May 1, 1956 E. C. LATHROP 2,744,037

PITH SEPARATION AND SUGAR RECOVERY FROM BAGASSE

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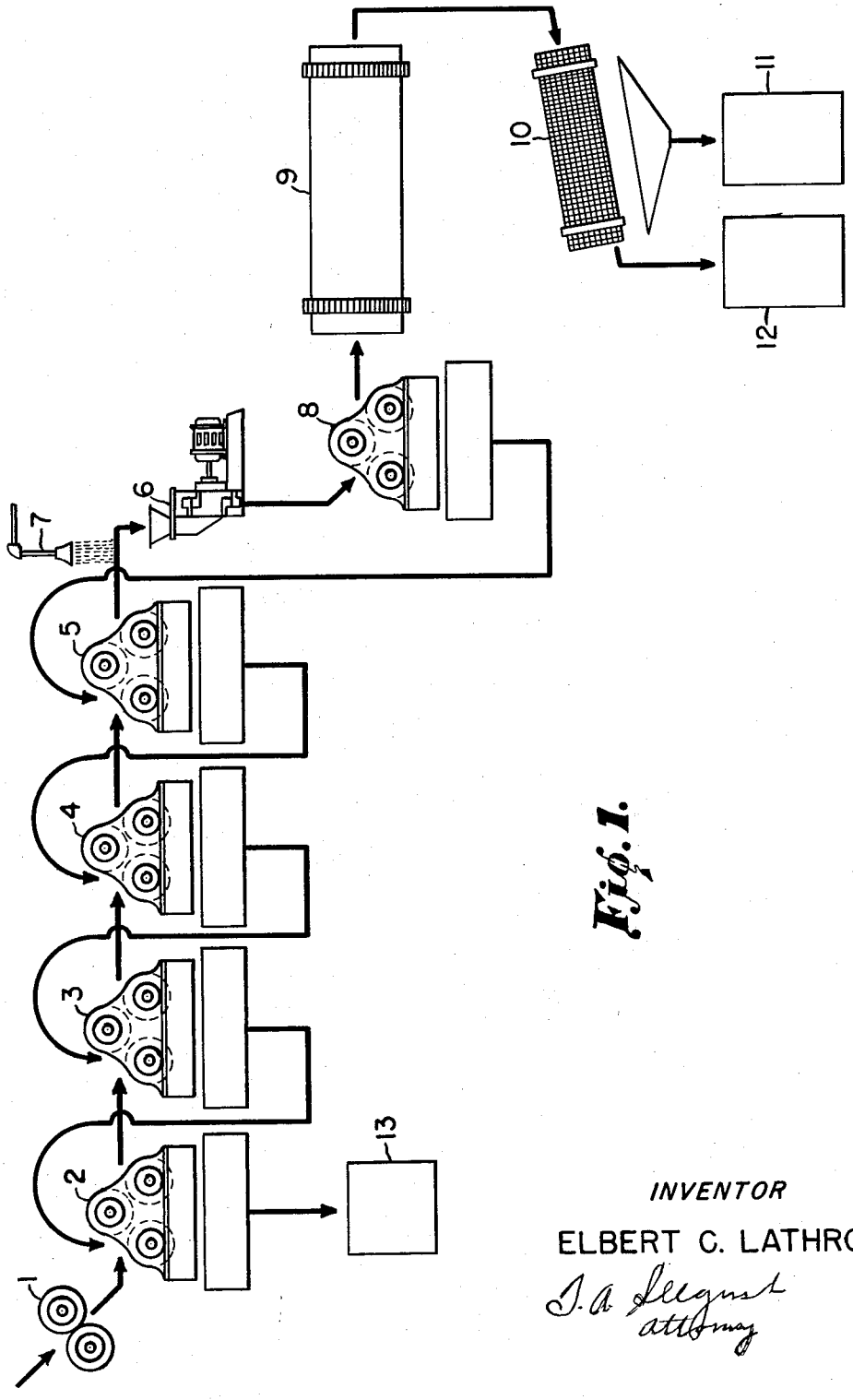


Fig. 1.

