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10 Sheets—Sheet 1.

W. KEAST.

MECHANICAL SCENIC EXHIBIT.

No. 548,879. Patented Oct. 29, 1895.

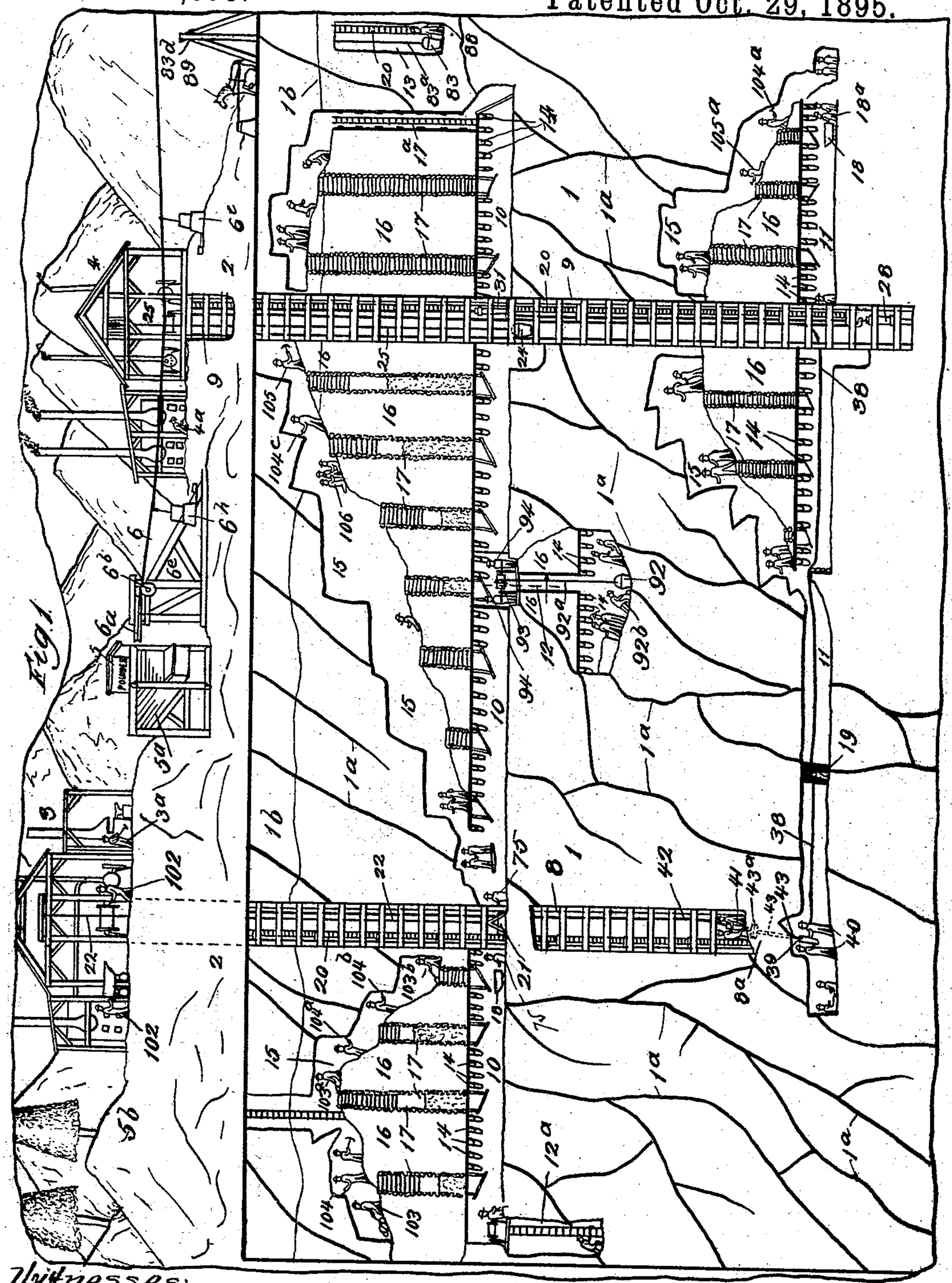

Fig. 1.

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MECHANICAL SCENIC EXHIBIT.

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Fig. 27.

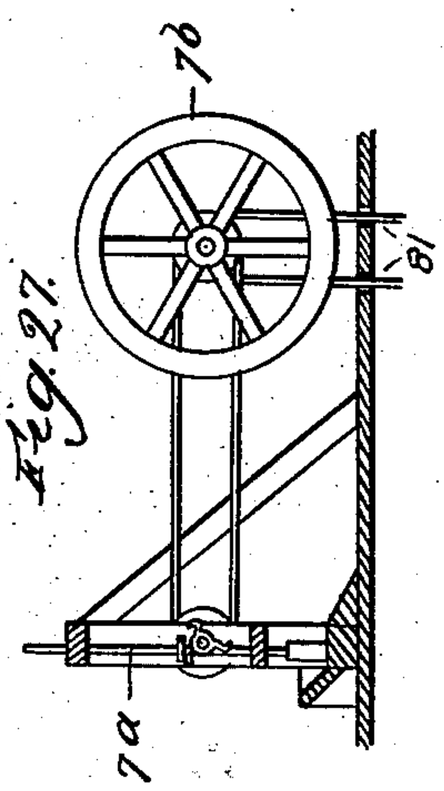


Fig. 29.

