Nov. 22, 1966 M. R. PETIT 3,286,625

RECORDING INSTRUMENTS

Filed July 28, 1965 2 Sheets-Sheet 1

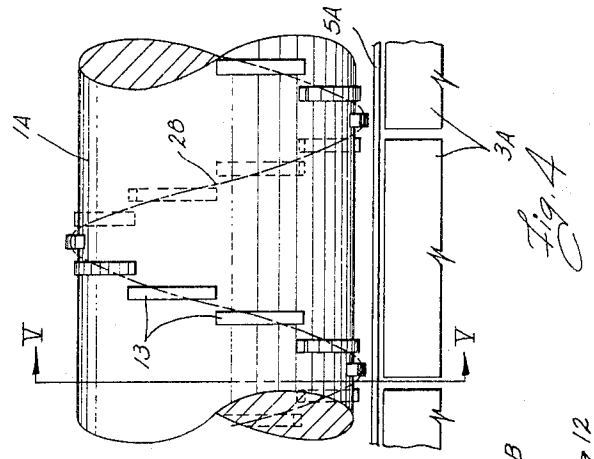


Fig. 4

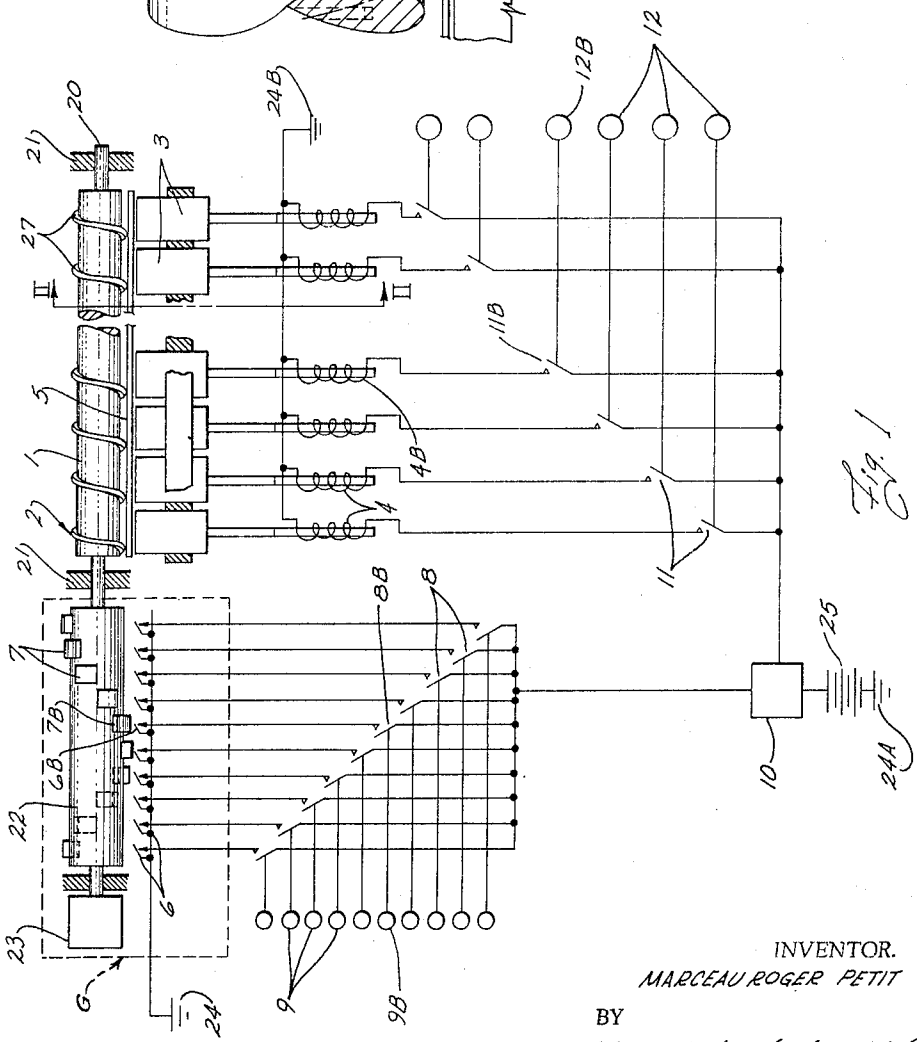


Fig. 1

INVENTOR.
MARCEAU ROGER PETIT
BY
Woodhams, Blanchard & Flynn
ATTORNEYS

Nov. 22, 1966 M. R. PETIT 3,286,625

RECORDING INSTRUMENTS

Filed July 28, 1965 2 Sheets-Sheet 2

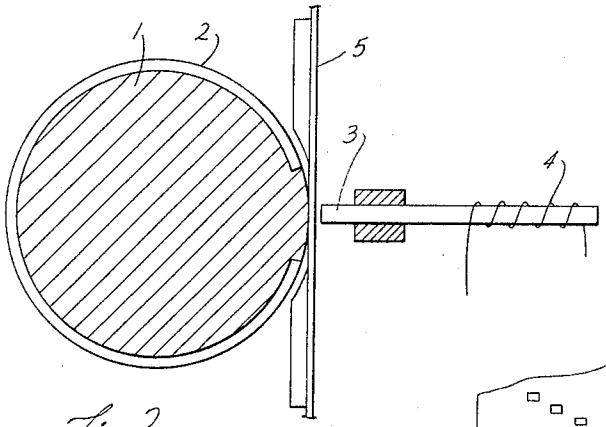


Fig. 2

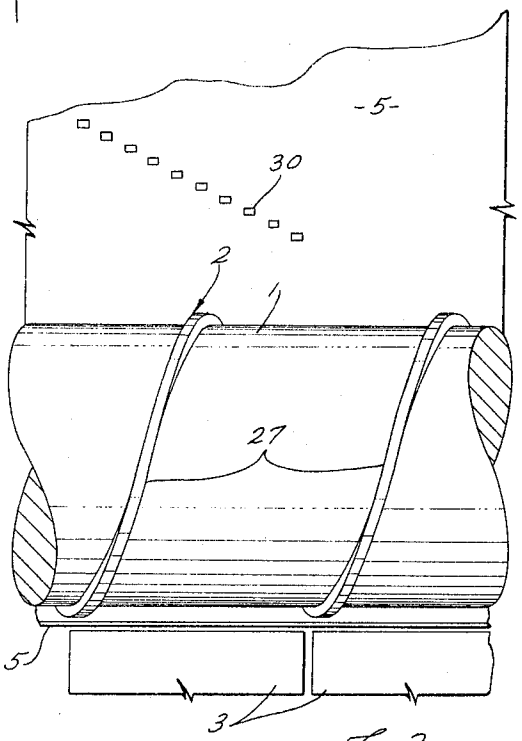


Fig. 3

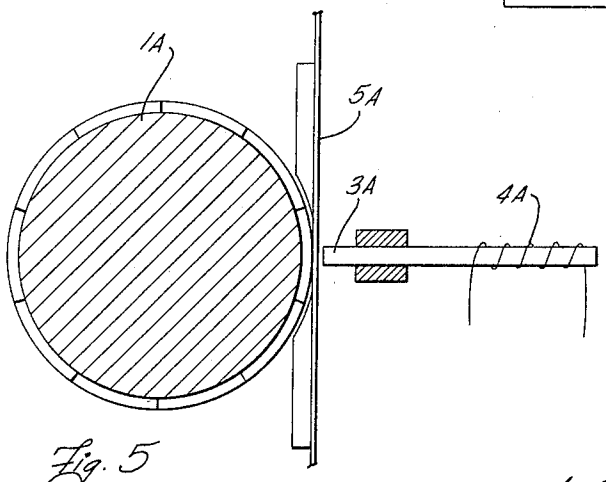


Fig. 5

INVENTOR.
MARCEAU ROGER PETIT

BY

Woodhams, Blanchard & Flynn

ATTORNEYS

United States Patent Office 3,286,625 Patented Nov. 22, 1966

3,286,625

RECORDING INSTRUMENTS

Marceau Roger Petit, Clichy, France, assignor to IER Impression Enregistrement des Resultats, Paris, France, a company of France

Filed July 28, 1965, Ser. No. 475,545
Claims priority, application France, Nov. 12, 1962, 915,074
5 Claims. (Cl. 101—93)

This application is a continuation-in-part of United States patent application Serial No. 322,467, filed November 8, 1963, now abandoned, and entitled, "Improvements in Recording Instruments."

