

IMPROVED UNDER-FEED ROLLERS

by D. HULETT

During the 1961 season an improved under-feed roller was devised at Darnall Mill and has proved to be an outstanding success, in that, with the installation of the roller on all the mills of the tandem, the extraction of the tandem increased by approximately one per cent.

It has been the belief at Darnall for a number of years now that a strong relation exists between the amount of imbibition water applied to the mill and the extraction. With this factor in view, thought was given to the efficient running of the boiler plant and the efficient use of steam so that a maximum amount of water could be poured on to the mill without the consumption of additional fuel.

The result of this work was that the water could be poured on the mill to the extent of 46 per cent on cane but, with this application of a large amount of water, a serious drawback occurred at the mill. It was found that the large amount of water caused serious slipping of the rollers with consequent increase in the bagasse moistures. The high bagasse moisture impaired the steam production and so an equilibrium was reached.

At this stage it was decided to split the imbibition on the mill so that no unit received more than half the previous amount of imbibition liquid. The object of this move was to improve the mill feeding, reduce the moisture per cent bagasse, improve the boiler steaming and hence apply more water to the mill. This scheme worked and consequently 56 per cent imbibition was applied to the mill with a consequent increase in extraction.

Although an increase in extraction was obtained by this splitting of the imbibition, it was realised that the most efficient use was not being made of the available water. The rollers of the tandem had in the meantime been severely arced and with the reduced slipping had become very rough indeed. These considerations inspired the Darnall Management to

again attempt straight compound imbibition and so the water was diverted all to the last mill.

56 per cent of the cane weight in water applied to the mills proved too much even for the rough rollers and engine speeds increased to their maximum as excessive slipping again occurred. The slipping of the mill was so bad that no amount of mill adjustment could eliminate the over-revving of the engines. A plan had to be made, and it was then that a scheme was devised to incorporate drainage in the under-feed roller.

The current under-feed rollers at Darnall consisted of 26-in. diam. drums set at between 10-in. and 6-in. from the top rollers and $\frac{1}{4}$ -in. from the feed rollers and having a surface speed of about 115 per cent of the top roll speed; the settings decreasing from the first to the last mill proportionately.

A new drum was made by shrinking on 26-in. diam. hoops made of 1-in. square bar to an old 24-in. under-feed roller and spacing the hoops at $1\frac{1}{4}$ -in. centres. $\frac{1}{2}$ -in. cube studs were welded every 3-in. along the periphery of the hoops and the drum was installed in the No. 4 unit of the tandem. Scraper blades were fitted to keep the grooves clean.

The most striking result achieved by the installation of this drum was the reduction in speed of the engine. The average speed of the No. 4 mill engine actually reduced from 375 r.p.m., its maximum permissible rev., to 275 r.p.m. So gratifying were the results of this alteration that a decision was made to install the new feeder rollers on all the mills of the tandem as soon as possible and within eight weeks the whole tandem had been converted.

A notable improvement was observed with the installation of the feeder roller to the first mill of the tandem which was receiving shredded cane without imbibition water added. The extraction of this unit improved by about 4 per cent.

