

MILLING UBA CANE AND MILLING IN GENERAL.

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Before proceeding to read this paper, the writer would like to draw your attention to a few points, which should be mentioned at this stage.

In compiling this paper most of the opinions and facts expressed are derived from experience and observations on Milling "Uba" Cane at Mount Edgecombe, and from results and figures obtained by other factories in this country, and it is hoped that some of them may prove useful and interesting to engineers and others connected with the Sugar Industry.

Up to the present not many papers or discussions on milling in this country have been compiled, and it is hoped that this paper may tend to promote future discussions upon a subject which is highly important to the Sugar Industry.

Further, it is not the intention of the writer to boost any one make of machinery, and although he may touch on one or two units in particular by name, it is his desire to treat the subject from an entirely unbiassed point of view.

The paper is divided into three parts, i.e., Preparation of the Cane, Milling and General. The preparation of cane is subdivided into four sections, i.e., Cane Carriers, Knives, Crushers and Shredders, these will be dealt with seriatim.

ment throughout the sugar cane world. The means of loading them differ, and this factor is arranged to suit the immediate topographical conditions at each particular factory. The more modern equipment consists of overlapping steel slats fastened to three strands of roller chain, and this is essential where high powered knives are installed to prevent the smaller particles of cut cane dropping through the slats. This unit is driven by a totally enclosed twin cylinder engine through a chain drive to the first reduction shaft and is a considerable improvement on the old type of engine.

It may be as well to mention one or two points with reference to carrier head gear which are frequently overlooked, and are the cause of trouble.

- (1) The arrangement of the head sprockets are sometimes set too far forward and the feed is delivered down the chute at a point too near the crusher rolls which tends to choke the crusher, due to the feed leaving the carrier in uneven quantities. This can be followed as set out in Figures Nos. 1 and 2.
- (2) In many cases the chute from the carrier head to the crusher is far too short; the minimum length of this chute should not be less than 12 ft. and at an angle of not less than 45 degrees.

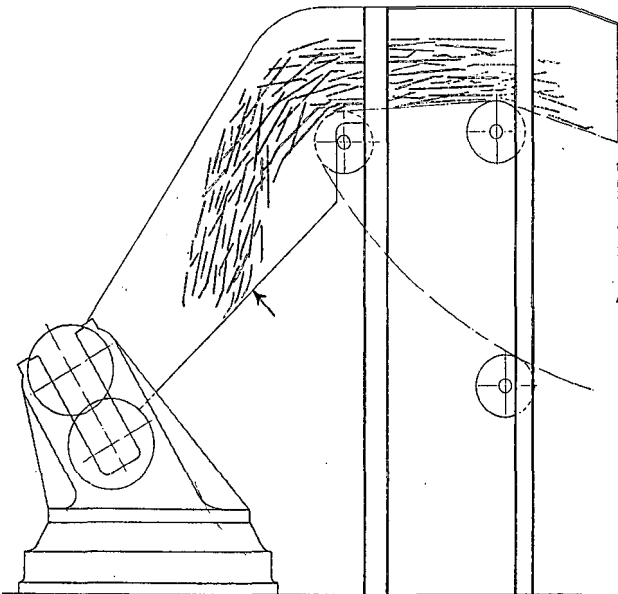


Fig. 1

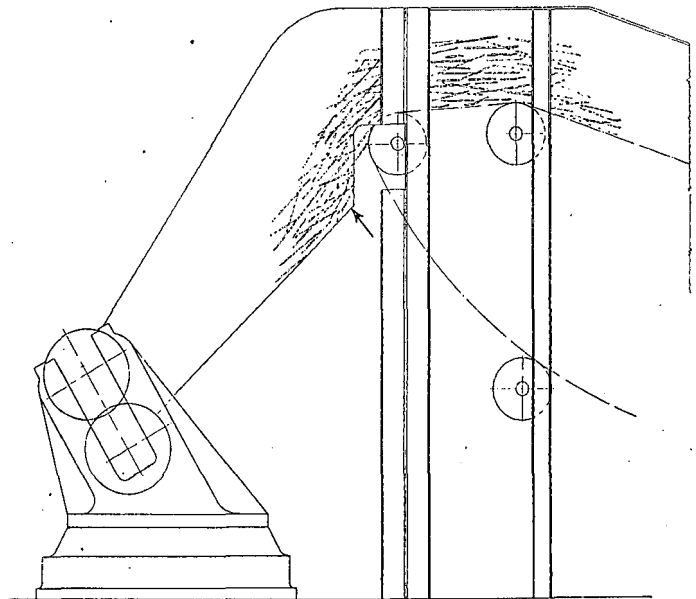


Fig. 2.

PREPARATION OF THE CANE.

CANE CARRIERS.

