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A New Bucket Wheel Excavator Complex for the Goonyella Mine

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Ein neuer Schaufelradbagger für den Goonyella Tagebau
Un nouveau complexe excavateur à roue à augets pour la mine de Goonyella
Un nuevo complejo de excavadora de cangilones para la mina de Goonyella

グーニエラ炭坑の新型バケットホイール掘削機コンプレックス

贡耶拉矿场的新型杓轮挖掘设施

مجمع حفارة الدواليب ذات القواديس الحديد الخاص بمنجم جونيلا

Summary

A bucket wheel excavator — conveyor system — spreader complex will be put into operation in Australia for the first time in particularly difficult winning conditions. These difficulties were taken into account by the exceptional stipulations laid down for the layout of the machines. The complex will be put into operation at the beginning of 1982.

1. Introduction

The Utah Development Company (UDC) operates a coal open cast mine at Goonyella, Bowen Basin in Central Queensland. This is coking coal situated at a depth of approx. 45 m. The overburden has been removed to date using American draglines (Fig. 1).

As the seam sinks deeper, the dragline operation becomes uneconomic. As a result UDC decided to remove the upper overburden layer of approx. 30 m depth with the help of a prestripping system and the rest as before with draglines.

The overburden consists mainly of hard clay with gravel and boulder beds. Strata of sandstone, siltstone and argillaceous rock occur which have to pre-blasted. Chunks with 80 cm edge length must be conveyed.

O & K Lübeck received the order for the design and delivery of the pre-stripping system consisting of excavator, tripper car and spreader in the summer of 1978. The conveyor system is being delivered by PHB Weserhütte, Australia.

2. Special Conditions

Comparable machines in Australia have only been put into operation by the SEC Victoria. These machines mainly win brown coal and small amounts of clayey overburden. In contrast to this in Goonyella there is an extremely hard overburden, which alternates with sharp edged pre-blasted stone. In addition to this, the overburden is extremely sticky during the rainy season.

In talks between UDC and the vendor it was therefore agreed that not only the German "Basis for Calculation of Large Open Cut Machines" should be observed, but also additional exceptional loading conditions were defined. The gearboxes were designed according to AGMA for an operating life of 100,000 h under full load.

3. Excavator Type SchRs $\frac{1800}{2.5} \cdot 25$

The excavator has a height of 25 m in high cut and a depth of 2.5 m in deep cut. The bucket wheel boom has a length of 36 m with a wheel diameter of 12.25 m. The discharge boom has a length of 40 m. The discharge boom can be raised and lowered between 3.5 and 19 m above crawler level and conveys by means of a hopper car onto the conveyor system. The belt width is 1,800 mm. The machine travels on six crawlers (Fig. 2).

The bucket wheel moves a theoretical output of 5,200 m^3/h loose with a specific weight of the masses of 1.8 tonnes/m^3.

The bucket wheel is driven by two direct current motors each of 600 kW. The wheel has a maximum circumferential speed of 3.1 m/s at the tooth circle. A digging force of 350 kN works at the buckets at 100 % motor output.

For the dimensioning of the machine for fatigue 150 % motor output or a digging force of 500 kN has been assumed. For operating conditions a digging force of 590 kN has been assumed. The 150 % motor output corresponds to the switching value of the safety coupling. This unit is an oil-cooled disk coupling.

The bucket wheel is conceived as a single-disk-wheel in the form of a conical shell. A particularly good emptying characteristic for sticky material is thereby achieved with this wheel design.

In addition the wheel has no hollow body which could fill with dirt, thereby worsening the position of the centre of gravity of the machine. The bucket wheel has been designed for a digging force of 350 kN. In addition an impact force of 1,280 kN has been taken into account.

