No. 796,499. PATENTED AUG. 8, 1905.

C. R. CLAGHORN.

ART OF MINING COAL.

APPLICATION FILED SEPT. 29, 1903.

5 SHEETS—SHEET 1.

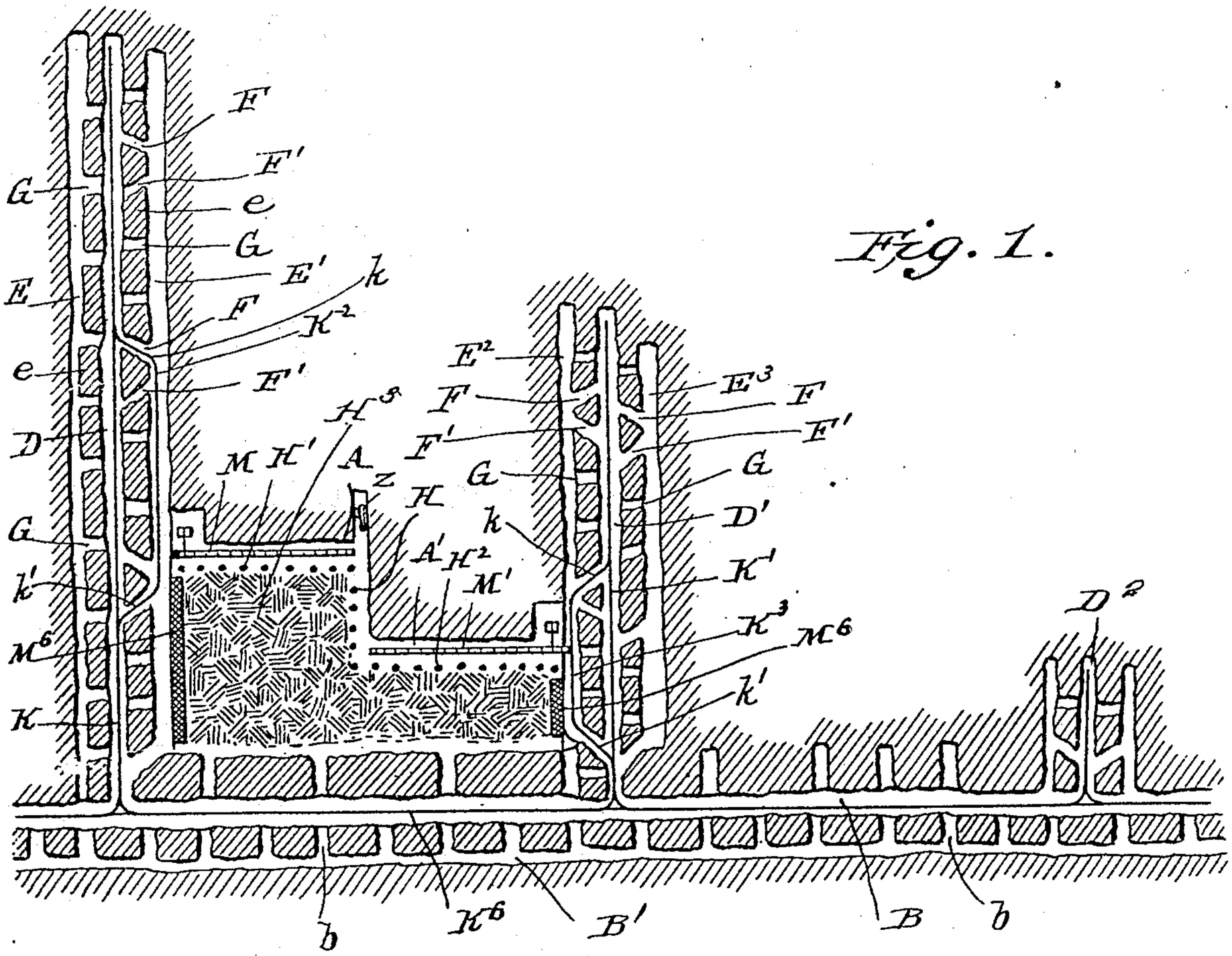

Fig. 1.

