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N. M. RUST ET AL
TELEGRAPHONE AND LIKE APPARATUS

2,098,596

Filed July 23, 1935

Fig. 1

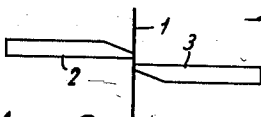


Fig. 2



Fig. 3



Fig. 4

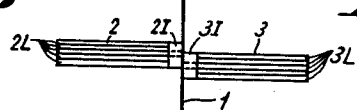


Fig. 6



Fig. 5

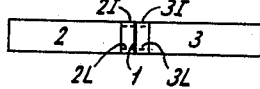


Fig. 7

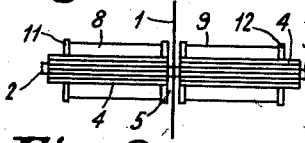


Fig. 9

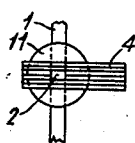


Fig. 13

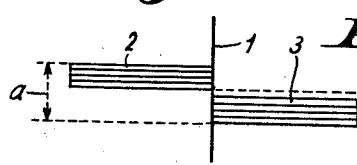


Fig. 15



Fig. 8

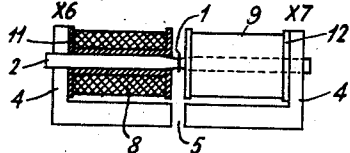


Fig. 14

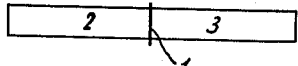


Fig. 10

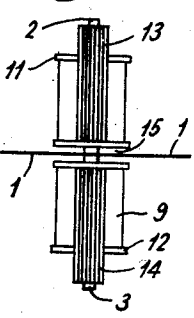


Fig. 12

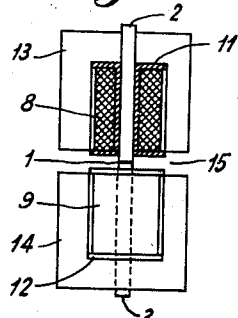


Fig. 16

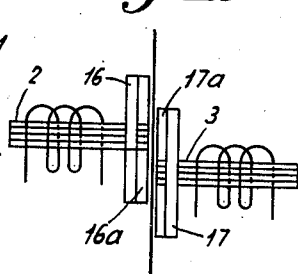


Fig. 17

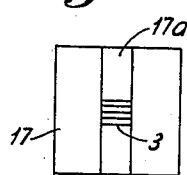


Fig. 11

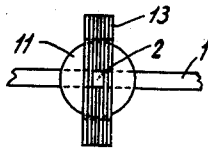
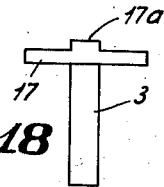


Fig. 18



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TELEGRAPHONE AND LIKE APPARATUS

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6 Claims. (Cl. 179-100.2)

This invention relates to telegraphones and like magnetic recording or pick up apparatus.

In known magnetic recording systems in which audio frequency or other signals are recorded upon and subsequently "picked up" from a moving tape or ribbon of magnetic material by means of electro-magnetic recording and pick-up devices comprising a pair of magnetic pole-tips located on opposite sides of the tape and associated with a winding or windings carrying the signal currents to be recorded or picked up, it is usual to employ pole tips of chisel shape and it is found in practice that with pole-tips of usual construction considerable wear takes place by reason of friction with the travelling tape, and the useful life of a pole-tip may be not more than two to three hours before deterioration of the characteristic of the recording or pick-up apparatus as a whole occurs on account of the alteration in flux distribution due to the wearing away of the pole-tips.

As above stated the pole-tips of such electro-magnetic recording or pick-up devices have hitherto generally been given a chisel-like form as shown in Figures 1, 2 and 3 of the accompanying drawing. In Figures 1, 2 and 3 the tape is indicated by the reference 1 and 2, and 3 are the pole-tips. Figures 1 and 2 are mutually perpendicular views and Figure 3 is a view looking from the left in Figure 1 and showing the face of the pole-tip 3. As will be seen the edge of the "chisel" is arranged transverse to the moving tape and the pole-tips on opposite sides of the tape are slightly staggered lengthwise thereof. Thus as wear proceeds the chisel-like edge of the pole-tip is worn "blunt" and the effective contact area between the pole-tip and the tape increases and the mean effective spacing of the pole-tips increases. This has a serious effect upon the frequency response characteristic of the device and an important object of the present invention is to provide an improved electro-magnetic recording or pick-up device in which wear of the pole-tips is substantially reduced and wherein the adverse effect upon the response characteristic of such wear as takes place is reduced or eliminated whereby the useful life of the pole-tips is greatly increased. This object is achieved according to the said invention by making the pole-tip of an electro-magnetic recording or pick-up device for use in a telegraphone or like recording or pick-up system of substantially uniform cross-section throughout an appreciable portion of the length thereof and embedding said portion in magnetically and electrically inert material (i. e., insu-

lating material) offering a resistance to wear of the same order as that of the material of the pole-tip proper.

