

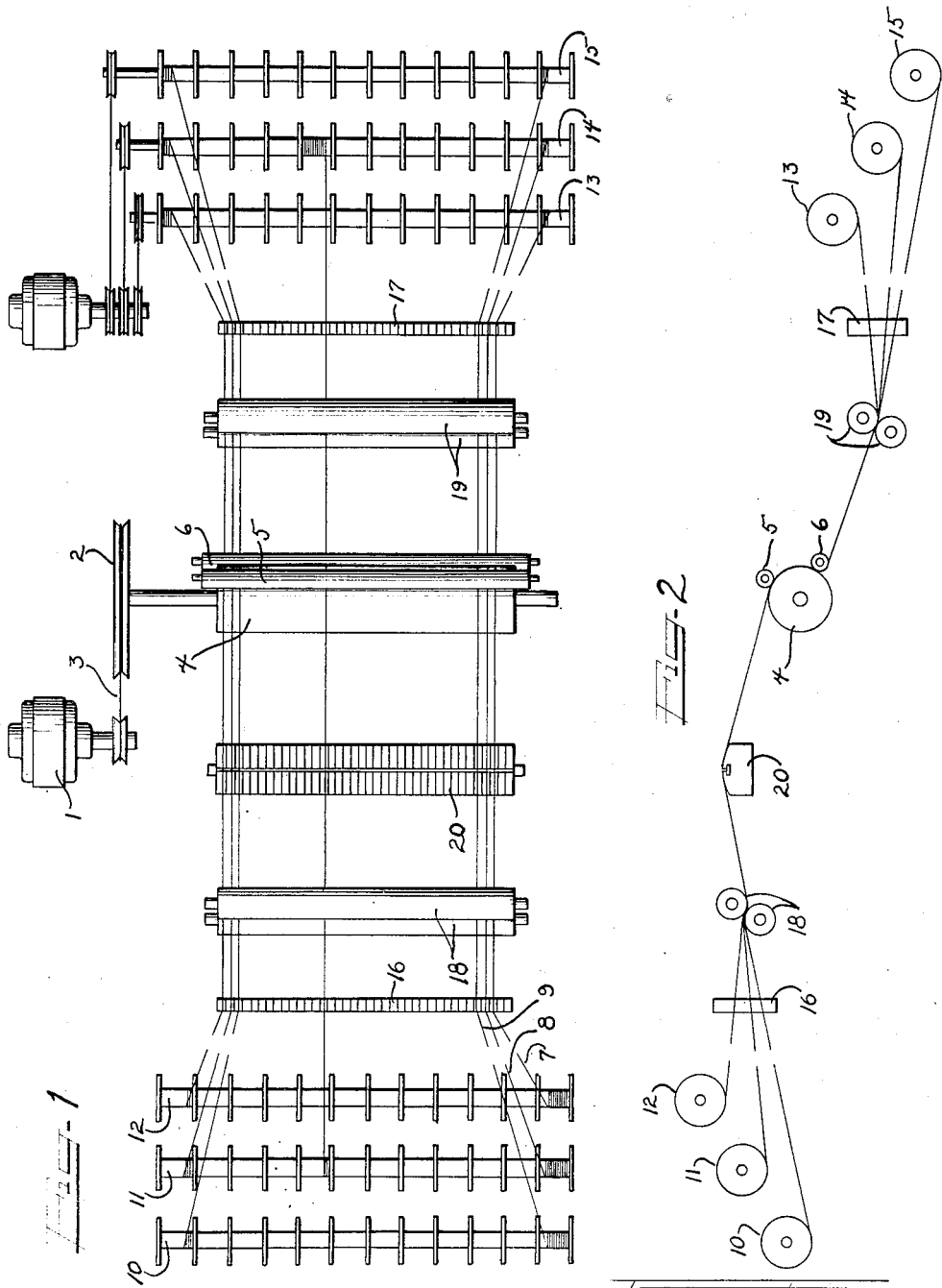
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R. J. TINKHAM
MAGNETIC RECORDER FOR PRODUCING
MULTIPLE DUPLICATE RECORDS

