Aug. 24, 1926. 1,597,023

E. DRENNEN

ART OF MINING COAL

Filed March 22, 1924 4 Sheets-Sheet 1

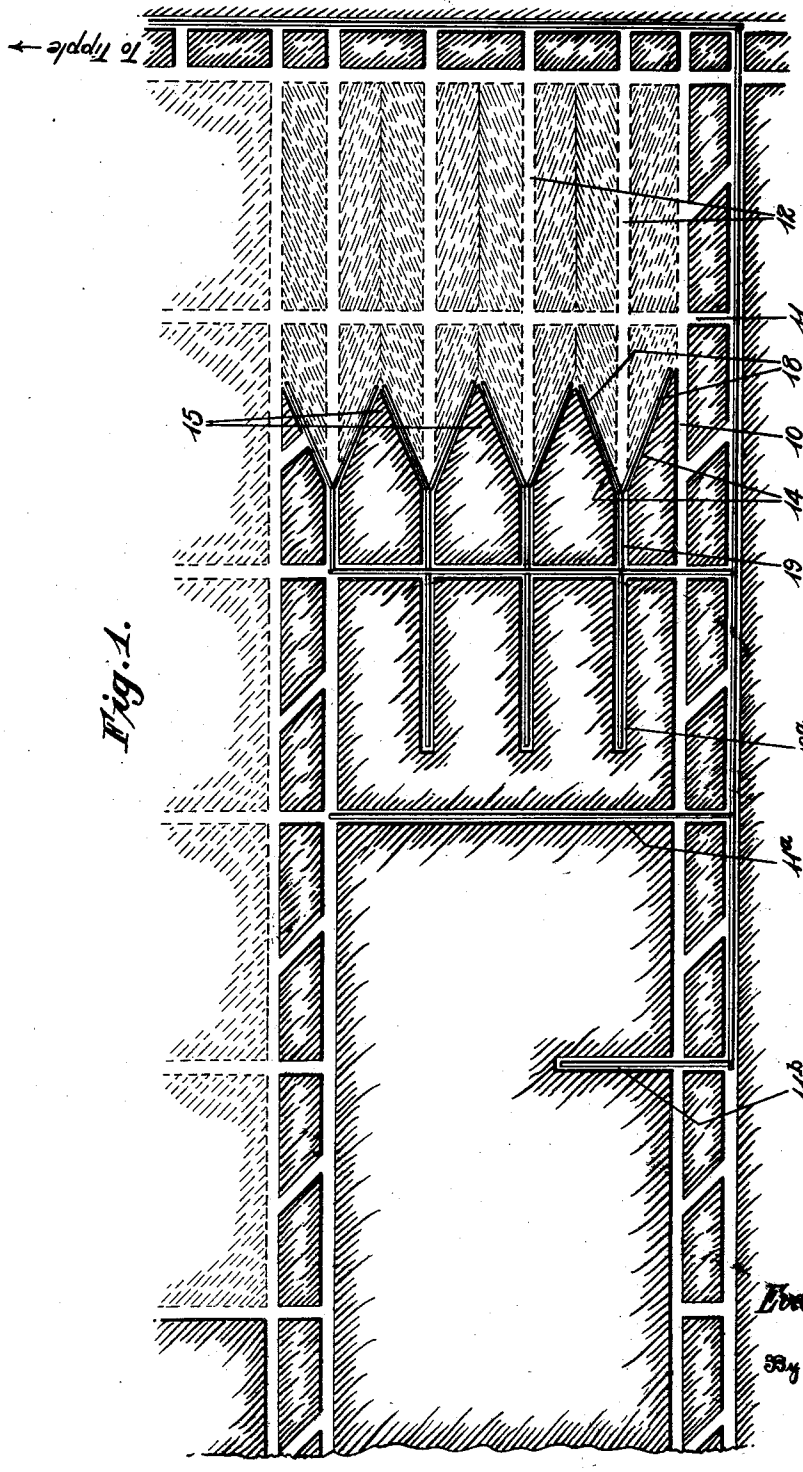


Fig. 1.

