March 4, 1941. C. A. LOVELL ET AL 2,233,621

POLE-PIECE ASSEMBLY FOR TELEGRAPHONES

Filed July 13, 1939

FIG. 1

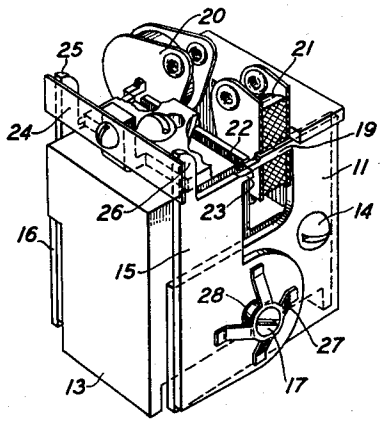



FIG. 2

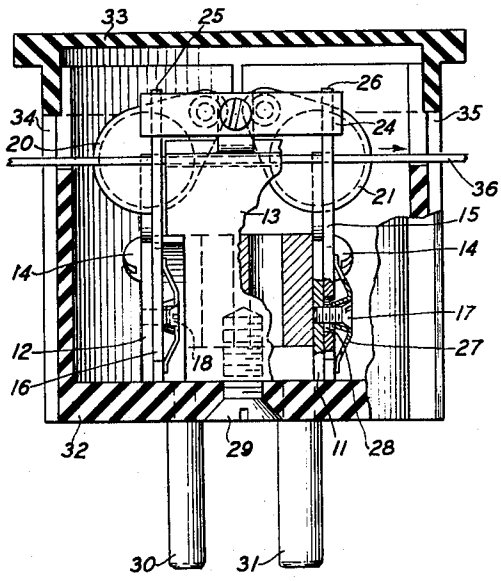



FIG. 3

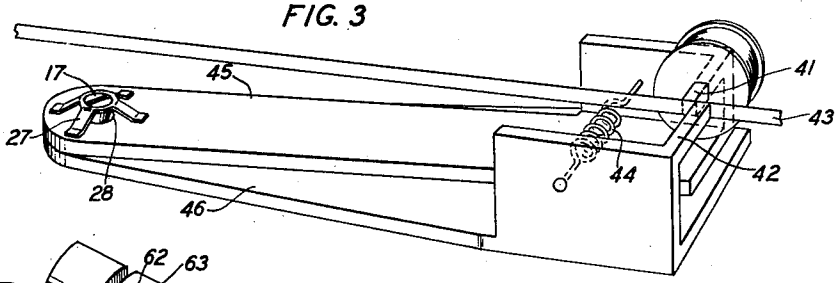



FIG. 4

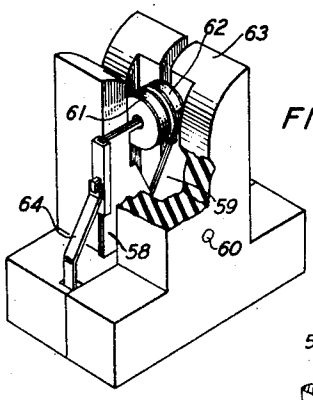



FIG. 5

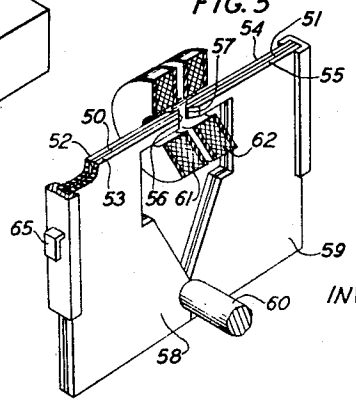
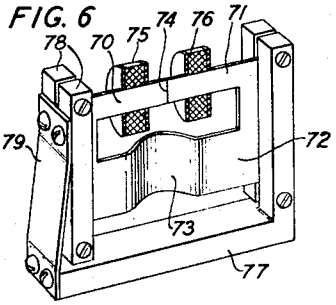



FIG. 6




INVENTORS: C.A. LOVELL
A.H. MULLER
D.E. WOOLDRIDGE

BY J.M. Campbell

ATTORNEY

Patented Mar. 4, 1941 2,233,621

# UNITED STATES PATENT OFFICE

2,233,621

## POLE-PIECE ASSEMBLY FOR TELEGRAPHONES

Clarence A. Lovell, Maplewood, and Arno H. Muller, Wood-Ridge, N. J., and Dean E. Wooldridge, Jackson Heights, N. Y., assignors to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application July 13, 1939, Serial No. 284,174

10 Claims. (Cl. 179—100.2)

This invention relates to magnetic telegraphones and the object of the invention is to improve the efficiency and the volume and frequency ranges of recording systems of this type.

