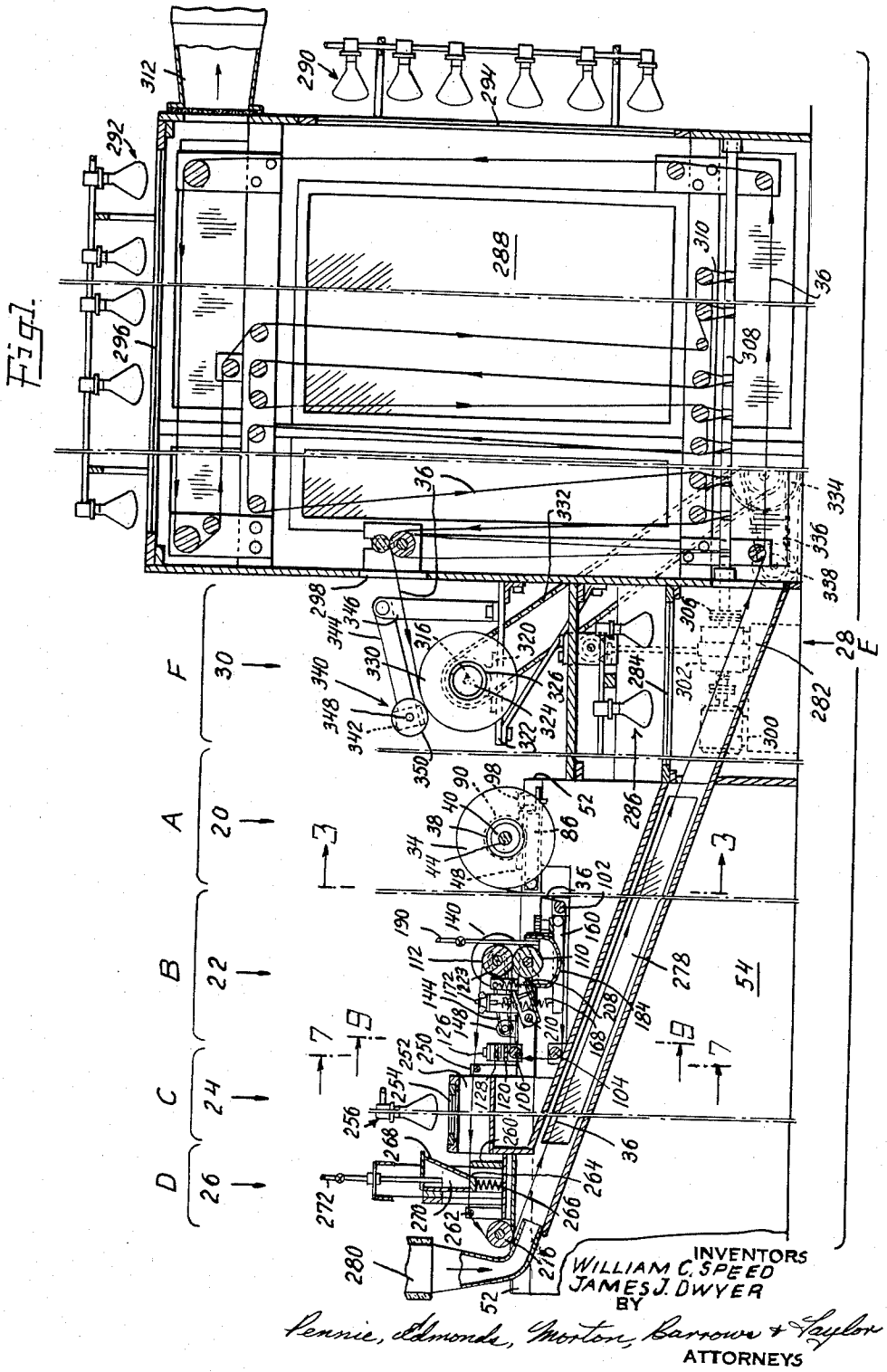
Aug. 9, 1955 W. C. SPEED ET AL 2,714,871

ROLLER MEANS FOR APPLYING MAGNETIC MATERIAL TO SOUND RECORDING TAPE

Filed June 20, 1952 3 Sheets-Sheet 1

Fig. 1.