Inventor
Everett Drennen
By Kingsbury
Attorneys

Aug. 24, 1926. 1,597,023

E. DRENNEN

ART OF MINING COAL

Filed March 22, 1924 4 Sheets-Sheet 2

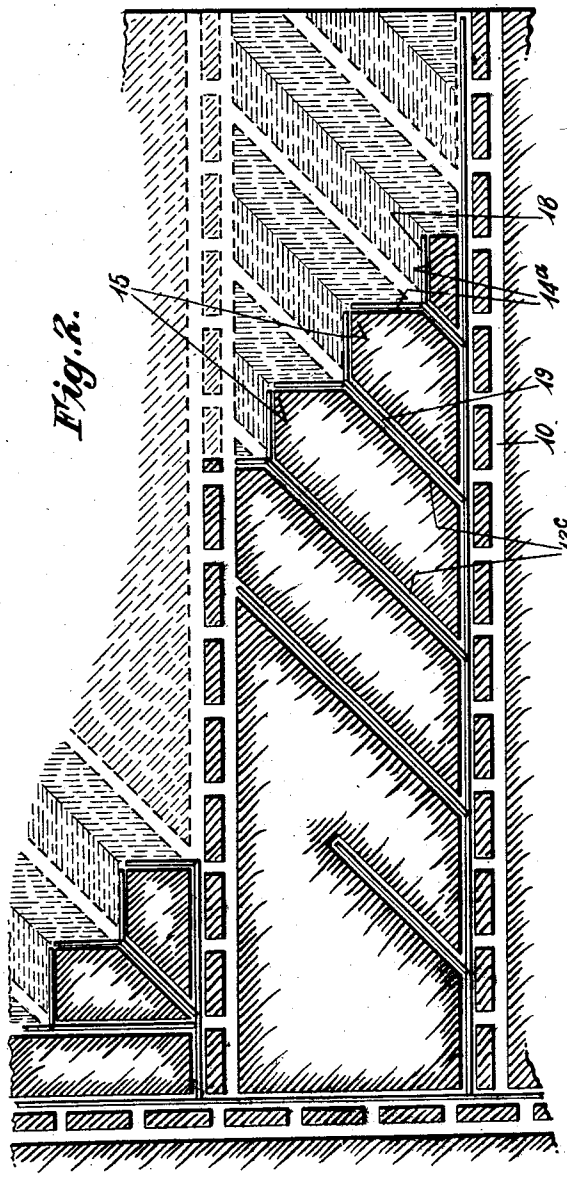


Fig. 2.

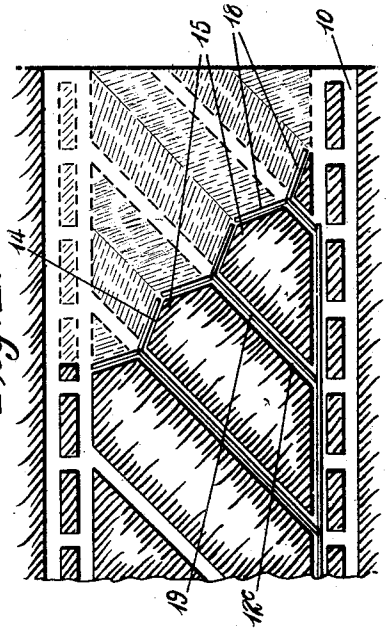


Fig. 4.

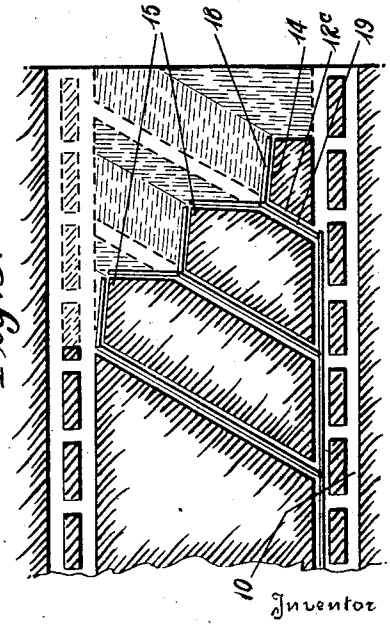


Fig. 3.

