May 9, 1933. A. P. LEONARD 1,908,519

SUGAR CANE MILL

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Fig. 1.

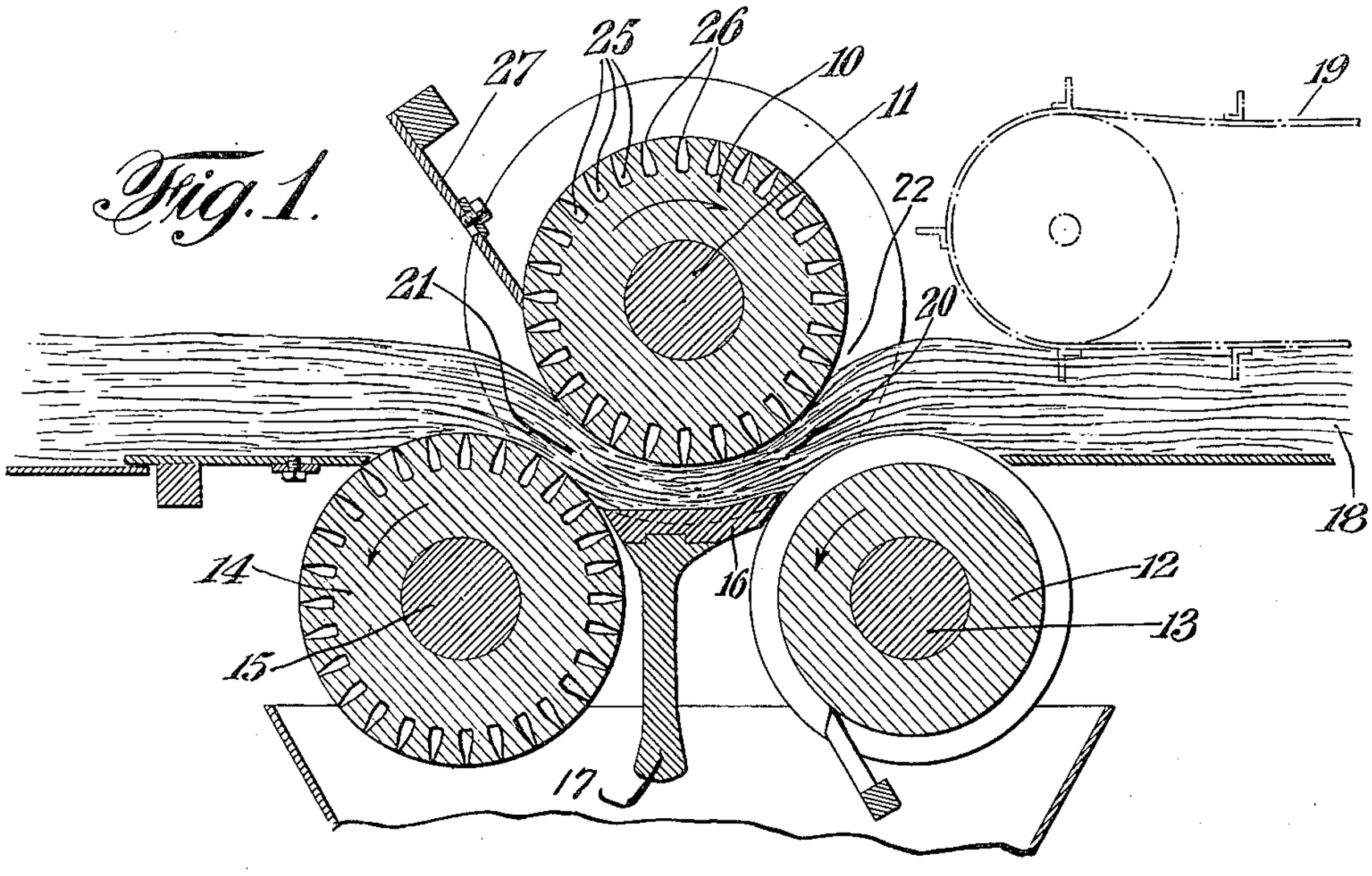

Fig. 2a.

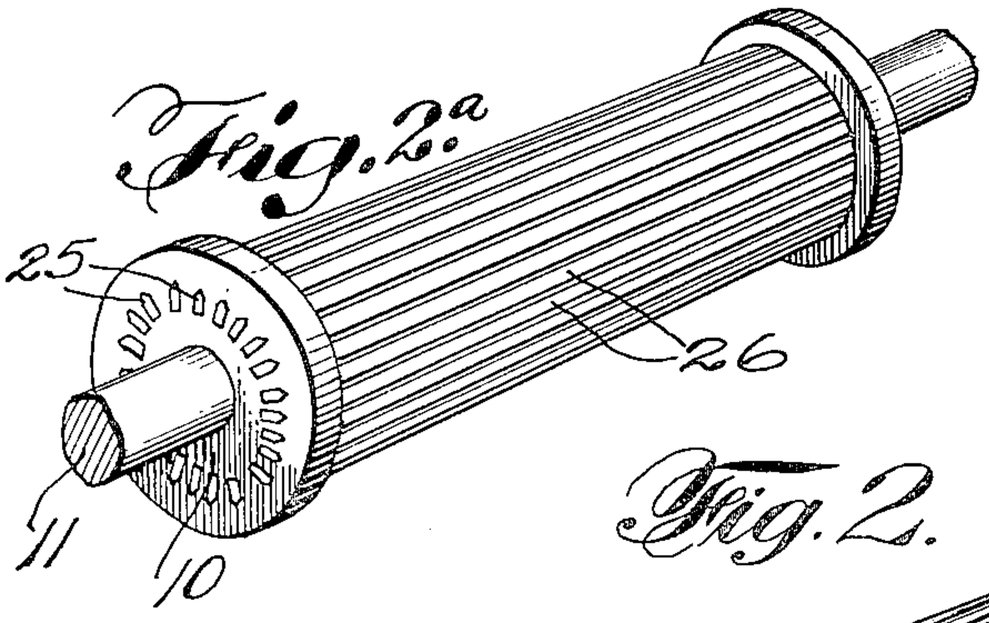

Fig. 2.