Under this heading there is not much to comment upon, as cane carriers are practically standard equip-

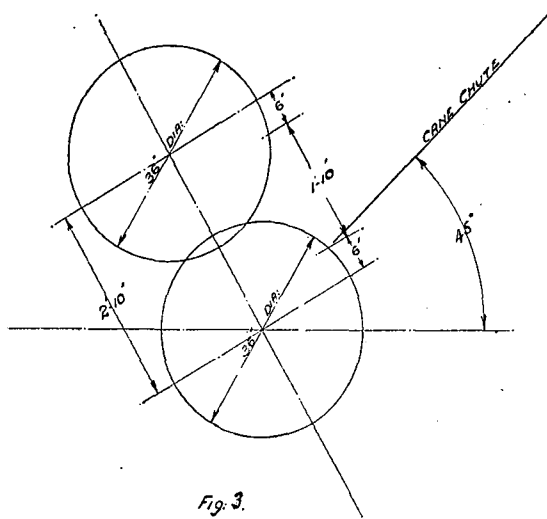
- (3) The width of the chute at the carrier head should always be narrower than at the entrance to the crusher rolls, so as to avoid a jamming action taking place when the crusher may refuse to take the feed.

All the foregoing defects tend to choke the crusher.

It is essential to keep the carrier loaded as evenly as possible as this has a bearing upon the subsequent blanket of bagasse entering the mills, and better extraction results. "Uba" cane as grown in Natal and Zululand is about the hardest cane in existence, with the highest fibre content found anywhere in the world (at least the writer thinks so), therefore it is reasonable to suggest that its structure should be broken down and well prepared for the Milling Plant if higher extraction is to be aimed at, and too much importance cannot be attached to the preparatory machinery for this purpose. The writer considers that Knives, Crusher and Shredder are the most suitable equipment for this duty.

KNIVES.

Although knives require constant upkeep the benefits derived outweigh the cost of maintenance and the results obtained are advantageous in many respects. They ensure a more even feed to the crusher, less chokes at the crusher, and increased capacity, which varies from 3 to 7%. The writer does not think it necessary to install more than one set of knives, providing they are good and have sufficient blades. The spacing between the blades should not be more than 2in. and the most suitable and economical speed is about 500 r.p.m., although



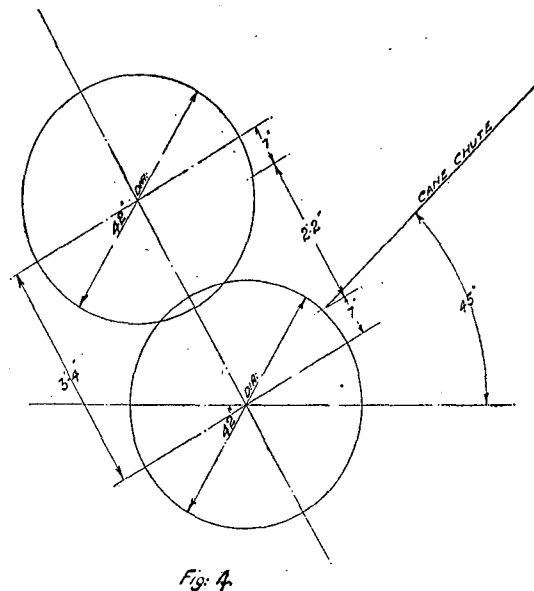
riers are not evenly loaded, and when the cane enters the factory with trash during wet weather.

CRUSHERS.

The crushers in this country vary in size, grooving, etc. Some are good, some indifferent, and others practically useless. A good type of crusher is essential to maintain good mill work and this unit plays a very important part in this respect.

It is the writer's opinion that crusher rolls in the majority of cases are far too small for the milling plants which they precede and he would recommend that the crusher rollers be at least 6in. larger in diameter; and 3in. wider than the Mill rollers. The larger the diameter of the rolls the greater the effective gripping power available for the feed. To explain this fully consider the diagrams in Figures 3 and 4.

In these two figures the points raised are clearly illustrated. Taking the dimensions of 6in. and 7in. respectively down from the centre of the roll as the point where effective gripping commences, we therefore, in Fig. No. 3 have "a" representing 1ft. 10in. and in Fig. No. 4, 2ft. 2in. With larger rollers a closer setting can be obtained and the unit can be run slower; a lower peripheral speed means less slip, wear, and tear, and higher extraction. The question of extraction results at varying



in some other countries a speed of 1,200 r.p.m. has been adopted; but at this speed the life of the blades would be considerably shortened whilst dealing with "Uba" cane.

Knives are sometimes installed with insufficient available power to drive them. With the knives set at approximately 3in. to 4in. from the slats, 2½ to 3 h.p. per ton of cane milled per hour should be allowed; but the writer favours the latter figure, which provides for a margin of power where car-

riage surface speeds of the rollers will be dealt with later in this paper.

It must be remembered that extraction lost on the first units is never fully regained by the following units, especially where the tandem comprises 3 to 4 mills only.

The 3in. extra length allowed on the crusher rollers is to compensate for the thickness of the side feed plates, and at the same time allow for the

feed chute to be narrower at the carrier head than at the crusher roll entrance, as explained under Cane Carrier head gear. Much has been said in connection with the type of grooving that crusher rollers should have to obtain the best results, and there are varied opinions on this subject. The writer cannot but state that in his opinion the circumferential zig-zag type of grooves is an improvement upon the horizontal zig-zag grooves and the splitter type of gooving. The horizontal zig-zag do not tend to give a free exit for the juice expressed and the gripping power is not so effective as on the circumferential zig-zag grooves. The splitter type of grooves of course give the required exit for juice expressed; but fail where capacity and effective grip are concerned and they do not give the same results in the preparation of the cane.