It is common practice in telegraphones to use companion pole-pieces disposed on opposite sides of the tape or wire to concentrate the flux in a small area of the recording member. With the pole faces in sliding contact with the tape, the reluctance of the flux path between them can be reduced to a low value, but the reluctance of the return path through the air remains relatively high. This high reluctance reduces the recording efficiency and makes it necessary to use an amplifier of greater gain than would otherwise be necessary to produce a given value of magnetization in the tape. During reproduction this reluctance not only reduces the initial level of the reproduced signal currents but it also may reduce the margin between the signals and the inherent noise level of the tape, thereby decreasing the useful volume range of the system. It has been proposed heretofore to reduce this reluctance by providing a magnetic yoke or return path for the signal flux. However, in a practical machine the spacing of the pole faces must be adjustable to permit the threading of the tape and maintenance of the proper pressure between the pole faces and the tape. Because of these requirements such yokes usually do not provide a continuous magnetic return path and applicants have found that their use results in little, if any, increase in efficiency.

According to this invention, high efficiency is obtained over a wide frequency range by means of pole-pieces having thick offset pole faces and a yoke which provides return paths of very low reluctance without restricting the necessary relative motion between the pole-pieces. In one embodiment of the invention, the pole-pieces have integral wing-like extensions disposed in overlapping relation with an area of overlap which is very large compared with the area of the pole faces. One of the pole-pieces is preferably fixed with the other rotatably mounted thereon by means of a pivot construction which holds the pole faces in the proper relative positions and maintains close contact between the wing extensions. Due to the large area of overlap, the reluctance of the flux path from one extension to the other is very small and can be made to approach closely to the value of the reluctance with a continuous magnetic yoke.

Two sets of these pole-pieces one for erasing and the other for recording and reproducing may be assembled, together with their associated coils and means for holding the pole-pieces in contact with the tape, on a common mounting and enclosed within a casing of the plug-in type.

The optimum design of the yoke in a given case will depend upon the area of the pole faces, but it is of course desirable that the yoke reluctance in every case be low as compared with that of the path between the pole faces. Large pole faces will, of course, have low gap reluctance and hence require wing extensions with a large area of overlap. If the pole tips are very thin, however, the reluctance of the path between the pole faces will be relatively high and hence a larger yoke reluctance is permissible. In such cases the yoke may, if desired, take the form of large wing extensions disposed in the same plane, since the flux leakage path between them is of very large area and hence of low reluctance compared to the path between the pole faces.

These and other features of the invention will be more clearly understood from the following detailed description and the accompanying drawing in which:

Fig. 1 is a perspective view of a pole-piece assembly according to the invention;

Fig. 2 is a sectional view of the assembly of Fig. 1 mounted in a plug-in type casing;

Fig. 3 shows a modified form of low reluctance yoke construction which is useful in certain special applications;

Figs. 4 and 5 show a pole-piece assembly with a type of yoke suitable for very thin pole-pieces; and,

Fig. 6 is an alternate low reluctance yoke construction for thin pole-pieces in which the yoke is continuous but the pole face spacing is adjustable.

In the pole-piece assembly of Figs. 1 and 2 of the drawing, the pole-pieces 11 and 12 are rigidly secured to opposite sides of a block 13 of hard rubber or other suitable non-magnetic material by machine screws 14, 14. Pivotally mounted on the pole-pieces 11 and 12 are the companion pole-pieces 15 and 16 which are held in overlapping contact with the pole-pieces 11 and 12 by the machine screws 17 and 18. While the amount of overlapping used will vary with the requirements of the particular case, it is usually desirable to have an area of overlap of the order of one hundred times the area of the pole face.