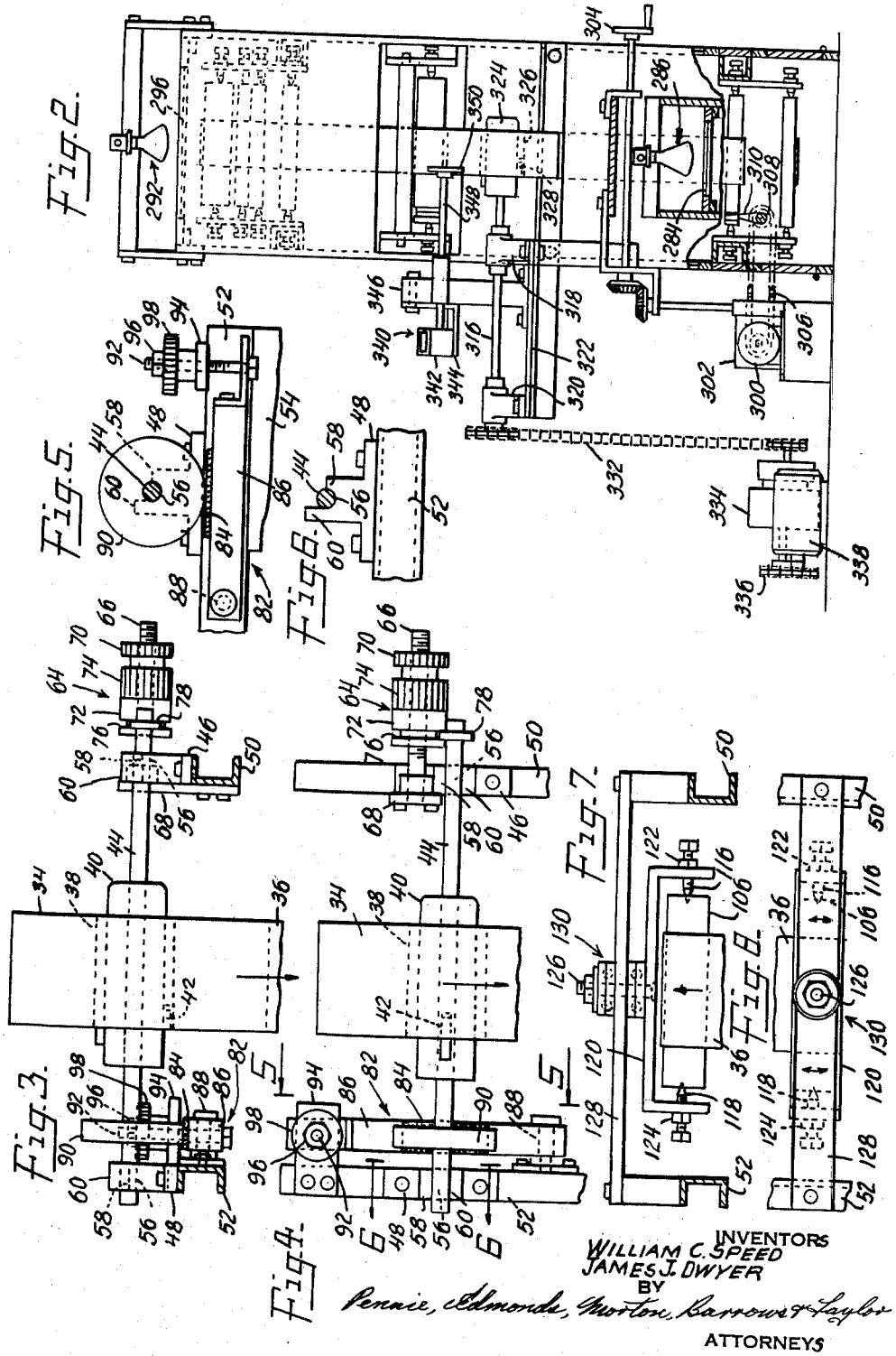
INVENTORS
WILLIAM C. SPEED
JAMES J. DWYER
BY
Pennie, Edmonds, Morton, Barrows & Taylor
ATTORNEYS