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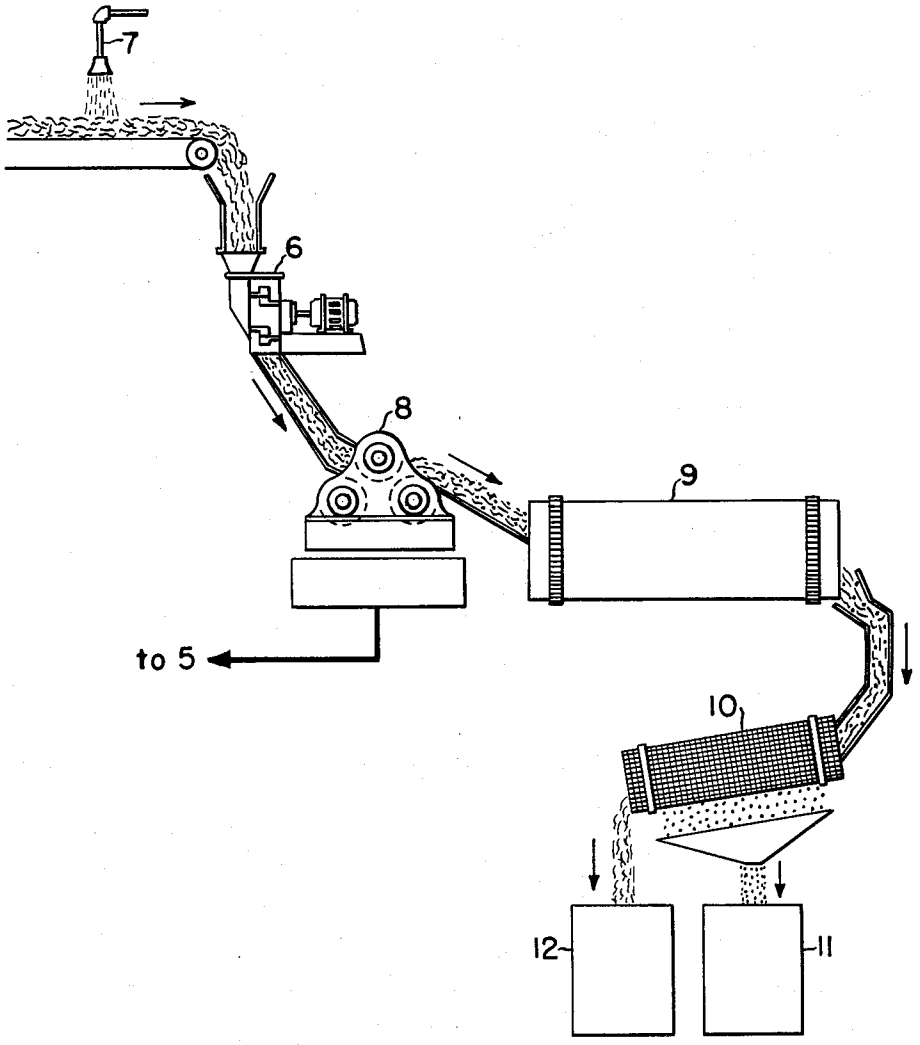


Fig. 2.

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PITH SEPARATION AND SUGAR RECOVERY FROM BAGASSE

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4 Claims. (Cl. 127—43)

(Granted under Title 35, U. S. Code (1952), sec. 266)

A non-exclusive, irrevocable, royalty-free license in the invention herein described, for all governmental purposes, throughout the world, with the power to grant sublicenses for such purposes, is hereby granted to the Government of the United States of America.

