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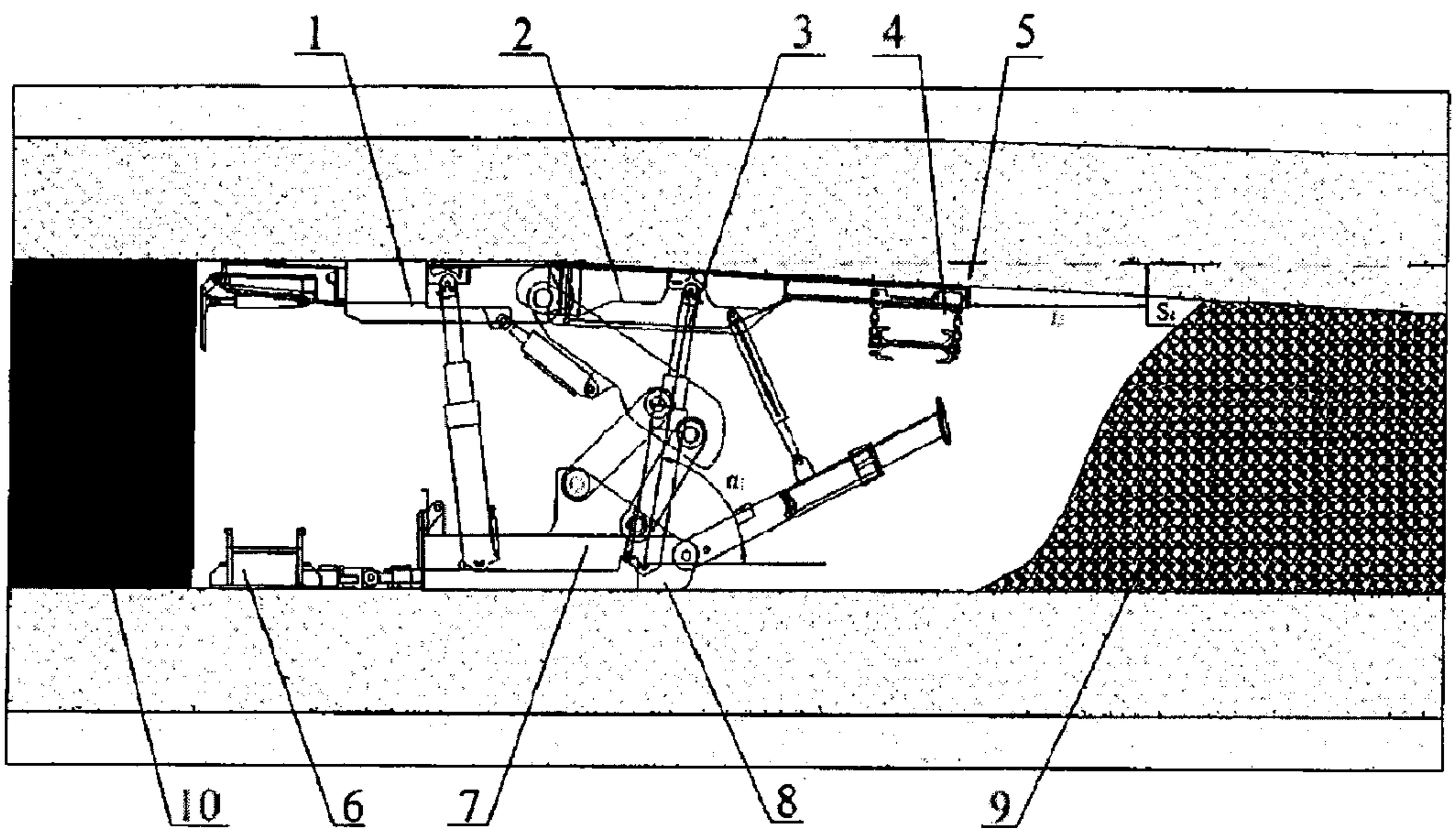
(54) Titre : METHODE DE SURVEILLANCE DE REMPLISSAGE HATIF DE PLAFOND PENDANT UNE EXPLOITATION MINIERE DE REMPLISSAGE DE SOLIDES ENTIEREMENT MECANISEE

(54) Title: METHOD FOR MONITORING EARLY SUBSIDENCE OF ROOF DURING FULLY-MECHANIZED SOLID FILLING MINING



(57) Abrégé/Abstract:
Disclosed is a method for monitoring early subsidence of a roof during solid filling mining, which is suitable for monitoring early subsidence of a roof on a working face in a fully-mechanized solid filling mining technology for underground mines. The method comprises: establishing a solid simulation model by utilizing Pro/Engineer™ software on the basis of dimension parameters and a geometrical relation between structures of a filling mining hydraulic support; and finally, obtaining the early subsidence of the roof on the working face during fully-mechanized solid filling mining according to the change of an oblique angle, measured in a filling mining cyclic operation, of a filling mining hydraulic support rear stand column. The method is reasonable in design, high in pertinence, low in cost, simple and easy to implement, and wide in practicability.

ABSTRACT

Disclosed is a method for monitoring early subsidence of a roof during solid filling mining, which is suitable for monitoring early subsidence of a roof on a working face in a fully-mechanized solid filling mining technology for underground mines. The method comprises: establishing a solid simulation model by utilizing Pro/Engineer™ software on the basis of dimension parameters and a geometrical relation between structures of a filling mining hydraulic support; and finally, obtaining the early subsidence of the roof on the working face during fully-mechanized solid filling mining according to the change of an oblique angle, measured in a filling mining cyclic operation, of a filling mining hydraulic support rear stand column. The method is reasonable in design, high in pertinence, low in cost, simple and easy to implement, and wide in practicability.