Inventor

Everett Drennen

By Knight Brothers

Attorneys

Aug. 24, 1926. 1,597,023

E. DRENNEN

ART OF MINING COAL

Filed March 22, 1924 4 Sheets-Sheet 3

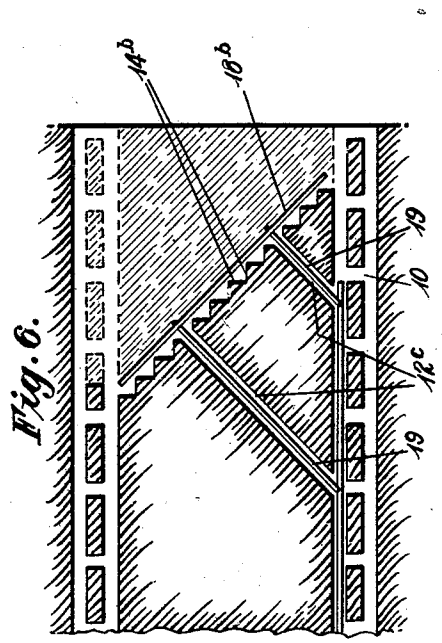


Fig. 6.

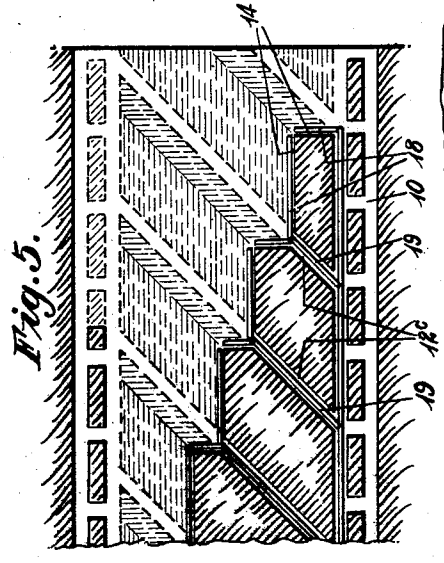


Fig. 5.

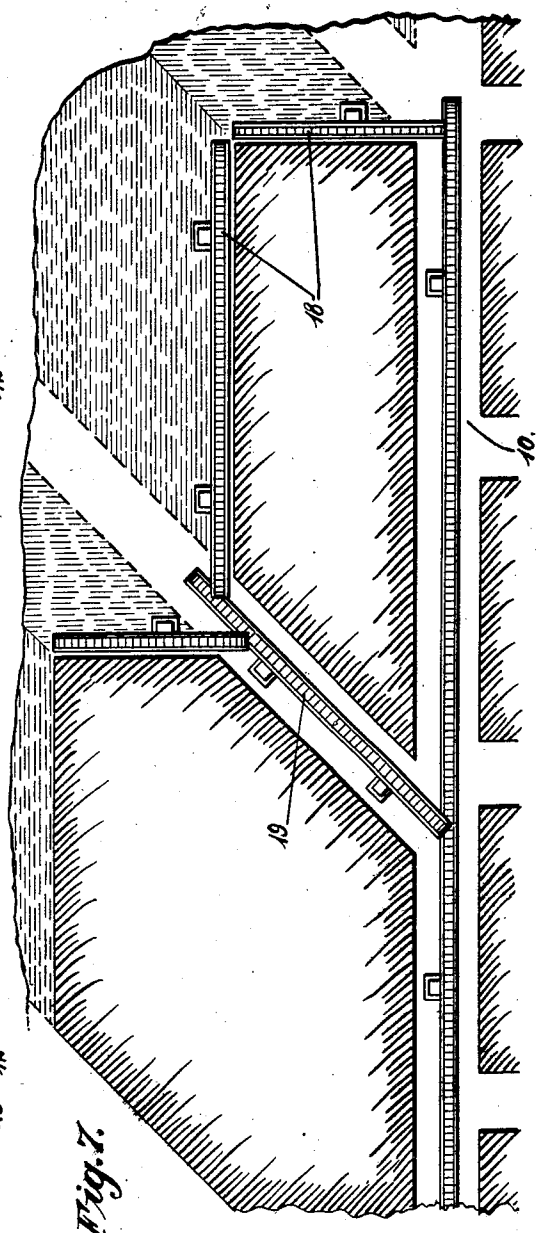


Fig. 7.

