the angular orientation of the head of one machine with the head of another machine which is intended to be used interchangeably with the same record or records. Such accuracy of orientation is most difficult to attain with head assemblies and head mounting structures of the prior art.

It is a general object of the present invention to provide a magnetic head assembly which overcomes one or more of the difficulties outlined above.

It is another object of the invention to provide a magnetic head having two translating flux gaps so arranged that one of the gaps may be used after the pole pieces surrounding the other gap have become so worn as to render it unsatisfactory in recording, reproducing or erasing, and thus to extend the useful life of the head.

It is a further object of the invention to provide a magnetic head which is symmetrical about three planes, whereby to provide for simplicity of conversion from one flux gap to another; and, moreover, to provide a magnetic head in which the two flux gaps both lie in a plane of symmetry of the magnetic head whereby to further simplify the adjustment of the head from a position in which one gap is operative to a position in which the other gap is operative.

Beyond the foregoing, the invention contemplates a symmetrical arrangement of laminations and windings wherein the effects of external magnetic fields may easily be balanced as between the two windings.

The invention also contemplates novel means of securing a magnetic head to a head support in a manner to provide for simplicity of adjustment of the position of the head relative to the record being scanned.

Finally, the invention contemplates a magnetic head structure achieving one or more of the objectives hereinabove recited and further embodying a core half member so proportioned in plan as to receive a prewound coil assembly and thus obviate the necessity for winding the coil on the lamination.

How these objects and others which will appear are attained will be apparent upon consideration of the detailed description of the invention which is contained hereinbelow and the drawings, in which:

Figure 1 is a vertical sectional view on an enlarged scale through the magnetic head assembly of the invention taken as indicated by the line 1—1 in Figure 2;

Figure 2 is a side elevation of the assembly of Figure 1;

Figure 3 is a horizontal sectional view taken from below as indicated by the line 3—3 in Figure 1;

Figure 4 is a plan view of the bottom of the head assembly taken as indicated by the line 4—4 in Figure 2; and

Figure 5 is a plan view, on a still larger scale, of a pair of laminar half-members in exaggerated spaced-apart relationship.

The magnetic head assembly of the invention comprises eight major parts, namely, a pair of symmetrical identical lamination halves A, a pair of identical winding assemblies B, an upper clamp C, a lower clamp D, a terminal strip E, and a mounting fixture F.

Each lamination half A consists of a stack of laminar half members **10** whose symmetrical plan form may best be seen in Figure 5. The number of such members **10** in a stack depends upon the desired magnetic properties of the finished head; for example, in the head illustrated in the drawings, which is intended primarily for erasing magnetic records, I employ nine members **10** to make up each half of the lamination. In heads which are intended for other functions, either more or fewer members **10** may be employed.

Each member **10**, and accordingly each lamination half A, is characterized by a pair of end surfaces **11** adapted to define, in cooperation with the corresponding surfaces of the other lamination half, a flux gap **12** at each end of the lamination. The surfaces **11** lie in the plane of symmetry of the members **10**, and, accordingly, the completed lamination is characterized by a pair of similar flux gaps lying in a common plane.

The portion of each member **10** lying between the end surfaces **11** is defined by a generally arcuate inner surface **13** and an outer surface **14**, the surfaces **13** and **14** being substantially concentric in the median or coil-supporting portion of the member **10**, and approaching one another in the region of the flux gaps. Each surface is uninterrupted from its intersection with the gap face at one end to its intersection with the gap face at the other end of the lamination. Rather generally stated, the lamination thus formed is roughly elliptical in shape and

is characterized by a flux gap at each end, lying on the major axis of the ellipse. Geometrically speaking, the inner surface **13** may desirably take the form of an arc of a circle, and the median portion of the outer surface **14** may also be an arc of a circle having the same center as the surface **13**, while the end portions of the surface **14** are defined by arcs having somewhat smaller radii. When a pair of such lamination assemblies are placed in juxtaposition, with their surfaces **11** in spaced apart parallel relationship, the result is a lamination symmetrical about three axes and provided with a pair of identical flux gaps and with a pair of identical coil-supporting portions, each of which is magnetically and physically related to each flux gap in the same manner.

