Installing guide ropes in a vertical shaft

A vertical shaft, 213 m deep, had been fitted with eight 2.2 cm. diameter guide ropes for two cages. The top and bottom ends of the guide ropes were anchored in steel framework, the lower framework being some 7.62 m below the bottom station at 7 level.

It was decided to deepen the shaft by another 213 m to the 426.72 m level and to install bigger guide ropes of 3.02 cm diameter, together with two rubbing ropes of 3.18 cm diameter. The rubbing ropes constituted a precaution against excessive twist on the cages which might be set up by increased rope spin at the greater depth of winding, it having been decided to adhere to Lang’s Lay rope.

Fig. 1 shows the ropes as they looked in the shaft. A blueprint was made for the guidance of the men working on the job, and the ropes numbered as shown. This numbering ensured that no mistake was made in locating each rope as it arrived at the shaft bottom.

The lower half of the shaft was sunk with the aid of a Galloway stage, which was also used for concreting bad portions of the shaft as it progressed. The two ropes for supporting the Galloway stage were also used as guide ropes for the sinking bucket and were located so that they were clear of the positions of the new guide ropes to be tailed, as shown on the plan. The sinking bucket rope was, of course, in the middle of the shaft.

Fig. 2 shows the shaft layout and indicates how the job was done. An underground hoist chamber was cut below 7 level and beams installed across the shaft to carry the two bucket guide ropes and the single bucket hoisting rope. It might be of interest at this point to mention that the hoist for the two guide ropes consisted of two single-drum 90 hp Fulton hoists coupled together and driven by a 40 hp electric motor through an extra gearbox. This gave a slow enough speed for moving the Galloway stage. A subsidiary vertical winze (not shown in the figure) was used for transferring waste from the sinking bucket up to 7 level and into the cages for hoisting to the surface. Shaft sinking proceeded according to plan and, finally, the steelwork for anchoring the bottom ends of the guide ropes was installed at a point below 14 level stations. Due to the transfer of activities to another section of the mine, this newly sunk portion lay dormant for some two years. Then came instructions to equip the shaft down to 14 level.

The preparations beforehand were as follows:

- The concrete headgear on the hillside supports steelwork, which carries the sheave wheels for winding. This steelwork was strengthened to allow for the deeper winding conditions.
- A steel structure was built on top of the headgear carrying a moveable sheave, which could be placed at any one of the ten positions of the guide ropes.
- The Galloway stage, which had been brought up to the sinking station below 7 level two years previously, was inspected and lowered once more down to 14 level. Fortunately, it was a dry mine, so there was not much water to be pumped out of the bottom of the shaft. The Galloway stage was then dismantled and stored at 14 station and the two guide ropes anchored at the steel structure below the station. This ensured the use of the bucket while installing the new ropes.
- The sinking pull-bell wire, which had been left in the lower portion of the shaft at completion of sinking, was connected to both the underground sinking hoist and to the permanent hoist on the surface.
- The guide ropes supplied by the makers were coiled on the usual wooden reels. A spindle was made to fit the reels, the spindle being in turn supported on a steel framework and revolving in bearings.

On receipt of instructions from the
manager to commence the changeover, all mining activity ceased.

The right-hand cage was disconnected and placed to one side in the adit. The first drum of 3,02 cm. guide rope was mounted at the mouth of the adit and the rope end pulled into the shaft and fastened by clamping to the right-hand winding rope. The left-hand hoist drum was unclutched and the guide rope brought up over the headgear sheave by the right-hand drum. When the end of the guide rope reached the hoist, it was anchored. Then the winding rope was run off the drum and coiled on the hillside out of the way.

The drum port was fortunately big enough for the 3,02 cm diameter guide rope, which was coiled on to the drum. When fully coiled, with a few feet of the lower end left dangling in the shaft, it was transferred to the movable sheave placed at No. 1 position. The end was then clamped to the top end of the first 2,2 cm guide rope to be discarded and this guide rope was loosened from its anchor in the headgear. The bottom end was then disconnected at its anchor on 7 level, pulled in by hand to 7 level and coiled there. The new 3,02 cm guide rope was paid out by the hoist driver from the right-hand drum at the same time and duly arrived at 7 level. It was then disconnected from the old rope, passed through the steelwork, and was now ready for lowering to its final depth of 426,5 m.

As previously mentioned, the pull-bell was connected to both the surface and underground hoists. Two men were lowered slowly in the bucket, stopping at each station for short periods to give the hoist drivers a rest. The surface hoist driver worked his right-hand drum so that the guide rope being paid out was on the slack side all the way. The bucket eventually arrived at the shaft bottom and the new 3,02 cm guide rope was anchored in No. 1 position and correspondingly in the headgear on surface.

It will be appreciated at this stage that the left-hand drum on the surface hoist could be used for raising and lowering personnel on changing shifts. The bucket was also clear for bringing personnel from the shaft bottom.

The second and succeeding guide ropes were pulled up the shaft from the adit by block and tackle until attached to the hoist drum. Then the lower end was passed down the shaft as previously explained, except that another clamp was made for attaching at the point below 7 level. One end incorporated a brass bush, which was a sliding fit on the rope previously installed. Only the surface hoist ran when lowering the rest of the ropes, as the weight of the rope carried it down the shaft and the clamp prevented the end from swinging. When the first four ropes had been installed, the right-hand cage was fitted with new guide bushes to suit the bigger diameter ropes and put back in the shaft. The left-hand cage was then taken out and the remainder of the ropes was installed.