Inventor

Everett Drennen

By Knight Bros

Attorneys

Aug. 24, 1926. 1,597,023

E. DRENNEN

ART OF MINING COAL

Filed March 22, 1924 4 Sheets-Sheet 4

Fig. 8.

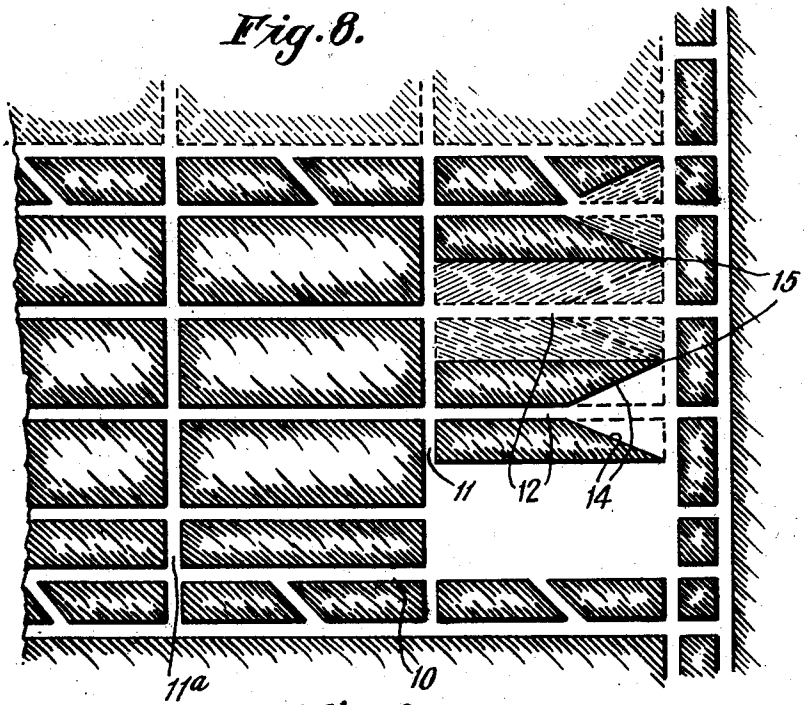
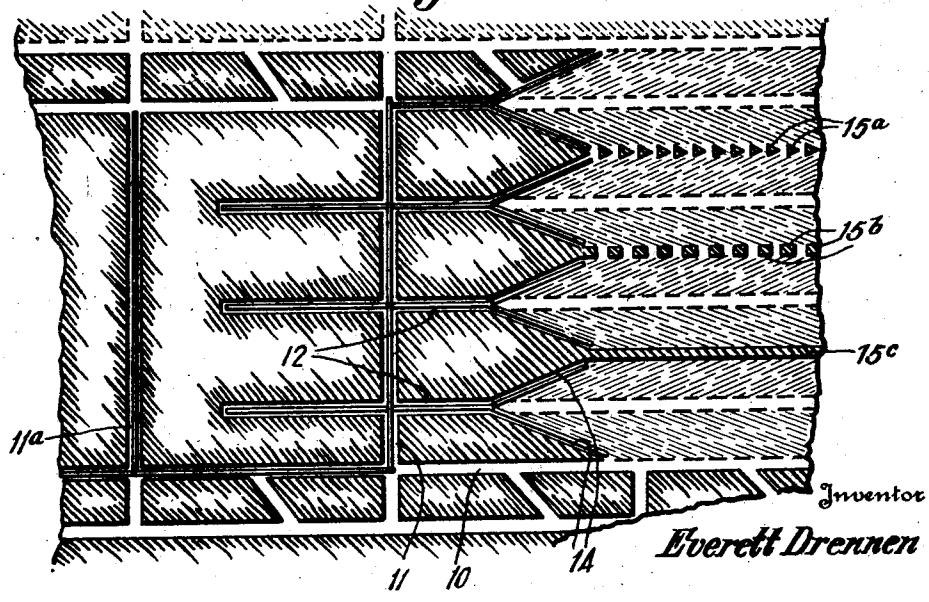


Fig. 9.



