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Slow loading yielding prop for underground mines - an invention

In general, underground mine/tunnels/roadways are supported especially in India, by using wooden cogs/props as support in addition to the massive use of roof bolting. But as wood is becoming scarce, there is need for suitable alternative supports to replace timbers in mines. Keeping in mind the Indian mining condition the support should be of greater longevity, light enough for easy portability and requiring less maintenance. Further, it should have facilities for height variation, sufficient yielding, continuous load monitoring and releasing remotely as the coal seam thickness varies widely in Indian mines. Then, the support material must be easily available and should have ease in operation by even an unskilled worker. Finally, the device must be economically viable for Indian mines, which is thriving for its longer life and should provide safety for miners. In this direction several efforts have been made to design such slow loading yielding props to meet all these requirements. After numerous attempts such innovative prop consisting of multiple disc springs has been designed and developed at CSIR-CIMFR of which the details description has been discussed in this paper.

Keywords: Slow loading, yielding prop, disc spring

1.0 Introduction

The present invention relates to a device for roof support of underground mine/tunnel. The present invention particularly relates to a mine support device which additionally providing unique yielding mechanism, continuous monitoring of roof load of underground mine/ tunnels/roadways with simple, easy and safe remote release mechanism.

In general, underground mine/tunnels/roadways are supported, especially in India, by using wooden cogs/props and roof bolts. Though in most of the mines roof bolting culture has started, but passive support systems cannot be avoided. In bord and pillar mining and longwal mining operation these types of supports are used extensively in addition to the roof bolting. But as wood is becoming scarce, there is need for suitable alternative supports to replace timbers in mines. Further, in deeper mines roof load decreases, thus to run the blasting gallery method of mining slow loading yielding props are required in addition to other support systems. Keeping in mind the Indian mining condition the support should be of greater longevity, light enough for easy portability and requiring less maintenance. Further, it should have facilities for height variation, sufficient yielding, continuous load monitoring and releasing remotely as the coal seam thickness varies widely in Indian mines. Then, it should have ease in operation by even an unskilled worker. Additionally, the device must be economically viable and acceptable to the miners. Many standing props have been designed in past like friction prop, hydraulic prop, screw prop, pit prop etc., but none has the all facilities as mentioned above.

In the above-referred props some of the drawbacks are:

a. Longevity of the props is less as the yielding element rubber may be affected by weathering condition as also faster wear and tear.
b. No facilities for giving proper setting load which is a vital parameter to be considered.
c. Roof support area is a point roof support, instead of broad area.
d. Simplest quick release system from a safe distance is not provided.
e. Lack of facility for easy dismantling and good portability.
f. No device to monitor the yielding as well as roof load
g. No facility for replacement of yielding mechanism
h. No facilities for varying the yielding range as in the case of helical spring amount of yielding is fixed.

This newly invented and patented slow loading prop has been given almost all features as required to upkeep proper safety in mines.

2.0 Description of the prop

In the present invention a device is provided useful for supporting underground mine tunnels/roadways. The device

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of the present invention consists of an externally threaded top tubular element, which is capable of being inserted telescopically into a bottom tubular element having external threads on the top portion. A detachable holding clamp having internal threading matching the external threads of the bottom tubular element is provided for coaxially placing set of disc springs and a tubular spring holding element on threaded part of the said bottom tubular element. The top tubular externally threaded element is provided with a lock nut for matching internal threads. The said lock nut is placed touching the top of the disc springs inside the tubular spring holding element on threaded part of the said bottom tubular element. On the top tubular element, above the said lock nut, another detachable holding clamp having internal threading matching the external threads of the top tubular element is provided for holding twin jacks placed between the holding clamps; one clamps, one clamp on the bottom tubular element and the other clamp on the top tubular element.

2.1 Detailed description of the different embodiments

The various parts of the present invention as shown in the Figs. 1, 2, and 3 of the drawing accompanying this specification are:

1. Top tubular externally threaded element.
2. Bottom tubular element having bracket to rest twin hydraulic jack and holding clamp.
3. Tubular spring holding element.
4. Detachable holding clamp having remote release mechanism.
5. Set of disc spring.
6. Lock nut.
7. Detachable holding clamp having internal threading matching the external thread of the top tubular element.
8. Twin jacks.
9. Square section canopy.
10. Detachable holding clamp for jack setting.
11. Remote release long handle.
12. Disc spring (two views).
13. Convergence/roof load indicator.

