Sept. 20, 1971 C. S. WISE ET AL 3,605,196

FIBER OPENER

Filed Oct. 14, 1968 2 Sheets-Sheet 1

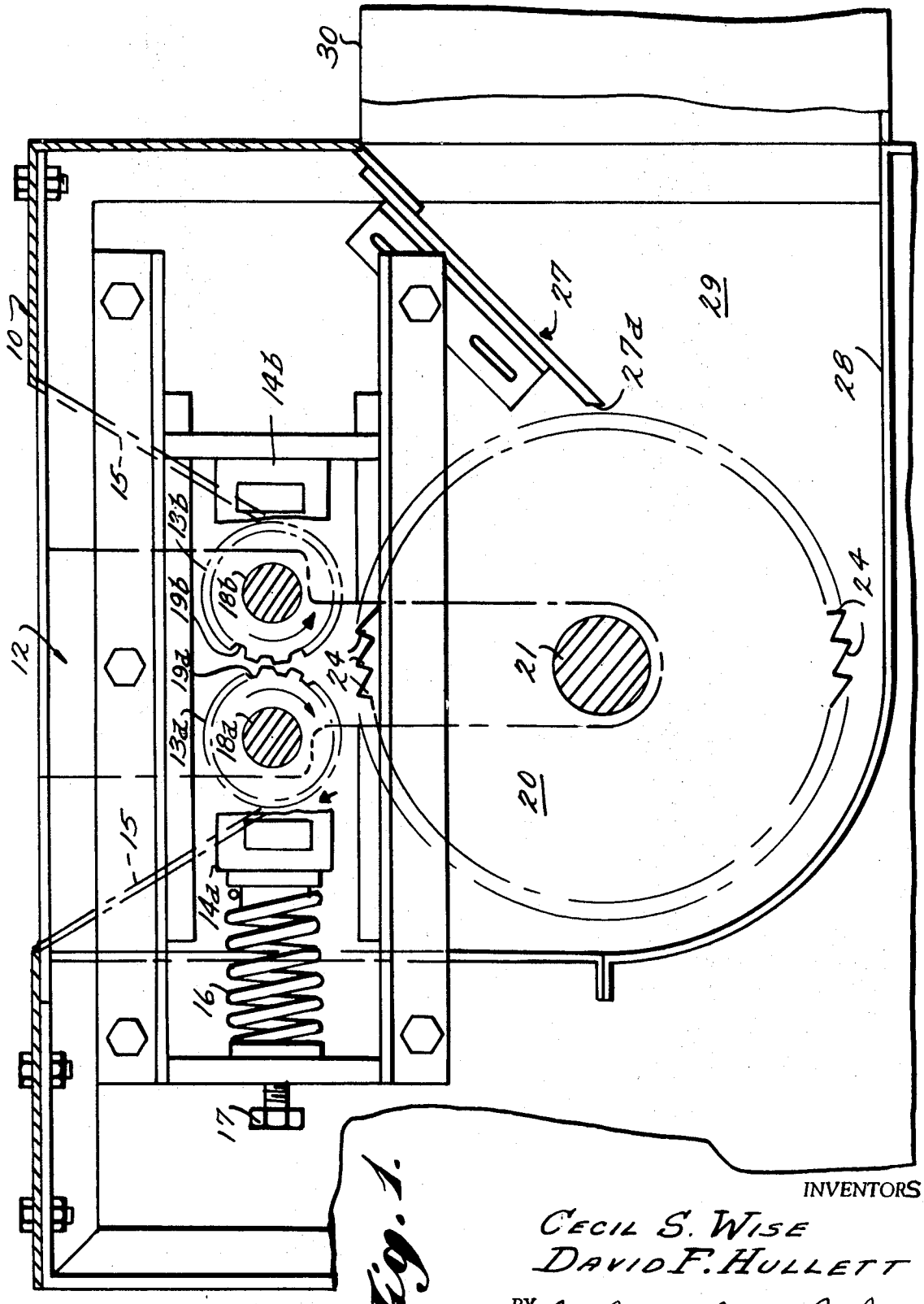


Fig. 1.

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Fig. 2.