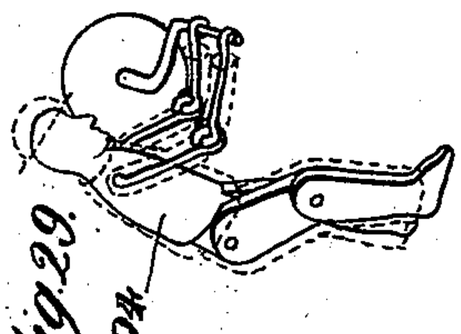


Fig. 28.

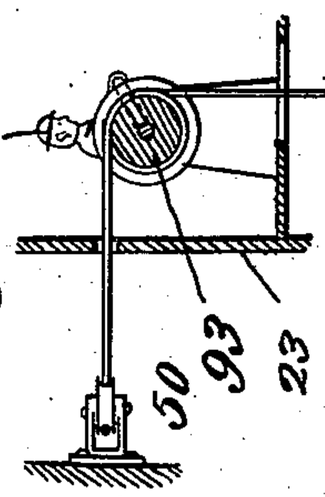


Fig. 30.

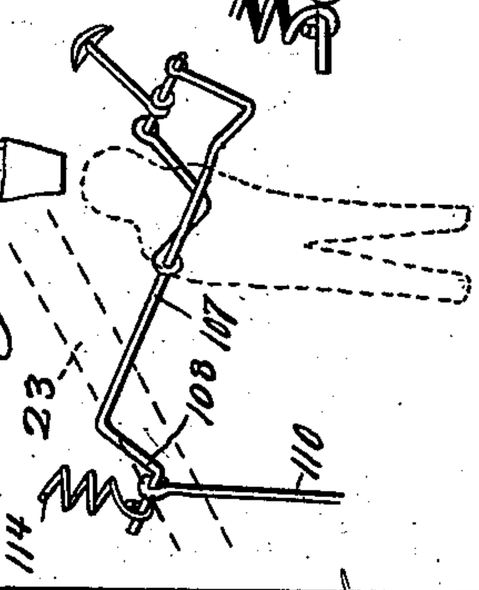


Fig. 31.

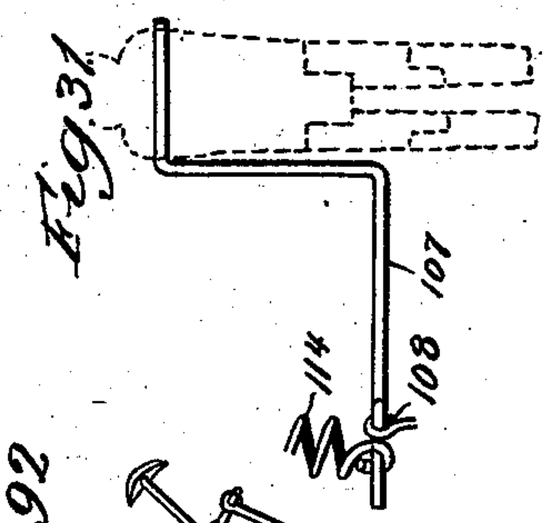
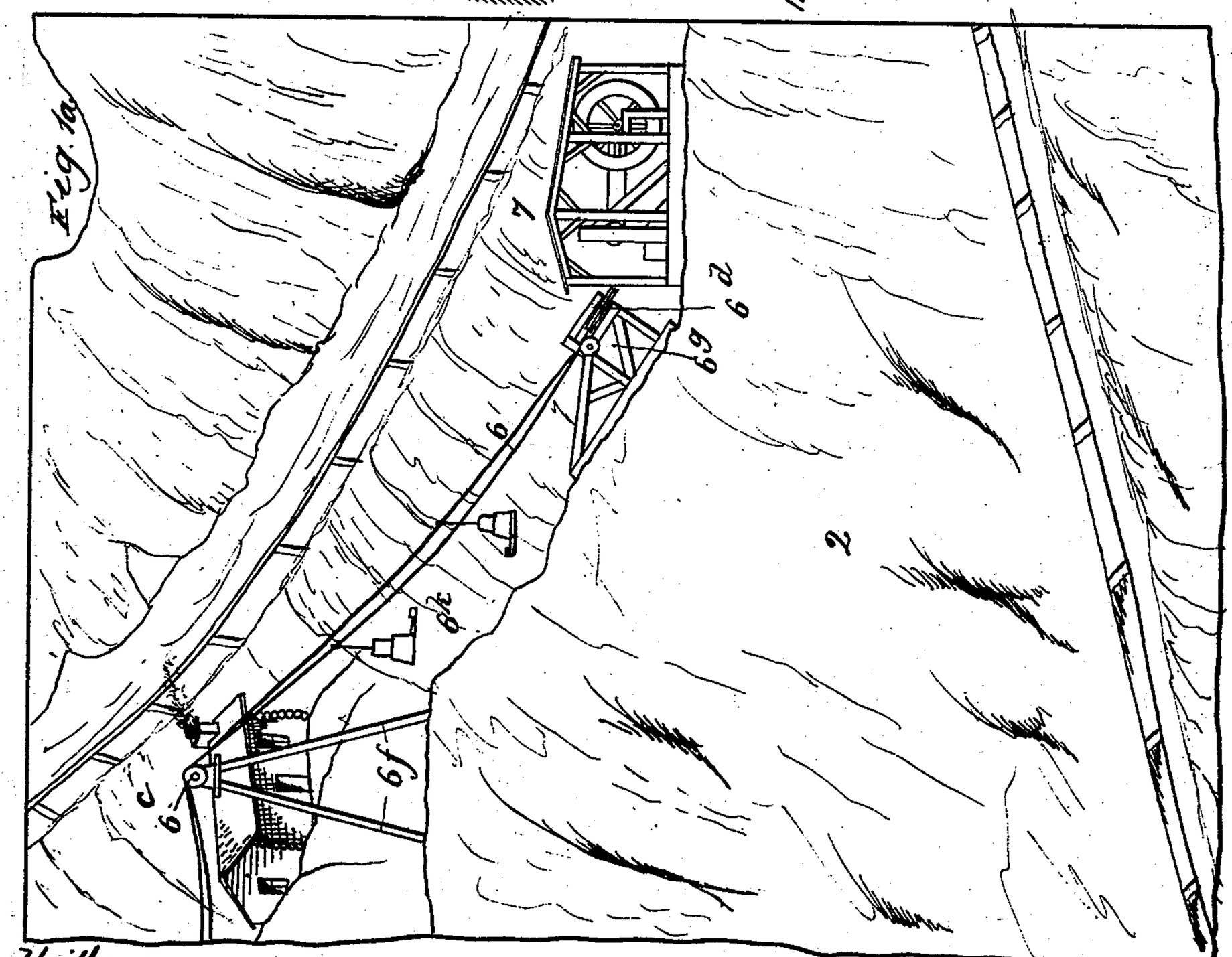