The larger wearing surface presented by the insulating material in which the pole-tip is embedded in accordance with this invention tends to minimize wear, the cross-sectional area of the pole-tip proper being small compared with that of the material in which it is embedded. The effect of any wear which does take place is minimized by making the magnetically active part of the pole-tip of a thin parallel-sided lamination so that over the useful life of the tip substantially the same contact area of magnetic material is exposed to the tape. The width of the lamination is, of course, arranged transversely of the direction of movement of the tape. Experiments show that a pole-tip constructed in accordance with the invention should have a normal life of about thirty hours or more.

The insulating material at the face of the pole-tip has to be carefully chosen since if it is harder than the magnetic material a certain undercutting action is liable to take place after prolonged wear. If, on the other hand, it is too soft it does not substantially increase the wearing properties of the tip. Experiments have shown that a vulcanite cement manufactured for dental work is a very suitable material, and such material can conveniently be moulded in a jig round the lamination constituting the magnetic portion of the pole-tip with the aid of gentle heat.

To refer again to present common practice, it is customary in known telegraphone pick-up apparatus to arrange two chisel shaped pole pieces, one on each side of the recorded tape or wire, and in "staggered" relation, i. e., not directly opposite one another but spaced apart in the direction of record travel. The amount of "stagger" has an important effect upon the frequency response characteristic; maximum output at any given frequency occurs when the "stagger" is equal to the length on the record of one half cycle of that frequency the said output falling away as the "stagger" is increased, reaching a minimum when the "stagger" is equal to the length on the record of one cycle of the frequency in question. Thus the use of a large "stagger" tends to increase response at low frequencies and reduce that at high while the use of a small "stagger" has a converse effect, reducing the output at low frequencies and causing it to be distorted. Therefore the present general practice is to adopt for the usual chisel-shaped poles of the pick-up or reproducing "head" a

compromise "stagger" such that, in the case of a record which has been recorded by a so-called constant current method, the reproducer output frequency curve has a peak at about 2,000 cycles per second and falls away gradually on either side of this peak. It is a comparatively simple matter to correct electrically for a characteristic curve of this shape—e. g., by connecting in the reproducer circuit a flatly tuned acceptor circuit broadly resonant at the peak frequency—but an objection to employing such correction is that the maximum signal-noise ratio is obviously reduced thereby. Another important object of this invention is to overcome this difficulty or defect and this object is achieved according to the invention by replacing the hitherto customary chisel shaped poles by blunt pole pieces in staggered relationship. These pole pieces may be, and preferably are, laminated to reduce losses and are arranged to be in good mechanical contact with the record over substantially their whole area. This may conveniently be effected by mounting each pole piece with its active end or face flush with the surface of end cheek of hard insulating material, such as ivory.

The invention is illustrated in Figures 4 to 18 inclusive of the accompanying drawing.

Figures 4, 5, and 6 show one embodiment of the invention, Figures 4 and 5 being mutually perpendicular views and Figure 6 showing the face of the pole piece 3 as viewed from the left of Figure 4. Referring to Figures 4, 5 and 6 each of the pole-pieces 2, 3, of the recording or pick-up device are built up from a number of laminations 2L or 3L of magnetic material the centre lamination in each case projecting beyond the laminations on either side thereof to constitute the pole-tip, the projecting end of said centre lamination being slightly reduced in width as shown in dotted lines in Figure 5 and embedded in insulating material 2I or 3I to bring the overall dimensions of the composite working face up to those of the cross-section of the pole pieces.

In order to take up wear and to allow for any irregularity in the movement of the tape, the two oppositely located pole pieces are mounted in a manner so as to be relatively movable and in one arrangement illustrated in the accompanying Figures 7, 8 and 9 (which are mutually perpendicular views, Figure 8 being half in section) the laminated pole-pieces 2, 3, are slidably arranged in a laminated yoke 4 of magnetic material adapted to link the two pole-pieces together, the pole-pieces being lightly loaded by springs (not shown) so as to urge the pole-tips into contact with the moving tape 1. In such an arrangement the magnetic yoke, which is approximately C-shaped may form with the pole-pieces a substantially complete magnetic circuit except for the gap through which the moving tape passes, or, as illustrated, the yoke may be split into two halves at a point 5 opposite the gap for the tape each half of the laminated yoke being clamped in an insulating block (not shown) and the said blocks hinged about suitable axes e. g., axes passing through the crosses marked 6, 7, in Figure 8, to facilitate inserting and withdrawing the tape. The windings 8, 9, are arranged on bobbins 11, 12 surrounding the pole-pieces, said bobbins being attached to the yoke and the pole-pieces being free to slide in said bobbins.

