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METHOD OF AND APPARATUS FOR INDICATING
FAILURE OF MINE ROOFS
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Fig. 1.

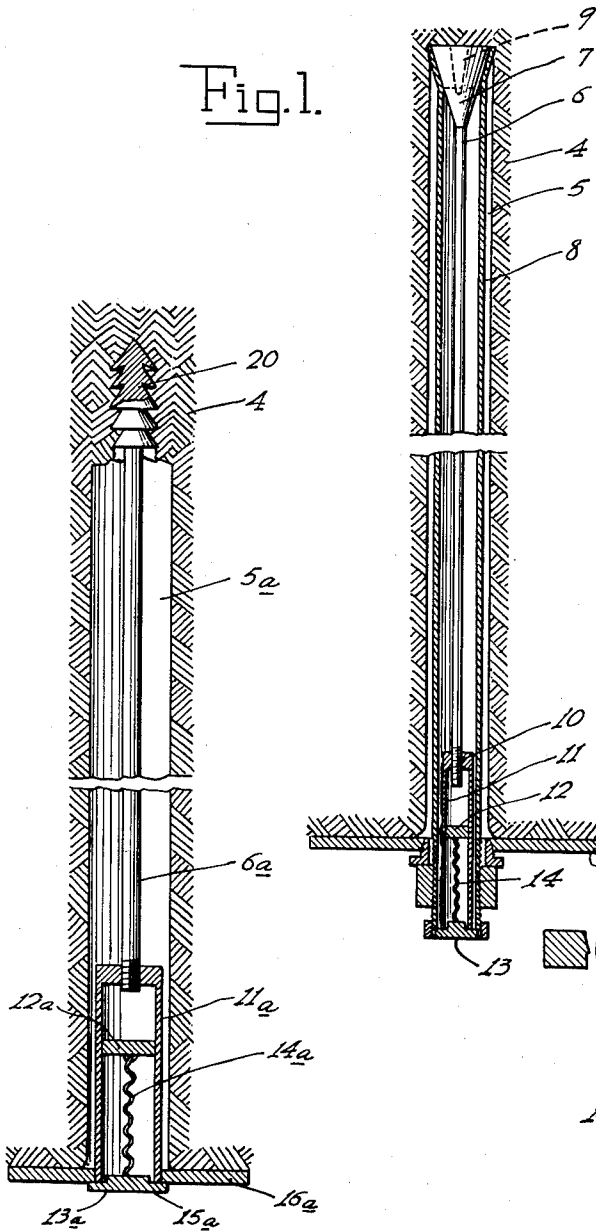
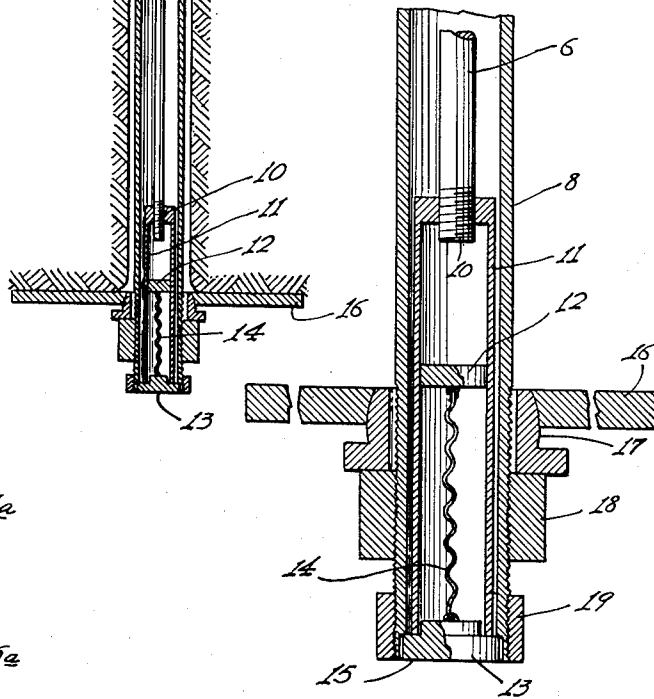


Fig. 2.

Fig. 3.



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METHOD OF AND APPARATUS FOR INDICATING FAILURE OF MINE ROOFS

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5 Claims. (Cl. 116—114)

This invention relates to a method of and apparatus for indicating incipient failure of a subterranean roof, as for example, a mine roof.

This invention has certain features which are common to those disclosed in my copending application entitled, Method of and Apparatus for Reinforcing and Supporting Mine Roof and the Like, Serial No. 156,199, filed April 15, 1950, to which reference is hereby made. The present invention while primarily directed to providing an indication of incipient mine roof failure may utilize the invention of my said copending application to additionally provide a mine roof support.