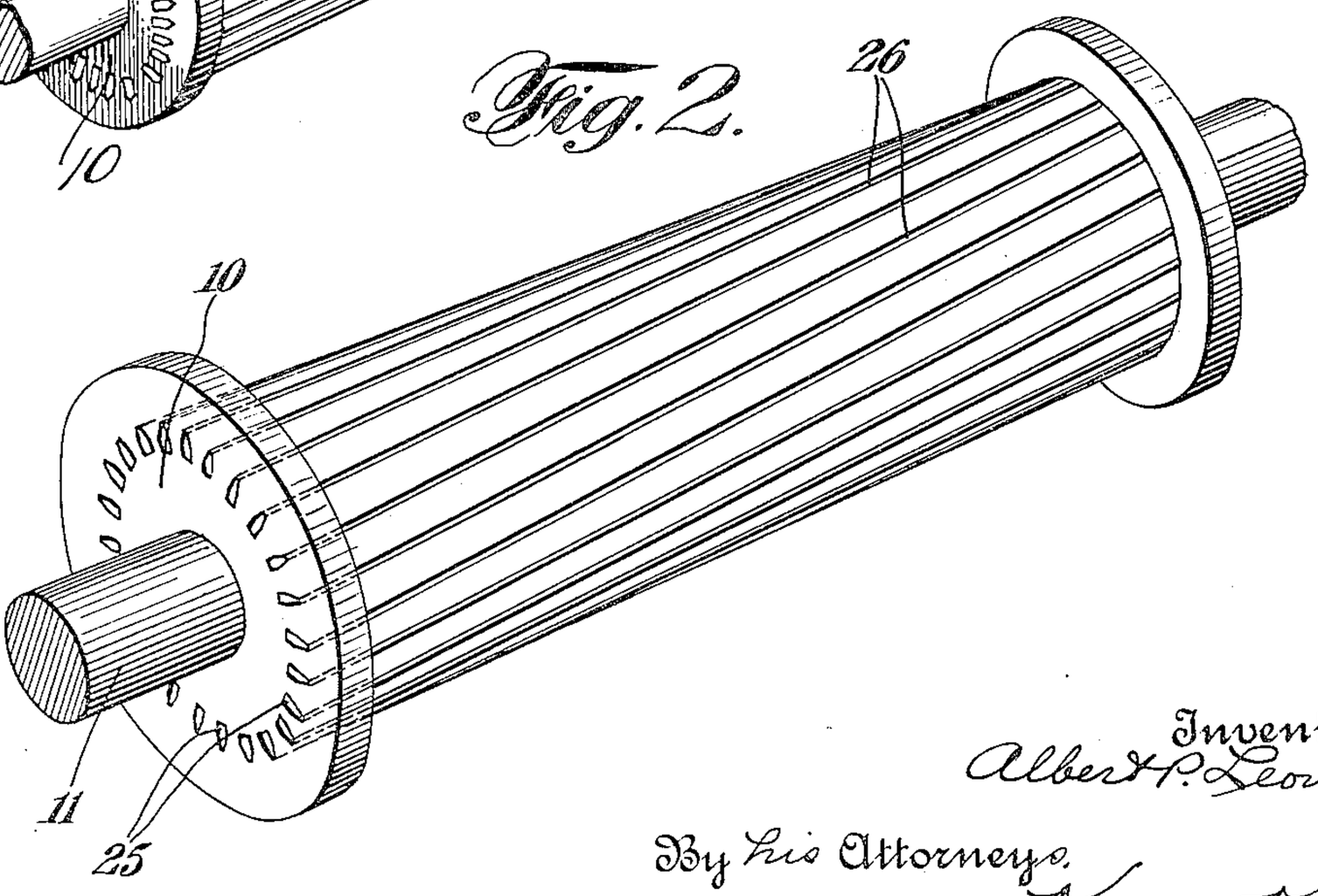

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Fig. 3.