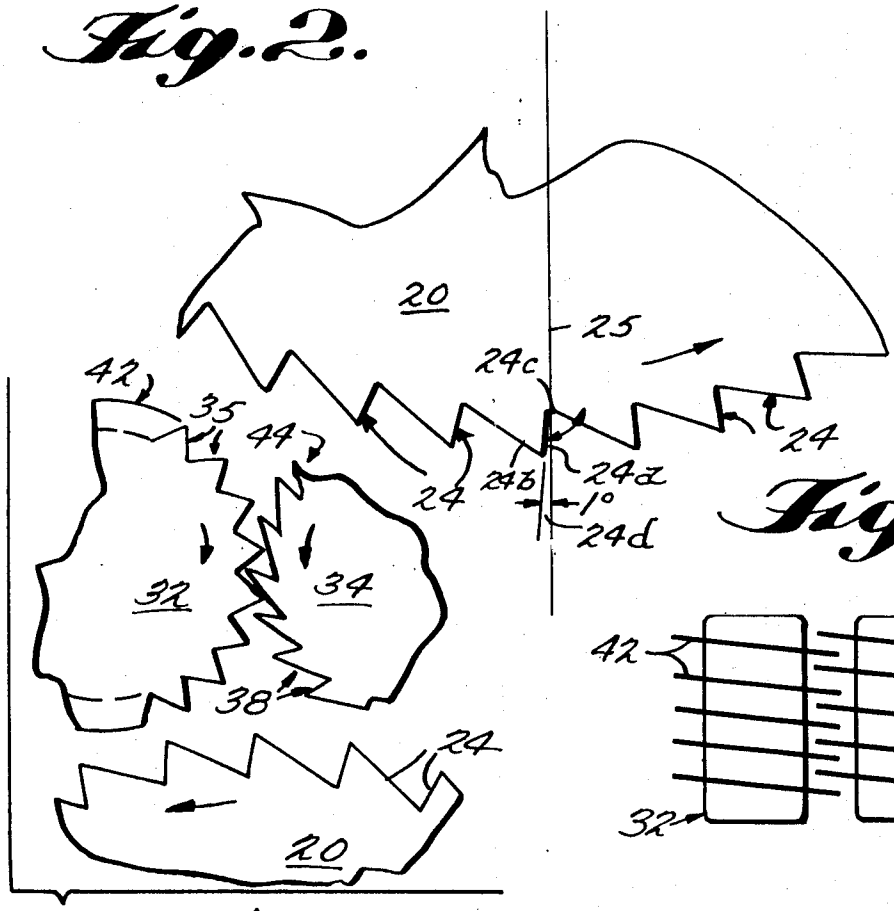


Fig. 5.

Fig. 3.

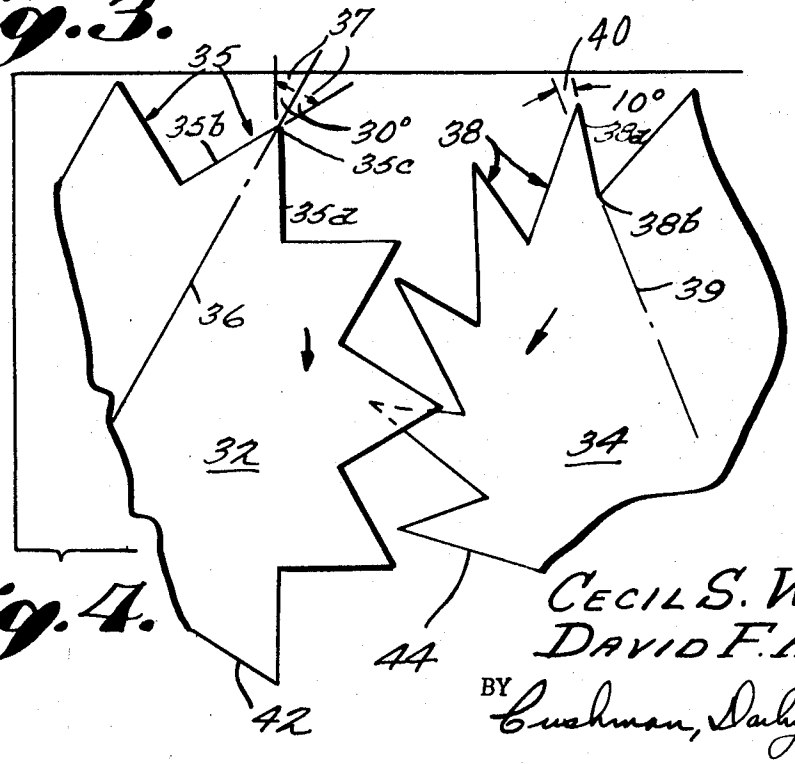


Fig. 4.

