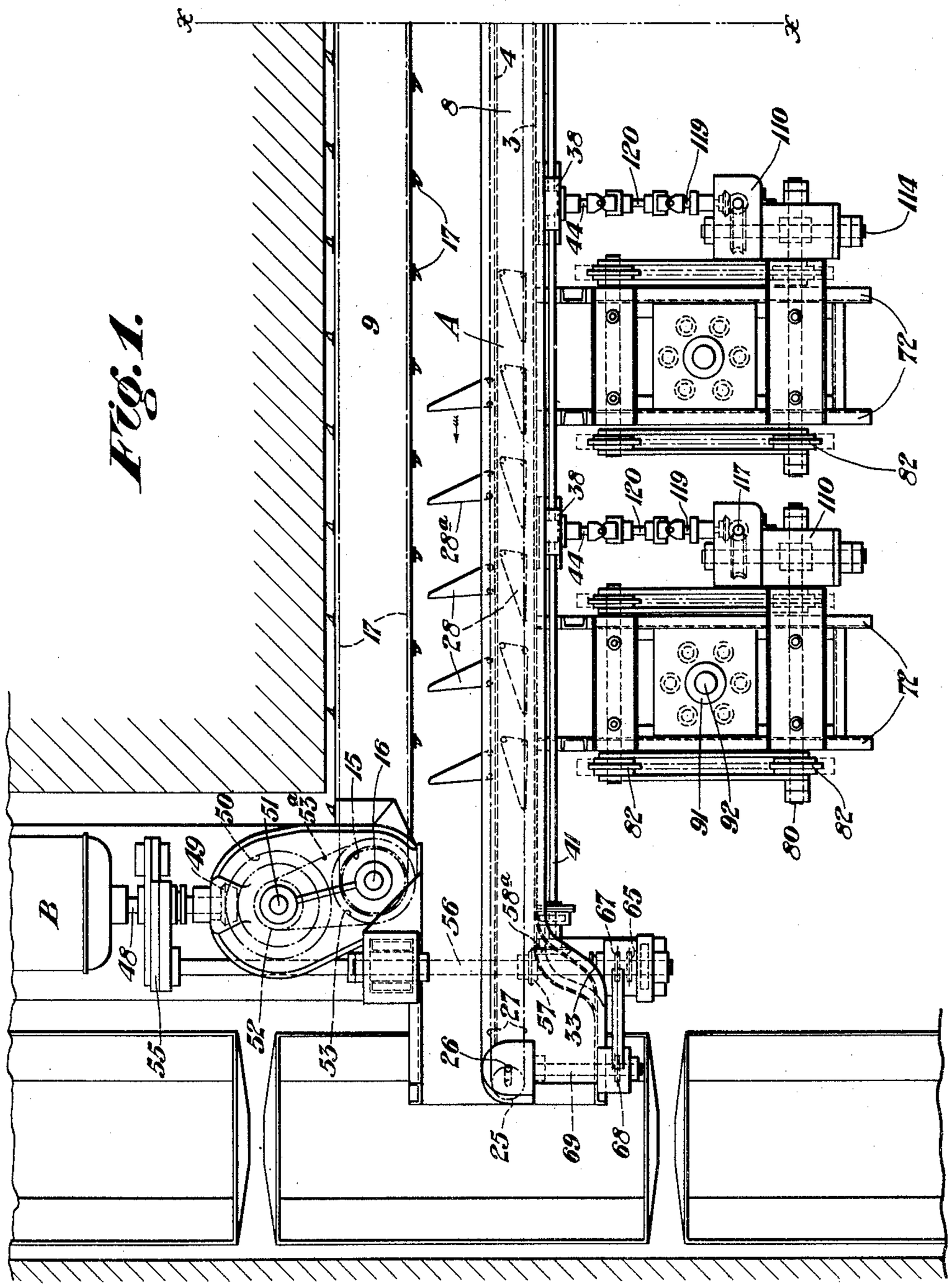
June 15, 1926. 1,588,987

E. O'TOOLE

METHOD OF MINING

Original Filed Sept. 16, 1924 9 Sheets-Sheet 1

Fig. 1.



Witnesses:

Edwin Trueb

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June 15, 1926. 1,588,987

E. O'TOOLE

METHOD OF MINING

Original Filed Sept. 16, 1924 9 Sheets-Sheet 2

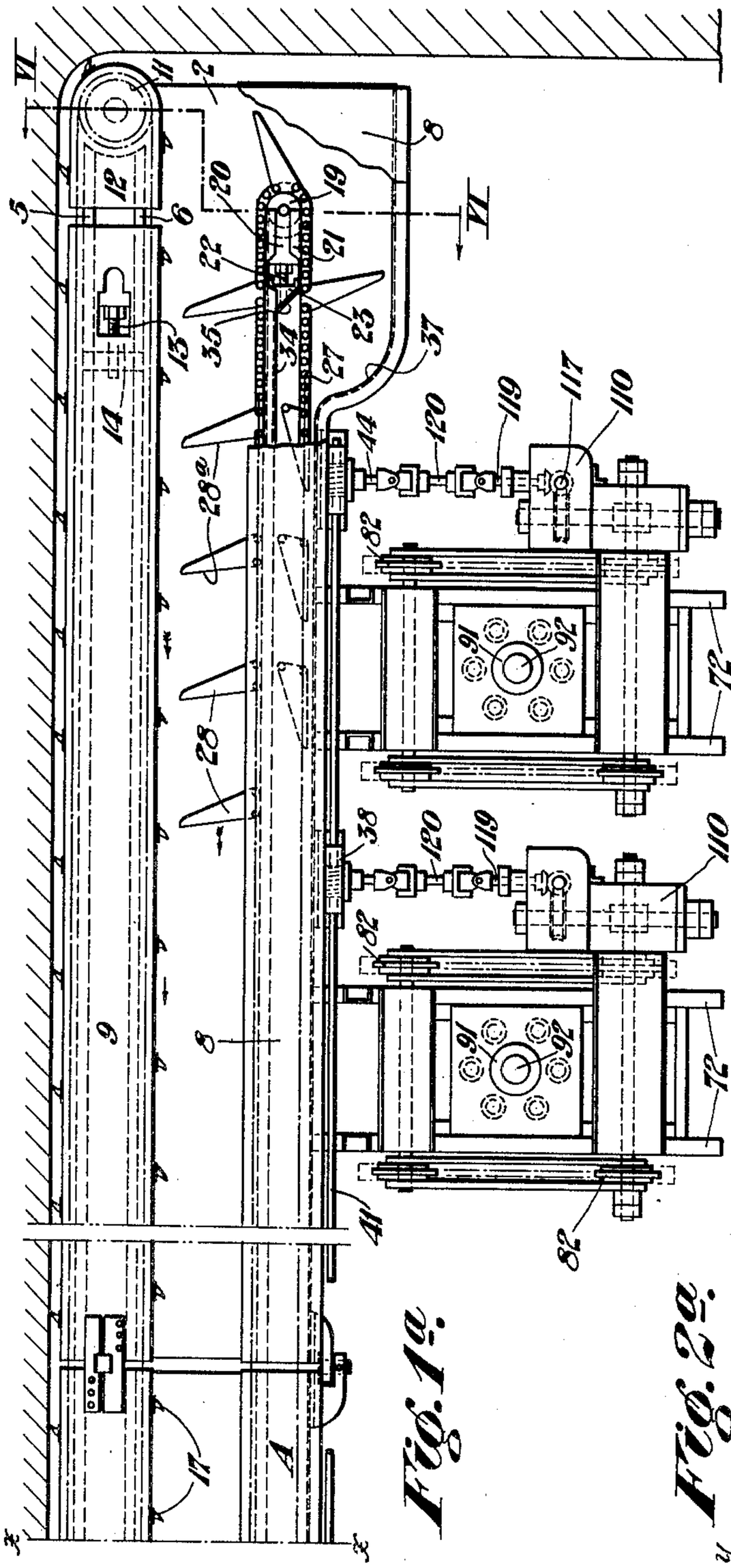

Fig. 1a.