Fig. 1a.



Witnesses;
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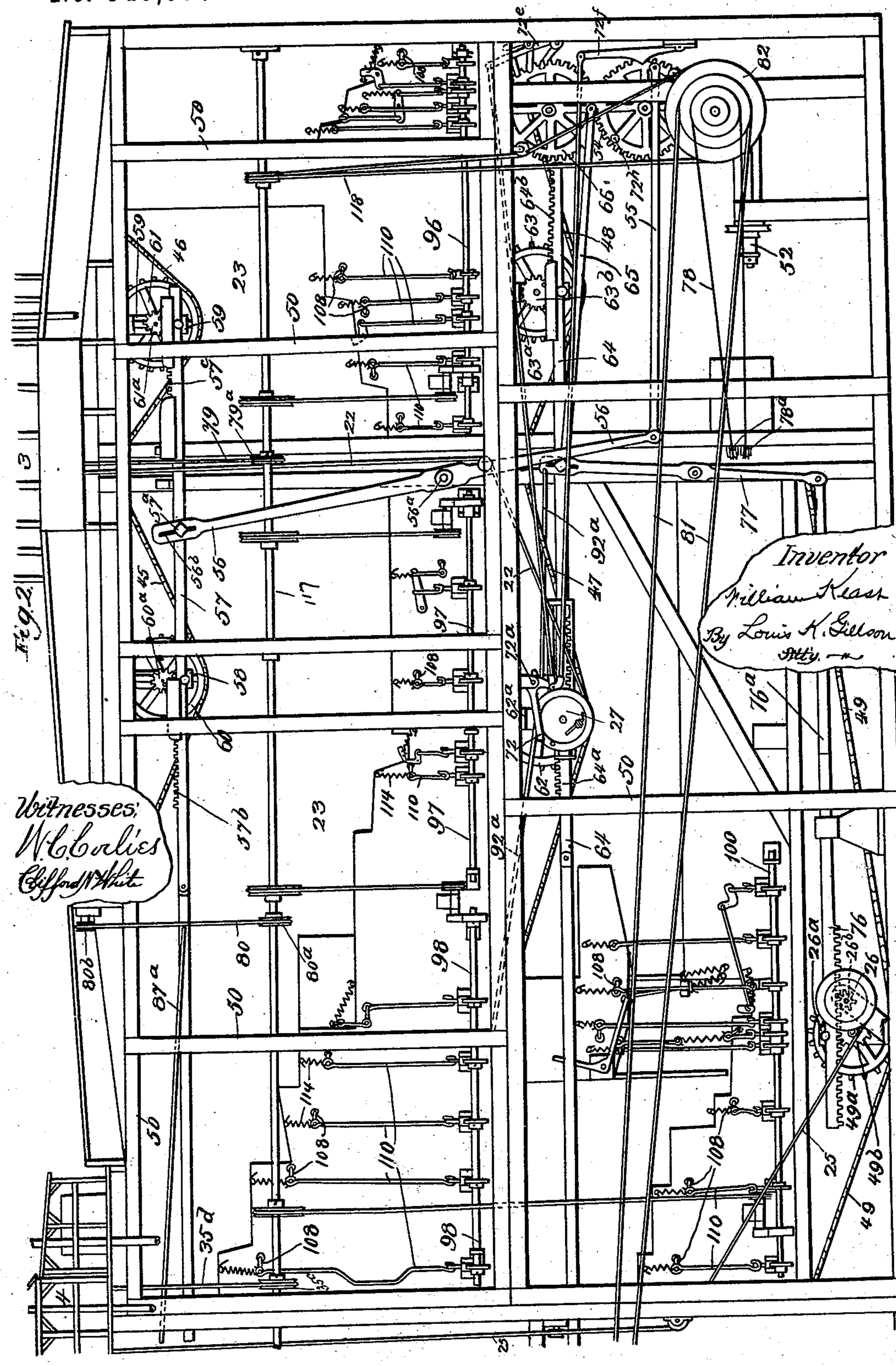