This invention relates to a method for treating pressed sugar cane (bagasse) to separate the pressed cane into a pith component and a fiber component, and relates more particularly to a method for treating sugar cane as it comes from a sugar mill after the sugar juice has been expressed therefrom by a process which affords the recovery of considerable residual sugar associated with the pressed cane and which also affords the separation of the treated cane into the two aforementioned components. It relates also to a method for operating sugar cane mills whereby increased sugar recovery is attained and wherby the solid cellulosic residue may be obtained in the form of two components, one having a high proportion of pith and the other a high proportion of fiber. The invention also has within its scope a method for operating a sugar cane mill whereby the bagasse-like product obtained directly therefrom is in two components, each characterized by the pith and fiber content previously mentioned.

In the normal operation of a sugar cane mill the raw cane is fed to a series of expression rolls after first being crushed or macerated in a device which chops the cane into fragments. The rolls are commonly placed in series or tandem, three to a group termed a mill, the number of groups and mills being determined by the particular type of sugar cane being milled, the type of rolls employed and other factors unrelated to this invention.

In order to obtain increased recovery of sugar juice from the cane, it is common practice to add a certain relatively small amount of water which travels generally countercurrently with respect to the cane. This water, commonly known as "maceration water" is collected from one mill and may be led to the feed end of the mill preceding it. As the liquid comprising sugar cane juice and maceration water is led from the first mill in the series, i. e. the mill receiving the fresh macerated cane, it is then sent to the sugar recovery system of the mill.

The exhausted cane which comes from the last mill in the series contains approximately 2 to 3 percent by weight of sugar and about 44 to 52 percent by weight of moisture.

This expressed cane, or bagasse as it is termed, is normally burned. It is partially freed of moisture, and usually some loose pith is shaken out and used as a filter aid in sugar recovery. Some bagasse is used in the manufacture of building materials such as insulating board. For such use the bagasse is baled wet and stored. Some is used in paper manufacture, in which case some pith may be removed; generally that which can be separated by dry screening.

The great potential utility of bagasse pith and bagasse fiber has led to a variety of attempted methods for their separation and separate recovery. For example, some

mills in Louisiana and Florida pass the bagasse as it comes from the last series of sugar cane mills through driers and then through hammer mills or other disintegrators to loosen some of the pith. The disintegrated product is then dry screened and the fiber containing fraction sold as litter, mulch or for use in paper manufacture.

However, none of the methods heretofore used in the industry afford a separation of more than one-third of the pith. In most methods, particularly those involving dry disintegration, the separation is not clean, since the screened pith fraction contains a high proportion of fine fiber.

Although raw bagasse or the so-called fiber fractions obtained by the separatory methods mentioned previously contains a high proportion of good quality long fiber, it is not entirely satisfactory, as such, for use as litter, mulch, or in the manufacture of board, paper, etc. because it still contains pith particles which become loosened on further handling leading to dustiness, an undesirable condition. In addition to the fiber, the bagasse also contains a relatively high proportion of pith which clings tightly to the fiber fragments of the bagasse and which interferes in the preparation of paper and similar products.

According to the present invention the pressed sugar cane, preferably as it comes in the form of raw bagasse from the last roll mill, is treated with a certain critical amount of water and is then subjected to a mechanical treatment which loosens the pith particles clinging to the fiber of the bagasse. The mechanical action required in this step is essentially one of rubbing or attrition, although the actual rubbing or attrition which is required for successful loosening of the pith is not that which comes from the mechanical device itself but rather from the internal friction of the fibers as they are rubbed vigorously over each other. The individual fiber fragments are forced transversely across each other to loosen adhering pith particles. It is thus a scouring or scrubbing rather than an attrition. The action is best obtained in disc-type mill which may be either of the single-running or the double-running type. The plates in the mill are set very wide apart so that substantial disintegration of the fibers is avoided.

After the moistening and pith-loosening steps, the bagasse is then led to an additional squeeze roll which may be a conventional sugar mill roll. In this mill the moisture content of the bagasse is again reduced to approximately 44 to 52 percent. The squeezed bagasse material coming from this roll is then dried as in the customary manner.

