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Longface and longwall mining methods being tried in Oklahoma coal fields

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LONGFACE AND LONGWALL MINING METHODS
BEING TRIED IN
OKLAHOMA COAL FIELDS

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Of a number of long wall and long face mining methods in use in Oklahoma mines at this time, I shall outline four in this paper. Two of these methods are in use in mines which are comparatively level. The first of these is in the Kali-Inla mine near Hartshorne. The second is in the Milby-Dow Coal Company mine at Dow. The Mullen Coal Company mine near McAlester and the Hailey-Ola Company mine near Lutie are steep pitching mines.

THE KALI-INLA COAL COMPANY SYSTEM

Last year Mr. Franklin Bache presented a paper before the American Mining Congress which explained in detail the long face operations in the Kali-Inla mine. This is a complete caving system with rigid roof support, a roof break being induced after every cut, by means of collapsible cast steel props, known as "jacks," with no supporting timbers or cribs of any kind in use on the face. Coal is hand loaded on a reciprocating conveyor. Within the past year there has been developed a modified system for use under bad top. The system as explained by Mr. Bache involves loading over the side of the conveyor throughout its entire length, and moving it up towards the face as a complete unit after the shooting and loading of each cut.
PLAN OF LONG FACE LAYOUT WITH STEEL JACKS

SECTION A-A

KALI-INLA COAL CO.
LONG FACE SYSTEM
NORTHWEST OKLAHOMA
Under the old system coal loading had to be stopped when it was necessary to load rock because the conveyor was being loaded from the side along its entire length. Obviously, coal and rock could not be placed on the conveyor at the same time.

Under the old system the unsupported span between solid coal and the first row of jacks was nine feet wide by three hundred feet long, a total area of two thousand seven hundred square feet. Under draw slate or local bad top considerable trouble was encountered and heavy expense incurred due to the fact that all coal had to be removed from the conveyor before any rock could be loaded.

Now when the face encounters bad top, the machine sumps in at the lower end and cuts up the wall twenty-five or thirty feet. This coal is shot down and loaded on the conveyor from the side. Then the conveyor is moved into the space just cleared of coal. Roof jacks are set within three feet of the solid rib, which allows room for the conveyor and mining machine to operate. The machine cuts for a distance of four or five feet and is stopped.
Jacks are then set as near the undercut as possible and kept three feet from the solid rib. This coal is shot down and loaded on the conveyor by two men while the machine cuts another distance of four or five feet; the jacks are advanced and the cycle repeated as before. A short pan is used to keep the conveyor at a minimum distance from the coal.

The net result of this modification of the working cycle has been to reduce the total unsupported roof area to fifty square feet or a span of ten feet for a distance of five feet along the face. If it is found necessary to take down some of the bad roof this can be loaded immediately, as the rock will be loaded on the end of the conveyor without waiting for all coal to be removed. The rock can be loaded into a separate car at the lower end of the conveyor without the necessity of hand picking.

It has been found that this method greatly reduces the amount of rock to be loaded and that less time is lost per car of rock loaded. It has been possible to advance this face under bad top as much as sixty to
sixty-five feet in an eight hour shift with a crew of eight men. This gives sixty to sixty-five tons of coal or seven and one half to eight tons per man employed at the face.

THE MILBY AND DOW SYSTEM

This might be described as an intermittent caving system, with non-rigid roof support except at the time of inducing a break. The No. 9 mine of this company is in the McAlester seam, which is uniformly two feet and ten inches thick and dips seven to eleven degrees. The top is good for a time after the coal has been taken out but after it has been exposed to the air for some time and a little weight comes on, it has a decided tendency to break into small pieces. This causes the haulage ways to appear ragged but very little trouble is experienced with fallen rock on haulage roads.

At the bottom of a six hundred foot shaft two slopes are driven on the dip of the seam. At three hundred and fifty foot intervals on these slopes entries are turned to right and left. The entries are driven on one percent grades favoring the loads. This mine uses animal haulage except on the main entry approaching the shaft bottom. A parallel connection is driven three
PLAN OF LONG FACE LAYOUT WITH TIMBER BREAKING WALL

SECTION A - A

MILBY-DOW COAL CO.
LONG FACE SYSTEM
DOW, OKLAHOMA
hundred feet distant from the slope and a face is started from the inside rib.

The entries are driven fifty-five feet wide and have two haulage ways on thirty-eight foot centers—each brushed to a height of seven feet. This allows about eighteen inches for settling of the top and heaving of the fire clay bottom. It is necessary to brush the top because when the bottom is once broken it will crumble badly. Bottom brushing was tried on one entry. The bottom crumbled under the cribs that were supporting the upper side of the entry, and caused the whole entry to cave in after it had been advanced about two hundred feet.

When the day shift comes off at four o'clock, three machine men are ready to start cutting the wall. This is usually finished at seven o'clock when seven men go on to drill the face and to move the conveyor. While three men are drilling the wall, four others are dismantling the conveyor and laying the pans to the side nearest the face. By the time the drilling is finished the conveyor has been dismantled and the seven men move the driving unit of the conveyor toward the face. It is so placed that the pans will be about six inches from the undermined coal. A pit car loader
is placed at the discharge of the conveyor. The pans are then moved into position and connected. A shot firer follows this shift of men and shoots the entire wall.

