CONTINUOUS HAULAGE
THE COAL AND ALLIED EXPERIENCE

By

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ABSTRACT

In an attempt to increase underground productivity Coal and Allied has introduced a continuous haulage unit into its Moonee colliery. A second unit is planned for Kailarah colliery in the near future. Both systems will be roof mounted or monorail type and manufactured by Joy Manufacturing Pty Ltd.

The introduction of these machines is seen as a logical step in improving the efficiency of mining with continuous miners. This could be in conjunction with longwall mining in the rapid development of gate roads or, as in the case with these machines, as conventional development and extraction units.

The advantages of the continuous haulage system are:

1. Relatively low cost.

2. Ability to obtain high productivity in irregular or disturbed coal reserves not suitable for longwall mining.

3. Increased worker safety with the elimination of shuttle cars and the majority of trailing cables.

4. Increased productivity independent of soft or difficult floor conditions.

At the time of writing the Moonee installation is 6 months old. The Kailarah machine is due for delivery March 1988.

INTRODUCTION

Moonee and Kailarah collieries are located approx. 30 km south of Newcastle close to the coast. The seams mined form part of the upper section of the Newcastle coal measures. At Moonee colliery only the Kailarah seam is mined. At Kailarah colliery both the Kailarah and Great Northern seams are mined.

Both mines produce low sulphur steam coal which is in good demand on the export market.

While reserves for longwall extraction exist in the area most lie under what is known as the ‘eastern claystones’. To date coal under this type of roof has not been successfully mined. Hence there is an urgent need to increase productivity in the remaining reserves suitable for continuous miner extraction only.

The following is a brief description applicable to both the Moonee and Kailarah systems. (fig 1)

DESCRIPTION OF F.C.T.

The Joy F.C.T. is a mobile, fixed length belt conveyor which in this case is suspended in cars from a monorail attached to the mine roof. The special nature of the belt material and the flexible connections between the cars allows the system to negotiate several 90 degree turns. The F.C.T. overlaps the panel conveyor belt and transfers coal along a length back from the normal tail end. This allows the F.C.T. to follow the continuous miner into each working place providing continuous haulage of coal from the face.

The system is moved by traction units called ‘sules’ located in the F.C.T. train. These units drive through elastomer wheels that grip on the monorail web. These systems have 3 sures in each train.

The mined coal is loaded onto the F.C.T. by a ‘bridge conveyor’. This is a short straight conveyor which is suspended at one end by the monorail and at the other end by steerable rubber tyred wheels that run on the mine floor. This conveyor transfers the coal from near the floor level up and onto the flexible F.C.T. belt. It has no independent traction powers and is simply pushed and pulled by the F.C.T. train.

A major consideration with the operation of the F.C.T. is the low height clearance as the coal passes along the length of the machine.

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No lump coal greater than 200mm can be carried without the possibility of damaging the suspension frame or the belt rollers. For this reason a breaker has been fitted to the throat of the continuous miner to size the coal before it is discharged.

Both systems are 122m in length from Inbye to outbye drives of the F.C.T. The bridge conveyor and surge car extend the reach of the system by 9m and 7m respectively. A brief description of the major components of the F.C.T. is as follows:

A) F.C.T. Belt - This belt is made to stretch like a giant rubber band but is limited to 8% stretch by a limiter riveted to the bottom side. This controlled pre-stretch ensures that the belt will always have tension in it. When going around a curve the stretch increases on the outside of the belt and decreases on the inside but is always present. Therefore the belt does not ripple on the inside or tear on the outside.

B) F.C.T. Monorail - This rail is in several lengths but all is made out of 155x73 mm universal or tapered flange beam. The different types are colour coded for easy identification.

Each rail is hung by a chain from one end while the other end interlocks with the previous rail. A special roof bolt plate is used to allow adjustment in the length of chain.

C) Electrical control boxes - Two electrical control boxes are suspended from the monorail and become part of the F.C.T. train.

One box is the normal type of gate and box or D.C.B. and provides all the power to the F.C.T., surge car and continuous miner. The other is the F.C.T. control box and controls all the operations of the F.C.T. The F.C.T. can be controlled from this box or from a 'stand' which can be plugged into the F.C.T. at various points along its length.

