United States Patent

Trifunovic et al.

[15] **3,681,819**

[45] **Aug. 8, 1972**

[54] **PROCESS FOR MECHANICALLY TREATING MATERIALS HAVING A MOVABLE FLEXIBLE RETARDER**

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[22] Filed: **April 19, 1971**

[21] Appl. No.: **135,109**

Related U.S. Application Data

[62] Division of Ser. No. 793,704, Jan. 24, 1969, Pat. No. 3,597,814.

[52] **U.S. Cl.**.....**26/18.6**, 162/111

[51] **Int. Cl.**.....**D06c 21/00**

[58] **Field of Search**.....26/18.6; 28/1.5, 72.14; 162/111, 113, 280; 264/282

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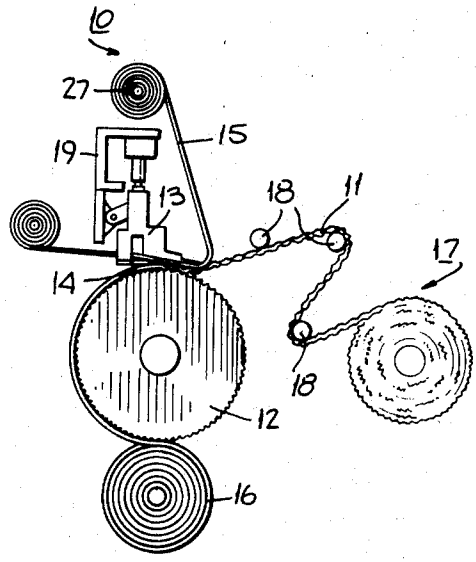
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[57] **ABSTRACT**

The flexible retarder is of a higher coefficient of friction than the primary surface and is mounted to be moved relative to the driving roll to avoid excessive wear. The retarder can be an endless belt, jacketed roller or an elongated strip and can be moved continuously or intermittently to expose fresh surfaces to the material being compacted.

6 Claims, 9 Drawing Figures



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SHEET 1 OF 4

Fig. 1.

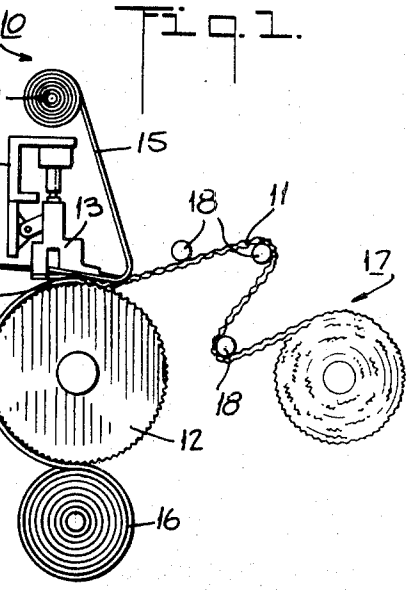


Fig. 2.

