SINKING AND EQUIPPING No. 16a SHAFT AT CROWN MINES.

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The writer's paper entitled "Sinking No. 16a Shaft at Crown Mines" was published for the Third (Triennial) Empire Mining and Metallurgical Congress. In that paper the position of the shaft up to the end of August, 1929, was fully described with the method of sinking and blasting, and in order to bring that information up to date, further figures showing progress and costs are now given.

The complete record for sinking was as follows :—

Month.	Footage Sunk.	Depth below 19Level.	Footage Walled.	Station Footage.	Remarks.
1928.					
May	52	52	15	—	Small Temp. Hoist used.
June	110	162	44	—	do.
July	170	332	202	—	Permanent hoist operating
August	201	533	263	—	
September ...	211	744	173	—	
October ...	208	952	216	12	Cable Station.
November ...	203	1,155	187	—	
December ...	166	1,321	214	—	Hard dyke met.
1929.					
January ...	200	1,521	149	—	Dyke causing bad ground.
February ...	83	1,604	131	44	29th Level Main Station.
March	162	1,766	121	26	29th Station completed.
April	143	1,909	179	37	31st Station completed.
May	177	2,086	149	33	32nd Station completed. Two days' delay due to engine.
June	157	2,243	186	24	33rd Station completed.
July	185	2,428	168	35	34th Station completed.
August ...	109	2,537	125	65	35th Level Main Station completed. Soft dyke in Shaft.
September ...	167	2,704	161	31	36th Station completed.
October ...	165	2,869	170	41	37th Station completed.
November ...	176	3,045	174	34	38th Station completed.
December ...	155	3,200	168	68	39th Station completed. 40th Station started.
1930.					
January ...	151	3,351	122	51	40th Station completed. 41st Station started.
February ...	110	3,461	104	64	41st Station completed.
March	66	3,527	106	51	Loading and spillage stations completed.
	3,527	3,527	3,527	616	

From the above it will be seen that the average rate of sinking and walling over the whole period of 23 months was 153·4 ft. per month, and in addition an average of 26·8 ft. of cross-cutting was done per month in connexion with stations.

The average cost of sinking and walling, including stations, was as follows :—

Sinking	£16	1	2	per foot.
Walling	7	11	8	,,
Winding 16a Shaft	5	2	4	,,
Ventilation	1	0	4	,,
Total costs at 16a Shaft	£29	15	6	,,
Tramming and Winding No. 16 Shaft ...	6	16	5	,,
Total	£36	11	11	,,

As soon as shaft-sinking operations were completed the walling stage was brought up the shaft, and all pipes, etc., were removed from the shaft. A re-arrangement of the headgear pulleys was necessary before the permanent equipment could be installed so as to allow the bucket, stage ropes, temporary guide ropes, and the winding rope to run in the large portion of the shaft where the two man cages have to operate. A cross-section of the shaft is shown in Fig. 6 with the sizes of the various steel members and wooden buntons and the position of the ventilating pipe, air main, and cables.

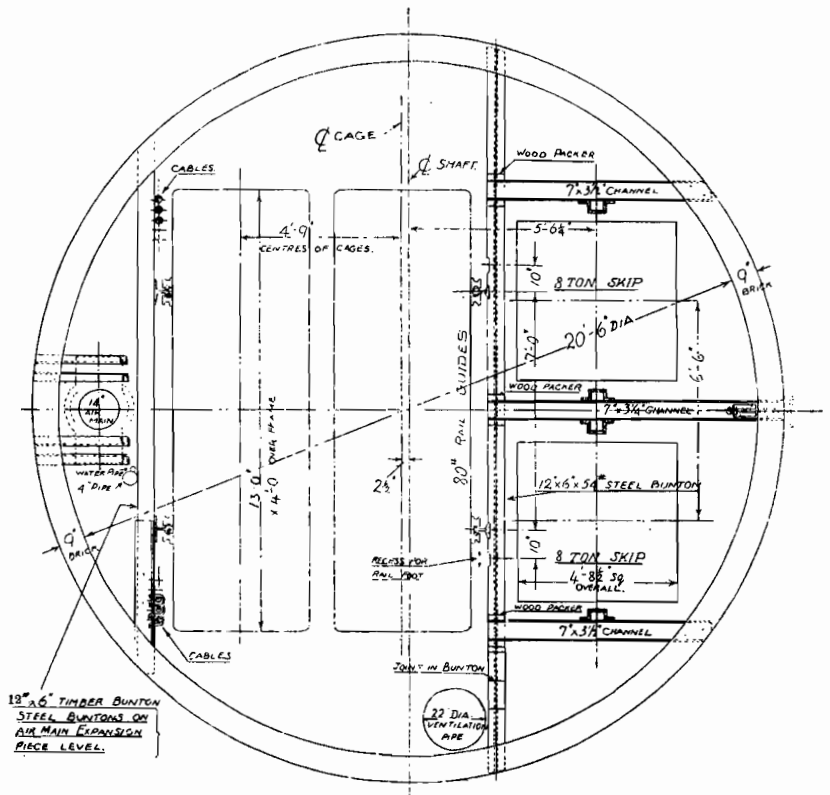

FIG. 6.