D) Inbye and Outbye belt drive units - The F.C.T. belt is driven by the end pulleys at both ends of the machine. This is necessary due to the nature of the belt and to reduce tension at points along the belt. There are 2x20kW motors at each end for this purpose. (total of 4 motors). Automatic brakes are built in to these units.

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E) Traction or mule units - Units are located at the inbye end, middle and outbye end of the train. Each unit is powered by 2 dual speed motors. Trimming speeds of 0.15 and 0.35 m/sec are obtained. The motors are 1.8/3.7kW. The large diameter elastomer wheels squeeze the web of the monorail through the action of a manually pumped hydraulic cylinder.

F) Standard cars - These cars make up the majority of the machine length and total 90 in number. They simply contain the rollers and edge guides to contain the F.C.T. belt.

G) Bridge conveyor - This unit has an independent belt driven by a 22kW motor. The hydraulic power to steer the wheels is provided from this motor also. An accumulator can store this power and allow a small number of steering movements if the belt is not running i.e. when filling the machine.

The movement of the bridge conveyor is much like the action of a long wheelbarrow supported and pushed by the F.C.T. If there are obstructions in the floor then considerable forces can be placed on the monorail. The same can occur if the continuous miner or surge car is driven against the bridge conveyor. Care is required in this respect as bent monorail and serious damage has occurred.

H) Cable handling system - This is a system used to suspend the power, compressed air and water lines to the face area. These lines are clamped at intervals to trolleys which run on the monorail at the outbye end of the F.C.T. train. The lines are looped between the trolleys similar to a telephone type cord in a spiral fashion. This extends during advancement and retracts automatically during retraction.

From the outbye end of the F.C.T. these lines are permanently fixed along the length of the train to the bridge conveyor where they can be used in the face area.

I) Surge car - This is a 1000v 1500 left hand drive shuttle car which is located between the continuous miner and the bridge conveyor. The purpose of this unit is to smooth the output from the continuous miner onto the F.C.T. It has an extended and narrowed delivery boom and dual (instead of the normal single) conveyor motors to cope with the continuous duty.

OPERATIONAL CONSIDERATIONS

While the F.C.T. as described is almost identical at both Moonee and Kallarah collieries the means of operating is significantly different.

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PRODUCTION POTENTIAL

To assess the production potential of the machine an analysis of the production cycle with shuttle cars was made. Based on measurements made underground in a variety of situations a typical cycle was obtained. (Fig 4) This indicated a production potential of 433 t/shift average.

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Coal Loading</td>
<td>25.1%</td>
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<tr>
<td>Other Delays</td>
<td>9.3%</td>
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<tr>
<td>Roof Support</td>
<td>18.9%</td>
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<tr>
<td>Cables</td>
<td>7.1%</td>
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<tr>
<td>Camp Crossing</td>
<td>7.1%</td>
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<tr>
<td>Other Delays</td>
<td>11.1%</td>
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<tr>
<td>Elect. Delays</td>
<td>3.6%</td>
</tr>
<tr>
<td>Travel</td>
<td>14.3%</td>
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<tr>
<td>Total</td>
<td>100%</td>
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Fig (4)

From this information the cycle was reassessed with two differences. The shuttle car wait time was eliminated because of the continuous haulage and the roof support cycle increased slightly to reflect the extra time required to install mesh. (Fig 5) This indicated a production potential of 602 t/shift average.

<table>
<thead>
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<tbody>
<tr>
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<td>Other Delays</td>
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<td>Cables</td>
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<td>Camp Crossing</td>
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<tr>
<td>Other Delays</td>
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Fig (5)

Both of these analyses were based on development situations. In pillar extraction the affect of eliminating the shuttle car wait time was judged to be even more significant especially in wide panels with considerable single wheeling.

PRODUCTION EXPERIENCE TO DATE

Production to date has been well below expectations. Figure 6 indicates production to date at Moonee colliery. These results reflect the large amount of down time attributable to the F.C.T. The extent of the problems became so acute that in November the machine was withdrawn from service so that major modifications could be made.

