March 10, 1942. K. LEHMANN 2,275,912

SYSTEM OF WORKING BEDLIKE DEPOSITS, PARTICULARLY THICK BEDS OF LIGNITE AND MINERAL COAL

Filed June 6, 1940 4 Sheets-Sheet 1

Fig. 1

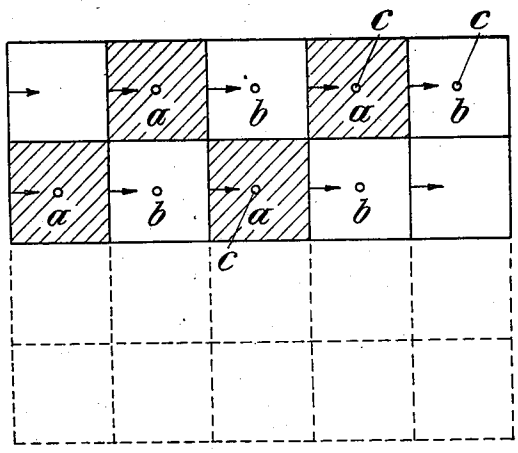

Fig. 2

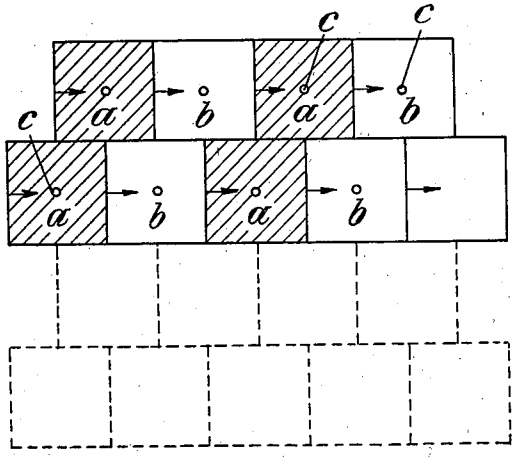

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Fig. 3

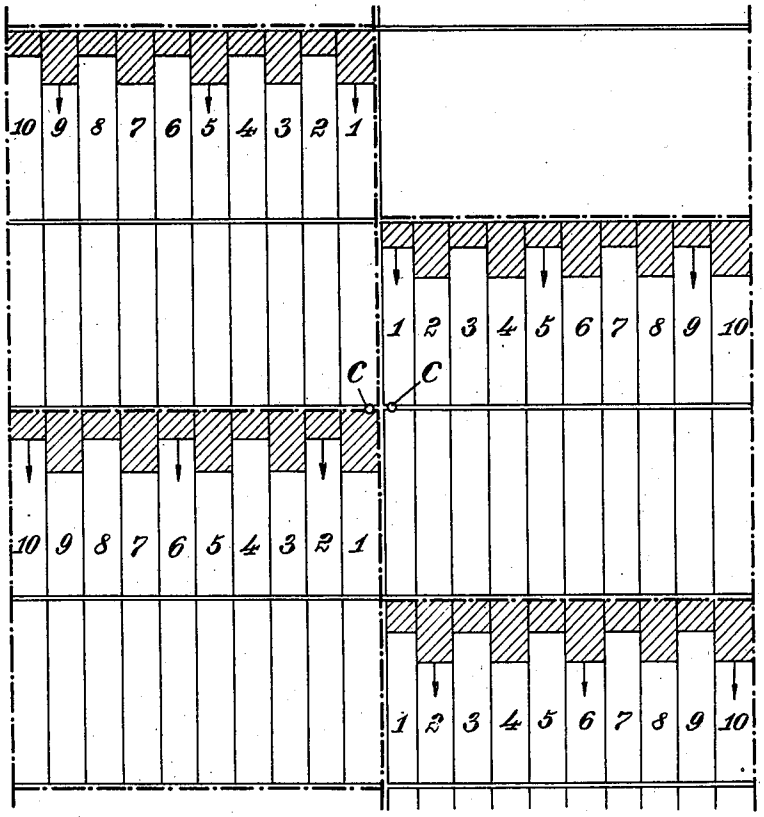