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3 Sheets-Sheet 2



INVENTORS
WILLIAM C. SPEED
JAMES J. DWYER
BY
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ATTORNEYS

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3 Sheets-Sheet 3

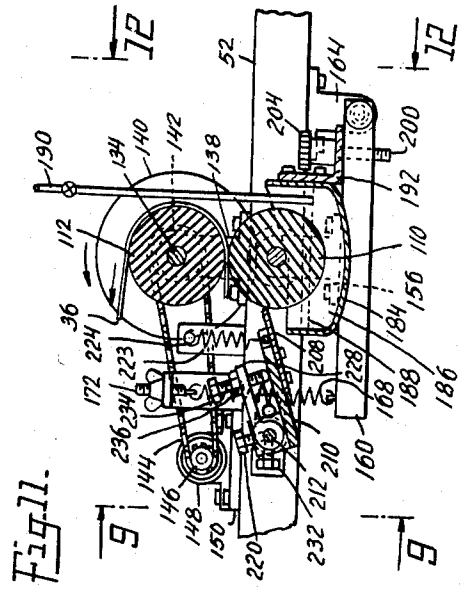


Fig. 11.

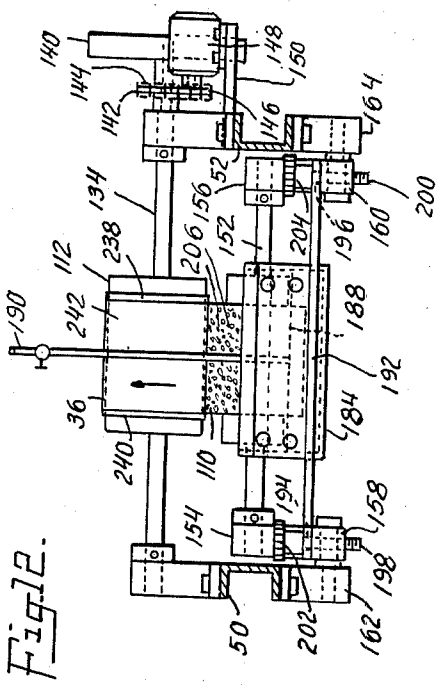


Fig. 12.

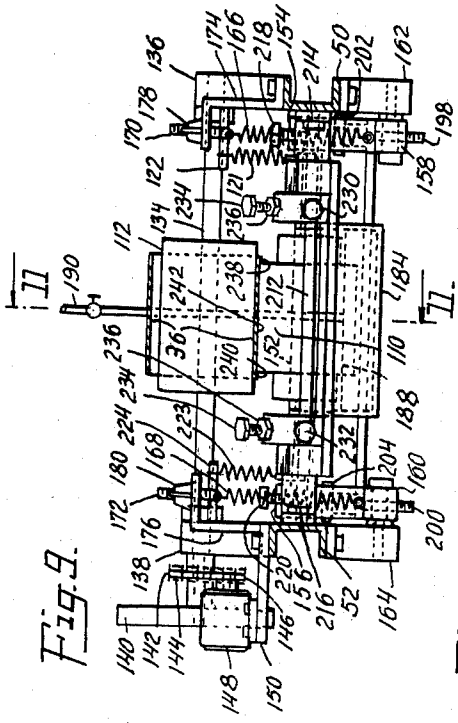


Fig. 9.

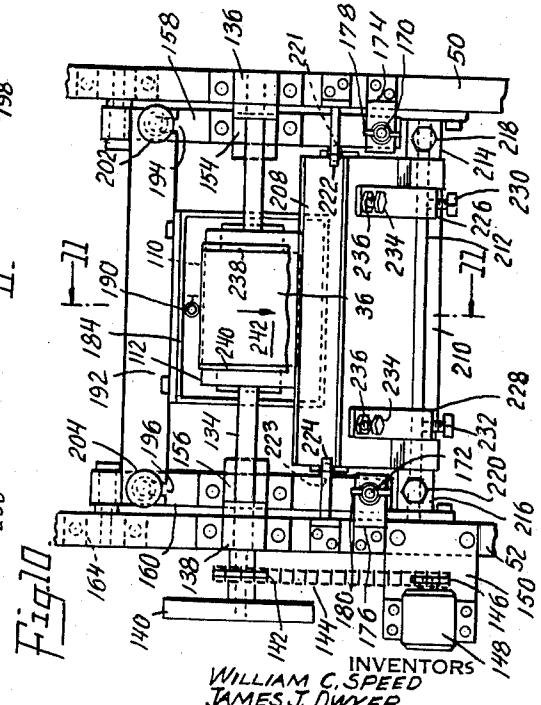


Fig. 10

INVENTORS
WILLIAM C. SPEED
JAMES J. DWYER
BY
Pennie, Edmonds, Morton, Barrows & Taylor
ATTORNEYS