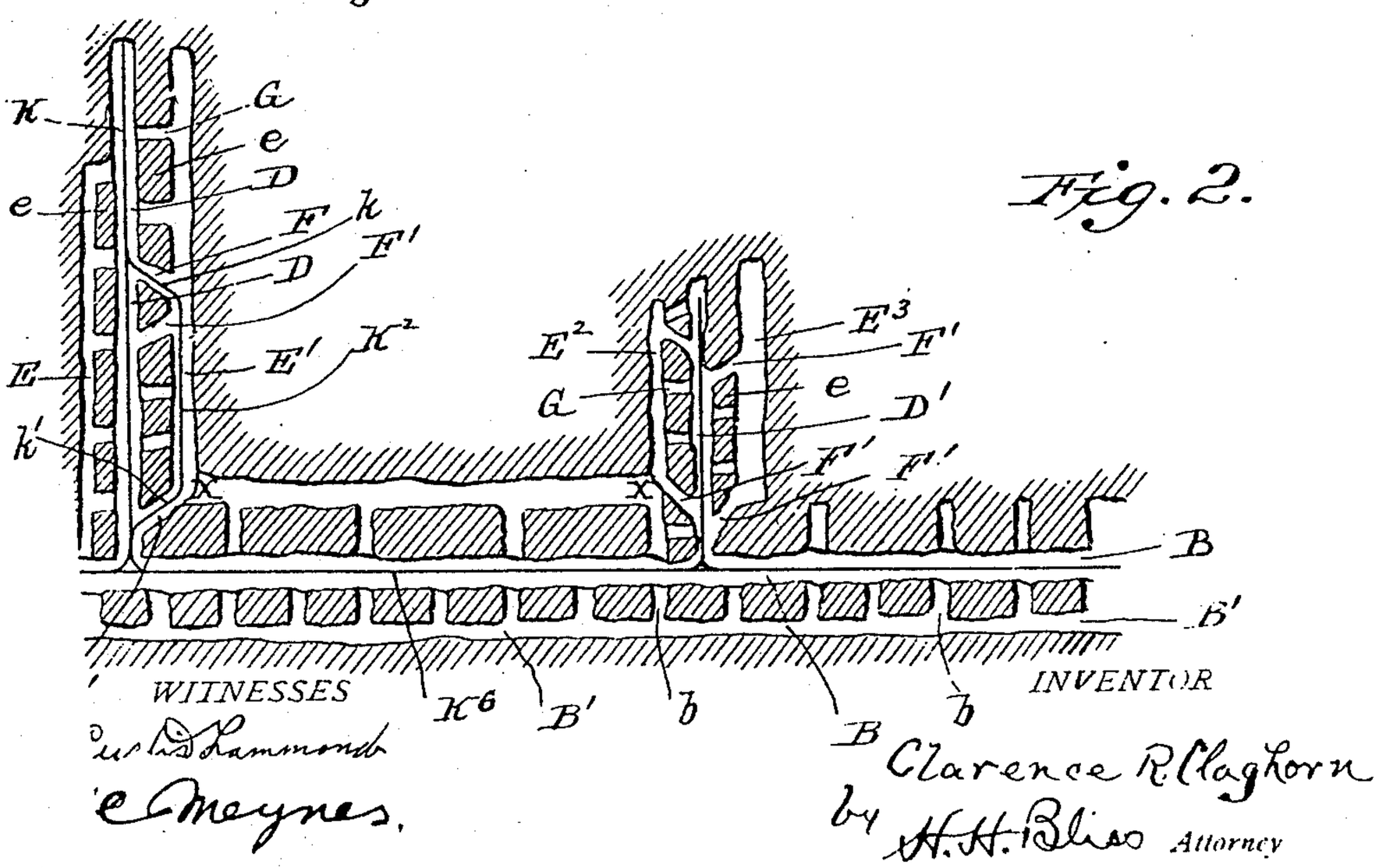

Fig. 2.

WITNESSES

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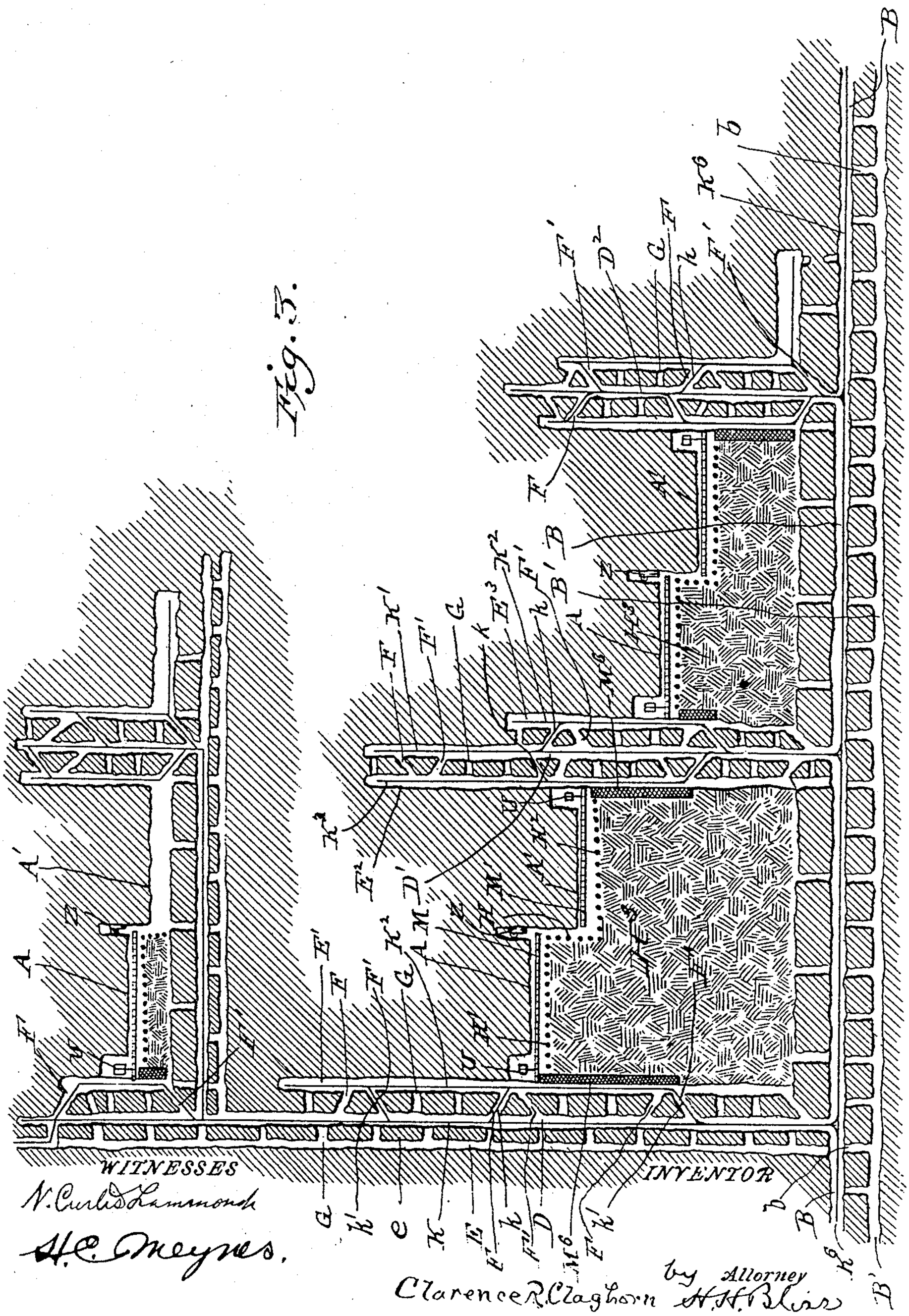
5 SHEETS—SHEET 2.