Fig. 4

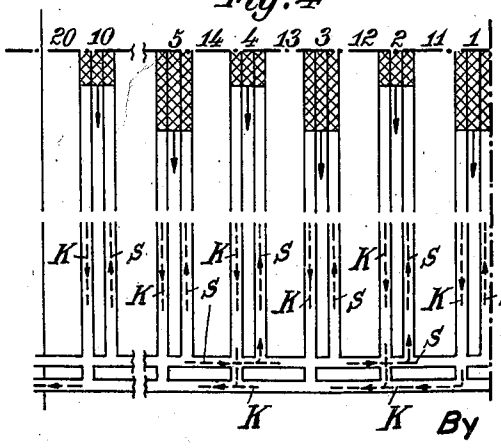

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Fig. 5

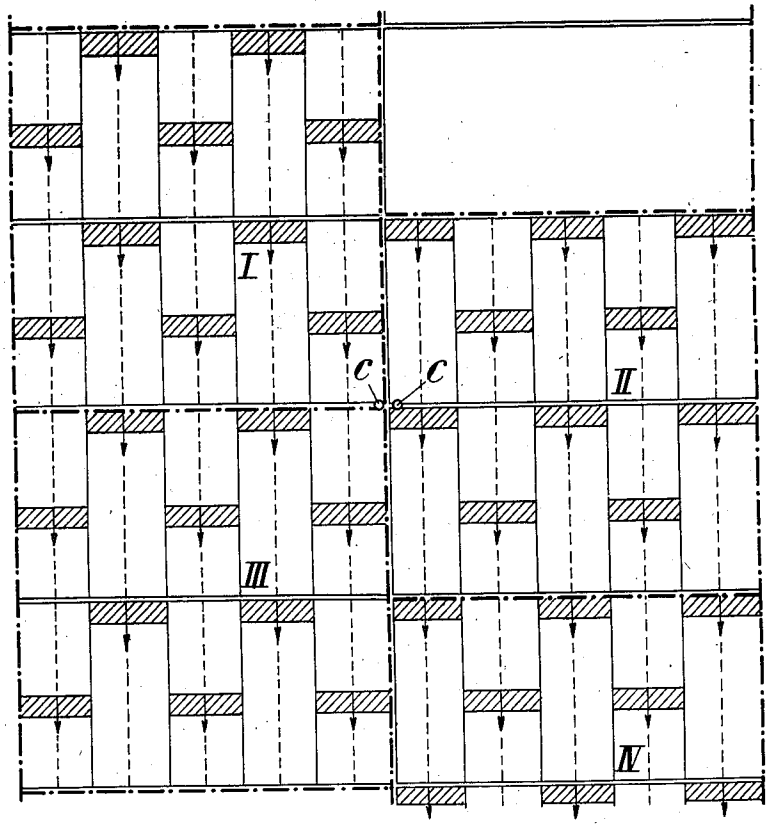

Fig. 6

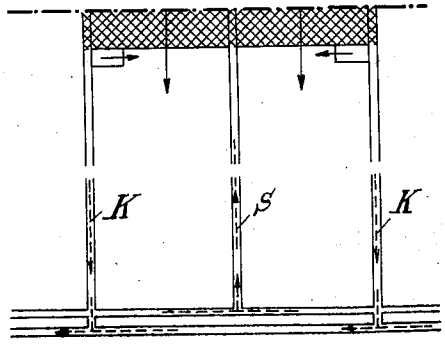

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Fig. 7

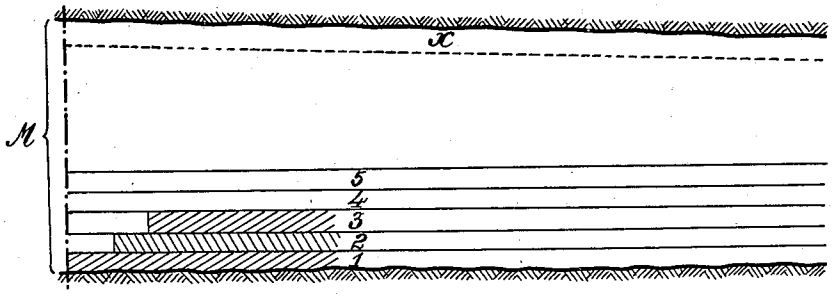
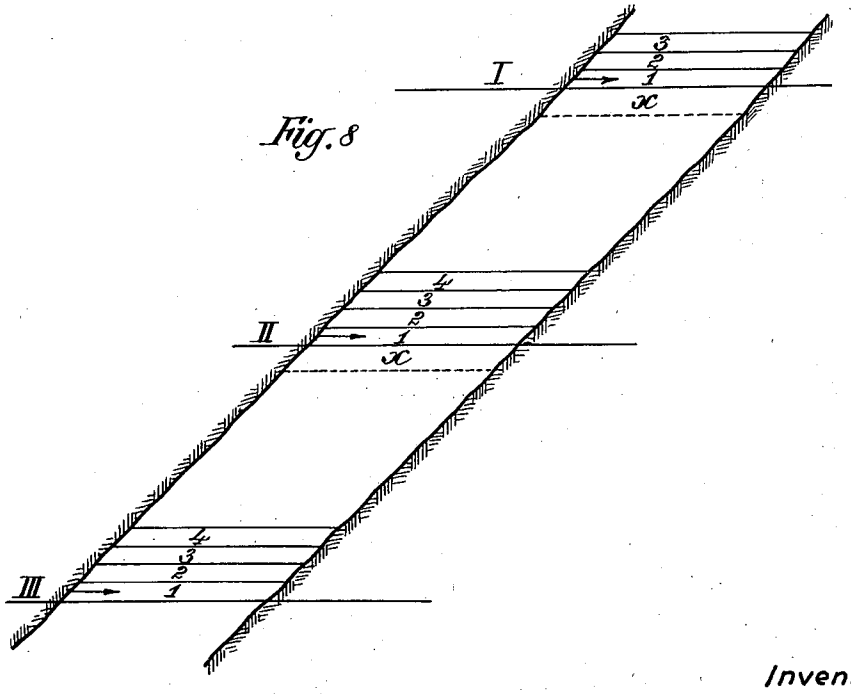