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ROLLER MEANS FOR APPLYING MAGNETIC MATERIAL TO SOUND RECORDING TAPE

William C. Speed, Riverside, and James J. Dwyer, Stamford, Conn., assignors to Audio Devices, Inc., New York, N. Y., a corporation of New York

Application June 20, 1952, Serial No. 294,636

2 Claims. (Cl. 118—249)

This invention relates to the production of magnetic sound recording tape and has for its object improvements in the method of and apparatus for producing such tape.

It is customary in the production of magnetic sound recording tape to pass a long and narrow tape base or band successively from a roll unwinding zone through, usually, an adhesive precoating zone, an adhesive precoat partial drying zone, a magnetic coating zone, and a magnetic coat drying zone to a roll winding zone. To this end there are provided, in sequential association with each other, a roll unwinding device, an adhesive precoating device, an adhesive precoat partial drying device, a magnetic coating device, a magnetic coat drying machine and a roll winding machine.

The tape base is formed of paper or plastic, such as cellulose acetate. One side is precoated, in whole, in part or parts, with a suitable adhesive liquid, such as a copolymer of polybutadiene with acrylonitrile, the methyl esters of carylic acid, etc. The purpose of the adhesive precoating step is to prepare or condition that side of the tape base for receiving and retaining the magnetic coating. A better adherence of the magnetic coating is assured by the interposition of the adhesive coating between the tape base and the magnetic coating. The adhesive coating may be regarded as a mid-layer in a laminated structure, the tape base being bound to the adhesive coating and the magnetic coating being bound, in turn, to the adhesive coating to form an integral unitary whole. The magnetic material usually is finely divided, synthetically produced, magnetic oxide of iron in a dispersion of binder and solvent liquids.

A practice such as that briefly referred to is disclosed for example, in our co-pending applications, Serial Nos. 201,974 and 201,977, filed December 21, 1950.

The present improvements relate more especially to the adhesive precoating operation. Because of its sticky nature, troublesome difficulties are encountered in the use of adhesive liquids. Even when operating with extreme caution, the apparatus employed tends gradually to become covered, in part at least, with some of the adhesive liquid at most undesired places. The adhesive liquid may find its way to the reverse side of the tape base, thus impairing if not destroying its usefulness. The adhesive coating may tend to vary in thickness. It tends to vary also in its attachment to the tape base, being less securely bonded thereto in some areas than in others.

Efficient production is aided when the tape base can be passed rapidly, without interruption, through the successive zones mentioned. When such adhesive precoating difficulties arise, however, it is necessary often to stop the passage of the tape base. All power-driven machinery employed to propel the tape base must be shut down. Time and labor are consumed to clean up the messes; an affected section of the tape base may have to be cut out; its ends must be joined, etc.

Such interruption of the passage of the tape base also affects, unforunately, the magnetic coating operation. The dispersion of magnetic material is free flowing and tends

promptly to spread over surrounding areas of the apparatus. Time and labor are consumed also in cleaning up that mess. Affected sections of the tape base must be cut out, be spliced, etc., to restore desired operating conditions.

Our investigations have led to the discovery that the adhesive precoating operation may be conducted in a substantially clean and continuous manner. The adhesive liquid is applied and confined solely to the area desired on the same side of the tape base. So far as the adhesive precoating step is concerned, there is no need to stop the operation, a selected area only of the apparatus is touched by the adhesive, and the reverse side of the tape base remains free of adhesive.

These and other features of the invention will be better understood by referring to the accompanying drawings, taken in conjunction with the following description, in which:

Fig. 1 is a diagrammatic side elevation in section of an apparatus illustrative of a practice of the invention;

Fig. 2 is an end elevation, partly broken away, looking toward the magnetic coat main drying chamber and the winding machine shown in Fig. 1;

Fig. 3 is a section on the line **3—3** of Fig. 1, showing the unwinding device of that figure;

Fig. 4 is a plan view of the same;

Fig. 5 is a section on the line **5—5** of Fig. 4;

Fig. 6 is a section on the line **6—6** of Fig. 4, showing a demountable shaft arrangement for the unwinding device;

Fig. 7 is a section on the line **7—7** of Fig. 1, showing a tape base self-aligning device;

Fig. 8 is a plan view of the same;

Fig. 9 is a section on the line **9—9** of Figs. 1 and 11, showing a transverse end elevation of the pre-coating machine counter to the general direction of travel of the tape base;

Fig. 10 is a plan view of the same;

Fig. 11 is a longitudinal cross-section on the line **11—11** of Fig. 10; and

Fig. 12 is a transverse end elevation on the line **12—12** of Fig. 11, showing the precoating machine in the general direction of travel of the tape base.