The necessary re-arrangement of the headgear was completed during April, 1930, and equipment was started. During the equipment period, progress was as follows :—

	Equipment Installed.	Remarks.
1930.		
April	86 feet.	Only 3 days' work.
May	787 ,,	
June	900 ,,	Includes 29 Station.
July	840 ,,	Includes 31, 32, 33, 34, 35 and 36 Stations.
August	750 ,,	Includes 37, 38, 39, 40 and 41 Stations.
September ...	164 ,,	

This completed the equipment of guides and buntons in the shaft, but did not complete the skip loading or tipping arrangements. There was also a little work to be done on the headgear portion of the shaft before the cages could be run. The permanent headgear pulleys were installed and, as soon as the cages were put in, a 14 in. diameter compressed air main was installed to the 41st Level and Kep gear was put in at the 19th Level Station. This work was done during October, and in November development was started on various levels down to 35th Level. The ventilation was not considered to be good enough to do any work below that level until a connexion between the shaft and the mine workings had been obtained on 29th Level, and until an independent airway could be established between 35th and 29th Levels.

Thus the shaft-sinking was started in May, 1928, and completed in March, 1930, whilst equipment, with the exception of certain items specified above, was sufficiently far advanced to allow the cages to run and development to start by November, 1930.

As will be seen from the cross-section (Fig. 6) the shaft is equipped with rail guides for cages to be used for men, material and waste rock, and with steel guides for the eight-ton rock skips. The total cost of the equipment to the time development started was £50,928, whilst the estimated final cost is £69,769. This latter amount includes all loading chutes, tips, skips, cages, ropes with the various cappels, safety hooks, etc., but does not include the main winding engines or their chambers.

The main steel buntons are 12 in. by 6 in., I Section girders 54 lb. per foot.; the channels 7 in. by 3½ in., and the wooden buntons 12 in. by 6 in. pitch pine. The bunton holes were cut with the assistance of Holman Super A Pneumatic Pick Machines. All buntons and channels were accurately set to plumb lines and wedged in position by steel wedges and each bunton hole was concreted solid. The buntons were placed at 7 ft. 6 in. centres and the 80 lb. per yard steel guide rails and 40 lb. per foot steel guides, all 29 ft. 11⅞ in. long, were bolted thereto. All guides were fitted together before leaving the shops and the joints were ground so as to leave no unevenness for the guide shoes to work against. They were also straightened before leaving the surface and finally tested underground before being lowered into the shaft.

The plumb lines were tested at frequent intervals and fixed to buntons so that the length of the hanging plumb lines did not exceed about 300 ft. Gauges were provided between rails and guides and the whole was accurately fitted together before the buntons were finally concreted into position.

The man hoist has two parallel drums, 16 ft. in diameter with parallel grooves, and is driven by a 1,600 h.p. 2,000 volt three-phase motor. Each drum carries a double-deck cage with a man load of 33 persons per deck, or a maximum rock load of 10,500 lbs.

The rock hoist which is in process of erection is of the Ward-Leonard type with compensated drums. The motor of the generator set is rated at 2,826 h.p. and there is a motor on each end of the drum shaft. The total peak load is stated at 5,647 h.p. This hoist has a capacity of 288 tons of rock per hour from the 41st Level. The skips will have a capacity of eight tons each.

Ventilation will be provided by means of two fans of the aeroplane propeller type, and in addition a smaller fan will draw hot air from the man hoist motor and starter and from the motor generator set of the rock hoist and pass it out on the 19th Level, so that the temperature of the lower levels will be practically unaffected by the heat produced by the winding engines.

J. Richardson: Mr. Walton and his staff are to be congratulated on the outstanding achievement of sinking and walling a sub-vertical shaft at the rate of 154 ft. per month, also on the low cost of £29 15s. 6d. per foot for the work.

In an endeavour to judge the achievement, I venture to make certain comparisons with the sinking of the Ventilation Shaft at Randfontein.

	16a *Crown Mines.*	*Ventilation Shaft, Randfontein.*
Diameter	20 ft. 6 in. clear.	22 ft. clear.
Sunk	3,527 feet.	3,421 feet.
Lined	3,527 feet.	3,421 feet.
Total Time	23 months.	24 months.
of which a section of	1,359 feet.	3,239 feet.
was sunk and lined in	7 months.	16 months.
equalling	194 feet per month.	202 feet per month.