SHREDDERS.

It is surprising that there are not more shredders in existence in this country to-day. Mount Edgecombe is the only factory to have one. There was one (a Maxwell) at the Umfolosi Planters' Co-operative Factory; but it has been discarded, the reason for doing so is not known to the writer. The Shredder (Searby) is looked upon by most people with indifference in this country, as it has been argued that:—

- (a) It does not perform any duty in juice extraction.
- (b) The power taken to drive this unit does not warrant its installation.
- (c) The speed it runs at is somewhat excessive.
- (d) The maintenance cost is far too high; and other minor supposed disadvantages, which are really of no consequence.

It is true the shredder does not express juice from the cane, but it is the subsequent benefit derived at the Mills which makes it a very profitable and economical unit when dealing with "Uba" cane and this will be verified later by figures and costs given.

As previously mentioned "Uba" cane is very hard, therefore the more it is disintegrated the better the milling results will be. The bagasse after passing the shredder enters the 1st Mill in a condition equal in size, and in some instances smaller, to the bagasse leaving the last mill in many other factories.

With bagasse in such a state the cells of the cane are exposed to a far greater degree to the imbibition water, which is better able to penetrate. Shredded bagasse allows a higher application of imbibition while at the same time no considerable quantities of imbibition water run off through the apron carrier slats; therefore the water applied is used to the greatest benefit. Further, less power is required by the Mills, and there is less wear and tear on them.

A test was run without the shredder in operation

on October 31st, 1933. The duration of test was 6 hours 22 minutes. Tons of cane crushed per hour 96.1; Sugar in bagasse was 3.05%; moisture 52%; Mill Extraction 92.25%. Samples were taken half-hourly. Comparing these results with the figures obtained for the previous 24 hours, there was a rise of 0.5% sugar in bagasse, and a drop of 1.3% in the extraction. If a basis of comparison of the average figures obtained for the whole year the drop in efficiency by discarding the Shredder would be nearer 2% in the sucrose extraction. This drop of efficiency was not noticed on the 1st Mill very much; but was evident to a marked degree on the remaining units.

The average motor speeds and amperes of the various units for a few days before and during the test were as follows:—

	Mills With Shredder		Mills Without Shredder	
	Motor Speeds	Amps.	Motor Speeds	Amps.
Crusher ..	398	180	394	208
1st Mill ..	433	244	485	267
2nd Mill ..	427	221	436	278
3rd Mill ..	428	236	441	272
4th Mill ..	422	219	434	279
Total Amps. ..	1,100		Total Amps. ..	1,304
Total with Shredder ..	1,275.			

As the shredder is situated between the crusher and the 1st Mill and therefore no benefit is gained by the crusher from the shredder, we can deal with the units from the 1st to 4th Mills inclusive.

With the shredder the average total current for the four Mills was 902 amps. and the average individual Mill Motor speed was 449 r.p.m. Therefore there is a difference of 176 amps. which equals approximately 19% more power registered by the four Mills when the shredder was not in operation. The increased average speed on the Mill Motors amounted to approximately 5%, but the 1st Mill Motor Speed was increased by approximately 12%. Of the 29 minutes stoppages during the test, the 1st Mill accounted for 60% of the time lost, due to chokes on this unit.

The tonnage crushed before the test was 97 tons and during the test 96.1 tons per hour. It should be noted that the Mill settings remained unaltered for the test.

The Hydraulic weights were slightly more active during the test than before.

All the figures in connection with power were based upon the readings of the ammeters, as no watt-hour meters were available to base the calculations of H.P. and power factor ratings.

From the foregoing we have the advantages in favour of a shredder as follows:—

Total power required by the Mills—approximately 15 to 19% less.

Increase in extraction by—1.3%.

Less wear and tear on the Mills.

Since these figures were obtained, a week's run has been completed without the shredder in operation, and the figures compare in practically every respect, with the exception of the extraction, when the latter test showed a drop in the extraction of 1.9% based on the following week's run.

There is no need to expand upon the construction of the Searby Shredder as you are all acquainted with this. The maintenance costs on this unit are as follows:—

Based on a 344,916 tons cane crop, with attention the bearings will last four to five years. The cost per set is £40. Say £10 per year	£10	0	0
One set of hammers will grind approximately:—230,000 to 240,000 tons cane at a cost of £220 per set. Therefore one and a half sets required for 340,000 ton crop	£330	0	0
One set Grid Bars (2 complete bars) will grind 300,000 to 327,000 tons cane at a cost of	£60	0	0
One Anvil bar will grind 200,000 to 250,000 tons of cane at a cost of £25, there it will require one and 2 edges of another bar to grind 340,000 tons cane	£37	10	0
One set of Discs will last approximately six to seven years, with the exception of the end discs which last approximately three to four years. The total cost of discs about £140, or say £40 to £50 per year	£50	0	0
Labour for changing the above items equals £100 per year	£100	0	0
			£587 10 0

This figure may appear to be a bit startling. However, if based on cost per ton of cane crushed it amounts to only 0.41d. per ton; but then the shredder is responsible for an increased extraction of 1.3% to 1.9%, and if we convert this to £. s. d. on a 344,916 ton crop, it will be seen what it represents in extra revenue. Taking the comparative figures for the week's run without the shredder, and the following week:—

	Fibre % Cane	Sugar % Bagasse	Mill Extr.
Week ending June 23rd (No Shredder)	15.73	2.39	92.51
Week ending June 30th (Shredder)	15.69	1.89	94.40

The shredder is responsible for an additional 1.9 extraction on a crop of 344,916 tons of cane at say 14.4% sucrose containing 49,657 tons of sucrose. This increased extraction is equivalent to 1.9% of 49,657 = 943½ tons of sucrose added to the juice entering the boiling house.