Returning to Fig. 1, which gives one an over-all side view of the apparatus, it will be noted that it may be regarded, in terms of operation, as being divided into: (1) roll unwinding zone A; (2) adhesive precoating zone B; (3) adhesive precoat partial drying zone C; (4) magnetic coating zone D; (5) magnetic coat drying zone E; and (6) roll winding zone F. In terms of apparatus the same zones may be considered as (*a*) roll unwinding device **20**; (*b*) adhesive precoating machine **22**; (*c*) adhesive precoat partial drying device **24**; (*d*) magnetic coating device **26**; (*e*) magnetic coat drying machine **28**; and (*f*) roll winding machine **30**. They will be taken up in that order, primary emphasis being directed to the adhesive precoating zone and machine and the manner in which it cooperates, particularly, with the adjacent zones and devices.

Roll unwinding zone

Roll unwinding device **20** is shown in Figs. 1, 3, 4, 5 and 6. A roll **34** of tape base **36** on a hub **38** is mounted on a core **40**, being securable thereto by a key **42**. The core in turn is mounted integrally on the intermediate portion of a removable shaft **44**. The arrangement is such that a roll of tape base to be processed may be mounted on a core-shaft unit in readiness for placement on the roll unwinding device; for example, when a preceding roll is unwound and its core-shaft unit is removed.

To make such action possible, the end portions of

the shaft may be fitted in open journals **46** and **48** secured to the tops of side channels **50** and **52** fastened to a base **54**. The journals (Fig. 6) have an open recess **56** limited by a low rear shoulder **58** and a high forward shoulder **60**. The pull or thrust of the roll, as it is unwound, is downwardly toward the higher shoulders. This restrains the shaft from jumping out of its recesses in the journals.

It is important that the tape base from the roll be closely confined in a predetermined path of travel as it goes to adhesive precoating machine **22**. An adjusting device **64**, therefore, is associated with the near end of the unwinding shaft. It includes a threaded lateral rod **66** integrally secured at its far end to a vertical bar **68** fastened to side channel **50**. Rotatably mounted on the rod are a knurled lock-nut **70** and a threaded adjusting member **72**. The near end of the latter has a knurled knob **74** for easy turning and the far end is provided with an annular recess **76**, into which fits an annular shoulder **78** integrally secured to the near end portion of the unwinding shaft. It will be clear that the adjusting member may be moved back and forth on the lateral rod and that the shaft in turn will be moved in a corresponding direction. In this manner roll **34** may be accurately positioned to unwind tape base **36** in its path of travel as it advances to be precoated. When the desired adjustment is made, the lock-nut is turned to maintain the adjusting member in that position.

It is important also that the tape base not be unwound from the roll too rapidly. There is a marked tendency for this to occur as the roll decreases in size and its momentum continues at a high rate. The tape base should be fed to the precoating zone at the same rate it proceeds through the magnetic coating and magnetic coat drying zones.

A brake device **82** (Figs. 3, 4, and 5) is provided for regulating and controlling the rate of unwinding of the tape base from its roll. The device includes a brake block **84** on the top of a lateral arm **86** pivoted at one end **88** to side channel **52**. The brake block is directly below and in frictional engagement with a circular brake disc **90** mounted integrally on the far end portion of the unwinding shaft. The other end of the arm is fitted with a vertical threaded rod **92** extending through a lateral bar-support **94** attached to the top of the same side channel. Mounted on the upper end of the rod is a lock-nut **96** and a threaded adjusting member **98**. The upper end of the latter contains a knurled hand knob for easy turning. It will be clear that the arm may be pivoted up or down by turning the adjusting member; that the amount of braking action of the brake block on the brake disc may thus be regulated from time to time, as required, and that the lock-nut may be turned to lock the adjusting member against the bar support.