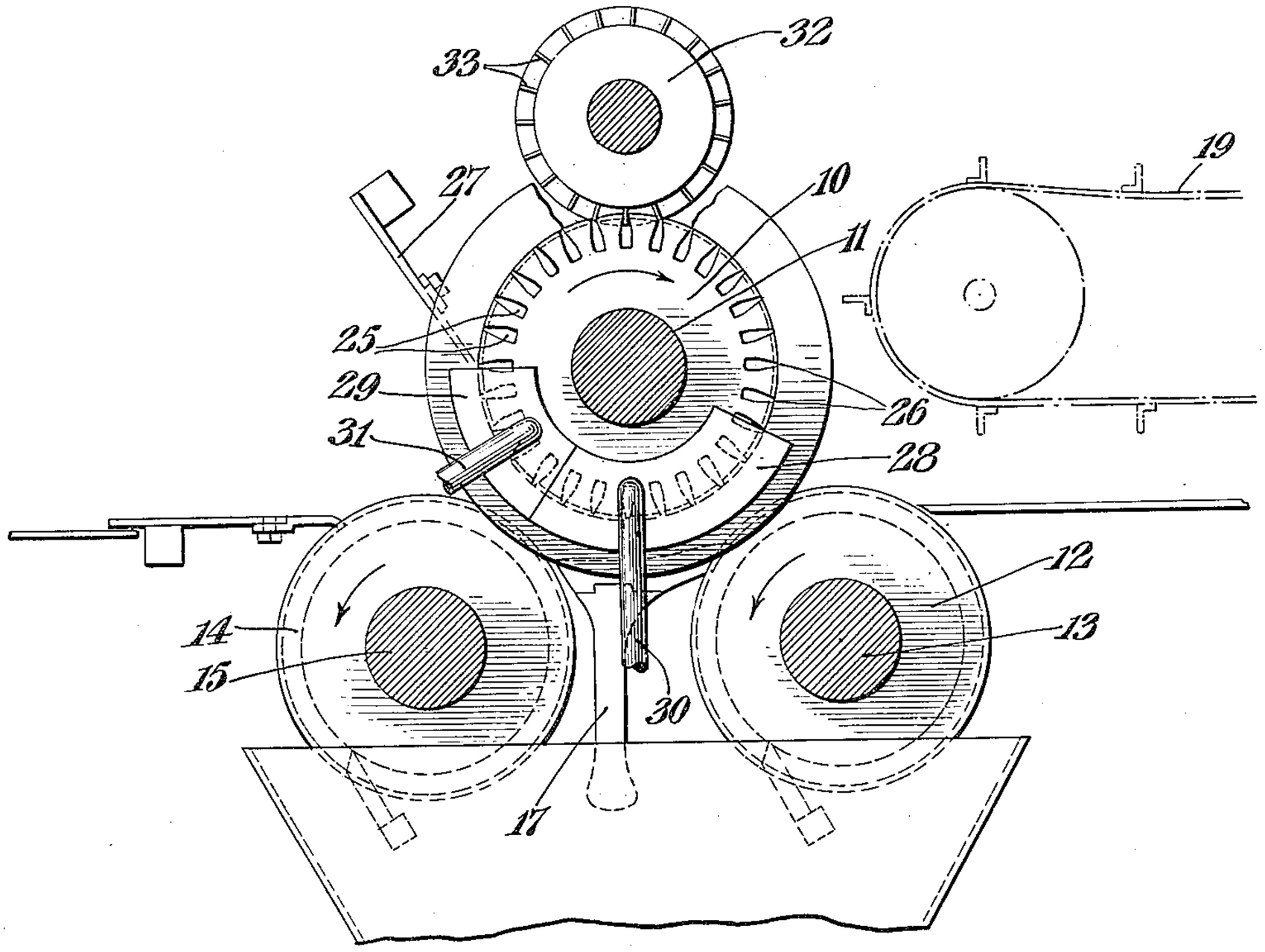

Fig. 4.

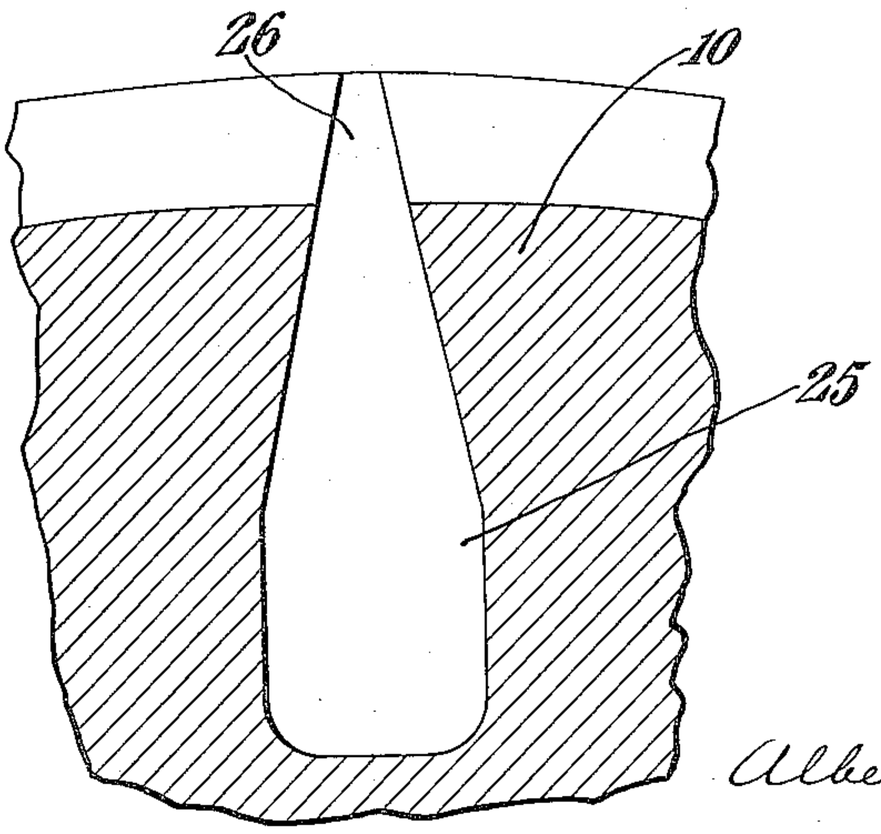

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Fig. 5.