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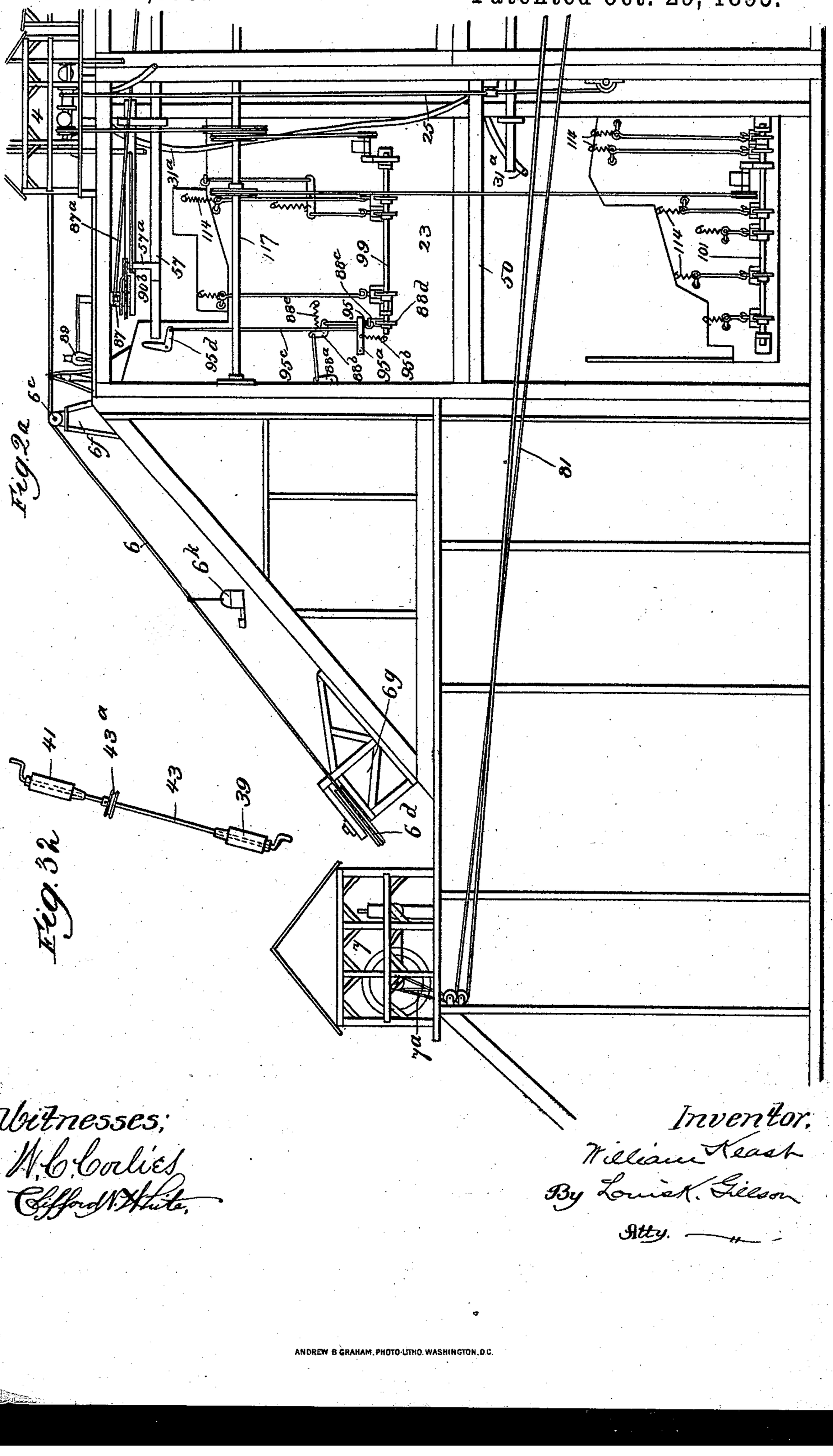

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W. KEAST.

MECHANICAL SCENIC EXHIBIT.

