United States Patent [19]

Bechtel, Jr.

[11] **3,737,953**

[45] **June 12, 1973**

[54] **CARD CLOTHING**

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[21] Appl. No.: **71,481**

[52] **U.S. Cl.** **19/113**

[51] **Int. Cl.** **D01g 15/26**

[58] **Field of Search** 19/97, 112, 113, 19/114

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Primary Examiner—Dorsey Newton

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[57] **ABSTRACT**

Card clothing for flats comprising a plurality of elongated wire strips assembled in side by side relationship and inclined at an angle to the direction of fiber flow across the flats. The strips have upstanding portions laterally spaced apart, and each upstanding portion provides a row of teeth having sides inclined at an angle to the direction of fiber flow.

1 Claim, 26 Drawing Figures

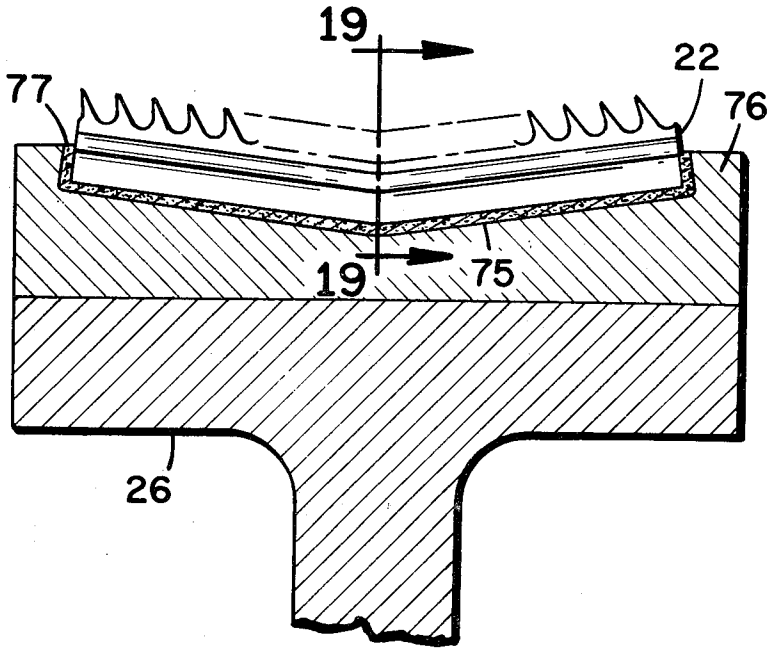

FIG. 1

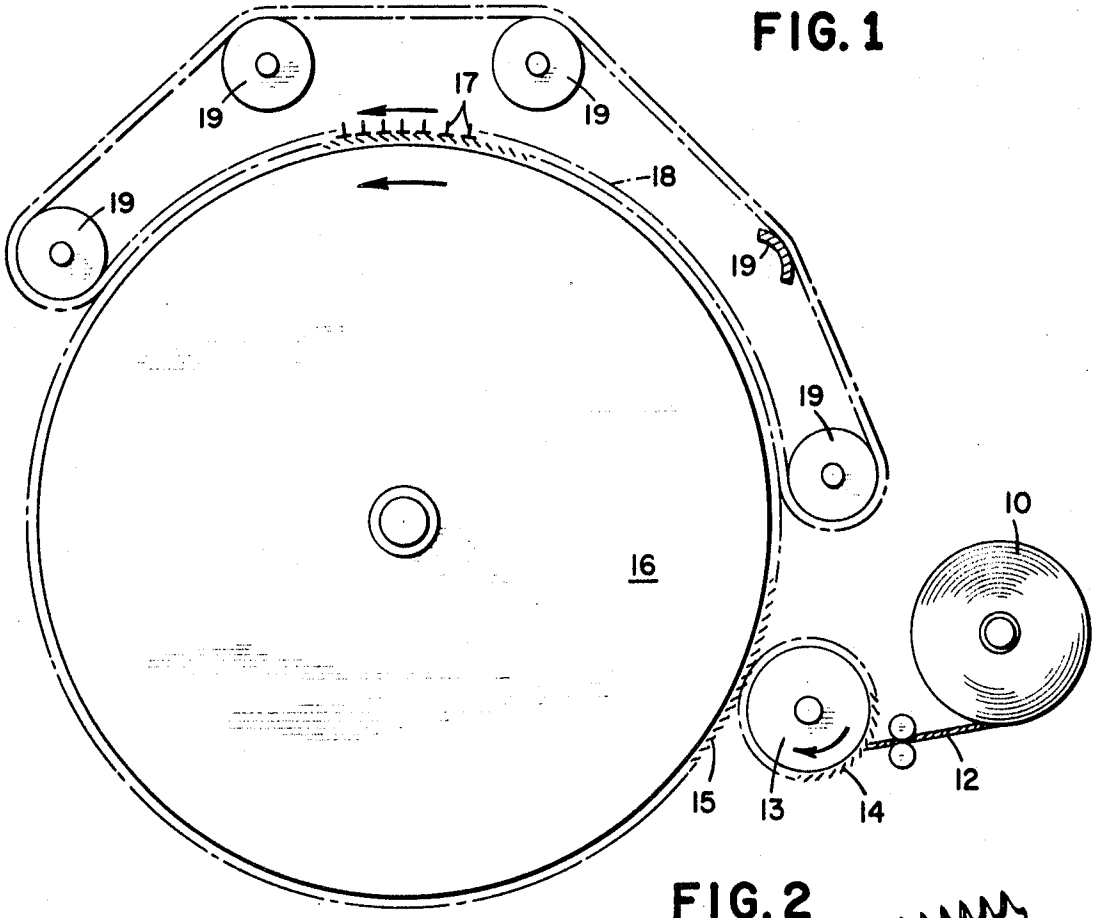

FIG. 2

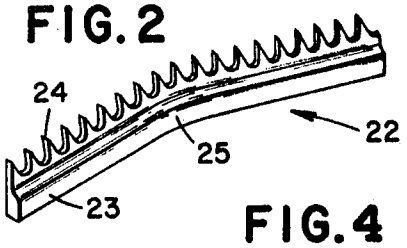

FIG. 3

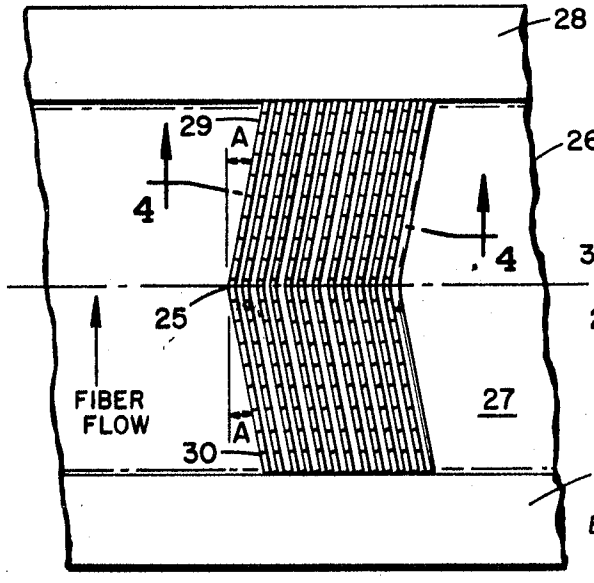

FIG. 4

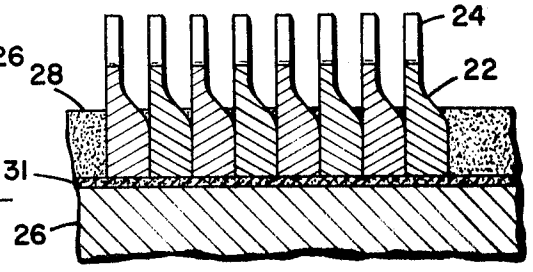

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FIG. 5

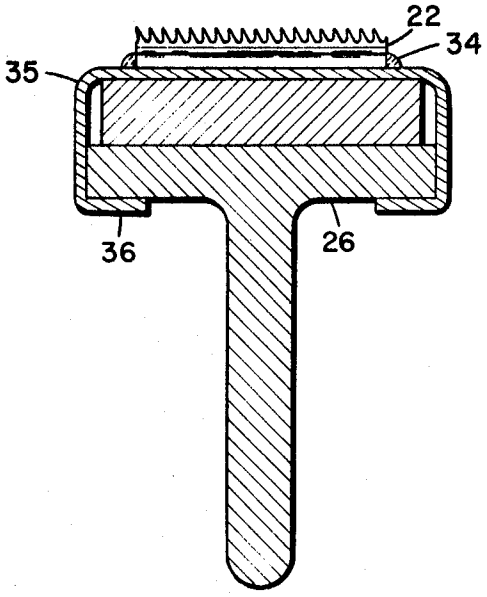
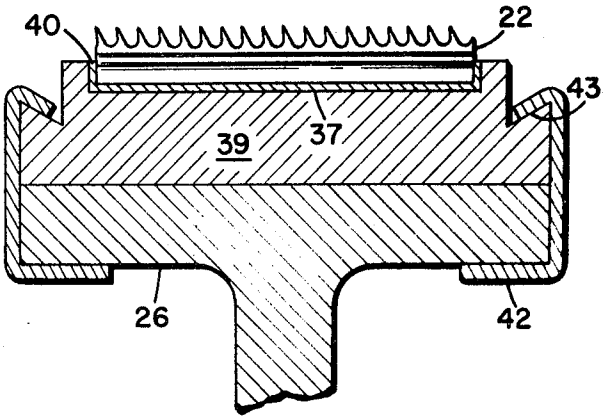


FIG. 6



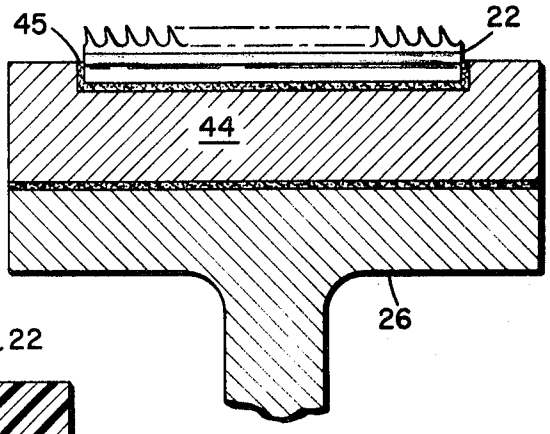


FIG. 7

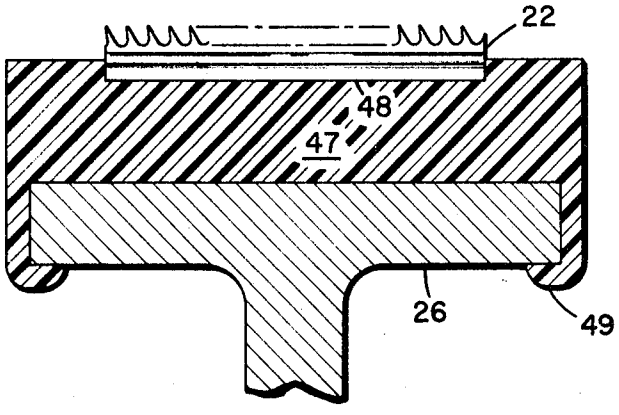


FIG. 8

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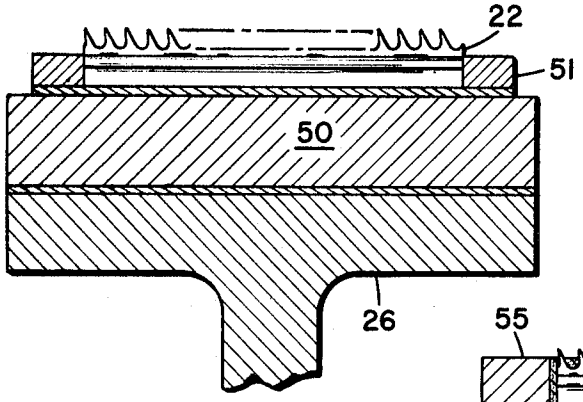
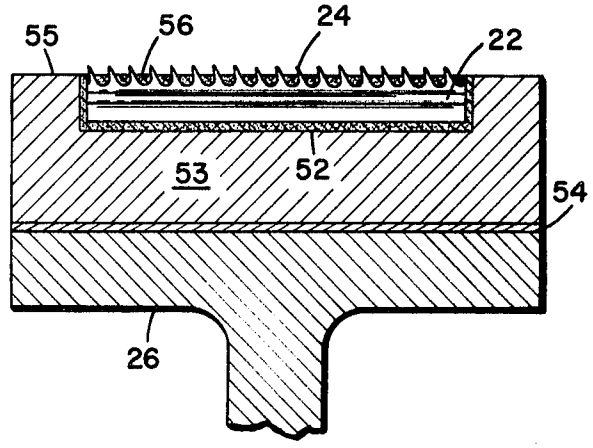
FIG. 9