In accordance with the principles of this invention, the apparatus for indicating incipient mine roof failure is mounted in a cylindrical opening bored upwardly in a mine roof. The apparatus mounted therein continuously observes the length of such opening and any change in its length is translated into an indication of possible mine roof failure. This apparatus, generally stated, comprises a part secured at the inner end of the opening, and a part secured at the outer end of the opening. Relative movement between such parts is utilized to indicate a change in the condition of the roof strata in which the opening is formed, and possible roof failure. When a subterranean roof begins to fail, it will sag at its surface and an opening cut upwardly therein will increase in length. In accordance with this invention, separate means located respectively at the upper and lower ends of the bored opening are utilized to give a continuous observation of the length of the opening, and when the roof sags and increases its length, such means operate to give a warning of roof failure.

As explained above, one of the principal objects of this invention is to provide a method of and apparatus for indicating incipient mine roof failure in response to a change in length of an opening bored therein.

A further object of the invention is to provide apparatus which will continuously observe the length of an opening bored in the strata forming a roof opening and which will utilize any increase in the length of such opening to warn of impending roof failure.

Still another object of this invention is to provide apparatus for warning of impending roof failure which will additionally operate to reinforce and support the roof against failure.

A further object is to provide apparatus for indicating the condition of a mine roof which may be mounted in an opening bored in a mine roof, and which when so mounted, will be effective to observe the condition of the strata forming the roof and to translate changes in the strata into an indication of a weakened roof condition.

Other objects and advantages of the invention will be apparent from the following description of the invention.

This invention will be described with particular reference to its use in indicating mine roof failure, but it is to be understood that the structure and principles involved, may be used, as already stated, in connection with any subterranean roof.

This invention may be more clearly understood by reference to the following figures in which:

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Fig. 1 shows a sectional view of a preferred form of apparatus as applied to an opening in a subterranean roof;

Fig. 2 is a sectional view showing a modified form of apparatus as applied to an opening in a subterranean roof; and

Fig. 3 is a fragmentary enlarged sectional view of a part of the apparatus shown in Fig. 1.

Referring to Fig. 1, the numeral 4 designates the earth strata forming a mine roof which has an opening 5 cut upwardly therein. This opening may be formed in any convenient manner, as by drilling or boring, and is located at any place where it is desired to provide an indication of roof failure. The opening is of sufficient length that any sag in the roof will cause its lower end to be displaced downwardly relative to its upper end, and has a diameter sufficiently large to receive the apparatus hereinafter to be described. This apparatus comprises an elongated member 6, in the form of a steel rod, which is inserted in the opening and has an enlarged upper end portion 7 by which it is secured to the roof strata 4 at the inner end of the opening 5. As described in my copending application, the enlarged end 7 is engaged with the end of the tube 8 which is employed to carry the rod 6 to a position with its end 7 adjacent the inner end of the opening 5. The tube is then forced upwardly by an air hammer or the like, and the enlarged end 7 acts as a wedge to expand the end of the tube, slotted as at 9, into tight holding engagement with the earth at the inner end of the opening 5 to secure both the rod 6 and tube 8 in position in the opening 5. The space around the tube may be filled with concrete (not shown) as explained in my copending application to anchor the tube in position.

The rod 6 has a length shorter than the opening 5 and has its lower end threaded as at 10. An inverted receptacle 11 is threaded on the end 10 of the rod 6 and has a partition 12 mounted therein. The lower end of the receptacle has a closure plug 13 frictionally engaged therein. A string or wire 14 provides a connection between the partition 12 and plug 13. The plug 13 has an annular shoulder 15 which is engaged by the lower end of the tube 8 for a purpose to be described.

A plate 16 is mounted on the lower end of the tube 8 in a position in supporting engagement with the surface of the mine roof. The plate 16 is supported on a universal connector 17 which has a rounded surface engaged with a similar rounded surface provided by an opening centrally of the plate 16 so that the plate will have a limited universal movement on the connector 17 to compensate for irregularities in the surface of the mine roof. A nut 18 threaded on the lower end of the tube 8 engages with the connector 17 to force it and the plate 16 upwardly to a position in which the plate 16 engages tightly with the mine roof. A reinforcing collar 19 is threaded on the outer end of the tube 8.

The mounting of the plate 16 is such that any separation of the strata in which the opening 5 is formed will lower the plate 16. The plate 16 can lower only by stretching the tube 8 on which the plate 16 is mounted, and such stretching action will effect a corresponding lowering movement of the lower end of the tube 8. Since the receptacle 11 is secured to the upper end of opening 5 through rod 6 and wedge 7, it will be seen that downward movement of plate 16 and tube 8 will be a movement relative to the receptacle 11, or a movement relative to the inner end of opening 5. With the tube 8 engaged with the shoulder 15 of plug 13, such relative downward movement will force the plug 13 out of the receptacle 11, and it will drop to a position determined by the length of the cord 14. The dangling

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plug 13 will thus indicate that a separation of the strata along the opening 5 has taken place with a corresponding weakening of the mine roof structure, and will thus give an indication of incipient failure of the mine roof.