Adhesive precoating zone

Adhesive precoating machine **22** is shown in Figs. 1, 7, 8, 9, 10, 11 and 12. As shown in Fig. 1, the tape base passes forwardly and downwardly from the roll to and around a transverse guide rod **102**; horizontally forward to and around a second transverse guide rod **104**; upwardly to and around a self-aligning guide roller **106**; horizontally to and between a pair of superposed rollers **110** and **112**; and around the latter roller to adhesive precoat partial drying device **24**.

Guide rods **102** and **104** are fixed, preferably, so that they may help to exert braking action on the tape base at its leaves the roll. They are secured at their ends in side supports, as indicated in Fig. 1.

Self-aligning guide roller **106** (Figs. 7 and 8), on the other hand, is suspended between two pivot pins **116** and **118**. The main body portion of each pin is threaded to fit in threaded holes in the depending legs of a pivoting channel bracket **120**. Lock-nuts **122** and **124** are used to secure the pins and hence their pivot points in an optimum position for the rotation of the guide roller. The bracket is suspended on a vertical rod **126** extending through a crossbar support **128** and a roller-bearing **130** to facilitate pivoting of the guide roller. As the tape base passes over the roller, the roller is free to oscillate back and forth to keep the tape base aligned or centered in its path of travel to the rollers.

The rollers, preferably, are formed of material, such as rubber, to permit gripping of the tape base as it passes between them. Upper roller **112** is mounted on a power-driven shaft **134** supported in journals **136** and **138** attached to the tops of side channels **50** and **52**. A fly wheel **140** is mounted on the far end of the shaft. The same end portion of the shaft is fitted with a sprocket wheel **142**, fitted with a sprocket chain **144** extending to a sprocket-wheel **146** on the near end of the drive shaft of a motor **148** secured to a platform **150** attached to side channel **52**.

Lower roller **110** is mounted on a floating shaft **152** suspended at its ends in journals **154** and **156** attached to the tops of lateral arms **158** and **160** pivoted at their right ends, as one views Figs. 1 and 11, to brackets **162** and **164**. Springs **166** and **168** are attached at their lower ends to the left ends of the lateral arms; and at their upper ends to threaded rods **170** and **172**, extending through Z-lugs **174** and **176** attached to the tops of channels **50** and **52**. Wing nuts **178** and **180** on the upper ends of the rods permit raising or lowering the lateral arms, and hence the amount of pressure exerted by the rollers on each other and on the tape base passing between them.

A removable pan **184** is located directly below the lower roller, the lower portion of the roller extending well into the pan, and into a body of adhesive liquid **186**, maintained at a level **188** by means of an automatic feed line **190**. The pan is secured (Figs. 11 and 12) to an angle support **192**, the ends of which extend over the right end portions of lateral arms **158** and **160**. The bottom leg of the angle support is provided (Fig. 10) with open slots **194** and **196**, respectively, over the lateral arms. Threaded rods **198** and **200** extend through threaded holes in the arms, the upper ends of the rods terminating in knurled hand knobs **202** and **204**. It will be clear that the pan may be locked in position under the lower roller by turning the knobs. This arrangement also permits the removal of the pan, say at the end of a work day or period, for cleaning or any other desired purpose.

As shown in Fig. 11, the upper roller turns counterclockwise, and the lower roller is caused to rotate in a clockwise direction; again, as one views Figs. 1 and 11. The lower roller contains a great many uniformly spaced small surface pockets **206** (Fig. 12) of optimum size. Since the roller dips into the pan, the pockets are filled with adhesive which is carried toward the tape base.

To make certain that a metered amount of adhesive is thus conveyed to the tape base, a doctor blade **208** is used (Figs. 1, 9, 10 and 11). It is secured to a cross-plate **210** mounted pivotally on a cross-rod **212**. The ends of the cross-rod fit in brackets **214** and **216** and the cross-rod is held in fixed position by set screws **218** and **220**. The cross-plate and doctor blade are adjustable as a unit with respect to lower roller **112**. To this end springs **221** and **223** are fastened at their lower ends to the forward portion of the cross-plate and at their upper ends to anchors **222** and **224**. A pair of spaced arms **226** and **228** are mounted on the cross-rod **212**, being integrally secured thereto by set-screws **230** and **232**. The forward end of each arm has a threaded hole through which extends a threaded adjusting rod **234**, having a lock-nut **236**. With this arrangement, the rods can be turned to regulate and locked to fix the amount of pressure of the doctor blade on the lower roller, and hence to level off and control the amount of adhesive liquid that reaches the under-side of the tape base pass-

ing between the rollers. As shown to advantage in Fig. 11, the adhesive coated tape base moves around the right half portion of the upper roller, the uncoated side, however, only being in contact with that roller.