As 86.5% of the sucrose in the treated juice was recovered as commercial sugar in bags, 86.5% of 943½ = 816 tons of commercial sugar. 816 tons of sugar @ £13 per ton = £10,608, representing the money value of the additional extraction obtained through shredding the cane.

MILLING.

Under this heading there are several factors which need careful attention and have an important bearing upon the extraction results obtained. There is really no hard and fast formula for setting of Mills, as each plant has to be treated individually and each has its own idiosyncrasies. It is essential for the engineer to keep records of the settings from year to year, together with any alterations made during the crop for future reference.

It is necessary to adjust the mills weekly, even if the extraction is good; a very slight adjustment to rollers, scrapers, etc., compensates for the wear that takes place during the week's run.

Again it is essential to have tests taken over the week of the performance of each individual mill and so ascertain if each unit is doing its fair share of the work.

It is indeed a hopeless business for an engineer to keep mills set in trim without some means of checking the work done by them, and here the chemical laboratory plays an important part. Samples of bagasse are taken daily from each unit in the tandem, and the results of this daily control are averaged and set out at the week-end. This method was dealt with by Mr. J. Rault in a paper read by him at the Congress in 1931, so there is no need further to expand upon this point.

There is another method of determining the work done by the individual mills, under the heading of "Milling Control by juice density Curves" by Raymond Elliott¹. This article was published in the proceedings of the Hawaiian Sugar Technologists' Association, and according to details given it appears to be a simple method.

The following points are important in setting mills and should be carefully watched:—

(1) **Ratio between opening of front and back rollers**, i.e., opening between feed roller and top roller, and top roller and discharge roller. This point is sometimes neglected and is the cause of chokes due to the fact that excessive uneven pressure applied on the top brass causes the hydraulics to function ineffectively and in some instances not at all. The ratio varies on different plants, with different grooving, fibre content, and maceration applied, but the figure of 2.0 to 2.25 to 1 is about normal for "Uba" cane. An indication of the above ratios can be observed from or at least taken by the amount of juice expressed from the front and back rollers and should be about 75% to 25% respectively.

¹ Int. S. Jour. 1934, 230.

(2) **Trashplate Setting and Sweep.**—This feature of the mill could be rightly termed the seat of all trouble, or at least, most of the troubles experienced in milling are associated around this point. Should the trashplate be set too high this causes slipping, choking between the feed and top rollers, and also sets up unnecessary friction and loss of power on the plate itself. On the other hand the trashplate when set too low causes the bagasse to pile or ball up at the entrance to the discharge roller and also results in choking the mill. Furthermore, slipping takes place due to the blanket of bagasse not passing over the trashplate at the same rate as the surface speed of the top roller. Therefore it is logical to expect that the feed to the discharge roller must be along the line of impulses, if it may be termed as such, and in this way would have a tendency to break the blanket up, and cause pockets of juice to form and hence reabsorption. In some instances a mill working under these conditions would be frequently, but incorrectly, stated to be doing good work because the hydraulic weights keep jumping up and down incessantly. Again if a trashplate is set with too great a sweep, or in other words with too large an increase of opening from toe to heel, it will have the same results on the discharge rollers. The increase of the above clearance should not be more than $\frac{5}{8}$ in., on rollers $\frac{36}{16}$ in. diameter with approximately 15.5% fibre

and 105 tons cane per hour. The blanket of bagasse should travel over the trashplate at the same speed as the surface speed of the top roller with no tendency to pile in front of the discharge roller.

It is necessary to have the width of the trashplate as narrow as possible and so curtail the friction and consequently assist the satisfactory working of the mill.

(3) **Adjustment of Trashplates.**—This is absolutely necessary to keep the trashplate adjusted properly to the cane roller and this point should be carefully examined at the week-end. If neglected the grooving will wear and foul with bagasse. It is quite unnecessary to put undue strain on the hook adjusting bolts as this will tend to cause the points of the trashplate grooving to curl and eventually act as an obstruction to the feed.

(4) The position marked "E" on Fig. 5 represents juice clearance, i.e., opening between heel of trashplate and discharge roller and should not be stinted. These clearances vary with size of grooves on the roller and the quantity of maceration applied. Where $\frac{1}{2}$ in. grooves are used and 40% maceration applied the clearance should not be less than $\frac{5}{8}$ in. and in the case of 1 in. grooves not less than $\frac{3}{8}$ in.