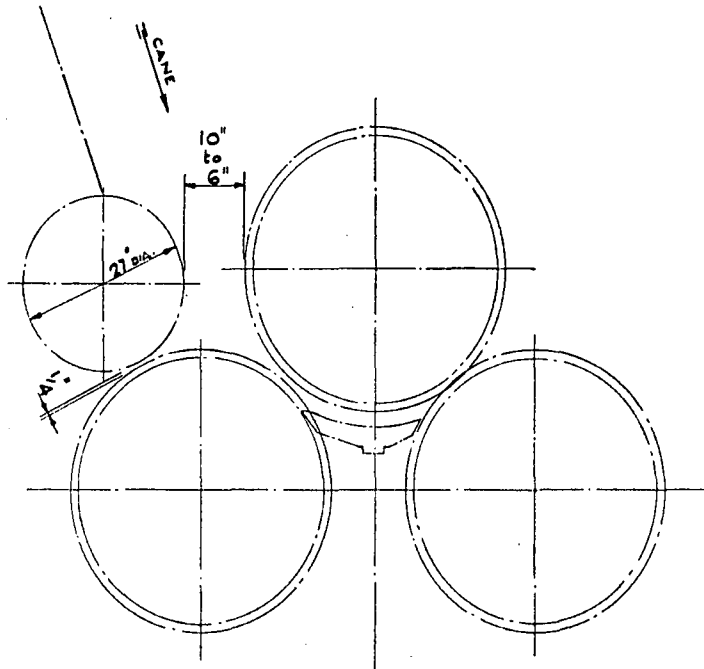


FIG. 1
FEEDER ROLLER POSITION

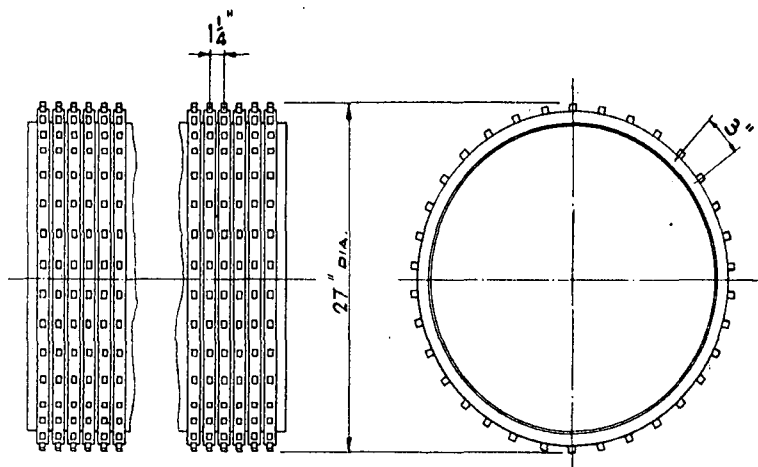


FIG. 2
FEEDER ROLLER

Mr. Gunn, in the chair, said that he was of the opinion that the amount of maceration used on a mill bore no relationship to the moisture content of the bagasse leaving the last unit. This applied to the normal amount of imbibition used and he asked the author if, with the large amount of water applied at Darnall, he had had the same experience. He also enquired if the size of the underfeed roller was 24 inches in diameter through preference, or was it that size because there was such a size roller available, or whether in fact the author would prefer a larger diameter?

Mr. Hulett stated that he agreed with the finding that the amount of imbibition applied bore no relationship to the moisture content of the bagasse leaving the mill, except that when abnormally high quantities of water were used sometimes slipping occurred, and this then led to a higher moisture content of the bagasse.

Regarding the size of the under-feed roller he stated that he had tried rollers with a diameter of 16 inches as compared with the mill rollers, which were 43 inches in diameter. He had found these rollers unsatisfactory. He then tried 24 inch rollers and found a great improvement and now had installed rollers of 29 inch diameter. He considered that the bigger the diameter of the under-feed roller the better it would work.

Mr. Cargill related that he had tried an under-feed roller some years ago and it was unsuccessful. He had come to the conclusion that this type of feed was unsatisfactory unless used in conjunction with a high feeding chute.

Mr. Hulett said that originally the carriers at Darnall did not accommodate a high feeder chute. He subsequently altered them and obtained a drop of about 5 feet from the top of the carrier to the under-feed roller. Although he did not think this made a very material difference, it was some improvement. He then described an apron-type carrier which he had installed on the first mill and which was fed from under the shredder. He had placed an idler shaft in such a way that this carrier fed the cane directly downwards at an angle of about 70 degrees on to the under-feed roller and this worked satisfactorily. The height of the sloping section of this apron-type carrier was about 3 feet.

Mr. Ashe stated that the reason for the larger under-feed roller, and in his case why the large sprockets on his apron-type carrier assisted the feeding of the mill, was that the area of contact of the cane between the feeder roller and the top roller was greater with the larger roller, and therefore a better wedge effect was formed with consequent better feeding.

Mr. Rault recalled the visit of Dr. Kerr to South Africa when that gentleman advocated the installation of very high feed chutes. He also gave a short account of a visit to Mauritius where it was claimed that mills could not operate so satisfactorily and with such high throughput without under-feed rollers.

Mr. Ashe asked if there was not a lot of excess dropping from the under-feed roller.

Mr. Hulett replied that with the correct installation of the under-feed roller, he discovered that the speed of the mill could be radically reduced and still take the same quantity of cane. As a subsequent step he reduced the size of the feed opening of the mill, which had the effect of increasing the apparent extraction at the first squeeze of the mill, and great quantities of *cush-cush* did appear from underneath the feeder-roller. However he claimed that provided the clearance between the feeder-roller and the feed roller of the mill was as small as possible, no inconvenience was caused.