Before tracing the further progress of the tape base, several items of importance should be noted. The lower roller is somewhat narrower than the upper roller. The lower roller is narrower, in turn, than the tape base so that its marginal edge portions **238** and **240** (Figs. 9 and 10) do not contact that roller and hence are not coated with adhesive liquid, the intermediate portions **242** only being coated. The tape base, on the other hand, is narrower than the upper roller so that the tape base is fully supported transversely by that roller. That support helps to keep the freshly coated tape base from warping as well as to keep it in its normal path of travel. Also, as already indicated, the pressure of the rollers may be regulated to work the adhesive liquid thoroughly thereon, thus to assure a uniformly good bond between the two, as well as to propel the tape base in its path of travel. The rollers, particularly when under substantial pressure, appear to grind or rub the adhesive into the pores of the tape base, thus assuring a firm unitary structure.

Adhesive precoat partial drying zone

Adhesive precoat partial drying device **24** is shown in Fig. 1. It includes a guide rod **250** to direct the tape base, precoated side uppermost, horizontally through an elongated drying tunnel **252** having a glass top **254**. A bank **256** of electric light bulbs, preferably infra-red bulbs, extends across the glass top so that radiant heat may be applied to the adhesive precoat. As indicated, the adhesive is only partly dried. The magnetic material appears to form a better bond with a partially dried adhesive precoat than with a wholly undried one, at least with the adhesive liquids now used. It would be inadvisable, of course, completely to dry the adhesive precoat at this stage. To do so would defeat the very purpose of the adhesive coating step. The amount of drying can be controlled in various ways, such as by the speed of travel of the tape base through the tunnel, the length of the tunnel, the number and intensity of the bulbs in the bank, etc.

Magnetic coating zone

Magnetic coating device **26** is shown in Fig. 1. It includes guides **260** and **262** to direct the partially dried tape base between a bottom support **264** mounted on springs **266** and a fixed feed hopper **268**, which receives a dispersion of magnetic material **270** through a feedline **272**. As the tape base passes under the hopper, its partially dried adhesive precoat receives a coating of the magnetic material. The two coatings are bonded easily and quickly to form a firm integral unitary whole.

Magnetic coat drying zone

Magnetic coat drying machine **28** is shown in Figs. 1 and 2. Going to the former, it will be noted that the magnetic coated tape base passes around a gripping roller **276** downwardly through an inclined extending duct **278**, where it meets air heated by a heater **280** and blown by a fan, not shown; that the tape base thus partially air-dried passes through an extension **282** of the duct, with a glass top **284** over which is a bank **286** of infra-red bulbs, for further drying by air and radiant heat; and that the tape base then moves into a final drying chamber **288** where it is heated by additional banks **290** and **292** of similar bulbs, through glass side **294** and glass top **296**, as the tape base pursues a tortuous, more or less zig-zag, but extensive course of travel around a plurality of spaced guides to an exit opening **298**.

Power to propel the tape base along its long course is obtained through a motor **300**; a gear-reducer **302**, the speed of which is controlled by way of a hand-wheel

304 (Fig. 2); a sprocket chain **306** (Fig. 2); a drive shaft **308** (Figs. 2 and 1); and drive belts **310** connecting the drive shaft and guide rollers.

During its passage through the chamber, the coatings on the tape base are well dried by the heated air and radiant heat. Binder and solvent liquids are gradually volatilized and escape, with the spent air, through a vent **312**, preferably to the outside atmosphere.

Roll winding zone

Roll winding machine **30** is shown in Figs. 1 and 2. It includes, briefly, a winding shaft **316** supported on its far side in journals **318** and **320** secured to a platform **322**. The near end of the shaft is fitted with a core **324**. As shown in Fig. 1, a hub **326** is fitted on the core, being secured thereto by a key **328** (Fig. 2). The dried tape base issuing from the main drying chamber, through exit opening **298**, is shown being wound into a roll **330** on the hub.