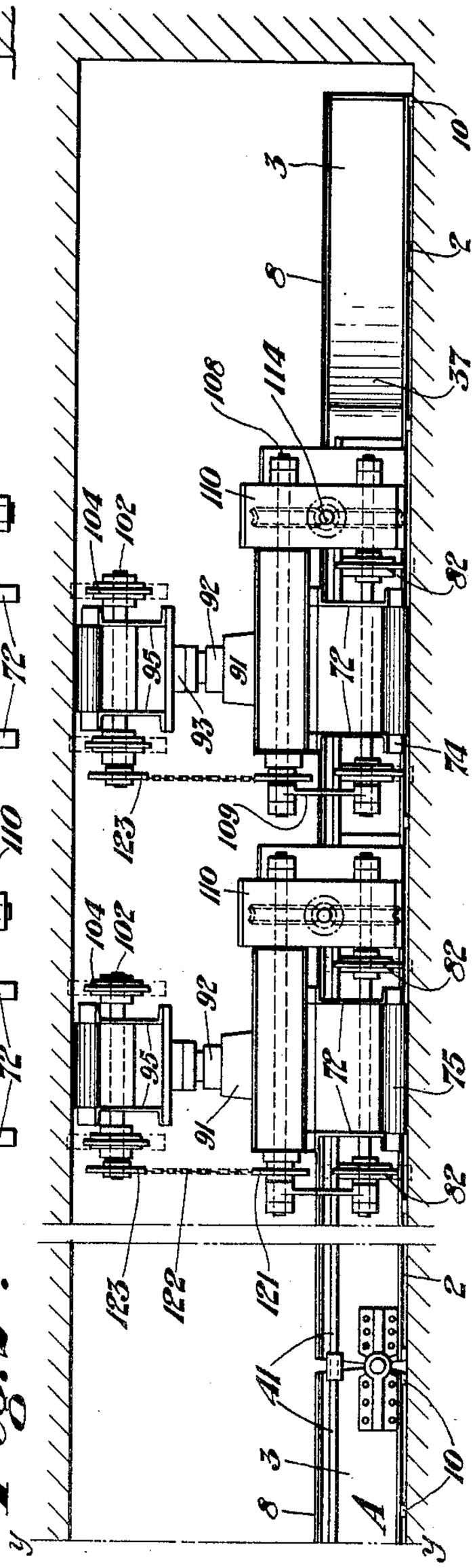

Fig. 2a.

Witnesses:
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1,588,987

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METHOD OF MINING

Original Filed Sept. 16, 1924 9 Sheets-Sheet 3

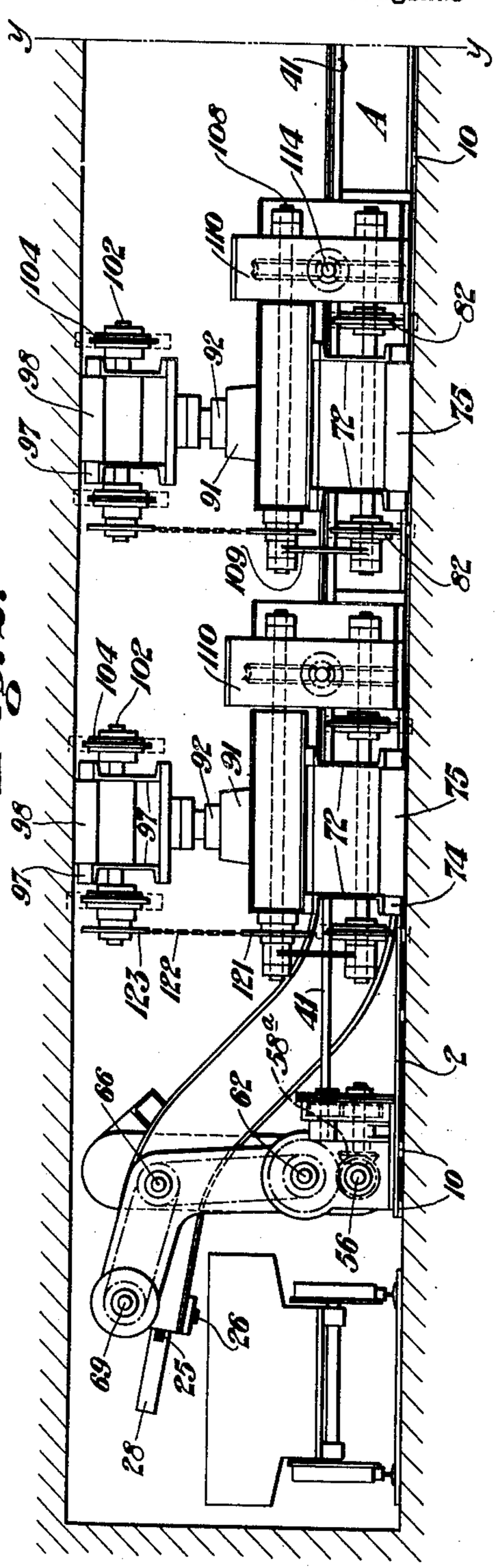

Fig. 2.