The bagasse, after having been dried, is critically different from bagasse as commonly produced in the prior art. Its major distinction is in the relationship of the pith component to the fiber component. Bagasse produced according to our invention is in reality a mixture of fiber and pith components which are physically separate from each other, the pith being present in discrete particle form. The bagasse also differs in a second major characteristic in that it contains considerably less sugar than prior bagasse. The moistening, attrition and squeezing steps reduce the sugar content to about 1 percent or less.

After the drying step the bagasse may then be screened to achieve a remarkably clean separation of pith particles from fiber. The depithed fiber is a high quality material which has considerable increased value and utility as mulch, litter, and for making board and paper products, and the like. The pith fraction, which bears only minor amounts of fiber, is readily utilizable as an absorbent for use in feeds, fertilizers, filtration medium, and the like; or it may be used as fuel in the sugar mill for generation of heat or power.

The present invention is illustrated in the accompanying drawing.

Figure 1 is a diagrammatic representation of a cane juice mill circuit showing the position of the attrition device in relation to a series of mills.

Figure 2 is a portion of the bagasse end of a sugar milling circuit showing the apparatus in greater detail.

Referring to Figure 1, sugar cane is passed through crusher rolls **1** and then through primary mill **2** to second, third and fourth mills, **3**, **4**, and **5** respectively. The juice collected from the fourth mill is passed forward to the third, and that collected from the third is passed forward to the second. The representation of juice passages is not intended to be limiting on this invention nor is the specific number of roll mills in the circuit. For example, any desirable system of juice passage may be followed as in combining the juice from the third and fourth mills and passing it forward to the second. The juice coming from the first mill is richest in sugar content and is passed directly to the juice treatment apparatus where it undergoes the usual liming, defecation, filtration and other conventional sugar recovery processing.

After the fourth mill the bagasse is led directly to a disc attrition mill **6** which may be a conventional single running attrition mill. The mill must be of the type which permits plate settings of at least 0.25 inch clearance. Before passage to the disc mill the bagasse is treated with water as by sprinkling head **7** which is adjusted to bring the moisture content of the bagasse up to about 65 to 85 percent by weight. The moistened bagasse is treated in the attrition mill to achieve pith loosening by the internal scouring and scrubbing action heretofore described. The bagasse coming from mill **6** is then passed directly to roll mill **8** which expresses sufficient juice from the bagasse to bring its moisture content down to 44 to 52 percent. The juice collected from roll mill **8** is passed forward to mill **5** where it may be considered as maceration water, entering the juice passage system of the circuit as a whole. The bagasse coming from mill **8** is passed to dryer **9** which may be a rotating dryer, and the dry material is then passed to screen **10** fitted with 8 or 10 mesh wire screen whereupon pith particles are separated from fiber component, the former being recovered at **11** and the latter being recovered at **12**.

The amount of water added to the bagasse as it enters the attrition mill must be regulated so that the total moisture content is adjusted within the range of 65 to 85 percent by weight as previously noted. Less water will result in too high consistency and will unduly increase the power requirement for the pith loosening step. Even more important than the power demand, however, is the fact that bagasse bearing less than the critical minimum of 65 percent will be damaged by the attrition action. Fibers will be cut or torn and there will be an undue amount of fine fiber in the final separated pith. Using more than the designated 85 percent moisture will not only interfere with the sugar recovery from the pressed out water collected at **13** in the drawing but is unnecessary and presents unneedful complications in placing the pith separation into the sugar mill circuit, since the pressed out water should become or at least should join the maceration water circulation system. Moreover, the method of this invention is essentially a "dry" method in contrast to previous wet pith loosening methods such as are included in the disclosures of copending applications Ser. No. 285,042, filed April 29, 1952, and Ser. No. 271,297, filed February 12, 1952, and it possesses all the attendant advantages of "dry" treatments in the handling of materials and in equipment needs.