Each winding assembly B comprises a coil form **15** comprising a rectangular body **16** and a pair of end flanges **17**. Body **16** is proportioned to receive the thickness of the lamination stack, and its length and width are so-related that while it may be slipped over the end of a lamination stack, it will engage the curved coil-supporting portion of the lamination with suitable snugness. According to the invention, a coil **18** is wound on each form **15** prior to assembly on the laminations.

Clamps C and D are generally C-shaped in section, as may best be seen from Figure 2, comprising a body **19** and jaws **20** adapted to engage the laminations near the flux gaps, as may be seen in Figure 3, and are further characterized by holes **21** reinforced by flanges **22** and adapted to receive clamping screws, as will appear, and holes **23** which are adapted to receive mounting screws, as will also appear. Clamps C and D are identical, with the exception that the apertures **21** in lower clamp D are tapped to receive the clamping screws above referred to.

Clamps C and D are preferably formed by die-casting from non-magnetic material, which may be metallic, i.e., white metal or aluminum; or resinous, for example, phenol formaldehyde.

Terminal strip E, which may be formed of any convenient dielectric material, is approximately equal in width to clamp C but is appreciably longer and carries soldering lugs **24** at either end in positions out of contact with clamp C. In addition, terminal strip E is pierced by six holes adapted to be aligned with holes **21** and **23** in clamps C and D.

Mounting fixture F consists of a shouldered shank **25**, welded or otherwise secured to a base plate **26**. Base plate **26** is characterized by four tapped holes **27** adapted to be aligned with holes **23** of clamps C and D and by a raised hump **28** centrally located with respect to holes **27**. Hump **28** is formed by inverting plate **26** and striking the plate with a pointed tool to produce a dimple **29** (see Figure 1) on the lower side and the hump **28** on the upper side.

While the several elements hereinabove described lend themselves to assembly in a number of different ways, I have found that the following procedure is most desirable:

The lamination halves A are formed by inserting the desired number of laminar half members **10** in a fixture comprising a trough whose inner surface is congruent with the convex outer surface of the half members **10**. The members **10** are pressed into approximate position with the fingers and axial pressure applied thereto with a clamp. The members **10** are then secured to one another in the clamped position by applying a small amount of solder.

A plurality of lamination halves so formed are then placed side by side in another fixture comprising a trough similar to the fixture above mentioned but long enough to accommodate several lamination halves and shallow enough to expose the end surfaces **11**. The end surfaces **11** are then polished to provide flat, coplanar gap-defining surfaces by inverting the fixture containing the lamination halves over a plate upon which has been spread a quantity of abrasive material. The fixture with the surfaces **10** against the abrasive carrying plate is then moved relative to the plate to accomplish the actual grinding operation.

The actual assembly of the head is carried out with the assistance of a third fixture consisting of a steel block on whose upper surface are mounted a pair of vertical pins adapted to engage a pair of holes **23** in clamps C and D, for example, the two holes **23** at the upper end of Figure 3. The assembly is commenced by dropping a bottom clamp D over the pins with the jaws **20** facing upwardly.

A winding assembly B is now slipped over each of a pair of lamination halves A, and the lamination halves, each bearing its winding, are dropped into position on the clamp D.

The top clamp C with the jaws **20** facing downwardly is now dropped into position with the pins engaging the holes **23**, as in the case of clamp D. The terminal panel E is then dropped into position and the clamping screws **29** are dropped into the holes **21** and started.

A brass shim **30** is then inserted between the opposing faces of the lamination halves at each end of the lamination.

The various parts are now approximately positioned by hand and pressure is then applied to the end of the lamination opposite the end adjacent the pins, thus pressing the pole pieces between the pins and forcing the lamination halves toward one another.

The coil leads are now soldered to the lugs on the terminal plate.

The head is next transferred to a test stand where it is subjected to the influence of an extraneous magnetic field of audible frequency, and the head is connected to a sound reproducing device. The relative positions of the two lamination halves are then adjusted for minimum audible response by shifting one lamination half relative to the other in a direction along the major axis of the lamination. When this condition has been attained, the clamping screws **29** are tightened.

The pole pieces are then polished by urging the ends of the lamination against a moving belt carrying abrasive material.

Finally, the head is secured to the mounting fixture by means of screws **30** which are dropped through holes **23** in clamps C and D and then started in holes **27** in base plate **26**.