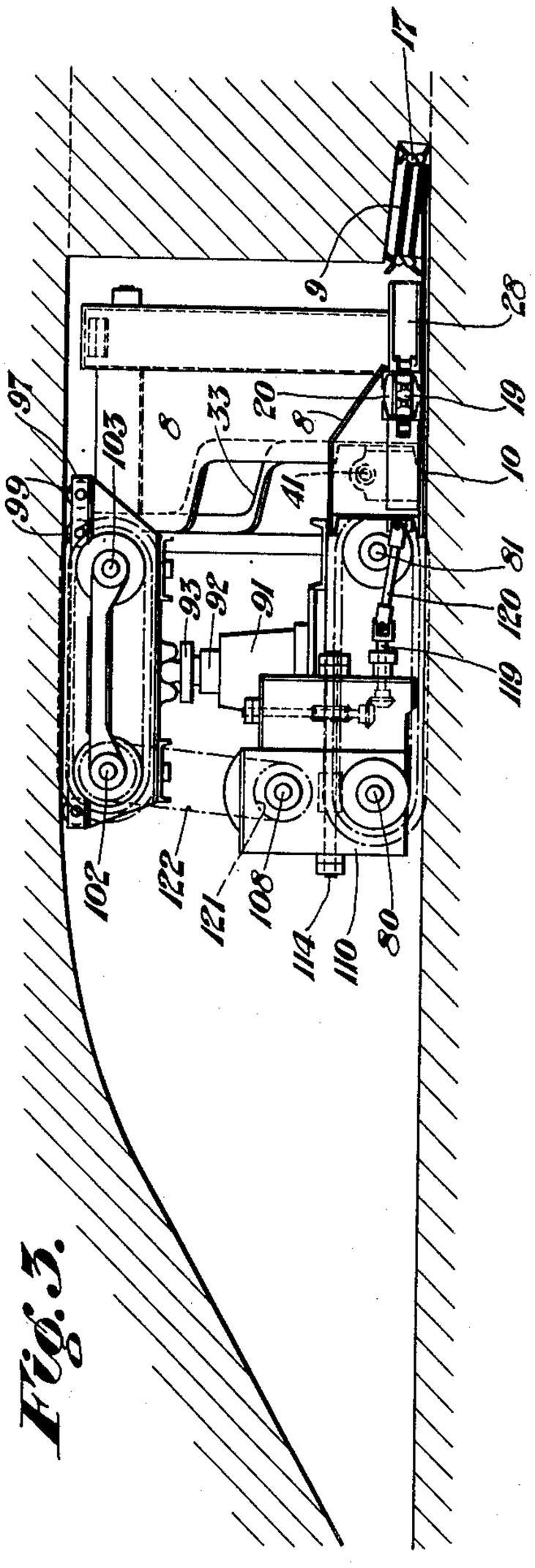

Fig. 3.

Witnesses.
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1,588,987

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METHOD OF MINING

Original Filed Sept. 16, 1924 9 Sheets-Sheet 4

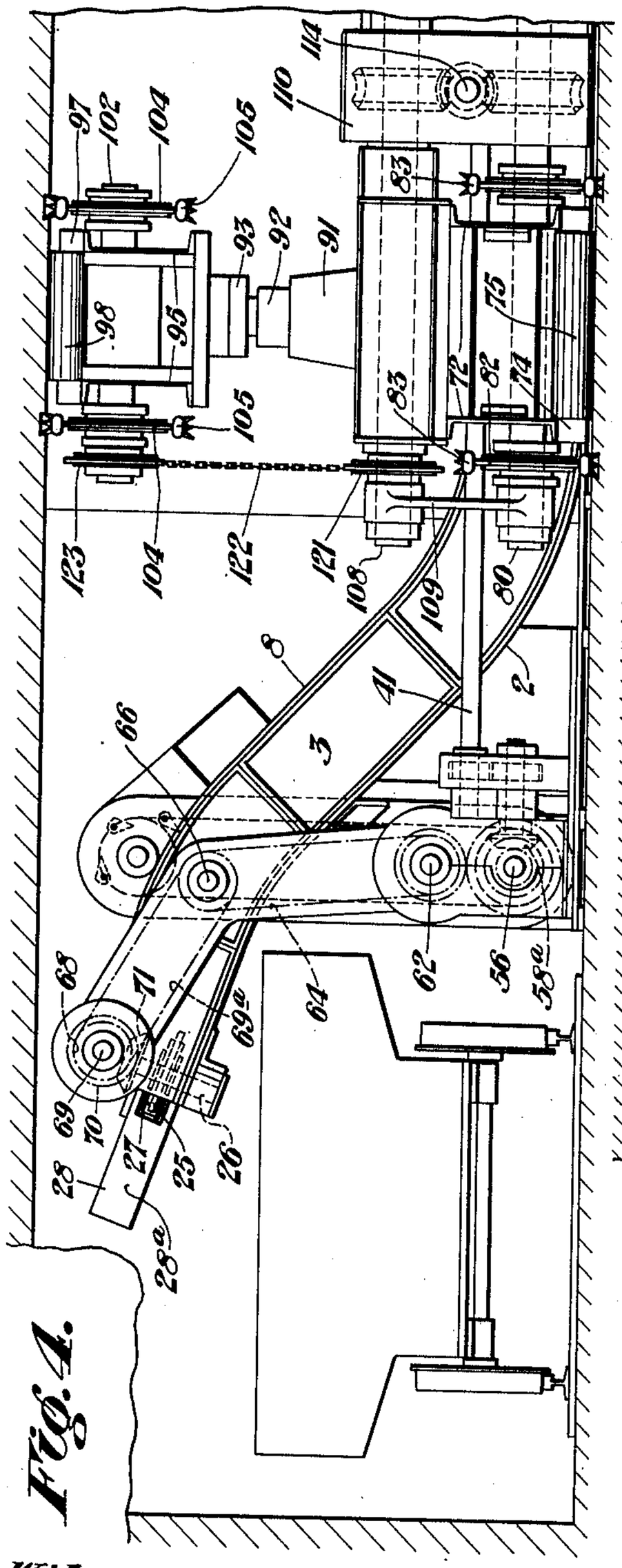

Fig. 4.

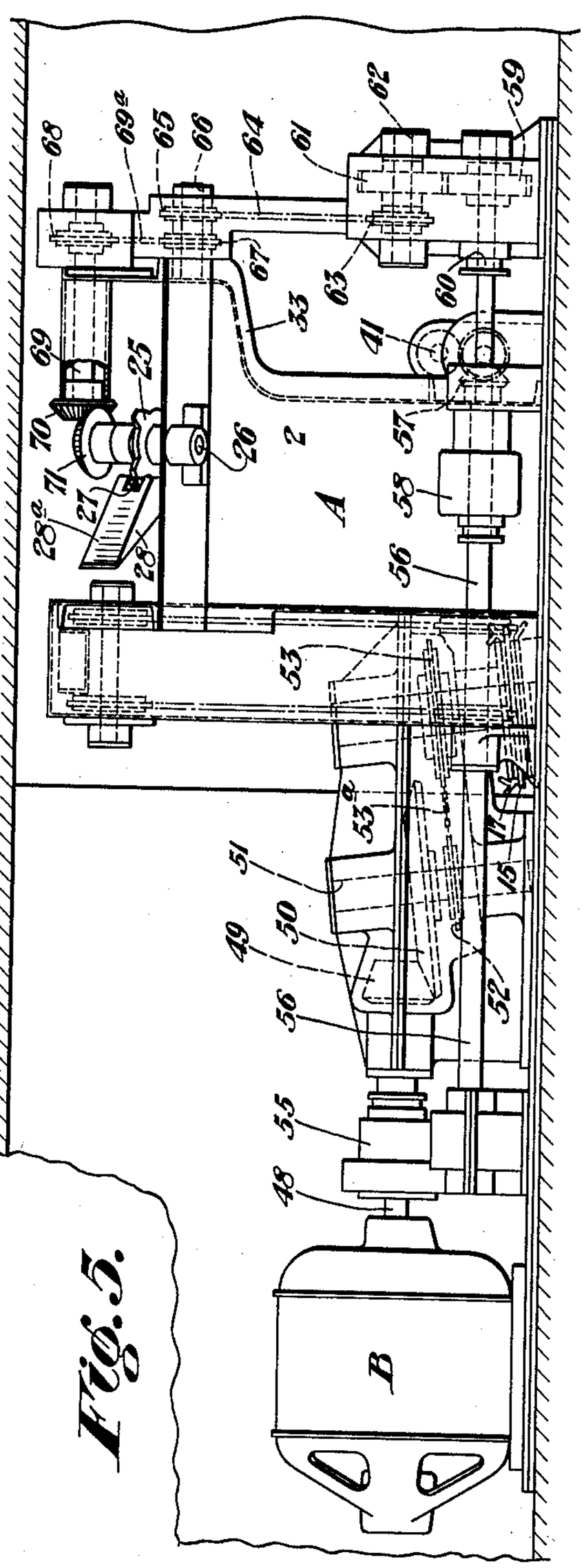

Fig. 5.

