March 21, 1944. J. H. JAMES ET AL 2,344,615

MEANS FOR AND METHOD OF MAKING JOINTS

Filed April 2, 1942 2 Sheets-Sheet 1

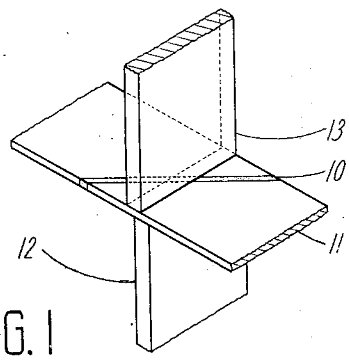

FIG. 1

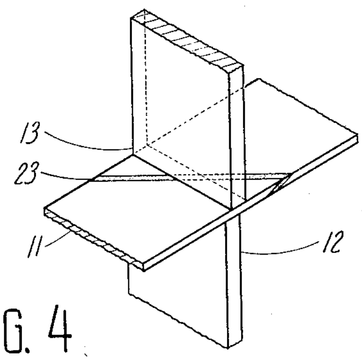

FIG. 4

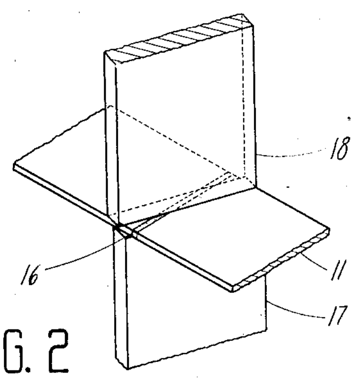

FIG. 2

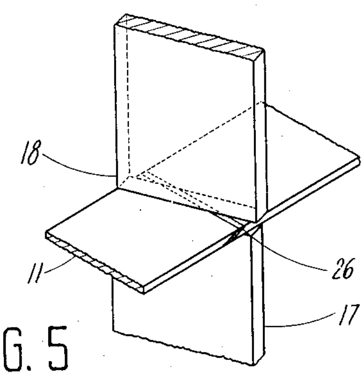

FIG. 5

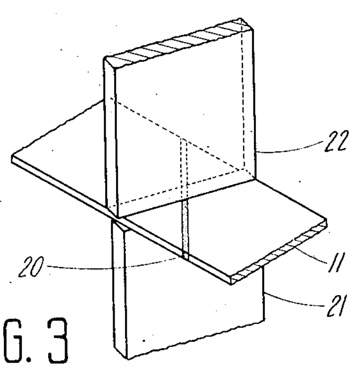

FIG. 3

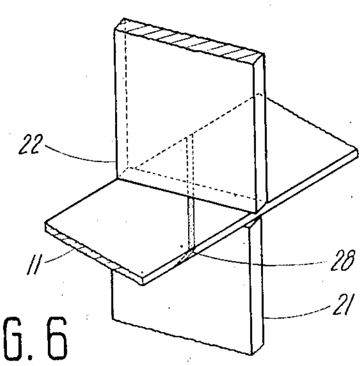

FIG. 6

INVENTORS
JOHN H. JAMES
HARRY B. MILLER

BY

Elmer J. Hyde
ATTORNEY.

