NOTES ON THE RUNNING AND MAINTENANCE OF DEEP LEVEL VERTICAL SHAFTS AT RANDFONTEIN ESTATES.

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The shaft is a four compartment 27 ft. 9 in. by 12 ft. 1 in. outside timber, and is served by a 7,500 h.p. steam hoist for the men and material side and a Ward-Leonard 5,000 h.p. electric hoist for the rock side.

In the South Vertical shaft 1,228,368 tons of rock were hoisted during 1932 and an average of about 5,100 Europeans and natives were lowered and raised daily, also the necessary material, *i.e.*, drill steel, timber, rails, etc.

The shaft is timbered with 9 in. by 9 in. pitch pine, the setts being at 7 ft. intervals except for 200 ft. (at 2,000 ft.) where they are at 3 ft. 6 in. intervals.

The depth of wind is 4,745 ft., the time available for the examination of the shaft is limited and is on Wednesday afternoons (six hours) and week-ends (28 hours) for the skip compartments and 24 hours for the cage compartments at week-ends only.

With the limited time for shaft examination and repairs it was found necessary :—

(*a*) to increase the number of points of attack.

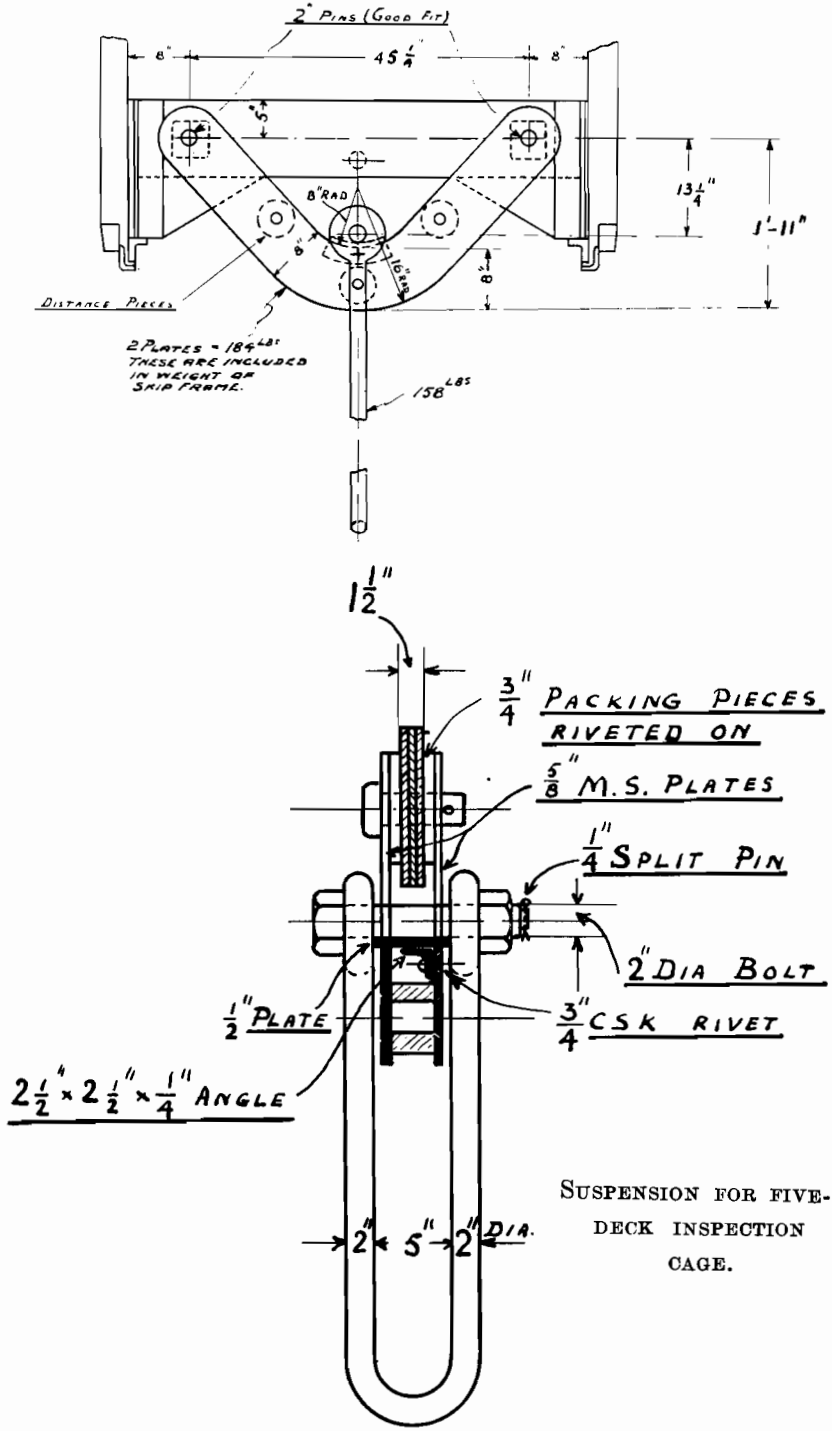
(*b*) to find a guide which would give a longer life.

