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MAGNETIC TRANSDUCER

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Fig. 1.

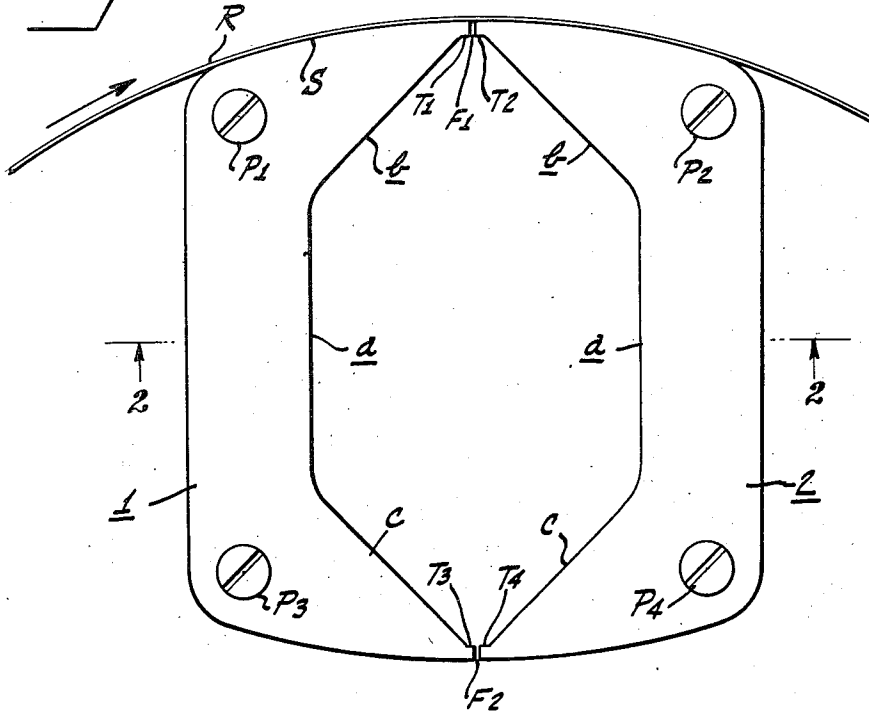
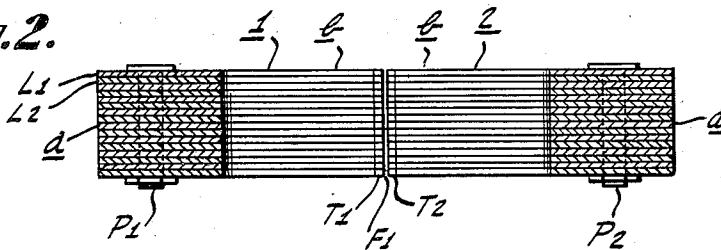


Fig. 2.



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MAGNETIC TRANSDUCER

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This invention relates to improvements in magnetic transducers or "sound-heads" for use in conjunction with a sound-track of the type comprising a longitudinally extending magnetic trace applied, usually, to a wire or tape-like record.

It has long been known that the frequency response-characteristic of a sound-head of the type suitable for use in conjunction with longitudinally magnetized (or magnetizable) records is a function of the width dimension of the non-magnetic gap or slit over which the record travels during recording and reproducing intervals. The rule as to this is well stated in "Elektrotechnische Zeitschrift" No. 45, November, 1935, pages 1219-1221: "The size of the magnetic slit, that is to say, the extent of the recording magnetic field in the feeding direction of the tape must be around $\frac{1}{2}$ of the lowest half-wave-length, . . . to make a sharply delimited magnetic slit of said size is the real and basic problem of magnetic sound recording." Obviously, to achieve a "sharply delimited slit," the polar extremities which define the boundaries of the slit in the magnet must be ground and polished with extreme care.

It also has long been known that the amplitude or "sensitivity" response-characteristic of a sound-head of the character described is a function of the quantity of fringing flux which can be concentrated in the vicinity of the non-magnetic gap or slit. The conventional way of achieving a desired concentration of flux is to employ tapered pole-pieces arranged with their narrow ends on opposite sides of the gap. Since the record in moving over the gap subjects the tapered ends of the magnet to wear, one cannot, as a practical matter, make said tapered ends as thin as would be necessary to achieve the theoretically optimum sensitivity response-characteristic.

With the foregoing general rules of design in mind, it would appear that, given the necessary materials, a skilled technician could construct a magnetic transducer, of the longitudinal type, having frequency and sensitivity response-characteristics of any desired value. Such indeed is the fact. However, the same technician, following the same technique, would find it extremely difficult, if not entirely impossible, to construct a multiplicity of sound-heads which would each possess the same response-characteristics. That this is so will be apparent when it is appreciated (1) that the grinding and polishing operations required to achieve a "sharply delimited magnetic slit," necessarily increase the effective cross-sectional areas of these parts (i. e., the tapered

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ends) of the magnet which determine the "sensitivity" response-characteristic and (2) that in making a number of magnetic core pieces it is extremely unlikely that exactly the same amount of material would be removed in the grinding and polishing operations performed on each piece.

Accordingly, the principal object of the present invention is to obviate the above described difficulties in the manufacture, upon a commercial scale, of magnetic transducers having substantially duplicate, frequency and sensitivity response-characteristics.