Since the re-introduction of the machine after this period there has been a substantial improvement in availability and coal clearance capacity. This can be seen as the increased production in the period after December 1987. While the expected levels of productivity have still not been achieved the delays can be more directly attributable to geological and operational reasons.

It must also be stated that the industrial climate generally has been unsettled during the period that the machine has been in operation.

MOONEE F.C.T. WEEKLY PRODUCTION

MODIFICATIONS TO MOONEE MACHINE

1) The stretch limiter has been changed in the type of belt material used. Problems are still occurring with the actual flexible conveyor belt particularly around the...
belt clips. Small perpendicular tears are still occurring at the edge of the belt. These tears are the centre of further investigation.

B) Dust suppression was a problem area when the F.C.T. was first commissioned. This has been overcome with the installation of spray systems at the outbye drive and discharge chute as well as the receive hopper of the bridge conveyor.

C) The bridge conveyor and transfer area were major problems under Moonee colliery's conditions prior to the modifications.

Substantial delays were occurring with blockages at the transfer point due to the high angle with which the bridge conveyor delivered coal onto the F.C.T. Many initial changes were made to the yoke arrangement which supports the outbye end of the bridge conveyor to solve the problem. These only had limited success. Ultimately the entire inbye end of the F.C.T. had to be lowered to give a reduced transition angle between the bridge conveyor and the F.C.T. This was simply achieved by manufacturing longer support brackets between the monorail trolleys and the top of the belt frame.

This a problem which will be present in any thick seam operation and as a result Joy Manufacturing has made suitable modifications.

A buildup of fine coal within the frame of the bridge conveyor around idler and drive rollers was also alleviated by the modifications. This was done by changing the design of the bottom guards on the bridge conveyor and cutting out slots in the plate work around the inbye end of the bridge conveyor.

Considerable changes have been made to the renewal hopper and skirting rubber/plates. This has been done to ensure that the surge car can deliver coal onto the bridge conveyor in high tram. Associated with this in the skirting rubber modifications to prevent small coal from finding its way into the underside regions of the bridge conveyor. The prime source of fine coal generation is around the idler and drive rollers.

Still further design is being undertaken to resolve the situation further.

D) Drive unit modifications have been made to overcome two main problems in the Moonee situation.

An increase in the drive pulley diameter was made to increase the F.C.T. belt speed. This was made to reduce a problem with lump coal jamming between the belt frames and the belt. The increase in speed results in a thinner bed of fines on the F.C.T. belt, this allows more clearance for lump coal to pass underneath the belt frames.

Ceramic lagging was placed on both the inbye and outbye drives to stop the degradation of conventional rubber lagging on the drives. The degradation was coming about by the return of small lumps of coal on the bottom belt travelling around the inbye drive. This movement of coal between the belt and drive lead to rapid wearing away of the lagging.

E) Additional edge rollers were installed on the top and bottom belts at the inbye end of the F.C.T. This was done to reduce the tendency for the belt to jump out of the rollers.

F) A counterweight was installed on the discharge chute to help centralize the delivery of coal from the chute onto the section belt.

G) Major modifications and design changes had to be made to the discharge chute to give a satisfactory transfer of coal onto the section belt. These changes were made to reduce fine coal bouncing off the section belt and to reduce the width of the flow and hence allow more free board on the section belt. Chute blockage delays have also been overcome in the design changes.

Problems have also occurred with the installation of roof bolts to suspend the monorail and F.C.T. These have been overcome with attention to operator training as to the importance of correct installation techniques.

CONCLUSIONS

The introduction of the F.C.T. to Moonee colliery has been a difficult project taking place at a difficult time industrially. It would be fair to say that neither Joy Manufacturing or Coal and Allied expected anything near the extent of the technical problems that persisted during the first three months of operation.

Since this period there have been many major modifications made to the machine. These have resulted in major improvements to reliability and performance.

Productivity of the system is now just beginning to exceed that achievable with shuttle cars. While the operating experience is still limited the potential to greatly improve this performance definitely exists.

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