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The two rubbing ropes were the last to be installed and were guided all the way from the surface. The clamp was disconnected at 7 level, the rope passed through the steelwork, and the clamp once more connected.

When all ten ropes had been installed, the old steelwork was cut out at 7 level. The two bucket guide ropes were then disconnected at 14 level and coiled on to the drums of the underground stage hoist. The bucket was then disconnected and the rope coiled on to the drum of the underground sinking hoist. Finally, the steelwork supporting the sinking sheave wheels below 7 level was cut out and the shaft was now clear to lower the right-hand cage to 14 station.

The necessary station marks were given to the driver and after a few trips, the lefthand cage was installed. Inspection by the timbermen followed, then a final inspection by the inspector of machinery from Pretoria.

The job took five days to accomplish. A great deal of the time consumed was taken up in ensuring safety precautions at all stages of a somewhat dangerous job. The only accident occurred when a man on surface tipped over a wheelbarrow containing a bottle jack and broke his big toe.

The eight original guide ropes were coiled up on 7 level and brought to surface at leisure, as was the sinking equipment and discarded steelwork.

The new 3,02 cm guide ropes were equipped with coil springs under different compressions at the top anchorage in the headgear to nullify any tendency for resonant vibrations to occur when winding.

In actual practice, very little twist on the cages was noticeable and the rubbing ropes serve merely as a safety precaution.

**Discussion**

Mr. RG Thomas (past president): It is interesting to hear from Mr. Shippen that they are using Langs Lay ropes with rope guides and that they experienced no difficulty. I take it that he speaks from having had experience of this for some time. In South Africa, of course, we do not manufacture locked coil ropes – at least we have not been able to do so up to the present time and the normal practice, I think, with rope guides is to use non-spin ropes. During a recent visit that I paid overseas, I was fortunate enough to have an interview – with Mr. AE Crook, whose designation is Her Majesty's Chief Inspector of Machinery for Mines, and he was most emphatic in a discussion I had with him on the question of rope guides in shafts that you must have locked coil-winding ropes. Mr. Shippen's experience is therefore certainly very interesting and I would like to know how long this installation has been in operation and whether, in fact, they have since had any difficulty of which he is aware.

Mr. AWP Hallett (president): In elaboration of Mr. Thomas' remarks I may mention that I once experienced considerable trouble by the "bird-caging" of the Lang's lay winding rope when shaft sinking.
with buckets and a loose crosshead. Considerable spin of the rope occurred when the bucket was near the shaft bottom and free of the restraint of the crosshead. The trouble was overcome when an ordinary lay rope was substituted for the Lang’s lay rope. Both ropes were 2.2 cm in diameter.

There was one point in Mr. Shippen’s description that was not quite clear to me. What anchorage was used to prevent the spin of the first guide rope that was lowered? Perhaps Mr. Shippen will elaborate on his description of that detail.

**Author’s reply**

Mr. JW Shippen (associate member): In reply to Mr. Thomas, there is not a great deal of spin on the 2.2 cm in diameter Lang’s Lay winding ropes. The dead weight on the winding ropes is about 2,25 tonnes and this makes for good winding conditions. The sun was practically directly overhead at the time, and I found out by accident that at roughly ten minutes after midday it shone very nearly straight down the shaft. It was possible to observe the cage from the headgear very close to the shaft bottom. I can assure you that the cage twisted in the orthodox fashion for a short distance when pulling away. Then it reversed the twist and kept on alternating the twist all the way up the shaft. The amount of twist was not sufficient to bring the rubbing plates we had bolted on to the cages in contact with the rubbing ropes, so we took them off. Observation over a few days showed that there was no danger of the cages fouling each other when passing in the shaft.

When I left there some two years ago, the shaft was very busy indeed. Hoist trips were over 800 on some days, and hoisting was being done from nearly all of the 14 stations. In fact, it was the busiest shaft on the mine and no trouble was experienced with excessive twist. As far as I know, no trouble has developed since.

In reply to the president, the loose end of the new 3.02 cm guide rope was towed down to 7 level by the old 2.2 cm guide rope being pulled in on 7 level. It was then disconnected from the old guide rope and passed through the steelwork below 7 level. It was lowered a short distance further until it came level with the bucket at the original top station of the sinking shaft. A clamp had been fashioned out of flat bar about 1.22 – 1.52 m in length. One end clamped tight on to the bucket rope, about 0.91 m above the bucket. The other end clamped tight on to the 3.02 cm guide rope. Two men got into the bucket and gave the necessary bell signals to lower to both hoists simultaneously.

The surface hoist driver paid out the 3.02 cm guide rope and kept it on the “slack” side all the way down. The clamp pulled the guide rope down with it as it went down with the bucket rope lowered by the underground bucket hoist. The guide rope tended to spin and pull the bucket to one side, but the bucket guide ropes dampened down this effect and the bucket arrived safely at the bottom after a somewhat hair-raising experience by the two men.

The first guide rope was then put into its correct position and pulled tight. On lowering the second guide rope, the same procedure was carried out to 7 level. From this level to the shaft bottom, a clamp similar to the first one was used except that one end clamped tight to No. 2 guide rope and the other end was fitted with a bronze bush made to slide down No. 1 guide rope. No. 2 guide rope was lowered to the shaft bottom and kept from spinning by the clamp sliding down No. 1 guide rope. Its own weight was sufficient to lower it by the surface hoist driver. The rest of the guide ropes were lowered by the same method.

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