Witnesses:
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June 15, 1926. 1,588,987

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METHOD OF MINING

Original Filed Sept. 16, 1924 9 Sheets-Sheet 5

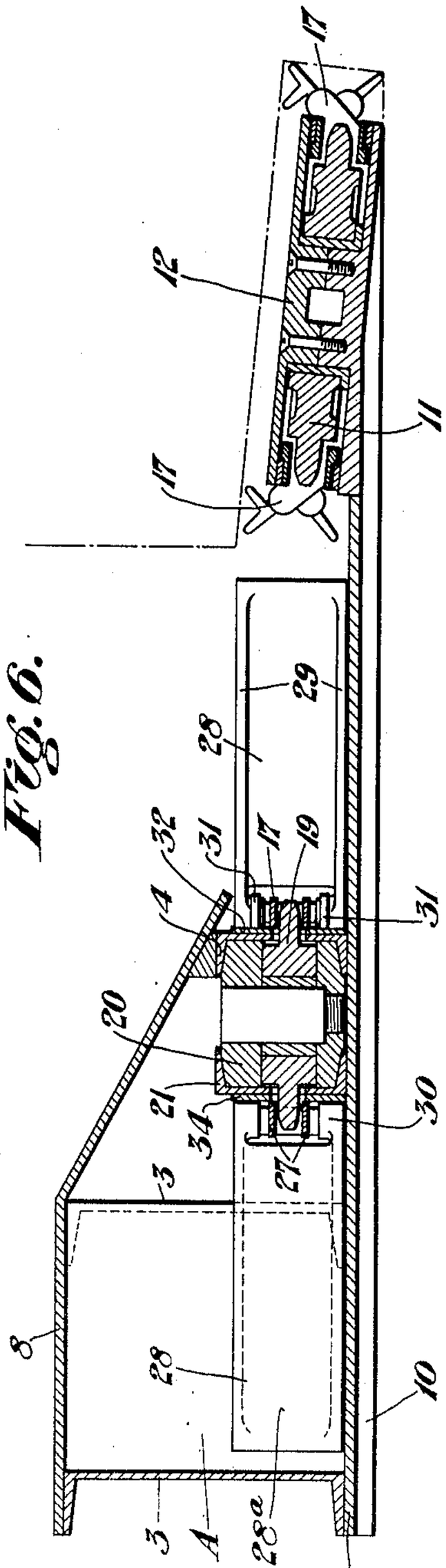

Fig. 6.

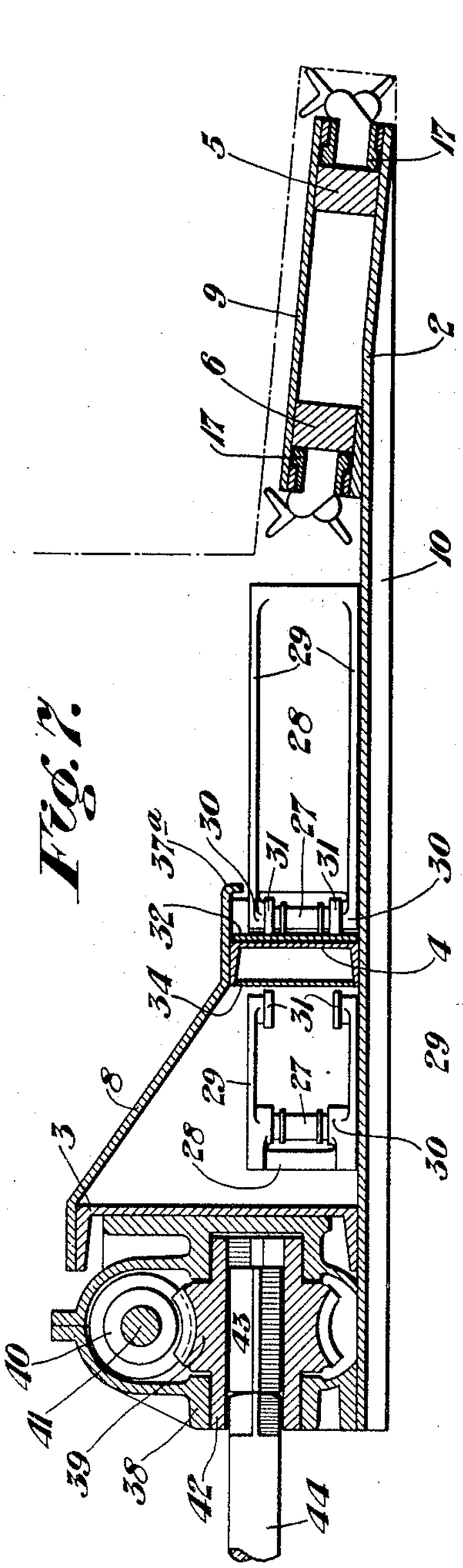

Fig. 7.