METHOD FOR MONITORING EARLY SUBSIDENCE OF ROOF DURING FULLY-MECHANIZED SOLID FILLING MINING

BACKGROUND

Technical Field

The present invention is directed to a method for monitoring early subsidence of a roof during fully-mechanized solid filling mining, which is particularly suitable for monitoring early subsidence of a roof during fully-mechanized solid filling mining of underground mines.

Related Art

Dynamic change of a roof in a fully-mechanized filling mining technology is required basic data. After a solid material is fed into a goaf, with the propulsion of a working face, dynamic conditions of a roof are mastered in time, thus not only contributing to analyzing and mastering of a mine pressure behavior of solid filling mining, but also contributing to detecting of execution conditions of a filling process and reflecting of a filling effect to ensure good management of a filling body over the roof. Therefore, research on an accurate and practical early roof subsidence monitoring method plays an important role in ensuring a filling effect of a solid filling mining technology in a coal mine engineering field.

SUMMARY

Technical problem: the present invention is directed to a method for monitoring early subsidence of a roof under technical conditions of fully-mechanized solid filling mining.

Technical solution: the method for monitoring early subsidence of a roof during fully-mechanized solid filling mining of the present invention comprises:

(1) establishing a solid simulation model by utilizing Pro/Engineer™ software according to a three-dimensional solid model of a filling mining hydraulic support and dimension parameters of each component structure of the model to obtain an oblique angle-support height curve of a filling mining hydraulic support rear stand column;

(2) in a customary filling mining cyclic operation, cutting coal on a filling mining

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working face, pushing a scraper conveyor, pushing a filling mining hydraulic support and performing solid material filling to complete a cyclic operation, and after the solid material filling is completed, measuring an oblique angle α_1 of the filling mining hydraulic support rear stand column at this moment;

(3) starting a second cyclic operation, and after the second cyclic operation is carried out until the filling mining hydraulic support is completely pushed, before the solid material filling is started, measuring an oblique angle α_2 of the filling mining hydraulic support rear stand column at this moment again;

(4) on the basis of the oblique angles, monitored twice, of the filling mining hydraulic support rear stand column, obtaining, according to the solid simulation model established by utilizing the Pro/Engineer™ software, an oblique angle-support height curve of the filling mining hydraulic support rear stand column, so as to obtain a support height difference Δl between the oblique angles, monitored twice, of the filling mining hydraulic support rear stand column; and

(5) simplifying the filling mining hydraulic support into a geometric figure, overlapping the filling mining hydraulic supports at two positions, and ideally taking triangles formed by connecting early subsidence sections of rear top beams and roofs of the filling mining hydraulic supports at two stages as similar triangles, i.e., $\frac{l_3}{l_1+l_2}=\frac{\Delta l}{S_d}$, so as to obtain early subsidence of a roof at a breaking point of a filling mining hydraulic support rear top beam, i.e., $S_d=\frac{\Delta l(l_1+l_2)}{l_3}$.

According to an aspect of the invention, there is provided a method for monitoring early subsidence of a roof during fully-mechanized solid filling mining, characterized by comprising the following steps:

(1) establishing a solid simulation model by utilizing Pro/Engineer™ software according to a three-dimensional solid model of a filling mining hydraulic support and dimension parameters of each component structure of the model to obtain an oblique angle-

support height curve of a filling mining hydraulic support rear stand column (3);

(2) in a customary filling mining cyclic operation, cutting coal on a filling mining working face, pushing a scraper conveyor (6), pushing a filling mining hydraulic support (7) and performing solid material filling (9) to complete a cyclic operation, and after the solid material filling (9) is completed, measuring a first oblique angle α_1 between the filling mining hydraulic support (7) and the filling mining hydraulic support rear stand column (3);

(3) starting a second cyclic operation, and after the second cyclic operation is carried out until the filling mining hydraulic support (7) is completely pushed, before the solid material filling (9) is started, measuring a second oblique angle α_2 between the filling mining hydraulic support (7) and the filling mining hydraulic support rear stand column (3);

(4) on the basis of the oblique angles, monitored in the two cyclic operations, of the filling mining hydraulic support rear stand column (3), obtaining an oblique angle-support height curve of the filling mining hydraulic support rear stand column (3) according to the solid simulation model established by utilizing the Pro/Engineer™ software, so as to obtain a support height difference Δl between the first oblique angle and the second oblique angle; and

(5) generating a geometric figure of the filling mining hydraulic support overlapping the filling mining hydraulic supports (7) at two positions, and taking triangles formed by connecting early subsidence sections of rear top beams and roofs of the filling mining hydraulic supports at two stages as similar triangles according to $\frac{l_3}{l_1+l_2}=\frac{\Delta l}{S_d}$, and detecting early subsidence of a roof at a breaking point of a filling mining hydraulic support rear top beam according to $S_d=\frac{\Delta l(l_1+l_2)}{l_3}$.

Beneficial effect: due to adoption of the above-mentioned solution, during practical application of the method for monitoring early subsidence of a roof during solid filling mining of the present invention, it is only necessary to measure an oblique angle of a filling mining hydraulic support rear stand column after a filling mining hydraulic support is pushed in each filling mining operation cycle, so early subsidence of a roof during solid filling mining can be obtained according to a solid simulation model and each structure dimension parameter of the filling mining hydraulic support as well as a geometrical relation between structures. The method for monitoring early subsidence of a roof is simple and easy to implement, low in cost, and wide in field practicality.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagram of a three-dimensional solid model of a four-column type filling mining hydraulic support in a specific implementation mode of the present invention.

