United States Patent

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[54] **MANUFACTURE OF MAGNETICALLY SENSITIZED WEBS**
8 Claims, 1 Drawing Fig.

[52] **U.S. Cl.** **117/238,** 117/235
[51] **Int. Cl.** **H01f 7/00**
[50] **Field of Search** 117/238, 235

[56] **References Cited**

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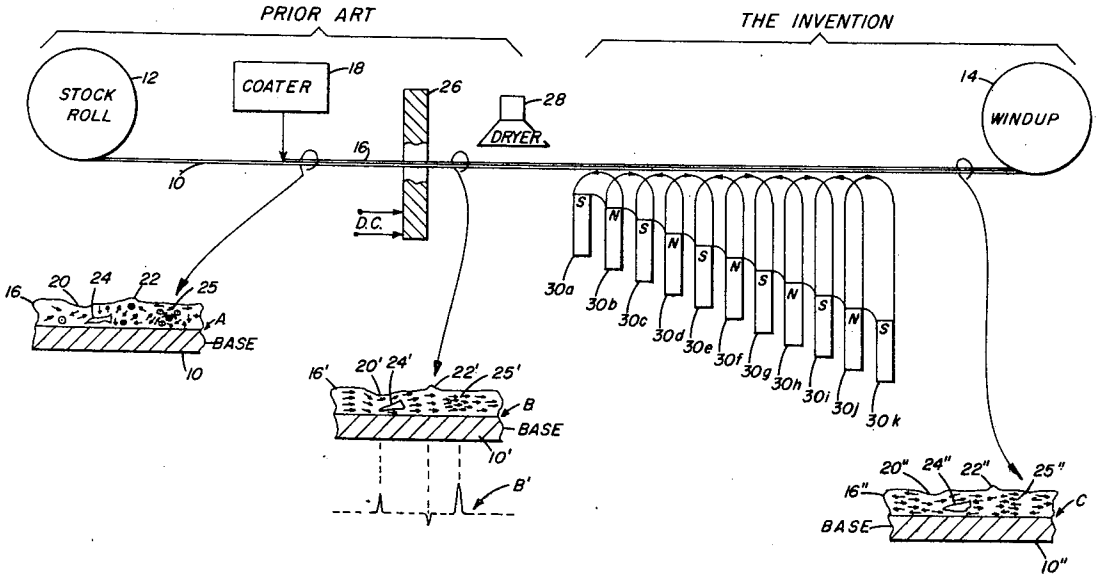
ABSTRACT: The requirement for time-consuming, costly bulk-erasing of the magnetic sound track on motion picture film is eliminated in the disclosed process. As indicated, film is coated with a magnetically sensitized stripe. Prior to the time when the stripe dries, the film is exposed to a strong particle-orienting magnetic field, thereby to improve the recordability of the stripe. Such particle orientation causes the particles to become unidirectionally magnetized, which in combination with coating irregularities increases measurable noise level. To remove such noise, the invention provides that the film be exposed to alternating magnetic fields of gradually decreasing strength, such fields being disposed after the coating dries and before the film is wound. The invention may be practiced in the manufacture of other magnetically sensitized recording webs.