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1,588,987

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METHOD OF MINING

Original Filed Sept. 16, 1924 9 Sheets-Sheet 6

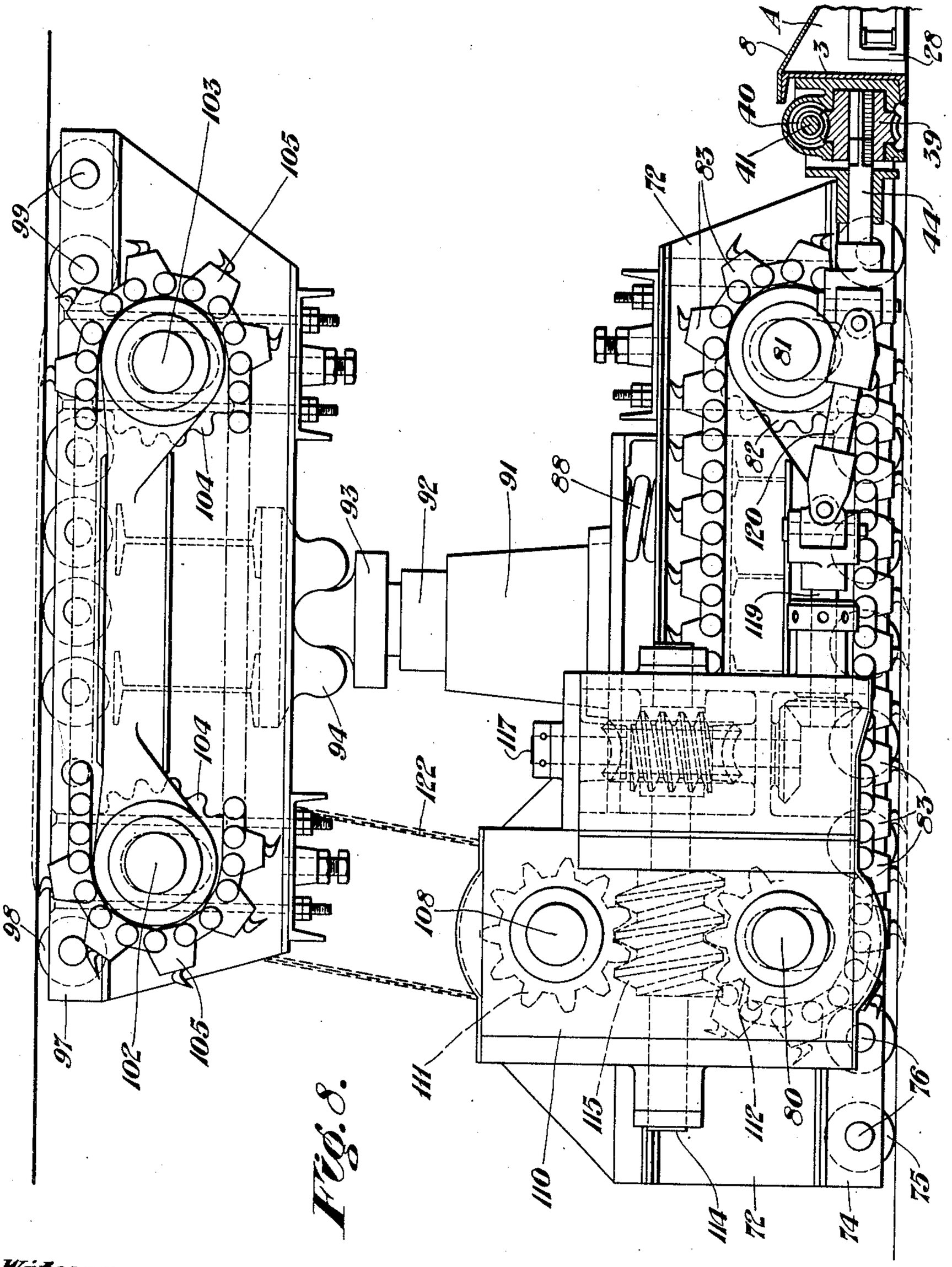

Fig. 8.

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METHOD OF MINING

Original Filed Sept. 16, 1924 9 Sheets-Sheet 7

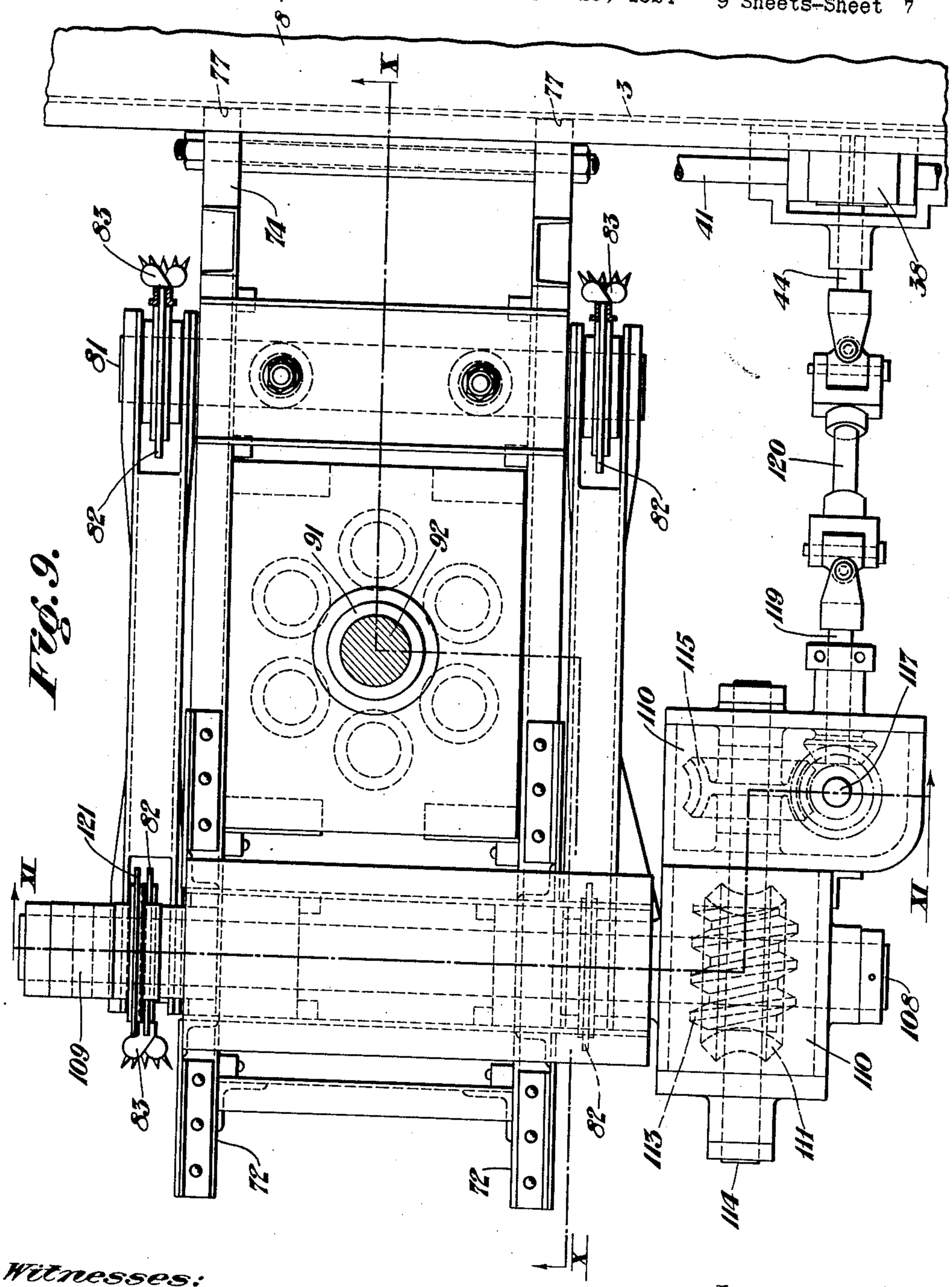

Fig. 9.