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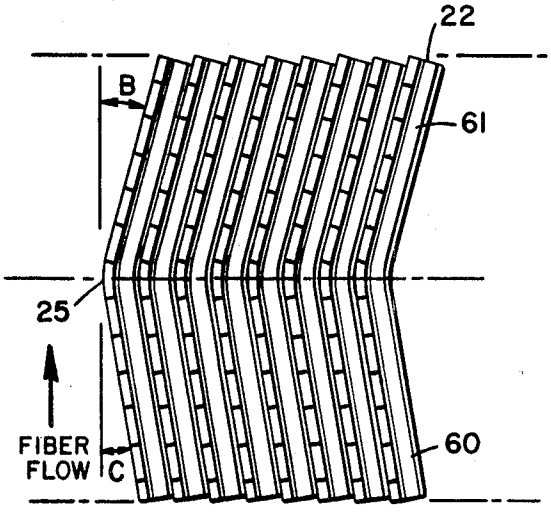

FIG. 11

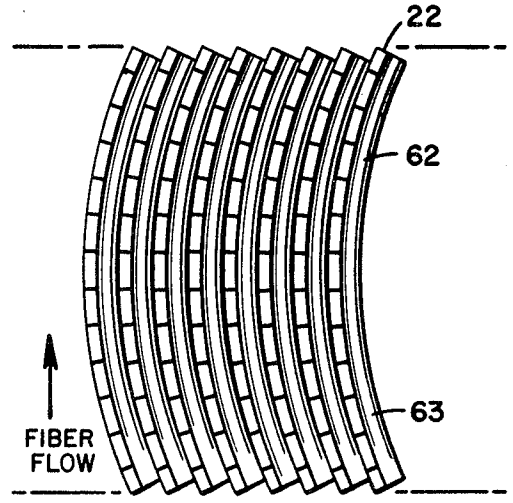

FIG. 12

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FIG. 13
PRIOR ART

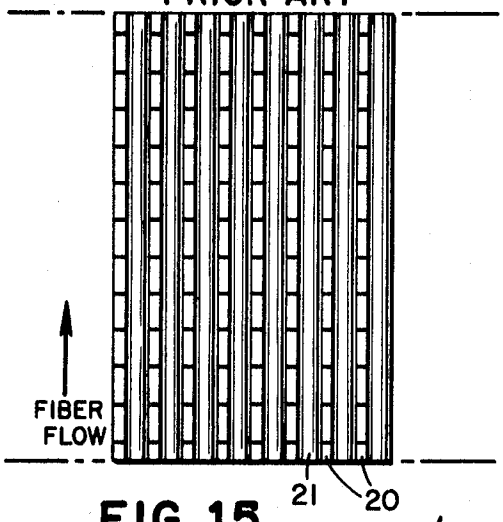

FIG. 14

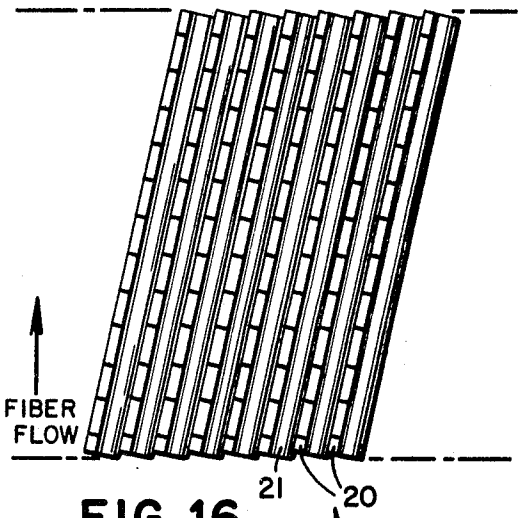

FIG. 15

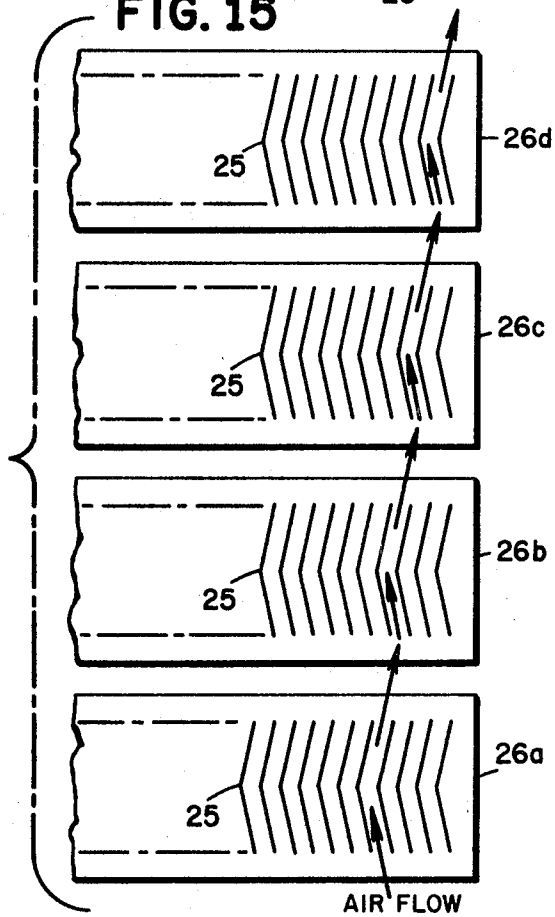

FIG. 16

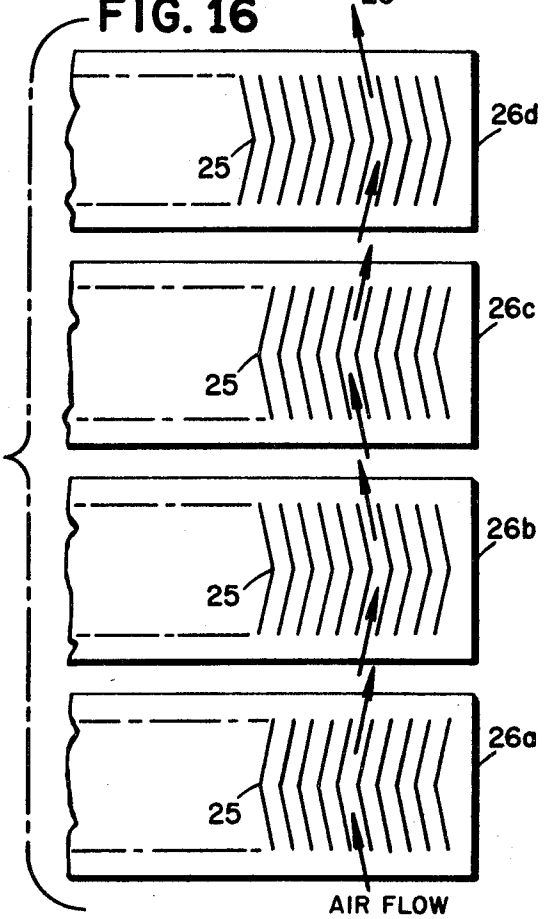

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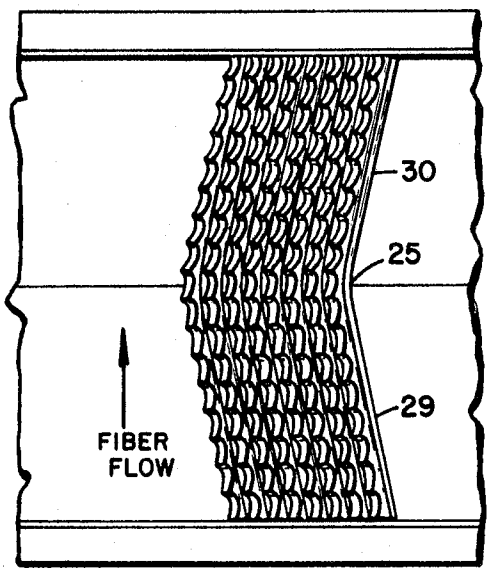
FIG. 17