Fig. 3.



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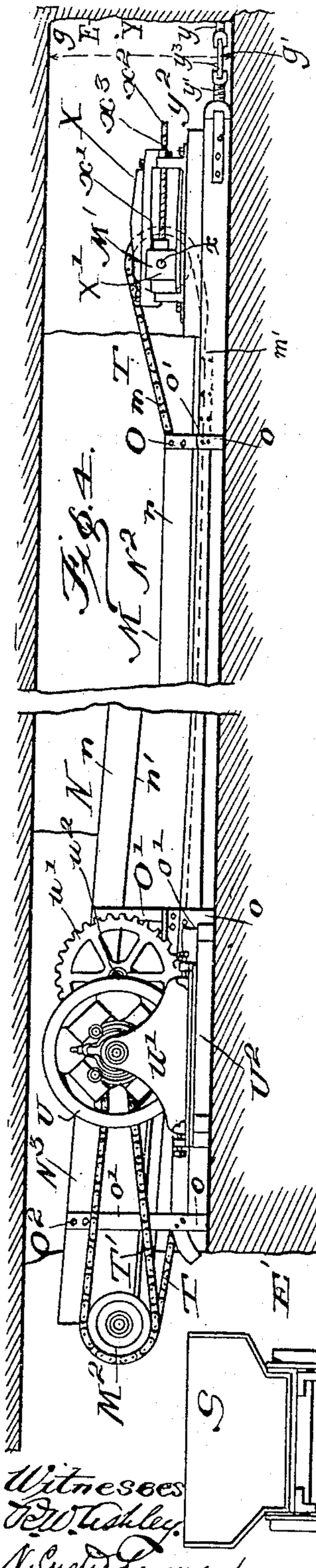

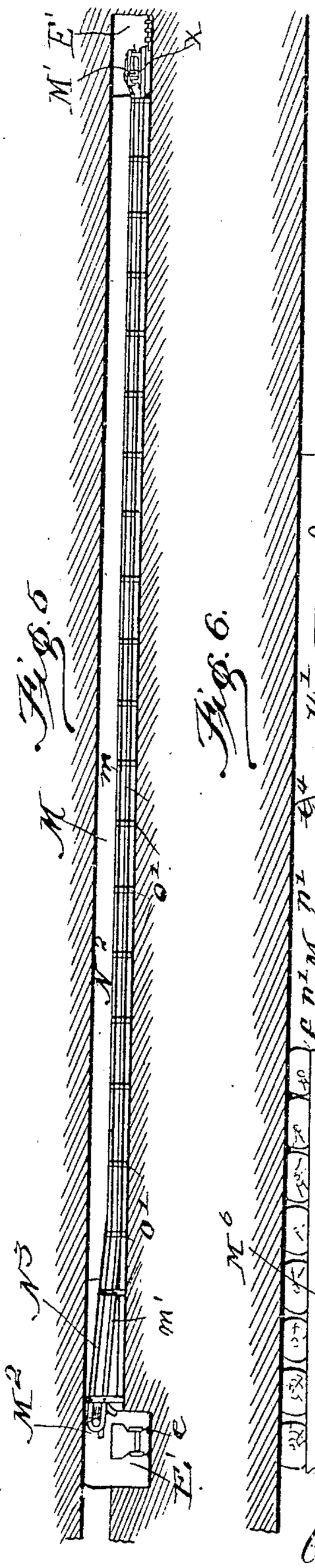

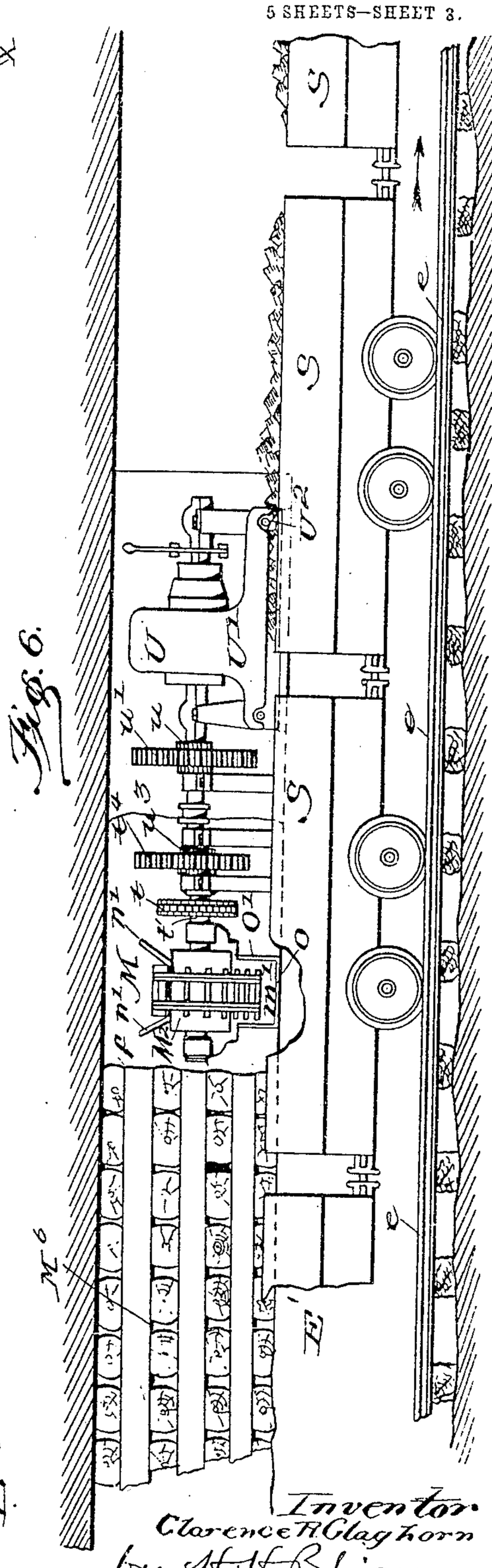

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5 SHEETS—SHEET 4.