The structure shown in Figures 1 and 3 represents a preferred embodiment of the invention by which the plate 16 is made to furnish an effective support for the mine roof as explained in the above-mentioned depending application. However, if only a warning is desired, the tube 8 may be dispensed with and a simplified structure, such as shown in Fig. 2, may be used. In this showing, a plate 16a in engagement with the mine roof is supported directly on the shoulder 15a of a plug 13a in the end of a receptacle 11a. The receptacle 11a is connected to the rod 6a as explained above, but the rod 6a is provided with a serrated end 20 which may be driven or threaded into the inner end of the opening 5a. In this modification, the receptacle 11a is in effect secured to the inner end of the opening 5a and the plate 16a is secured to its outer end. Relative movement between the inner and outer ends of the opening 5a will result in a similar movement between plate 16a and receptacle 11a to pop the plug 13a out of the position illustrated to a dangling position warning of roof sag and possible roof failure.

In both of the modifications described above, the warning given in response to separation of the earth strata causing roof sag is had by movement of the closure plugs 13 or 13a from a position frictionally supported in the end of the receptacle 11 to a dangling position supported by the cord or wire 14 from the partition 12. The movement of the plug 13 out of its frictionally supported position is effected by a relative movement between the receptacle 11 and roof-engaging plate 16. The positions of the receptacle 11 and roof-engaging plate 16 respectively correspond to the position of the inner and outer ends of the opening 5. It will, of course, be understood that the specific arrangement of plug 13 and the manner in which it operates to give a warning of roof failure is only one example of indicating apparatus which may be used, and that other warning structure responsive to relative movement between the inner and outer ends of the opening 5, or relative movement between any two points at spaced intervals along the axis of the opening 5, may be substituted in place of the plug 13.

From the foregoing, it will be apparent that there is provided a novel arrangement of apparatus for indicating mine roof sag and incipient roof failure in response to separation of the strata forming the mine or other subterranean roof. Attention is particularly directed to the fact that practice of the invention necessitates drilling or boring an opening through the earth strata forming the mine roof. The apparatus which is inserted in the opening so formed continuously observes the condition of the strata through which the opening extends, and any weakening of the strata such as a slight separation thereof which would eventually result in failure of the mine roof is immediately translated into a warning that roof sag has taken place which may eventually result in failure of the mine roof. In addition to observing the condition of the earth strata immediately above the surface of the mine roof, the provision of the opening in which the apparatus of this invention is mounted conceals the warning structure and provides a mount therefor in which it will be ineffective to obstruct or interfere with other operations.

Attention is also directed to the fact that the warning apparatus of this invention continuously observes the relative positions of the inner and outer ends of the opening and translates relative movement between such ends into a warning of possible roof failure. For example, the receptacle 11 being anchored through the part 7 or part 20 to the inner end of the opening 5 has a position corresponding to the inner end of such opening and continuously observes the position of such inner

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end. On the other hand, the plate 16 being engaged with the surface of the mine roof has a position which corresponds to the outer end of the opening, and it thus continuously observes the relative position of such outer end with respect to its inner end. Separation of the earth strata such as will cause roof sag can be had only by moving the plate 16 relative to the receptacle 11, and this relative movement is utilized to warn of roof sag and possible roof failure.

While I have illustrated and described one specific embodiment of my invention, it will be understood that this is merely by way of illustration, and that various changes and modifications may be made therein within the contemplation of my invention and under the scope of the following claims.

I claim:

1. Apparatus for warning of failure of a subterranean roof having an opening extending upwardly therein comprising, a rod having its upper end secured to the strata at the inner end of said opening and its lower end terminating adjacent the outer end of said opening, a plate supported on the lower end of said rod in a position engaged with the surface of said mine roof, and means responsive to downward movement of said plate by sagging of the earth strata forming said roof for warning of incipient roof failure.

2. Apparatus for warning of failure of a subterranean roof having an opening extending upwardly therein comprising, a rod having its upper end secured to the strata at the inner end of said opening and its lower end terminating adjacent the outer end of said opening, an inverted receptacle secured to the lower end of said rod, a plug closure frictionally mounted in the end of said receptacle and having a flange projecting beyond the edge thereof, and means for disengaging said plug from said receptacle to warn of roof sag comprising a plate engaged with the surface of the roof about said opening, and means for supporting said plate including parts engaged with said flange so that downward movement of said plate by sagging of the roof will disengage said plug from said receptacle.

3. Apparatus for warning of failure of a roof having an opening extending upwardly therein comprising, a rod having its upper end secured to the roof at the inner end of said opening and its lower end terminating adjacent the outer end of said opening, a plate supported against the surface of the roof at the outer end of said opening, and indicating means connected with said lower rod end and operated by said plate in response to movement thereof relative to the lower end of said rod.

4. Apparatus for warning of failure of a roof having an opening extending upwardly therein comprising, a first part secured to the roof adjacent the inner end of said opening, a second part secured to the roof adjacent the outer end of said opening, and means operatively connected with said parts to be responsive to downward movement of said second part relative to said first part by sagging of the roof for warning of incipient roof failure.

5. Apparatus for warning of failure of a roof having an opening extending upwardly therein comprising, a first means providing a reference point of the position of the roof strata at the inner end of said opening, a second means providing a reference point of the position of the roof strata adjacent the outer end of said opening, and means operatively connected with said first and second named means to be responsive to a change in the relative positions of the reference points provided by said first and second means for warning of incipient roof failure.

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