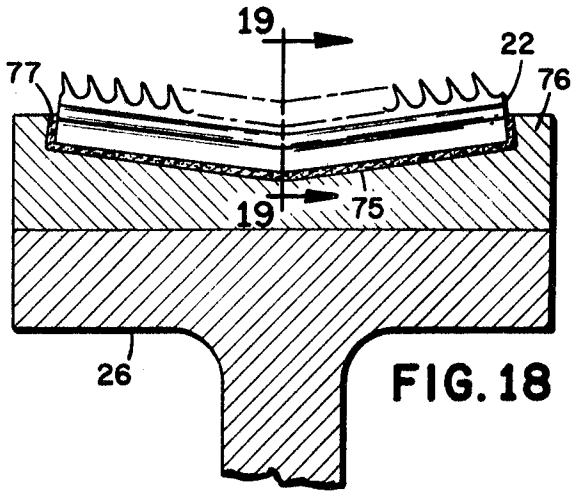


FIG. 18

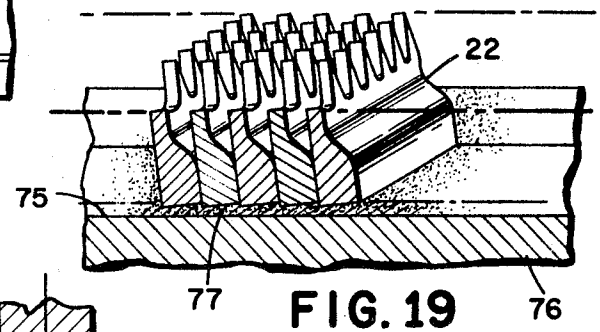


FIG. 19

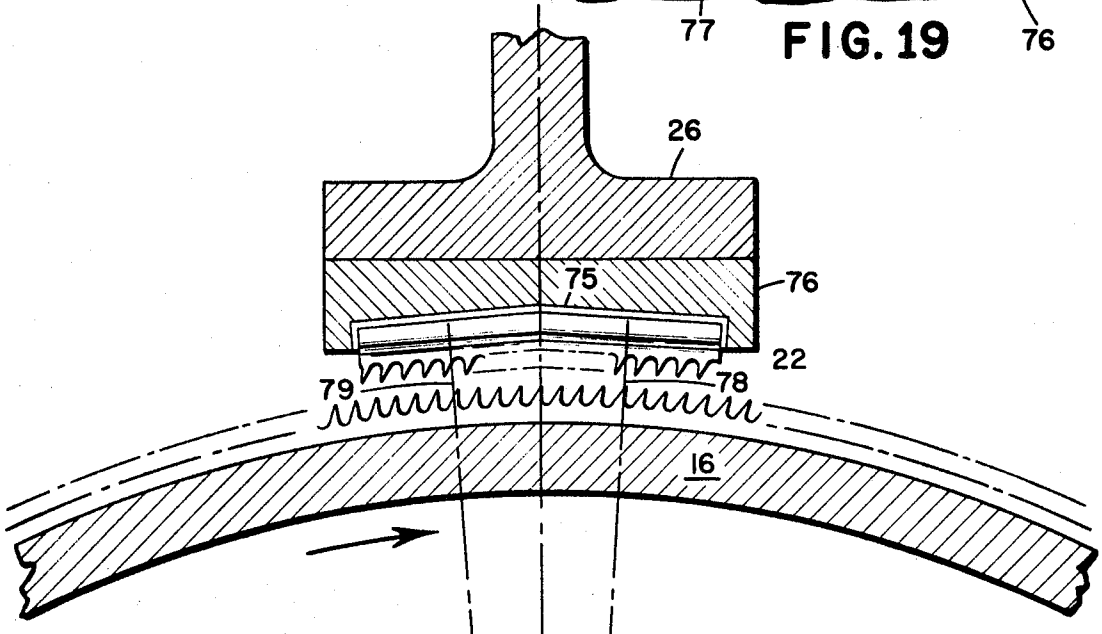


FIG. 20

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FIG. 21

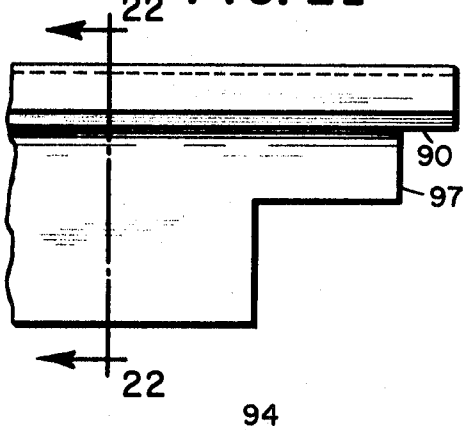
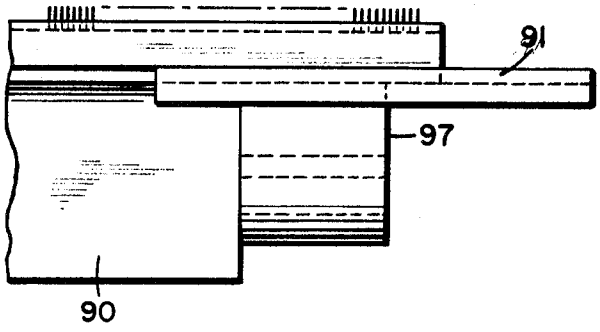


FIG. 25



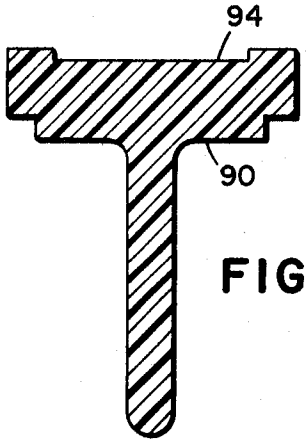
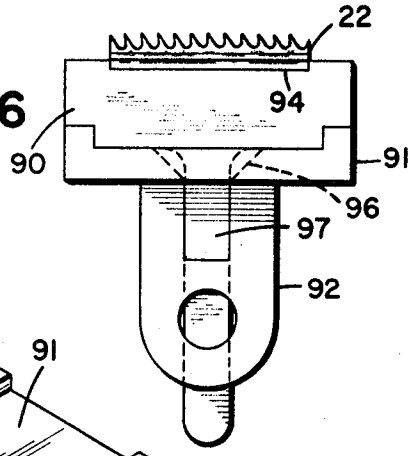


FIG. 22

FIG. 26



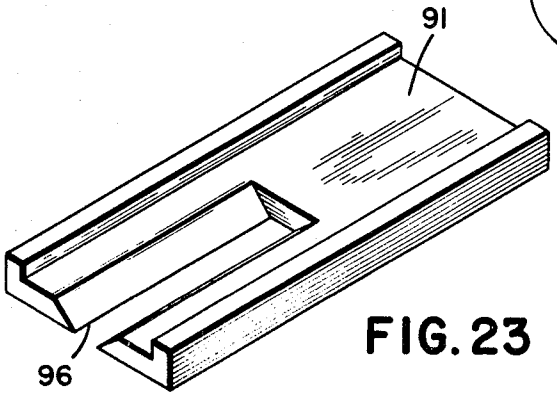


FIG. 23

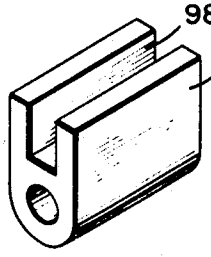


FIG. 24

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CARD CLOTHING

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to apparatus for carding fibers and particularly to carding surfaces utilizing toothed metallic strips.

2. Discussion of the Prior Art

Conventional carding machines consist of a rotating carding cylinder and a plurality of flat bars, commonly called flats, which surround about one third of the surface of the carding cylinder. The surfaces of the carding cylinder and the flats are usually toothed or provided with upstanding pins so that the interaction of the carding cylinder and the flats opens and combs the fibers and removes foreign matter therefrom. The result of the carding process is a clean, combed, uniformly dispersed sheet or web. The carding cylinder rotates, and typically the flats move also, in the same direction as the carding cylinder, but at quite different speeds. For example, the carding cylinder normally has a peripheral surface speed in the magnitude of **2200-5000** feet per minute, while the flats move at a speed of about **4** to **15** inches per minute. Only a few thousandths of an inch separate the teeth or pins of the carding cylinder from those of the flats. The great degree of relative motion between carding cylinder and flats causes a combing and teasing action in the fibers, resulting in the formation of the web.

