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MACHINE FOR CRUSHING AND SHREDDING SUGAR CANE AND LIKE MATERIAL

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Fig. 1.
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MACHINE FOR CRUSHING AND SHREDDING SUGAR CANE AND LIKE MATERIAL.

This invention relates to machinery for crushing and shredding sugar cane. Crushing and shredding are totally distinct operations and have customarily been carried out by distinct stands or units in the mill train. This involves, among other disadvantages, expense of construction and upkeep, and use of extensive floor space.

Of one of the primary objects of the present invention is to furnish a machine constituting a combined crusher and shredder for sugar cane, comprising crushing and shredding rollers, all mounted in a single stand or unit.

Another object is to furnish a crushing-shredder having at least two crushing rollers and one shredding roller, one of said crushing rollers cooperating with the other in the crushing of the cane under heavy pressure while rotating at slow speed, and said first named crushing roller cooperating also with the high speed shredding roller in a direct manner in the operation of shredding, which is performed almost simultaneously with the crushing, that is to say, as the cane is issuing or discharging from the crushing rollers.

Another object of the invention is to provide an improved method of treating sugar cane or the like by combing the same while issuing from but held by a pair of crushing rollers.

A machine constructed in accordance with this invention may, for example, comprise two crushing rollers and one shredding roller mounted in the same stand or housing, with or without pressure mechanism acting on the crushing rollers, and on the shredding roller, and with or without a trash turner or scraper for directing the crushed cane from between the crushing rollers to pass between one of said rollers and the shredding roller, and means for driving the several rollers with the shredding roller rotating many times faster than the crushing rollers.

The rollers are mounted in housings so that each roller may be easily withdrawn in any known manner. Throughway bolts may be provided to give strength to the machine in accordance with the usual practice.

One of the pair of crushing rollers may have a surface circumferentially grooved, or otherwise formed; for instance it may be provided with zig-zag circumferential gutters, as described in British Patent 17,534, of 1915, or it may be provided with deep circumferential grooves for draining purposes. The other pressure roller is provided with teeth or projections and grooves of any known forms. When the first named pressure roller is toothed it may mesh with the teeth of the second pressure roller. The pressure rollers may be arranged vertically over each other, or inclined in the manner usual for the feed and top rollers of ordinary cane crushing mills.

The surface of the shredding roller is provided with teeth and may be formed of discs assembled together on a shaft or formed in any known manner. The teeth may be formed on an otherwise smooth cylinder or upon circumferential grooves and projections on the cylinder. In the latter case the pressure rollers would be formed with circumferential grooves and projections corresponding to those on the shredding roller, the trash turner being formed to operate with these rollers.

Power may be applied to either of the pressure rollers and separately to the shredding roller.

The speeds of the two pressure rollers may be identical or otherwise. Where differential speed is desired, the same may be obtained by driving one roll from the other by toothed pinions having unequal numbers of teeth, or equal numbers of teeth may be used in conjunction with rolls of different diameters.

The shredding roller revolves at considerably higher speed than the pressure rollers and may be carried in water cooled bearings and may be driven by electric motor direct or through flexible couplings, or may be gear driven or belt driven from separate motive power or from the motive power which drives the pressure rollers.

The higher speed roller is casued in to prevent shreds of disintegrated cane from escaping otherwise than by deposit on the intermediate carrier which conveys the shreds to the subsequent mills.

The openings for passage of cane between rollers may be governed by adjusting means of known form, such as wedges acting upon the bearings.

Referring to the accompanying drawings:

Fig. 1 is a diagrammatic side view of one form of machine made in accordance with this invention;
Fig. 2 is a rear elevation and Fig. 3 is a plan; Fig. 4 is a side view of an alternative form of machine made in accordance with this invention;