March 21, 1944. J. H. JAMES ET AL 2,344,615

MEANS FOR AND METHOD OF MAKING JOINTS

Filed April 2, 1942 2 Sheets-Sheet 2

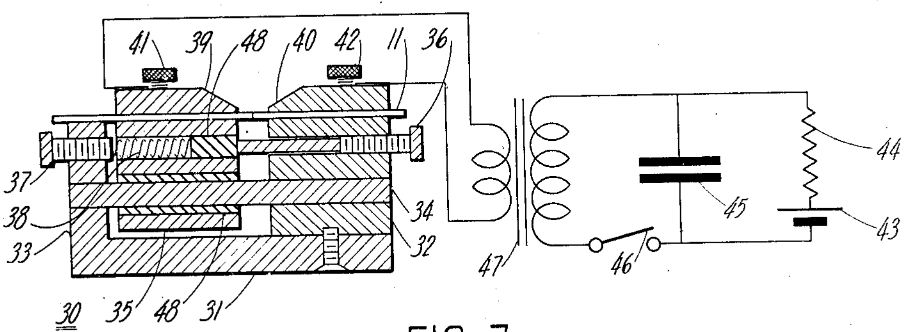

FIG. 7

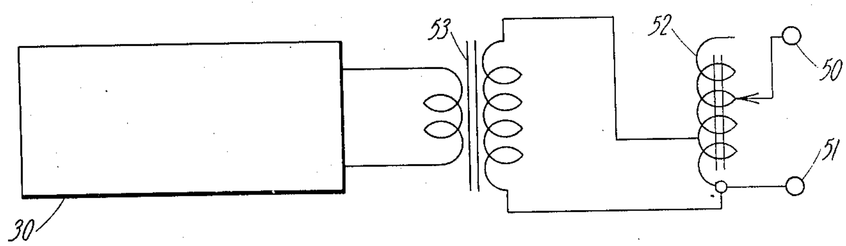

FIG. 8

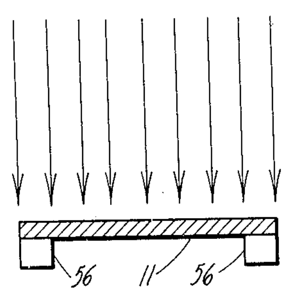

FIG. 9

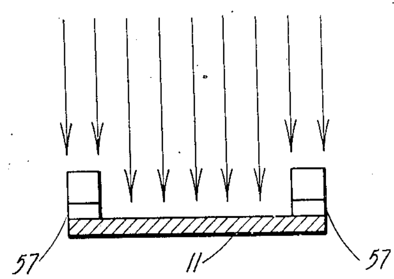

FIG. 10

INVENTORS
JOHN H. JAMES
HARRY B. MILLER

BY Eber J. Hyde

ATTORNEY

Patented Mar. 21, 1944 2,344,615

UNITED STATES PATENT OFFICE

2,344,615

MEANS FOR AND METHOD OF MAKING JOINTS

John H. James, Cleveland Heights, and Harry B. Miller, Cleveland, Ohio, assignors to The Brush Development Company, Cleveland, Ohio, a corporation of Ohio

Application April 2, 1942, Serial No. 437,350

3 Claims. (Cl. 179—100.2)

Our invention pertains to magnetic tapes and more particularly to tape joints and the means and methods of making them.

An object of our invention is to provide a magnetic tape having an improved joint.

Another object of our invention is to provide a magnetic tape for acoustical devices wherein the click produced by the tape joint is less objectionable.

A further object of our invention is to strengthen the joint in a magnetic tape.

Still another object of our invention is to provide quickly and easy means and method of making a joint in a magnetic tape.

Other objects and a fuller understanding of our invention may be had by referring to the following specification and the accompanying drawings in which:

Figures 1 to 6 illustrate different types of joints in magnetic tapes.

Figure 7 is a schematic cross section of a device for making tape joints.

Figure 8 illustrates another circuit which may be used with the device illustrated in Figure 7.

Figures 9 and 10 illustrate means for protecting the tape during heating.

Devices for magnetically recording and reproducing signals have been made utilizing a length of magnetic material in the form of a tape for the signal carrier. For maximum usefulness some of these devices require that the tape be in the form of an endless belt in order that it may be repeatedly rotated at a rapid rate to cause the signal recorded thereon to be reproduced a number of times, or to obviate rewinding the tape after the record has been played. A short tape of this endless type is useful with an oscilloscope as it permits visually studying a transient condition. A longer endless tape may be used with a device for acoustical reproduction of the signal, such as the Mathes Patent No. 1,542,566 wherein an endless tape is repeatedly rotated in the sending and in the receiving apparatus of a secret signaling device.

The joints which we propose for magnetic tapes are primarily adapted for use with acoustical recording and reproducing devices. That is, for devices which reproduce the recorded signal through a loudspeaker or earphone in order that a person can hear it. In acoustical devices long duration of a slight discontinuity in the signal caused by the tape joint is not as detrimental as a short sharp loud discontinuity.

Our tape joint is designed to produce a discontinuity which is much less objectionable than the ordinary tape joint, but which lasts over a longer period of time. It may be used with optical reproducing devices as well as with acoustical reproducing devices although it is primarily designed for use with the acoustical reproducing devices.

The process of magnetically recording and reproducing a signal usually comprises bringing the magnetic tape to a state of uniform flux density, altering the flux density to set up a flux pattern in the tape in accordance with the signal to be recorded, and passing the magnetized tape past a reproducing head in order to establish in the head an electromotive force in accordance with the magnetic pattern on the tape. In order that the reproduced signal be an exact facsimile of the recorded signal many conditions must be met. One of the most important conditions is that the permeability must be substantially uniform throughout the length of the tape. The tape joint has a different permeability than the remainder of the tape thereby producing a sharp click in the reproduced signal. In devices having a length of tape sufficient that the tape joint click is produced only once in three to five minutes the discontinuity is not too objectionable. But in devices having a very short length of tape in which the click is produced on the order of every few seconds the discontinuity becomes very objectionable, even to the point of rendering the signal unintelligible.