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Fig. 3

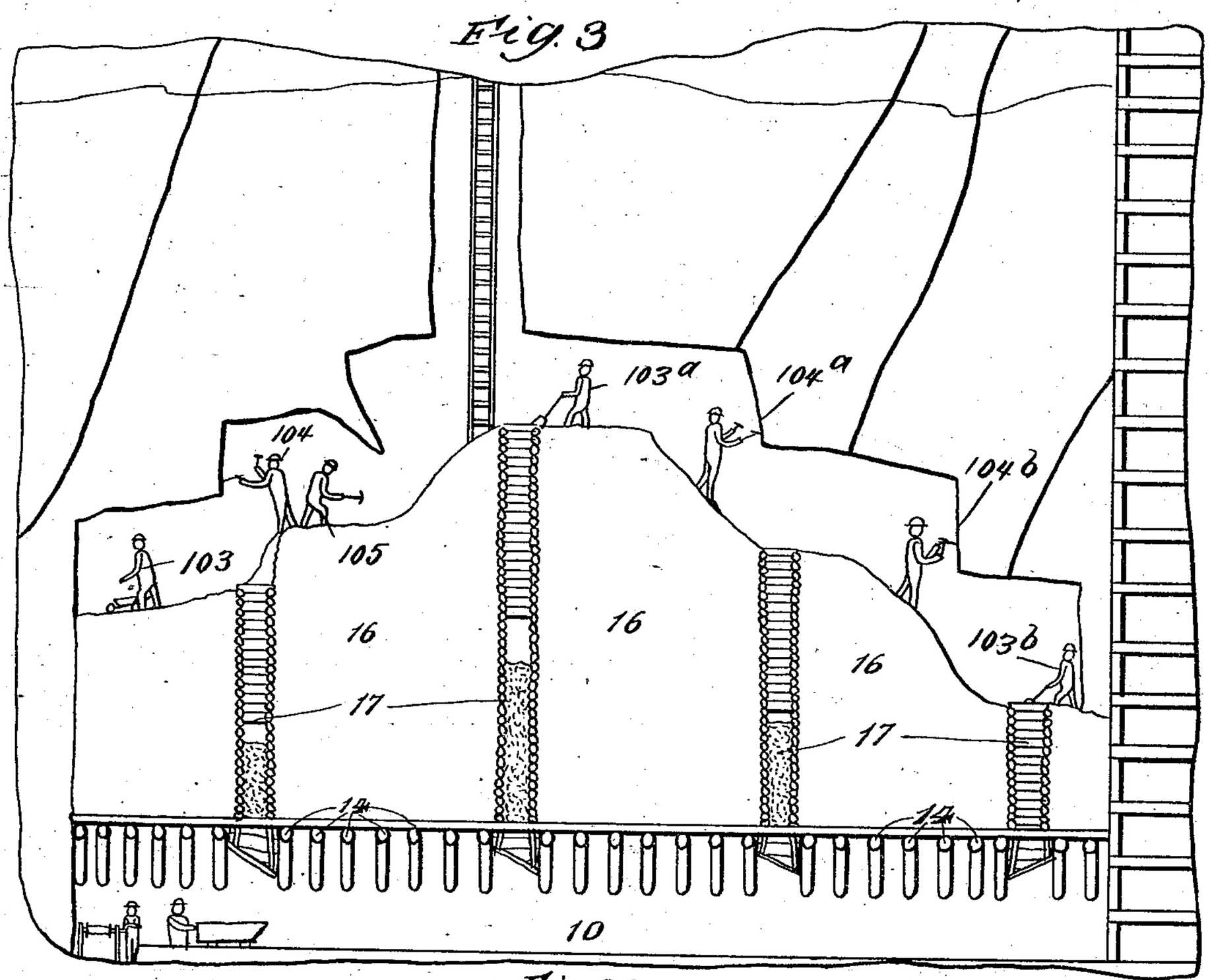


Fig. 23.

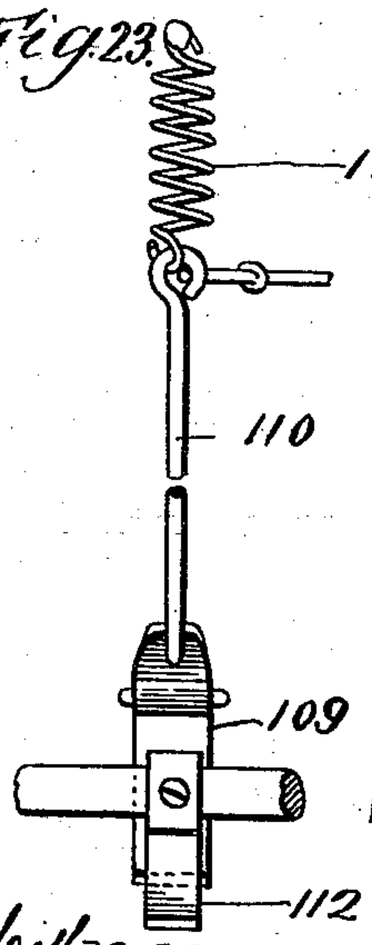


Fig. 24.

