

May 10, 1949.

H. E. ROYS
MAGNETIC SOUND RECORDING AND
REPRODUCING TRANSDUCER
Filed April 30, 1945

2,469,444

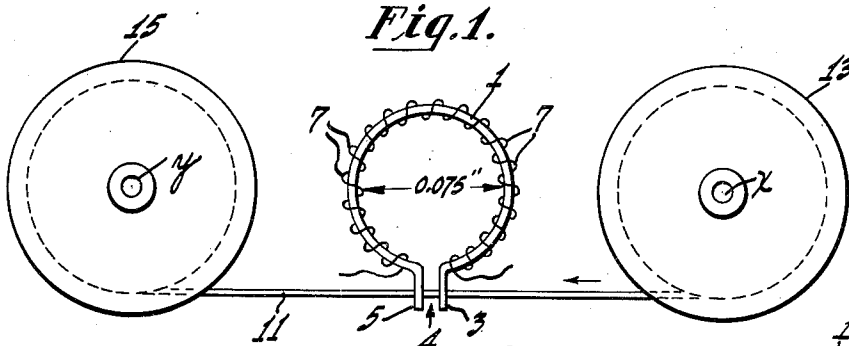


Fig. 3.

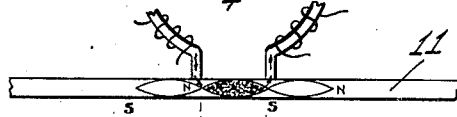


Fig. 3 a.

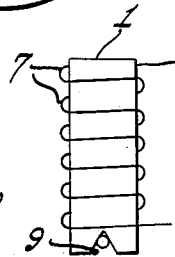
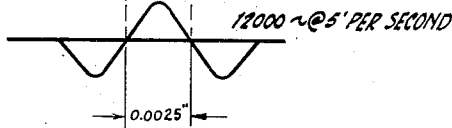


Fig. 2.

Fig. 4.

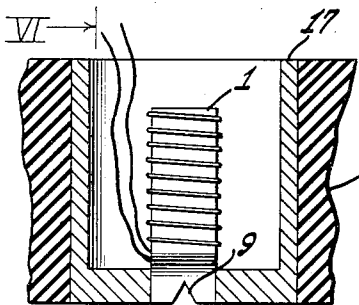
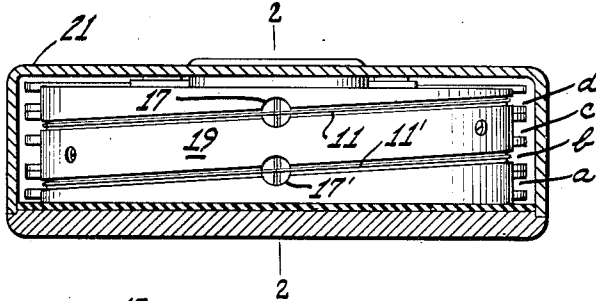


Fig. 5.

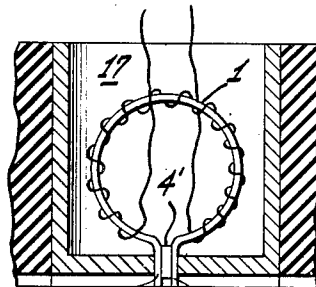


Fig. 6.

INVENTOR.
HENRY E. ROYS
BY
C. D. Ruska
ATTORNEY

UNITED STATES PATENT OFFICE

2,469,444

MAGNETIC SOUND RECORDING AND
REPRODUCING TRANSDUCERHenry E. Roys, Indianapolis, Ind., assignor to
Radio Corporation of America, a corporation of
Delaware

Application April 30, 1945, Serial No. 591,071

1 Claim. (Cl. 179—100.2)

1

My present invention relates to magnetic sound recording and reproducing apparatus and has special reference to the provision of improvements in magnetically actuated transducers or "sound-heads" for use in connection with wire and tape records.