Inventor
Everett Drennen

By Knight Bros

Attorneys

Patented Aug. 24, 1926.

1,597,023

UNITED STATES PATENT OFFICE.

EVERETT DRENNEN, OF ELKINS, WEST VIRGINIA.

ART OF MINING COAL.

Application filed March 22, 1924. Serial No. 701,087.

This application is a continuation in part of my copending application filed May 13, 1922, Serial No. 560,605.

My invention relates to improvements in the art of mining coal, in general to that style of operating coal mines termed "long-wall mine" and more particularly to a modification of this system or a long-wall panel method of operation and equipment; that is, my invention contemplates in general the long-wall system but modified in that the working face is formed into shorter angularly disposed panels, which is conducive of better results because the workmen and equipment are protected by the support given to the roof by the projecting faces of the unmined area, and secondly, because for a given area a larger working face is available, giving maximum concentration of development and operation, with consequent minimization of the cost of ventilating, drainage, haulage, and auxiliary mining equipment.

In another aspect my invention combines the advantages of the retreating long-wall system (protection by the unmined area) with the advantages of the advancing long-wall system (quick development of maximum production). Whether the mine is developed by the advancing or by the retreating method, the workers and mining equipment, such as conveyors and loading devices, are protected by the projecting angularly disposed working faces and by the unmined seam through which the coal is always removed.

Another feature of my invention consists in straight-away substantially concurrent development and recovery, from one boundary to the opposite boundary; that is, my invention contemplates carrying on development or advancing in the panels in the same direction and preferably at substantially the same rate of speed as recovery or secondary mining. This expedient enables me to mine and transport a large production of coal from a small area and with minimum haulage equipment and auxiliary service (posting, ventilation, etc., etc.). In other words, by my improved method, mining and transportation are carried on intensively in a relatively small area, thus keeping down to a minimum the total working area which must be maintained in a safe condition, reducing to a minimum the investment in advance development which must be idle until reached by the recovery operations, and also minimizing the total length of installed haulage equipment, whether trackage or conveyor.

In the accompanying drawings several modifications of this general system of mining are illustrated as well as the system of conveying employed therewith whereby those skilled in this particular art may readily appreciate the advantages derived from the use of this invention.

In the drawings:

Fig. 1 is a diagrammatic view of a coal mine which is being operated in accordance with my improved method;

Figs. 2 to 6 inclusive are similar views showing modified forms of working faces;

Fig. 7 is a plan view showing an assembly of the face, cross and lateral conveyors;

Fig. 8 is a diagrammatic view illustrating a modification of my method of mining for use where a weak roof must be contended with; and

Fig. 9 is a similar view illustrating several methods of leaving supporting pillars of solid coal in rear of the mining operations.

In Fig. 1 there is illustrated a preferred manner of carrying out my invention. Starting from a heading or haulway 10, a lateral entry 11 is driven, preferably at substantially right angles to the haulway in the present embodiment of my invention, but as will hereinafter appear, my invention may be realized in certain of its aspects by driving the lateral entries at any angle to the haulway. The driving of the first lateral entry 11 is preferably started as soon as practicable after the haulway has been developed to a suitable point, it being an important result of my improved method that maximum daily output of coal may be very quickly attained in a relatively small area. Consequently, development of the main, lateral and cross entries is pressed forward locally as fast as practicable in order to reach the stage of quantity production of coal as soon as possible. Further development of

the haulway and lateral and cross entries is kept somewhat in advance of the mining operations at the working faces but not very much in advance because, as previously stated, a high output can be attained by the development of a very small area, as compared with previous practice, and it is, therefore, unnecessary to open up and prepare for mining the large areas which must be opened up under present practice, whether of the room and pillar or of the long-wall system, before production in large quantity can be reached.