FIG. 2 is a diagram of a two-dimensional framework model of a four-column type filling mining hydraulic support in a specific implementation mode of the present invention.

FIG. 3 is a diagram of an oblique angle-support height curve of a four-column type filling mining hydraulic support rear stand column in a specific implementation mode of the present invention.

FIG. 4 is a side view of a working face state after a solid material filling operation in a first cyclic operation when monitoring begins according to the present invention.

FIG. 5 is a side view of a working face state before a solid material filling operation in a second cyclic operation when monitoring begins according to the present invention.

FIG. 6 is a simplified diagram of an overlapped state of a filling mining hydraulic support in two cyclic operations during monitoring according to the present invention.

In the drawings: 1-filling mining hydraulic support front top beam, 2-filling mining hydraulic support rear top beam, 3-filling mining hydraulic support rear stand column, 4-porous bottom unloading type conveyor, 5-roof at end point of filling mining hydraulic support rear top beam, 6-scraper conveyor, 7-filling mining hydraulic support, 8-filling mining hydraulic support base, 9-solid filling material, 10-solid coal wall.

DETAILED DESCRIPTION

The present invention will be further described hereinbelow in conjunction with embodiments in the drawings.

With a ZC5200/20/38™ four-column type filling mining hydraulic support as an example, a method for monitoring early subsidence of a roof during solid filling mining of the present invention will be described in detail.

(1) Firstly, comprehensive equipment is disposed on a solid coal wall of a coal mining working face according to the prior art, according to a three-dimensional solid model of a filling mining hydraulic support as shown in FIG. 1 and dimension parameters of each structure, by utilizing Pro/Engineer™ software, a two-dimensional framework model as shown in FIG. 2 is established, and finally, an oblique angle-support height curve of a filling mining hydraulic support rear stand column 3 as shown in FIG. 3 is obtained.

(2) In a customary filling mining cyclic operation in the prior art, a scraper conveyor 6 is pushed and a filling mining hydraulic support 7 is pushed to cut coal on a filling mining working face, and solid filling material 9 filling is performed to complete a cyclic operation. As shown in FIG. 4, after the solid filling material 9 filling is completed, for the filling mining hydraulic support rear stand column 3, an oblique angle α_1 is measured to be 80.52°, and according to the value of α_1, it may be obtained, through a curve shown in FIG. 3, that a support height at this moment is 3200mm.

(3) After a filling mining cyclic operation is completed, a second filling mining cyclic operation is started. After the filling mining hydraulic support 7 is pushed forward for a step pitch of 600mm in the second cyclic operation, before the solid filling material 9 filling is started, at a position shown in FIG. 5, it is measured again that for the filling mining hydraulic support rear stand column 3, an oblique angle α_2 at this moment is 79.59°. According to the value α_2, it may be obtained, through the curve shown in FIG. 3, that a support height at this moment is 3000mm.

(4) On the basis of the oblique angles, measured twice, of the filling mining hydraulic support rear stand column 3, according to the solid simulation model established by utilizing the Pro/Engineer™ software, an oblique angle-support height curve of the filling mining

hydraulic support rear stand column 3 is obtained, so as to obtain a support height difference Δl between the oblique angles, monitored twice, of the filling mining hydraulic support rear stand column.

(5) Filling mining hydraulic supports 7 at two positions are overlapped, wherein l_2 section is a distance 600mm, obtained by pushing the filling mining hydraulic support 7 for a step pitch. As shown in FIG. 6, triangles formed by the two overlapped filling mining hydraulic supports 7 can be ideally taken as similar triangles for processing, i.e., $\frac{l_3}{l_1+l_2}=\frac{\Delta l}{S_d}$. Therefore, for a roof at an end point of a filling mining hydraulic support rear top beam 2, early subsidence S_d can be calculated according to the following formula:

$$S_d=\frac{\Delta l(l_1+l_2)}{l_3}=\frac{200\times(4462+600)}{1550}=653.16$$

where,

S_d-early subsidence of a roof at an end point of a filling mining hydraulic support rear top beam, mm;

-support height difference between oblique angles, monitored twice, of filling mining hydraulic support rear stand column, 200mm;

l_1-length of filling mining hydraulic support rear top beam, 4462mm;

l_2-distance obtained by pushing a filling mining hydraulic support for a step pitch, 600mm; and

l3-horizontal distance between a hinged point of a rear top beam and a four-link mechanism and a hinged point of a rear top beam and a rear stand column, 1550mm.

CLAIMS

What is claimed is:

1. A method for monitoring early subsidence of a roof during fully-mechanized solid filling mining, characterized by comprising the following steps:

(1) establishing a solid simulation model by utilizing Pro/Engineer™ software according to a three-dimensional solid model of a filling mining hydraulic support and dimension parameters of each component structure of the model to obtain an oblique angle-support height curve of a filling mining hydraulic support rear stand column (3);

(2) in a customary filling mining cyclic operation, cutting coal on a filling mining working face, pushing a scraper conveyor (6), pushing a filling mining hydraulic support (7) and performing solid material filling (9) to complete a cyclic operation, and after the solid material filling (9) is completed, measuring a first oblique angle α_1 between the filling mining hydraulic support (7) and the filling mining hydraulic support rear stand column (3);

(3) starting a second cyclic operation, and after the second cyclic operation is carried out until the filling mining hydraulic support (7) is completely pushed, before the solid material filling (9) is started, measuring a second oblique angle α_2 between the filling mining hydraulic support (7) and the filling mining hydraulic support rear stand column (3);