Referring to Figure 2 the bagasse entering attrition mill **6** has a moisture content of approximately 75 percent. In the mill the fibers are moved vigorously against each other in this relatively thin zone which exists between the mill plates. This action is one which inherently tends to scrub off pith particles from the fibers without appreciable physical alteration of the fibers themselves. The moisture content of the material is such that the material is in a solid form, having no liquid moisture as evidenced by dripping. The pith-loosened mass is passed directly to roll mill **8** from which it comes having a gross appearance not greatly different from ordinary bagasse. Close examination reveals, however, that most of the pith is present in discrete particle form. This material is then sent to a dryer **9** which is preferably of the rotating and tumbling type. Other types of dryers, such as tray dryers, may be employed, but the tumbling type is preferred since the dried product produced is easier to screen. The dried product is then sent to rotary screen **10** and the pith and fiber components separately recovered as heretofore explained.

In the drawings the attrition mill has been shown positioned between the last roll mill and a supplementary roll mill added to the circuit. The particular position of the attrition mill is not critical, inasmuch as it may be placed between any two proceeding mills. We have found, however, that the attrition mill should be placed in what might be called the lower half of the mill circuit in order that proper loosening of the pith may be accomplished. In any given mill circuit it is therefore not necessary that an additional roll mill be supplied, since the water addition and pith loosening devices may merely be inserted in the circuit as it already exists.

The following specific example illustrates the key phase of loosening pith from bagasse under conditions analogous to those which occur in a typical sugar mill circuit.

EXAMPLE

Fresh bagasse from three different geographic sources was mixed with sufficient water to bring the moisture content to approximately 75 percent, and the moistened bagasse was then passed through a conventional single-running disc attrition mill provided with waveline plates set 0.300 in. apart. In passage through the mill the bagasse was subjected to vigorous internal scrubbing, and the discharge was immediately dried to a moisture content of about 5 percent. The dried product was then passed over a flat 10 mesh screen, inclined slightly from the horizontal and having a vigorous lateral oscillatory movement. The pith particles passing through the screen and the fiber portion passing over the screen were separately collected. The yields are tabulated below, and are based on a 6.5 percent loss of solubles.

Table

Exp. No.	Type of Bagasse	Recovery		Yield	
		Fiber	Pith	Fiber	Pith
		Pounds	*Pounds*	*Percent*	*Percent*
1	Hawaiian	10.35	3.39	70.4	23.1
2	Puerto Rican	7.91	3.47	65.0	28.5
3	Florida	8.39	3.54	65.7	27.8

I claim:

1. The method comprising adjusting the moisture content of raw sugar cane bagasse to within the range of 65 to 85 percent by weight, passing said bagasse to a zone of transverse rubbing wherein the individual fibrous fragments of bagasse are forced transversely across each other to effect internal scouring and scrubbing within said zone and to loosen adhering pith particles therefrom, expressing sugar-containing juice from said treated bagasse to a moisture content of below 52 percent, drying said treated bagasse and separating loosened pith particles therefrom by screening.

2. In a method of extracting juice from sugar cane comprising passing the cane through a mill circuit wherein the cane is subjected to successive crushing actions, and collecting sugar containing juice squeezed out of the crushed cane thus producing raw sugar cane bagasse of moisture content of about 52 percent or less and subse-

quently separating the bagasse into a pith-rich component and a fiber-rich component, the improvement comprising raising the moisture content of said raw sugar cane bagasse to within the range of 65 to 85 percent by weight, passing said bagasse to a zone of transverse rubbing wherein the individual fibrous fragments of bagasse are forced transversely across each other to effect internal scouring and scrubbing within said zone and to loosen adhering pith particles therefrom, expressing sugar-containing juice from said treated bagasse to a moisture content of below 52 percent, drying said treated bagasse and separating loosened pith particles therefrow by screening.

3. The method of claim 2 in which the transverse rubbing action is effected by passing the raw sugar cane bagasse between the plates of a disc-type attrition mill in which the plates are set sufficiently wide apart so that substantial disintegration of the fibers is avoided.

4. The method of claim 3 in which the sugar-containing juice expressed from the disc-milled bagasse is returned to the mill circuit as maceration water.

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