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2 Sheets-Sheet 1



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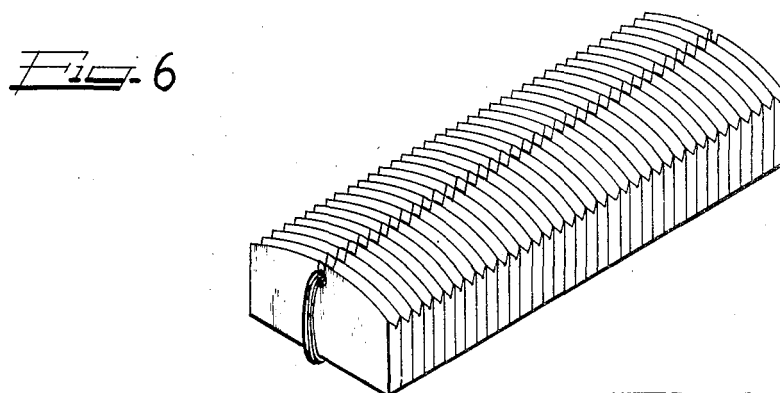
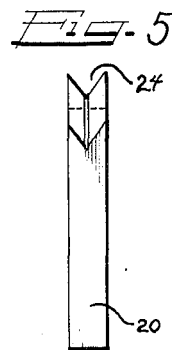
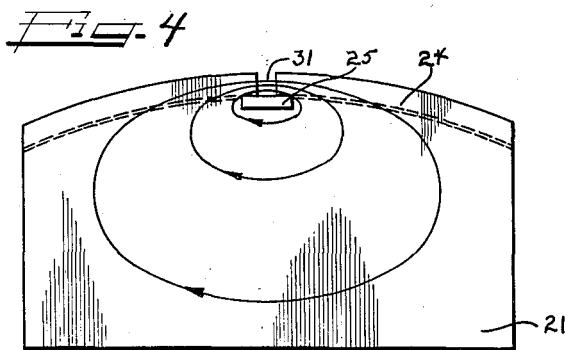
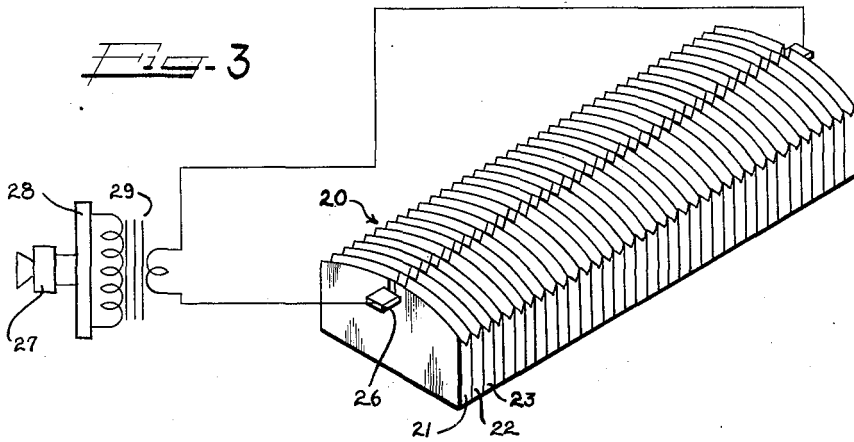
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Checked and Approved
bu *Russell J. Tinkham* Fig-6

UNITED STATES PATENT OFFICE

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MAGNETIC RECORDER FOR PRODUCING MULTIPLE DUPLICATE RECORDS

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6 Claims. (Cl. 179-100.2)

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This invention relates to magnetic wire recording or reproducing apparatus, and more specifically, it relates to a multiple duplicating apparatus for simultaneously making a plurality of identical wire recordings from a single master wire record.

As is well known in the art, if a wire, say of the order of 0.004 inch in diameter (or a tape) of paramagnetic material is moved longitudinally between closely spaced confronting poles of an electromagnet, generally referred to as a recording head, the wire will become longitudinally magnetized along incremental longitudinal portions thereof in exact accordance with current variations in the coil of the electromagnetic head.

A common way of first moving the wire longitudinally for recording purposes is to unwind it from a first spool onto a second spool by a suitable friction drive powered by an electric motor. After the magnetic record is made on the wire it is rewound onto the first spool from the second. After that the wire is again unwound from the first spool onto the second for the reproducing process.

It will be understood, of course, that if the wire is used with only a reproducing apparatus it may be similarly rewound so that the record may be played or reproduced as often as desired, since, as described above, if music or voice signals enter a microphone which is electrically connected to the coils of the electromagnet a magnetic pattern will appear longitudinally of said wire corresponding exactly to such music or voice signals.