The sound-heads employed in present day magnetic phonographs usually comprise an "E and I," "C and I" or other transformer having a bi-part or tri-part solid or laminated iron core which, by reason of its ponderous construction, is peculiarly susceptible to stray magnetic fields such as may emanate from the driving motor or other nearby electrical installation. As is well known, the presence of a stray magnetic field adjacent to the recording or pick-up point gives rise to hum and other spurious sound effects. Since it is not always possible to obviate the presence of such disturbing fields by shielding their source, resort has heretofore been had to the use of "compensating" or "hum-bucking" coils, similar to those shown in Evershed et al. U. S. P. 1,333,298, Sinnott et al. 2,105,167, and Camras et al. 2,351,008. Irrespective of the advantages claimed for such hum neutralizing systems it may be said generally that they complicate the construction and add to the cost of the phonograph, recorder, or other unit in which they are incorporated.

Accordingly, the principal object of my invention is to provide an improved magnetic sound-translating device which shall be substantially immune to stray fields of any ordinary intensity, and one which operates successfully without the use of bucking coils or other auxiliary hum-neutralizing or hum-shielding means.

Another and important object of my invention is to provide a highly efficient magnetic transducer and one which, by reason of the simplicity and economy of its parts, lends itself readily for use in a record cartridge or other unit wherein compactness and low cost are prime desiderata.

My invention is predicated upon my belief that the tendency of a magnetic sound head-to pick up stray flux is a function not only of its mass but also of the continuity of the flux path therein and I have discovered that the spacing and relative arrangement of the ends or pole pieces of the magnetic core of the transducer is an important factor in hum neutralization. More particularly, I have discovered that the tendency of the transducer to be influenced by stray flux is minimized when the core and its pole pieces are of a novel unitary construction (later described) and the width of the non-magnetic gap across which the wire or other recording medium travels is made

2

small as compared with the distance the wire travels in the time consumed by a single cycle of the sound-representing signals.

Certain preferred details of construction, together with other objects and advantages will be apparent and my invention itself will be best understood upon reference to the following specification and to the accompanying drawing wherein:

Fig. 1 is a partly diagrammatic view of a magnetic phonograph incorporating a transducer, sound head or "pick-up" constructed in accordance with the principle of my invention,

Fig. 2 is a side elevational view of the magnetic transducer of Fig. 1,

Fig. 3 shows the distribution and polarity of the flux in a portion of the wire record of Fig. 1,

Fig. 3a is a curve illustrative of the flux-time phenomena with which my invention is concerned,

Fig. 4 is an end view of a record cartridge having two sound heads incorporated therein,

Fig. 5 is an enlarged sectional view of one of the sound heads of Fig. 4, and

Fig. 6 is a sectional view taken on the line VI—VI of Fig. 5.

As shown in the drawing the magnetic transducer of my invention may comprise a thin ribbon 1 constituted of steel or other paramagnetic metal, say 0.3 of an inch long, and bent in the form of a loop with its opposite ends turned outwardly to form a pair of spaced apart parallel pole pieces 3 and 5 which extend in a direction normal to the path of the recording medium 11. The circular bend or loop of the strip 1 comprises a support for a magnetic coil 7 which may comprise say 250 turns of No. 43 gauge (0.0022" diameter, bare) enameled copper wire. The pole pieces 3 and 5 extend outwardly from the perimeter of the loop about 0.020 of an inch and are preferably cut away as shown at 9, Figs. 2 and 5, to define a pair of retaining slots or grooves for guiding the wire or other magnetic record 11 across the intervening gap 4 in a direction normal to the direction of extension of the pole pieces. The storage and take-up reels 13 and 15 between which the record 11 runs, may be mounted for rotation on different axes x , y , as shown in Fig. 1, or they may rotate about a common axis z as later described in connection with Fig. 4.

