SWINGING BAGASSE PLOUGHS

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Abstract

Rubber conveyor belts to feed bagasse to boilers are a viable capital expenditure choice if an efficient plough can be designed to feed the bagasse at the required rate.

The development of a suitable plough and its problems are discussed.

Introduction

The conventional method of feeding bagasse to boilers in South African sugar mills is with a chain slat conveyor. These are, however, maintenance intensive and generally noisy; they cost 20% more in capital than a rubber conveyor belt and the running maintenance costs are estimated to be 20 to 50% higher than with a rubber conveyor belt. With these figures in mind, it was obvious that a rubber belt should be installed to feed the 90 ton boiler at Mount Edgecombe. The design philosophy was to build ploughs with no moving parts.

An experimental conveyor belt was installed in the bagasse shed and a stationary plough of 25 mm square bar was bolted to the chute at an angle of 40° to the belt, as shown in Figure 1.

The system proved to be successful, but because of the bagasse feed, did not show any of the problems found in the operational ploughs. Based on the above experiments and the boiler requirements, the following equipment was installed.

Description of Plant

The new No. 1 boiler is fed by four chutes. Each chute is 625 mm long and 300 mm wide. The chutes are all on one side of the conveyor belt and are at 1 700 mm centres, as shown in Figure 2.

The conveyor belt is 1 500 mm wide and 80 metres long and is driven by a 30 kW motor through a 40:1 worm gearbox. The ploughs are installed in a staggered pattern across the conveyor belt so that each plough has its own slice of the feed. On the opposite side of the chutes there are three movable ploughs which are installed between the chute ploughs to feed the bagasse across the belt.

Commissioning

The first set of ploughs was installed with the chutes 156 mm from the edge of the conveyor belt, as shown in Figure 3.

The friction of the stationary dead zone between chute and belt was the failure of the original plough. To overcome the friction, the ploughs were lined with stainless steel 304 and were moved to the centre of the chute to allow the bagasse to fall into the chute as shown in Figure 4.

The bagasse feed to the boiler improved with the movement of the ploughs to the centre of the chute, but was still inadequate. To exert more force on the bagasse, the ploughs were extended, altered and raised as shown in Figure 5. The force of the bagasse on the ploughs caused the ploughs to lift off the belt, causing chokes with overloading and tripping the motor.