(4) on the basis of the oblique angles, monitored in the two cyclic operations, of the filling mining hydraulic support rear stand column (3), obtaining an oblique angle-support height curve of the filling mining hydraulic support rear stand column (3) according to the solid simulation model established by utilizing the Pro/Engineer™ software, so as to obtain a support height difference Δl between the first oblique angle and the second oblique angle; and

(5) generating a geometric figure of the filling mining hydraulic support overlapping the filling mining hydraulic supports (7) at two positions, and taking triangles formed by connecting early subsidence sections of rear top beams and roofs of the filling mining

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hydraulic supports at two stages as similar triangles according to $\frac{l_3}{l_1+l_2}=\frac{\Delta l}{S_d}$, and detecting early subsidence of a roof at a breaking point of a filling mining hydraulic support rear top beam according to $S_d=\frac{\Delta l(l_1+l_2)}{l_3}$.

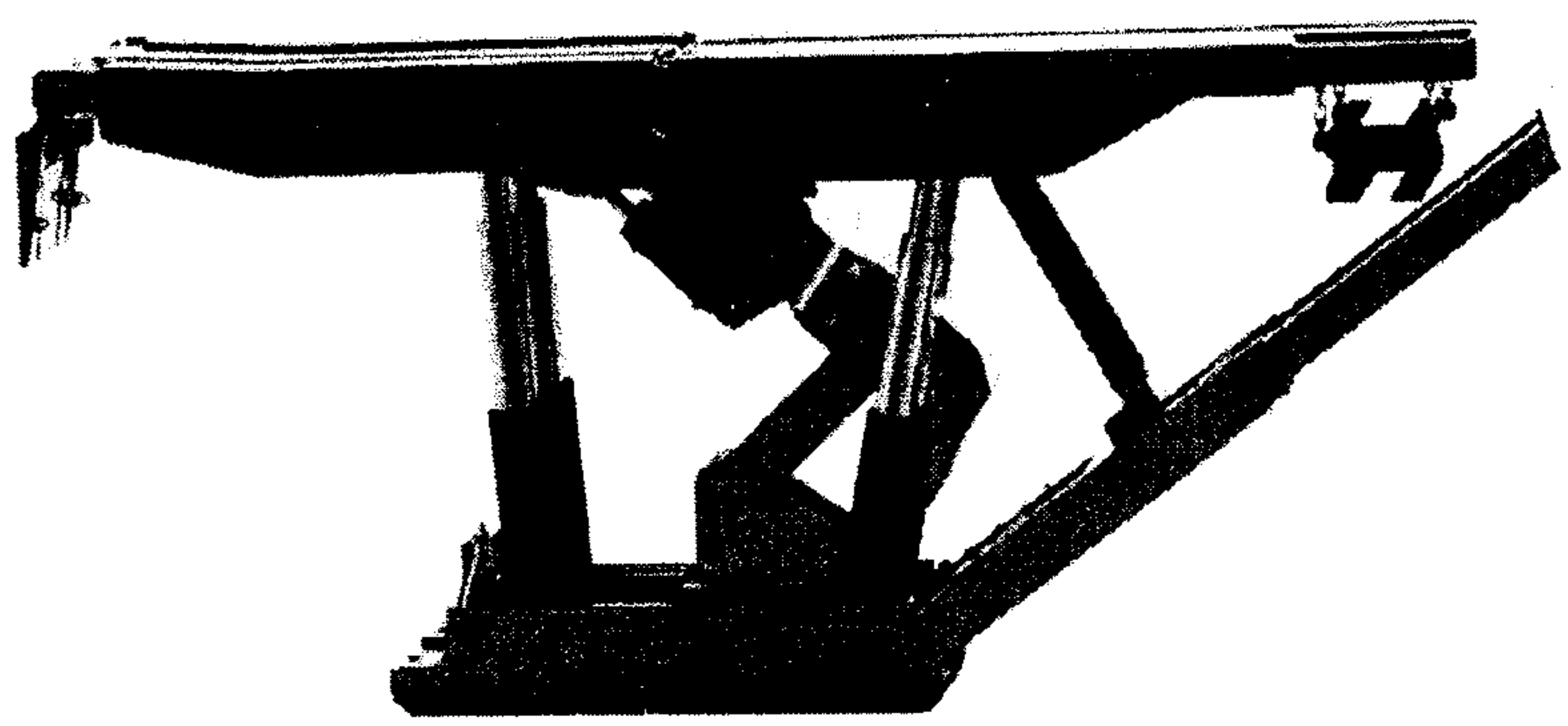


FIG. 1

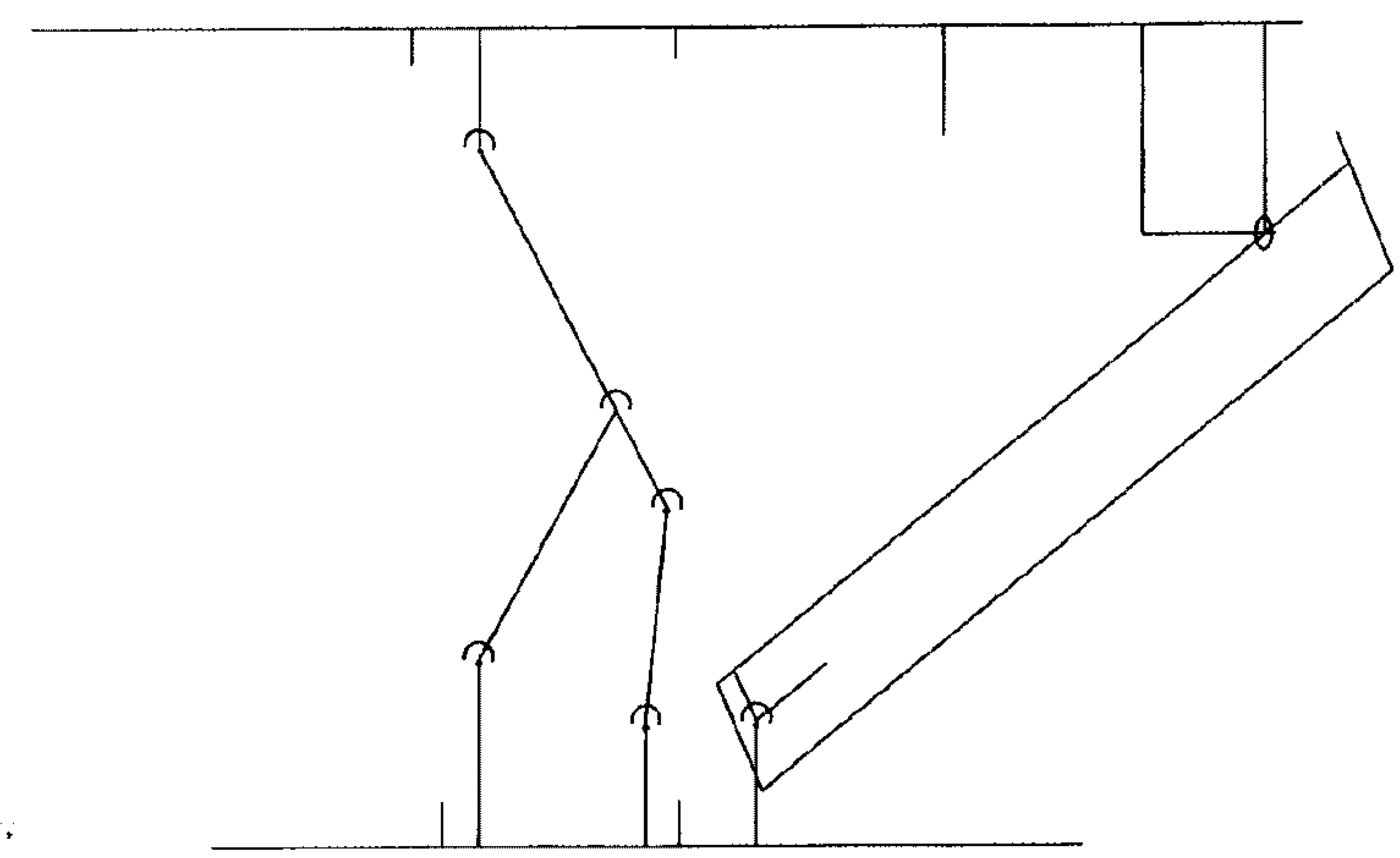


FIG. 2

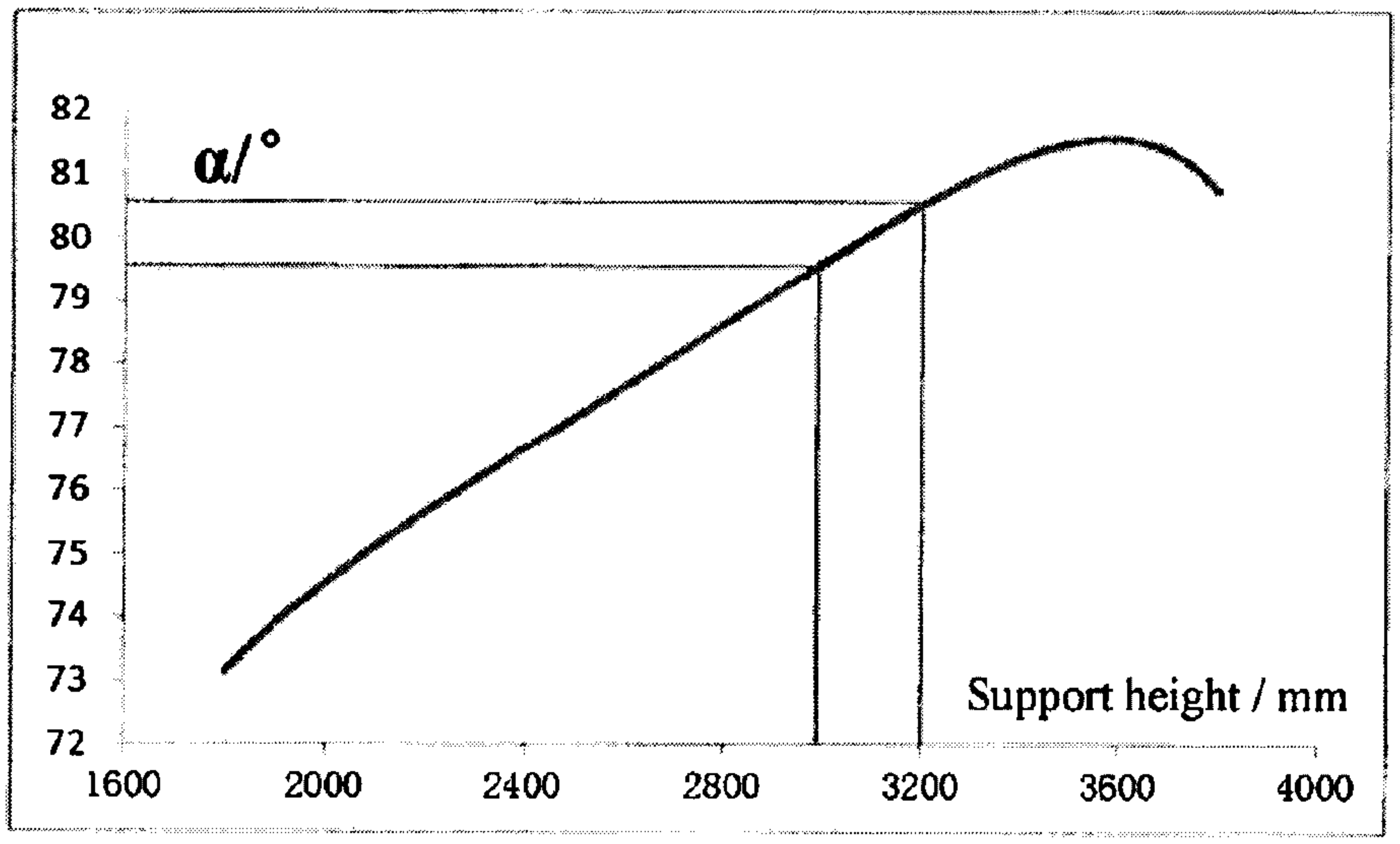
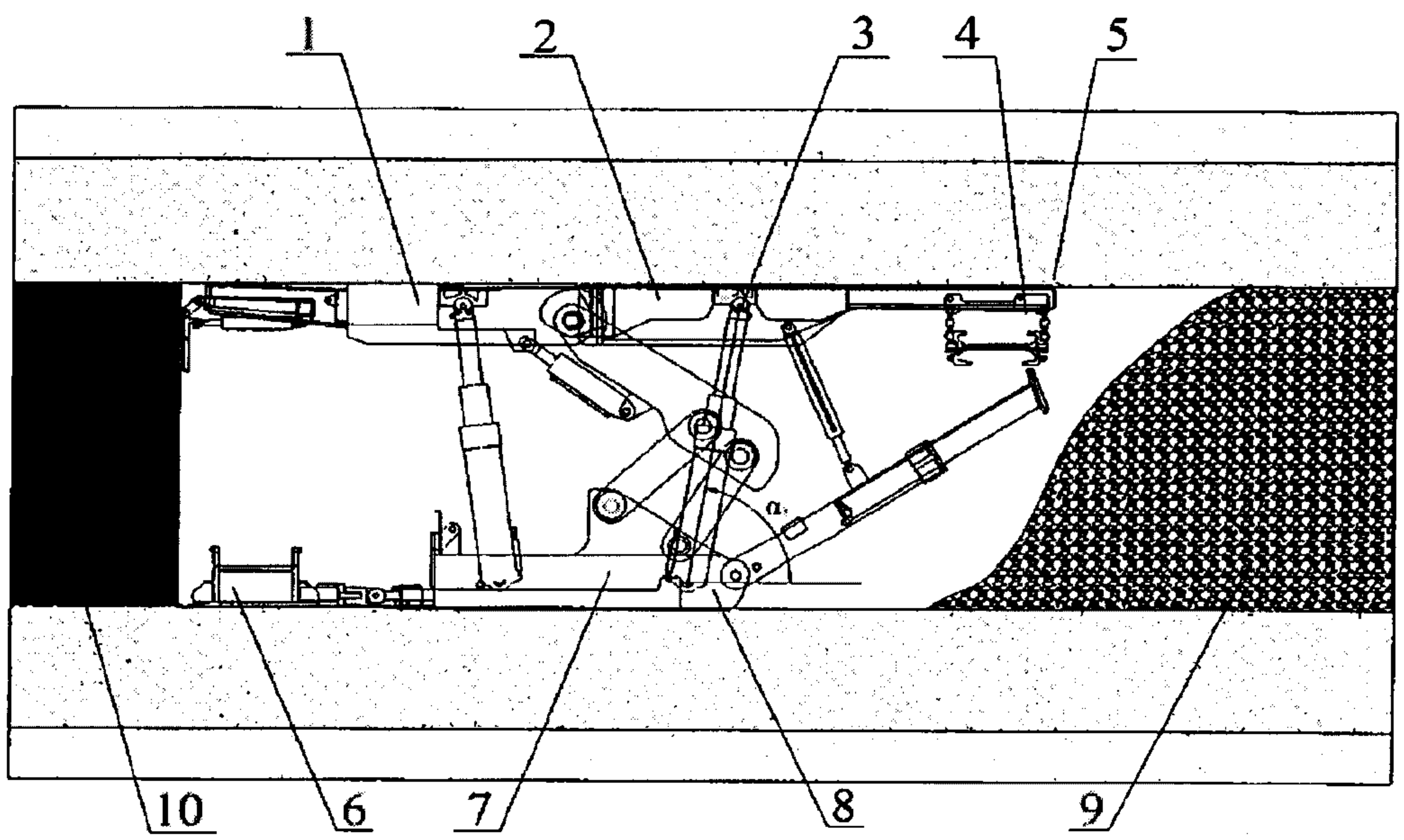

82
81
80
79
78
77
76
75
74
73
72
α/°
1600
2000
2400
2800
3200
3600
4000
Support height / mm

FIG. 3


1
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α
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9