Fig. 5 is a rear elevation of the form of machine shown in Fig. 4

a is a shaft adapted to be driven by a gas engine or the like, b is a reduction gearing driven off the shaft a, c c are crushing or pressure rollers driven through the medium of the reduction gearing b, d being pinions coupling the rollers c, c so that they rotate at the same speed in opposite directions. h is a system of magnifying pulleys which are also driven off the shaft a, j is a shredding roller which is driven at high speed by the pulley system h, k, k are wedge adjusting devices adapted to vary the distance between the crushing rollers, o is a chute, p is a trough, g is a conveyor and r is a casing. It will be observed that, owing to the large reduction in speed brought about by the reduction gearing b between the shaft a and the crushing rollers, and owing also to the considerable increase of speed obtained by interposing the system of magnifying pulleys h between the driving shaft and shredding roller, the latter will be rotated many times as fast as the crushing rollers, as required by the essential difference in function between a crushing roller, on the one hand, and a shredding roller, on the other hand. The crushing is performed by slow rolling under heavy pressure, so as to crush and cut the cane and thereby extract a considerable amount of juice from it, whereas the shredding is not to extract juice, but to cut or reduce the crushed cane or bagasse from the crusher to a fine fiber, and thus render it more responsive to the further extraction stages carried out in the subsequent series of mills.

In use sugar cane is passed down the chute o and is slowly drawn between the rollers c, c and crushed. Passing out at the other side of the rollers the cane is torn into shreds by the high speed shredding roller j which is pressed against the crushed cane by the spring devices m, one of the rollers c forming an abutment. The casing r confines the shreds of cane and delivers them to the conveyor g. The trough p catches the juice that is expelled from the cane by the crushing rollers c, c.

In Figs. 1, 2 and 3, the top crushing roller is vertically above the other, the lower crushing roller acts as an abutment for the shredding roller and the crushed cane after emerging from the crushing rollers passes directly to the shredding roller. In this case the lower crushing roller cooperates with the upper one in crushing the cane or other material, and cooperates with the shredding roller in shredding the cane or other material, the action of the high speed roller being in effect a combing action upon the material while still held in the bite of the crushing rollers mounted in the same stand or unit with the shredding roller, such combing preferably taking place after the breaking of the cane by the toothed herein shown, or a similar toothed, which effectively serves the purpose of feeding and gripping the cane and breaking it.

In this form of machine the shredding roller is disposed in close proximity to the upper roller so that it will remove any of the crushed cane adhering to the upper roller.

In Figs. 4 and 5 the arrangement of parts is somewhat modified. The crushing rollers are inclined towards the chute and the cane after being crushed is guided by a trash return plate t to between the upper crushing roller and the shredding roller. The spring devices m press the bearings n towards the upper roller until further movement is limited by nuts u. The opening between the shredding roller and the upper roller c can be varied by adjustment of the nuts u, while should any foreign body be present the springs allow the shredding roller to move back momentarily.

With a machine made in accordance with this invention the cane is gripped firmly between the pressure rollers either or both of which are toothed whereby feeding is facilitated, at the same time the pressure rollers crush and partly break the cane expressing a considerable amount of juice, while the shredding roller completes the disintegration of the cane so that the hard outer rind is broken up finely so that the expression of juice by subsequent treatment is rendered efficient. It is to be noted, however, that while the improved machine and process are particularly useful in connection with the treatment of sugar cane, I do not limit myself in all aspects of the invention to its employment on or in connection with this particular material.

What I claim and desire to secure by Letters Patent is:

1. In combination in apparatus for crushing and shredding sugar cane or the like, a pair of cooperating crushing rolls, means for applying and adjusting the pressure between said rolls, cooperating crushing teeth on the surface of said rolls, and a shredder roll disposed at the delivery side of said crushing rolls and adjacent to one of said crushing rolls to cooperate therewith in shredding the cane, and means for regulating and controlling the pressure between said shredder and cooperating crushing roll.

2. In combination in apparatus for crushing and shredding sugar cane or the like, a pair of cooperating crushing rolls, means for
applying and adjusting the pressure between said rolls, means for rotating said crushing rolls at a relatively slow speed and a shredder roll disposed at the delivery side of said crushing rolls and adjacent to one of said crushing rolls, to cooperate therewith in shredding the cane, means for regulating and controlling the pressure between said shredder and cooperating crusher roll, and means for rotating said shredder roll at a relatively high speed to act on the cane issuing from but held by the crushing rolls, thus effecting a differential shredding action between the shredder and its cooperating crushing roll.

3. In combination in apparatus for crushing and shredding sugar cane or the like, a pair of cooperating crushing rolls provided with roughened surfaces and so spaced as to flatten out the cane and break down its fibers, and a shredder roll disposed at the delivery side of said crushing rolls adjacent to one of said rolls, and having a relatively higher speed than the crushing rolls to shred the cane as broken down and relatively retarded by the grip of said crushing rolls, substantially as described.

In testimony whereof I affix my signature.

FRANCIS MAXWELL.