Another and related object is to provide an improved magnetic transducer for use in connection with longitudinally magnetized (or magnetizable) sound-tracks and one which, by reason of the novel construction and processing of its parts, may be manufactured in commercial quantities to exhibit "standardized" response-characteristics, irrespective of the number of units in said quantity, and thus to permit the standardization of other parts of the instruments which said sound-heads are designed to serve.

In the drawing:

Fig. 1 is a plan view of a substantially rectangular-shaped magnetic transducer embodying the invention, and showing the path of a tape-like record on the surface of the core; the magnet coils of the transducer are omitted since they may be of conventional form and dimensions and form no part of the present invention, and

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1, showing the bi-part laminated structure of the magnetic core.

As previously set forth, in the manufacture of magnetic cores having conventionally tapered polar extremities, the removal of any of the magnetic metal from the tapered ends of the core (during the grinding operation necessary to provide a sharply delimited flux-gap between said ends), necessarily increases the effective area of said ends and thus alters the sensitivity response-characteristic of the core. The present invention retains the advantage (i. e., high concentration of flux) of tapered cores but obviates its disadvantages by the provision of what may be designated as a "finishing tip" at the free end of the tape. These finishing tips, which are designated T1, T2, T3 and T4 in the drawing, are of uniform cross-section, hence if the grinding and polishing operations employed in finishing the boundary surfaces of the flux gaps (F1, F2) is confined to said finishing tips, the extent and the angle of the tapered part of the core remain constant and the sensitivity response-characteristic of the

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transducer is unaffected, hence one can produce any desired number of units exhibiting the same sensitivity response-characteristic. It is apparent that if the boundary surfaces of the flux gaps are of the required flatness, then said gaps may be made of any desired width, simply by inserting a non-magnetic spacing element (not shown) of standard thickness between said polished boundary surfaces. Thus, the frequency response-characteristic and the sensitivity response-characteristic may be made uniform in any desired number of units.

In the drawing, the invention is shown as applied to a bi-part magnetic core structure consisting of two C-shape parts 1 and 2 of laminated construction (see Fig. 2). Each of the lamina L₁, L₂ etc. are of substantially identical or duplicate size and shape. The central or body portion *a* of each C-shape piece is of uniform width and the arms or pole pieces *b* and *c* of each part taper off in the direction of the ends of the C and terminate in the "finishing tips" T₁, T₂, etc., dictated by the present invention. The original length of the tips T₁, etc., as measured from the end of the tapered portion of its pole piece to the end of the tip, need be no greater than is found necessary to permit the tips to be ground to the flatness and smoothness required in the formation of the adjacent gap (F₁ or F₂), and ordinarily need be no longer than, say 0.01 of an inch. In one practical embodiment of the invention wherein the original length of the tips was approximately 0.007 of an inch, a satisfactorily smooth surface was achieved in grinding away approximately 0.005 of an inch of the tip.

The thickness dimension of the tips should be as small as practical, i. e., said dimensions should be so small that the enhanced sensitivity-response incident to the taper, is not adversely affected, yet it should be large enough to allow for wear incident to the friction resulting from the movement of the record R in contact with the convex outer surface S of the core. These requirements have been found to be met in a laminated core-structure made of "mu-metal" (i. e., a nickel-iron alloy), when the thickness dimension of the tips was of the order of 0.02 or 0.03 of an inch.

In manufacturing the core of the invention, the magnetic laminations L₁, L₂, etc. (Fig. 2) of the desired form and dimensions are preferably provided with a number of holes for the reception of non-magnetic, press-fit, alignment pins P₁, P₂, etc. and, after being sprayed with a thermosetting cement, are stacked on the press-fit pins (or in a jig, not shown) and heat-treated to cure the

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cement. The magnet coils (not shown) may then be wound upon the individual core stacks.

The next step in the assembly is the grinding and polishing of the polar extremities or "finishing tips" T₁, T₂, etc. to plane, smooth surfaces. As above indicated, the quantity of tip material removed during the polishing operation is quite small so that, to a first order approximation, the reluctance of the gap or gaps between the polar extremities of the magnet is maintained constant on all units produced in accordance with the invention.

What is claimed is:

1. A transducer for a magnetic record, said transducer comprising a magnetic structure having an outer surface-portion upon which said record moves during recording and reproducing intervals, said magnetic structure having a pair of polar extremities defining the boundaries of a non-magnetic gap in said surface adjacent to the path of said record, said polar extremities being tapered inwardly in the direction of said gap and terminating adjacent to said gap in projections of substantially uniform cross-section, said magnetic structure being of stacked laminated construction each lamina of which being of duplicate size and shape.

2. A transducer for a magnetic record, said transducer comprising a magnetic structure having an outer surface-portion upon which said record moves during recording and reproducing intervals, said magnetic structure having a pair of pole pieces terminating in projections of substantially uniform cross-section, said projections defining the boundaries of a non-magnetic gap in said surface adjacent to the path of said record, said pole pieces being tapered divergently in directions away from their respective projections, and said magnetic structure being of stacked laminated construction, each lamina thereof being of duplicate size and shape.

3. The invention as set forth in claim 2 wherein the cross-section area of said projections is substantially equal to the minimum cross-section area of their associated pole pieces.

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