The lateral entry 11 is driven through to the opposite side of the section to be mined which in the present instance is bounded by a previously mined area. As the lateral entry 11 advances, cross entries 12 are driven from the opening of the mine toward the lateral entry 11 and in the present embodiment of my invention these cross entries should be parallel to the haulway 10.

When these cross entries have been developed as far as the lateral entry 11 a working face is established across the ends of the entries. In this present instance the working face is shown as composed of a plurality of faces 14 angularly disposed with relation one to another and to the cross entries, thereby forming projections or piers 15 of unmined coal which constitutes spaced supports for the mine roof and thus provide relatively sheltered spaces between the working faces in which men and mining equipment may operate with safety.

Any known or suitable means may be employed for leading and carrying out the mined coal. However, I prefer to employ a mechanical conveying system comprising belt sectional conveyors. As shown diagrammatically, there is provided adjacent each face 14 a face conveyor 18, each two of said conveyors preferably depositing the material conveyed thereby on what will be termed herein a cross conveyor 19, one of which is disposed in each of the entries 12. These cross conveyors may be composed of a suitable number of separable sections and in turn convey the material to the adjacent lateral entry 12 where they may deposit the material on cars or on another conveyor whereupon the material may be conveyed to the main heading and thence to the entrance of the mine. The relation of the face, cross and lateral conveyors is shown in Fig. 7.

The working faces 14 may be attacked in any approved manner for the purpose of breaking up and loading the coal, but the profile of the working face should be maintained with substantially the same configuration. This will result from retreating the faces in uniform, parallel stages, as shown in broken lines on the drawing, these lines representing successive passed stages of the faces 14. The face conveyors will be advanced step by step with the faces 14 and the cross conveyors will be correspondingly shortened from time to time by the removal of sections.

As the faces 14 are retreating further development should go on. Thus a second lateral entry 11^a will be formed and cross entries 12^a will be driven to meet it; while a third lateral entry 11^b may be started, the haulway 10, of course, being kept somewhat in advance of other developments. It will be noted that the cross entries 12^a are continuations of or are in line with the cross entries 11, and it is an important feature of my invention that this relation of the cross entries be maintained throughout a given section to be mined, so that all coal removed from the working face from one boundary of the section to be mined to the other boundary, will pass through this series of longitudinally disposed parallel cross entries. This means that the working faces will be kept continuously adjacent the cross entries and a minimum amount of shifting of mining equipment will be required. The face conveyors will be moved only for the purpose of keeping up with the retreating faces, but otherwise, will not be shifted. The cross conveyor sections, as they are removed from adjacent the working faces, may be loaded on to the remaining portions of the cross conveyor and thus carried back to the lateral entry and on into the advancing cross entries 12^a.

By the method above described I claim, in addition to the well known advantages of long-wall mining, a special combination of features which have heretofore been peculiar to either advancing or retreating but not common to both. That is, the section to be mined is advanced in the sense that operations are started at one end of the property near the mine entrance and development or advancing in the panels progresses continuously and in one direction from one boundary to the other, but by withdrawing the coal through the cross entries in the same direction as this development, I am enabled to work the panels by the retreating method, taking advantage of the unmined area as protection for the conveying entries and equipment therein, and carrying on the recovery also continuously and in one direction, with the resulting economies hereinbefore mentioned. It should be understood, however, that the advancing development of the section to be mined, although preferred for some reasons, is not the only manner in which my invention may be employed, and in its broadest aspects, particularly in reference to the angularly disposed working panels, my invention is applicable to the retreating method of development in which the entries are carried to the remote boundary of the section to be

mined before the working face is established.