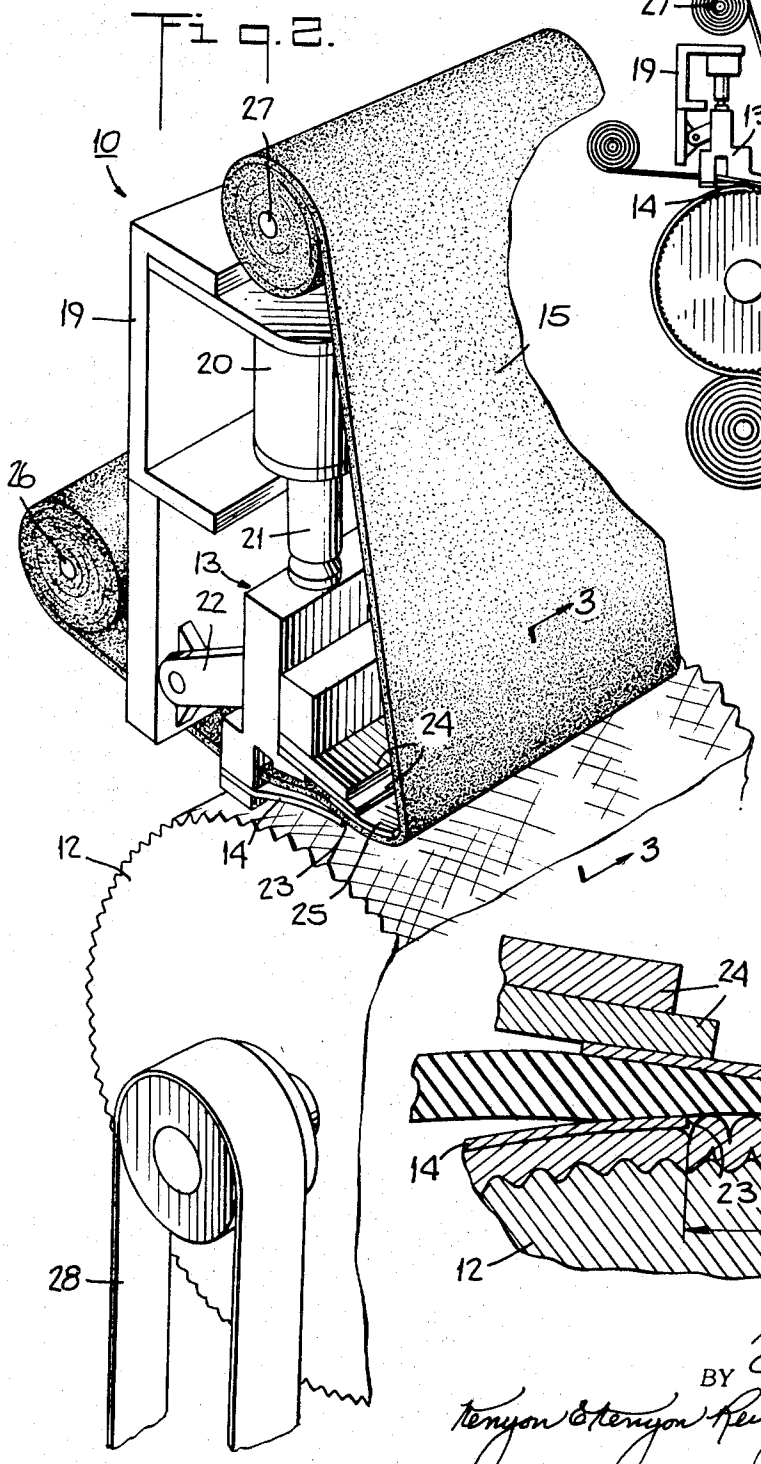


Fig. 3.