The tape joints are usually made with silver solder which has a different permeability than the material from which the tape is made, or the tape is spot welded in which case the permeability of the tape is permanently changed at the location of the weld. Due to the different permeability of the tape at the joint, the signal reproduced from it is not the same as the signal which was applied to it.

In order to reduce the effects of this change in permeability we position the tape joint and the pole piece of the reproducing (or recording) head at an angle to each other. The angle between the pole piece and the joint is such that as the joint passes under the pole piece there is always a certain amount of tape having uniform permeability beneath the pole piece. This assures that there is always a flux path from one pole piece through a uniform portion of the tape to the other pole piece.

If the tape joint and the pole piece are parallel to each other there is a complete break in the flux path as the joint passes beneath the pole piece. According to our invention, when the pole piece and the joint are at an angle to each other, there is never a complete break in the flux path, but merely a progressive break starting at one edge of the tape and moving toward the other edge.

Figure 1 illustrates a butt joint 10 at an angle with respect to the direction of movement of the tape. This assures that as the joint 10 passes between the pole pieces 12 and 13 there is always an area of tape between the pole pieces 12 and 13 which does not include a discontinuity due to the joint. Accordingly, the level of acoustal output of the tape joint is much lower than it would be if the joint were parallel to the direction of the pole pieces, and in many instances the level may be below the level of the signal recorded on the tape, which signal thereby almost completely masks the disturbance caused by the joint.

Figure 2 illustrates a butt joint 16 which is at a 90 degree angle to the direction of movement of the tape 11, and pole pieces 17 and 18 which are at an angle with respect to the direction of movement of the tape. This produces the same general effect as the arrangement shown in Figure 1. It is to be remembered that if the recording head pole piece is at an angle with respect to the tape, then the reproducing head pole piece must be at the same angle with respect to the tape.

Figure 3 illustrates a butt joint 20 at an angle to the direction of movement of the tape 11, and pole pieces 21, 22 at a different angle to the direction of movement of the tape. By making both the joint and the pole pieces at an angle it takes slightly longer for the joint to pass the pole piece and the click is a little less objectionable.

Figures 4, 5, and 6 illustrate lap joints in the tape 11. Figure 4 shows a lap joint 23 at an angle with respect to the direction of movement of the tape, and the pole pieces 12, 13 at a 90 degree angle with respect to the direction of movement of the tape. This is similar to Figure 1 except that a lap joint is shown instead of a butt joint. By using a lap joint a much larger tape area may be used for soldering or spot welding the two ends of the tape together. Accordingly, a stronger joint is produced.

Figure 5 is somewhat similar to Figure 2 except that a lap joint 26 is used. The joint extends straight across the tape 11 and the recording and reproducing head pole pieces are at an angle to the direction of movement of the tape.

Figure 6 shows a lap joint 28 at an angle with respect to the direction of movement of the tape, and the pole pieces also at an angle and crossing the tape joint.

We have found that the angle between the joint and the pole piece for the various above mentioned embodiments should be sufficient that the linear distance of the tape occupied by the tape joint (span of the tape joint) should be greater than the width of the pole piece. When this relationship is obtained or exceeded the discontinuity due to the tape joint is reduced to a minimum.

Figure 7 illustrates a schematic cross section of a jig 30 for holding the two loose ends of tape 11 in position while they are being joined together. The jig comprises an insulating base 31 to which is connected a metal block 32. The base 31 has an upstanding insulating end portion 33. Between the fixed end 33 and the fixed metal block 32 there is a shaft 34, and upon the shaft 34 there is slidably mounted a metal block 35. A screw 36 is threaded into a hole through the stationary block 32 and has a long shank which butts against the movable block 35. A tensioning screw 37 is provided threadably engaging the upstanding end 33 of the base 31, and a spring 38 is position between the screw 37 and the movable block 35. The spring 38 biases the movable block 35 toward the stationary block 32. The screw 36 regulates the position of the slidable block 35 with respect to the stationary block 32, and the screw 37 and spring 38 regulate the bias on the block 35. On the top of each of the blocks 32, 35 there is a metal clamping block 39, 40 for clamping an end of the tape 11. One end of the tape is placed between blocks 35 and 39 and the screw 41 is turned to clamp the tape 11. The other end of the tape is placed between blocks 32 and 40 and the screw 42 is turned to clamp the tape. Milled slots may be provided in the blocks 32, 35, 39, 40 in order to line up the two ends of the tape 11. The screw 36 is then turned to allow the bias established by the spring 38 to push the slidable block 35 toward the stationary block 32 until the two ends of the tape touch. Silver solder or other such material may be applied to the tape and the tape heated electrically or by flame to melt the solder. Cooling will then establish a firm tape joint.