Another important advantage achieved by my method above described depends upon the fact that angular disposition of the working faces very largely increases the length of the working face as a whole, and since the rate at which coal may be mined must vary directly as the dimensions of the working face, other conditions being assumed to be adequate, it will be obvious that coal may be withdrawn from a mine having a small area developed in accordance with my invention in quantities attainable in mines developed by known methods only by the development of areas many times greater. Among the advantages which flow from this may be mentioned the earlier attainment of maximum production because of the relatively smaller amount of development necessary and reductions in such items of expense as ventilation, drainage and auxiliary equipment, which are roughly proportional to the extent of the area developed.

That part of my invention which relates to the angular disposition of the working faces may be realized in various ways and a few alternatives are shown in Figs. 2 to 6. In these figures the lateral entries 12^c are disposed obliquely to the haulageway 10, an arrangement which does not realize all of the advantages of my improved method but serves to illustrate the adaptability to various kinds of development of the feature of angularly disposed working faces. As shown, these working faces may be disposed at right angles to one another or at any other angle less than 180 degrees, and in some situations it may be desired to have the working faces of different lengths, as shown in Fig. 5. Another modification is shown in Fig. 6, in which the working face is broken up into shorter faces of serrations 14^b and the face conveyor 18^b extends across the whole working face. In this embodiment a certain amount of protection will be afforded by the projecting points to a workman operating between the conveyor and the face.

In mines which have a more than usual weak roof, a modification of my method may be employed to advantage. (See Fig. 8.) In this modification the lateral cross entries and the working faces are formed in the manner previously described with reference to Fig. 1, but instead of working all of the faces simultaneously alternate pairs and the corresponding cross entries will be worked to remove the coal in strips, as shown. Thereupon the roof may be permitted or caused to fall into the mined strips and the remaining alternate pairs of faces and cross entries may then be worked to remove the rest of the coal under the protection of the pack walls automatically formed by the fallen, broken material of the roof.

In Fig. 9 there is illustrated another modification directed to the end of furnishing a support for the roof at the expense of a little coal left unmined. As shown, in taking away the coal, a portion may be left unmined, either in the form of triangular pillars 15^a, square pillars 15^b or as a solid unbroken wall 15^c.

Having thus described my invention, what I claim is:

1. The method of mining coal which consists in forming a pair of diverging working faces, driving an entry through the unmined seam from the intersection of said working faces, and conveying coal from said working faces to and through said entry, the progression of the working faces being in the same direction as the conveyance of coal through said entry.

2. The method of mining coal which consists in forming a series of working faces in zig-zag relation across one end of a panel to be mined, thus providing a series of jutting piers of unmined coal with sheltered working areas between the piers, driving substantially parallel entries through the unmined seam from the intersections of said working faces remote from the apexes of said piers, and conveying coal from said working faces to and through said entries, the progression of the working faces being in the same direction as the conveyance of coal through said entries.

3. The method of mining coal which consists in forming a series of working faces in zig-zag relation across one end of a panel to be mined, thus providing a series of jutting piers of unmined coal with sheltered working areas between the piers, driving substantially parallel entries longitudinally through the unmined panel from the intersections of said working faces remote from the apexes of said piers, conveying coal from said working faces to and through said entries, the progression of the working faces being in the same direction as the conveyance of coal through said entries, and driving lateral entries from time to time and at convenient points to intersect said first-mentioned entries and collect the mined coal from said entries, whereby development and mining of the panel proceed continuously and simultaneously until all of the coal in the panel has been recovered.

4. The method of mining a seam of coal having a weak roof, which consists in forming a series of working faces in zig-zag relation across one end of a panel to be mined, thus providing a series of jutting piers of unmined coal with sheltered working areas between the piers, driving substantially parallel entries through the unmined panel from the intersections of said

working faces remote from the apexes of said piers, recovering coal from alternate pairs of said working faces and conveying the coal to and through the adjacent entries, permitting the roof to fall into the strips thus mined, and then recovering the coal from the remaining alternate pairs of working faces and conveying the coal to and through the adjacent entries under the protection of the fallen roof in the previously mined strips, the progression of the working faces in each stage being in the same direction as the conveyance of coal through said entries.

The foregoing specification signed at New York, N. Y., this 29th day of February, 1924.

EVERETT DRENNEN.