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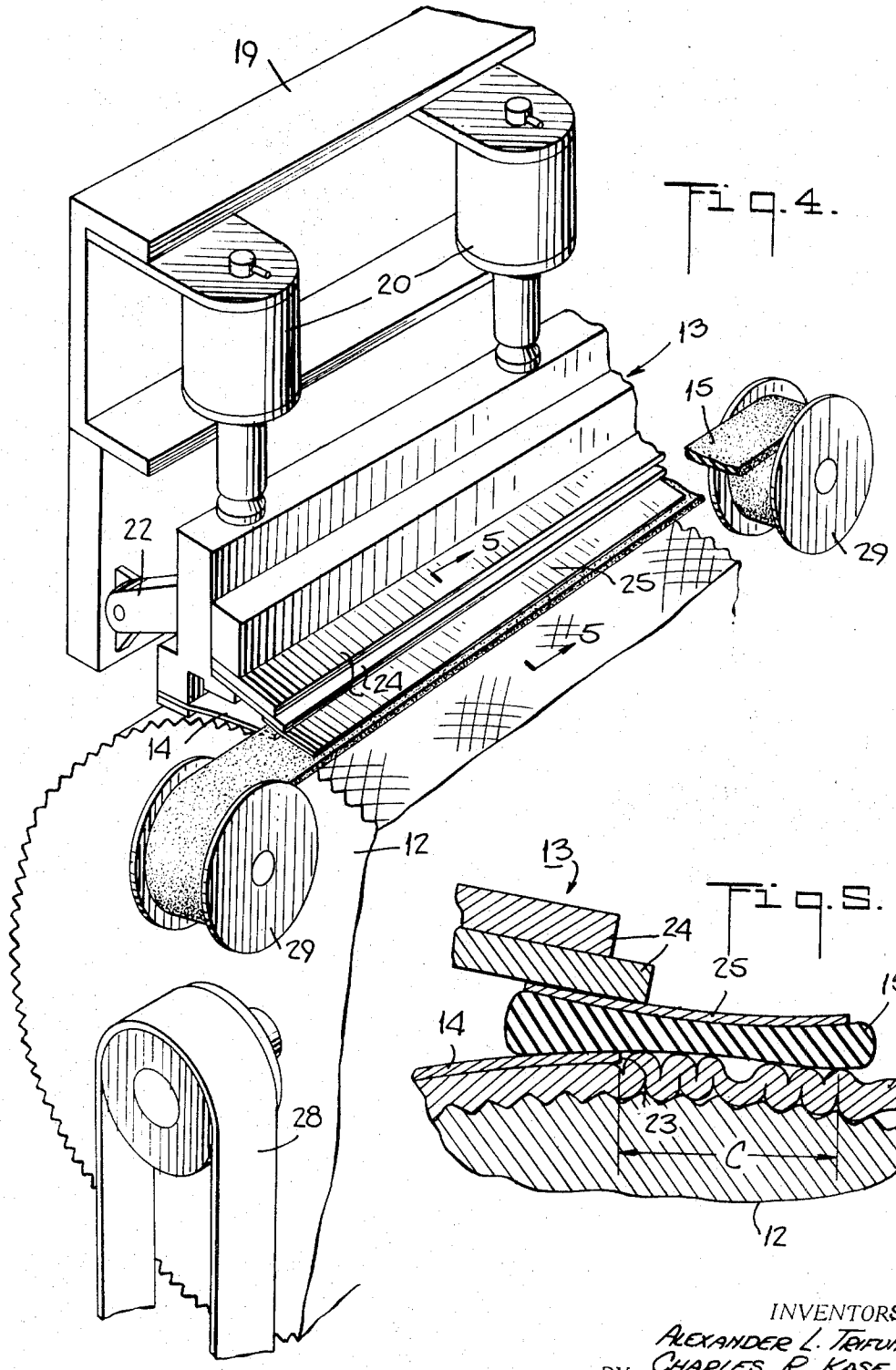
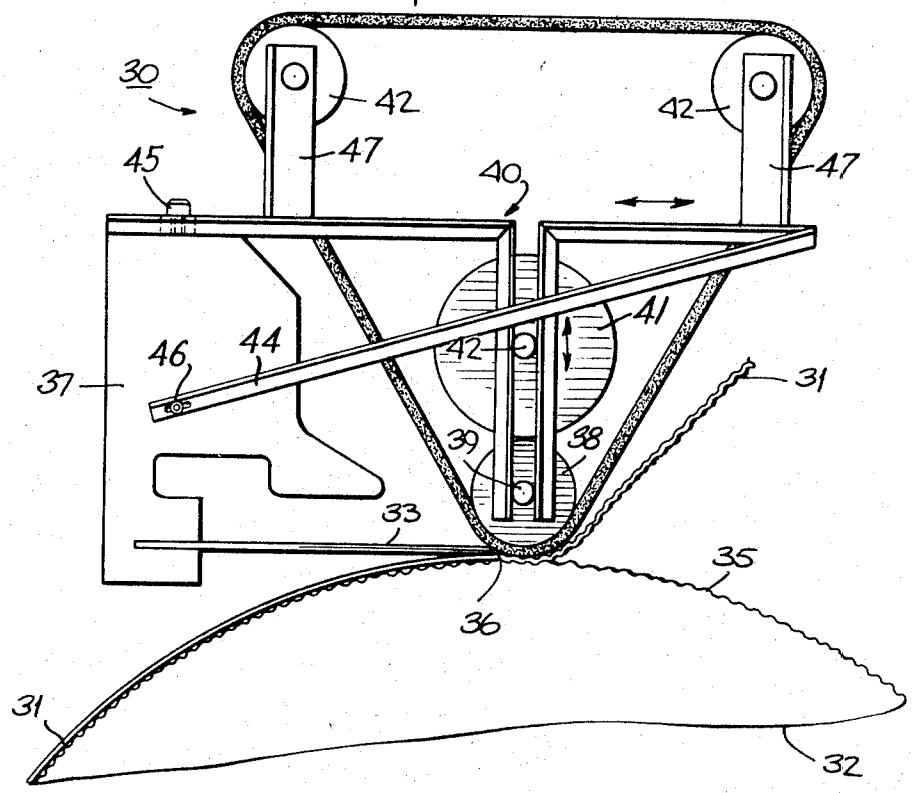


Fig. 4.

Fig. 5.

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Fig. 6.



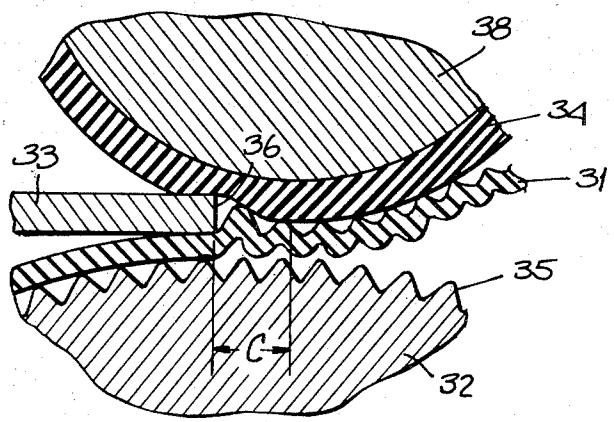


Fig. 7.