The machine slewing gear delivers 120 kW for a slewing speed at the wheel of 30 m/min. The lateral force acting on the wheel for the determination of the fatigue strength has been derived from 150 % motor output here, too. This is 300 kN. This is considerably larger than the inertia forces occuring when the wheel is slewed at full speed against the

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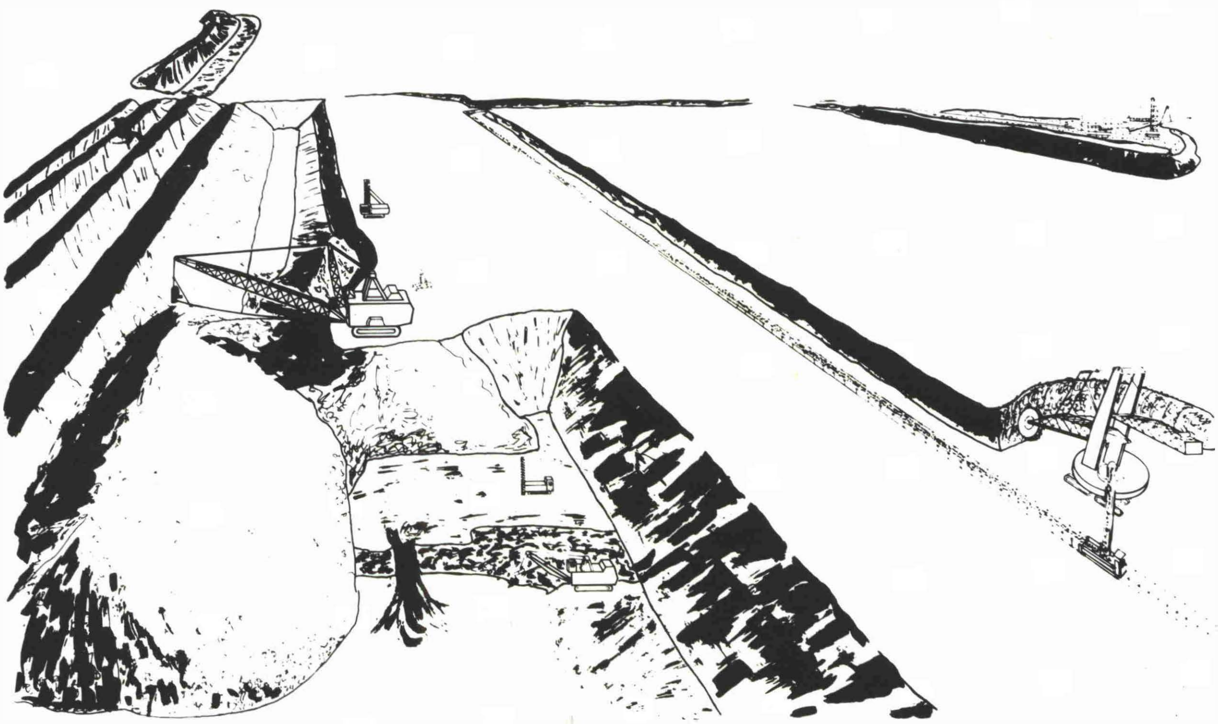
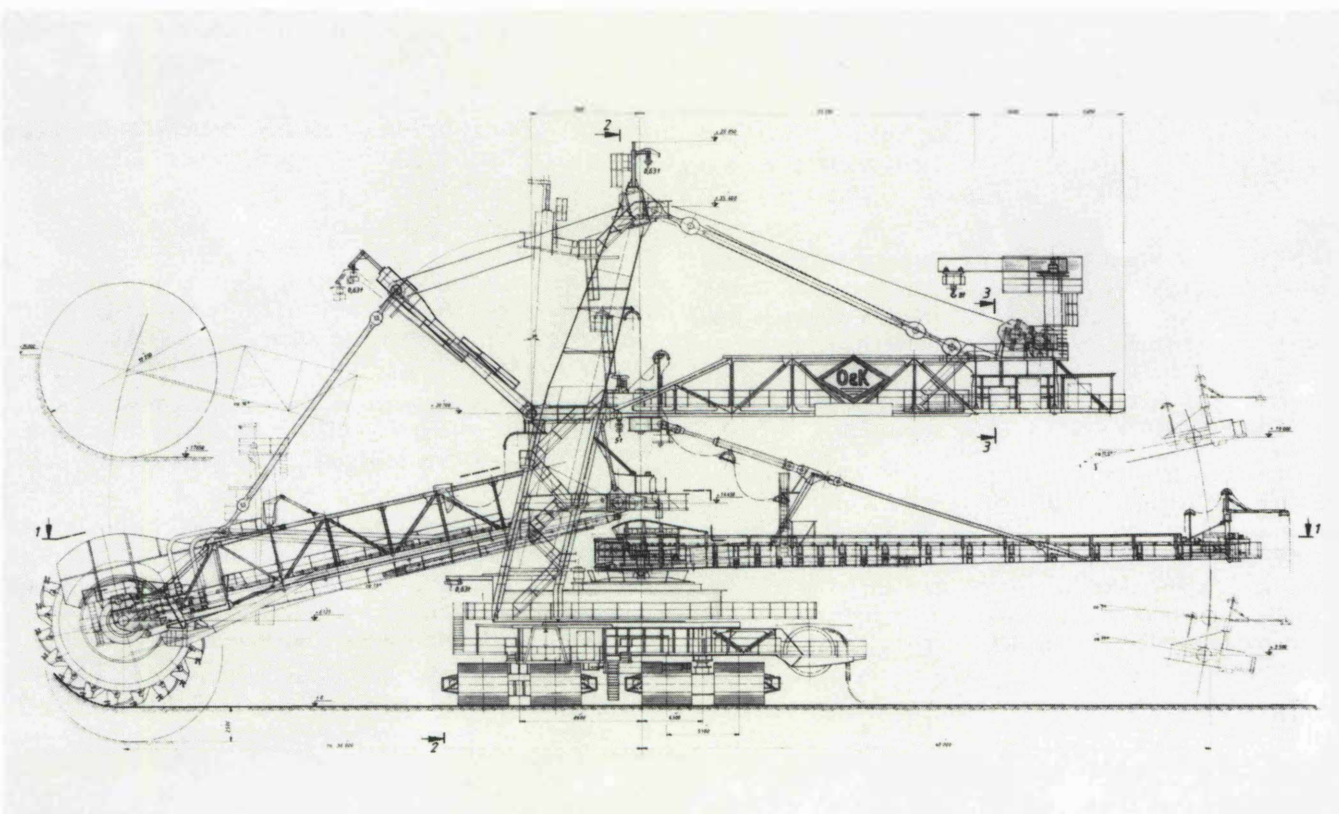


