United States Patent

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[72] Inventors **Alexander L. Trifunovic**
Wilmington;
Charles R. Kase, Jr., Newark, both of, Del.

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[73] Assignee **Joseph Bancroft & Sons Co.**
Wilmington, Del.

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[54] **MACHINE FOR MECHANICALLY TREATING MATERIALS HAVING A MOVABLE FLEXIBLE RETARDER**
22 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** **26/18.6,** 162/280, 264/282
[51] **Int. Cl.** **D06c 21/00**
[50] **Field of Search** 26/18.6; 28/1.6; 162/111, 113, 280; 264/282

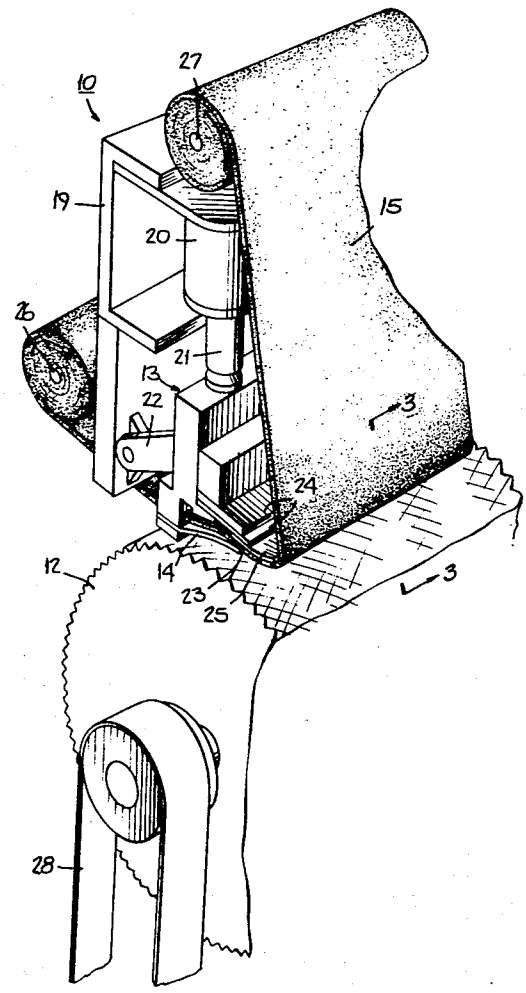
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Primary Examiner—Robert R. Mackey
Attorneys—Kenyon and Kenyon and Reilly, Carr & Chapin

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



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4 Sheets-Sheet 1

Fig. 1.

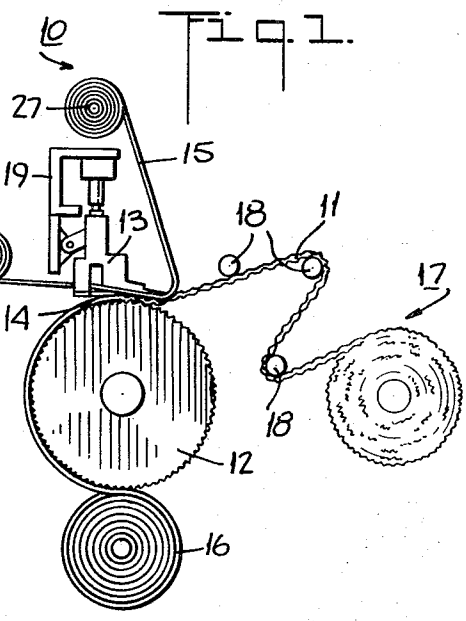


Fig. 2.