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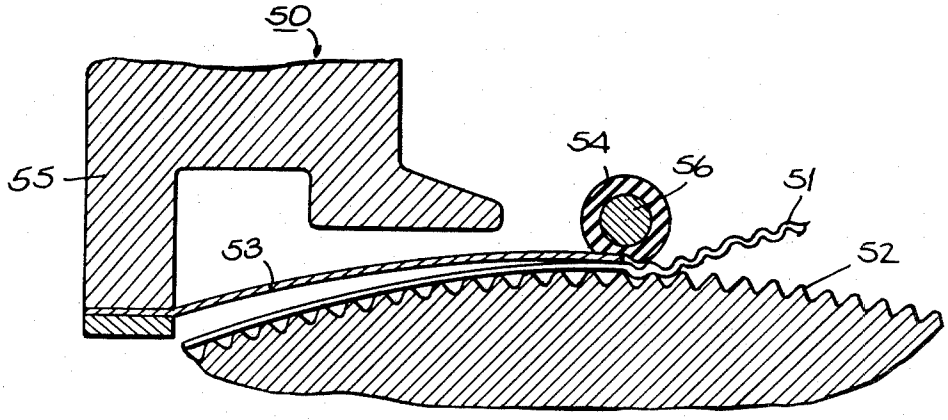


Fig. 8.

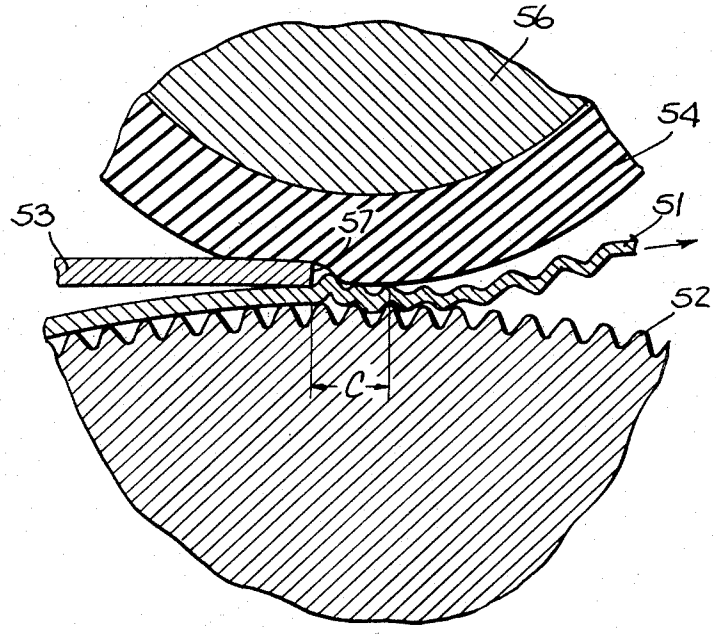


Fig. 8.

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PROCESS FOR MECHANICALLY TREATING MATERIALS HAVING A MOVABLE FLEXIBLE RETARDER

This application is a division of Serial No. **793,740**, filed January **24, 1969** and now U.S. Pat. No. 3,597,814 granted Aug. 10, 1971.

This invention relates to a process for mechanically treating materials. More particularly, this invention relates to a process for longitudinally compressing fabric materials under the influence of movable frictional surfaces.

Mechanical compression of materials such as textiles, paper, films and the like which are capable of being mechanically compressed to a fractional proportion of original length has been known, for example, as described in U.S. Pat. application Ser. No. 525,039, filed Feb. 4, 1966 and now U.S. Pat. No. 3,452,409 granted July 1, 1969. The machines which have been utilized to mechanically compress materials in the manner suggested above have usually relied on a first surface to confine the material to a predetermined thickness relative to a driving surface on the opposite side of the first surface as well as a second surface opposite the driving surface to define a cavity which decreases in the direction of movement of the material from the first surface and in which the material is compressed. In many instances, this second surface has been formed of a wearable material such as rubber. However, it has been found that the wearable second surfaces, especially when made of rubber, tend to wear out rapidly and require a change, for example, after each 50 to 100 yards of material is processed.

Because of the need to change the wearable second surfaces of these machines at such frequent intervals, these machines have not been capable of extended efficient use. Further, these machines have required a relatively long period of down-time in order to permit replacement of the wearable second surfaces.

Accordingly, it is an object of the invention to increase the operational time of mechanical compressing machines.

It is another object of the invention to reduce the down-time for replacing wearable friction surfaces in mechanical compressing machines.