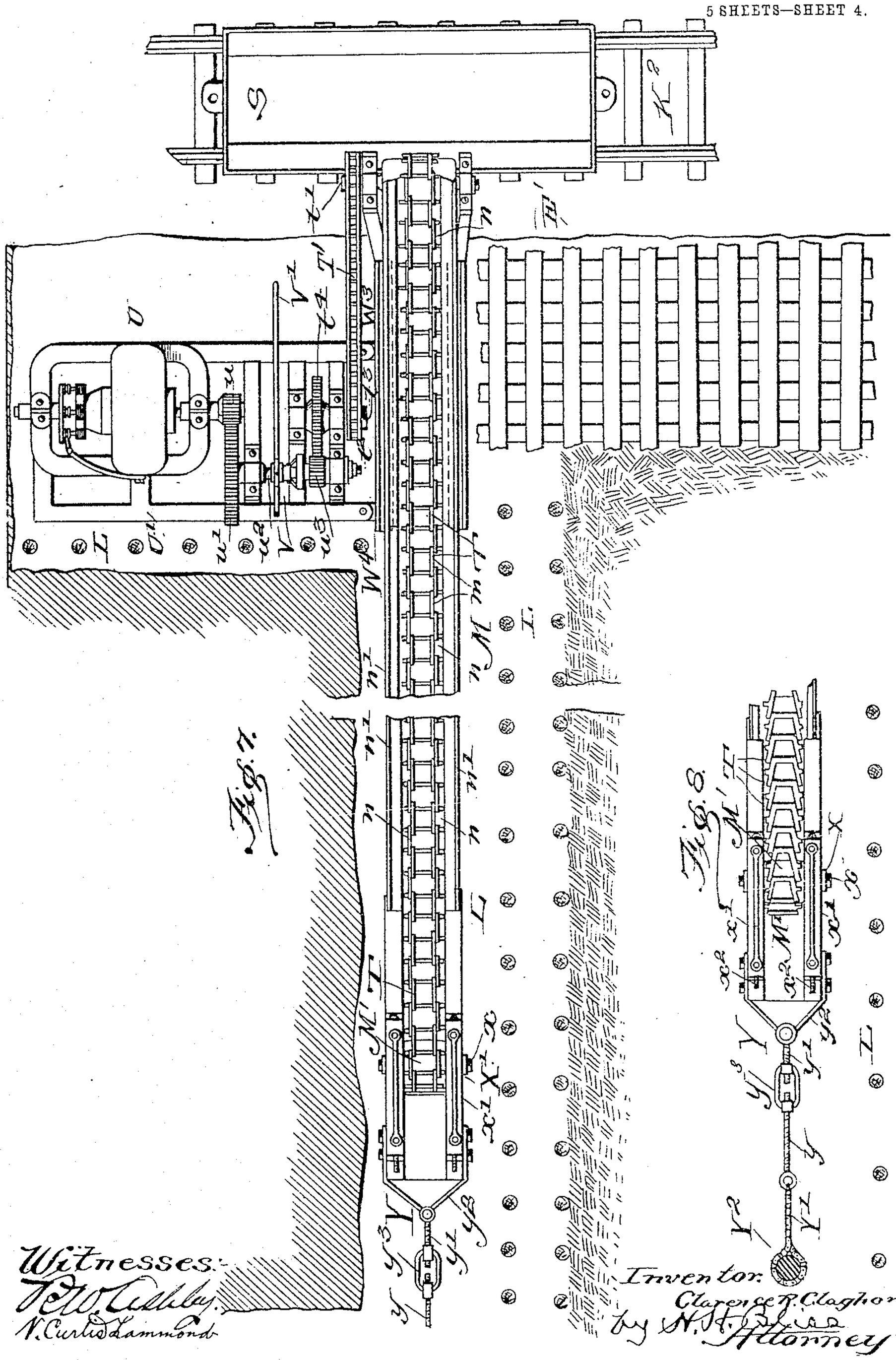

Fig. 7.

Fig. 8.