The day shift finds the conveyor in place, the coal shot down and everything ready to begin loading. Each loader is assigned forty feet of the face to load as his days work. Two drivers and one man attend to the loading and haul the coal to the parting at the slope.

Four timber men go on with the day shift. Their first duty is to build three cribs at the lower end of the wall immediately out by the lower end of the conveyor. The first crib is of six-foot timbers hewn on two sides with four timbers to the layer. This crib is filled with rock. Three feet above this crib another one is built of timber only. It is of six inch by eight inch by four foot timber laid solid. A similar crib is built above this and just out by the driving unit of the conveyor. When these three cribs have been completed the timbermen start building a row of cribs of split timber on fifteen-foot centers along the entire length of the wall. These cribs are not filled. As the loading is nearing completion timbermen set split props on eight-
foot centers three feet from the solid rib. These timbers are not capable of any great resistance to pressure and are used only for the protection of the miners while they are at work. As the weight comes on, the unfilled cribs are crushed, allowing the roof to settle gradually. The foreman of each crew keeps a lookout to the area that has been mined out. If the cribs and timbers in the second and third row from the face show signs of failure, he stops any operation that is going on and builds a solid timber wall of six inch by eight inch by four foot blocks as near the conveyor as possible. These timbers are laid with the length parallel to the face. It has been found that this wall will break the top at this place and cause no trouble at the working face. A short time ago this wall was built during the day shift and no loading time was lost. In one or two instances only a short section of this wall was built, effectively stopping a threatened break.

Since this method has been in use there has not been a shift lost, due to caving at the face. Prior to this, a heavy break would come when the face had advanced sixty-five to one hundred feet from the starting point. This would necessitate the driving of another place
through to the entry above and often a part of the conveyor had to be taken from under the fall. In one or two instances the machine was also covered by the fall.

Each cycle produces one hundred and fifty tons of coal. This is about six and one half tons per man employed at the face.

THE MULLEN COAL COMPANY SYSTEM

In the Mullen Coal Company mine no attempt is made to cave the roof at a definite place. An area has been determined under which it is practical to work. This area is then mined out and abandoned. The roof is supported, only for the time necessary to complete a section, by straight props and cribs.

The Mullen Coal Company is in the McAlester seam. The coal at this place is four feet thick and dips twenty degrees to the south. There is a layer of draw slate and bone above the coal which varies from two to eight inches in thickness. Above the draw slate the top is too bad to be worked successfully by room and pillar method because the rooms have to be kept open too long. By working a long face the section can be mined out and abandoned before the roof gives any trouble.
PLAN OF LONG FACE LAYOUT
DRIVING UP STEEP PITCH

SECTION A-A
At one hundred fifty foot intervals on the slope a pair of entries are driven on the strike of the seam. These entries have a twenty-five foot pillar left between them, and are connected at twenty-five foot intervals by crosscuts. The lower one is brushed for a haulage way. The upper entry is used only as an airway.

The practical distance to drive these faces, for this mine, is one hundred feet. The length is along the strike of the seam and the face is driven up the pitch. A two hundred fifty foot pillar is left to protect the slope. Beginning just past the end of this pillar, the first face is started.

A row of timbers is securely set thirty inches from the upper rib of the airway. A row of two inch by ten inch boards with a sixteen pound rail bolted along the center is placed on the upper side of these props to hold the mining machine to the face while it is cutting.

The machine sumps in at one end and cuts along the strike of the seam to the opposite end of the face. As the machine advances the coal breaks down of its own weight. The corners require a light shot. Otherwise, no explosives are used on the face. This is a very desirable thing as the coal is soft and is easily made into slack by shooting.
Chutes are made from the haulage entry to the face, through the crosscuts, by laying galvanized metal sheets on the bottom and fastening them to the bottom with nails. These chutes are kept within a few feet of the face. Chutes are protected by a row of cribs on ten foot centers staggered on either side.

Two miners start behind the machine to break the large lumens that have fallen from the wall and place the coal in the chutes. When the machine men have finished cutting, they help the two miners break the coal and put it in the chutes.

The driver loads the cars from the chutes on the haulage way. The chute is kept partly filled with coal to avoid breakage, due to coal rushing down an empty chute and striking the car or other coal at the lower end.

The face is driven up the pitch about one hundred feet before any trouble is experienced with the roof. As soon as the roof begins to give trouble the equipment is taken out and the face is abandoned. A hole is driven through to the entry above, for ventilation, if the top does not get too bad to get through.

The only timber used on the face, in addition to the row of cribs on each side of the chute, are the timbers that are set as a guide for the machine.
Very little of the coal has to be handled over a great distance. The cutting and loading is completed on a one hundred foot face by a crew of five men, including the driver, in eight hours. When the face is worked every day, a section is mined out in twenty-five days. Each cut produces fifty-five tons of coal which is eleven tons per man. As each section is worked out, the machine is taken to a new position just out by the one that has just been abandoned. This face is advanced along the one just worked out. No pillar is left between them.