We show a means of heating the tape by its own resistance. A battery 43 is connected through a resistance 44 or a thyratron tube to a condenser 45. With the switch 46 open the condenser is charged by the battery 43 and upon closing the switch 46 the condenser discharges through the transformer 47, the secondary of which is connected to the two ends of the tape. This heats the tape and causes the solder to melt. Upon the condenser 45 reaching a discharged state the tape 11 cools rapidly and the joint is made. Insulation 48 is provided to prevent a short circuit through the blocks 32, 35.

The jig 30 is very useful for the welding process as the screw 37 and spring 38 may be used to regulate the pressure between the ends of the tape 11. In welding accurate control of the pressure between the parts being welded is almost as essential as accurate control of the current. When our jig is being used for welding the ends of the tape together the screw 36 is backed out of its threaded hole until the ends of the tape touch each other. The screw 36 is then turned a little bit more thereby putting spring pressure on the two ends of the tape. When the weld takes place the ends of the tape melt slightly and the spring 38 keeps pushing the tape together.

It is also possible to use our jig for arc welding.

For lap joints it may be desirable to provide means for limiting the vertical movement of the ends of the tape 11 as the spring 38 pushes the two ends together.

In a brazing or soldering process our jig may be used with a circuit such as is shown in Figure 8. The terminals 50, 51 may be connected to a 100 volt A. C. line or another suitable source, and a transformer 52 or a potentiometer may be provided for accurate regulation. The secondary of a transformer 53 is connected to the jig at 39 and 40.

When a tape is cut at an angle one of the corners has a rather long thin point. Heating this long thin point by flame or by electrical resistance or induction is apt to cause it to curl or even burn and shrivel up. To prevent this we provide means for keeping the corners at a lower temperature.

Figure 9 shows a cross section of a tape 11 looking toward a joint which is being heated. The arrows indicate the direction of the heat. Beneath the tape 11 and positioned under the corners which are apt to burn are positioned two blocks 56 of heat conductive material which serve to transmit a portion of the heat away from the corner of the tape thereby maintaining them at a lower temperature.

Figure 10 illustrates a tape 11 and two blocks 57 of material positioned between the corners of the tape and the source of the flame. These blocks 57 may be heat conductors to shunt away heat or non-conducting insulators, to prevent too much heat from reaching the tape at the areas where it is apt to curl.

When soldering or brazing a tape it may be found desirable to use two materials of different melting points; for instance, a low melting point solder could be used on the tape near the conductor blocks 56, and a higher melting point solder used between the blocks 56 where the heat from the flame can reach it.

In the process using shielding block 57 two steps of soldering may be necessary. The first step would use a higher melting point solder and would leave the joint beneath the shields 57 unconnected. The second step would be to remove the shields and connect the corners by using a lower melting point solder and less heat.

We claim as our invention:

1. A jointed magnetic tape adapted to cooperate with a transducer head having a pole piece of appreciable thickness, said joint extending across the tape at an angle to the direction of movement of the tape which is sufficiently different from 90 degrees that the distance between the ends of the joint along the direction of movement of the tape is greater than the thickness of the pole piece, whereby the major part of the magnetic flux through the pole piece when the tape joint is opposite the pole piece passes through the tape independently of the joint.

2. In apparatus for the magnetic recording and/or reproducing of signals of relatively high frequency, the combination of a jointed tape of magnetic material to receive the signal, and a transducer head disposed adjacent the tape in magnetic flux linkage relationship with the tape, said pole piece being thin lengthwise of the tape and adapted to record or reproduce the relatively high frequency signals and the joint of the tape being at an angle to the length thereof such that the distance between the ends of the joint measured lengthwise of the tape is greater than the thickness of the pole piece and the major part of the magnetic flux through the pole piece when the tape joint is opposite the pole piece passes through the tape independently of its joint.

3. In apparatus for the magnetic recording and/or reproducing of signals of relatively high frequency, the combination of a jointed tape of magnetic material to receive the signal, and a transducer head disposed adjacent the tape in magnetic flux linkage relationship with the tape, said pole piece being thin and adapted to record or reproduce the relatively high frequency signals, said tape joint and said thin pole piece being at such an angle with respect to each other that only a relatively small portion of the joint lies under the pole piece at any one given time whereby the major portion of the magnetic flux through the pole piece when the tape joint is opposite the pole piece passes through the tape independently of its joint.

JOHN H. JAMES.
HARRY B. MILLER.