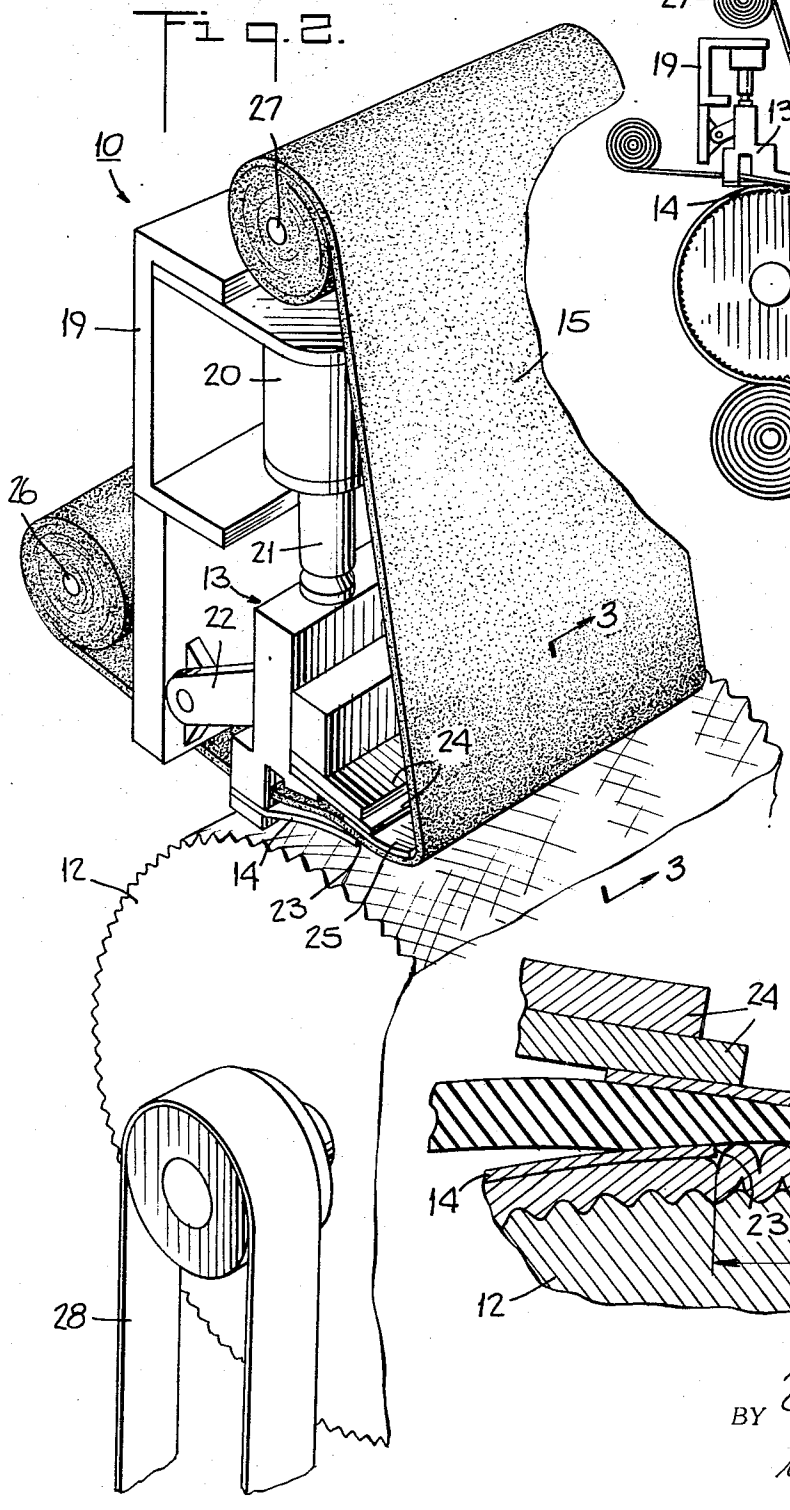


Fig. 3.