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FIBER OPENER

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U.S. Cl. 19—83 5 Claims

ABSTRACT OF THE DISCLOSURE

A machine for opening or grinding waste or new fibers or the like in which the fibers to be opened are fed between two oppositely rotating feed rolls, which are spring biased towards each other. If asbestos fibers are being opened, the surfaces of the feed rolls are fluted, otherwise the surfaces of the feed rolls have teeth for use with other types of fibers. The feed rolls serve to hold the fibers while moving them forward to be torn at and opened by the teeth on an opening cylinder of the licker-in type. In the case where teeth are used on the feed rolls, the teeth on one feed roll act to hold onto the fibers while the teeth on the other feed roll clean the spaces between the teeth on the first feed roll and the opening cylinder pulls the fibers apart. The teeth on the opening cylinder are at an angle which causes self-doffing to take place within one revolution of the opening cylinder. A cut-off bar is provided to aid removal of any fibers from the opening cylinder which are not self-doffed.

This invention relates to machines used for opening entangled fibers, especially natural fibers such as cotton, wool and asbestos, or the like regardless of whether the fibers are "waste," i.e., reworkable fibers that have previously been processed to some degree but because of rejection or other reason have been returned useable for reprocessing, or are new (unprocessed or raw) fibers. In particular this invention relates to fiber opening machines which grip and hold the fibers while pulling them apart, thereby opening the fibers so that they do not create in subsequent opening, feeding, weighing or processing equipment, such problems as jamming or wrapping around a doffer or inaccurate weighings because such subsequent equipment cannot normally open the fibers sufficiently.

Raw cotton fibers or the like or reworkable fibers are frequently tangled, twisted, wadded, stranded, clumped, knotty and the like (herein generally referred to as "entangled" or "unopened" fibers or the like). It is therefore necessary to provide equipment which will sever the strands and open the fibers so that subsequent processing may be accomplished which will yield the desired final product. When reworkable fibers are involved, this general process is sometimes referred to as "waste grinding."

Conventional machinery available for accomplishing the aforementioned opening or waste grinding often includes a licker-in or opening cylinder which tears at and opens the fibers. A major problem in the conventional licker-in type device however has been to provide suitable means for feeding the fibers to be opened to the licker-in. Generally a feed roll and a feed plate or a pair or perhaps three feed rolls of some type are used, but remembering that the purpose for a fiber opener is to prevent unopened or unground fibers from tangling in or wrapping around similar rolls in subsequent processing machinery, it will be understood that this very problem will be presented when one is dealing with feed rolls which must handle unopened fibers.

It is therefore an object of this invention to provide for fiber opening or waste grinding apparatus containing

an opening cylinder for tearing and pulling apart entangled or otherwise unopened fibers which are presented and held therefor by a pair only of feed rolls, which either are fluted and biased toward each other in accordance with one feature of this invention, or in accordance with another and presently more preferred feature having meshing teeth of respectively different shapes to effect self cleaning and holding of the fibers for the opening cylinder.

Another object of this invention in conjunction with the preceding object is the provision of an opening cylinder or licker-in which will itself doff the opened fibers from its teeth.

Other objects, aspects and features of the invention will become apparent upon referring to the description of the preferred embodiments below and the appended claims in conjunction with the attached drawings in which:

FIG. 1 is an end elevational view partially broken away of one embodiment of the invention,

FIG. 2 is an enlarged partial end view of an opening cylinder used in FIG. 1,

FIG. 3 is a diagrammatic partial end view of an opening cylinder and an alternative feed roll embodiment,

FIG. 4 is an enlarged partial view of the FIG. 3 feed rolls, and

FIG. 5 is a diagrammatic top view of the FIG. 3 feed rolls.

In the first preferred embodiment shown in FIG. 1 a generally rectangular cabinet **10** has an opening in its top with two walls **15** angling downward therefrom forming a chute **12**. It is into chute **12** that the fibers to be opened or reworkable waste are introduced in any desired way, as manually, by gravity or by conventional pneumatic conveying means. Walls **15** are angled in such a manner that the fibers to be opened are directed into the paths of oppositely rotating feed rolls **13***a* and **13***b* which rotate about parallel and coplanar shafts **18***a* and **18***b*, respectively. Shafts **18***a* and **18***b* are mounted on brackets **14***a* and **14***b*, respectively, portions of which are broken away to show the details of feed rolls **13***a* and **13***b*. While bracket **14***b* is rigidly mounted, it will be noted that bracket **14***a* is mounted on an end of a coil spring **16**, the other end of which is rigidly mounted. Spring **16** biases feed roll **13***a* in the direction of feed roll **13***b*. The tension of spring **16** may be adjusted by a set screw **17**. As is apparent from FIG. 1, the feed rolls in the first preferred embodiment of the invention are biased into surface contact and recessed from the cylindrical surfaces thereof are cut-outs or flutes **19***a* and **19***b*, respectively. These flutes may be staggered from one roll to the other as shown, or they may overlap or be directly opposite each other if desired. Preferably, the flutes spiral in unison along the length of the feed rolls, though they may be straight (parallel to shafts **18***a* and **18***b*) if desired.