The present invention is concerned in general with improvements in recording instruments or printing machines. More especially, although not exclusively, the invention relates to a recording machine which produces an analogue marking and which is of the type comprising a marking cylinder on which is formed at least one raised portion substantially defining a lineal configuration, such as a helix, and at least one marking means such as a hammer or another cylinder. There is a printing support, such as a strip of sheet material, and drive means for causing the printing support to move between said cylinder and said hammer. Other means are provided for adjusting the angular position of the cylinder for each impression and for driving said hammer against said cylinder for the purpose of applying the impression upon the printing support.

Machines of this type are already known, as shown for example in United States Patent No. 2,909,996 issued to Fitch October 27, 1959, and entitled, "High Speed Printing Mechanism," which can be employed for conventional printing. These machines are primarily useful for the purposes of analogue marking wherein the control of the marking means and of the angular position of the marking cylinder is carried out, for example, by means of a synchronous signal-train generator which comes into operation in respect of predetermined positions of the cylinder, the signals produced by said generator being transmitted to the hammers by means of gates which are controlled by coded pulses, a clear image of which it is desired to obtain on the printing support. However, machines of this type are subject to certain drawbacks.

In the first place, such prior machines lack precision inasmuch as the accuracy of the ordinate of the impression on the printing support, which is measured parallel with the axis of the cylinder, depends on the exact angular position of said cylinder at the moment of marking in view of the fact that the marking is applied against a raised portion defining a lineal path, such as a helical configuration.

In the second place, where prior machines of this general character have used a helical rib on the cylinder, the helix has in one 360 degree revolution around the cylinder been required to produce a range of 100 digits, each of which must be produced at a different rotational position of the cylinder with respect to the hammers. In other words, each 3.6 degrees change in rotational position of the cylinder represented an increase or decrease of one digit. Accordingly, any slight wear in the driving mechanism for the cylinder or any slight malfunction in the synchronization of the associated parts

could produce a sufficient error in the angular speed or position of the surface of the cylinder to exceed the 3.6 degrees so than an inaccurate impression would be made upon the printing support.

The object of the present invention is to overcome the disadvantages noted above. To this end, one embodiment of the improvements in accordance with the invention is essentially characterized by providing a single, helical raised portion or rib, which is arranged upon the peripheral surface of the cylinder so that it defines 10 substantially identical helixes around said cylinder between the ends thereof. Thus, according to the first embodiment of the invention, the single raised rib follows a selected path along and preferably around the cylinder.

In another preferred embodiment of the invention, each of the aforementioned helixes is made up of 10 arcuate segments or sectors which are preferably spaced from each other and extend circumferentially a distance somewhat longer than their extent axially of the cylinder. Thus, while the segments are preferably located along a substantially helical path, they constitute a discontinuous series of unitary raised portions, which substantially define planes at right angles to the axis of the cylinder.

It will be apparent that, in the second form of the invention, the marking means or hammer cooperates with the raised segments so that the impression is consequently the same irrespective of the exact angular position of the marking cylinder. Thus, the ordinate of the point of impression on the printing support does not depend for its precision upon the exact angular position of the cylinder, but upon the axial location of the unitary raised portion upon said cylinder.

A clear understanding of the invention will in any case be obtained by reference to the description which follows hereinafter and which is given with reference to the accompanying drawings, in which:

FIGURE 1 shows diagrammatically a recording machine for producing analogue representations, said machine comprising a cylinder on which is formed a raised helical ridge having 10 similar convolutions.

FIGURE 2 is a sectional view substantially as taken along the line II—II in FIGURE 1.

FIGURE 3 is an enlarged fragment of FIGURE 1.

FIGURE 4 is a further enlarged fragment of FIGURE 1 showing an alternate construction.

FIGURE 5 is a sectional view taken along the line V—V in FIGURE 4.

Referring first to FIGURE 1, it can be seen that a machine for logical marking essentially comprises a cylinder **1** on which is formed a rib **2** of substantially helical configuration. In this embodiment, the rib **2** includes 10 similar and 360 degree convolutions between the ends of the cylinder **1**. There is mounted opposite each convolution or pitch of the helical rib a hammer **3** which is subjected to the influence of operating means **4** consisting of a solenoid or an electromagnet so designed that the armature of said electromagnet can be driven forward against the hammers **3** so as to drive these latter in their turn against the marking cylinder **1**. Thus, if a printing support **5** is being moved between the hammers **3** and the cylinder **1**, a mark will be made on said support at the point of contact between the striking edge of the hammer **3** and the rib **2**. It will be readily apparent that the marking means could be constituted by a second cylin-

der which is adapted to rotate in conjunction with the printing support, the impression being in that case produced by radial movement of the second cylinder or by the flow of an electric current between said second cylinder and the nearest point on said rib.