If, afterward, the wire bearing this magnetic pattern is again fed longitudinally in the same direction through the same or a different electromagnet, but which is connected through an amplifier to a loud speaker instead of a microphone, the original music or voice signals will be reproduced in such loud speaker since the varying magnetization of the wire record causes magnetic flux changes in the electromagnet which accordingly varies the current flow in the electromagnet coils which is then amplified and converted into sound by the loudspeaker.

In the past various schemes have been provided for making a plurality of identical recordings on different wires at the same time from a single master wire record. A common objection to most of such schemes is that the apparatus is cumbersome and expensive to manufacture and that relatively few recordings may be duplicated at one time.

An object of this invention is to provide a mag-

netic wire duplicating apparatus that is devoid of the above mentioned objections of prior art devices, that is, one that is relatively simple in construction, inexpensive to manufacture and which is adapted to make a large number of identical wire records at the same time.

A more specific object of this invention is to provide a novel electromagnetic recording head which is adapted to receive a large number of wires at the same time for longitudinal magnetization or recording in exact accordance with the magnetic pattern on a master wire record also passed through the recording head.

A still more specific object of this invention is to provide a novel electromagnet or recording head made up of a plurality of laminations each having a slot along an edge thereof for accommodating a magnetizable wire and another slot thereunder at right angles thereof for accommodating an electrical conductor whose current variations will effect corresponding duplicate magnetic patterns on said plurality of wires.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization, method of operation and manner of construction, together with further objects and advantages thereof, may best be understood by reference to the accompanying drawings, in which:

Fig. 1 is a top or plan view, somewhat schematic, of a multiple duplicating machine embodying the principles of my invention for making a plurality of wire records corresponding to a given magnetic pattern.

Fig. 2 is a side view of the machine shown in Fig. 1.

Fig. 3 is an enlarged perspective view of a novel type multiple-reproducing head, together with the associated electrical circuit, comprising a plurality of laminations and embodying the outstanding features of this invention.

Fig. 4 is a front view of a single lamination of the head shown in Fig. 3.

Fig. 5 is a side view of the single lamination shown in Fig. 4, and

Fig. 6 is an enlarged perspective view of a modified multiple-reproducing head.

Referring more particularly to Figs. 1 and 2 which show the multiple magnetic wire recording machine in its entirety, numeral 1 denotes an electric motor for driving a pulley 2 through a belt 3, which pulley drives a capstan drive roller 4. One or more pressure rollers, such as 5 and 6, are yieldably urged by suitable means, such as

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springs (not shown) against the drive roller 4 so as to tightly sandwich and longitudinally drive a plurality of magnetizable wires 7, 8, 9 etc. of suitable magnetizable material such as stainless steel of small diameter, that is, of the order of 0.004 inch. The wires are unwound from supply spools 10, 11, and 12 and wound onto take-up spools 13, 14 and 15. Comb-like wire guides 16 and 17 are provided to guide the wires and keep them suitably spaced from each other. Shock absorbing idler rollers 18 and 19 are provided also for guiding the wires for taking up some of the slack and for reducing shock. All of the wires are moved through an electromagnet or multiple-recording head 20 for the purpose of making a plurality of duplicate wire records.

Referring more particularly to Figs. 3, 4 and 5 which are enlarged views showing the details of recording head 20 it will be noted that the head is made up of a plurality of laminations of magnetic material, 21, 22, 23 etc., stacked up so as to simulate a loaf of sliced bread in appearance. Each of the laminations has a slot disposed along an arcuate edge thereof as will appear more clearly from Figs. 4 and 5 showing a single lamination, such as 21, having a V- or U-shaped slot 24 disposed along the arcuate edge thereof. An enlarged rectangular slot, such as 25, is provided centrally of the arcuate edge of each of the laminations so as to receive an elongated bar 26 of electrically conducting material which bar extends at right angles to the surfaces of the laminations and to the directions of the other slots such as slot 24.

Voice or sound variations which are received by a microphone 27 are amplified by a power recording amplifier of any well known type, illustrated by block diagram 28, whose output is fed to the matching transformer 29, having a secondary winding that causes a varying current flow through conducting bar 26 corresponding to the voice or sound variations received by microphone 27.

A small gap 31 is provided in each lamination immediately above slot 25 so as to, in effect, provide confronting pole pieces having pole faces of relatively small area on each lamination. If it be assumed that current is flowing through conductor 26 in a direction into the plane of the drawing of Fig. 4, the magnetic lines of flux developed as the result of such current flow will be in the direction indicated by the arrows. It will be noted that the lines of flux will be concentrated across gap 31 so as to cause longitudinal magnetization of the incremental wire portion that bridges gap 31 at a given moment. Each lamination, therefore, acts as a complete electromagnet for longitudinally magnetizing the wire traversing its particular groove disposed along its arcuate edge.

