Drilling Strata Movement Detection Experiment on Failure Law of Overlying Strata Movement

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Abstract

The principle and test method of drilling strata movement detection is introduced. The failure law of stope drilling strata movement was analyzed and judged by useing the swell character of compresspoed wood when it met upon the water and moves along with surrounding rock. The height of caving zone and subsidence movement failure law of overlying strata and alienation layer could be concluded by combining with the detection experiment of drilling strata movement.The research showed that drilling strata movement detection could make sure the level of destruction of surrounding rock movement and detected the result visualized and met the fine detective requirement with high precision and high resolution, the result was reliable.

Keywords: strata movement, drill, detect.

1. Introduction

Under the long-term action of geostress, underground rocks stay a balanced state. Because of excavation of underground rocks in mining engineering, the original stress in excavated rocks transform to the surrounding rock mass and cause stress redistribution and local stress concentration, and make the surrounding rock deformation, movement and destruction. In order to study failure law of surrounding rock movement, it has a significant meaning to detect to the destructive state of surrounding rock movement, and its detective achievement supply the important design basis for supporting methods of roadway, upper

mining limit of mine, retainment of waterproof pillar and reasonable arrange of the work, etc.

In recent several decades, the detection of stope strata has made a great progress in the aspects of theory and practice and its theory system tends towards maturity. The detection technology of mining mountain strata has experienced a relative longer development progress at home and abroad. In different region, the status of geology and detective degree varys a lot, different subdiscipline in geology intercross and interpenetrate with strata detection. Nowadays, the failure law technology of the surrounding rock movement includes hydrogeology drilling method, borehole and piecewise injection method, the strata movement detection method, borehole and ultrasonic imaging and radio wave penetration method, etc[1,6]. Among them, the drilling rock movement detection can realize accurately the migration time, speed amplitude and other characteristics of the surrounding rock strata ,in order to grasp the activity law of surrounding strata movement destruction. This method is suited for the displacement measurement in stope roof and floor strata, also used to deduce the damage range of rock and theoretical research of strata movement.

2. Drilling strata movement detection principle

Drilling strata movement detection technology uses experimental measurement to analyze and study changed displacement caused by the function of dynamic and static loads and the change of occurrence condition in the rock engineering. The purpose is to realize the migration time, speed and amplitude and other characteristics of all strata subsidence movement after coal mining, further to grasp the activity law of the overlying strata.

The compressed wood was installed to scheduled site of the drill hole and made it as a fixed test site by useing the character of compressed wood swell when it met upon water. Because filling water in the borehole after a period of time, compressed wood swell and cling to the hole-wall surrounding rock, no relative displacement between them ,and compressed wood move along with the movement of rock. Every measuring point uses steel wire to link to orifice measuring device to measure displacement value of directly from all measuring points to orifice, and according to observed data to analyze and judge the failure law of stope overlying strata movement.

3. Field applications

In order to check the detection effect, a caving testing face under lake of one mine was choosen to do a prospecting test

on the spot.

3.1 Operating methods

(1) The production of compressed wood

Selecting Korean pine or Manchurian ash processed into several pieces cuboid as 200mm × 200mm × 100mm. In the press, the vertical direction of wood grain forced into board's shape and used metal plate fixture to fix it for 24 hours; and then, joined together , and its diameter should be less shorter than the hole diameter of the cylinder.

(2) Compressed wood drilling installation

A metallic tube was put in the center of compressed wood cylinder. Lathing thread in its two side ends, screwing a nut in the upper end and fastening a piece of steel wire. And in the lower end, a hollow was spined and mental truncated cone was inverted and using its weight to hoist the compressed cylinder to the desired depth of drilling hole. Then it will fasten to the hole wall when compressed wood swell after meeting water. In the upper section, each measurable point of each drill point adopted the same method to hoist compressed wood, but it must enable the steel wire of test point of lower section pass through the hollow circular hole of the compressed wood cylinder from the upper section test point, and made sure that it can slide free without resistance.

(3) Orifice measurement

The steel wire of each test point draw from orifice and hang a heavy hammer in the respective pulley through orifice support. The roof remote measuring sensor was installed in the heavy hammer and transformed the displacement signal into voltage signal that was proportional to the displacement signal, and transformed to the computer of monitoring room through carrier transmission of telephone wire, and did the automatic timing itinerant monitor system by the program controlled computer and record and typed the observed result automatically. The resolution of detecting displacement in this method reached at 0.01mm. The hole inner structure and orifice observation system of drilling rock movement detection was shown in Figure 1.