FIG. 4

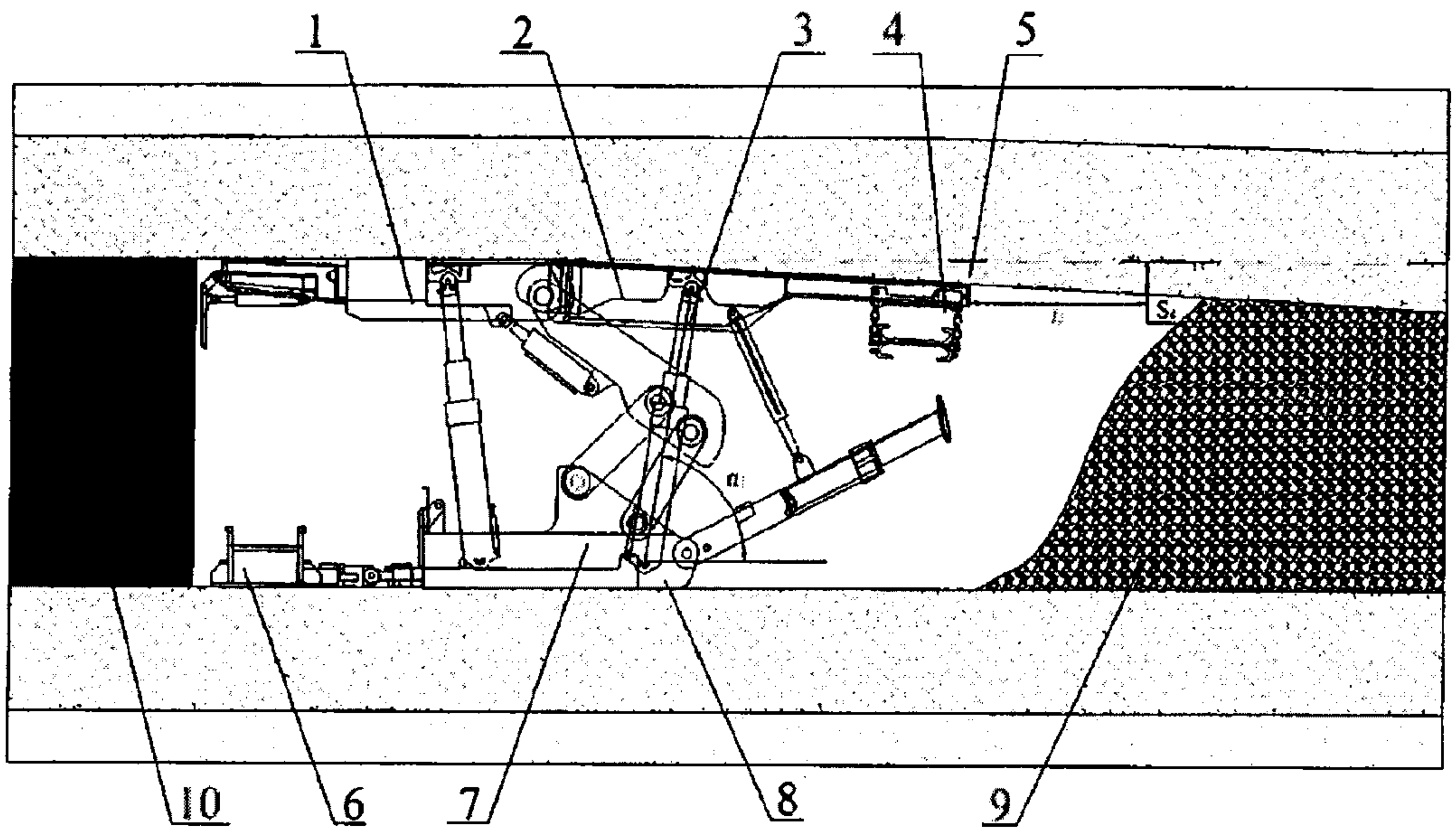

FIG. 5