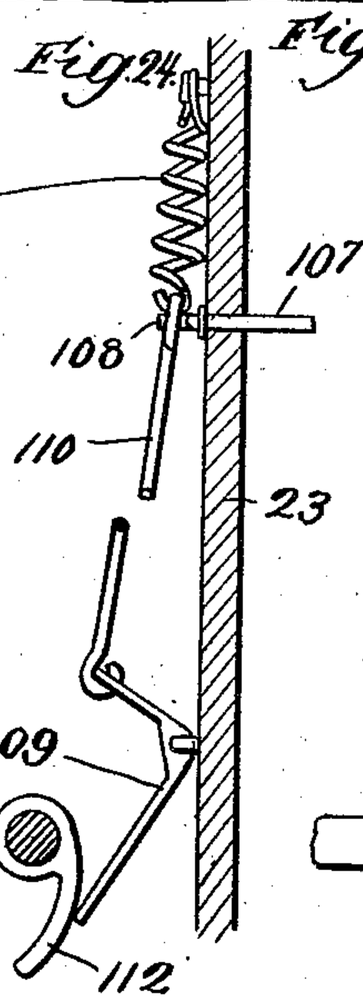


Fig. 25.

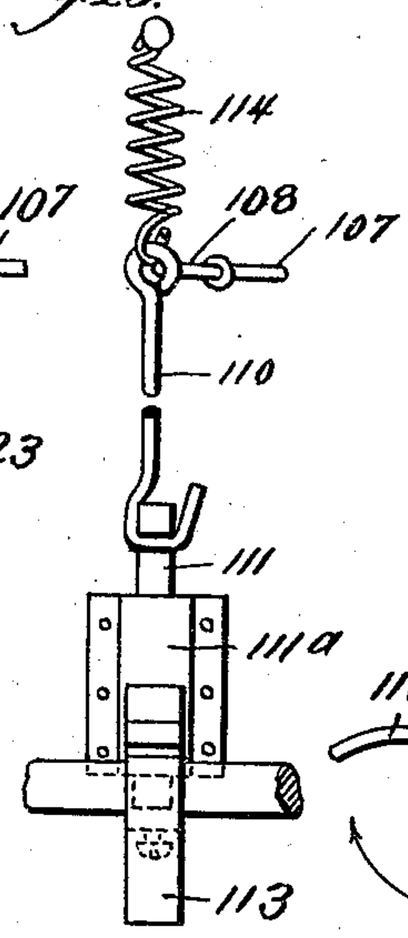
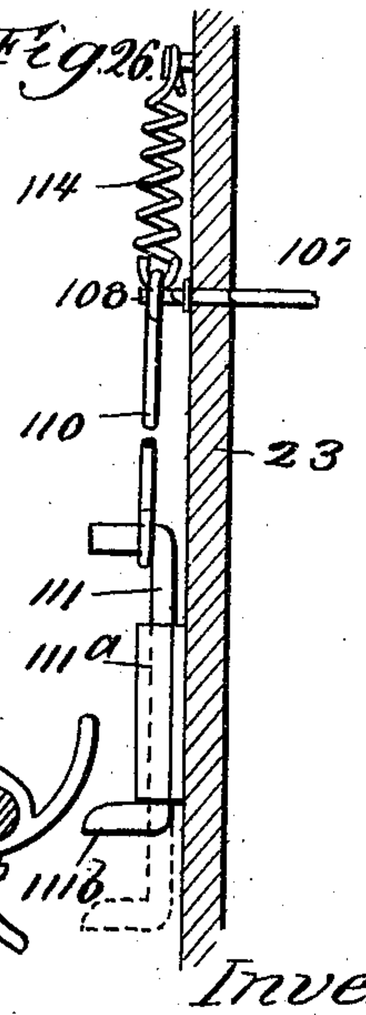


Fig. 26.