FIGURE 1 illustrates diagrammatically the means for driving the cylinder **1** and the means for operating the hammers **3**. Specifically, the cylinder **1** may be coaxially mounted upon a shaft **20** which is supported by bearings **21**. A signal cylinder **22** is also mounted coaxially upon the shaft **20** which is connected to and rotated by the motor **23**. Thus, the cylinder **22**, which is part of the synchronous, signal-train generator G, and the cylinder **1** are simultaneously rotated by the shaft **20**.

The signal-train generator G produces a number of signals corresponding to angular positions of the marking cylinder **1** as defined by locations of the switch actuators **7** on the cylinder **22**. In this particular embodiment, there are 10 switch actuators **7** on the cylinder **22** located at equal or 36 degree intervals around the circumference of the cylinder. Said actuators are preferably disposed uniformly along a single path on the cylinder, such as to form a helix. Ten normally open switches **6** are located adjacent the peripheral surface of the signal cylinder **22** so that each switch is radially aligned with the portion of the cylinder **22** upon which one of the switch actuators is located. To simplify the mechanism, the switches **6** are preferably arranged along a straight line parallel with the axis of the shaft **20**. Each switch **6** is closed by one of said actuators each time the signal cylinder **22** is rotated, and said switches **6** are electrically connected in parallel between the amplifier **10** and ground **24**. The amplifier **10**, which may be of any conventional type, is connected through a source **25** of electrical potential to the ground **24A**. Each switch **6** is connected in series with an "and" gate or normally open switch **8**, which is operated through its connection to the terminal **9**.

There are 10 solenoids, one being mechanically linked to each hammer **3**, which are electrically connected in parallel between the amplifier **10** and ground **24B**. Each solenoid **4** is connected in series with an "and" gate or normally open switch **11** which is operated through its connection to the terminal **12**. The hammer **3** connected to the core of any given solenoid is driven against the rib **2** on the cylinder **1** when such solenoid is energized from the source **25** through the amplifier **10** and the closure of the appropriate switch **11**. The amplifier is operated to energize a solenoid **4** in response to the simultaneous closing of a pair of series switches **6** and **8** whereby the signal from the generator G is converted to a suitable output for energizing the solenoid **4** from the source of energy **25**.

The terminals **9** and **12**, associated with the switches **8** and **11**, respectively, may be points for receiving electrical impulses from a control circuit in a manner substantially and generally similar to that disclosed in the Fitch Patent No. 2,909,996. That is, referring to FIGURES 6 and 7 of the Fitch patent, each input terminal **12** may correspond to a separate input line **107** of Fitch, a single line **113** and, omitting the translator **115**, the line **117** and a gate **123**, which corresponds to applicant's gate **11**. The lines **117**, **118**, **119**, and so forth, of Fitch correspond to applicant's terminals **9**. Thus, it will be seen that the recorder of the invention can be used with existing devices which feed impulses to the terminals **9** and **12**, whereby the switches **8** and **11** are operated to complete a circuit between the generator G and one of the hammers **3** in a predetermined manner.

On the other hand, the terminals **9** and **12** may merely be pushbuttons, manually operable for the purpose of closing the switches **8** and **11**, respectively. In fact, for the purposes of this invention, it is immaterial whether the terminals **9** and **12** are relays, switches, pushbuttons or conductors for impulses, so long as they do in fact effect a controlled closing (or opening) of the switches **8** and **11** in response to a predetermined arrangement which results in operation of the hammerse **3** whereby an impression is made on the printing support **5**.

It will be apparent, however, that the axial location of the impression on the printing support **5** depends on the exact angular position of the marking cylinder **1**, due to the helical shape of the rib **2**. Consequently, the accuracy of the impression which is applied on the printing support **5** depends upon the synchronization of the hammers' movement with the rotational speed of the cylinder **1**. For this reason, the applicant designed the marking cylinder, as shown in FIGURE 1, so that the helical rib **2** is comprised of 10, preferably identical, 360 degree convolutions **27**, each of which has an associated hammer **3** which, under normal operation of the recorder, can strike its corresponding convolution at 10 different locations thereon spaced approximately 36 degrees apart circumferentially of the cylinder **1**. Each convolution **27** corresponds to a decade so that the 10 convolutions give a range of from 0 to 99 numerical digits that can be impressed or plotted upon the printing support **5**, and each convolution provides 10 digits. The pitch of the helical rib **2** may be, and preferably is, relatively steep to minimize error in the ordinate or axial direction resulting from poor synchronization. It is though that such lack of synchronization will be substantially uniform in the abscissa or circumferential direction so that control over deviation in the ordinate is far more important. That is, a shift in the abscissa is easily compensated by relocation of the zero point. However, a shift in the ordinate can alter values in an indeterminable amount.