Fig. 1: General arrangement of pre-stripping system

bank face and is decelerated over a distance of 30 cm. The loading of the belts has been determined alone from the cross-section of the belts independent of the wheel output. A load of 8.6 kN/m is derived from the normal cross-section which corresponds to a conveyor output of 7,740 m³/h or 14,000 tonnes/h.

In addition an exceptional cross-section of 19.5 kN/m is required which is only possible when the space between the guide plates above the conveyor belt is filled. The guide plates have been substituted for by ropes in order to prevent the occurance of this loading condition. In spite of this the load bearing structure has been designed to carry this exceptional payload.

Fig. 2: Bucket wheel excavator



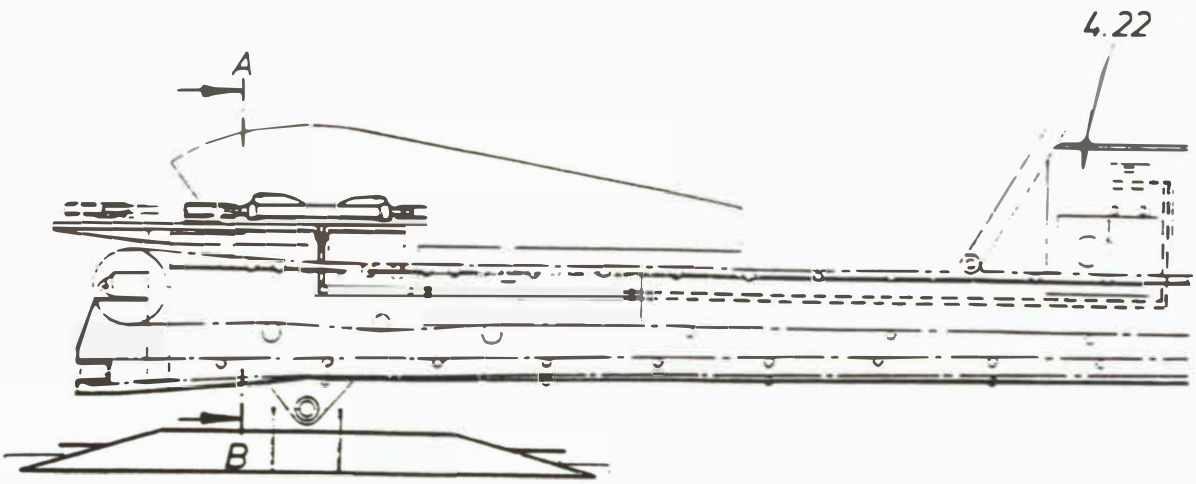


Fig. 3: Transfer chute with rock box

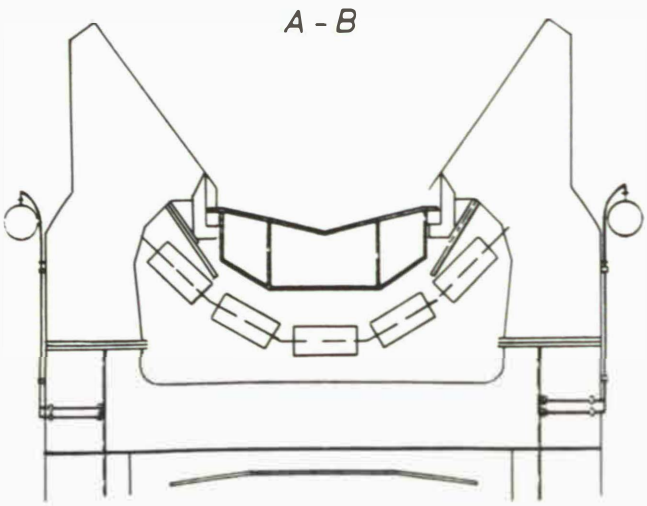


Fig. 4: Transfer chute with rock box, Section A—B

A belt speed of 4.5 m/sec is provided for the conveyance of clay and sand. If, however, sharp edged chunks (blasted rock) are conveyed the belt speed can be reduced to 2.25 m/sec. For this purpose change-pole motors are provided on the belt drives.

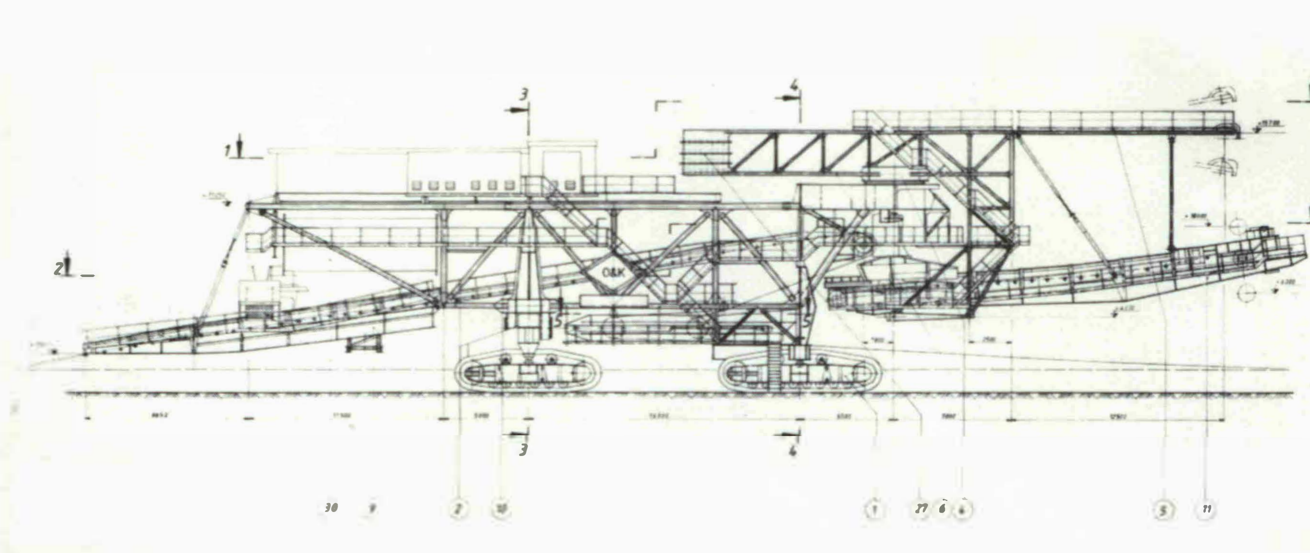
In order to prevent damage to the belts at the transfer points, by sharp edged chunks, a movable baffle plate (rock box) can be hydraulically positioned over the belts. When sticky material is being conveyed the baffle must be retracted (see Figs. 3 & 4).