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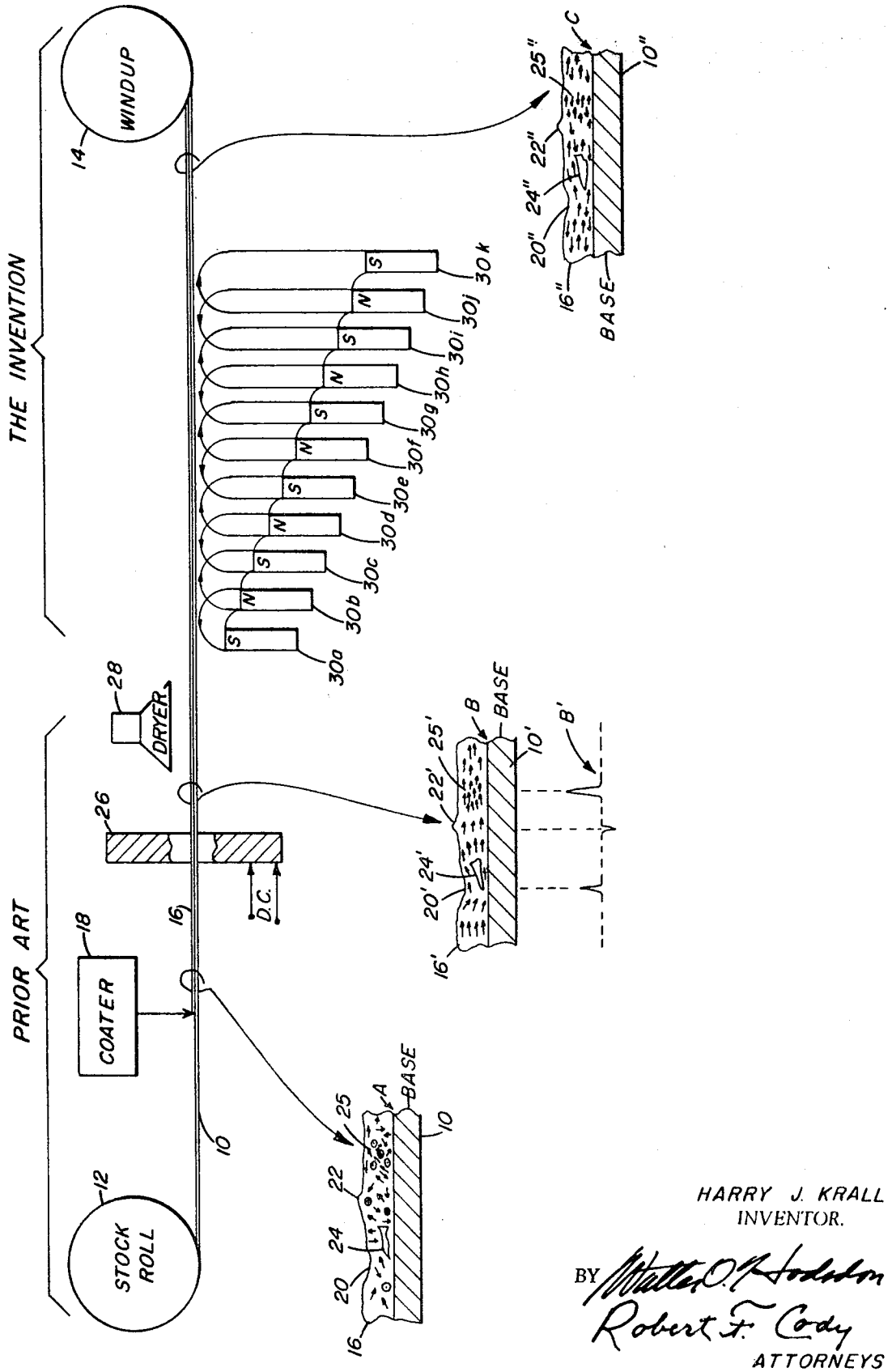

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MANUFACTURE OF MAGNETICALLY SENSITIZED WEBS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to manufacturing processes; and in particular to the manufacture of magnetic recording webs; and still more particularly to the manufacture of motion picture film having a magnetic recording medium thereon.

2. Description of the Prior Art

U.S. Pats. No. 2,784,259 and 3,222,205 are representative of art relevant to the invention.

Prior to the invention, motion picture film with a magnetic recording stripe and been manufactured as follows: A web of photographically sensitized film was conveyed from a roll thereof to a windup stage under controlled lighting conditions. As the webs moved along, a hopper deposited a solution, containing a dispersion of elongated magnetic particles, along one edge of the film. Before the solution became dry, the web was passed through a strong magnetic field, parallel to the length of the web, to cause the magnetic particles to orient so that their respective easy directions of magnetization, i.e. their respective major axes, were parallel to the length of the web. This was done so that audio recording on the stripe would be at high "resultant" signal levels. The strong magnetic field, while accomplishing its intended purpose of particle orientation, undesirably left such particles so magnetically ordered that the net external field of the stripe was at a constant saturated level everywhere except in the vicinity of stripe discontinuities; and so, because of such discontinuities, and other irregularities within the coating, polarized particle concentrations produce transient output noise signals. Such noise signals have been defined as modulation noise by Skipwith W. Athey, in his treatise (available from the Superintendent of Documents) on Magnetic Tape Recording, SP-5038, pages 160 through 163, prepared under Contract NASw-945, Jan. 1966, National Aeronautics and Space Administration. Obviously, such noise had to be removed "prior to exposure" of the striped film so that high quality visual and audio reproductions would obtain. To this end, so-called bulk-erasure of noise was employed.