In this particular embodiment, the leftward convolution **27** in FIGURE 1 covers the decade 0 to 9, the second leftward decade covers 10 to 19, and so forth, rightwardly along the cylinder **1**. It will be apparent that the particular rotational position of the cylinder **1** at the time of impact by the selected hammer **3** in any given instance will be determined by the units signal produced from the pulse generator G.

Although the arrangement of the rib **2** disclosed in FIGURES 1, 2 and 3 has produced an improvement over the prior art structures wherein a single helical convolution is used for the entire range of 0 to 99 and wherein a different type of signal generator G is utilized, the embodiment of applicant's invention shown in FIGURES 4 and 5 has produced a further refinement. That is, the rib **2** has been broken up into a plurality of circumferentially arranged, arcuate segments **13** which are spaced from each other axially of said cylinder **1A** and which, in a preferred embodiment, extend through an angle of approximately 36 degrees along the circumference of said cylinder. The segments or sectors **13** are preferably located so that a single line **28** extending through the centers thereof substantially defines a helix around the cylinder **1A**. However, it will be apparent that said segments **13** can be arranged along a different type of linear path, if desired. There are 10 segments **13** in each 360 degree convolution of the helical line **28** which are engageable by a single hammer **3A**. Preferably, the segments **13** in any given convolution are positioned so that they correspond to the positions of the switch actuators **7** on the signal cylinder **22**.

The main advantage of the FIGURE 4 construction over the FIGURE 3 construction resides in the greater accuracy of the ordinate during a recording operation. That is, for example, where relatively small spacing is required between adjacent units in any decade, errors in circumferential positioning of the cylinder **1** which, could make a material difference in the axial position of the impression produced by the rib **2**, would have no effect whatsoever upon an impression made by one of the segments **13** on the cylinder **1A**. The relative immateriality of the abscissa shift would remain the same as in cylinder **1** for the same reasons. Thus, it can be seen that the structure of FIGURE 4 provides a greater margin in which an error of synchronization can be ignored, and this

can be very advantageous to a high speed recorder involving the mechanical operation of the hammers **3**.

If the impression is effected by an electrical impulse passing, for example, from a hammer **3** to the aligned segment **13**, then the likelihood of error can be reduced even further, due to the substantially instantaneous operation of an electrical impulse, particularly by comparison with the mechanical movement of the hammer.

While the cylinders **1** and **22** are shown as coaxial and mounted upon the same shaft **20**, it will be recognized that these cylinders could be located in a variety of different relative positions and driven by separate shafts so long as their rotational movements are accurately synchronized in a predetermined manner. That is, there must be a predetermined relationship between the closing of the switches **6** by the actuators **7** and the rotational speed of the cylinder **1**.

The device of the invention can be used to plot or graph data on the printing support **5** by operation thereof in a manner which is probably evident from the foregoing descriptive material. That is, for example, if it becomes desirable to impress the printing support **5** with a mark corresponding to the numeral **35**, the terminal **12B** is operated, or energized as the case may be, to close the switch **11B**, and the terminal **9B** is operated or energized to close the switch **8B** whereby the circuit is completed from the switch **6B** through the switch **8B** and the amplifier **10**. Also, the circuit is closed from amplifier **10** to ground **24B** through switch **11B**. Thus, when the switch actuator **7B** closes the switch **6B**, an electrical impulse passes through the amplifier **10**, whereby the circuit including the solenoid **4B**, the switch **11B** and the amplifier **10** is energized by the source **24** to operate the solenoid **4B** and thereby move the hammer **3B** against the rib **2** on the cylinder **1**. Due to the synchronized rotational movement of the cylinders **1** and **22**, the hammer **3B** will cause an impression to be made upon the printing support **5** at a rotational position on the cylinder **1** corresponding to the rotational position of the switch actuator **7B** on the cylinder **22**. By following this procedure, any number in the range of 0 to 99 can be applied to the printing support **5** by the appropriate hammer **3**.