(5) It has been brought to the writer's notice where insufficient clearance has been allowed

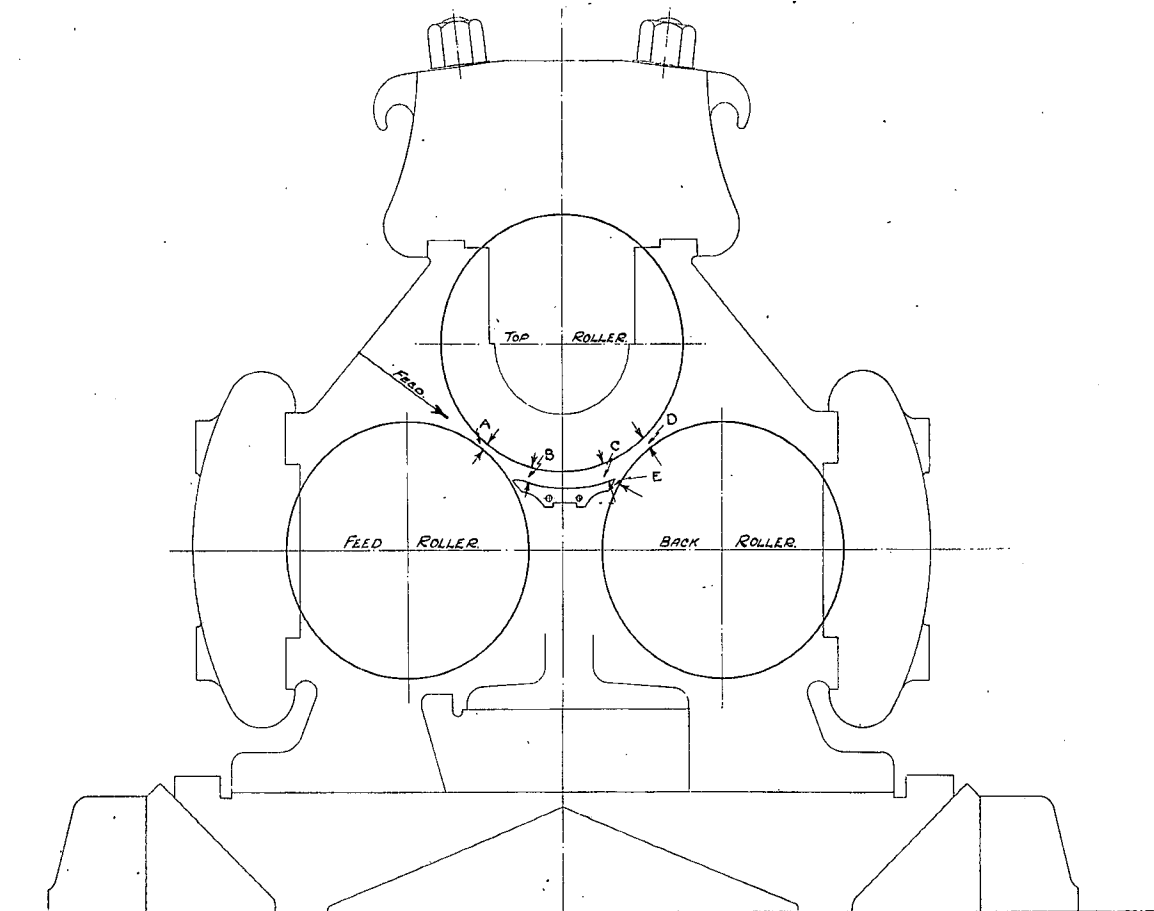


Fig. 5.

between the root of the teeth and the tips of the teeth on roller pinions. As the rollers wear down the diameter of the pinions remain the original size, so eventually they become too large and will not allow for adjustment during the crop. It is advisable to carry spare pinions smaller in diameter to meet these conditions and not have to turn down the original ones, which would become too small when new rollers are fitted.

In setting the mills, especially the trashplate, consideration must be given to the tons of cane crushed per hour, fibre content and maceration applied, and in this respect the records kept each year, together with the engineer's experience enables him to arrive at the correct settings required.

In connection with mill settings, some good results have been obtained with the following ratios:—

If A equals say 126 sq. ins. B should be approximately 65% more than A, this figure includes area of grooves of the top roller. C, should be 20 to 25% more than B. The ratio of A to D as previously mentioned is from 2 to 2.25 to 1.

grooves of the top roller and also would ensure less slipping. This is borne out by the fact that the mills function much better with the plates grooved after the first season's work than at the commencement of operations with new plates.

Since these notes were compiled the writer understands that the Umfolozi Co-op. Sugar Planters have installed plates as described above and they have given very good results.

We use Stainless steel plates and the wear on these plates after two seasons' work is considerably less than the wear on any ordinary plate after a season's work. The approximate wear after two seasons' work on a stainless steel plate is shown in Fig. 6.

Two of these plates have each completed three year's work, and during this period 1,014,900 tons of cane has been crushed. The frictional resistance of the stainless steel plates is very low and the surface is polished like a mirror and never rusts.