2.2 Methods of Operation

The device is erected vertically so that it can touch the mine roof. Then twin jacks (8) will be placed between the two clamps (10) and (7) and the pump of the twin jacks (8) will be operated to extend the ram of the jack for lifting up the tubular structure (1) against the roof. When the induced load to the tubular structure (1) will be around 5 tonnes, the lock nut (6) will be tightened against the spring (5). Once the prop is set, the jacks (8) along with the top clamp (7) and bottom clamp (10) will be withdrawn from the site. During loading, the load will come through the top tube (1) to the disc spring (5) through lock nut (6) and then transmit to the bottom tube (2) through the holding clamp (4). As the load increases, the spring will be compressed, which in turn facilitates the yielding of the prop. During withdrawal, the holding clamp (4) will be opened from a safe distance by lifting the arm and rotating the nut by long handle (11) through which connecting lever expands outwardly and facilitates the opening of the clamp, therefore allowing tubular structure (3), disc spring (5) and top tube (1) with lock nut (6) to fall down. During entire loading condition, the roof load coming on the canopy (9) and transmitted to the prop and then convergence of the roof can be measured with the help of a pointer (13) attached to the disc spring (5) and (12).

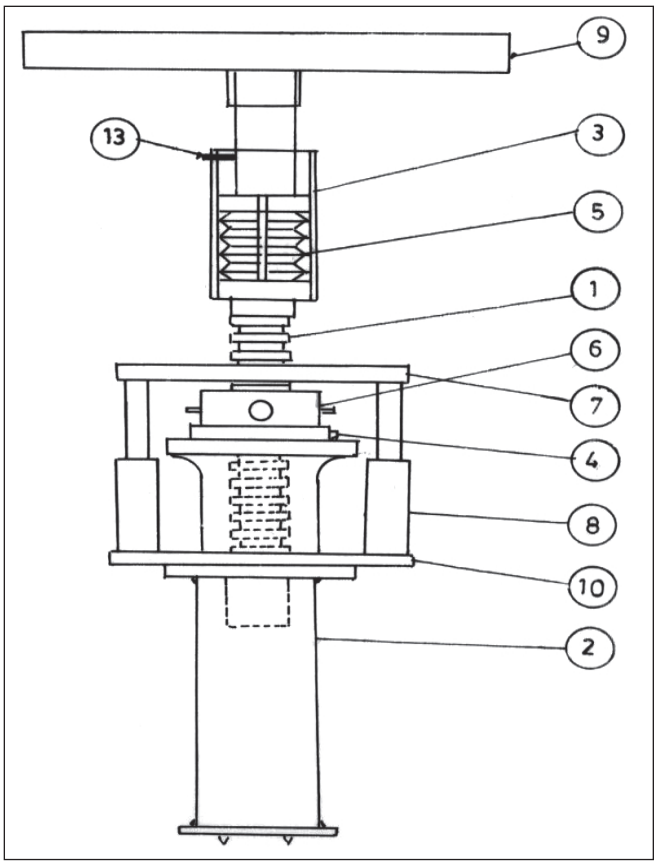

Fig.1

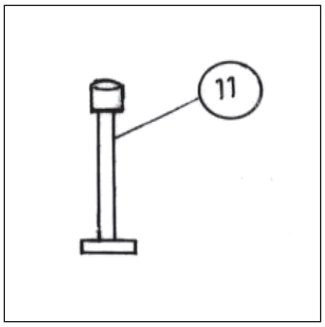

Fig.2

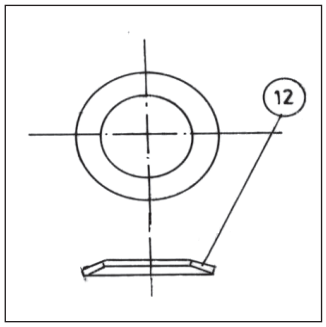

Fig.3