The first preferred embodiment of the invention is particularly useful with asbestos fibers. Such fibers requiring opening are introduced into chute **12**, compressed and held by oppositely rotating feed rolls **13***a* and **13***b*, while being conveyed thereby downward into the path of, i.e., opened by a large opening cylinder **20**, and are torn and pulled apart, teeth **24** of cylinder **20**. It has been found when asbestos fibers are being processed that fluted feed rolls serve this purpose best. In those cases where unusually large clumps of fibers are to be operated on they might not ordinarily pass between feed rolls **13***a* and **13***b*, but spring **16** has been provided to allow feed roll **13***a* to be pushed away from feed roll **13***b* thereby allowing such clumps to pass through.

Opening cylinder **20** is mounted to rotate upon a shaft **21** immediately below feed rolls **13***a* and **13***b*. This is par-

allel to shafts **18***a* and **18***b* and is centrally disposed below and between those shafts so that opening cylinder **20** will rotate in close proximity to and directly below both feed rolls **13***a* and **13***b* (for example, there may be approximately 0.020 inch via common radical lines, between opening teeth **24** and the surface of feed rolls **13***a* and **13***b*). Teeth **24** are caused to project outwardly about ½ inch in any suitable manner, for example they are mounted on the circumference of opening cylinder **20** by spirally winding a toothed wire in a groove around the cylindrical surface of opening cylinder **20** so that, in the preferred embodiment, teeth **24** are placed circumferentially at five teeth per inch to effect two threads or tooth circles per inch. Teeth **24** allow opening cylinder **20** to operate in the well-known manner of a licker-in when the opening is rotated. That is, feed rolls **13***a* and **13***b* convey the fibers downward and hold them in the path of teeth **24**. The teeth tear at and open the fibers while pulling them away from the feed rolls.

As illustrated in FIG. 2 teeth **24** on opening cylinder **20** are triangular shaped. The side of the triangle which will first pass a point on the rotational path of opening cylinder **20** is the forward edge of the tooth. On tooth **24** this would be edge **24***a*. The angle edge **24***a* forms with the base of the tooth on the circumference of opening cylinder **20** is the forward base angle **24***c* of tooth **24**. A radial line **25** drawn through base angle **24***c*, forms an angle **24***d* between it and edge **24***a* of 1°. Because this angle is generated by rotating edge **24** from radial line **25** in a direction opposite the direction of rotation of opening cylinder **20**, angle may be called a negative angle, and tooth **24** may be said to have a 1° negative rake. By giving teeth **24** a substantially upright forward edge, the ability of opening cylinder **20**, by means of its centrifugal force, to self-doff the fibers torn and raked from feed rolls **13***a* and **13***b* is significantly enhanced. In the preferred embodiment with teeth **24** made in a configuration as described hereinabove and with opening cylinder **20** having a diameter of 12 inches and operating at a velocity of 1200 r.p.m. self-doffing will occur within ½ to ¾ of a revolution of opening cylinder **20** from the point where fibers are pulled from the feed rolls.

A flat cut-off bar **27** having a pointed edge **27***a* and mounted at approximately a 45° angle with horizontal is provided to remove from opening cylinder **20** any fibers which are not doffed. Cut-off bar **27** extends the full length of opening cylinder **20**, and its pointed edge **27***a* is placed close enough to teeth **24** so that pointed edge **27** will remove undoffed fibers therefrom without striking teeth **24**. Cut-off bar **27** along with bottom wall **28** forms an output chute **29**. Chute **29** communicates with a further processing means **30** which may be a feeder, condenser screen, separator, distributor, chute feeder, weigher, or any other device which requires opened fibers for further processing. It must be noted that means **30** need not be directly connected to the fiber opener, and a conveyor, such as the well-known pneumatic conveyors, may be used to transport open fibers from the fiber opener to means **30**.