Whilst on the subject of trashplates it may be of interest to touch upon the wear that took place on a trashplate which was removed from the 1st mill, where the rollers are grooved 2in. pitch. The surface of the plate was corrugated, and these corru-

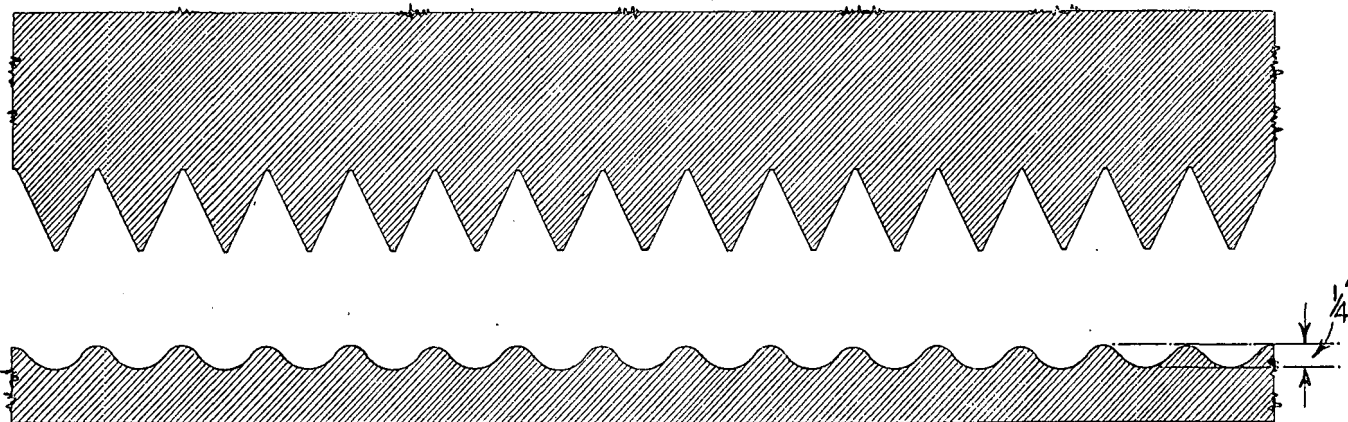


Fig. 6.

PART CROSS SECTION THROUGH ROLLER AND TRASH BAR

E should be approximately: minimum 32 sq. ins. and maximum 55 sq. ins., these areas do not include area of grooves on the back roller, nor the meschaert grooves in back roller at intervals of 4in. pitch. The above figures given would vary slightly according to fibre % cane, and the quantity of maceration applied. With large grooving on the rollers, it is most noticeable that channelling or grooving to a fair depth takes place on the surface of the trashplates and it is the opinion of the writer that improved results would be obtained if the trashplates were grooved when new, similar to these grooves worn on the plates after a season's run. It would mean a more even distribution of pressure over the surface of the plate and on the

gations did not go directly across the plate but diverged slightly towards the ends as shown in Fig. 7.

The writer attributes this condition to the chevron grooves having a semi screw action towards the flanges of the roller and this was borne out by the fact that several of the set screws securing the flanges were fractured during the crop.

HYDRAULICS.

The question of pressures that should be carried on individual mills entirely rests upon the good judgment (tempered by experience) on the part of

the engineer in charge. After all the fundamental principle of milling is the extraction of juice by pressures, and to obtain good mill work it is of primary importance to apply the pressures effectively. The best results are not always obtained through loading the mills up to the possible maximum pressures that a plant can safely carry. In making this statement it is necessary to go back to the remarks already made upon the shredder. With shredded bagasse it has been found that with high imbibition, i.e., 40% no better results are obtained when pressures of 65 to 70 tons per lineal foot are carried, as against 50 to 55 tons per lineal foot. This may be due to the high imbibition on shredded bagasse.

High imbibition on shredded bagasse makes the

In the instance quoted the ram on the gear side is 15in. diameter or 176¾ sq. ins. and on the pintal side 14in. diameter or 154 sq. ins. One accumulator was connected to both these rams, and it was found that the pintal side lifted 3/16in., and the gear side did not lift at all.

A separate accumulator was then connected on either side of the mill, and when put into operation weights had to be added to the accumulator for the pintal side to bring about an even float of the top roller. The extra amount registered on the gauge for the pintal side equalled 200 lbs. per sq. in. To summarise out the above conditions the following results are obtained.