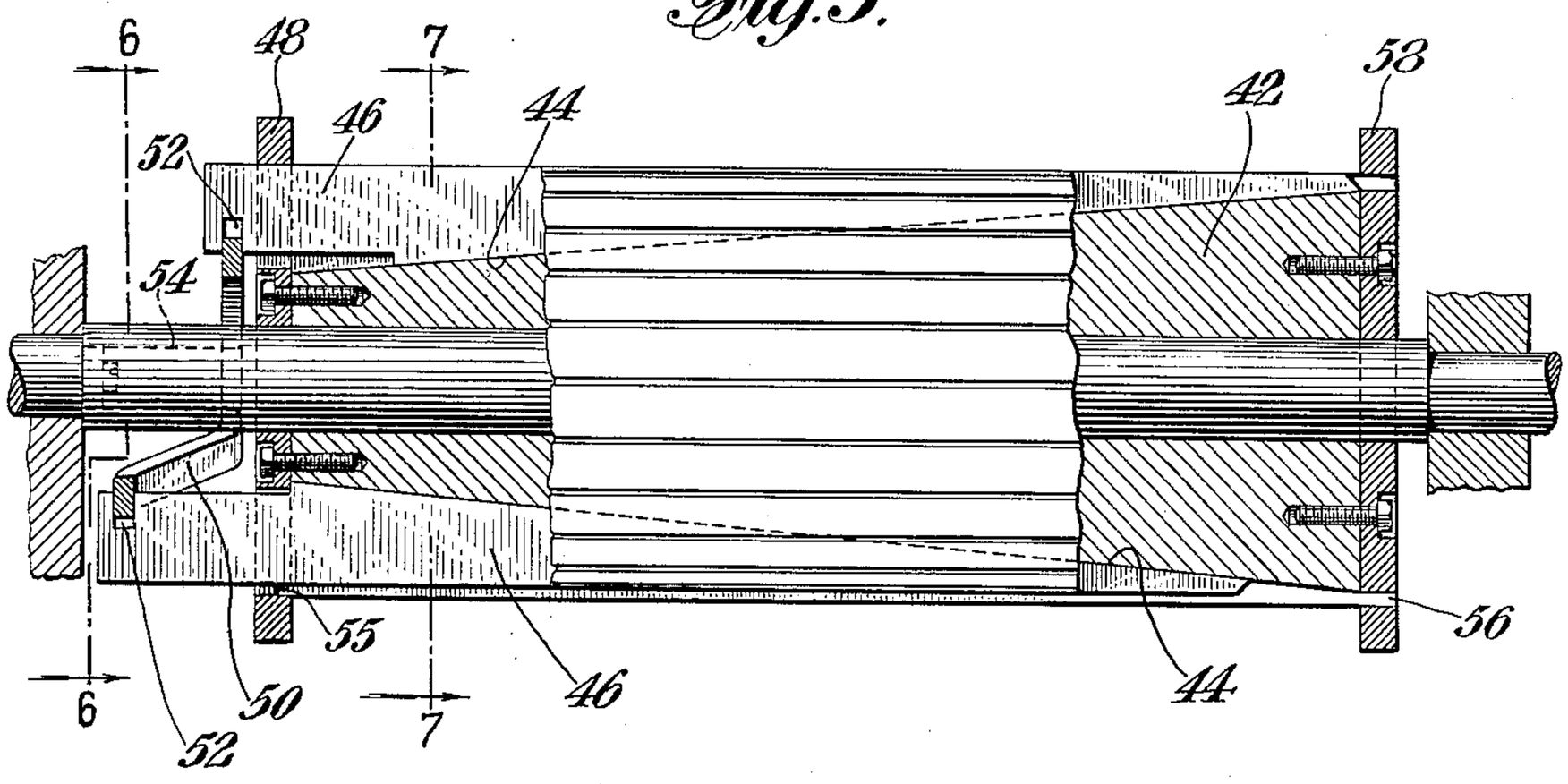


Fig. 6.