INVENTORS
ALEXANDER L. TRIFUNOVIC
BY CHARLES R. KASE, JR.
Kenyon & Kenyon
ATTORNEYS

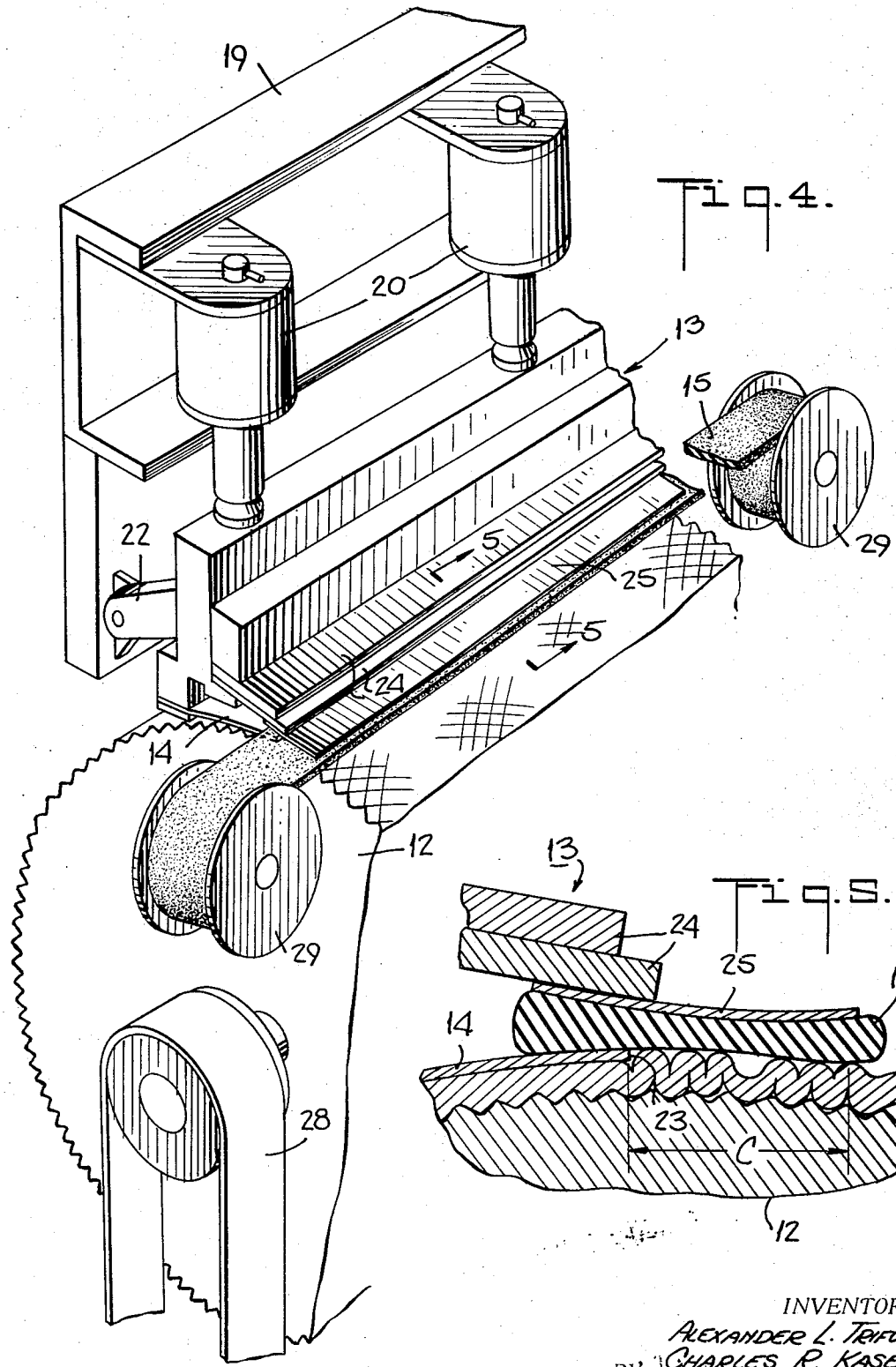
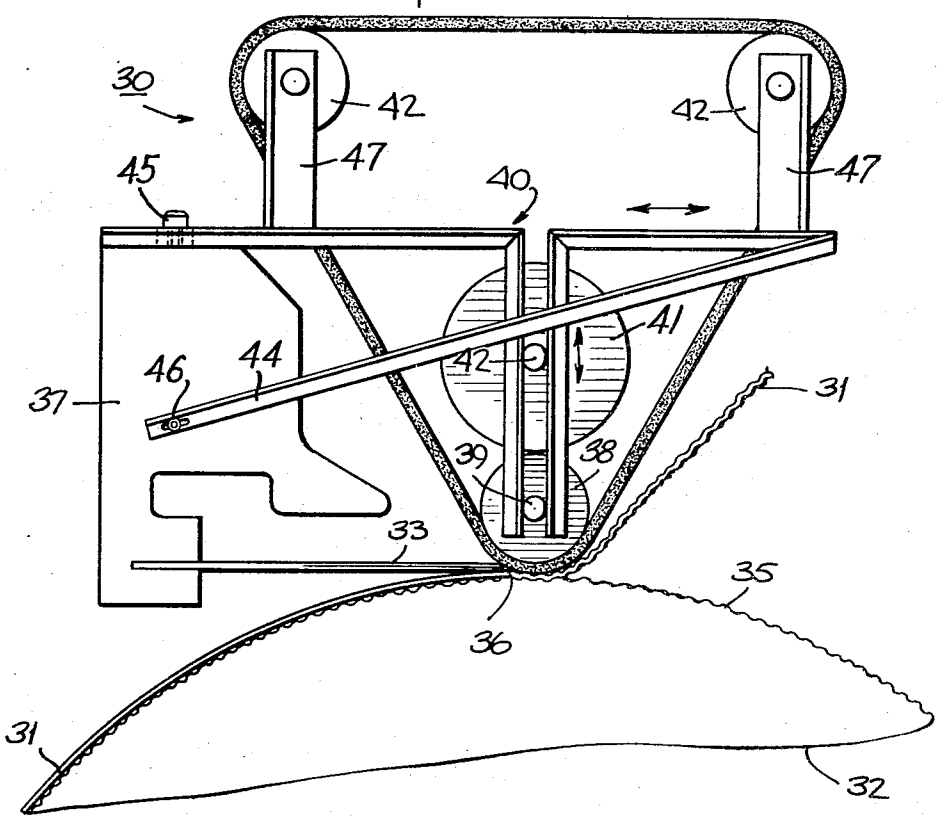