As indicated by the dotted lines and n (north) and s (south) symbols in Fig. 3, when the wire or other record 11 is in its normal running position within the slots 9 the magnetic circuit of the transducer is completely closed. Hence when the

3

record 11 is travelling across the gap 4 during the recording and reproducing intervals "leakage flux" is minimized. By "leakage flux" I mean the flux which is set up by the wire due to its magnetization, or because of the recording on it, linking only part of the turns on the circular portion of the loop 1. By making the loop very small most of the flux picked up at the pole pieces 3 and 5 passes through the entire core instead of through only a small portion of it.

In an embodiment of the invention wherein the diameter of the loop 1 was approximately 0.075 of an inch and the width of the gap 4 was of the order of 0.0025 of an inch excellent results were achieved in recording and reproducing frequencies of up to 12,000 cycles per second when the linear speed of the wire 11 was approximately five feet per second. At a wire speed of two and one-half feet per second satisfactory results were achieved with frequencies up to 6000 cycles.

As indicated by the curve of Fig. 3a the gap in the transducer, as above described, corresponds in dimension to a half wavelength of 12,000 cycles at a wire speed of five feet per second and these conditions (i. e. gap dimensions and wire speed) determine the cut-off point in the frequency range. Thus, if frequencies above 12,000 per second are to be recorded the width of the gap could be made even smaller. A gap width of 0.0025 of an inch, however, has been found to be satisfactory for nearly all frequencies. Thus, in recording speech (where it is usually unnecessary to allow for frequencies beyond, say, three thousand cycles) it is preferable to slow down the wire speed rather than to increase the width of the gap.

As shown more clearly in Fig. 6, the spacing between the parallel pole pieces 3 and 5 may be established by a wafer 4' constituted of brass or other non-magnetic material of the desired thickness, and this spacing maintained as by forcing the pole pieces, with the spacer 4' in position between them, into a slot provided for the purpose in a non-magnetic cup or similar housing 17. If desired, the pole piece assembly, 3, 4', 5 may be soldered in place in the said slot. Since the housing 17 of the transducer unit may be very small it may conveniently be mounted in an insulating guide block 19 of a record-cartridge 21 (Fig. 4). In fact, as shown in Fig. 4 and as described in copending application Serial No. 584,197 to Terry M. Shrader, filed March 22, 1945, the small size of the transducer unit permits the use of two of them, in a single plural-wire cartridge. In this

4

case the reel assembly within the cartridge includes a storage groove and a take-up groove for each of the two wires 11 and 11'. These duplicate units 17 and 17' are selectively energized so that one of the records (say, the wire 11) may be silently rewound from its take-up groove d onto its storage groove c while the other record 11' is running over its energized transducer unit 17 between the storage groove a and the take-up groove b.

As previously indicated, the extremely small size of the transducer of my invention eliminates the necessity of an auxiliary hum-bucking or hum-neutralizing system. Thus it will be apparent that irrespective of the direction of any stray field the transducer can pick-up or "cut" very few disturbing lines of force. Furthermore, if the direction of the said lines of force is parallel to the direction of the pole pieces 3 and 5 they are effectively balanced out by the opposite halves of the coil 7.

It is thus apparent that my invention provides an improved magnetic transducer and one which lends itself readily for use in or in connection with a record cartridge or other unit wherein compactness and low cost are prime desiderata.

I claim as my invention:

A transducer unit for magnetic-wire records said unit comprising a cup-shape receptacle constituted of non-magnetic material and provided with a slot across which said record is adapted to travel, a core constituted of a ribbon of magnetic material mounted within said cup and bent in the form of a loop with the terminals of the ribbon bent outwardly and seated in said slot with the ends thereof adjacent to the path of said record, a non-magnetic element mounted within said slot between said terminals for maintaining said terminals in spaced relation, and a coil wound upon the loop portion of said ribbon within said receptacle.

HENRY E. ROYS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,277,305	Clopton -----	Mar. 24, 1942
2,351,003	Camras -----	June 13, 1944
2,351,007	Camras -----	June 13, 1944
2,351,011	Camras -----	June 13, 1944