(*c*) to increase the useful life of new repair work done in the shaft.

(*d*) to increase the speed of work during examination time.

(*a*) *To increase the number of points of attack.*—This was done by constructing a skeleton cage 38 ft. overall length, with six platforms—five for the men to work from and one for the accumulator cells which supply the skeleton with electric light and power. This skeleton cage is hung below the skip as shown in Fig. 24. The time taken to put on the skeleton or remove it is about 15 minutes, about the same time as would be required to put on or remove a hood. Tools and materials are placed in boxes on each deck, and cylinders for oxy-acetylene burning plant are placed in the middle deck in pockets provided.

The shaft in each compartment is divided into vertical sections of about 200 ft., starting at the collar sett as (1), and seven guides below would be (2), etc. This is done by 4 in. brass numbers being placed on the slats between wall plates.



SUSPENSION FOR FIVE-DECK INSPECTION CAGE.

FIG. 24.

Three Europeans and ten natives form a crew. At the commencement of the shift the skeletons are put on in each skip compartment, the crew take up their positions with one European on each alternate deck and two natives on each deck. The skeleton is then lowered at about 80 ft. per minute. An intermediate native watches for shaft section numbers and calls out same, the bottom European gauges the shaft and notes on a piece of soft pine anything more than plus or minus $\frac{1}{2}$ in. in gauge error, the top and middle Europeans watch guides and blocking, noting any loose or missing bolts or missing blocks. Thus during the first hour of each shaft examination period, a complete record of what is required to be done is made.

The crew then returns to the surface and notifies the engine driver that work has to be done in certain sections, starting at say Section (1) and finishing at Section (8). The repairs are then proceeded with, and at the completion of the shift, repairs done are scored off and the following shifts continue in a similar manner. This system has enabled us to keep the shaft in fairly good order.

(*b*) *To find a guide which would give a longer life.*—After July 1928, it was decided to date all guides put in the shaft (this was done by cutting the date in Roman figures on the back of the guide) and it was found that the life of certain guides was only four months. It was then decided to find a timber which would give a longer life. Jarrah and Karrie woods were decided on for trial. Twelve guides of each were put in each of the skip compartments at exactly the same points and closely watched.

These guides gave a considerably longer life, there being nothing to choose between the two timbers, but as the Karrie guides were in straighter lengths, it was decided to continue using Karrie only. Some of these guides have now been in commission for 20 months and have not given any trouble.

(*c*) *To increase the useful life of new repair work done in the shaft.*—To increase the useful life of repair work done in the shaft two important changes were necessary.

(1) Due to vibration the holes in the guide brackets became enlarged. To overcome this, it was decided to put in a longer bracket with the holes at a greater distance apart, giving the bracket a longer base. This was increased from $5\frac{1}{2}$ in. centres to $17\frac{5}{8}$ in. centres.

(2) The thread of the standard Whitworth bolt was found to be too fine and, although lock nuts were used, the bolts were loosened with the vibration. To overcome this Dardelet bolts $11\frac{1}{4}$ in. by $\frac{7}{8}$ in. only are used in the shaft for the guide brackets and $5\frac{1}{4}$ in. by $\frac{3}{4}$ in. with $\frac{5}{8}$ in. head for the fastening bolts for the guides. By reducing the size of the head to $\frac{5}{8}$ in. with $\frac{3}{4}$ in. bolts the diameter of the counter sunk in the guide was reduced, which also helped to increase the life of the guide. Spring washers are also used with all bolts put in.

(*d*) *To increase the speed of work during examination time.*—Increased speed of work was achieved by using oxy-acetylene burning plant, which is housed in the middle deck of the skeleton, to burn off bolts, iron or steel work to be changed. Also all new holes drilled in timber are made with an electric drill.

Replacement of Guides.—From the system of examination, *i.e.*, gauging the shaft and examination by eye, guides to be discarded are easily picked out. The guides are changed from the skeleton cage. Six guides are hung from the cross-head at the top of the skeleton, leaving two spare slings.

The driver is notified that guides are to be changed in, say, Section (9), he lowers the skeleton at about 600 ft. a minute to the top of the section and then reduces speed to about 60 ft. a minute until signalled to stop. The skeleton is then brought into position for the guide to be changed.

As soon as the skeleton comes to rest the natives, under the supervision of the European, loosen the bolts at all five brackets at the same time. The guide being free it is then swung into the skeleton and the new guide brought into position and bolted up at all brackets at the same time. This can be done with two guides at the same time, *i.e.*, one on each side.