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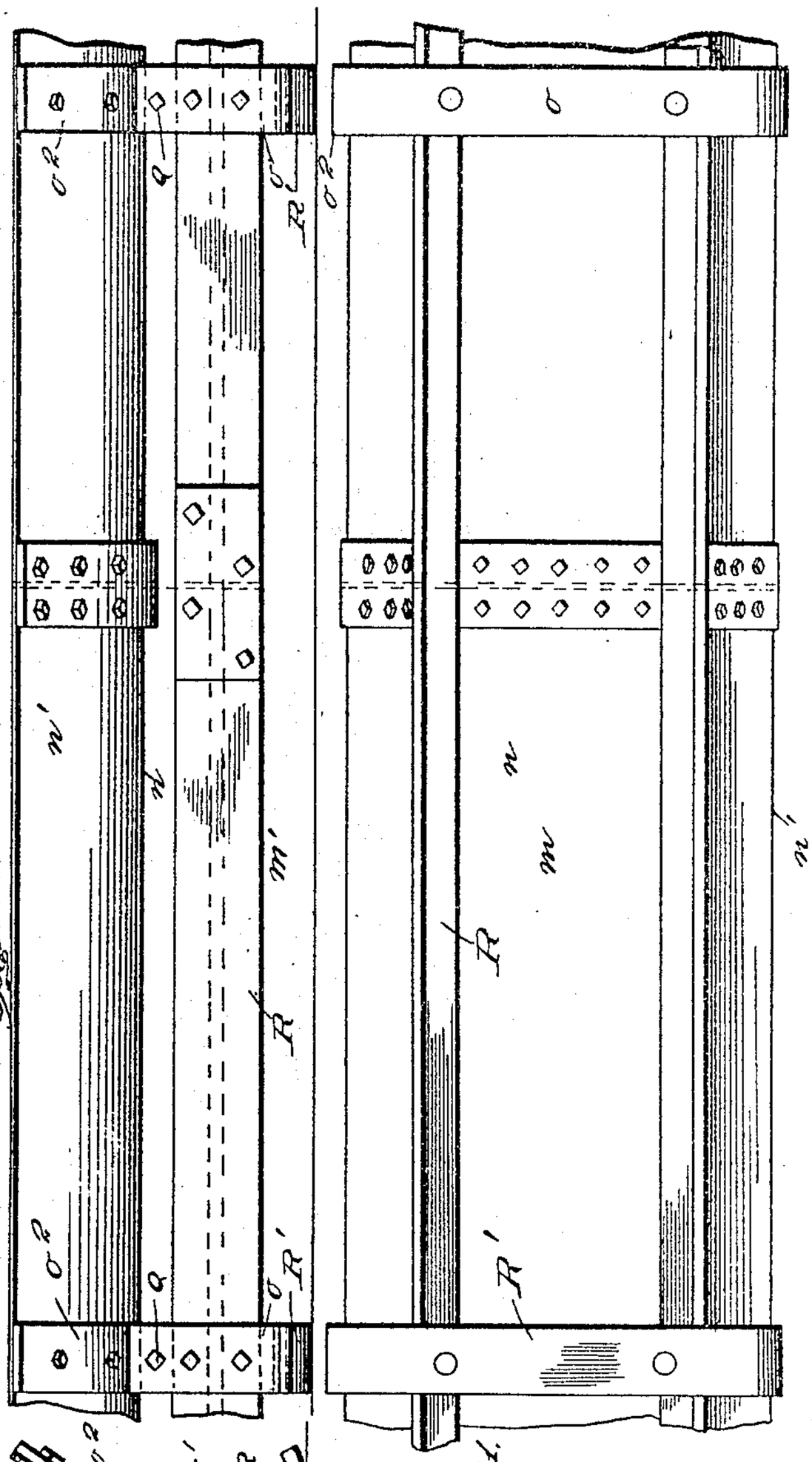
5 SHEETS—SHEET 5.



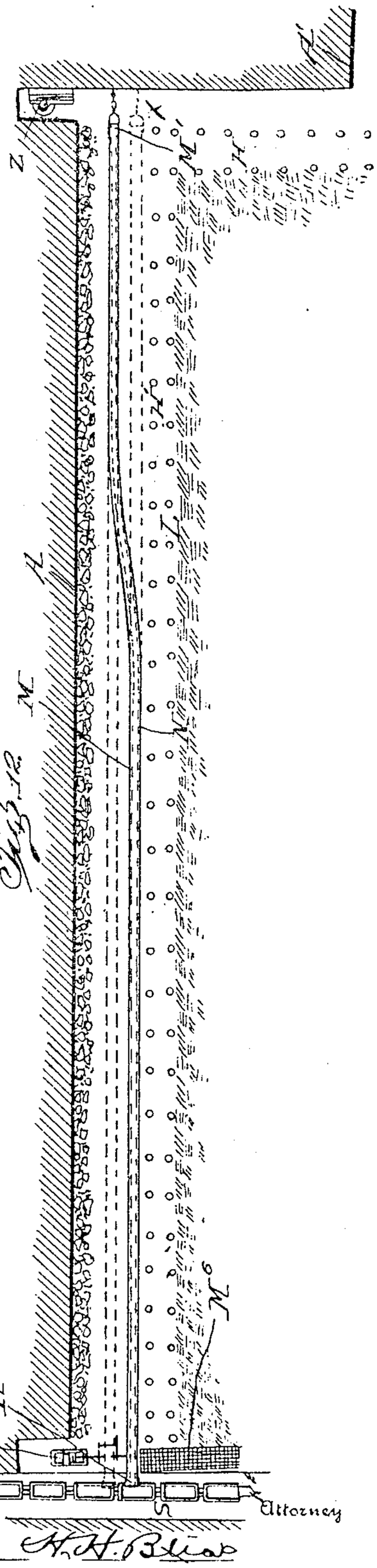


Fig. 9.

Fig. 11.

Fig. 10.

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UNITED STATES PATENT OFFICE.

CLARENCE R. CLAGHORN, OF WEHRUM, PENNSYLVANIA.

ART OF MINING COAL.

No. 796,499. Specification of Letters Patent. Patented Aug. 8, 1905.

Application filed September 29, 1903. Serial No. 175,062.

To all whom it may concern:

Be it known that I, CLARENCE R. CLAGHORN, a citizen of the United States, residing at Wehrum, in the county of Indiana and State of Pennsylvania, have invented certain new and useful Improvements in the Art of Mining Coal, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to an improvement in the art of mining, it consisting of a system of parts and a mode of operation such as will be below described, wherein use is made of a continuously-acting conveyer arranged along the prolonged face of a coal-working which can be caused to closely follow the face by a bodily movement laterally and which delivers the coal to cars moving on a transverse line, the cars being brought to and from the coal in an expeditious and economical manner.

Figure 1 is a diagrammatic view illustrating my system of operating a long-wall coal-mine. Fig. 2 is a diagram illustrating the positions of entries, headings, &c., at the time the working is commenced on a long wall of the coal. Fig. 3 shows similar matters at a later state in the working. Fig. 4 is a view in side elevation of part of the carrier, part being broken away. Fig. 5 is a view of a conventional diagrammatic character, showing the relations of the parts at the face of the coal. Fig. 6 is an elevational view looking inward along the working space at the face of the coal. Fig. 7 is a plan view. Fig. 8 is a plan view of the inner end of a conveyer of a modified sort. Fig. 9 is a cross-section of the conveyer. Fig. 10 is a side view of a portion of the conveyer. Fig. 11 is a bottom view of the parts in Fig. 10. Fig. 12 is a diagrammatic view showing the conveyer at the time of adjustment laterally.

I have illustrated in the drawings one of the several ways, conforming to my invention, of forming the entries or headings in a coal-mine and exposing the body of the coal which is to be worked out and withdrawing it after it has been loosened.