Fig. 8



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Patented Mar. 10, 1942

2,275,912

UNITED STATES PATENT OFFICE

2,275,912

SYSTEM OF WORKING BEDLIKE DEPOSITS, PARTICULARLY THICK BEDS OF LIGNITE AND MINERAL COAL

Karl Lehmann, Essen, Ruhr, Germany

Application June 6, 1940, Serial No. 339,146
In Germany April 13, 1939

9 Claims. (Cl. 262—1)

This invention relates to the art of mining and, more particularly, is intended to provide a new method of working horizontal or inclined beds, particularly those of lignite or mineral coal, whereby the roof or hanging wall is caused to be lowered to as small an extent as possible and in a uniform manner as the bed is worked.

When an underground bed is worked by known mining methods, the removal of areas thereof causes non-uniform lowering of the hanging wall. Such non-uniform lowering is caused among other factors, by the horizontal pull exerted on the roof at the edge of the worked area and by the buckling and stretching of the roof in a vertical direction. These factors and effects result in destruction of the roof or hanging wall and increase in seriousness with the depth of the deposit. Particularly in the deep working of lignite, serious damage is unavoidable although such expedients as hydraulic packing may be resorted to.

The principal object of the invention is to provide a system of working which will reduce to a minimum the horizontal and vertical forces acting on the roof or hanging wall and will therefore cause uniform sinking of the hanging wall as the underlying bed is exploited.

A further object of the invention is to provide an optimum arrangement of work stations under conditions which may obtain in either horizontal or inclined beds.

Other objects and features of novelty of my invention will be made apparent by the following description and the annexed drawings, it being understood, however, that such description and drawings are only illustrative of the invention and impose no limitation thereon or on the appended claims.

Referring to the drawings, in which similar reference numerals refer to like parts:

Fig. 1 is a horizontal diagrammatic plan view of an area which is to be worked, showing a preliminary division thereof according to the invention;

Fig. 2 is a view similar to Fig. 1, showing an alternative preliminary division of an area which is to be worked;

Fig. 3 is a diagrammatic plan view of one of the subdivision of Figs. 1 or 2, showing a further division thereof in a manner according to the invention;

Fig. 4 is a further view of one of the quarters shown in Fig. 3, illustrating also an arrangement of passageways or drifts leading to the working faces;

Fig. 5 is similar to Fig. 3 and illustrates a modified arrangement of working stations;

Fig. 6 illustrates the passageways leading to one of the working stations shown in Fig. 5;

Fig. 7 is a view, taken in vertical section, showing one method of working a horizontal bed in a manner according to the invention, and

Fig. 8 is a view, taken in vertical section, showing one method of working an inclined bed in a manner according to the invention.

The invention achieves the desired objects by a new method of spacing and arranging the work stations which are simultaneously worked in exploiting the bed, which is effected by dividing the area to be worked, and sub-divisions thereof, in a manner providing a systematic spacing of the work stations or group thereof. The arrangement, number and relative arrangement of work stations according to the invention will depend to some extent on the size of the area to be worked, its depth, thickness and inclination, on the time within which the area is to be worked and on the existing working conditions. From such data the possible effects of extraction on the hanging wall or roof may be computed and optimum spacing of the work sections determined. Evaluation of such data will determine an arrangement of work sections in the bed which is to be worked, which sections will be separated ordinarily from one another by sections of equal size that will only be worked after complete exploitation of the sections originally worked. However, it is possible, in accordance with the invention, to simultaneously work adjacent sections or parts thereof. It will be apparent that the method according to the invention can be advantageously applied both to the division and working of a single area of a bed and also to the division of the working of a large area.