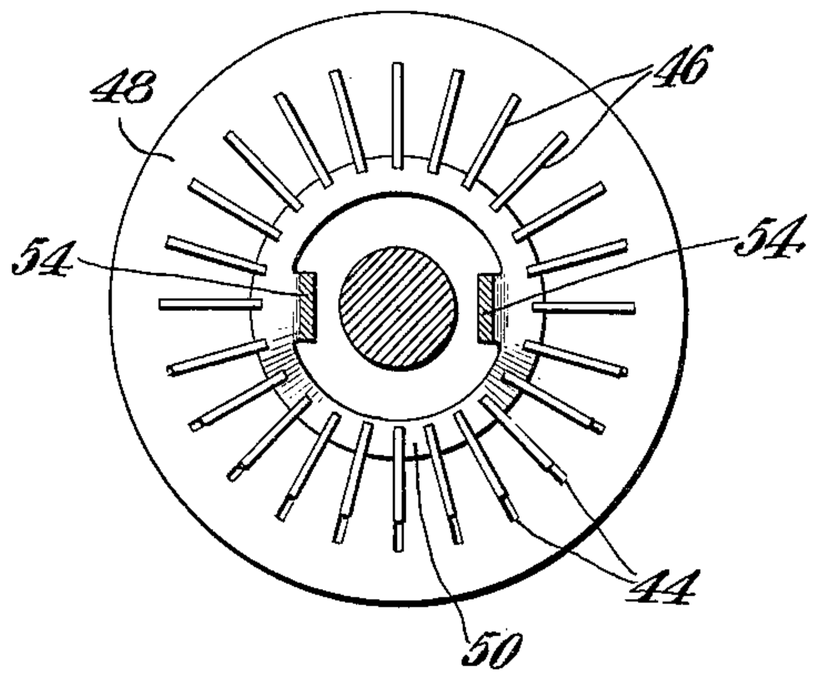
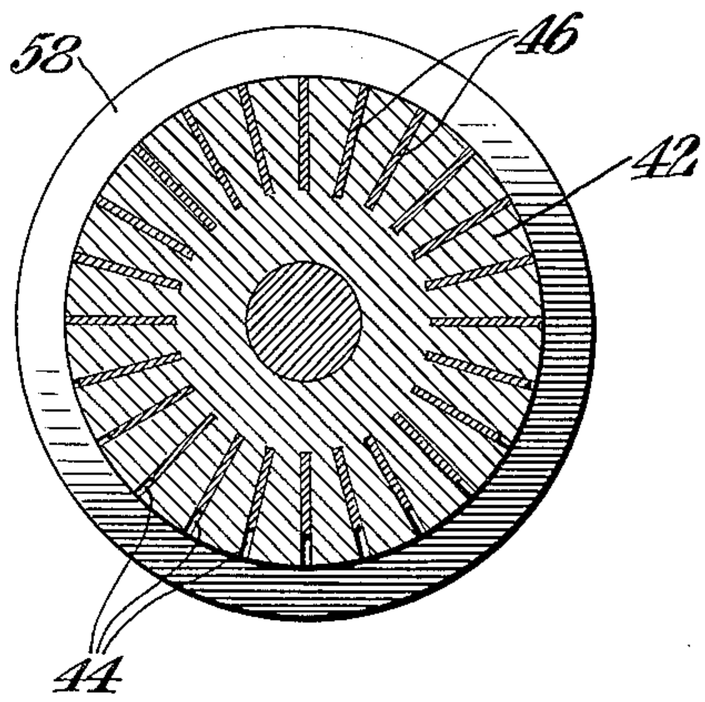


Fig. 7.



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Patented May 9, 1933

1,908,519

UNITED STATES PATENT OFFICE

ALBERT P. LEONARD, OF JACKSON HEIGHTS, NEW YORK

SUGAR CANE MILL

Application filed July 10, 1928. Serial No. 291,649.

My invention relates to sugar cane mills and the like and particularly to crushing rolls for use therein and to the provision of means for collecting and withdrawing from the rolls the maximum quantity of cane juice. An important feature of my invention relates to the removal of the liquid from the upper strata of the crushed mat of bagasse or other material.

The ordinary sugar cane mill with which my invention is adapted to be employed consists of three crushing rolls mounted on parallel horizontal shafts supported in triangular relation. Of the two lower rolls the one which first comes in contact with the cane is known as the feed roll, the other lower roll by which the pressed cane is ejected is known as the bagasse roll. Above and between the lower rolls is a top roll which presses down upon the same with enormous force, crushing and mangling the cane into what is known as bagasse, squeezing out the cane juice, and rising and falling with variations in thickness of the matted bagasse. A turn plate is located between the lower rolls to guide the cane from the feed roll to the bagasse roll and a pan is provided below the rolls to collect the expressed juice.

The pressure of the rolls upon the cane results in the squeezing out of a substantial proportion of the juice and the crushing and matting of the fibrous structure of the cane. When compressed between the rolls and turn plate of the mill at the high pressure commonly used, the blanket of bagasse becomes so densely packed as to have a structure approaching that of wood. The resistance of this densely matted fibrous material to the flow of juice therethrough is extremely high. In grinding at high capacity and with consequently thick blankets of bagasse it is apparent that much of the juice in the upper strata of the bagasse will be prevented from flowing downward into the pan below and that the operation of the mill will be rendered ineffectual to that extent.

In order to facilitate the collection of the juice which is in the lower portion of the mat, it has been customary in sugar cane mills of this character to provide the lower rolls with deep circumferential grooves which constitute open channels for the flow of juice into the pan. These grooves greatly increase the efficiency of the mill by effecting the removal of a greater proportion of expressed juice than is possible in similar mills not provided with such grooves.

But no means has heretofore been known so far as I am aware for facilitating the removal of the juice which appears in the upper strata of the cane or bagasse adjacent the top roller. This juice being prevented by the density of the mat from passing downwardly to the lower rolls and so to the pan is in large part compelled to remain in the mat as it passes between the pressure rolls and is at once reabsorbed by the bagasse upon the removal of pressure as the material passes out of the mill. It has apparently been thought impossible to provide the top roll with passages for the removal of the juice as these passages would constitute open channels permitting flow of juice from the crushed cane at the inlet side of the machine to the bagasse at the outlet side of machine thereby in effect short circuiting the mill. For this reason existing devices are effectual to only a limited extent and it is necessary to pass the cane through a long series of mills in order to extract all of the juice which it is economically possible to obtain from the cane.

The objects of this invention include the provision of means for removing juice exuded from the upper portion of the bagasse mat in the sugar cane mill, the provision of longitudinal grooves in the top roller both for removing juices and for improving the feeding effect of such roller, and in general to provide means for making sugar cane mills of this type more efficient so that each mill is capable of extracting a greater percentage of expressed juice than heretofore, and so that a lesser number of mills in series is capable of extracting the same or a greater quantity of juice.

Other objects, novel features and advantages of this invention will be apparent from the following specification and accompanying drawings wherein:—

Fig. 1 is a vertical section through one embodiment of the invention.

Fig. 2 is a perspective view of one form of top roller.