First, a main entry or heading is cut through the coal, as shown at B. Substantially parallel to this is formed the air course for this main heading, as indicated at B′, and between them, at suitable intervals, are formed the holes or apertures *b* for the ventilating-air. At suitable distances apart—say six hundred and fifty feet—along the main heading are commenced the cross headings or entries, (indicated by D D′ D^2.) The coal is cut and mined and carried outward from these headings as they are extended. After they have been carried sufficiently far the coal is removed, as at E E′ E^2 E^3, on lines approximately parallel to these cross-headings D D′ D^2, in such way as to form elongated rooms or entrance-spaces, designated by miners as "uprisers." Between these and the headings or entries proper, D D′ D^2, there are left walls or "barriers" of coal, as indicated at *e*. of sufficient—say fifty feet—width to serve as pillars or supports for the roof along the headings or entries, which latter must be kept open and into which the roof must not be allowed to drop. Through these walls or barriers of coal there are formed apertures or openings, as shown at F, F′, and G.

It is to be understood that the improvements which are here presented are particularly intended for use in "long-wall" mining, which is generally followed where the coal-vein is comparatively thin. Economy demands that the great bulk of this coal should be gotten out without excavating any of the roof or bottom material; but in order to permit traveling through the mine, and particularly to permit the employment of cars of sufficiently large capacity, it is necessary to excavate to a greater depth along the lines where the cars are carried. Hence the headings and the cross headings or entries are made deeper than the vein of coal, this being generally accomplished by digging out the bottom along the lines of the headings after the coal has been removed.

The "dog-holes" or "air-passages" at *b* and G need not be any deeper than the thickness of the coal; but the openings at F F′, I excavate deeper in order that they may also serve as cross-passages for cars and operatives, and, as will be seen in the drawings, I prefer to cut these on lines inclined to the headings D D′ D^2 and inclined to the chambers or open spaces E E′ E^2 E^3, those at F being inclined in one direction relatively to the line of the heading and those at F′ being inclined in the opposite direction, for reasons that will be explained.

The headings D D′ D^2 should be extended well ahead of the working face at which the main body of the coal is being attacked.

After the cross heading or entries D D′ D^2 and the clearance-spaces or uprisers E E′ E^2 E^3, &c., have been extended far enough, and after I have formed a sufficient number of air-

holes G and cross-passages F F′, I form an opening between the two inner spaces or uprisers E′ E² along the line at X X (see Fig. 2) approximately parallel to the heading B and fifty feet or thereabout distant from the latter. From this line X X the main body of the coal is attacked. As this coal-bed is possibly six hundred and fifty feet wide, as above stated, it is difficult to remove in one direction all the coal that is loosened along the face. I therefore advance a portion of the total work, preferably about one-half of it, somewhat ahead of the remainder, as is shown at A, which indicates one working face. As soon as the coal has been removed sufficiently I introduce and put into working position an endless conveyer. At present I shall refer to it as an entirety and designate it by the letter M. It may be, as here illustrated, two hundred and fifty to three hundred feet long and is provided with a motor at its outer end. This conveyer is placed immediately adjacent to the working face, having a substantially unobstructed space between it and the coal.

K⁶ indicates the railway-track that is laid in the main heading B.

K indicates the track that is extended along the cross-heading D, and K′ that along the cross-heading D′. Track is also laid, as shown at K², along the clearance-spaces or uprisers E E′ E² on lines adjacent to the face of the natural bed of the coal and extending to points somewhat back of the working face. The track K² is connected to the track K by a branch track *k*, laid in one of the inclined passages F ahead of the face A, and is also connected thereto by a branch track *k*′ through one of the passages F′ in the rear of the working face A.

After the coal has been undercut and broken down along the face it is loaded immediately into the conveyer and by the latter is transported to points adjacent to the track K², where it is at once dropped by the conveyer into the cars. Empty cars are brought in a train or "trip" first along the track at K⁶ in the main heading to and then along the track K in the cross-heading to a point well up in the latter heading far enough to be carried beyond the cross-track *k*. Then they are passed over this cross-track *k* to the track K² in the upriser E′, which enables them to be brought in series to the loading end of the conveyer. They are filled one after the other, and when the train or trip is loaded it passes on in the same direction until it reaches the cross-track *k*′ in one of the passages F′, inclined oppositely to the incoming passages F, and there it returns again to the track K in the heading and is ready to be carried out of the mine. As soon as the working face at A has been carried forward sufficiently far the other portion of the block or area of coal can be attacked along the face at A′. Here an oppositely-disposed conveyer is arranged, adapted to transport the newly-cut coal toward the cross-heading D′. Trains or trips of empty cars are brought through this heading and are transferred over a branch track *k* to the track K³, and as they in series pass the delivering end of the conveyer M′ they are loaded and carried out in the manner above described.

As soon as the working face has been advanced sufficiently far to have exposed a considerable part of the roof it becomes necessary to furnish artificial supports. This is first accomplished by means of posts, which are inserted between the roof and the floor. Back of the posts is piled the refuse H³, consisting of rock and foreign matter, generally termed "goaf," which is separated from the coal. The posts immediately behind the working face at A and behind the conveyer there employed are indicated by H′. Those behind the working face A′ and its conveyer are indicated by H², and then in order to maintain free ventilation lines of posts, as at H, are left, which extend from those at the front to those at the rear. Where these posts are inserted the roof is sustained; but over the area behind or outside of the posts in mines operated upon this plan the roof-rock rapidly settles and the area upon which it settles becomes impassible. As the removal of the coal proceeds the rear posts are withdrawn and are reinserted behind the conveyers as the latter are moved forward in following the working faces; but it is necessary to sustain the roof along the sides of the outgoing track at K² *k*′ for a considerable distance behind the face, and to effect this I employ a bracing structure, such as indicated at M⁶, this being formed of timbers so arranged as to serve as a temporary support, but which can be removed after the coal-face has been advanced sufficiently far. This bracing structure or "pack-wall" should be allowed to remain far enough back to protect the outgoing track branch at *k*′. After the face has been advanced so far that the next inclined track-passage *k*′ can be utilized, the railway-track and its supports can be removed and replaced at an advanced position.