In FIGURE 3, the printing support **5** is disclosed with impressions **30** thereon to indicate one type of marking that may be produced by the striking of a hammer **3** against the rib **2** in 10 successive strokes.

The operation for the embodiment shown in FIGURES 3 and 4 is substantially the same as set forth above with respect to the embodiment of FIGURE 1, except that the accuracy of the ordinate is increased by the circumferential positioning of the discontinuance segments **13**, without affecting the accuracy of the abscissa.

It will be readily understood that the foregoing embodiments of the invention have been described in detail solely by way of example. It accordingly follows that any and all detailed modifications which are made in the said embodiments, without thereby departing from either the scope or the spirit of the claimed invention, are fully contemplated.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A recording machine for making impressions on a printing support comprising the combination:

a cylinder having at least one series of axially spaced, circumferentially elongated and radially projecting sectors arranged to define on the periphery of said cylinder a linear path extending along, and at least partially around, said cylinder, the angular extent of each sector being substantially less than 90 degrees;

means for continuously rotating said cylinder;

a plurality of hammers distributed axially along said cylinder, each hammer extending axially of said cylinder to be engageable with a plurality of adjacent sectors, the engaging surface on each hammer adjacent said cylinder having a dimension, in a direction circumferentially of the adjacent surface of the cylinder, substantially smaller than the circumferential extent of the sectors engageable thereby;

a printing support disposed between said hammers and said cylinder for engagement by said hammers whereby to press said support against those of said sectors radially aligned with said hammers, each sector being capable of providing the same type of impression throughout its circumferential length;

means for moving said support between said cylinder and said hammers transaxially of said cylinder;

means for driving selected ones of said hammers toward said cylinder; and

means for synchronizing the movement of said hammers with the rotation of said cylinder.

2. A machine according to claim **1**, wherein said sectors are arranged in a spiral having a plurality of convolutions around said cylinder; and

wherein each of said hammers is engageable with the sectors defining one convolution.

3. A recording machine for making impressions on a printing support comprising the combination:

an elongated marking member and means supporting same for rotation around a lengthwise axis thereof;

rib means secured to said marking member and projecting radially outwardly therefrom, said rib means extending both circumferentially and axially along the periphery of said member, said rib means being arranged to define not more than one substantially helical path having a plurality of similar 360 degree convolutions around said member, said rib means having radially outwardly facing, arcuate surface means substantially coincident with and defining a cylinder concentric with said axis, substantially any plane passing through said surface means and perpendicular to said axis defining along said surface means an arcuate line of substantial length, the area of said surface adjacent said line being capable of providing the same type of impression throughout its length;

means for continuously rotating said marking member;

a plurality of hammers distributed axially along said member, each hammer having engaging edge means ajacent said surface means substantially parallel with said axis, each said edge means being engageable with substantially any part of said surface means in one convolution, the engaging edge means on each hammer having a dimension parallel with said axis substantially equal to the axial extent of the convolution engageable thereby and a dimension transverse of said axis substantially less than the length of said area;

a printing support disposed between said hammers and said marking member for engagement by said edge means of said hammers whereby to press said support against the surface means radially aligned with said hammers, the surface means on each convolution being capable of providing the same type of impression substantially throughout its length;

means for moving said support between said surface means and said hammers transaxially of said member;

driving means for moving selected ones of said hammers toward said surface means, said driving means including a signal member and switch means responsive to operation of said signal member for controlling the movement of the selected hammer; and

means for synchronizing the operation of said signal member with the rotation of said marking member.

4. A machine according to claim **3**, wherein said marking member is cylindrical and concentric with said axis; and

wherein said rib means is a single band arranged in a helix around said member, the width of said band being approximately equal to one-tenth of the length of said edge means of each hammer.

5. A machine according to claim 3, wherein said path has at least 10 convolutions; and

wherein there are at least 10 hammers, each hammer being associated with one of said 10 convolutions, and the edge means of said hammers is arranged substantially along a single line.

References Cited by the Examiner

UNITED STATES PATENTS

2,909,996	10/1959	Fitch	101—93
2,926,602	3/1960	MacDonald et al.	101—93
3,128,693	4/1964	Thiemann	101—93

ROBERT E. PULFREY, *Primary Examiner.*

W. F. McCARTHY, *Assistant Examiner.*