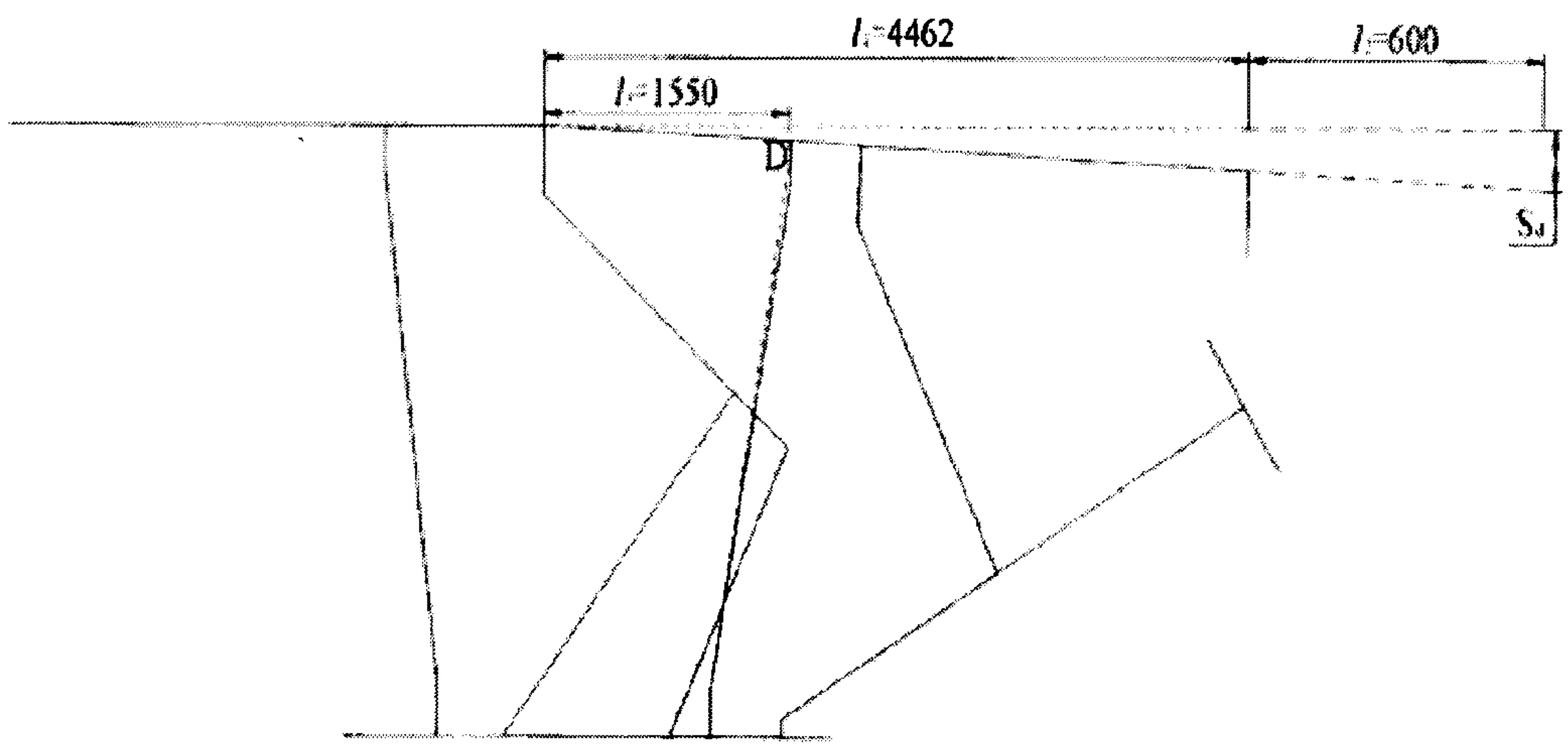

FIG. 6

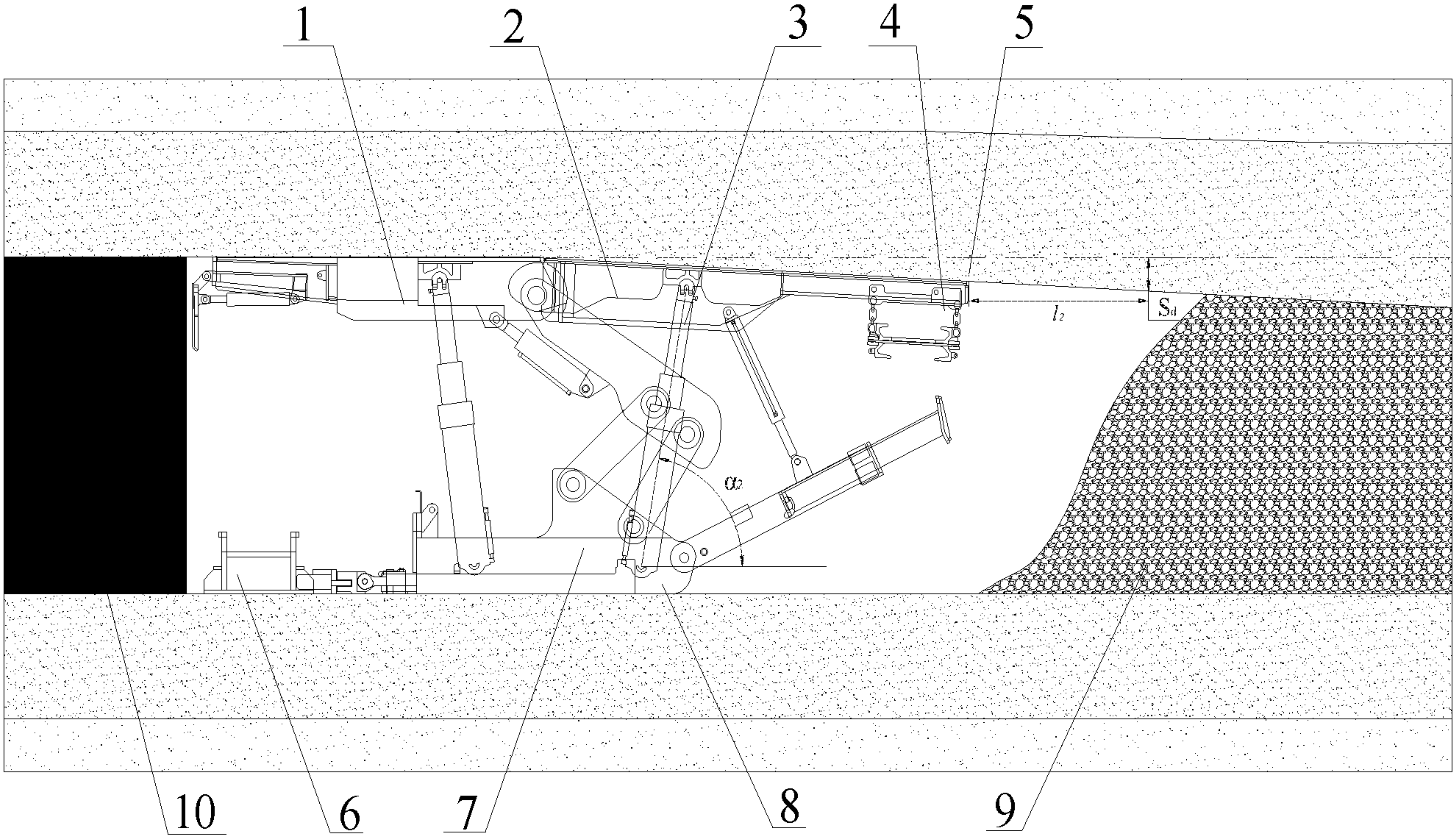

图 5