Witnesses:
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1,588,987

METHOD OF MINING

Original Filed Sept. 16, 1924 9 Sheets-Sheet 8

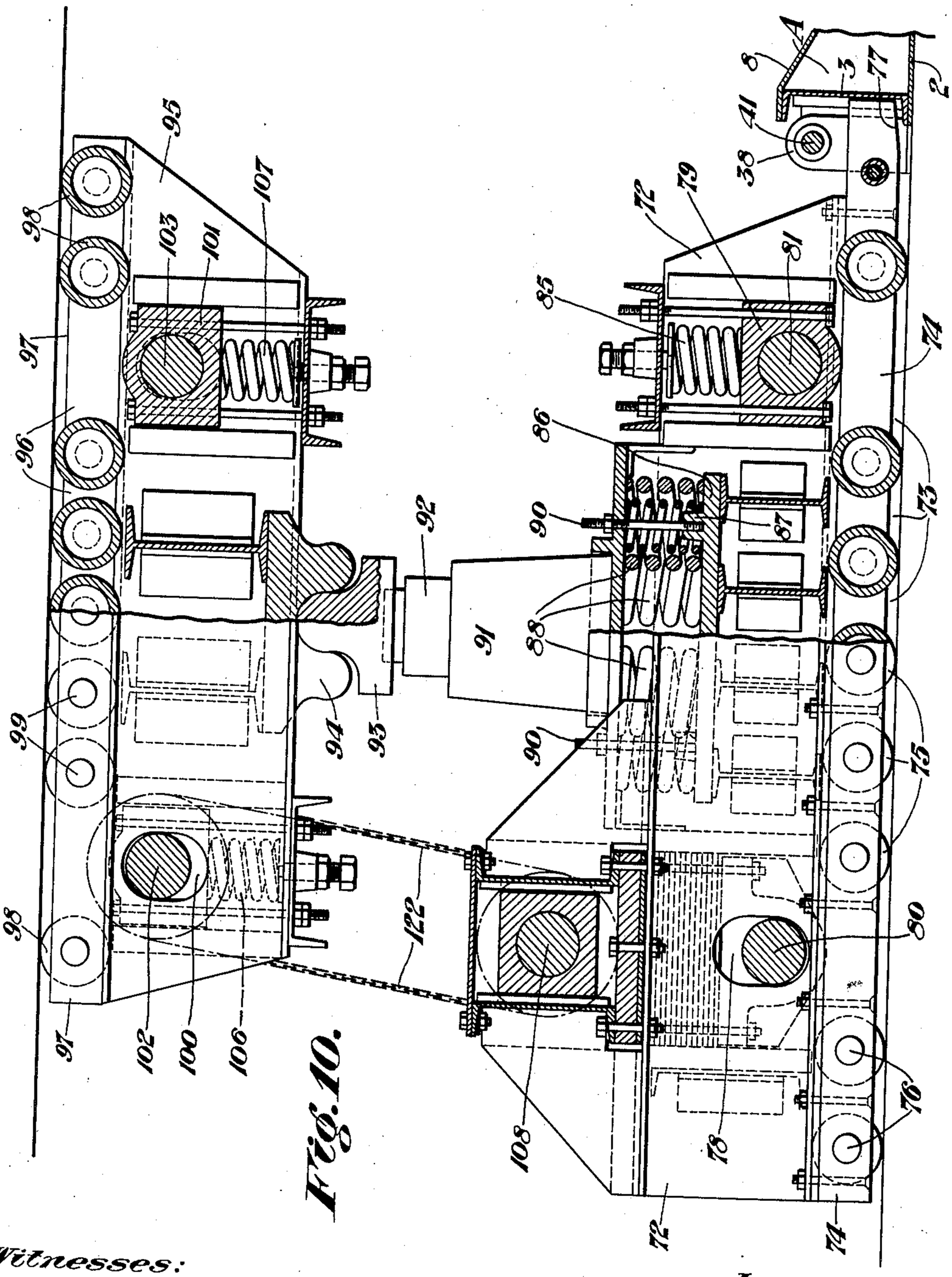

Fig. 10.

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June 15, 1926. 1,588,987

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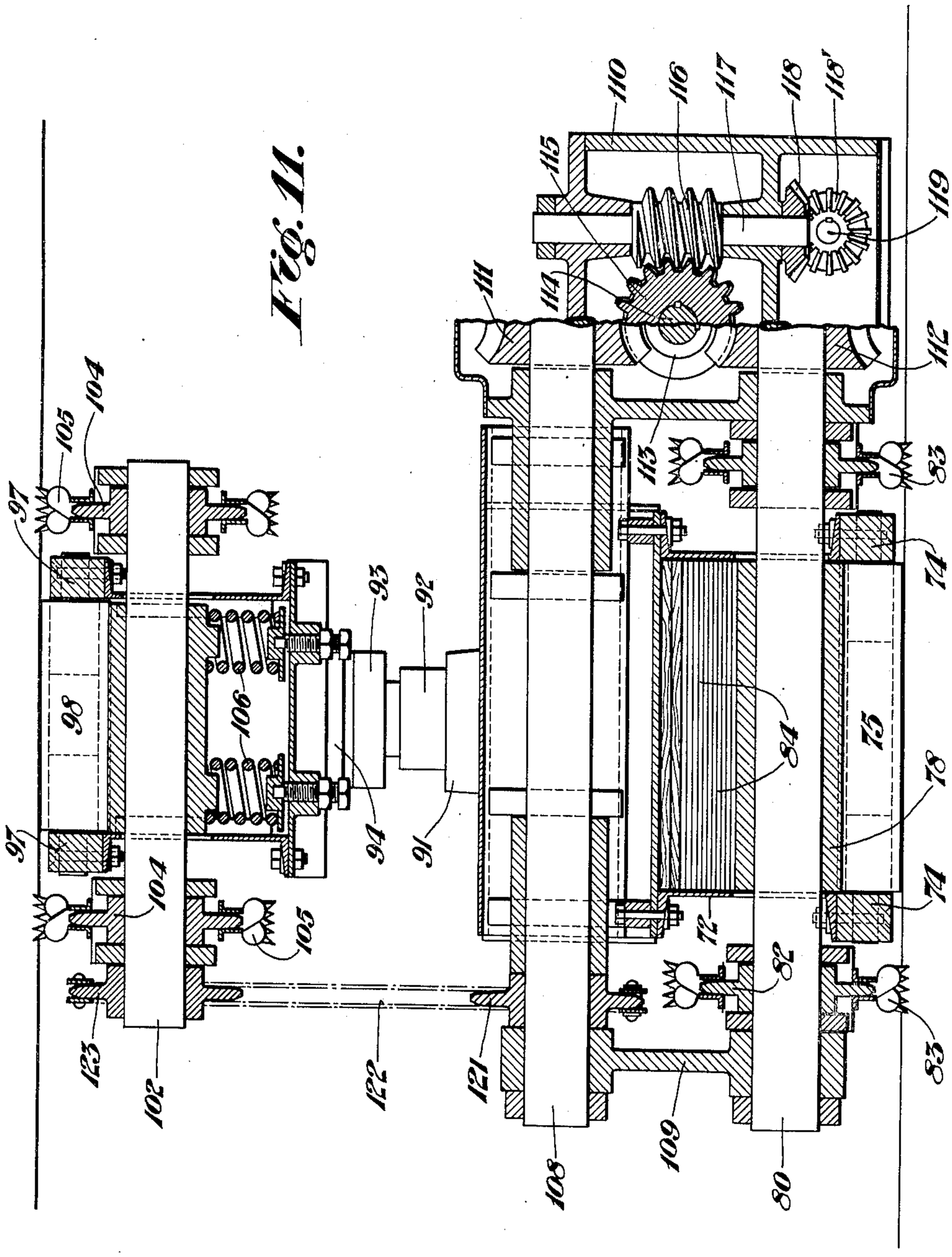
METHOD OF MINING

Original Filed Sept. 16, 1924 9 Sheets-Sheet 9

Fig. 11.



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Patented June 15, 1926. 1,588,987

UNITED STATES PATENT OFFICE.

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METHOD OF MINING.

Original application filed September 16, 1924, Serial No. 738,034. Divided and this application filed June 13, 1925. Serial No. 36,947.

This invention relates to a method of mining and more particularly to a novel method of supporting the roof of a mine, and has for one of its objects the supporting of the roof of a mine during the mining operation by mechanical supports which will be advanced as the mining progresses so as to permit a gob to form immediately to the rear of the supports.