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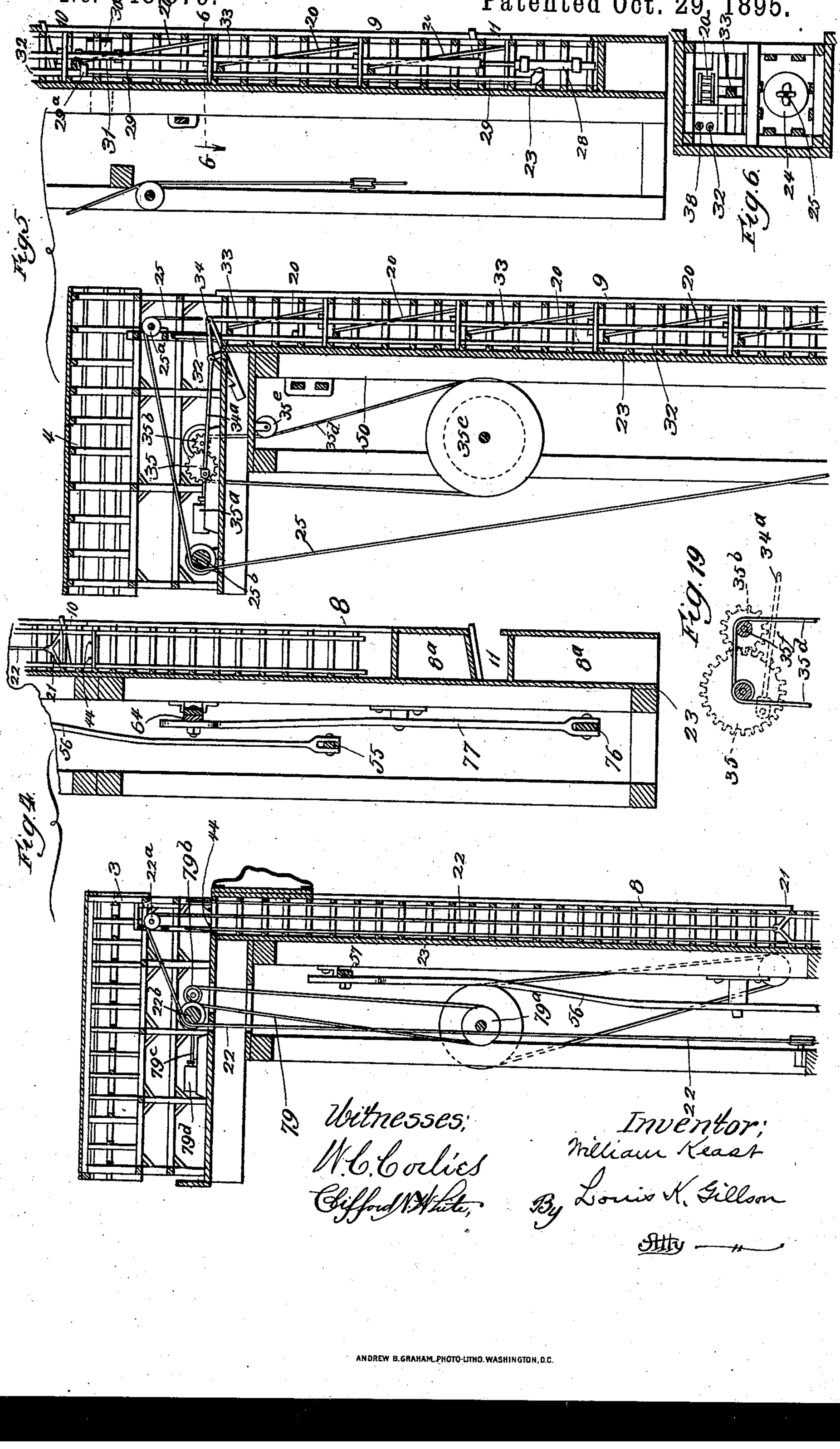

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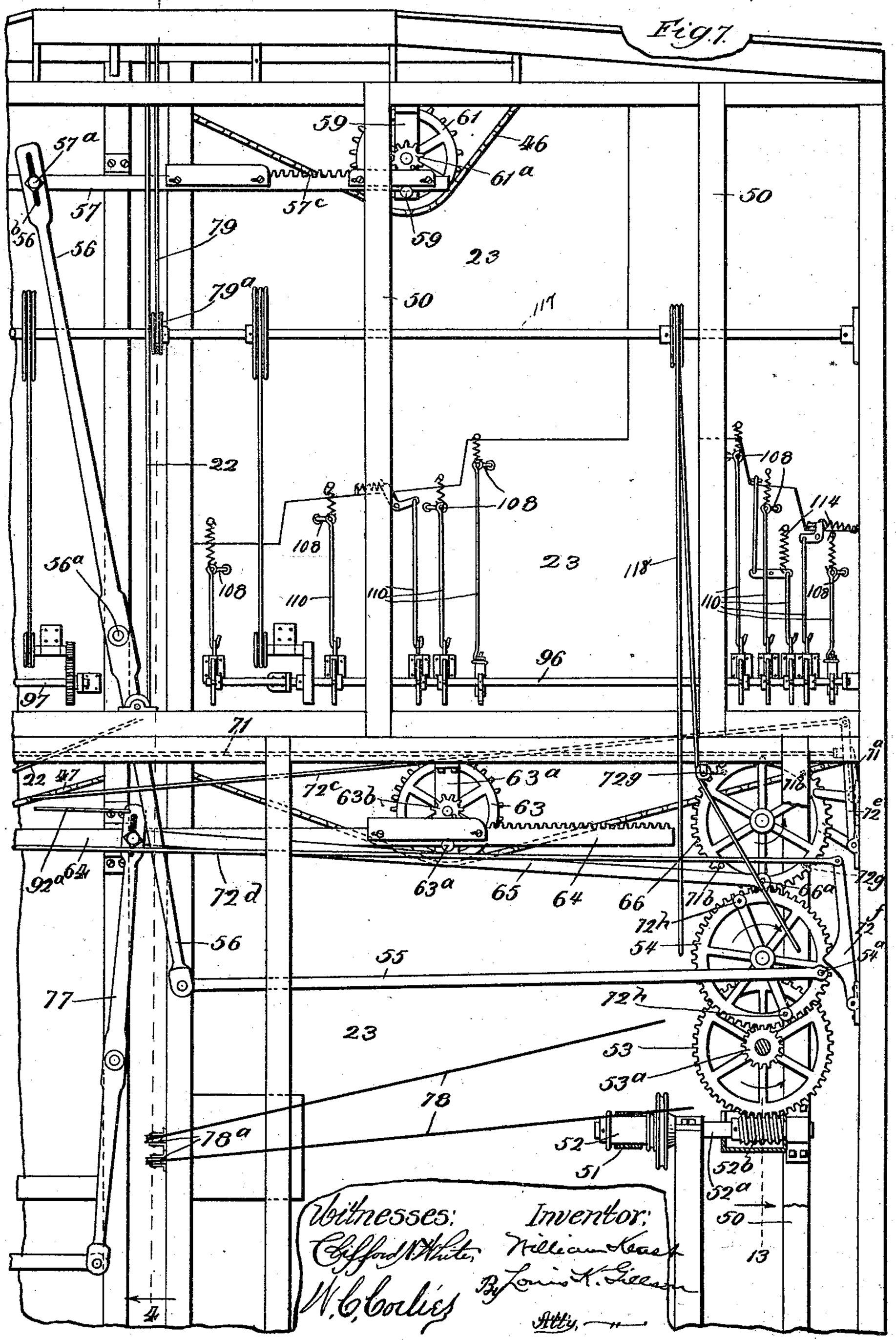