Typically both carding cylinder and carding flat comprise a base upon which card clothing is mounted. Card clothing can be a heavy fabric through which pins or teeth are pushed, or it can be constructed of metallic elements having pins or teeth. Carding cylinders have been covered with wrappings of toothed metallic wire wound helically around the cylinder. Flats have generally been constructed using fabric card clothing utilizing flexible wire, but some have been covered with short strips of rigid metallic wire oriented parallel to the direction of fiber flow across the carding surface.

During the carding process, the carding surfaces set forth in the prior art have been known to load up, collecting and holding fibers, and quickly becoming ineffective for about 50 percent of the working cycle. This is caused by the arrangement of teeth or pins commonly used, which provides unswept open lanes between the rows of teeth or pins parallel to the direction of fiber flow, and which allows fibers to be pushed down to the base of the teeth or pins where they accumulate. Unopened and short fibers, known as "flat strips", collected in the apparatus and had to be cleaned out and disposed of as waste. This normally results in a fiber loss of up to 4 percent in some cases, to which must be added the time and expense of shutting down and cleaning the machinery. Furthermore, prior art carding apparatus provides no means to control the currents of air that are created therein, and these currents of air can disturb the fiber flow through the apparatus, contributing to waste and ineffectiveness. It is also sometimes advantageous to provide a precise degree of exposure of the carding teeth or pins, a technique that is not easily achieved in prior art devices.

The prior art sets forth various methods and apparatus for providing carding surfaces which function more efficiently. However, these solutions to the above mentioned problems have consisted generally of adding complicated processes and equipment to the basic apparatus, and have not been satisfactory.