When the head assembly has been mounted in the magnetic recording apparatus by means of shank **25** and is ready for final alignment, a standard record is inserted in the machine, the machine is adjusted for reproducing, and screws **30** are tightened or loosened as the case may be, rocking the head on hump **28** until the maximum signal is obtained. When the longitudinal axis of the tape is perpendicular to the plane of the flux gap, this may most conveniently be done by first rocking the head in the plane of Figure 2 until the maximum signal is picked up from the record, thus indicating that correct vertical alignment has been made, and then rocking the head in the plane of Figure 1 until maximum high frequency response is obtained. Since the reproduction of high frequencies is rather critical with respect to the angular orientation of the head, this operation results in the optimum angular orientation for reproduction.

According to the procedure outlined above, the adaptability of the magnetic head of the present invention to mass production is thoroughly exploited and the assembly of the head itself is coordinated with the assembly and alignment of the complete magnetic recording and reproducing apparatus.

The structural characteristics of the head may be summed up by pointing again to the fact that each of the laminar half members is symmetrical and that the lamination formed by assembling pairs of such members is characterized by a pair of flux gaps lying in a common plane at opposite ends of the lamination, that the lamination is characterized by a plan form lending itself to assembly with prewound coils, that the coils as well as the

laminations are symmetrical, and that the complete head assembly, which is also symmetrical in three planes, is secured to the mounting fixture in a manner to provide for universal adjustment of the position of the gap and its angular orientation within a range adequate for aligning the head relative to a standard record.

Thus according to the invention, the completed head is characterized by physical, magnetic, and electrical symmetry about three axes. As a result of this construction, the flux gap at either end of the head may be employed in recording or reproducing, extending the useful life of the head.

In addition, the symmetrical arrangement of the various parts of the head reduces the response of the head to extraneous electrostatic and magnetic fields by virtue of the fact that the voltages induced in one winding by such fields are opposed to the voltages induced in the other winding.

The generally arcuate shape of the core half members permits the use of prewound coils, with the advantages pointed out in my copending application hereinabove identified. It should be mentioned that wherever herein the core half members are referred to as being "arcuate," and wherever the lamination is referred to as being "elliptical," these terms are used in a general rather than in a geometrically precise sense, for, as has been pointed out in the detailed description, the preferred form of the invention involves departures from strictly arcuate or strictly elliptical form.

I claim:

1. In the method of fabricating a magnetic transducer head including forming two coplanar surfaces at the opposite ends of a semi-elliptical lamination blank, mounting a coil on each of two such blanks, juxtaposing said surfaces of one such blank to the corresponding surfaces of the other such blank to provide a generally elliptical configuration with non-magnetic gaps between the respective juxtaposed surfaces of said blanks lying on the major axis of the configuration and with one of the gaps of size to carry out a magnetic transducing function with respect to a magnetic record, and securing the blanks in such juxtaposed relation, the improvement characterized by subjecting the juxtaposed blanks to an extraneous magnetic field, sensing the electrical output from said coils,

and moving one of said blanks relative to the other in the plane of said surfaces to a position corresponding to minimum output of said coils due to said extraneous magnetic field prior to securing of the blank in said juxtaposed relation.

2. The method of aligning a transducer head in magnetic recording and reproducing apparatus which comprises inserting a magnetic record with a standard magnetic recording thereon in the apparatus in contact with the transducer head and scanning the record with the head, rocking the head in a plane transverse to the record to angularly adjust the position of the head, securing the head as against transverse movement in a position where maximum output is observed and thereafter oscillating the head on an axis normal to the plane of the record and securing the head in the position of oscillation at which maximum high frequency response is observed.

3. In the method of assembling a magnetic transducer head including forming two coplanar surfaces at the opposite ends of a lamination blank, mounting a pre-wound coil on each of two such blanks, juxtaposing the surfaces of one such blank to the corresponding surfaces of another such blank to provide a generally elliptical configuration with non-magnetic gaps between the respective juxtaposed surfaces of the blanks lying on the major axis of the configuration and the gaps being of size to carry out a magnetic transducing function with respect to a magnetic record, the improvement characterized by subjecting the juxtaposed blanks to an extraneous magnetic field, sensing the electrical output from said coils, moving one of the blanks relative to the other of said blanks in a direction along said major axis of said configuration to a position correspondnig to minimum output from said coils in the presence of said extraneous magnetic field, securing said blanks in said position, and polishing the ends of the assembled laminations at at least one end of said configuration.

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