The wind loads are also exceptional at Goonyella. For the load case "out of operation" a wind speed of 160 km/h must be taken into consideration. This corresponds to a static pressure of 1,230 kPa.

The excavator carries a cable drum, with a feed length of 1,500 m, on the undercarriage.

The installed electric power is 3,400 kW. The machine has a service weight of 2,600 tonnes including 300 tonnes ballast.

Fig. 5: Tripper



4. Tripper Car ÜR 1800 x 20

The conveyor belt has a width of 1,800 mm and runs at a speed of 5.2 m/sec. The speed may be reduced to 2.25 m/sec.

The tripper car carries the belt drive with a rated capacity of 2 x 700 kW and conveys the masses over the 20 m long boom with a belt loop onto the spreader. The belt width on the slewable boom is 2,200 mm. Both boom and receiving section are raisable and lowerable (Fig. 5).

The tripper car moves on four steerable crawler units. In addition the tripper car carries a large cable drum with a length of 9 m and a diameter of 3.2 m. The wound length of cable is 2,000 m. The spreader and tripper car are electrically connected with each other and interlocked. The installed power of the tripper car is 3,800 kW, and the service weight is 770 tonnes.

5. Spreader ARS $\frac{1800}{40 + 60}$ x 25

The last member of the transport chain is the spreader with receiving and discharge boom (Fig. 6). The belts have a width of 1,800 mm. Their speed may be either 4.5 m/sec or 2.25 m/sec. The receiving boom rests on a separate movable support car. The support length is 40 $\pm$ 2 m. The 60 m long discharge boom can be raised from 6 m to 25 m above crawler level. The spreader travels on three crawlers, two of which are steerable. 500 m of cable are wound on a cable drum. A hydraulically retractable baffle plate is installed as is on the excavator. The payload laid down for the normal operating conditions is 14,000 tonnes/h, for the dimensioning of the machine, however, 32,000 tonnes/h.

In addition to the load cases defined in the "Basis of Calculation for Large Open Cut Machines" the following loads for dimensioning the machine were defined: For the load case "out of operation" a static wind pressure of 1,230 kPa has been assumed.

The discharge boom may be laid on the bank slope with a load of 260 kN at its extreme and simultaneously collide laterally with the slope with a force of 110 kN. This lateral force corresponds with a slew gear output of 150 %.

In addition it has been assumed that the boom may dig into the slope at the discharge pulley with a vertical force of 170 kN. This force corresponds to a lifting winch power of 110 %.

These load assumptions, which are very unpleasant for the dimensioning of the machine, led to an exceptionally robust construction with a service weight of 1,340 tonnes including 100 tonnes of ballast. The installed power is 1,400 kW.

6. Production and Erection

All structural members and a large proportion of the mechanical components were produced in Australia. The material is a particularly low sulphur content rolling, better than AS 1204 — 350 — L15. Welded connections were chosen as far as was technically possible. Particular attention was paid to the production of knotch-free and close toleranced weld seams.

Remaining erection connections are carried out as high tensile friction joints according to German standards. The erection was carried out by an Australian firm with the help of a German erection engineer.