SUMMARY OF THE INVENTION

This invention solves the problems set forth above. The novel carding surface disclosed herein is particularly well suited for use with flats. It is uncomplicated in theory and application, and results in carding machinery having high efficiency and a great deal of versatility.

In accordance with the teachings of this invention, a carding surface comprises a plurality of toothed strips arranged side by side such that the teeth are inclined at an angle to the direction of fiber flow across the carding surface. The toothed strips are advantageously in the form of strips of the metallic toothed wire often used as cylinder wire. In a preferred embodiment, each toothed strip is provided with a bend at a point intermediate the ends and a plurality of such toothed strips are nested together. The nest of toothed strips is oriented such that neither leg of the strips is parallel to the direction of fiber flow. It is also within the scope of the invention to form each toothed strip into a curved or arcuate configuration. This novel construction and orientation of toothed strips provides a random distribution of teeth over the carding surface, with no open lanes parallel to the direction of fiber flow into which unopened fibers and foreign matter can collect. Furthermore, the air flow through the carding machinery can be controlled by the orientation of the toothed strips, allowing optimum air flow characteristics for the particular machinery, speeds and fibers being utilized, and reducing the tendency of the apparatus to blow out fibers or to choke with fibers. The web of fibers resulting from the use of this invention is of quality superior to that provided by prior art devices. The life of the carding surface is long and the efficiency of the carding process is very high.

The toothed strip set forth in this invention can be mounted on conventional flats by a variety of methods, making the invention adaptable to virtually any carding machine. For example, the metallic strips can be glued to the base of a groove cut in the flat, or welded to a metal cap or glued to a plastic cap which is molded to or fitted over the flat, or assembled in a "throw-away" flat of inexpensive material which can be disposed of when the strips have deteriorated.

In another embodiment of the invention, the wire strips can be covered to a predetermined extent with resinous material so that only a certain portion of the teeth protrude above the resin, limiting the degree of exposure of the teeth. This is advantageous in situations where it is desired to expose the fibers to a small sharp tooth, and it still provides all the other advantages of this invention. Resinous material can, in like manner, be applied to the toothed wire used on other components of the carding machine such as the cylinder, lickerin, or doffer to limit the degree of tooth exposure.

The carding surface of this invention will not accumulate fibers or load up, since fibers cannot accumulate in lanes or at the base of the teeth or pins. Therefore, a clean working surface is presented at all times. The carding action is so complete that virtually all the fibers are completely opened, and there remain no unopened fibers which must be discarded as waste.

A measure of the advances obtained by the instant invention is best seen in a comparison of the efficiency

of carding machinery constructed in accordance with the invention with that of the prior art machines. Conventional carding machines operate with a total waste of between 1½ and 4 percent, while carding machines using flats in accordance with this invention have total waste of less than 1½ percent waste. This is because the flat waste present in prior art machines varies between 1½ and 2½ percent while in the instant invention there is virtually no flat waste.

It is an object of this invention to provide a new and novel carding surface which virtually eliminates waste due to loading, unopened fibers, and collection of foreign matter.

Another object of this invention is to provide a new and novel carding surface which controls air currents within the carding apparatus.

Another object of this invention is to provide a new and novel carding surface which can be applied to conventional movable carding flats.

Another object of this invention is to provide a new and novel carding surface which can be mounted on a flat in a variety of manners.

Another object of this invention is to provide a new and novel carding surface which limits the degree of exposure of each tooth above a smooth surface.

Other objects and advantages of this invention will become apparent from a study of the attached drawings and the description of the preferred embodiments set forth below.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side elevation showing the general arrangement of elements in carding machines;

FIG. **2** is a perspective view of a strip of toothed metallic wire in accordance with the instant invention;

FIG. **3** is a plan view of a plurality of the strips of FIG. **3** mounted on a flat;

FIG. **4** is a sectional view taken through **4—4** of FIG. **3**;

FIG. **5** is an elevation, partially in section, of one manner of mounting the toothed strips upon a flat;

FIG. **6** is an elevation, partially in section, of another manner of mounting the toothed strips upon a flat;

FIG. **7** is an elevation, partially in section, of still another manner of mounting the toothed strips upon a flat;

FIG. **8** is an elevation, partially in section, of still another manner of mounting the toothed strips upon a flat;

FIG. **9** is an elevation, partially in section, of still another manner of mounting the toothed strips upon a flat;

FIG. **10** is an elevation, partially in section, of another embodiment of the invention;

FIG. **11** is a plan view of still another embodiment of the invention;

FIG. **12** is a plan view of still another embodiment of the invention;

FIG. **13** is a plan view of a carding surface in accordance with the teachings of the prior art;

FIG. **14** is a plan view of a basic embodiment of the invention;

FIG. **15** is a plan view of a succession of flats in accordance with the invention showing the air flow therethrough;

FIG. **16** is a plan view of another succession of flats in accordance with the invention showing the air flow therethrough;

FIG. **17** is a plan view of still another manner of mounting the toothed strips upon a flat;

FIG. **18** is an elevation, partially in cross-section, of the arrangement in FIG. **17**;

FIG. **19** is a cross-section taken through **19—19** of FIG. **18**;

FIG. **20** is an elevation, partially in cross-section, showing the relationship between the flat shown in FIGS. **17–19**, and a carding cylinder;

FIG. **21** is a side elevation of a portion of the base plate of a disposable flat;

FIG. **22** is a section taken through line **22—22** of FIG. **21**;

FIG. **23** is a perspective view of the end piece of a disposable flat;

FIG. **24** is a perspective view of a sprocket seat and chain-screw housing for use with a disposable flat;

FIG. **25** is a side view of the elements shown in FIG. **21–24** assembled into the end portion of a disposable flat;

FIG. **26** is an end elevation of FIG. **25**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The process of carding textile fibers is accomplished by apparatus such as that pictured in FIG. **1**. The carding process begins with a roll of fibers **10** from which an uncarded bat or web of fibers **12** is fed to a lickerin **13**. A plurality of teeth **14** on lickerin **13** engage the web **12**. Interaction between teeth **14** on lickerin **13** and teeth **15** on carding cylinder **16**, and the surface speed differential between lickerin **13** and carding cylinder **16**, results in the transfer of web **12** to carding cylinder **16**. Surrounding about one-third of the periphery of carding cylinder **16** are a plurality of carding flats **17** carried by a flexible chain **18** and moving through a path delineated by guideways (not shown) approximating the shape of carding cylinder **16** and a plurality of guide wheels **19**. The actual carding process is performed by the interaction between carding surfaces of carding cylinder **16** and movable flats **17**. Both carding cylinder **16** and movable flats **17** move in the same direction. However, carding flats **17** move in the magnitude of about 4–15 inches per minute while the surface speed of carding cylinder **16** can be about 2200–5000 feet per minute. These ranges are by way of illustration and not by limitation. Only a few thousandths of an inch separate the teeth points of the carding cylinder **16** and the movable flats **17**. Once having been carded, fibrous web **12** is removed from carding cylinder **16** by means of a doffer, not shown.