The pole-pieces are all made from sheet molybdenum permalloy about .040 inch thick and, as the recording tape now used is frequently of the

order of .040 inch wide, the pole-pieces 11 and 12 have substantially square tip portions 19 carrying the erasing and translating coils 20 and 21 and terminating in square pole faces aligned with the tape slot 22 in the block 13. The pole-pieces 15 and 16 carry no coils and have relatively shorter tip portions 23, the faces of which are held against the opposite side of the tape in offset relation to the pole tip 19 by means of a flat spring 24 engaging the ears 25 and 26 of the pole-pieces.

It has been suggested heretofore that the pole faces may be relatively thick and so disposed that the leading edge of one is aligned with the trailing edge of the other. Applicants have found that with this pole-piece arrangement, the low frequency components of the signals are recorded longitudinally in the tape at high efficiency and that at the high frequencies the flux tends to concentrate in the transverse path of the aligned edges of the pole-pieces. At the higher frequencies, therefore, these thick pole-pieces operate in the same manner as very thin transversely aligned pole-pieces which are efficient in recording the higher frequencies.

The pole-piece design discussed above not only gives high efficiency by providing a low reluctance return path because of the large overlapping areas adjacent the pivot 17, but it is also particularly well adapted to maintain accurately the offset alignment of the pole faces which is necessary in order to obtain both high efficiency at low frequencies and good response at the higher frequencies. As shown in Fig. 2, the machine screw 17 which holds the pole-pieces together is provided with a spider-like spring washer 27 having a central tapered portion surrounding the screw and extending into the oversized tapered hole 28 in the pole-piece 15. As the screw 17 is tightened into place, the arms of the springs 27 are deflected to produce good contact between the pole-pieces 11 and 15 and the conical central portion of the washer engaging the tapered hole 28 acts as an automatic aligning device to insure that the pole faces are held in their proper relative positions.

The assembly of Fig. 1 is mounted in the casing of Fig. 2 by means of a screw 29 engaging the bottom of the block 13 and the coils 20 and 21 are connected to two pairs of pins 30 and 31, of which only one pin of each pair is shown in the drawing. The casing 32 is provided with a removable cover 33 and slots 34, 35 for the recording tape 36.

In certain applications, such as multiple-unit tone generators, the space available in the plane of the tape is sometimes very limited and in such cases the high efficiency of the structure just described can be obtained by shaping the yoke portions of the pole-pieces in the manner shown in Fig. 3. In this construction the pole tips 41 and 42 are disposed in offset alignment on opposite sides of the tape 43 and held in contact therewith by suitable resilient means such as a spring 44. The low reluctance return path is obtained by means of elongated pole-piece wing members 45 and 46, disposed close to the tape and extending parallel to it, to a pivot of the type described above comprising a machine screw 17 and washer 27. With this construction the members 45 and 46 may be made as long as necessary to obtain the reluctance desired while at the same time keeping the over-all dimensions of the pole-pieces in the plane of the tape as small as may be necessary to accommodate the unit in the space available.

In some cases sufficiently low reluctance may be obtained without any actual overlapping of the pole-pieces. This will often be the case in purely transverse recording systems using opposed pole-pieces with very thin pole tips. In Figs. 4 and 5, for example, the pole-pieces comprise very thin magnetic laminations 50 and 51 secured between non-magnetic supporting sheets 52, 53 and 54, 55 and terminating in directly opposed pole faces 56, 57. The pole-pieces have wing extensions 58 and 59 of very large area as compared with the area of the pole faces 56, 57, but disposed in the same plane for relative movement about the common magnetic pivot 60. This assembly together with its associated coils 61 and 62 may be mounted in a suitable non-magnetic supporting structure 63 which has a spring 64 engaging a lug 65 on each of the pole-pieces to hold the pole-pieces in firm contact with the tape. Due to the very large area of the wing extensions 58 and 59 as compared with the area of the pole faces the reluctance of the leakage path between them is relatively low as compared with the reluctance between the pole faces and very low as compared with the reluctance of a conventional yoke. In practice it is found that for thin pole tips the use of this yoke construction gives an efficiency substantially equal to that obtainable with a continuous magnetic yoke.