Fig. 2—*a* is a similar view of a modified form of top roller.

Fig. 3 is an end view partially broken away of an embodiment slightly modified from that of Fig. 1.

Fig. 4 is an enlarged partial section of a roller.

Fig. 5 is a side elevation partly broken away of a modified form of crushing roller.

Fig. 6 is an end view thereof, and

Fig. 7 is a section on the line 7—7 of Fig. 5.

The cane mill disclosed in the drawings consists essentially of a top roller 10 mounted on a shaft 11, a feed roller 12 mounted on a shaft 13, a bagasse roller 14 mounted on a shaft 15 and a turn plate 16 mounted on a turn-plate 17. These three rollers are normally geared together and are driven in such manner that the top roller rotates clockwise as shown in the drawings while the lower rollers rotate counterclockwise. The surface of these rollers may be serrated or grooved circumferentially or may be smooth. Bagasse, indicated at 18, is fed to the mill by a conveyor 19 and is gripped between the top roller 10 and the lower rollers 12 and 13 at zones indicated by the reference numerals 20 and 21 where it is subjected to enormous pressure which results in the crushing and mating of the cane and the exuding of a large portion of the juices therein.

Juice exuded from the lower portion of the bagasse mat is removed in the same manner as heretofore. The bagasse drawn between the rollers in the zone 20 forms a dense mat which is carried through the mill and juice expressed from the upper portion thereof has a tendency to collect in the zone designated as 22 and unless removed therefrom is reabsorbed by the bagasse. Between the zones 20 and 21 the pressure on the bagasse is somewhat relieved and juice exuded in the zone 21 tends to collect in the bagasse mat between zones 20 and 21. Beyond the zone 21 the pressure on the bagasse is again relieved and liquid may be supplied thereto for maceration purposes, if desired.

The upper roller 11 is provided with longitudinal channels 25 which extend through the end faces of the roller and communicate with the active surface of the roller through slots 26 of less width than the body of the channels. The channels 25 and the slots 26 are either slightly spiral as shown in Fig. 2 or parallel to the axis as shown in Fig. 2*a*. A scraper 27 is provided to contact with the surface of the roller 10 after the latter moves out of contact with the bagasse mat and strips from the roller bagasse adhering thereto. These channels and slots provide means for draining juice collecting in the zone 22 and in the bagasse mat between the zones 20 and 21.

As the roller 10 rotates juice in the zone 22 flows through the slots 26 and into the channels 25 by gravity. Upon further rotation of the roller 10 the slots 26 are bridged with bagasse which penetrates to a depth approximate equal to the width of the slots. As each channel approaches the zone 20 juice is forced thereinto through the bagasse bridge under pressure and this condition exists in varying degrees of pressure until after the channel passes through the zone 21.

At each end of the roller 10 there are provided hoods 28 and 29 which are stationary but are provided with suitable means for sealing them against the ends of the roller. A pipe 30 leads to the hood 28 and a pipe 31 leads to the hood 29. The hood 28 is in communication with the ends of the channels into which juice flows and collects juice from the channels 25 and discharges it into the pipe 30 by which it is led to any suitable collector. If desired the pipe 30 may be connected to a suction source to assist in the removal of the juice from the channels. Means may also be provided for connectinng the pipe 30 to a pressure source for introducing air or liquid into the channels if desired. The juice flows into the channels either by gravity or under pressure and is removed through the hood 28 either by gravity or with the aid of suction. The hood 29 is arranged beyond the pressure zone 21 and liquid may be supplied thereto through the pipe 31 for delivery to the bagasse mat for maceration purposes. The liquid supplied to these channels through the hood 29 may also be used to force out of the slots 26 the bagasse plugs therein. The roller 12 may be provided with similar channels and slots as shown in Fig. 1 or may have a smooth surface as shown in Fig. 3. When two rollers are provided with the drainage channels, the latter are so arranged that the channels of one roller are out of register with the channels of the other. Means may also be provided for applying suction or pressure through the channels in the roller 12. By this arrangement a high degree of efficiency in the removal of juice is obtainable. The hoods 28 and 29, while preferable, may be dispensed with and the juice be permitted to drop from the ends of the channels into the ordinary collecting pans.

The longitudinal slots 26 have the further function of assisting the feeding of the bagasse through the mill. In the first place these grooves remove the juice from the zone 22 and this tends to keep dryer the bagasse about to enter the mill insuring good contact between the top roller and the bagasse, thus assisting in feeding the latter between the rollers. The bagasse in contact with the roller penetrates the slots 26 to a depth approximately equal to the width of the slot

and as the pressure increases due to the converging of the top and lower rollers the bagasse is thrust firmly into the slots. In this way the roller 11 obtains a grip on the bagasse which although local is not confined to the bagasse from the slots may be effected if felt through a considerable zone due to the fibrous nature of the bagasse and its tendency to adherence due to the entwining of the fibers. After passing through the mill the bagasse adhering to the rollers is sheared off by the scraper 27 and any bagasse remaining within the slots is deprived of its supporting portion so that it may drop down into the channel by gravity or may be pushed by fresh bagasse as the roller rotates. The channels diverge sharply from the slots so that no support can be obtained for the loose bagasse from the sides of the channels. The bagasse which drops into the channels is carried out with the juice. The removal of bagasse from the slots may be effected if desired by means of a drum 32 (Fig. 3) having fins or vanes 33 adapted to project into the slots 26. This drum may be rotated in any suitable manner at proper speed to insert a vane into each slot and thus punch the bagasse into the channel. The bagasse plugs also may be forced outwardly by maceration liquid, if used, introduced through the pipe 31 and hood 29 into the grooves 25, thus also allowing free egress of the maceration liquid through the slots 26 to the upper surface of the bagasse mat.