Fig. 4.

Fig. 5.

INVENTORS
ALEXANDER L. TRIFUNOVIC
CHARLES R. KASE, JR.
BY
Kenyon & Kenyon
ATTORNEYS

Fig. 6.



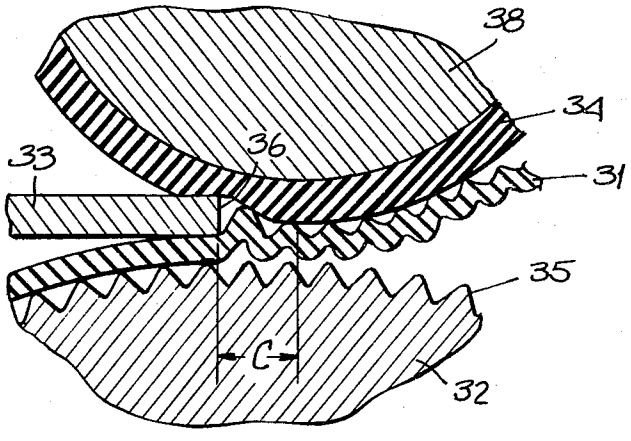


Fig. 7.

INVENTORS
ALEXANDER L. TRIFUNOVIC
CHARLES R. KASE, JR.
BY Kenyon & Kenyon
ATTORNEYS

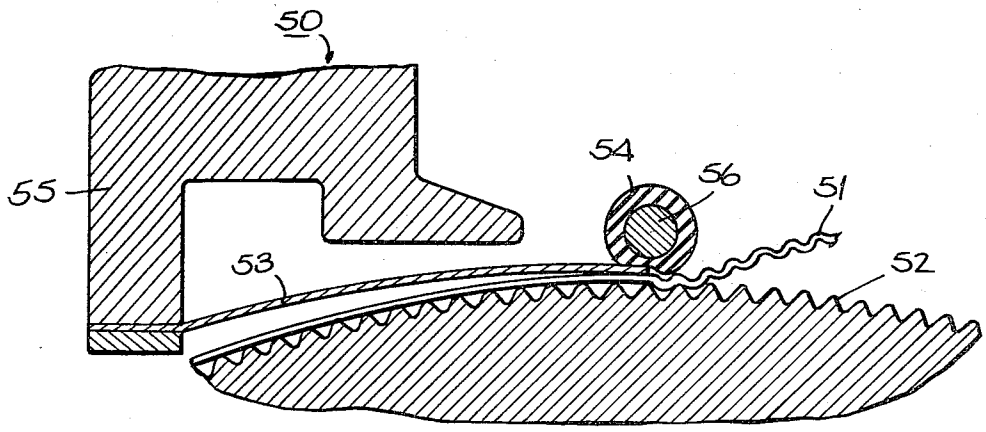


Fig. 8.

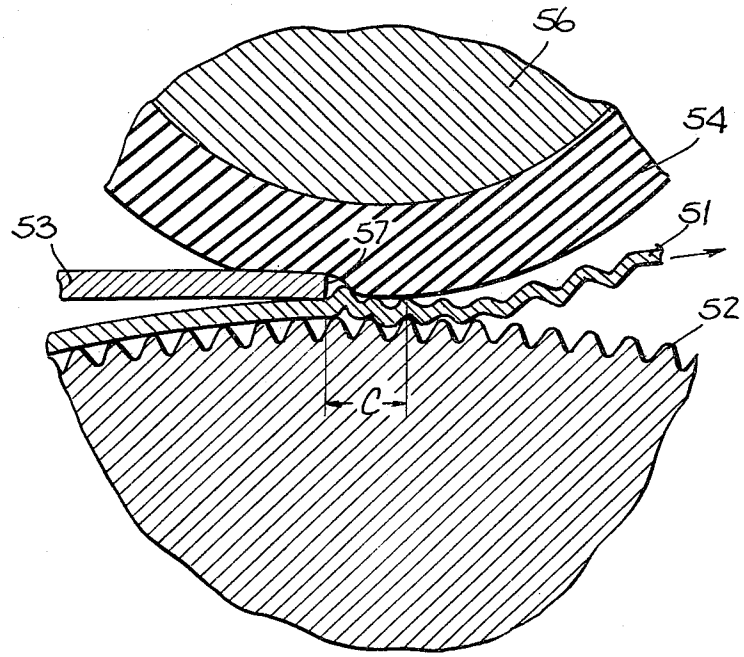


Fig. 9.

INVENTORS
ALEXANDER L. TRIFUNOVIC
BY CHARLES R. KASE, JR.
Kenyon & Kenyon
ATTORNEYS

MACHINE FOR MECHANICALLY TREATING MATERIALS HAVING A MOVABLE FLEXIBLE RETARDER

This invention relates to a machine for mechanically treating materials having a movable friction surface. More particularly, this invention relates to a machine for longitudinally compressing fabric material utilizing movable frictional surfaces on the materials.

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 downtime 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 downtime 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 severs 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 on 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 semiautomatically.

By moving the flexible retarder relative to the processed material, the downtime 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 a 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 at 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 backup 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 traverse 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 rollers 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 rollers 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, 27.

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 backup 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 shoe apparatus 13 past the free edge 23 of the primary surface 14 to a point sufficient to permit 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 backup 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 and 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 op-

posite 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 journaled 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 makeup 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 journaled 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 traveling 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 nonresilient 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 traveling 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 downtime of the machinery is considerably reduced so that a much more efficient operation can be carried our 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 extraordinary skill on the part of the machine operators. Furthermore, the system can be fully automated so that continuous operation can be carried out.

We claim:

1. In combination with a machine for mechanically compressing a web material having driving means for receiving and conveying the web, first means for confining the web between said first means and said driving means to a predetermined thickness immediately prior to mechanical compression thereof and a flexible retarder downstream of said first means for confining the web and for slowing the movement of the web between said flexible retarder and said driving means, said first means being pressed into said flexible retarder to define a confined compression cavity; means for moving said flexible retarder relative to said driving means at a speed less than the speed of said driving means to present fresh surfaces of said flexible retarder to the conveyed web during mechanical compression of the conveyed web.