FIG. 3 illustrates the second preferred embodiment of the fiber opener of applicants' invention. This embodiment is shown only partially and diagrammatically because the only change is in the configuration of feed rolls **32** and **34**, which incidentally, need not be biased toward each. It has been found that toothed feed rolls rather than fluted feed rolls are more desirable for feeding fibers other than asbestos, such as cotton or the like. Teeth **35** and **38** may be mounted on feed rolls **32** and **34**, respectively, in the same manner as teeth **24** are mounted on opening cylinder **20**. That is, the teeth are cut in a wire which is spirally wound around the cylindrical surfaces of feed rolls **32** and **34**, preferably in grooves thereon. This is shown in FIG. 5 where toothed wire **42** is wrapped around feed roll **32** and toothed wire **44** is wrapped around feed roll **34**. Teeth **35** are disposed on wire **42** at three teeth per inch and teeth **38** on wire **44** at five teeth per inch, with both wires being wrapped around their respective feed roll at four threads (circles) per inch of roll length. The teeth on both feed rolls protrude from the cylindrical surfaces thereof about 5/16 inch. As shown by FIG. 5, teeth **35** and **38** are interleaved or longitudinally meshed since wires **42** and **44** are alternately disposed. Such meshing is preferably of the order of ¾ of the height of teeth **35** and **38**, to effect good roll cleaning and fiber holding.

It is apparent from FIGS. 3 and 4 that teeth **35** and **38** are differently shaped. In the case of teeth **35**, as illustrated in FIG. 4, the shape is that of a pyramid. Relative to a radial line **36** drawn from the center of feed roll **32** through apex **35***c* of a tooth **35**, the extensions of sides **35***a* and **35***b* form equal angles **37** with radial line **36**, and in the case of the preferred embodiment angle **37** has been chosen to be 30°. Thus, tooth **35** may be said to be an isosceles triangle.

On the other hand, while teeth **38** of the other feed roll are also triangularly shaped, the shape may be said to be more nearly that of a right triangle. Relative to a radial line **39** drawn through the rear base angle **38***b* of a tooth **38**, an angle **40** created with the more upright side **38***a* is approximately 10°. Angle **40** may be said to be generated by rotating side **38***a* in a direction opposite the direction of rotation of feed roll **34** from radial line **39**. Side **38***a* is the rear side of tooth **38** with respect to the direction of rotation of feed roll **34**.

Although opening cylinder **20** operates in close proximity to the feed rolls, for example on a common radial line between shaft **21** and either shaft **18***a* or **18***b* the outer end of the teeth on feed rolls **32** and **34** is 0.020 inch from the outer end of the teeth on opening cylinder **20**, strands of unopened fibers may not be pulled from the feed rolls by opening cylinder **20** because they have tended to become wrapped around the feed rolls. This problem is alleviated by shaping and placing the teeth on the feed rolls as described above. The shapes of teeth **35** and **38** are such that these teeth pull in the unopened fibers from chute **12** of FIG. 1 while the backward slope **38***a* of teeth helps to give a better grip or restraint to the fibers as they are pulled on by the opening cylinder teeth **24**. However, the pyramidal shape of teeth **35**, which rotate between rows of teeth **38**, is such that they help sever the strands of fibers which have become entangled around feed roll **34**, thereby making the feed rolls self-cleaning.

Relative to the previously mentioned 12 inch diameter opening cylinder **20** operating at 1200 r.p.m., the feed rolls of this invention are preferably about three inches in diameter and rotatable at any desired speed by a separate variable speed drive (not shown) between 11 and 110 r.p.m., i.e. at about 0.01 to about 0.1 the opening cylinder speed, according to the amount of fiber opening necessary, the more entanglement the slower the feed roll speed employed.

It is apparent therefore that this invention provides apparatus for opening fibers or "grinding" fiber waste in which the opening cylinder by its own action doffs the open fibers, and in which the problem of the feed rolls becoming entangled with unopened fibers has been alleviated. Further, it will be apparent to those skilled in the art that the construction and arrangement of the elements of this invention may be modified within the scope of the appended claims.