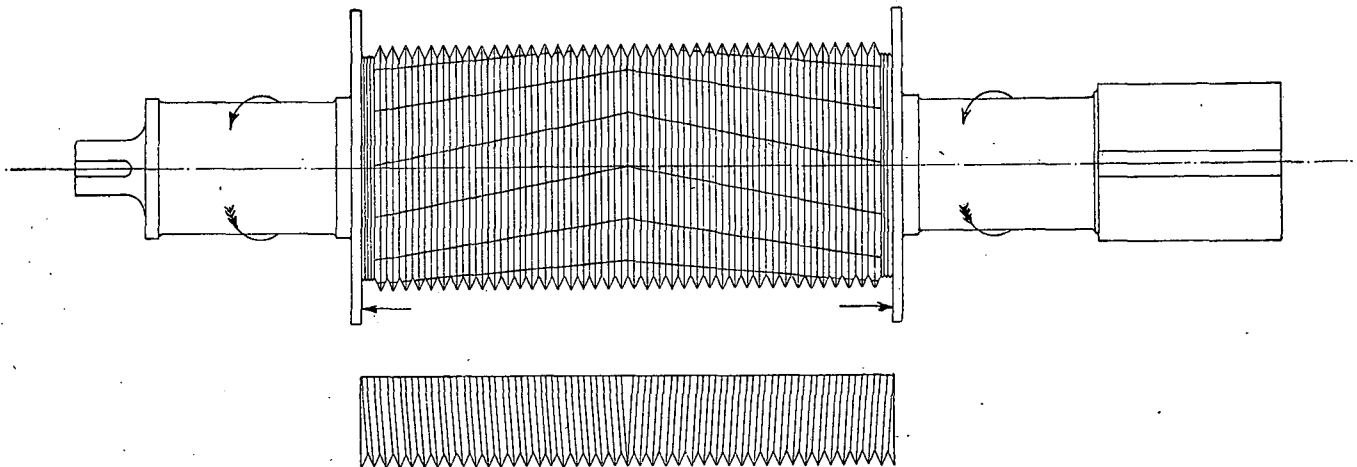


Fig: 7

conditions of feeding the mills (when "Uba" cane is being crushed) a little more difficult; but the extraction results are good.

Care should be exercised to ensure and maintain an even lift on the top roller, as unequal lifting of the top roller will cause chokes, hot bearings and irregular mill work.

It is not an easy matter to obtain the desired result, and in the writer's opinion at present the only effective means is to employ separate accumulators for either side of the top roller, where the rollers are driven by pinions on the one side only.

Where rollers are driven by pinions on both sides then one accumulator would function, possibly much better.

The writer has had experience where rams of different sizes are fitted; but it is difficult to arrive at the correct ratios which permit the top roller to float evenly. This is mainly due to the friction or pressure between the pinion teeth not remaining constant brought about by the lift of the top roller.

GEAR SIDE.

Area of ram 176¾ sq. ins.
 Pressure sq. in. 2,200 lbs.
 2,200 x 176¾ = 388,850 lbs.
 or 194.4 tons.

PINTAL SIDE.

Area of ram 154 sq. ins.
 Pressure sq. ins. 2,400 lbs.
 2,400 x 154 = 369,600 lbs.
 or 184.75 tons.

In this case it will be noticed that there is a difference of approximately 9 tons more weight carried on the gear side to obtain an equal lift of the top roller. In another instance where rams of different sizes are installed on mills of the same tandem the gear side ram is 15¾in. diameter and the pintal side 15in., both rams are served from one accumulator. The gauge pressure is 2,400 lbs. sq. in. giving the following differences:—

GEAR SIDE.

Area of ram 185.6 sq. ins.
 Pressure per sq. in. 2,400 lbs.
 2,400 x 185.6 = 445,440 lbs.
 or 222.75 tons.

PINTAL SIDE.

Area of ram 176.7 sq. ins.
 Pressure per sq. in. 2,400 lbs.
 2,400 x 176.7 = 424,080 lbs.
 or 212 tons.

So in this case we have a difference of 10.7 tons more weight on the gear side. Several tests have been taken from time to time of the lift on the top brasses. These tests show that the pital side lifts more than the gear side by approximately $\frac{1}{8}$ in. average, but in some instances this was found to be the reverse, i.e., the gear side lifted more than the pital side, even with the larger side ram on the gear side.

In the writer's opinion it would appear that at different mill settings, the meshing of the pinion teeth vary, increasing and decreasing the amount of friction between the teeth surfaces, together with lift on the top roller. It is therefore a difficult matter to specify the correct relative size of the rams. With separate accumulators it is possible to increase or decrease the weights to suit these conditions between and obtain an equal lift on the top roller. Furthermore, the exact position of the offset for the rams cannot be gauged with any degree of accuracy to suit the different conditions which arise, but it is necessary for the rams of the first unit to have a greater offset and then decrease down to the last unit in the ratios of from $\frac{7}{8}$ in. to about $\frac{5}{8}$ in.

The brasses should be kept free and an easy fit in the housings and the surfaces generously supplied with oil grooves and kept well lubricated.

The clearance between the journal and top brasses should be kept down to a minimum, about 15 thousandths is sufficient to ensure as little loss of motion as possible before the top roller transfers the hydraulic pressure on to the blanket of bagasse.

Setting the trashplate too high is a cause of the loss of pressure applied and a waste in power.

GROOVING & JUICE GROOVES (Messchaert).

The tendency in recent years has been to increase the size of the grooves due to the fact that increased tonnages are being milled by most of the larger factories, and without these larger grooves the higher rates per hour ground would not be possible, especially where high fibre content prevails. Larger grooves also give better gripping power and a freer exit for the juice.

Messchaert grooves are essential where high quantities of imbibition are applied; especially on the feed roller, and without this installation the crushing capacity is reduced by approximately 7 to 10%. These grooves are the means of shortening the life of the rollers, particularly the discharge rollers, when the grooves are spaced at close intervals, as numerous fractures occur to the grooving between the messchaert grooves when tramp metal passes through the mills. It is most noticeable on the last unit.

Much could be written about the size and shape of the grooves in general, but this subject can be omitted from this paper as it is difficult to specify any particular size of grooving to suit all types of plant and conditions prevailing in this country, but we have obtained good results from the following combinations:—

1st mill: 2in. pitch grooves; 2nd mill to 5th mill: 1in. pitched grooves (all intermeshed) with Messchaert grooves on feed and discharge rollers throughout, with the exception of the 1st mill.

CHEVRONS.