When the pole-piece laminations are very thin, as in the construction just described, it is also possible to use a continuous magnetic yoke without sacrificing the advantages of relatively adjustable pole-pieces. In Fig. 6, for example, the opposed pole-pieces 70 and 71 and the connecting yoke 72 are all stamped from a single thin sheet of magnetic material. The central portion 73 of the yoke is then offset as shown to give the structure flexibility in the direction longitudinally of the pole-pieces. The offsetting operation produces a certain amount of overlapping of the pole-pieces and this overlapping portion is then cut away to provide a small gap 74 for the tape. In practice the pole-pieces will preferably be stiffened by the addition of non-magnetic supporting sheets on either side, as in Fig. 5, and thin coils 75 and 76 are put in position by slightly bending the central portion 73 of the yoke. This assembly is then mounted in a suitable frame 77 at least one end of which has movable clamping members 78, 78 to which is secured a spring 79 for holding the pole faces in contact with the tape.

While the invention has been described for purpose of illustration with reference to specific structures, it will be understood that these structures may be modified in various ways within the scope of the following claims.

What is claimed is:

1. In a telegraphone, a magnetic tape, a pair of pole-pieces having relatively movable pole faces contacting opposite sides of the tape and wing extensions integral with the pole-pieces and forming between them a yoke of low reluctance as compared with the reluctance between the pole faces.

2. A pole-piece assembly for telegraphones comprising a pair of pole-pieces having pole faces adapted to contact the opposite sides of a tape record member and integral wing extensions of large area compared to the area of the pole face, a fixed support for the first pole-piece, means for securing the wing extensions together in pivotal, overlapping relation and resilient means engaging the support and holding the second pole-

piece in operative relation to the first pole-piece.

3. A pole-piece assembly for telegraphones comprising two pole-pieces of magnetic material having salient poles terminating in pole faces adapted to contact the opposite sides of a tape, and wing extensions integral with the salient poles and disposed adjacent each other to form a substantially continuous magnetic yoke between the poles, the wing extensions being of very large area as compared with the pole faces whereby the reluctance of the yoke is made negligible as compared with that of the gap between the pole faces.

4. A pole-piece assembly for telegraphones comprising a pair of pole-pieces having pole faces adapted to contact opposite sides of a tape and integral wing extensions of large area compared to the areas of the pole faces, means for securing the pole-pieces together with their extensions in pivotal, overlapping relation and means for automatically aligning the pole faces when the wing extensions are secured together.

5. A pole-piece assembly for telegraphones comprising a mounting block having a tape slot, a fixed pole-piece secured to the block at each end of the slot, a rotatable pole-piece pivotally mounted in overlapping relation on each fixed pole-piece and resilient means on the block engaging both of the rotatable pole-pieces and holding them in operative relation to the fixed pole-pieces.

6. In a telegraphone, a pole-piece housing having pin type plugs for connecting the housing to the telegraphone structure, a mounting block in the housing having a tape guiding slot, a tape in the slot, a fixed pole-piece secured to the block at each end of the slot and having a pole face contacting one side of the tape, a movable pole-piece pivotally mounted in overlapping relation on each fixed pole-piece and having a pole face adapted to contact the other side of the tape in offset alignment with the pole face of the fixed pole-piece, resilient means for holding all of the pole faces in contact with the tape, a coil on each fixed pole-piece and connections between the coils and the plugs on the housing.

7. In a telegraphone, the combination with a magnetic tape and pole-pieces having pole faces contacting opposite sides of the tape, of wing extensions integral with the pole-pieces disposed closely adjacent and parallel to the tape and means for holding the pole-piece extensions together in pivotal overlapping relation to form a low impedance yoke between the pole-pieces.

8. A pole-piece assembly for telegraphones, comprising pole-pieces having opposed pole faces for engaging opposite sides of a tape and substantially coplanar relatively movable wing extensions integral therewith and of such large area as to provide a flux leakage path between them of low reluctance as compared with the reluctance between the pole faces.

9. In a pole-piece assembly for telegraphones, a pair of pole-pieces each comprising two sheets of non-magnetic material with a thin sheet of magnetic material between them, each pole-piece having a pole face and a wing extension of very large area compared with the area of the pole face, and mounting means for supporting the pole-pieces in the same plane with the pole faces contacting the opposite sides of a tape.

10. A pole-piece assembly for telegraphones comprising a thin lamination having two salient poles terminating in opposed pole faces and a continuous yoke connecting the poles and having an offset portion, means for supporting said lamination with the poles on opposite sides of a tape and means on the mounting for deflecting the offset portion of the yoke to bring the pole faces into contact with the tape.

CLARENCE A. LOVELL.
ARNO H. MULLER.
DEAN E. WOOLDRIDGE.