Randfontein's footage is only 8 ft. per month more and is not to be compared when considering that the 16a Shaft is a sub-vertical.

Comparing costs we see that :—

	16a *Crown Mines.*	*Ventilation Shaft, Randfontein.*
Sinking	£16 1 2	£14 16 0
Walling	7 11 8	7 17 4
Winding	5 2 4	3 1 7
Ventilation	1 0 4	2 1 2
	£29 15 6	£27 16 1

The principal points of difference in the sinking of the two shafts were :—Single bucket winding at the Crown and double bucket at Randfontein and concrete brick lining at the former and monolith concrete lining at the latter. The relative winding costs appear to indicate that winding in balance is cheaper than the single bucket method.

Referring to Mr. Walton's cross-section of the shaft, I should like to ask why the long 13 ft. by 4 ft. type of cage was used in the original No. 16 Shaft of which 16a is a sister ; also what speed of winding is possible when using the single-sided claw grips between cage and guides.

Speaking as one unversed in circular shafts, I would have voted for two 9 ft. by 6 ft. cages, running on four-point guides installed in a similar manner to the skip guides ; admittedly the cost per foot of shaft would have been increased by £2 to £3.

Two minor questions are :—Why was the steel construction of the shaft departed from in the case of the 12 in. by 6 in. timber bunton on the cage side, even though they cost less than half the price of steel, and what type of check nut was used when bolting guides to buntons ? I ask this last question because bolts are presumably the only point of the equipment of a circular shaft requiring attention during the periodical examinations.

Since it may be of interest to members, I have made a few notes on the sinking of our No. 2 North Shaft. This shaft was abandoned in 1912 at a depth of 2,083 ft. on cutting a watercourse making a million gallons a day. Sinking recommenced in May, 1930, the shaft then being dry because the mine workings had drained it, and 104 ft. were sunk with one hoist. 1,800 ft. were sunk during the nine months June to February. This included a delay of three weeks, when sinking was suspended in order to equip two compartments with guides and commission the permanent rock hoist ; also a slowing up from November to February due to having water on the shaft bottom.

During March at 3,850 ft. the shaft entered a badly faulted water zone making 500,000 gallons per day. About 100 ft. were sunk with two engines bailing plus a string of air pumps. As this was unsatisfactory, a pump station was cut at the bottom of the shaft, 4,065 ft., and two four-stage Sulzers, each 22,000 gallons, were installed delivering to 26 Station, which had been connected to mine workings, *i.e.*, 365 ft. of head. The air pumps were replaced by two two-stage Sulzers which were built on to a platform at the bottom end of a 35 ft. sinking skeleton, their capacity being about 1,000,000 gallons per day delivered to a maximum head of 250 ft. They operate with a suction of 15 ft. and are capable of handling grit. The skeleton was lowered and raised by the hoist operating in No. 4 compartment. The skeleton is hooded and plated at the sides, the pumps are installed one on the top of the other, two suctions are provided but only one delivery which is connected through a rubber hose to the 6 in. rising main, a fire hose coupling being used for rapidity. A priming pipe is provided, and the delivery pressure is controlled by a throttle valve. A length of cable travels with the skeleton, being disconnected at blasting. Both pumps are run after blasting in order to lower the water rapidly.

Sinking was resumed in April and 306 ft. have been sunk to 15th June. Progress was retarded by the bad condition of the shaft walls, caused by a series of parallel faults striking at an oblique angle to the long axis of the shaft, which necessitated double setting of the timbers and the use of spreaders and decking in all compartments. The building of a ring and equipping for stage pumping caused further delay.

A point I would like to make is the noiselessness and efficiency of an electric pump installation as compared with air pumps for sinking. By using the two cages at shaft bottom—provided engine can raise unbalanced load—1,500,000 to 2,000,000 gallons could be handled.

In passing, I should like to say that the narrow type of seven-compartment shaft is probably the slowest and therefore the most expensive type to sink, the rate of sinking of shafts being governed by accessibility for lashing.

TIME TABLE OF DEEPENING No. 2 NORTH SHAFT, RANDFONTEIN.

1930:	May	...	104	feet.	1 Hoist.	1931:	January	...	214 feet.
	June	...	215	,,	2 Hoists.		February	...	190 ,,
	July	...	220	,,			March	...	90 ,,
	August	...	242	,,			April	...	94 ,,
	September		55	,,	*		May	...	134 ,,
	October	...	250	,,	3 Hoists.		June 15th	...	80 ,,
	November		200	,,					
	December		200	,,					

* Sinking was suspended in order to equip two compartments with guides and commission the Markham hoist.

19*th June*, 1931.