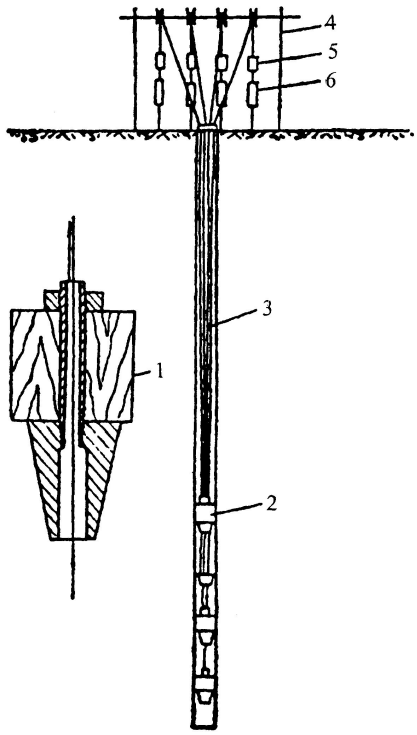

Fig1. Measuring point structure 2. Measuring point 3. Steel wire 4. Observation platform 5. Heavy hammer 6. Sensor

Fig. 1: Drilling strata movement observation system schematic diagram

3.2 Test condition

In the process of coal seam mining, the stress beard by poached original rock transform to the surrounding rock, causing the local stress concentration. And there is a surrounding rock deformation and movement in this procedure, accurate detection of surrounding rock deformation and destruction can supply reliable safe mining guidance[2].

4. Detection results analysis

Figure 2 pictured in one mine, deflection of drilling rock movement test point of caving testing face 8101 change over time in mining under lake. The drilling hole locate above the working surface and it's 20m to the stopping line in the direction of coal seam, it's 7m to upper drift on the tendency of coal seam.M_1、M_2、M_3、M_4 are four rock movement test point respectively, they install in the distance of 10m、13.5m、20.5m、28m to the coal seam roof respectively. Four curves reflect the sink movement failure law of overlying strata in mining course.

Because the direct top floor of eight coal seam is igneous rocks, its roof is tough and the roof hanging is long with a long periodic weighting to pressure (measured at 15d), weighting intensity is huge. From the measured curve, before 27th of March, the working surface pushing through drill hole in the range of 16m(advancing speed is 1m/d), that is ,within the periodic weighting, the vertical movement of overlying rock is slim. Start from 27th of March, the working surface push through drill hole 17m, the point M_1 sink dramatically 280mm in six days, and the average sinking speed is 46.7mm/d,while other three test point's deflection is little. From 2nd of April to 16th , the sinking speed of M_1 slow down and sink 50mm, M_2 is 45mm, M_3 is 25mm, M_4 is 20mm. The sink speed of different layer is different, the feature is that the speed is slower if the layer is upper, present the scene of $v_{M1}>v_{M2}>v_{M3}>v_{M4}$. Amount of loose space formed in each two layers

illustrate there have already been isolation layer. In 16th of April, sinking is stable, and M_1 sink 10mm, M_2 sink 2mm, M_3 sink 3mm, M_4 sink 5mm, its feature is the sinking speed of lower part is slower than the upper's speed except M_1, that is, $v_{M2}<v_{M3}<v_{M4}$. Consequently, all layers enter into the process of pressing fit each other in this period.

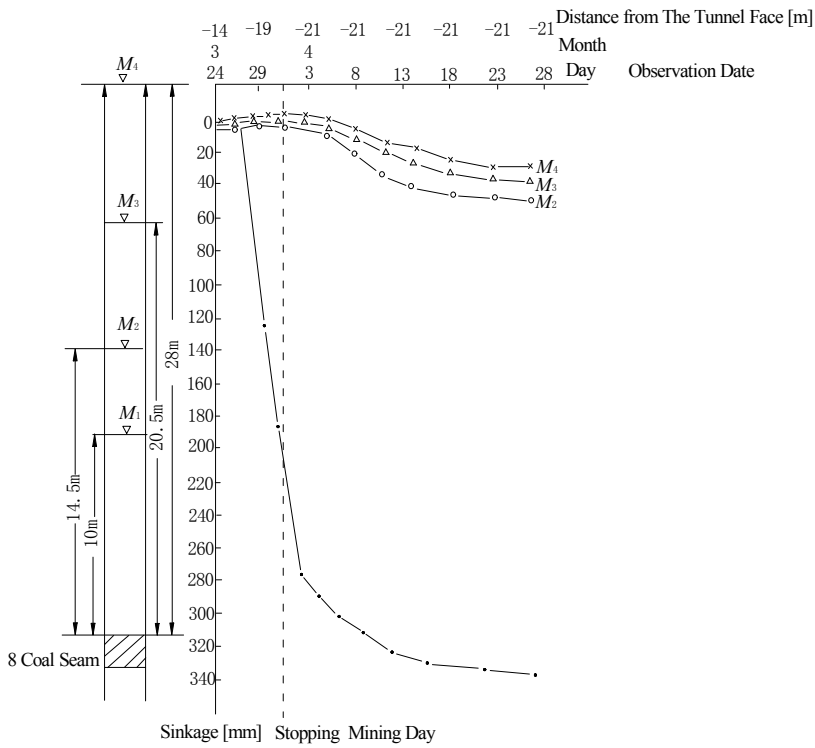

Fig. 2: Drilling strata movement observation curve

The above data showed that the point M_1 sunk sharply to 330mm suddenly, it must be in range of the caving zone, and the sinking speeds and amplitudes of points M_2、M_3、M_4 were further than that of M_1 and they must be inside the fractured zone. The height of caving zone was deduced about 10-13.5m.

5. Conclusions

Drilling strata movement detection can detect the level of destruction of surrounding rock movement clearly and directly, the detective achievement reaches an high precision and high resolution, it is a method with obvious effect to the surrounding movement destructive detection. As the development and improvement of the science and technology,

drilling strata movement detection has incomparable advantages and wide prospect of application.

6. References

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