The teachings of this invention will be described in regard to the movable carding flats used in carding apparatus, although the teachings apply equally well to other types of flats and to carding cylinders.

The general concept of this invention is best illustrated by a comparison of FIGS. **13** and **14**. The prior art, illustrated by FIG. **13**, includes flats in which the carding surface comprises rows of teeth **20** separated by open lanes **21**. It has been axiomatic in the prior art that these rows of teeth **20** be perfectly straight, and be aligned parallel to the direction of fiber flow. Fibers passing through lanes **21** are usually not opened and tend to collect therein. The air flow is uncontrolled. It

has been found, as now taught by the instant invention, that significantly better and more efficient carding can be obtained by aligning the rows of teeth **20** at an angle inclined to the direction of fiber flow, as shown in FIG. **14.** In the arrangement of FIG. **14,** the teeth **20** are randomly dispersed, exposing the entire spectrum of crossing fibers to the teeth, and lanes **21** are not parallel to fiber flow. Other embodiments of the invention, described below, offer certain additional advantages over the simple embodiment pictured in FIG. **14,** but in general, the novel orientation of the rows of teeth **20** with respect to the direction of fiber flow is basic to the inventive concept.

More sophisticated embodiments of the invention offer additional advantages. Looking to FIG. **2,** the basic element utilized in the invention is a toothed metallic wire strip **22,** which has a base portion **23** and an upstanding portion providing rigid, triangular teeth **24.** Base portion **23** can be of greater width than the toothed upstanding portion **24** to provide spacing between rows of teeth **24** when a plurality of strips **22** are assembled in side by side relationship to form a carding surface. Strip **22** is provided with a bend **25** at a point intermediate the ends. The use of bend **25** increases the randomization of teeth **24** without the excessive angularization that would be necessary to achieve the same result with a straight strip **22.** Bend **25** also helps greatly in the assembling of a plurality of strips **22** into a carding surface for mounting on a flat, because by virtue of bend **25** strips **22** can be nested together and are thus much easier to handle and align. Again, in keeping with the basic premise of the invention, the plurality of toothed strips **22** are oriented in such a manner as to have one side of the teeth **24** presented at an angle inclined to the direction of fiber movement. As illustrated in FIG. **3,** a plurality of bent strips **22** are assembled in side by side relationship upon a flat casting or base plate **26** having a receiving groove **27** and side sills **28.** The direction of fiber movement is perpendicular to the longitudinal axis of the flat. Strips **22** are oriented so that legs **29** and **30,** delineated by bend **25,** are both at an angle inclined to the direction of fiber movement. In FIG. **3,** both legs **29** and **30** are inclined at an angle A from the direction of fiber movement, and angles A are equal. However, these angles need not be equal, as later illustrated. FIG. **4** shows the side by side relationship of adjacent strips **22,** which are shown glued into place by a glue **31.**

FIGS. **5–10** show alternative methods of mounting toothed sections **22** upon a flat casting. For example, in FIG. **5,** a plurality of strips **22** are welded by a bead **34** to a metal cap **35** having inwardly turned flanges **36.** Cap **35** can then be attached to the flat casting **26.**

In FIG. **6,** a toothed strip **22** is glued into place in a groove **37** milled in the surface of a hard pressed paper backing **39.** Strips **22** are held in place by glue **40,** and backing **39** is clamped to flat casting **26** by clamps **42** engaging notches **43** cut into backing **39.**

The toothed strips **22** in FIG. **7** are glued to a backing **44** by glue **45** in a manner like those of FIG. **7.** The backing **44** is then attached to flat casting **26** by means of glue **46.**

The assemblage shown in FIG. **8** consists of a plurality of toothed strips **22** mounted upon a molded backing **47** which has a receiving groove **48** and a hooked flange **49.** Backing **47** can be molded on the casting **26** or can be molded separately and slid onto or snapped over flat casing **26.** Strips **22** can be glued to backing **47,** or can be pressed into backing **47** as it is being molded. Alternatively, the backing **47** may be extruded. Moreover, one of the hooked flanges may be eliminated on the trailing edge of the flat. Thus, the one flange **49** along the leading edge and the glued connection between the base plate and the backing **47** retains its snug relation to the base plate. The leading edge is that edge of the flat that faces into the direction of fiber flow, and thus is the edge first encountered by the fibers.

In FIG. **9** strips **22** are glued to the upper surface of backing **50.** Also glued to backing **50** are two sill strips **51.** Backing **50** is then glued to flat casting **26.**

The embodiment of the invention pictured in FIG. **10** is particularly advantageous when it is desirable to limit the degree of exposure of each of the teeth **24.** This is particularly advantageous when carding fibers to be used in making non-woven webs. In this embodiment, a groove **52** is provided in the upper surface of a backing **53** which is in turn attached to the flat casting **26** by means such as a glue **54.** A plurality of toothed strips **22** are positioned in groove **52** and are glued therein such that only a predetermined portion of teeth **24** extends above the upper surface **55** of backing **53.** A resinous material **56** is then applied over the strips **22** level with surface **55** to cover the valleys between the teeth to any desired depth on the teeth between the valleys and the points to leave only the tips of the teeth protruding above the resinous material. Resinous material **56** can be the same as that used to glue strips **22** into place. The result is a smooth surface **55** and **56** broken only by the protruding portions of teeth **24.** The advantages of the basic teachings of the invention are preserved. In the same manner resinous material may be applied to metallic wire teeth wound in the conventional helical manner around the cylinder, doffer or lickerin to cover the base of the wire and the valleys between the teeth to any desired depth on the teeth.