Dr. Douwes Dekker enquired whether it was possible to use the normal imbibition scheme with the large amount of imbibition applied at Darnall, after the under-feed rollers were installed.

Mr. Hulett stated that after the under-feed rollers were installed he was able to apply the whole quantity of imbibition water to the last mill and it was not necessary to split the water between two units.

Dr. Douwes Dekker said this was an important point. It showed that the mill was feeding better, but an even more important point was the fact that the under-feed roller on the first unit was working so well that the extraction of this unit was increased to a large extent.

He pointed out that there were two main functions in milling, one was to obtain the highest percentage of fibre in final bagasse giving the driest bagasse possible, and the other equally important point was to extract as much as possible at the first unit so that the juice remaining in the cane was reduced to a minimum allowing the imbibition to dilute this juice as much as possible.

Mr. Hill enquired how much power was used by the under-feed roller. He related that he had found with this roller that it was very important that the end of the feeding chute should be at least on the centre line of the feeder roller or slightly behind it. He found that if it were placed in front of the centre line the under-feed roller was not so effective.

Mr. Hulett stated that he could not say how much horse-power was absorbed by the under-feed roller, but he had on repeated occasions broken a 2½ inch pitch A.S.A. chain which breaks at 95,000 lbs.

Mr. van Hengel commented on a remark which Mr. Hulett had made to the effect that one should get the feeder roller as close as possible to the top roller. He said that the ratio of the opening between the feeder roller and the top roller should be about six times as large as the working opening at the discharge of that particular mill. He said that the no-void volume of the cane was, in any case, approximately three times the escribed volume of the last unit and therefore six times this figure was ample space for the feeder roller to force the cane into the mill. He contended that any opening of a larger ratio than this would be practically useless.

Mr. Hulett stated that he had definitely discovered that with the correct positioning of the feeder roller the speed of the milling unit could be reduced and

the throughput maintained. However he was sure that the extraction of his first unit did not increase when he reduced the size of the opening between the feeder roller and the top roller.

Mr. Saville asked what was the significant difference between the Darnall roller and the normal under-feed roller?

Mr. Hulett explained the construction of his under-feed roller and the fact that it was an under-feed roller with Messchaert grooves. He explained that when the knives were put in after the mill had started crushing a significant drop in revolutions per minute was noticed. This drop has been maintained ever since. If the knives became dislodged his under-feed roller became woolly and far less effective. He stated that the under-feed rollers were kept clean by the large quantity of imbibition used at Darnall and the large quantities of juice extracted by these rollers. The introduction of these knives caused a drop in moisture of his first unit from 60 to 56 or 57 per cent and the extraction of the first unit increased from 63 to 67 per cent. The extraction of the first unit was materially assisted by the very good preparation of the cane before it reached this unit, and also because of the fact that he had not got the very deep three inch grooving that was used on other first units. The chances of re-absorption were thus much less and he related that at Darnall 2 inch grooving was used throughout the milling train.

Mr. Hill enquired what the mill ratio was at Darnall and whether the introduction of this improved

under-feed roller allowed of the alteration of this mill ratio.

Mr. Hulett replied that he had adjusted his mill ratio subsequent to fitting the improved feeder roller and had found that a decrease in the mill ratio was not necessary. He had come to the conclusion that the size of the front opening was the important measurement, and a mill ratio of approximately 2.5 to 1 was necessary at the last unit.

Mr. Gunn commented on various points raised in the discussion. He said that in his experience he found that it was not critical to have the feeder-roller close to the feed roller of the mill and clearances of up to six inches were quite permissible provided a bar or some retainer were placed in this clearance to prevent bagasse from falling backwards. One feature brought to light was the necessity of having the feeder-roller as close as possible to the top roller. It had been found at Tongaat that a much lower mill ratio may be used and this has been changed from 5 to 1 at one stage down to as low as 1.8 to 1 at the present time. The size of the feeder-roller was important and the larger this could be made the better it would work.

One point raised which did not provoke much discussion was that the point at which the chute plate met the feeder-roller should be on the centre line or slightly behind it and the angle of the feed chute was very important. It was also mentioned that a high feed chute was preferable.