The endless conveyer proper is indicated as a whole by M. It has an upper run *m*, moving toward the entry E′ or E², and a lower run *m*′, moving backward therefrom, both substantially parallel to the face being operated on. At its inner end it is supported upon a guiding idler wheel or drum M′ and at its outer end upon a guiding and driving wheel or drum M², which preferably overhangs the entry E′ (or E², &c.) somewhat.

The upper run *m* of the conveyer is placed in a trough N, having the bottom *n* and the sloping sides *n*′. The lower run has a support N′. The trough N of the upper run extends along the greater part of the length of the conveyer—that is to say, over the greater part of the distance of three hundred feet—low, as shown at N², Fig. 5; but a few feet

in from the deeper entry E′ the trough and conveyer are gradually inclined upward, as shown at N^3, Figs. 4 and 5. By having the conveyer arranged with an open space over the greater part of its length, as at N^2, an abundant freedom of room is provided, over which there can be passed backward from the face of the coal the blocks of slate, pieces of rock, &c., which it is not desired to load with the coal, and there is also ample room for the shovelers to rapidly lift either their shovels of coal or the large blocks thereof, which they pick up by hand.

As the conveyer is moving continuously, loading operatives can be distributed over the whole three hundred feet of face, and the material which is placed in the conveyer by one will not interfere with that loaded by another, in contradistinction from the blockage that results when a series of separable cars are employed, each car for one or two of the operatives.

The framework of the conveyer, which is illustrated, consists of girder-sections O O O′ O^2. Each girder-section consists of a bottom cross-bar *o*, vertical leg-bars *o′*, and outwardly inclined or flared bars o^2. The trough-sections are made of sheet metal, each bent to have the bottom *n* and the flared side walls *n′*, the latter being bolted or riveted to the aforesaid inclined bars o^2. Each girder-frame thus formed is braced by means of a cross brace-rod Q and a spacing-tube *q*, secured to the upper parts of the vertical bars *o′*. These latter also carry angle-brackets or angle-bars R, which support the links or sections of the lower run of the conveyer. Each girder-section is provided on the bottom with runner-like devices, as shown at R′, these serving as shoes adapted to support the conveyer and its frame and permit the ready lateral adjustment thereof. Each conveyer-frame section is secured to the next by bolts or rivets, preferably in such manner that there shall be a flexibility at the places of union. Such flexibility permits the conveyer to be moved laterally and adjusted from one position to another in following up the face of the coal and avoids the necessity of having to overcome the weight and resistance of the entire structure at times when parts of it only are being moved. By reference to Fig. 12 it will be seen that in consequence of this flexibility the conveyer can be moved up by the application of crowbars to one section thereof after another successively.

The upwardly-inclined part of the conveyer at N^3 at the discharge end is constructed with parts substantially similar to those above described for the lower part N^2, the exception being that the cross-gird frames at O′ O^2 gradually increase in height, so as to bring the upper end of the conveyer-trough to lines well above the large coal-cars S, which, as aforesaid, travel to and from the conveyer.

The movable part or carrier proper consists of the links or hinged sections forming an endless chain T. I prefer to use a chain adapted to drag the material in masses of various-sized particles from comparatively finely reduced slack extending up to large lumps, and for this purpose a chain having links which are open at the centers and have laterally-projecting wings I find to be very efficient; but in this respect there can be such variation as preference or circumstances dictate.

Power is imparted to the chain by the drive-chain T′, which at one end meshes with the sprocket-wheel *t* on the driving-shaft *t′* of the conveyer and which at the other end engages with the sprocket-wheel t^2. This wheel t^2 is on a shaft t^3, mounted on the frame which supports the motor and its gearing and shafting.

U is an electric motor having the pinion *u* on the armature-shaft meshing with the wheel *u′* on a counter-shaft u^2.

u^3 is a gear-wheel mounted loosely on the shaft u^2 and meshing with the gear-wheel t^4 on the shaft t^3.

At V there is a friction-clutch adapted to connect the shaft u^2 with the gear at u^3, and V′ is a lever for operating the clutch V, whereby the operator can instantly stop and again readily start the conveyer, such stopping and starting being required when one of the cars S has been filled and when the next is brought into position for loading.

The motor-frame has a base U′, which is also provided with runners or shoes U^2. The motor-frame and the conveyer-frame at the delivery end of the latter are provided with mutually-fitting parts, as shown at W^3 W^4, which are loosely fitted together and permit the two frames to be independently adjusted laterally and then brought into proper relative position and temporarily fastened.

The motor considered as an entirety being constructed of sections flexibly connected together, it becomes advantageous to provide an adjustable and movable holding or anchoring device, together with tension-adjusting means. As shown, there is at the inner end of the conveyer a framework, (indicated as a whole by X,) which carries boxes X′ for the shaft *x* of the wheel or drum M′, these boxes being mounted in a guideway formed by the guides *x′* and being adjustable therein by means of screws x^2, with which engage the nuts x^3. The bottom of this frame X is provided with shoes or slide-plates of such nature that it can be readily moved in either direction—that is, toward the face of the coal or on lines inward or outward parallel to said face. Y indicates an adjusting mechanism for effecting this last-mentioned movement of the inner end of the conveyer and its frame. Y′ is a section of chain connected to a post Y^2 and provided at its end with a threaded bar *y*. *y′* is a thread-

ed bar connected by the yoke y^2 to the frame X. y^3 is a turnbuckle having nuts which fit with the threaded rods $y\ y'$. By these devices the conveyer as a whole can be stretched taut and held firmly in position notwithstanding the fact that over its great length it may rest upon an uneven bottom or ground surface and at places be more or less out of theoretically true lines, and when thus held it resists the distorting actions of the power devices when they are driving the carrier. At the same time they permit the ready releasing of the inner end of the conveyer structure and a refastening thereof in the new position after a lateral adjustment has been effected toward a newly-cut face. If a post such as shown at Y^2 is employed, it can be readily detached and reset if it be made in the common way with jacking-screws for fastening it to or releasing it from the floor or the roof of the mine, or instead of such post for securing the inner end of the conveyer the latter may be "anchored" at one point and then at another in a vertical wall of the coal—as, for instance, in the wall at the inner end of the working face—this anchoring being effected by drilling or forming a hole in said coal-wall and then inserting an anchor-stem and wedges which coact to prevent the stem from being drawn out, although a powerful strain thereon be exerted.