Briefly, the invention provides a movable friction surface for a mechanical material compressing machine which utilizes a driving surface, a primary surface, and a flexible retarder to define a cavity in which the material is compressed. The driving surface in such machines functions as a driving means for driving the material through the compression cavity. The primary surface serves to confine the material to a predetermined thickness before entry into the compression cavity and the flexible retarder serves to slow the movement of the material in passing through the cavity relative to the speed at which the material enters the cavity.

The flexible retarder, according to the invention, is mounted in a manner to be moved relative to the primary surface so as to present different wear surfaces thereof to the cavity area. In one embodiment, the flexible retarder is formed as an elongated strip and is mounted to be moved either in the direction of movement of the material being processed or the opposite direction.

In another embodiment, the flexible retarder is mounted in strip form transversely across the material so as to be moved perpendicularly to the direction of movement of the material being processed.

In still another embodiment, the flexible retarder is constructed as an endless belt and is mounted so as to be moved parallel to the direction of movement of the material being processed. Further, in this embodiment, the flexible retarder is mounted on a frame which permits the flexible retarder to be adjusted horizontally and vertically with respect to the primary surface and driving surface.

In still another embodiment, the flexible retarder is constructed in cylindrical form as the peripheral surface of a roller and is mounted to rotate in a direction with or against the direction of movement of the material being processed.

In all of the above embodiments of the invention, the flexible retarder is moved with respect to the characteristics of the processed material which influence wear or the flexible retarder surface within the compression cavity. For example, the flexible retarder is moved with respect to such material characteristics as the type of the material, thickness, fiber content, weave, and the like. The amount and time of movement are such that a fresh surface of the flexible retarder is presented to the processed material within the compression cavity before the prior flexible retarder becomes worn to a degree which inhibits efficient and adequate processing of the material. In this way, the material can be processed substantially continuously without interruption on account of wear in the flexible retarder. Further, the movement of the flexible retarder can be effected in a continuous or interrupted manner. Where the movement is continuous, the flexible retarder is synchronized with the processing speed of the material, for example, at a speed reduction at 50 to 1, so as to be directly dependent on the movement of the processed material. Where the movement is interrupted, the flexible retarder can be initiated manually or automatically. For instance, after a predetermined length of material has been processed, as determined by a counting or measuring mechanism, a suitable transmission system can be activated to cause the flexible retarder to move an increment of length and then stop. Similarly, a timing mechanism can be used to indicate when a certain length of material has been processed, for example, by lighting or sounding a signal, so that the flexible retarder can be moved manually or semi-automatically.

By moving the flexible retarder relative to the processed material, the down-time which would otherwise be required for replacement of a worn surface is reduced considerably. Further, once an adjustment has been made for the flexible retarder relative to the compression cavity, succeeding sections of the flexible retarder surface exposed within the compression cavity can be moved within the compression cavity with little or no further adjustment. Thus, the processing of a material or materials can be carried out in a rapid efficient manner.

These and other objects and advantages of the invention will become more apparent from the following detailed description and appended claims taken in conjunction with the accompanying drawings in which:

FIG. 1 illustrates a schematic view of a machine for mechanically treating materials having a movable flexible retarder according to the invention;

FIG. 2 illustrates a fragmentary perspective view of the flexible retarder of FIG. 1;

FIG. 3 illustrates a view taken on line 3—3 of FIG. 2 showing the relationship of the movable flexible retarder relative to the compression cavity;

FIG. 4 illustrates a fragmentary perspective view of a modified flexible retarder according to the invention;

FIG. 5 illustrates a view taken on line 5—5 of FIG. 4;

FIG. 6 illustrates a side view of another modified flexible retarder of the invention in endless form;

FIG. 7 illustrates an enlarged detail of FIG. 6 taken through the compression cavity;

FIG. 8 illustrates another modified flexible retarder of the invention in endless form; and

FIG. 9 illustrates an enlarged detail of FIG. 8 taken through the compression cavity.

Referring to FIGS. 1 and 2, a machine 10 for mechanically compressing materials, for example, a web 11 of textile material, includes a drive roller 12 of knurled surface for driving the web 11, a shoe apparatus 13 containing a primary surface 14 in the form of a resilient plate for confining the web 11 against the roller 12 and a movable flexible retarder 15 in the form of a strip for retarding the forward motion of the web 11. The web 11 is delivered onto the knurled surface of the drive roller 12 in flattened form from a supply roll 16 positioned below the drive roller 12, as shown, or spaced horizontally from the driver roller 12 (not shown). In addition, the web 11, after processing, is taken up by a take-up system 17 located outside the machine 10 over a series of guide rollers 18 as is known.