In either case the area to be worked is first sub-divided into rows and tiers of equal sections, of which alternate sections only are to be simultaneously worked. Each of these sections is then sub-divided into regularly spaced working sections which are further divided into smaller areas which are the work stations. By means of this complete and uniform-sub-division of an area which is to be worked, and by following the teachings of the invention with respect to working only corresponding stations in each section which is being worked, a uniform sinking of the hanging wall and an elimination of the undesirable horizontal and vertical forces

causing non-uniform sinking of the hanging wall is achieved.

In each of Figs. 1 and 2 of the drawings there is shown an area which is to be mined or worked and which may be part or all of a horizontal or inclined bed. In accordance with the method or procedure illustrated in Fig. 1 this area is divided into a number of equal, square or rectangular sections *a* and *b* which are arranged in checkerboard manner and each of which are provided with a central shaft *c*. Alternate sections *a* in each row and in each tier are designated to be mined or worked first, leaving the sections *b* to be worked when sections *a* have been completely exploited. In the alternative arrangement illustrated in Fig. 2 the sections of each tier are displaced with respect to those in the adjacent tiers. In this case, also, alternate sections *a* in each tier are worked first, leaving the remaining sections *b* to be worked when sections *a* have been completely exploited. The size of the sections will be dependent on the depth of the bed and the other factors referred to hereinbefore and, in a typical case, each section might be 2000 or 3000 meters square.

Regardless of whether the area to be worked is divided in the manner shown in Fig. 1 or in the manner shown in Fig. 2, each of the sections *a* is sub-divided in the same manner. Thus, in Figs. 3 and 4 there is shown one method, according to the invention, of sub-dividing each section *a*. The entire section, which is illustrated in Fig. 3, is first sub-divided into four equal parts, the shaft or shafts *c* at the center of the entire section serving all four parts. Each sub-section or quarter is further sub-divided into slices, which may be ten in number and are numbered 1 to 10 in Fig. 3. Working is started from corresponding sides of quarters I and III of each section. In quarters II and IV of each section working is started from corresponding lines which are displaced from the starting lines of adjacent quarters I and III. The working faces in adjacent slices in each quarter are displaced from each other, alternate faces being kept on a common line which is advanced beyond the common line of intervening faces.

In a preferred method of working, the slices 1 to 10, each of which is approximately 150 meters in width if the entire section measures 3000 meters on each side, are sub-divided into preferably twenty operating slices as shown in Fig. 4. Of these, only alternate slices 1 to 10 are simultaneously worked, the intervening slices 11 to 20 being left unworked until slices 1 to 10 are completely exploited. Again, the working faces of alternate worked slices 1, 3, 5, etc., are advanced beyond those of alternate worked slices 2, 4, 6, etc.

As illustrated in Fig. 4, each worked slice may be provided with a delivery road or drift K and a second drift 5 through which back-filling material may be taken to the working face.

In exploitation according to the method generally illustrated in Figs. 1 to 4, all of the alternate sections *a* of Figs. 1 and 2 are simultaneously worked in the manner illustrated in Figs. 3 and 4. Thus, the exploited areas throughout the entire area being worked will be spaced apart in a regular and predetermined manner, each working face and therefore each emptied area being bordered in the same manner and relation by unworked areas which form a support for the roof. Back-filling is preferably done in order to assist in effecting the advantageous results flowing principally from the spacing of the working stations according to the invention.

When all of the corresponding working sections of each quarter of each section *a* have been completely exploited, the intervening sections, which until this time have not been touched, are worked in exactly the same manner as those previously worked. It will be seen now that back-filling of the sections which are first worked will be advantageous when the remaining sections are worked.

In Figs. 5 and 6 there is illustrated a long-wall method of working according to the invention. In this form of the invention, each quarter of each section *a* is divided into a smaller number of wider slices than is shown in Figs. 3 and 4, and the working faces in adjacent slices are staggered. Thus, as shown in Fig. 5, as each face advances it will have at each side thereof an unworked block of mineral supporting the roof. As shown in Fig. 6 filling material may be supplied to each working face through a central road S and mineral is taken from the working face through two drifts K which are preferably at opposite sides of the slice. As in Figs. 3 and 4, back-working is preferably done in order to provide improved support.