With bulk-erasure, spools of film are placed on a rotating table and gradually exposed to a magnetic field of decreasing strength, thus randomizing the distribution of those particle fields which are oriented one way, or the other. A random distribution of particle orientations produces a minimum net field in the vicinity of a sound-reproducing head: which is to say that such a distribution produces a minimum detectable noise.

Bulk-erasure is effective for its intended purpose, but adds a time-consuming, separate and expensive, step to the manufacturing process in question.

As used throughout the specification, all references to "-noise" are to be taken as references to modulation noise. (noise which is of an AC nature, and which is dependent on the number and arrangement of particles in a magnetic coating, is also referred to by Athey, but use of the invention will have virtually no effect on removal of "AC" noise.

SUMMARY OF THE INVENTION

Before indicating the nature of the invention, it is considered instructive to indicate first what the invention is not: the invention has nothing to do with the erasure of purposely recorded intelligence on a magnetic recording medium. Rather, the invention is concerned with "supplying" spools of magnetically sensitized web material to users thereof, which spools need not be erased—to remove recorded manufacturing noise—prior to recording thereon. Supplying noise-free magnetically sensitized webs is especially critical in the case of motion picture film for the obvious reason that taking motion pictures, with accompanying audio, is a once-through-the-camera procedure. That is, magnetic-sound cameras and magnetic-sound printers are customarily built without erase heads,

and their performance is limited by the noise level of the film as supplied by the manufacturer.

The invention suggests, in the manufacture of magnetically sensitized webs, the "in-line" use of alternating magnetic fields, which alternating fields are disposed in the direction of web travel after the stripe of oriented particles dries, but before the windup part of the process. The alternating fields gradually decrease in strength from drier to windup; and the maximum field strength so employed is preferably at least that necessary to reverse the direction of saturation of the particles. Movement of the web through gradually decreasing alternating fields causes the respective field orientations of the individual particles, one way or the other, to be in accordance with a "noiseless" statistical distribution, and this is so even through the axes of the particles are all disposed one way for purposes of improved recordability.

An object of the invention is to provide an improved process for manufacturing magnetically sensitized recording webs.

Another object of the invention is to provide an improved process for manufacturing magnetic-recording webs devoid of manufacturing noise.

Another object of the invention is to provide a method of manufacturing motion picture film having a magnetically sensitized recording medium thereon, which method obviates the prior need for bulk-erasure of manufacturing noise from the film.

The invention will be described with reference to the FIGURE. The FIGURE shows the prior art method of manufacturing magnetically sensitized webs as improved by the invention.

With reference to the FIGURE, a photographically sensitized web **10** of motion picture film is continuous from a roll **12** thereof to a windup section **14**. Magnetic particles, dispersed throughout a coating solution **16**, are applied to the web **10** at a coating stage **18**, say by means of a hopper. The coating solution **16**, as indicated by the cross section A, has the axes (and fields) of its magnetic particles oriented in all directions. The orientation (and field) of a particle is shown by a small arrow, circled dots and circled crosses indicating, respectively, arrows out of and into the figure. The coating solution, as represented in cross section A, has the following irregularities: a depression **20**, a mound **22**, a bubble **24** and a cluster **25** of particles, all of which irregularities may inadvertently occur during application of the coating **16** to the web **10**. A magnetic pickup head disposed proximate the coating of the cross section A would see no resultant (noise) field at the depression **20**; at the mound **22**; at the bubble **24**, or at the particle cluster **25**.

While a web with a cross section A is virtually devoid of recorded noise, the recording of intelligence on such a web leaves much to be desired. This is because deliberately recorder intelligence is reduced in intensity and quality by those particle fields which are not oriented in accordance with the recorded intelligence.