Fig. 6 shows a modification of the structure shown in Fig. 3 wherein a coil 32 made up of a plurality of wires is used instead of the longitudinal conducting bar 26. Such coil is particularly suited for recording high frequency signals.

An outstanding advantage of such laminated structure, therefore, is its flexibility to accommodate any given number of wires merely by adding to or subtracting from the number of laminations of the multiple recording head structure. A further advantage is that there is practically no physical limit to the number of duplicating channels, that is, laminations, within reason, therefore making it possible to make duplicate magnetic recordings on a large number of wires at

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one time. A still further advantage is that the recording head is compact, simple in structure and easy to manufacture and the wires are easily threaded therethrough.

Thus I have provided a relatively simple, multiple-magnetic wire recording device that is adapted to faithfully record a large number of duplicate wire records simultaneously. Of course, tapes of ferromagnetic material may be substituted for the wires if so desired.

In addition to being an exceptionally fine multiple-magnetic recording device, the invention is also particularly suited for reproducing where it is desired to combine a plurality of tones or a plurality of instruments whose musical notes or other signals are separately recorded on different wires and which sounds or signals are arranged to be combined in a single output. The arrangement will be the same as that shown in Figure 3, for example, with the exception that the input 27 will now be the output and it will further be understood that the transformer 29 is merely diagrammatically representative of means for raising the voltage or the like.

From the above it will be apparent that the present invention relates generally to magnetic recording and reproducing devices and in this connection the term "magnetic recorder" will be used to designate a magnetic device which is used for magnetic recording or for magnetic reproducing or for both. Since the magnetic head may be used for recording as well as for reproducing the term "transducer head" will be used to designate a magnetic head which is either a recording head or a reproducing head or both.

While I have shown a particular embodiment of my invention, it will, of course be understood that I do not wish to be limited thereto, since many modifications may be made, and I, therefore, contemplate by the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

I claim as my invention:

1. Multiple-wire recording apparatus including an electromagnetic recording head having a plurality of laminations, each having a pair of confronting pole pieces and each having a groove along an edge portion of said pole pieces for guiding a magnetizable wire in a direction at right angles to the pole faces, each of said grooves lying in the plane of its associated pair of pole pieces, and conductor means traversing said laminations at right angles to said planes and carrying a current whose variations are to be magnetically reproduced on said wires.

2. A multiple record member magnetic recorder having a transducer head including a laminated magnetic core of relatively low magnetic retentivity, said core having a plurality of guide means for guiding a plurality of traveling elongated record members along parallel disposed paths across said head, said paths being provided along an edge of individual laminations of said head there being a pair of pole portions having a non-magnetic gap therebetween in each lamination of said core, and a single electric energizable member mounted on such core and electromagnetically associated with all of said pole portions.

3. A multiple-wire magnetic recorder having a transducer head including a laminated magnetic core of relatively low magnetic retentivity, said core having a plurality of spaced parallel disposed grooves over one surface thereof for guiding a plurality of traveling magnetic wires across said head, said grooves each being disposed in an

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individual lamination of said core there being a pair of pole portions having a non-magnetic gap therebetween in each groove path, and a single electric energizable member mounted on said core and electromagnetically associated with all of said pole portions.

4. An electromagnetic transducer head for engagement with plurality of magnetizable record mediums comprising a plurality of like aligned substantially rectangular magnetic laminations, each having a groove along one edge to receive a magnetizable record medium, an opening there-through to receive an energizing conductor, and a slot extending from said opening to said edge to define a non-magnetic gap across which a medium travels; and an energizing conductor extending through said openings.

5. An electromagnetic transducer head assembly comprising a plurality of like aligned substantially rectangular magnetic laminations each having an arcuate edge having a V-shaped slot to receive a magnetizable record medium, each of said laminations having an opening to receive an energizing conductor, and a slot extending from

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said opening to said edge to define a non-magnetic gap; and an energizing conductor extending through said openings.

6. An electromagnetic transducer head assembly comprising a plurality of like aligned magnetic laminations each having a groove along one edge to receive a magnetizable record medium, each of said laminations having an opening through said lamination in close proximity to said edge to receive an energizing conductor, a slot extending from said opening to said edge to define a non-magnetic gap, and an energizing conductor extending through said openings.

RUSSELL J. TINKHAM.

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