It is contemplated by the invention that the method hereinbefore described may be applied to successive horizontal layers of a bed. Thus, in Fig. 7 there is illustrated a substantially horizontal bed which has been divided into a plurality of superposed layers, five of which are shown. Each of these layers will be worked in the manner hereinbefore described. However, working of each layer will begin at a point or line horizontally displaced from the beginning point or line of the adjacent upper and lower layers, all as shown in Fig. 7, thereby avoiding dangerous breaking strains.

In Fig. 8 there is illustrated the application of the invention to a thick bed of steep inclination. The bed is first divided into a plurality of superposed portions I, II and III by spaced horizontal lines, these portions to be worked simultaneously in a predetermined and similar manner. Each of these portions is again divided into a plurality of horizontal, superposed layers, those shown being numbered 1 to 4 in each portion. Correspondingly numbered layers of each portion are worked simultaneously. The vertical spacing between correspondingly numbered layers is so chosen that the points of first cutting of such corresponding layers will be horizontally displaced to an extent determined in the manner hereinbefore described and as illustrated in Figs. 1 and 2.

While I have described and illustrated certain ways in which my invention may be practiced, it will be understood that various other practices and modifications may occur to those skilled in the art, all of which are within the scope of the invention, for the limits of which reference must be had to the appended claims.

What is claimed is:

1. The method of working an underground area, which consists in dividing the area into sections of substantially equal size which are arranged in tiers and rows, sub-dividing each section into corresponding parts, subdividing the corresponding parts of each section into working sections, simultaneously working correspondingly spaced working sections of corresponding parts of alternate sections in each tier and row, and then working the remaining working sections.

2. The method of working an underground area, which consists in dividing the area into sections of substantially equal size which are arranged in tiers and rows, sub-dividing each section into quarters, sub-dividing the quarters of each section into slices, simultaneously working alternate slices of certain corresponding quarters of alternate sections in each tier and row and then working the remaining slices.

3. The method of working an underground area, which consists in dividing the area into sections of substantially equal size which are arranged in tiers and rows, sub-dividing each section into quarters, sub-dividing the quarters of each section into slices, simultaneously working alternate slices of each quarter of alternate sections in each row and tier, and then working the remaining slices.

4. The method of working an underground area, which consists in dividing the area into sections of substantially equal size which are arranged in tiers and rows, sub-dividing each section into quarters, sub-dividing the quarters of each section into slices, simultaneously working alternate slices of certain corresponding quarters of alternate sections in each tier and row, the working faces of adjacent worked slices being displaced from each other in the direction of working and then working the remaining slices.

5. The method of working an underground bed, which consists in dividing the bed into a plurality of sections of equal size which are arranged in tiers and rows, driving a shaft at the center of each section, sub-dividing each section into quarters, sub-dividing each quarter into a plurality of slices, mining the mineral in alternate slices in each quarter of alternate sections in each tier and row in such a way that the working faces in adjacent slices are displaced, the slices in each corresponding quarter of each section beginning at a similarly located line in the quarter, and then working the remaining slices in the same manner.

6. The method of mining underground beds, which consists in dividing the bed into a plurality of sections of equal size which are arranged in tiers and rows, sub-dividing said sections in the same manner, and simultaneously working corresponding parts of alternate sections in each tier and row such alternate sections are exhausted, sub-dividing the remaining sections in the same manner as the sections which were worked first, and simultaneously working corresponding parts of the remaining sections.

7. The method of mining underground beds, which consists in dividing the bed into equal sections arranged in rows and tiers, alternate sections in each row and tier being so spaced apart that when completely exploited the stressed set up in the roof in one section will completely neutralize those set up in the roof of the other section, and simultaneously working such alternate sections.

8. The method of mining underground beds, which consists in dividing the bed into equal sections arranged in rows and tiers, sub-dividing the sections into slices, sub-dividing the slices into work stations, and simultaneously working those stations which are so spaced from each other that the buckling and stretching forces developed in the roof by exploiting the stations neutralize each other.

9. The method of mining an inclined underground bed, which consists in dividing the bed by horizontal lines into a plurality of series of superposed horizontal layers, and simultaneously working corresponding parts of corresponding layers of each series, the vertical spacing of corresponding layers of adjacent series being such that the horizontal distance between the working stations of corresponding layers of adjacent series causes the stresses set up in the roof by exploitation of such working stations to neutralize each other.

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