Within the concept of presenting teeth **24** at an angle inclined to the direction of fiber flow many configurations of strips **22** are possible. In FIG. **3,** the strips **22** have a bend **25** at the midpoint, and are oriented with regard to the direction of fiber such that two equal angles A are established with respect to the longitudinal axis of the flat **27.** FIG. **11,** however, shows two unequal angles B and C, and legs **60** and **61** thus present their respective teeth **24** at different angles to the direction of fiber flow.

In FIG. **12,** toothed strips **22** have been formed into arcuate sections mounted with respect to the direction of fiber flow in such a manner that each tooth **24** presents an angle to the direction of fiber flow. Although shown as a continuous equal radius of curvature, identically disposed on either side of the longitudinal axis of the flat, strips **22** can be of other curvilinear configuration within the inventive concept.

This invention is also capable of controlling the air currents within the apparatus without additional elements and complicated structure. FIGS. **15** and **16** show two arrangements of a succession of flats **26***a*, **26***b*, **26***c*, and **26***d*, upon each of which a plurality of toothed strips **22** have been arranged in patterns to illustrate how the air flow through the flats can be controlled. In FIGS. **15,** strips **22** are constructed according to FIG. **3,** that is, they are provided with a bend **25** at a point intermediate the ends. The strips **22** on all the

flats 26*a*–26*d*, are faced with their bends in the same direction. The flow of air, shown by the arrows, is divided into streams between each pair of adjacent strips 22, and owing to the arrangement of strips 22 upon successive flats, these air streams are caused to move from left to right, as illustrated. In contrast, FIG. 16 illustrates an arrangement where the sections 22 are faced in opposite directions on adjacent flats 26*a*, 26*b*, 26*c*, and 26*d*. The result of this arrangement, as shown by the arrows in FIG. 16, is to keep the flow of air entirely within the flats 26*a*–26*d*, changing direction slightly as it crosses each flat, but never being directed to the outer edge of the flat. The latter arrangement is usually advantageous because the retention of the air flow within the toothed portion of the flat prevents migration of loose fibers to the edge thereby minimizing waste. These two examples by no means show the full range of air control available by the use of this invention. Obviously, many other flow patterns can be achieved, dependent only upon the configuration and pattern of strips 22 used and their arrangement on successive flats.

Set forth in FIGS. 17–20 is another embodiment of the invention which is particularly advantageous when the movable flats are being used in conjunction with a carding cylinder. The more contact between the carding surface of the flats and the carding surface of the cylinder, the more efficient the carding process. In the devices advanced by the prior art, the carding flat usually presents a straight surface which is tangential to the periphery of the carding cylinder at a single point only. By the instant invention, it is possible to quite simply construct a carding surface on a flat which is tangential with the periphery of the carding cylinder at two points. The carding surface is made from a plurality of toothed strips 22 provided with bends 25 at the midpoint, as illustrated in FIGS. 3 and 17. These strips 22 are mounted in a V-shaped groove 75 in a backing piece 76, as illustrated in FIG. 18. Strips 22 can be fastened into groove 75 by any of the means previously shown, such as a glue 77. When place in V-shaped slot 75, the bottom of the strips conforms to the bottom of the groove and the bend 25 engages the apex of the V-shaped groove 75. Thus, strips 22 are tilted and present on end view, a section that is V-shaped, to match groove 75 (see FIG. 18). FIG. 19, shows in section the arrangement of laterally tilted strips 22. As shown in FIG. 20, the resulting carding surface has two points 78 and 79 tangential with the periphery of carding cylinder 16, thus providing greater and more effective carding action. Of course, both legs 29 and 30 of strips 22 are mounted at an angle to the direction of fiber flow, as taught above. Thus, this embodiment provides all the previously described advantages of the invention.

FIGS. 21–26 illustrate the elements of a "throw-away" flat which is manufactured of inexpensive material and which is particularly well adapted for use within the novel concepts of this invention. The basic T-shaped section 90 is shown in FIGS. 21 and 22 and is manufactured of an inexpensive material such as any of the commercially available synthetic plastics. Installed on each end of T-shaped section 90 is an end piece 91 which engages the guides in the carding apparatus (not shown). End piece 91 has a slot 96 which receives the stem portion 97 of section 90. Stem portion 97 is formed by a cutout portion on the bottom at the end of T-shaped section 90. End piece 91 should, at least in part, be made of durable material such as metal. Also installed on each end of T-shaped section 90 is a sprocket seat and chain-screw housing 92, which should also be of metal. Housing 92 has a slot 98 which receives stem portion 97 so that housing 92 is positioned in the cutout portion of the stem portion. T-shaped section 90, end piece 91, and housing 92 are attached together by commonly used means such as glue. A slot 94 is provided on the upper surface of T-shaped section 90 for receiving a plurality of toothed strips 22 in any one of the manners previously described. The advantage of this flat resides in the fact that it is designed to take advantage of the use of inexpensive materials, and therefore entire flat can be discarded when the carding teeth become dull or otherwise deteriorate.

The invention set forth herein is not to be considered as limited by the embodiments described. Many additional modifications and other embodiments may become apparent to those skilled in the art, and the scope of the invention is to be limited only the following claims.

I claim:

1. A carding flat across which there is an established direction of fiber flow comprising

a base plate

a backing plate attached to said base plate, said backing plate having a longitudinal groove of V-shaped cross section in the upper surface thereof,

a plurality of elongated wire strips mounted in and extending across said groove, said strips being assembled in side-by-side relationship,

each of said strips having a base portion and an integral upstanding portion provided with a row of rigid, generally triangular teeth,

said base portion being of greater width than said upstanding portion to provide a spacing between adjacent upstanding portions,

each of said strips including a bend at a point intermediate the ends thereof dividing each said strip into a first leg and a second leg,

said plurality of strips being nested together and disposed such that said base portions of adjacent strips are in contact with one another and both said first leg and said second leg of each of said strips and said teeth thereon are inclined at an angle to said direction of fiber flow, and

said strips being positioned in said V-shaped groove such that said strips conform to the bottom of said V-shaped groove and said bend engages the apex of said V-shaped groove.

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