Using this method as many as 36 guides have been changed in a shift of 8 hours, as against 8 off the top of the skip. At No. 2. North Shaft, which is a standard seven-compartment shaft, the following work was accomplished :—

March 26th, 1933	...	...	...	84 guides changed.
April 2nd, 1933	...	...	...	76 guides changed.
April 9th, 1933	...	...	...	104 guides changed.

The following is a record of the work done on April 9th, 1933 :—

1st Shift	...	12 midnight to 7 a.m.	...	28 guides.
2nd Shift	...	7 a.m. to 3 p.m.	...	36 guides.
3rd Shift	...	3 p.m. to 11.45 p.m.	...	40 guides.
		TOTAL	...	104 guides.

Old and Disused Stations in the Vertical Shaft.—As the upper levels of the mine were exhausted the top stations in the vertical shaft became redundant, and it was decided to build concrete walls from the solid below the lip of the station up to the roof.

These walls were put in with a mixture of 1—2—6 of concrete and were about 4 ft. 6 in. at the base and tapering to 3 ft. 6 in. at the roof of the station. At the correct position for blocking, *i.e.*, opposite dividers, hitches were left in the wall to allow of blocks being put in ; at the ranger setts these were held in position with the angle brackets attached to the block and the studdle. When the station had a brow box this was filled in behind the wall with a mixture of 1—2—10 of concrete.

In places where the walls of the shaft show signs of fritting, it has been decided to put in reinforced concrete annular rings around the shaft, at vertical intervals of about 50 feet. Through these concrete rings $\frac{7}{8}$ in. steel wire rope will be threaded and anchored at the top and the bottom rings.

These ropes will be put in at horizontal distances of 18 in. apart so that a complete net will enclose the walls of the shaft, the net being held in vertical position by the concrete rings: the breaking strain of the rope being approximately 30 tons, any slabs which might come away are unlikely to damage the shaft timber or columns below. With these measures it is hoped that the future running of the shaft will be considerably improved.

Examination of Skips, etc.—Skips are examined daily. At the change of night and day shift skipmen, at 7 a.m., the first skip is filled and tipped at surface: boilermakers, engine-room fitter and rigger stand to.

As soon as the skip is cleaned out it is lowered to the collar, when all bolts, rivets and plates are examined and tested and where necessary tightened up, at the same time shoe liners are examined for wear. This wear is limited to any one liner being worn down to $\frac{3}{8}$ in. starting new at $\frac{5}{8}$ in.

The skip is examined in three sections.

(*a*) Tail is examined from timbers across the collar.

(*b*) Middle including pan, arms and brackets.

(*c*) Top which includes cross-head, king bolts, link pin, and detaching hook, etc.

At the same time the rigger examines the thimble and rope splice.

The skip is then run down and the same operation is carried out on the other skip.

For this examination a boilermaker with two natives stand on opposite sides of the shaft and the positions are changed about daily. Depending on the daily examination the skips are changed in from 14 to 18 running days, this being the life of the shoe liners.

Four skips are in use; two running in shaft, one overhauled and one in process of being overhauled. Each time a skip is taken out of the shaft the shoe liners are changed, these being of Benox steel.

After each skip has been in commission for one month all guide liners and one-half of cross-head are taken down, which allows of a thorough examination of hidden faces of cross-head and channel frame, also allows for a thorough examination of the king bolt. At the same time the detaching hooks and all attachments are taken down for inspection. When the skips have been in commission for four months, *i.e.*, running time, the cross-head and all attachments are annealed and examined at the workshops before re-assembly at the shaft.

All cross-heads and attachments are destroyed every four years, provided no defect is detected previously. That is to say, each cross-head attachment has an active life of two years.

Prior to October, 1931, the skips were made of steel with a capacity of six tons. The maximum output with these skips was 976,800 tons for 12 months.

There were two methods of increasing the tonnage :—

(1) Increase speed of wind.

(2) Increase skips capacity.

(1) As the hoist was travelling at 3,500 ft. per minute, this was not thought desirable.

(2) To increase the total load of the skip was also not desirable as the converter set for the hoist was about at its limit. There remained only the choice of a lighter material for the construction of the skips, and it was found that duralumin would increase the load of rock hoisted from 6 to 7 tons whereas the total load would be reduced by about 530 lbs., the ropes remaining the same.

Taking comparative figures of total tons hoisted :—

SOUTH VERTICAL.

Year 1930	... ...	976,800 tons	
Year 1931	... ...	1,088,375 tons	From 15th October, 1931 duralumin skips were in use.
Year 1932	... ...	1,228,368 tons	

Showing an increased tonnage hoisted of 251,568 tons.

NORTH VERTICAL.

Year 1930	... ...	1,069,751 tons	
Year 1931	... ...	1,155,700 tons	From the 20th March duralumin skips were in use.

Showing an increased tonnage hoisted of 85,949 tons.

21*st April*, 1933.