It is the present plan of the company to drive two pairs of entries to the boundary and retreat with a series of these faces. It is believed that by removing the pillar between the entries, as part of the face, 100% recovery can be obtained with this system.

THE HAILEY-OLA LONG FACE SYSTEM

This is a non-caving system with semi-rigid support, the roof being held up by timbers until the face squeezes, when it is abandoned and a new face started.

The Hailey-Ola Coal Company's mine No. 5 is in the lower Hartshorne seam. The coal has a normal thickness of five feet. There are no dirt bands and the bottom is
PLAN OF LONG FACE LAYOUT DRIVING ACROSS STEEP PITCH

SECTION ON PITCH

SECTION A-A

HAILEY-OLA GOAL CO.
LONG FACE SYSTEM
LATE CALIFORNIA
very hard, making it necessary to cut in the coal. The pitch varies from thirty-seven degrees at the outcrop to twenty-five degrees at the eleventh level. The coal is very brittle and every precaution is taken to avoid unnecessary degradation. The top is a gray slate and is considered brittle. It causes very little trouble at the time the coal is taken out. Breaks are hard to control and considerable trouble has been experienced in this way.

The entries are turned to right and left of the main slope at intervals of one hundred and eighty feet. These are driven on three and one half percent grade, favoring the loads. The empty cars are pulled to the loading place with a rope and the loads run to the parting at the slope by gravity. No brushing is taken. Track is laid on waste built up on lower side of the entry.

The most practical length of wall is one hundred fifty feet. This can be cleaned up in an eight hour shift by eight men. A night crew of three men cut and timber the wall. The machine sumps in at the lower end of the wall and cuts up the pitch. Machine cuttings are thrown into the gob as there is very little market for screenings in this field.
The cutting is done in three hours. After the wall is finished the machine cuts the entry heading which is kept about fifty feet in advance of the wall. The coal is undercut to a depth of six feet. A timberman follows the machine up the wall, setting props four feet apart and as close to the coal as possible. The machine men help the timbermen if they get too far in advance of the timbers. The coal is shot down on the night shifts.

A small platform is built high enough to clear a car and long enough to intersect the bottom on about ten percent grade. This platform is four feet wide and ten feet long. It is easily removed to the new position.

At the beginning of the day shift, two men start at the lower end of the wall with pick and bar. In most cases the bar is of most advantage to break the coal loose. At times a wedge has to be used to break the larger lumps. When eight feet of the wall has been taken down the two men lay a flat sheet below the end of the wall. This sheet is four feet by eight feet, fourteen gauge galvanized iron. It is held in place by six or eight twenty penny nails driven into the bottom coal, which is left by the machine. This process is continued until the top of the wall is reached.
Then the "sweeping down" or preparing for the machine starts. This operation consists of beginning at the top of the wall, taking up the sheets and placing them to one side, to be used again, and taking up the three to four inches of bottom coal left by the machine and shoveling it into the chute formed by the sheets. As the chutes are taken up, all coal that has fallen to the side is placed in the chute and loaded out. All of the coal slides to the car by gravity, when it is loosened on the wall.

Two timbermen follow the miners up the wall, setting a row of timbers between the row set by the night crew and the row outby them which is the row set by the crew of the previous night. This leaves timbers on three foot centers on the strike of the seam and four foot centers on the dip. These are triangular-shaped split props, with a minimum side of six inches. These timbers will hold the roof until the wall has been advanced from sixty-five to one hundred and twenty-five feet. A number of walls have been lost between these limits. They were recovered, if the wall had been cut, by taking out this cut or by driving a new wall up ten feet inby the one that had just caved in. This is a costly process and often had to be done when the demand for coal was greatest. It was found that by setting a double row of heavier props, eight-inch round, at fifty foot intervals,
that this cave could be delayed while the face advanced two hundred and fifty feet. The plan at the present time is to place cribs every sixty or seventy-two feet, then to drill holes eight feet into the top outby these cribs and to break the top at distances under which it is practical to work.

It had been found that the coal on the level below one that has been mined out is crushed on the upper end of the wall. This crushed coal is found for a distance of twenty-five or thirty feet from the rib of the entry above. The chain pillars on the upper side of the same entry show very little effect of the weight. This operation is being carried on under, approximately, eight hundred feet of cover.

Ten men complete the cycle of operation over a period of about twelve hours. The machine men and timbermen, working as a night shift, usually finish their work in four hours. One hundred and fifty tons are produced in each cycle.

The management considers the long face as an experiment with several details to be completed. Perhaps the greatest problem to be solved is a method of breaking the top at some definite place. The disadvantage of handling heavy timber or jacks on a steep pitch makes
roof control very expensive. If this control can be economically obtained, the operation of a long face on a steep pitch will be as practical as in the more level seams.
Bibliography


Most of the information in the body of the paper has been gained from observation of the practice of the described methods.
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