Referring to FIG. 2, the shoe apparatus 13 is pivotally mounted on a fixed frame 19 of the machine 10 over the drive roller 12 and is pressed towards the drive roller 12 under the influence of a pneumatic or hydraulic press 20 also mounted on the frame 19. The press 20 which can include a plurality of spaced rams 21 abuts on the top of the shoe apparatus 13 so as to prevent upward movement of the shoe apparatus above a predetermined spacing from the drive roller 12. The rams 21 are adjustable with respect to the shoe apparatus 13 so as to permit the spacing of the shoe apparatus 13 from the drive roller 12 to be varied.

The shoe apparatus 13 is freely pivoted on suitable links 22 at the ends of the frame 19 to rest on the drive roller 12 and mounts the primary surface 14 in the form of a flexible steel plate a the bottom. The primary surface plate is mounted in a cantilever manner to extend over the drive roller 12. Additionally, the shoe apparatus 13 is slotted at the rear to permit passage of the flexible retarder 15. The flexible retarder 15 is disposed in a plane above the primary surface plate and extends past the free edge 23 of the primary surface 14. A pair of rigid pressure plates 24 are secured in the shoe apparatus 13 on an inclined plane and press against the flexible retarder 15 and primary surface 14 to ensure a pressure contact between the web 11 and these parts. In order to facilitate the positioning of the flexible retarder 15 and to avoid sharp corners, a back-up blade 25 is secured, as by recessed screws or by welding, to the underside of the plates 24 and extends out from the plates 24 over the flexible retarder 15.

The flexible retarder 15 is in the form of a strip or belt and is of a frictional material such as rubber having a Durometer of about 50 and a coefficient of friction higher than the primary surface 14. The strip is mounted on and between a pair of rollers 26, 27 so as to be wound and unwound from the respective rollers to transverse a path passing through the shoe apparatus 13.

Referring to FIG. 3, the drive roller 12, primary surface 14 and flexible retarder 15 define a compression cavity C in which the web 11 is longitudinally compressed. The cavity C begins at and extends from the free edge 23 of the primary surface 14 forwardly between the drive roller 12 and flexible retarder 15 at a decreasing rate of height. The cavity C at the edge 23 of the primary surface 14 is of greater height than the space between the primary surface 14 and drive roller 12 so that the web 11 which is slowed in passing between the drive roller 12 and flexible retarder 15 can begin to longitudinally compress immediately upon entry into the cavity C. Depending on the rate of wear on the flexible retarder 15 within the cavity C, the flexible retarder 15 is moved relative to the cavity C to present fresh surfaces to the cavity C.

The movement of the flexible retarder 15 is accomplished in an intermittent manner so as to move in increments equal to the length of the flexible retarder surface within the cavity C. Alternatively, the flexible retarder 15 can be moved continuously at a rate relative to the speed of the travelling web 11. For example, where the flexible retarder surface would wear out after exposure to about 100 yards of web, the flexible retarder 15 is moved at a rate to present a fresh surface within the cavity after passage of about 80 to 90 yards of web. This will further ensure against any wearing out of the flexible retarder surface which might cause imperfections in the compressed web.

The movement of the flexible retarder 15 is accomplished by rotating the rollers 26, 27 so that as the retarder 15 unwinds from one roller it also winds up on the other roller. In order to rotate the rollers 26, 27, a suitable manually operated handle (not shown) is connected to one roller to allow manual rotation of the roller. In this case, the other roller can be freely mounted so as to rotate under the pulling force of the retarder 15. Also, this latter roller can be suitably braked so as to avoid an excessive rate of unwinding of the flexible retarder 15.

Alternatively, the roller 26, 27 can be connected mechanically to the drive (not shown) of the drive roller 12 via a suitable transmission. That is, the drive of the drive roller 12 which is connected thereto by an endless belt arrangement 28 also drives at least one of the roller 26, 27 at a reduced rate with respect to the drive roller 12. In order to allow intermittent movement of the flexible retarder, a clutch mechanism is interconnected in the drive so as to selectively engage and disengage the drive to and from the rollers 26, 22

Referring to FIG. 4, wherein like numerals indicate like parts as above, the flexible retarder 15 is mounted transversely of the drive roller 12. As above, the flexible retarder 15 is in strip form and is positioned to pass between the primary surface 14 and the back-up blade 25 of the shoe apparatus 13. The flexible retarder strip is of a width to extend from a point between the primary surface 14 and show apparatus 13 past the free edge 23 of the primary surface 14 to a point sufficient to per-

mit formation of the compression cavity C as above described. Additionally, the shoe apparatus **13** is under sufficient pressure to clamp the flexible retarder **15** between the back-up blade **25** and primary surface **14** to prevent a pull out of the flexible retarder in the direction of travel of the web **11** under the forces generated by the web **11**. However, the clamping forces on the flexible retarder **15** are such as to permit longitudinal sliding of the flexible retarder **15** so as to facilitate a change in the surface of the flexible retarder presented to the compression cavity C. Alternatively, the flexible retarder **15** can also be clamped against such longitudinal sliding. In this alternative case, the pressure exerted by the shoe apparatus **13** on the flexible retarder **15** is periodically relieved so as to permit longitudinal displacement of the flexible retarder strip.