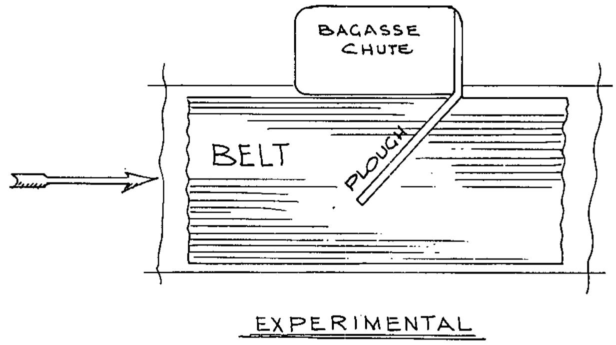


FIGURE 1 Experimental stationary plough

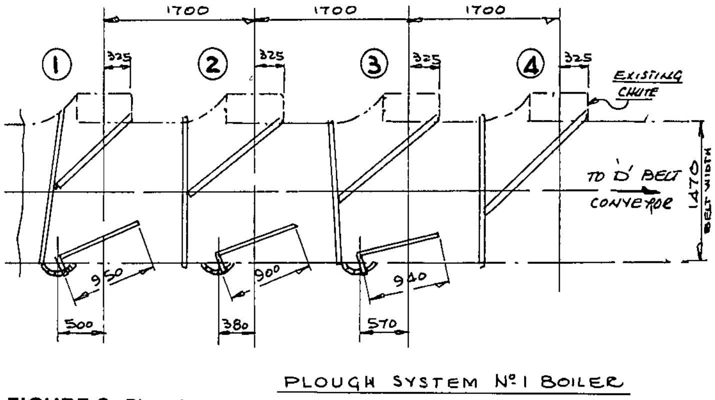


FIGURE 2 Plough system No. 1 Boiler

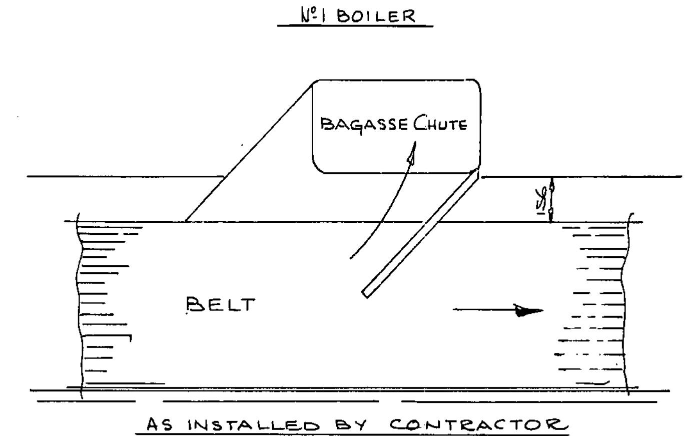


FIGURE 3 Original installation

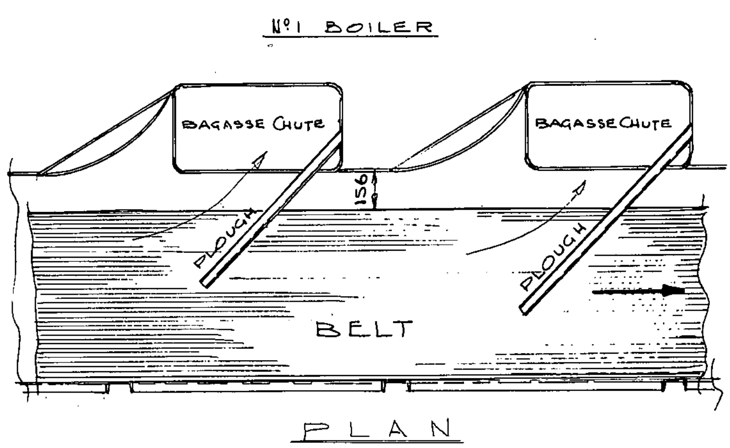
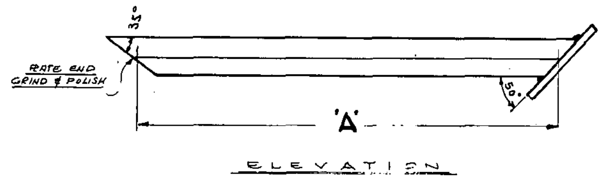


FIGURE 4 Modified installation



PLOUGH	A	B	C	D
No 1	880	32°	61	106
No 2	1200	39°	77	122
No 3	1260	41°	86	132
No 4	1470	49°	80	120