The method of getting out coal which I have devised will be readily understood from the above description, in connection with the drawings, when I illustrate one of the numerous mechanisms which can be employed therein. A long-wall mining-machine is first caused to traverse the face of the coal, it making a cut along the bottom of a vein of several feet in depth horizontally and a few inches in depth vertically, the conveyer apparatus at such time being immediately adjacent to the path of the mining-machine and because of its narrowness allowing the roof to be supported by posts up to a line relatively close to the face. After the mining-machine has effected its cut of three hundred or more feet the coal above the cut is broken down either artificially or because of the squeeze or downward pressure from the roof. The conveyer apparatus is then moved by sliding it over the floor close up to the newly-loosened coal. The above-described flexibility incident to the conveyer-frame permits it, notwithstanding its great length, to be thus brought up, one section being adjustable or movable more or less independently of those adjacent, although the structure is at all times integral throughout. The shoes under the girder-frames obviate resistance from the floor or ground. The higher part of the frame at N^3 at the delivery end is similarly moved up, it temporarily moving away from the motor or engine frame. The latter frame is thereafter also moved up to the new position, and by means of the guiding and spacing devices at W it is immediately brought into proper working position relative to the conveyer and is again secured for the next operation. The tension and adjusting devices at Y are released from the post or the anchor which fastens them to the roof and bottom or to the coal-wall, and the frame X is brought up to a proper position, and the anchoring and tension devices are again set. A car or train of cars S having been brought from the main entry B over the track *d* into the cross-entry E, the carrier is put in motion and the loading is effected. A large number of operatives are distributed along the face. The slate, rock, and other materials foreign to the coal are readily passed backward over the conveyer into the area behind the same. The coal can be rapidly shoveled from the foot of the face into the conveyer-trough.

What I claim is—

1. The herein-described improvement in the art of mining coal, it consisting in forming an entry or heading adapted to receive a track for the passage of cars, forming a clearance-space or upriser approximately parallel to the heading and adapted to have tracks and cars therein, forming an elongated working face of coal on lines transverse to the said upriser, passing cars or relatively large vehicles from the heading to the upriser, then past the working face, and then back to the heading, loosening the coal along the working face and conveying the loosened coal by an elongated endless carrier to the cars in the upriser, substantially as set forth.

2. The herein-described improvement in the art of mining coal, which consists in forming a main heading, cross-headings connecting therewith, two or more of which extend in substantially the same direction as the sides of a relatively wide intervening area of coal, forming a clearance-space or upriser relatively near each heading, said main heading, cross-headings and uprisers being relatively deep and provided with track systems, forming two working faces, both transverse to the said cross-entries, breaking down the coal along the said working faces, transporting the broken-down coal along one face by an endless conveyer in one direction toward a clearance-space or upriser and depositing the coal in the cars therein and transporting the coal in the opposite direction by a second endless conveyer extending from the opposite heading and delivering the coal to the cars in the clearance-space adjacent to said heading, substantially as set forth.

3. The herein-described improvement in the art of mining coal, consisting in forming a heading adapted to receive a track for the passage of cars, forming a clearance-space or upriser-passage approximately parallel to the heading and adapted to have tracks and cars therein with a relatively wide roof-supporting barrier-wall between the heading and the up-

riser, forming passages through said barrier-wall from the heading to the upriser adapted to have tracks and cars therein, then forming an elongated working face of coal on lines transverse to the said upriser, passing cars from the heading through the said barrier-wall to the upriser and past the said working face, loosening the coal along the said working face and conveying the loosened coal by an elongated endless carrier to the cars in the upriser, substantially as set forth.

4. The herein-described improvement in the art of mining coal, it consisting in forming an entry or heading, forming a clearance-space approximately parallel to the heading, forming an elongated working face of coal on lines transverse to the said clearance-space, passing cars from said heading to said clearance-space, and then past the said working face, loosening the coal along the working face, and conveying the loosened coal by an endless conveyer to the cars in the clearance-space.

5. The herein-described improvement in the art of mining coal, it consisting in forming a main heading, cross-headings connected therewith, two or more of which extend in substantially the same direction, each pair of cross-entries being separated by a relatively wide intervening coal area, the cross-headings being provided with means for conveying the mined coal to the main heading, forming two working faces in said area of coal, both transverse to said cross-headings, breaking down the coal along the said working faces, conveying the broken-down coal from one face by an endless conveyer to the conveying means in one of said cross-headings, and conveying the broken-down coal from the other face by an endless conveyer to the conveying means in the other cross-heading.

6. The herein-described improvement in the art of mining coal, it consisting in forming a main entry or heading, forming cross-headings connecting therewith, two or more of which extend in substantially the same direction, each pair being separated by a relatively wide area of coal, and each being provided with means for conveying the mined coal to the main entry, forming two working faces in each area of coal between a pair of cross-headings, breaking down the coal along both of said faces, that along one face being broken down somewhat in advance of that along the other face, conveying the broken-down coal along one face in a substantially continuous stream in one direction to the conveying means in one of said cross-headings, and conveying the broken-down coal along the other face in a substantially continuous stream in the opposite direction to the conveying means in the other of said cross-headings.

In testimony whereof I affix my signature in presence of two witnesses.

CLARENCE R. CLAGHORN.

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ROBT. H. ORRISON.