Referring again to FIG. **4**, the strip of flexible retarder **15** is mounted on a pair of rollers **29** of the flanged-type to be wound and unwound thereon as above. The rollers **29**, **30** are rotatably mounted and are rotated either by manual or mechanical controls as described above. Further, the longitudinal displacement of the flexible retarder **15** is carried out, as above, either in increments or continuously. Accordingly, since the movement and controls for movement of the flexible retarder **15** are similar to those described above, further description of such is not believed to be necessary hereat.

Referring to FIGS. **6** an **7**, an alternate machine **30** for mechanically compressing a web **31** of material includes a drive roller **32**, a primary surface **33** and an endless flexible retarder **34**. The drive roller **32** is constructed as above with a knurled surface **35** for initially receiving the web **31** and for driving the received web through the compression cavity C (FIG. **7**) formed between the drive roller **32** on one side and the primary surface edge **36** and flexible retarder **34** on the other side. The primary surface **33** is formed of a resilient plate such as a stainless steel plate which is cantilevered over the drive roller **32** from the frame **37** of the machine **30**. The flexible retarder **34** is formed of a resilient endless belt which passes under the lower point of the surface of a pressing roller **38**, for example, of steel. The roller **38** is slidably mounted at opposite ends via stub shafts **39** in a guideway **40** for vertical displacement. In addition, a second roller **41** of greater weight and diameter than the roller **38** is likewise slidably mounted via stub shafts **42** in the guideway **40** so as to place a weighted load on the roller **38** and consequently on the flexible retarder **34** within compression cavity C (FIG. **7**). The latter roller **41** is replaceable so that different loads can be imposed on the flexible retarder **34**. The diameter of the pressing roller **38** is such as to concentrate the weight pressing down on the flexible retarder strip within the limited area of the compression cavity C.

The guideway **40** which freely mounts the rollers **38**, **41** is mounted in the frame **37** so as to be slidable in a horizontal plane. For example, the guideway **40** is secured to the top of the frame **37**, as by a screw **45**, passing through a suitably slotted opening in the guideway. In addition, the guideway **40** is supported by a pair of arms **44** which are mounted on opposite ends of the guideway **40** and which are secured, as by a screw **46** passing through a suitably slotted opening in each arm **44**, to the frame **37**. The rollers **42** are journalled in support members **47** which are mounted on the top of the guideway frame **40** so as to move therewith. Thus, depending on the material make-up of the web **31** being processed, the size of the compression cavity C can be varied by moving the guideway **40** horizontally as well as by changing the weights of the rollers **38**, **41** or the size of the roller **38**.

The endless belt flexible retarder **34** is also mounted to pass over a pair of rotatably mounted rollers **42** suitably journalled in the machine **30** so as to form a triangular shaped path. At least one of the rollers **38**, **42** is driven so as to intermittently or continuously cause the endless belt retarder **34** to move in a direction with or against the direction of movement of the travelling web **31** In this regard, the drive for these rollers **38**, **42** is taken off the main drive of the machine **30** in a manner similar to that above described.

Referring to FIGS. **8** and **9**, a further alternate machine **50** for mechanically compressing a web **51** of material as above includes a drive roller **52**, a primary surface **53** and an endless flexible retarder **54**. The drive roller is constructed as above with a knurled surface as above for driving the received web **51** through the compression cavity C (FIG. **9**). The primary surface **53** is mounted in cantilevered fashion from a frame **55** of the machine **50** so as to confine the web **51** to a predetermined thickness, for example, in the case of textile fabrics to a thickness slightly less than the normal thickness of the web immediately prior to entry into the compression cavity C and in the case of paper, to the free thickness of the paper. As above, the primary surface **53** is formed by a resilient plate such as a stainless steel plate. The flexible retarder **54** is formed as a flexible coating, sleeve or strip over the surface of a roller **56** of non-resilient material such as steel. The roller **56** is driven, for example from the main drive of the machine **50** either intermittently or continuously to cause the flexible retarder **54** to move in the direction of or opposite to the travelling web **51**. The roller **56** is further mounted in a manner which directs a constant force during operation downwardly against the primary surface **53** towards the drive roller **52**. This force can be developed by mounting the ends of the roller **56** in an adjustable yoke arrangement (not shown) or by spring mounting the ends of the roller **56**.