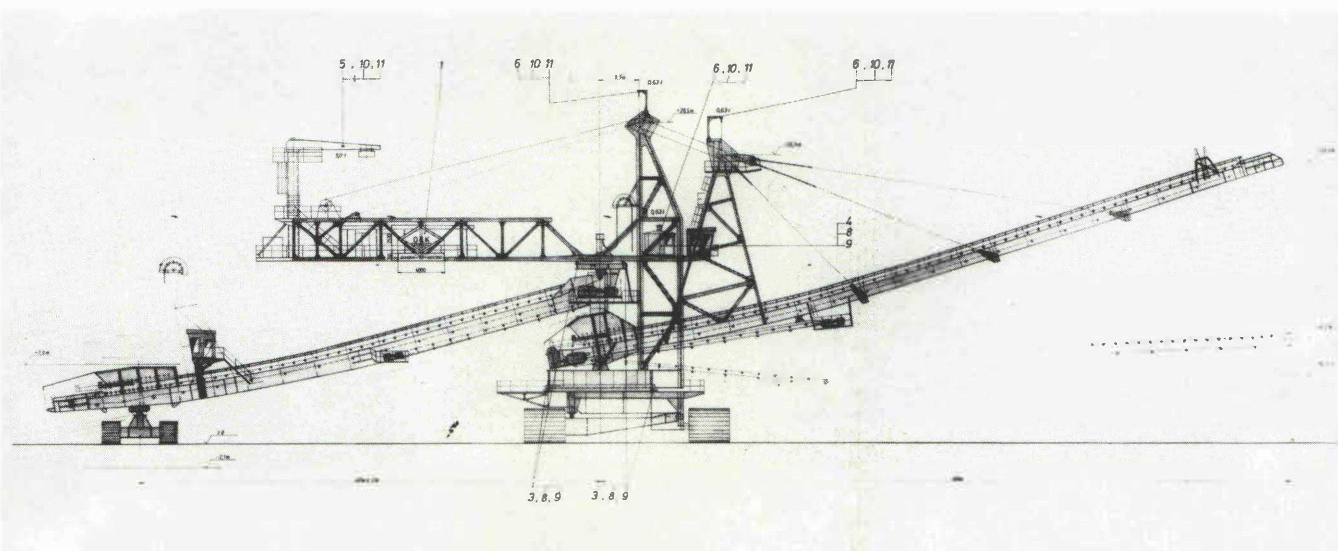
The machines will be mechanically operational at the end of 1981. They will be weighed in December under the supervision of an independent expert.

It is to be determined, by means of the experimental evaluation of the position of the centre of gravity, whether or not the calculated amount of ballast must be corrected, in order to guarantee sufficient stability of the machines under all conditions. Figs. 7—12 show the different machines during erection.

7. Conclusion

The three machines will be put into operation at the beginning of 1982. According to the experience that the vendor has made with hard overburden and pre-blasted rock in mines in Canada and India, it is expected that the new