It is also essential to cut chevrons on the top rollers and thus gain better feeding results and minimise slipping, and they give good results when spaced approximately at 8in. to 9in. intervals. In some factories it is customary to cut chevrons on the feed rollers and good results have been obtained. The writer has no personal experience in this respect, but is of the opinion that chevrons cut on the feed roller would increase the amount of cush-cush in the juice to be screened out and put back on the mills.

APRON SLAT CARRIERS.

There are several means of conveying the bagasse from mill to mill, but the apron slat carrier is the most efficient, because it ensures an even blanket of bagasse being fed to each unit and is a means of assisting the feed. The only real disadvantage if it can be claimed as such, is perhaps the maintenance cost, i.e., wear and tear on the chains; but if given sufficient attention during the off-season they ensure continuity of service during crushing.

SURFACE SPEED OF ROLLERS.

The peripheral speed of mill rollers plays an important part in extraction results, especially on the crusher, as the feed to this unit is of a greater volume than to the subsequent units. When dealing with "Uba" cane more slip is experienced at higher peripheral roller speeds at the crusher and to a lesser degree on the mills. From tests carried out on the crusher for extraction it was found that at a peripheral speed of 20 to 21 feet per minute an extraction of 45% could be obtained. At a speed of 25 to 26 feet per minute the extraction fell to 39%.

It appears therefore that approximately 22 feet per minute is an efficient speed for a crusher, and increasing in speed by about 1.3 feet per minute for each unit of the tandem.

Since all crushing plants have economical limits which are functions of the peripheral speed of the rollers, the fibre content and the mill settings, it is clear that a point can be reached when efficiency is forsaken for capacity. An example of this position is afforded by a consideration of the work of the two factories given below.

CUBA.

Plant comprises 1 set of knives, 2 roller crusher and 7 mills 36½in. x 84in. peripheral speed of last mill rollers approximately 42 ft. per minute. Capacity 204 tons per hour, 11% fibre, imbibition 15%, sugar in bagasse 3.04%, moisture 50% extraction 94%.

HAWAII.

Plant comprises 2 sets knives, 2 roller crusher, and 6 mills, 34in. x 72in., peripheral speed approximately 22 ft. per minute. Capacity 80 tons per hour 12.39% fibre, imbibition 34%, sugar in bagasse 0.97%, moisture 42.73%, extraction 98.3%.

As you will see, the above figures are self-explanatory.

GENERAL.

There is a point which arises in connection with the higher mill extraction from "Uba" cane, particularly when the canes are not too good and have withstood prolonged periods of drought, and the purities of the juice are low, and the impurities high. The writer refers to the defecation, boiling and curing house, when a point may be reached where it would not be profitable to increase the efficiency on the one side to the detrimental effects of the other. Perhaps at this stage the writer may be quite safe in saying that to obtain a higher extraction than 94.5 to 95% when crushing "Uba" cane would be the outside economical limit even with the most modern equipment.

It seems to be the opinion and belief of some people that if mills are driven by electrical motors a much higher mill extraction is obtained than when driven by steam engines and vice versa. Everything being equal, i.e., roller sizes, peripheral roller speeds, application of imbibition and fibre content, the extraction results should be the same. There are several advantages which electrically driven mills possess over the steam driven units but it is not the intention of the writer to go into this matter now, as it can be the subject of a paper at some

future date. For individual mill control the electric drive presents a most flexible combination. In the past too much has been heard about the extraction results obtained in other countries; but one has not far to go to understand why the difference exists. Figures and conditions collected from other countries give a very comprehensive explanation and when brought down to a comparative basis quite a few of the factories in this country need have no shame, with the extraction results obtained by them. This statement is also based upon the tests that have been carried out on the soft varieties of cane which have been milled during the past two seasons and the writer has no hesitation in stating that with 100% soft canes Natal would become a second Hawaii.



CHAIRMAN: I am very glad that Mr. Macbeth has introduced the subject of Milling into our discussions. The Milling phase of the Industry has been sadly neglected in the discussions and I am pleased to think that the paper just read has given us a start on this matter. Mr. Macbeth has touched on most of the more important aspects of milling and has made out a very good case for the shredders which are operated at the factory with which he is personally concerned, and he has also brought up one or two very interesting points from a practical aspect of the subject—points with which all mill engineers are constantly in touch. There will no doubt be considerable discussion on this matter, as it is to a great extent a fresh subject in our Congress, but in the first place I should like to make one or two remarks. All milling figures depend to a great extent on the condition of repair in which the milling plant is kept. When you buy a milling plant new it is designed to do a certain duty, but the wear and tear on machinery of this kind is so enormous—there is very little industrial machinery apart from stone crushers and rolling mills, to which our own milling plant is analagous, on which wear and tear takes place to such an extent. Milling plant may be designed for a certain extraction and performance, without very efficient and constant repair and maintenance these results very rapidly fall away. In this country we are unfortunate in having such a long crushing season; it makes it difficult to maintain a milling plant at its full efficiency throughout that season. It is obvious on reading the factory reports month by month how this happens. We see the extraction and other figures gradually dropping off from the beginning of the crop, and after the middle of the crop they decline very rapidly.

As Mr. Rault's paper is intimately connected with Mr. Macbeth's I shall ask him to read his and then we can discuss both together.