In operation, the roller **56** is synchronized with the movement of the drive roller **52** so that in the case of continuous motion the roller **56** rotates at a predetermined relative speed with respect to the drive roller **52**. In the event of an intermittent motion the roller **56** is intermittently driven in an increment sufficient to present a fresh surface of the flexible retarder **54** within the compression cavity C. As shown, the compression cavity extends from the free edge **57** of the primary surface **53** across the respective surfaces of the flexible retarder **54** and drive roller **52** in a decreasing manner.

It is noted that the compression cavity C in all of above described embodiments, assumes a configuration such that at the entry, the cavity is of its largest height and thereafter decreases to the end. Additionally, the passage leading to the compression cavity C is of less height than the entrance of the cavity. Consequently, the web which is being processed initially enters the cavity C at a predetermined thickness,

thereafter is abruptly increased in size due to the added height of the cavity C at the entrance, and is subsequently decreased in height under the influence of the convergence of the cavity C. At the same time, the material is slowed in travel in passing through the cavity due to the increase in friction and corresponding drag forces on the web from the flexible retarder.

It is further noted that in those embodiments above where the flexible retarder moves across the edges of the primary surface that the corners of the respective primary surfaces can be slightly rounded so as to avoid scoring of the flexible retarder surface during relative movement. It is also noted that in order to avoid any scoring of the flexible retarder by the corners of the primary surfaces that the flexible retarders can be moved in incremental fashion after the pressure between the flexible retarders and primary surfaces is relieved.

The invention thus provides a means of processing a large quantity of material before replacement of the flexible retarder is necessary. Because of this, the down-time of the machinery is considerably reduced so that a much more efficient operation can be carried out than otherwise possible.

The invention also provides a system wherein the flexible retarder can be manipulated to present fresh unworn surfaces to the compression cavity of the machine without reliance upon extra ordinary skill on the part of the machine operators. Furthermore, the system can be fully automated so that continuous operation can be carried out.

What is claimed is:

1. In a process for mechanically compacting a material of predetermined thickness including the steps of driving a length of the material via a driving means while confining the material to maintain the predetermined thickness and substantially undistorted state of the material, thereafter driving the length of material via said driving means into an accumulation cavity having an inlet of a predetermined clearance greater than the predetermined thickness of the material and an outlet of a predetermined clearance less than the predetermined clearance of the inlet, and frictionally engaging the material being advanced through the accumulation cavity on one side of the material with a surface of a flexible retarder throughout the accumulation cavity to impose a friction force thereon in a direction substantially opposite to the direction in which the material is advanced for slowing the forward movement of the material while simultaneously supporting the material on the opposite side on the driving means throughout the accumulation cavity to increase the thickness of the material upon being advanced into the cavity and to accumulate and compress the material longitudinally within the cavity as the material is advanced through the cavity; the step of moving the flexible retarder relative to the driving means at a speed less than the speed of the driving means to present fresh surfaces of said flexible retarder to the conveyed web during mechanical compaction of the web.

2. In a process as set forth in claim 1 wherein the flexible retarder is moved through an endless path.

3. In a process as set forth in claim 1 wherein the flexible retarder is moved at a speed ratio of about 50:1 with respect to said driving means.

4. In a process as set forth in claim 1 wherein the flexible retarder is moved continuously during movement of said driving means.

5. In a process as set forth in claim 1 wherein the flexible retarder is moved intermittently during movement of said driving means.

6. In a process of mechanically compacting a material of predetermined thickness which comprises driving the material into an accumulation cavity having an inlet of a predetermined clearance greater than the predetermined thickness of the material and an outlet of a predetermined clearance less than the predetermined clearance of the inlet, and while simultaneously supporting the material on one side on a moving member throughout the accumulation cavity, frictionally engaging the material on the opposite side with a surface of a flexible retarder throughout the accumulation cavity to impose a friction force thereon opposite to the direction in which the material is driven for slowing the forward movement of the material to increase the thickness of the material and to accumulate and longitudinally compress the material within the accumulation cavity as the material is driven through the cavity, and preventing the accumulated material from backing up out of the accumulation cavity; the step of moving the flexible retarder at a speed slower than the moving member during movement of the moving member to present fresh surfaces of the flexible retarder to the web during compaction of the web.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,681,819 Dated August 8, 1972

Inventor(s) Alexander L. Trifunovic et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

First printed page, under "Related U.S. Application Data" "Division of Ser. No. 793,704" should be --Division of Ser. No. 793,740--

Column 2, line 20, "or" should be --on--

Column 3, line 50, "a" should be --at--

Column 4, line 58, "22" should be --27--

Signed and sealed this 9th of January 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334