Another object is to provide a method of mining including as a step the provision of a plurality of roof supports which are continually advanced as the mining progresses so as to permit the progressive formation of the gob to the rear of the supports and also permitting the settling of the roof to shear off any undercut material along the face being mined.

The novel method of this invention is primarily adapted for use with longwall systems of mining, although it may be used to advantage with other systems, and is preferably carried out by mechanism shown and described in the accompanying drawings, although other mechanism may be used without departing from my invention.

The mechanism shown in the accompanying drawings is described and claimed in my co-pending application, Serial No. 738,034, filed September 16, 1924, of which this application is a division.

In the drawings:

Figures 1 and 1ª combine to illustrate a plan view of a mining machine with which the combined roof supporting and advancing rigs of this invention are primarily adapted for use.

Figures 2 and 2ª combine to show a rear elevation of the machine of Figures 1 and 1ª.

Figure 3 is an end view of the butt end of the machine of Figures 1 and 1ª, showing the roof supporting and advancing rigs in position.

Figure 4 is an enlarged rear elevation of the delivery end of the mining machine.

Figure 5 is an enlarged end elevation of the delivery end of the mining machine.

Figure 6 is a transverse sectional elevation through the mining machine on the line VI—VI of Figure 1ª.

Figure 7 is a transverse sectional elevation through one of the drive connections of the mining machine which drive the roof supporting and advancing rigs.

Figure 8 is an enlarged side elevation of one of the combined roof supporting and advancing rigs.

Figure 9 is a horizontal cross-section thereof.

Figure 10 is a sectional elevation on the line X—X of Figure 9.

Figure 11 is a similar elevation on the line XI—XI of Figure 9.

Referring more particularly to the drawings, the letter A designates the elongated main frame of the mining machine as a whole, which is composed of a bottom plate 2, a main channel beam 3, extending longitudinally along the rear edge of the plate 2, a second channel 4 secured on the bottom plate intermediate the rear and forward edges of the plate 2, and a pair of spaced cutter chain guides 5 and 6 extend longitudinally adjacent the forward edge of and are secured to the bottom plate 2. A cover plate 8 is secured to and extends between the channel beams 3 and 4, and a second cover plate 9 is secured to and extends between the cutter chain guides 5 and 6. A plurality of skid bars 10 are secured to and extend transversely across the bottom face of the bottom plate 2 and serve as both skids and stiffening members.

A cutter chain idler sprocket 11 is journaled to rotate about a substantially vertical axis in a bearing block 12 which is adjustable longitudinally of the frame A by means of the screw threaded adjusting bar 13 mounted in the rigid cross bar 14 secured between the cutter chain guides 5 and 6.

A cutter chain head or power sprocket 15 is mounted on a substantially vertical shaft 16 journaled at the head end of the machine. A cutter chain 17 of standard design is trained over the sprockets 11 and 15 and passes through the guides 5 and 6.

A conveyer idler sprocket 19 is journaled to rotate about a substantially vertical axis in an adjustable bearing block 20 slidably mounted between a short length of channel 21 and the channel 4. The bearing block 20 is adapted to be adjusted by means of a screw threaded adjusting rod 22 threaded into a fixed block 23.

The head or loading end of the frame A is inclined upwardly sufficiently to permit the conveyer to discharge the mined material directly into cars. A conveyer head

or power sprocket 25 is mounted on a substantially vertical shaft 26 at the head end of the frame A.

A conveyer chain 27 is trained around the sprockets 19 and 25 and carries conveyer flights 28. The flights 28 are substantially triangular shaped in plan and comprise a vertically disposed material engaging face or wall 28[a] and a pair of rearwardly extending flanges 29. The flights 28 are pivotal at their heels, as at 30, to the conveyer chain 27, and are adapted to be folded back along the conveyer chain during their return passage so that the flanges 29 extend over and under the chain 27. The flanges 29 are provided with rollers 31 for a purpose to be described.

The forward face of the channel 4 is provided with a hardened wear plate 32 and the conveyer chain 27 and flights 28 are adapted to ride along this plate when conveying material, so that the rollers 31 will contact with the plate and prevent the flights from moving about their pivotal connections 30. Therefore, the flights will be held in extended position to convey the mined material.

The main or rear channel member 3 is bent rearwardly at the head end of the frame, as at 33, to provide clearance for the extended conveyer flights 28 as they travel around the head sprocket 25. As the flights pass around the sprocket 25 they will engage the back of the channel 3 and be moved about their pivotal connections 30 so as to fold back along the chain 27. The space between the channels 3 and 4 being considerably less then the length of the conveyer flights 28, the flights will be held in their folded position as they return to the butt end of the machine.

A wear and guide plate 34 is secured between the flanges of the channel 4 and the rollers 31 of the conveyer flights 28 engage and run on this plate during their return passage.

A guide or cam plate 35 is secured between the flanges of the channel 4 adjacent the butt end of the frame and is curved rearwardly so as to pass along the rear side of the channel 21 and around the idler sprocket 19 and join with the butt end of the plate 32. The plate 35 is slotted to permit the chain 27 to engage the teeth of the sprocket 19 and join with the butt end of the plate 32, and also to serve as a guide against which the rollers 31 of the flights 28 will engage and thus force the flights outwardly into extended or material engaging position. The rear or main channel member 3 is also bent rearwardly at the butt end of the frame, as at 37, to provide clearance for the flights as they are forced into extended position.

The cover plate 8 is extended over the forward edge of the channel 4, as at 37[a], and serves to maintain the conveyer chain 27 in position.

A plurality of worm and worm-wheel casings 38 are secured at spaced intervals along the rear face of the main channel member 3 and suitable worm-wheels 39 are journaled therein which are meshed with worms 40 on a power shaft 41 extending along the rear of the machine and journaled in suitable bearings at each end of each of the plurality of boxes or casings 38.

The spindles 42 of the worm-wheels 39 are provided with centrally arranged squared openings adapted to receive a filler bar 43 and the squared forward end of a power shaft 44 adapted to be connected to the drive mechanism of the roof supports to be described.

The main frame A has its head end widened out and extended forwardly to provide a support for the driving motor B and its associated gearing, shafting, etc., necessary to drive the machine.

The motor B is mounted on the extreme forward portion of the main frame and has its armature shaft coupled directly to a shaft 48 which has a bevel gear 49 on its rear end in mesh with a bevel gear 50 on a substantially vertical stub shaft 51. The shaft 51 also carries a sprocket 52 which is operatively connected by a chain 53[a] with a sprocket 53 on the shaft 16 on which the cutter chain head or power sprocket 15 is mounted. From the foregoing it will be readily understood that the cutter chain is driven by the motor B through the above mechanism, and it is to be noted that the above drive connections are so arranged that the cutter chain will be driven in clockwise direction.

The shaft 48 is connected through suitable reducing gearing 55 to a shaft 56 which carries a bevel gear 57 intermediate its ends and a clutch 58 for operatively connecting the gear 57 with the shaft. The gear 57 is in mesh with a bevel gear 58[a] on a spur shaft 58[b] which is connected through gears 58[d] to the power shaft 41 which extends lengthwise along the rear side of the machine.