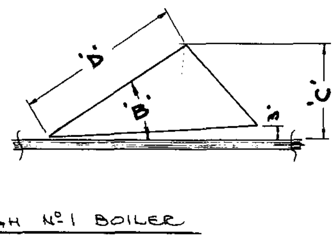


FIGURE 5 Modified plough design

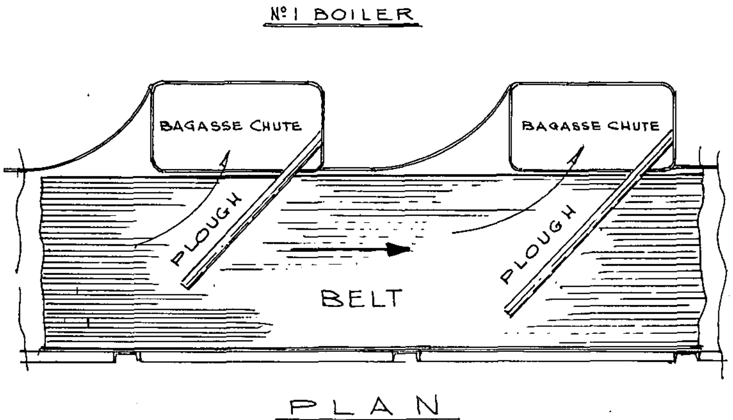


FIGURE 6 Repositioning of bagasse chute

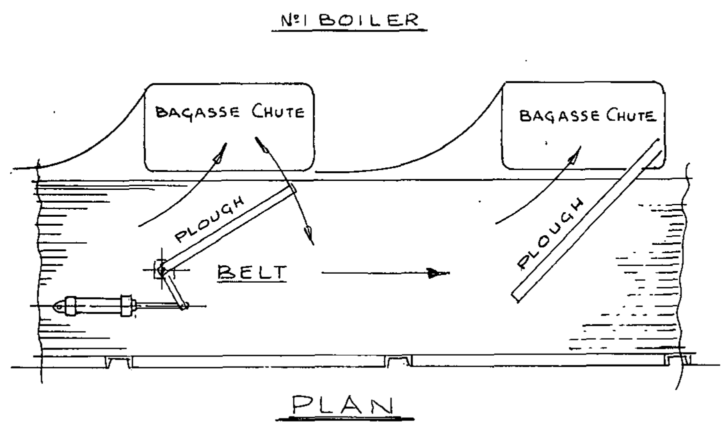


Figure 7 Prototype movable plough

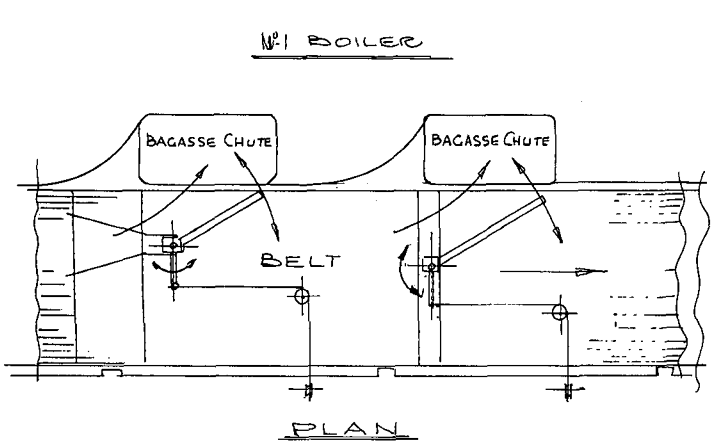


FIGURE 8 Automatic plough control

To reduce the problem of forces on the plough, it was decided to move a chute adjacent to the conveyor belt. This modification reduced the friction across the dead zone and the bagasse flowed with ease. After moving all four chutes adjacent to the belt, as shown in Figure 6, no problems occurred with the rate of the bagasse feed. Bridging across the chutes occurred when the bagasse belt was fully loaded. This required a labourer to be stationed nearby to unchoke the chutes. To solve the choking, pneumatic cylinder pushers were installed above the chutes. These were actuated automatically when it was indicated that there had been no feed on the chute for ten seconds.

The use of pneumatic cylinders suggested that movable ploughs to regulate the bagasse chute should be used.

Two solutions were considered:

- Telescopic ploughs to extend or retract the plough. This required expensive controls to regulate the bagasse feed and was therefore discarded.
- Movable stern rudder type ploughs with the pivots in the bagasse flow as shown in Figure 7.

Stern Rudder Ploughs

The stern rudder plough consists of a 45 mm square bar welded to a 50 mm diameter round bar. The round bar is supported in bearings 530 mm above the belt. The force to hold the plough across the belt is supplied by a torque arm and variable mass hung via pulleys onto the arm as shown in Figure 8. The mass is adjusted by adding or subtracting mass to suit the bagasse conditions on the belt so that sufficient feed is obtained but also so that the force of the bagasse on the plough is sufficient to open the plough in choked conditions.

Precautions to be observed when installing bagasse ploughs

(1) Power of the conveyor belt motor must be 40% above that normally installed.

(2) Escape areas under the plough supports must be large enough to prevent bridging.

(3) Discharge chutes must be adjacent to the belt with no dead zone.

(4) Chutes and side plates must have smooth profiles, i.e. no rubber seals.

Conclusions

The advantages of rubber conveyor belts compared with slat conveyors are:

- A capital cost saving of approximately 20%.
- A maintenance cost saving estimate to be 30% per annum.
- Maintenance inspections are easy to carry out.
- A conveyor belt is more suited to seven day continuous operation as most maintenance can be carried out whilst in operation.

The disadvantages of rubber conveyor belts compared with slat conveyors are that:

- they are difficult to seal against dust, and
- ploughs need to be engineered for different types of bagasse, i.e. diffuser or mill bagasse, different moistures and fibre lengths.

Rubber conveyor belts with stern rudder type ploughs are therefore an economic method to feed bagasse to sugar mill boilers.