The rotation of the top roller 10 periodically brings each slot and channel into the zone 22 and the juice collects in this zone flows into the channel through the slots by gravity. As the channel and slot move from the zone 22 to the zone 20 the juice is forced into the channel through the slot under pressure, after the groove and slot pass the zone 20 the pressure is relieved somewhat, but the juice is still forced through the grooves into the channels under pressure until after zone 20 is passed and the pressure on the bagasse is relieved. While moving from the zone 22 to the zone 21 the channel is in communication with the hood 28 and the juice in the channels is drained into the hood either by gravity or by suction. After the zone 21 is passed the channel is in communication temporarily with the hood 29 and liquid may be supplied thereto for maceration purpose, and also to push out the bagasse plug. The scraper 27 removes surplus bagasse and should maceration liquid not have been used, the scraper shears off the projecting portions of the bagasse blocks or tears them out of the slots. The drum 32 ensures removal of the bagasse blocks from the slots for the vanes 33 project into the slots and positively force any obstruction in the slot into the channel.

Heretofore it has been necessary to form the roller surface of a metal which becomes very rough and granular when acted upon by the acids in the juice and the mechanical contact of the bagasse. This has been necessary in order to provide a surface which would assist in feeding the bagasse through the mill. In view of the fact that the longitudinal drainage and feeding channels of the present invention takes care of the feeding action of the roller without the assistance of specially rough and granular roll metal the roller surface may be smooth and polished and may be chilled iron of a composition which will resist the acids and the mechanical action of the bagasse and which will wear as smooth as possible in order to produce long roll life. One of the largest sources of expense in the operation of a cane milling plant as at present constituted consists in the replacement of the rollshells. Ordinarily such shells have to be thrown away after having been worn down. In view of the fact that with applicant's invention a special metal is not necessary the roller after it has become worn may be set up in a lathe and metal deposited thereon by means of an electric arc or other welding method after which the surface may be turned down to the desired size.

As before stated the roll surface may be provided with circumferential shallow grooves or may be provided with longitudinal V grooves extending parallel with the axis of the roller or parallel with the drainage channels. Moreover if desired the surface of the roller may be given a checkerboard or pyramid surface if desired for certain conditions.

In the modification disclosed in Figs. 5, 6 and 7, an upper roller 42 is employed, which roller is provided with a plurality of longitudinal grooves 44, each groove being tapered from one end of the roller to the other, so that at one end of the roller the grooves 44 are deep while at the other end they are relatively shallow. In each groove 44 there is provided a bar 46 adapted to slide longitudinally and radially in the groove. The thickness of each bar is such as to fill the groove with only sufficient clearance to permit sliding of the bar in the groove. Each bar 46 is likewise tapered so that when lying in its corresponding groove with its tapered edge in contact with the tapered bottom of the groove the outer edge of the bar either lies in the cylindrical surface of the roller or parallel to that surface. The bars 46 extend at one end through flange 48 of the top roll into contact with a cam surface 50 which controls the movement of the bars relative to the roller 42. The bars may cooperate with the cam surface in any desired manner. As herein shown each bar 46 is provided with a notch 52 adapted to fit over the cam surface 50 so that longitudinal movement of the bars

in each direction is controlled by the cam. The bars which are adjacent the lower portion of the roller are moved by the cam surface 50 longitudinally toward the deep end of the groove thereby permitting radial movement of the bars toward the center of the roll. The bars at the side and top of the roller are moved longitudinally in the opposite direction by the cam surface 50 so that by force of the wedging action of the tapered surface of the bars and grooves their outer edges approach the outer cylindrical surface of the roller. The cam surface 50 may be supported in any desired manner as by lugs 54 attached to the frame upon which the top roller is supported.

The operation of this modification is as follows: As the top roller rotates and each bar 46 approaches the crushing zone it is drawn longitudinally with respect to its groove and by reason of its taper is permitted to move at the same time radially inward, thereby producing an open channel running longitudinally of the roll, the outer edges of the bars forming the bottom of the channel. The crushing process forces juice and bagasse from the top of the mat into the channel so formed, the bagasse bridging over the channel and the juice flowing into it under enormous pressure. The juice is then permitted to flow longitudinally of the roller through the passages and escape through spaces 55 and 56 in the flanges 48 and 58 respectively of the top roller. Any appropriate means may be provided for collecting and withdrawing the juice which is thus forced out at the end of the top roller. As the top roller rotates further and the bar emerges from the crushing zone it is moved longitudinally by the cam surface 50 and by wedging action it is moved at the same time radially outward, thereby scraping the sides of the groove and forcing out any bagasse which has adhered to the groove. Thus when the bar in question rotates once more into the crushing zone and moves endwise and radially to form an outlet passage for the juice, as described, the outlet passage is clean and free of bagasse and effective for the purpose desired.

In this last modification as well as in the former one bagasse is forced into the grooves provided in the surface of the top roller and assist the latter to obtain a grip on the bagasse mat. In this way the roller obtains a grip on the bagasse which although local is not confined to the bagasse in the grooves but its feeding force is felt through a considerable zone due to the fibrous nature of the bagasse and its tendency toward adhering due to the intertwining of the fibres. Likewise the grooves 44 constitutes channels through which juice collected in the region 22 is enabled to quickly drain off and thus tend to dry the bagasse about to enter the mill.