The shaft 56 extends beyond the gear 57 to the rear of the main frame and has a gear 59 thereon adapted to be connected to or disconnected from the shaft by means of a clutch 60. The gear 59 is in mesh with a gear 61 on a stub shaft 62 which also is provided with a sprocket 63. The sprocket 63 is connected by a chain 64 with a sprocket 65 on a stub shaft 66, which also carries a sprocket 67 which is connected to a sprocket 68 on a head shaft 69 by a chain 69[a]. The shaft 69 carries a bevel gear 70 which meshes with a bevel gear 71 on the conveyer head sprocket shaft 26.

The driving gearing and shafts for driv-

ing the conveyer chain 27 are so arranged and connected that the conveyer chain will be driven in a counter-clockwise direction, that is, in the opposite direction to the direction of travel of the cutter chain 17, so that the return strand of the cutter chain moves parallel with and in the same direction as the working or conveying strand of the conveying chain, and thus the cutting bits of the cutter chain and the flights of the conveyer will co-operate to move the mined material lengthwise of the machine.

The roof support comprises a base 72 which is built up of structural shapes and plates and is provided along its bottom face with a centrally arranged recess 73 and side flanges 74. A plurality of anti-friction rollers 75 are mounted in the recess 73 and project below the lower or bottom face of the base 72, and have their axles 76 journaled in suitable bearing openings in the flanges 74. The forward end of the base 72 is shaped as at 77 to fit against the rear face of the beam 3 of the mining machine.

The base 72 is provided at its opposite ends with bearings 78 and 79, respectively, for transverse tractor shafts 80 and 81 having sprockets 82 against each end, over which are trained tractor chains 83 adapted to engage the floor of the mine when in operation to feed the lower portion of the device or rig forwardly.

The bearings 78 and 79 are provided with cushioned mountings so as to permit a limited vertical movement of the shafts 80 and 81, respectively. The rear bearing 78 is cushioned by a rubber cushion member 84 mounted in the base 72 above said bearing and adapted to be compressed thereby. The forward bearing 79 is cushioned by springs 85 so as to permit vertical movement thereof.

The base 72 is provided with a centrally arranged jack supporting plate 86 having a plurality of upwardly projecting spring guides 87 thereon. A plurality of heavy coil springs 88 are mounted on said jack supporting plate, and a jack base 89 is mounted on the springs 88 and adjustably held in position by tie bolts 90 passing through suitable apertures in the jack base and screw threaded into the plate 86.

A jack 91 of any ordinary and well known construction, but preferably of the hydraulic type, is mounted on the jack base 89. The jack plunger or lifting element 92 is provided with a head member 93 having a pivotal connection with a co-operating member 94 on the bottom face of the roof supporting beam 95.

The beam or roof member 95 is built up of structural shapes and plates and is provided along its upper face with a centrally arranged roller recess 96 and side flanges 97. A plurality of anti-friction rollers 98 are mounted in the recess 96 and have their axles 99 journaled in suitable bearing apertures in the flanges 97.

The roof member 95 is provided at its opposite ends with bearings 100 and 101, respectively, in which are journaled transverse tractor shafts 102 and 103 having sprockets 104, over which are trained tractor chains 105 adapted to engage the roof of the mine when in operation to feed the upper portion of the rig forwardly.

The bearings 100 and 101 are cushioned for vertical momement by means of spring mountings 106 and 107, respectively.

A drive shaft 108 is mounted on the rear end of the base member 72 directly above the sprocket shaft 80 and is supported at one end on the shaft 80 by a connecting bearing member 109, and at its other end by the drive gearing housing 110. It will thus be seen that any vertical movement of the sprocket shaft 80 will be communicated direct to the drive shaft 108, and, therefore, these shafts will remain constantly spaced, irrespective of the vertical movement of the shaft 80 due to its cushioned bearing.

The shafts 108 and 80 are provided with worm-wheels 111 and 112, respectively, within the housing 110, which mesh with the opposite sides of a worm 113 on a longitudinally extending shaft 114 journaled in the housing 110. The shaft 114 is provided with a worm-wheel 115 in mesh with a worm 116 on a vertical shaft 117 journaled in the housing 110, and provided with a bevel gear 118 on its lower end, which is in mesh with a bevel gear 118′ on the rear end of a horizontal power shaft 119, which extends through the forward end of the housing 110 and is connected to the power shaft 44 by a universal coupling member 120.

The shaft 108 is provided with a sprocket 121 at its end opposite the worm-wheel 111, which is connected by a chain 122 to a sprocket 123 on the tractor shaft 102.

From the above description of the drive mechanism it will be readily seen that as the shaft 41 is operated by the motor of the machine, each of the several roof supporting rigs will be steadily and constantly driven so as to slowly advance toward the coal face. The rate of advance of the roof supporting rigs is preferably arranged to be substantially equal to the cutting capacity of the cutter chain 17 on the mining machine, since the roof supporting rigs also bear against and advance or push the mining machine into the kerf cut in the coal face. The advance of the roof supporting rigs is, therefore, equal to the advance of the mining operation.

In carrying out my novel method with the apparatus above described the roof supporting rigs are arranged in a single row a short distance to the rear of the mining machine, and the mining machine and roof

supports are set in motion. The mining machine will undercut the coal and will be moved into the kerf formed by its cutter chain by the roof supporting rigs, which bear or push against the rear side of the machine. As the mining machine progresses the complete row of roof supporting rigs will be constantly advanced at exactly the same rate of speed as the mining machine, thereby maintaining a constant distance between the machine and the unsupported portion of roof. This maintaining of a constant distance between the unsupported portion of roof and the mining machine is important since the roof is thus permitted to settle and form a gob immediately to the rear of said supports and also to set up shearing forces which will shear off or break down the coal along the entire face which has been previously undercut by the machine.

It will, of course, be understood that the method of this application may be carried out with other apparatus than that shown and described and the method of supporting the roof may be used with other mining machines or in conjunction with hand mining by the longwall method.

When the roof supports are used with other mining machines or in conjunction with hand mining, other means for driving the crawler members of said supports will be used, such as separate motors on each support and the movement of said supports will be timed to permit the slower mining operation to progress in time with the movement of the supports.

I claim—

1. A method of mining coal which consists in removing the coal over a longwall face, supporting the roof by a plurality of roof supports for a limited distance back of said face, and advancing said supports as the removal of the coal progresses, so as to permit the roof to settle and form a gob immediately back of said supports while supporting the roof between said supports and coal face, but permitting sufficient settling of the roof along the coal face to shear and break down undercut coal along said face.

2. A method of mining coal which consists in removing the material being mined over a longwall face, supporting the roof by a single row of roof supports along the longwall face and spaced a relatively short distance to the rear of said face, and providing a constant advance movement of said supports so as to permit the roof to settle and form a gob back of said supports and the coal face, but permitting sufficient settling of the roof along the coal face to shear and break down undercut material along said face.

3. A method of mining coal which consists in removing the material being mined over a longwall face, supporting the roof by a single row of roof supports along the longwall face and spaced a relatively short distance to the rear of said face and providing a constant substantially equal advance movement of all of said supports at approximately the same speed as the mining progresses so as to permit the roof to settle and form a gob back of said supports while supporting the roof between said supports and the coal face, but permitting sufficient settling of the roof along the coal face to shear and break down undercut material along said face.

In testimony whereof, I have hereunto set my hand.

EDWARD O'TOOLE.