The far end of the winding shaft terminates in a sprocket wheel fitted with a sprocket chain **332**. The sprocket chain also fits over a sprocket wheel on the near end of the driven shaft of an automatic speed controller **334**. The far end of the driven shaft terminates in a sprocket wheel fitted with a sprocket chain **336** which is mounted also on a sprocket wheel on the far end of the drive shaft of a motor **338**.

A linear length or footage counter **340** is located adjacent the roll. It is in the form of a housing **342** secured to the free end of a lateral arm **344** pivotally connected to a vertical support **346** resting on the platform. The shaft **348** of the counter terminates in a friction disc **350** adapted to engage and ride on the upper surface of the tape base as it is wound onto the roll. Due to the manner in which the counter is pivotally mounted, the friction disc rises automatically as the diameter of the roll increases.

Speed controller **334** regulates the speed of rotation of winding shaft **316** so that it automatically adjusts itself to whatever speed is required to roll the dried tape base as fast as it issues from the drying chamber. In other words, the rotational speed of the winding shaft is gradually reduced as the roll increases in diameter.

When the desired amount of dried tape base is wound onto the roll, motor **338** is stopped. The dried tape base is cut transversely intermediate the exit opening and the roll; the roll and its hub are removed as a unit from core **324**, and an empty hub is placed on the core to permit the starting of another roll of dried tape base.

It will be clear to those skilled in this art that the specific embodiment described is by way of illustration and that the practice of the invention readily lends itself to the use of other embodiments.

We claim:

1. In apparatus for producing magnetic sound recording tape by advancing a long narrow tape base successively from a roll unwinding device through an adhesive precoating device, a precoat partial drying device, a magnetic coating device and a magnetic-coat drying machine to a roll winding machine, the improvement comprising an adhesive precoating machine which includes a vessel for containing and supplying adhesive liquid to one side of the tape base, a pair of opposed superposed pressure rollers mounted over the vessel for the application of the adhesive liquid to and the passage of the adhesive coated tape base therebetween to level off the adhesive liquid, to provide a good bond between the tape base and the adhesive coating; the lower roller having a cylindrical adhesive applying surface shorter than the upper roller and disposed intermediate the ends of the upper roller and extending partly into the vessel and below the level of the adhesive liquid normally confined therein, so that the cylindrical adhesive applying surface of the lower roller may be wetted with and thus transfer adhesive liquid to said side of the tape base; the lower cylindrical adhesive applying

surface being narrower than the tape base and disposed only across the intermediate transverse portion of the tape base so that its marginal edge portions will not be coated with the adhesive liquid; the outer cylindrical adhesive applying surface of the lower roller being provided with a plurality of spaced small surface pockets to be filled with adhesive liquid; and a doctor blade extending transversely across the lower roller between the adhesive liquid level of the vessel and the upper roller to level off such liquid in the pockets and for removing excess adhesive liquid from the cylindrical adhesive applying surface of the lower roller before it contacts the tape base.

2. In apparatus for producing magnetic sound recording tape by advancing a long narrow tape base successively from a roll unwinding device through an adhesive precoating device, a precoat partial drying device, a magnetic coating device and a magnetic-coat drying machine to a roll winding machine, the improvement comprising an adhesive precoating machine which includes a vessel for containing and supplying adhesive liquid to one side of the tape base, a pair of opposed superposed pressure rollers mounted over the vessel for the application of the adhesive liquid to and the passage of the adhesive coated tape base therebetween to level off the adhesive liquid, to provide a good bond between the tape base and the adhesive coating; the lower roller having a cylindrical adhesive applying surface shorter than the upper roller and disposed intermediate the ends of the upper roller and extending partly into the vessel and below the level of the adhesive liquid normally confined therein, so that the cylindrical adhesive applying surface of the lower roller may be wetted with and thus transfer adhesive liquid to said side of the tape base; the lower cylindrical adhesive applying surface being narrower than the tape base and disposed only across the intermediate transverse portion of the tape base so that its marginal edge portions will not be coated with the adhesive liquid; the lower roller being mounted on a shaft resting at its ends in a pair of journals; each journal being supported by a pivoting arm intermediate its ends; one end of each arm being pivoted to a fixed bracket and the other end being resiliently supported by a spring; and adjusting means for increasing and decreasing the tension of the springs and thus increasing and decreasing the pressure of the rollers on the tape base passing between them.

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