What is claimed is:

1. Fiber opening apparatus comprising:

first chute means for receiving unopened fibers,

a rotatable toothed self-doffing opening cylinder,

a pair only of oppositely rotatable operatively associated feed rolls disposed between said chute means and opening cylinder for receiving and holding between said feed rolls the said unopened fibers from said chute while conveying those held fibers into the path of said opening cylinder whereby said opening

cylinder, when rotating, tears, pulls, opens and doffs said unopened fibers, each of said feed rolls being cylindrically shaped and having spirally wound on its surface a wire upon which is mounted along the length thereof a series of teeth in a spaced relationship to one another and extending radially from the surface of the feed roll, said teeth on one of said feed rolls being pyramid-shaped with the bases thereof resting on the surface of said roll and with the sides thereof forming equal angles with a radial line through the apex of said pyramid, said teeth on the other of said feed rolls being triangular-shaped with the rear edges thereof, with respect to the direction of rotation of said other feed roll, forming an acute angle in a direction opposite the direction of rotation of said other feed roll with radial lines from the feed roll center of said other feed roll through the rear base angles of said triangular teeth to effect the aforesaid holding of said unopened fibers, and said teeth being placed on said one feed roll and said other feed roll so that rows of said teeth on said one feed roll rotate between rows of said teeth on said other feed roll whereby said pyramid-shaped teeth serve to clean strands of fibers from between said triangular-shaped teeth,

second chute means for receiving and conveying opened fibers doffed from said opening cylinder, and

cut-off bar means for removing from said opening cylinder and into said second chute means fibers which are not self-doffed by said opening cylinder.

2. An apparatus for opening fibers,

a rotatable toothed, self-doffing cylinder for tearing and pulling at and opening unopened fibers,

a pair only of feed rolls disposed adjacent said cylinder and cooperatively rotatable in opposite directions for feeding unopened fibers to said cylinder,

each of said feed rolls having teeth circumferentially disposed along its length to effect longitudinal alternation and interleaving of the feed roll pair teeth,

the teeth on one roll **34** each having a first configuration which includes a trailing edge inclined backwardly opposite to the direction of rotation of said one roll **34** to aid holding of the unopened fibers while the said cylinder tears, pulls and opens those fibers as aforesaid, and

the teeth on the other roll **32** each having a second configuration substantially in the form of an isoceles triangle which is different from said first configuration and which includes a trailing edge inclined forwardly in the direction of rotation of said other roll **32** for aiding removal of fibers caught by the teeth on said one roll.

3. An apparatus for opening fibers,

a rotatable toothed, self-doffing cylinder for tearing and pulling at and opening unopened fibers,

a pair only of feed rolls disposed adjacent said cylinder and cooperatively rotatable in opposite directions for feeding unopened fibers to said cylinder,

each of said feed rolls having teeth circumferentially disposed along its length to effect longitudinal alternation and interleaving of the feed roll pair teeth,

the teeth on one roll **34** each having a first configuration which includes a trailing edge inclined backwardly opposite to the direction of rotation of said one roll **34** to aid holding of the unopened fibers while the said cylinder tears, pulls and opens those fibers as aforesaid, each such trailing edge of said one roll **34** being inclined in the order of 10 degrees relative to a radial line of said one roll **34**, and

the teeth on the other roll **32** each having a second configuration substantially in the form of an isosceles triangle which is different from said first configuration and which includes a trailing edge inclined forwardly in the direction of rotation of said other roll **32** for aiding removal of fibers caught by the teeth on said one roll, said trailing edges of said other roll **32** being inclined forwardly in the order of 30 degrees relative to radial lines of said other roll.

4. Apparatus as in claim **2** or **3** wherein the teeth on said feed rolls are of approximately the same height and longitudinally overlap or mesh with the order of about ¾ of said height and wherein the teeth on each of said rolls spiral therearound for the length of the respective roll.

5. Apparatus as in any of the preceding claims **2**, **3** or **4** wherein the teeth on said one roll are disposed on the order of 5 teeth per inch,

wherein the teeth on said other roll are disposed in the order of three teeth per inch

wherein the teeth of the respective rolls spiral thereabout in the order of four threads per inch

wherein the diameters of the feed rolls are substantially equal and substantially smaller than the diameter of said opening cylinder, and

wherein said feed roll rotate at substantially the same speed and in the order of about 0.1 to about 0.01 the speed of said opening cylinder.

References Cited

UNITED STATES PATENTS

288,327	11/1883	Goddard	19—96
927,955	7/1909	Dixon	19—97
2,893,064	7/1959	Rusca et al.	19—97UX
2,911,684	11/1959	Hunter	19—203
3,169,664	2/1965	Meinicke	19—105UX
3,172,165	3/1965	Helm	19—203

FOREIGN PATENTS

499,210	1/1939	Great Britain	19—114
835,215	5/1960	Great Britain	19—96
178,018	6/1966	U.S.S.R.	19—202

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U.S. Cl. X.R.

19—97