To improve the recordability of the coating **16**, the coated web **10** is passed through the core of a strong solenoid **26** before such coating dries (dryer **28**). The solenoid **26** exerts a magnetic field on the particles within the coating **16**, causing such particles to orient so that their respective axes are all aligned parallel to the length of the web **10**. See cross section B. Recording on a web with its particle axes parallel to the length of the web allows the individual particle fields to switch one way, or the other, in bunches according to the sound being recorded, i.e. at high signal levels. Such increase in recordability creates a noise problem within the web **10**: The concentrations of magnetic particles at the dispersion **20'** of cross section B, at the bubble **24'**, at the mound **22'**, and at the particle cluster **25'**, appear at noise modulation frequencies; and since the particles of each such concentration are similarly oriented, they produce resultant noise signals which may be picked up by a sound reproducing head. See the signal B' associated with the cross section B; the diagram B' shows noise signals corresponding to the concentrations of particles.

Were it not for the invention, the web **10** of magnetically sensitized film would be spooled directly by the windup **14**; after which the spooled film would have to be bulk-erased, as noted above, so it could be supplied noise-free to users thereof. To avoid this costly and time consuming manufacturing procedure, the invention suggests that decreasing alternating fields be disposed between the dryer **28** and windup section **14** of the process. As presently practiced, at least ten field reversals are provided by an array of equal-strength bar magnets, **30***a* through *k*, which magnets are progressively positioned father and farther from the web **10**. The magnets are preferably disposed normally to the web **10**; and the magnets are so positioned with respect to the web **10** that their respective effective fields at the web decrease progressively in increments of about 5 percent. The effective strength of the magnet **30***a* at the web **10** is about that necessary to switch the orientations of the fields of the magnetically saturated particles. Thus, the magnet **30***a* will tend to switch the fields of most particles; the magnet **30***b* will switch fewer fields, the magnet **30***c* still fewer, etc. Attendantly a randomized orientation, one way or the other, of particle fields obtains, there being no net resultant noise field within the coating which can be pickup up by a sound reproducing head. The cross section C of the figure shows the axes of all particle similarly oriented, their respective fields being statistically distributed, one way or the other, regardless of the coating irregularities **20''**, **22''**, **24''**, **25''**. After being wound into spools, the film may be used without further processing.

The invention has been described in detail with particular reference to a preferred embodiment thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention. For example, whereas the figure shows equally strong magnets disposed farther and farther from the web **10**, the same effect would obtain with progressively weaker magnets all of which are similarly positioned relative to the web; or by differently orienting the magnets. Also, whereas permanent magnets **30***a* through *k* are preferably employed because they do not themselves generated any heat, electromagnets may be substituted for such magnets; etc.

I claim:

1. In a process for the manufacture of a web having magnetic recording medium thereon which has a low modulation noise level, which process includes the steps of

a. conveying said web from a first point to a windup point,

b. applying a fluid coating of magnetic particles to said web between said first and said windup points,

c. exposing said web to a first magnetic field, after application of said coating and before such coating dries, said field being sufficient to orient similarly the axes of the said particles,

d. drying the said oriented coating, and

e. winding the coated web into a roll thereof at said windup point, the improvement of exposing said web after said coating dries and before said windup point, to alternating magnetic fields of decreasing strength, whereby to randomize one way of the other the orientations of the respective fields of the particles.

2. The process of claim **1** wherein the magnetic particles are generally elongated, and wherein the first magnetic field is disposed to orient the lengthwise axes of the said magnetic particles substantially parallel to the length of the web.

3. The process of claim **1** wherein at least one of the alternating fields is of a strength sufficient to reverse the directions of the fields of the respective particles within the said coating.

4. The process of claim **3** wherein the said alternating fields are provided by an array of permanent magnets.

5. The process of claim **4** wherein the said permanent magnets are bar magnets disposed normally to the said web.

6. A process for the manufacture of motion picture film having a magnetic recording stripe thereon comprising the steps of

a. conveying a web of photographically sensitized film from a source thereof to a windup section,

b. striping a fluid coating of magnetically sensitized material on said film before said film reaches the windup section,

c. passing said film through a unidirectional magnetic field after it is striped and before such stripe dries,

d. exposing said film to alternating magnetic fields of decreasing strength after said stripe dries and before said film is wound, thereby to reduce the modulation noise level of said magnetically striped film, and

e. winding said magnetically striped film into a roll thereof.

7. The process of claim **6** wherein the said fluid contains elongated magnetic particles, wherein the alternating magnetic fields are provided by an array of permanent magnets, and wherein at least one of the alternating fields is strong enough to switch the magnetization of the particles within the stripe.

8. The process of claim **7** wherein the permanent magnets are bar magnets disposed normally to the film.

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