2. The combination as set forth in claim **1** wherein said flexible retarder comprises an elongated strip disposed longitudinally of said driving means, and said means for moving said flexible retarder includes a pair of rotatably mounted rollers mounting the respective ends of said strip thereon in wound-up manner whereby said strip is adapted to be wound from one of said rollers onto the other of said rollers during movement relative to said driving means.

3. The combination as set forth in claim **1** wherein said machine further includes a backup plate disposed over said flexible retarder to extend over a portion of the planes of said means for confining the web and said driving means, and a shoe apparatus connected to said backup plate for imposing a load on said flexible retarder to deflect said flexible retarder relative to said means for confining the web in a direction towards said driving means.

4. The combination as set forth in claim **1** wherein said flexible retarder is made of rubber.

5. The combination as set forth in claim **1** wherein said flexible retarder comprises an endless belt.

6. The combination as set forth in claim **5** wherein said means for moving said flexible retarder includes at least a pair of rotatably mounted rollers, said flexible retarder passing over each of said rollers to be moved thereby.

7. The combination as set forth in claim **6** which further includes a pressing roller mounted over said flexible retarder on an opposite side from said driving means for pressing said flexible retarder towards said driving means.

8. The combination as set forth in claim **7** which further includes a guideway slidably mounting said pressing roller therein for vertical movement relative to said driving surface, said guideway being slidably mounted in said machine for horizontal movement relative to said driving surface to change the size of said compression cavity.

9. The combination as set forth in claim **8** which further includes a weighted roller of larger diameter than said pressing roller mounted over said pressing roller in weighted contact therewith to transmit a load onto said pressing roller.

10. The combination as set forth in claim **1** wherein said flexible retarder includes a roller and an endless strip mounted on said roller.

11. In combination with a machine for mechanically compressing a traveling web of material within a compression cavity, defined by a drive surface on one side, a free edge of a first surface spaced from said drive surface to confine the traveling

web to a predetermined thickness prior to entry into said cavity, and a friction surface of a flexible retarder spaced from said drive surface, said friction surface extending from said free edge to define a continuous surface opposite said drive surface, said cavity having a greater height than the spacing between said first surface and said drive surface at said free edge and being of decreasing height downstream of said free edge; means for moving said flexible retarder relative to said drive surface at a speed less than the speed of said driving means during mechanical compression of the web to present different portions of said flexible retarder within said compression cavity to form said friction surface.

12. The combination as set forth in claim 11 wherein said means for moving said flexible retarder moves said flexible retarder longitudinally of said drive surface.

13. The combination as set forth in claim 11 wherein said flexible retarder is an elongated strip.

14. The combination as set forth in claim 11 wherein said flexible retarder is an endless belt.

15. The combination as set forth in claim 11 wherein said flexible retarder is a sleeve and said means for moving said flexible retarder includes a rotatably mounted roller mounting said sleeve around the periphery thereof.

16. The combination as set forth in claim 11 wherein said flexible retarder is made of rubber.

17. The combination as set forth in claim 11 wherein said means moves said flexible retarder continuously.

18. The combination as set forth in claim 11 wherein said means moves said flexible retarder intermittently in predetermined increments.

19. The combination as set forth in claim 11 wherein said means moves said flexible retarder at a speed reduction at about 50:1 with respect to said drive surface.

20. The combination as set forth in claim 1 wherein said means for moving said flexible retarder moves said flexible retarder intermittently in predetermined increments during mechanical compression of the conveyed web.

21. The combination as set forth in claim 1 wherein said flexible retarder comprises an elongated strip disposed transversely of said driving means, and said means for moving said flexible retarder includes a pair of rotatably mounted rollers mounting the respective ends of said strip thereon in wound-up manner whereby said strip is adapted to be wound from one of said rollers onto the other of said rollers during movement relative to said driving means.

22. The combination as set forth in claim 11 wherein said means for moving said flexible retarder moves said flexible retarder transversely of said drive surface.