In an alternative arrangement illustrated in the accompanying Figures 10, 11 and 12 (which again are mutually perpendicular views) each of the laminated pole pieces 2, 3, constitutes the

middle limb of an E-shaped magnetic circuit 13, 14, the outer limbs of which constitute the return magnetic paths. These two E-shaped magnetic circuits are located on opposite sides of the tape 1 and a slight air-gap 15 is left between the outer limbs of the oppositely disposed E-shaped circuits. Each of the magnetic circuits is urged towards the tape by means of springs (not shown), each circuit, including its pole piece, moving as a whole. This arrangement has a good magnetic circuit since there are double return paths provided by the outer limbs of the E-shaped circuits and since the laminated pole-pieces are clamped to their respective cores there is no relative movement due to irregularities in the tape and thus fluctuations in the reluctance of the magnetic path due to such movement are eliminated, the only change in the reluctance of the magnetic circuit being due to a comparatively very small change in the air-gaps. Movement of the pole-pieces relative to the core tends to cause hiss and crackles in the reproduced signals.

In the arrangement of Figures 10 to 12 the windings 8, 9, are fixed relatively to the pole-pieces and this avoids any contributory cause of hiss which might be caused by slight relative movement between the energizing windings and the pole-pieces.

It will be noted that in the embodiments illustrated so far the return magnetic paths for flux traversing the pole-pieces, leads the said return flux away from the tape and thus substantially prevents inconsistency and anomalies of adjustment and to a large extent minimizes distortion effects. Moreover the very small stray field which is set up substantially reduces "cross talk" between different recording and/or pick-up heads and stray induction effects from outside fields are minimized.

Figures 13, 14 and 15 show another embodiment of the invention as applied to a reproducer or pick-up, Figures 13 and 14 being mutually perpendicular views and Figure 15 showing the face of the pole piece 3. Each pole piece is preferably laminated, as shown, and has its active face in contact with the tape 1 the pole pieces being blunt and of such size as to give relatively large area pole faces in contact with the tape. As will be seen the poles are "staggered" but, since the said poles are not chisel shaped in effect the advantages of small and large "staggerers" are simultaneously obtained. For high frequencies the effective "stagger" is the dimension "b" while for low frequencies the effective "stagger" is the dimension "a". The thickness of each pole piece (i. e., its dimension in the direction of tape travel) is considerably greater than the length on the tape of a half-cycle of a high frequency and this leads to a certain amount of loss of high frequency response, but this is not a serious disadvantage (if it is a disadvantage at all) since it eliminates the "double humping" which would otherwise occur in the frequency response characteristic.

In order to ensure good mechanical contact between pole faces and tape over the whole pole face areas it is preferred to modify the arrangement of Figures 13, 14 and 15 as shown in Figures 16, 17 and 18. Figures 16 and 17 are views corresponding to the views of Figures 13 and 15 respectively and Figure 18 is a view taken at right angles to Figure 17 and showing the end cheek and pole arrangement. In the modification of Figures 16 to 18 each pole is mounted with

its active face flush with the surface of an end
cheek 16 or 17 made of a hard insulating mate-
rial such as ivory and formed with a central
raised rib 16a or 17a with the surface of which
the pole face in question is flush. The rib faces
and the pole faces flush therewith bear against
the tape and will wear away relatively slowly and
substantially evenly.

Having now particularly described and ascer-
tained the nature of our said invention and in
what manner the same is to be performed, we de-
clare that what we claim is:—

1. An electro-magnetic recording or pick-up
device comprising a pole tip made of substan-
tially uniform cross-section throughout an appre-
ciable portion of its length, said portion being
embedded in a mouldable non-magnetic insulat-
ing material having a resistance to wear of the
same order as that of the material of the pole-
tip proper, the said pole tip being made of lam-
inations extending transversely of the direction
of record travel.

2. Apparatus as claimed in claim 1 wherein
the mouldable non-magnetic insulating material
is vulcanite cement as employed for dental work.

3. Apparatus as claimed in claim 1 and where-
in the mouldable non-magnetic insulating mate-
rial is ivory.

4. Apparatus as claimed in claim 1 and where-
in the pole tips form part of a laminated mag-
netic circuit.

5. Apparatus as claimed in claim 1 and where-
in the laminated magnetic circuit is fixed in re-
lation to the telegraphone tape or the like, said
pole tips being movable in relation to said circuit
and biased towards said tape or the like.

6. Apparatus as claimed in claim 1 and where-
in the laminated magnetic circuit is movable and
biased as a whole towards the telegraphone tape
or the like said pole tips being fixed in relation
to said circuit.

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