Fig. 6: Spreader



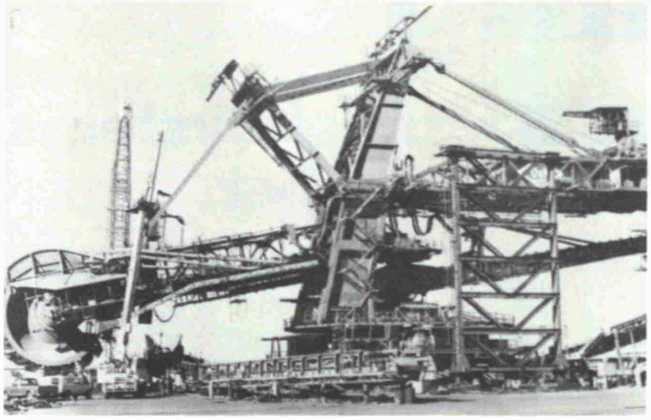


Fig. 7: Bucket wheel excavator during erection

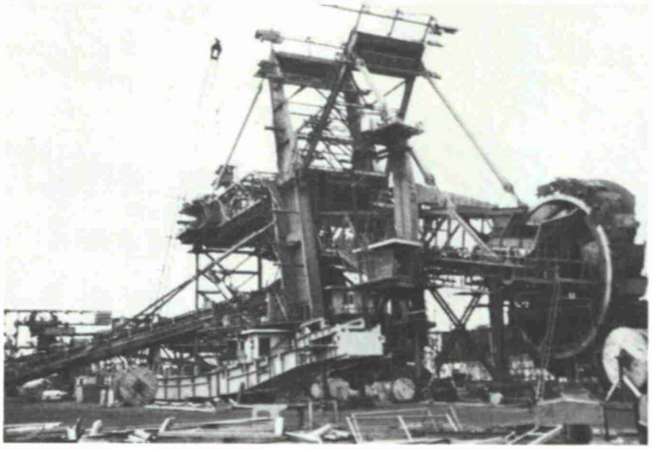


Fig. 8: Bucket wheel excavator during erection

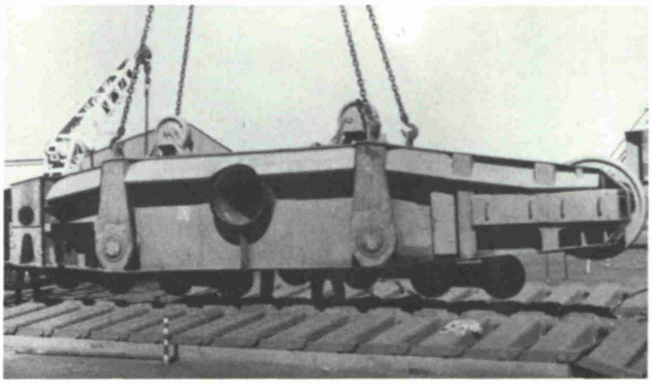


Fig. 9: Crawler

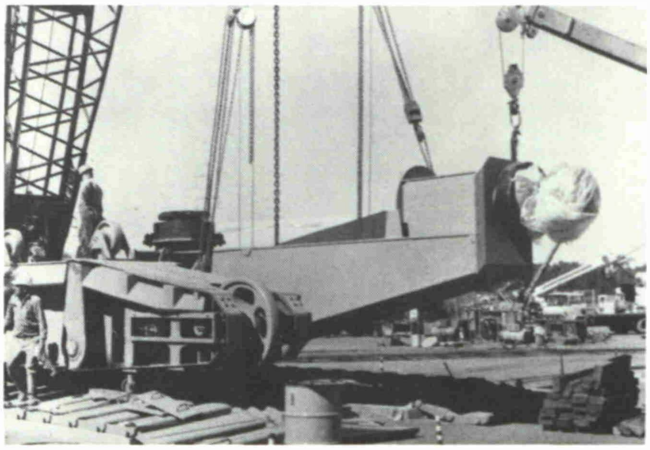


Fig. 10: Steering girder

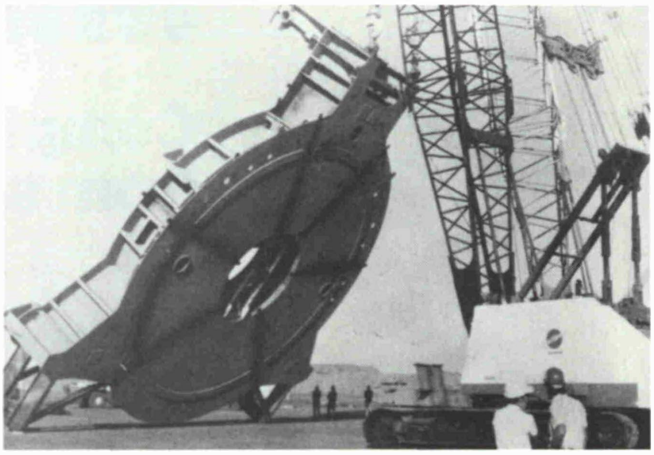


Fig. 11: Undercarriage of BWE

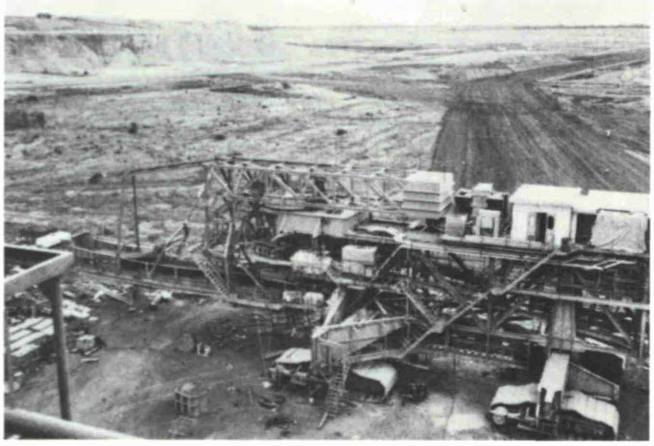


Fig. 12: Tripper

complex will accommodate the described difficult mining conditions prevalent in Goonyella. This confidence is supported by the exceptionally heavy dimensioning of the machines and by the great care spent on their design and construction.

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