This application is a continuation in part of applicant's co-pending application, Serial No. 61,896 filed October 12, 1925 for Sugar cane mill.

It will be, of course, understood that the foregoing description of the invention and illustration of a device embodying it in the drawings are not intended as limitations of the invention and that a wide variety of changes and modifications may be made in the structure and operation thereof without departing from my invention as defined in the appended claims.

I claim:—

1. A sugar cane mill having a plurality of rollers adapted directly to engage bagasse supplied thereto at least one of which is provided with substantially full length longitudinally extending narrow slots communicating with channels of greater width and having discharge openings at each end of the roller to conduct the juice expressed from the cane, said slots being adapted to receive bagasse by means of which the feeding action of the roller is increased.

2. A sugar cane mill having a plurality of rollers adapted directly to engage bagasse supplied thereto at least one of which is provided with substantially full length longitudinally extending slots communicating with channels having discharge openings at each end to conduct the juice expressed from the cane, said slots being adapted to receive bagasse by means of which the feeding action of the roller is increased and mechanical means to effect removal of bagasse from said slots.

3. A sugar cane mill having a plurality of rollers adapted directly to engage bagasse supplied thereto at least one of which is provided with substantially full length longitudinally extending narrow slots communicating with channels of greater width and having discharge openings at each end of the roller to conduct the juice expressed from the cane, said slots being adapted to receive bagasse by means of which the feeding action of the roller is increased and circumferential grooves traversing said slots.

4. A sugar cane mill having a plurality of rollers adapted directly to engage bagasse supplied thereto at least one of which is provided with substantially full length longitudinally extending slots communicating with channels having discharge openings at each end of the roller to conduct the juice expressed from the cane, said slots being adapted to receive bagasse by means of which the feeding action of the roller is increased and means to effect removal of bagasse from said slots and circumferential grooves traversing said slots.

5. A sugar cane mill having a plurality of rollers adapted directly to engage bagasse supplied thereto at least one of which is pro-

vided with longitudinally extending channels having narrow slots opening onto the surface of the roller for removing juice expressed from the cane and for receiving plugs of bagasse to assist in feeding the bagasse mat through the mill and means for forming the bagasse plugs through said slots into said channels.

6. A sugar cane mill having a plurality of rollers adapted directly to engage bagasse supplied thereto at least one of which is provided with full length longitudinally extending channels having narrow slots opening onto the surface of the roller for removing juice expressed from the cane and for receiving plugs of bagasse to assist in feeding the bagasse mat through the mill and drainage means communicating with both ends of said channels.

7. A sugar cane mill having a plurality of rollers adapted directly to engage bagasse supplied thereto at least one of which is provided with full length longitudinally extending channels having narrow slots opening onto the surface of the roller for removing juice expressed from the cane and for receiving plugs of bagasse to assist in feeding the bagasse mat through the mill, means for forcing the bagasse plugs through said slots into said channels and drainage means communicating with both ends of said channels.

8. A sugar cane mill comprising a feed roller, a discharge roller, a top roller disposed in triangular arrangement therewith, said top roller being provided with full length longitudinal slots arranged at intervals in its surface for receiving of bagasse to assist in feeding the bagasse mat through said mill, said slots communicating with channels of greater width and having discharge openings at each end of the roller.

9. A sugar cane mill comprising a feed roller, a discharge roller, a top roller disposed in triangular arrangement therewith, said top roller being provided with longitudinal slots at intervals in its surface forming channels to conduct away the juice expressed from the cane, said slots being adapted to receive bagasse plugs to assist in feeding the same through the mill, and means for forcing said bagasse plugs inwardly through said slots.

10. A sugar cane mill comprising a feed roller, a discharge roller, a top roller disposed in triangular arrangement therewith, said top roller being provided with longitudinal slots at intervals in its surface forming channels to conduct away the juice expressed from the cane, said slots being adapted to receive bagasse plugs to assist in feeding the same through the mill, means for forcing said bagasse plugs inwardly through said slots and drainage means communicating with both ends of said slots.

11. A sugar cane mill comprising a feed roller, a discharge roller, a top roller disposed in triangular relationship therewith, said top roller having full length longitudinal channels provided with narrow slots leading to the surface of the roller, and means communicating with both ends of said channels for connecting the same with a pressure or vacuum source.

12. A sugar cane mill comprising superposed horizontal crushing rollers, the upper roller being provided with longitudinal drainage channels open at both ends of the roller communicating with the roller surface through narrow slots for removing juice extracted from the upper strata of bagasse blanket.

13. A sugar cane mill comprising a feed roller, a discharge roller, a top roller disposed in triangular relationship thereto, said top roller being provided at intervals in its surface with slots parallel to the axis of the roller for receiving bagasse plugs to assist in feeding the bagasse blanket through said mill, and channels communicating with said slots, said channels being of greater width than said slots and having discharge openings at both ends of the roller.

In testimony whereof, I have signed my name to this specification.

ALBERT P. LEONARD.

CERTIFICATE OF CORRECTION.

Patent No. 1,908,519. May 9, 1933.

ALBERT P. LEONARD.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, line 92, for "connectinng" read "connecting"; page 3, line 6, strike out the words "from the slots may be effected if" and insert instead "in the slots but its feeding force is"; page 5, line 81, claim 12, before "bagasse" insert the word "the"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 8th day of August, A. D. 1933.

M. J. Moore.

(Seal) Acting Commissioner of Patents.