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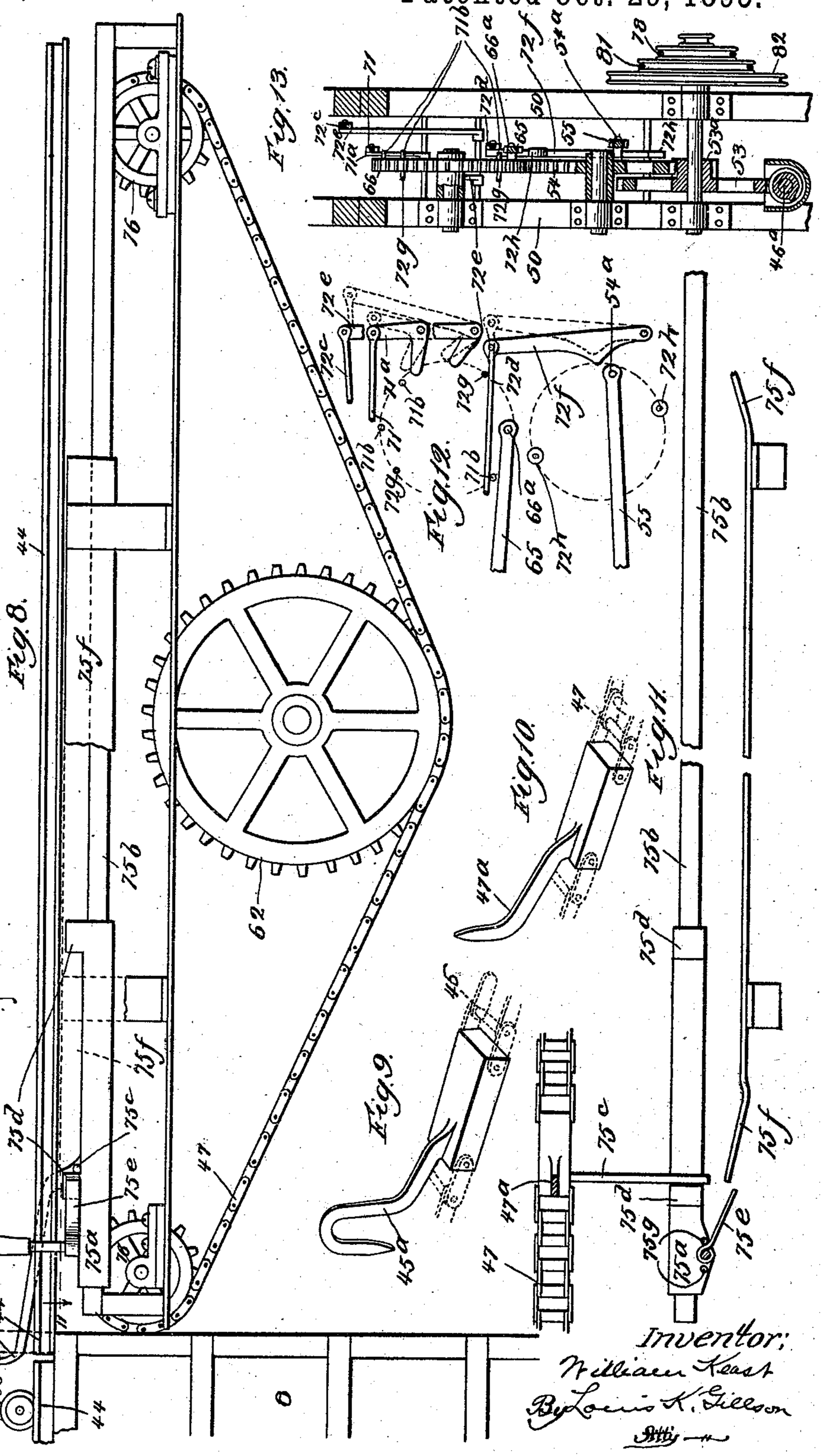

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Fig. 14.

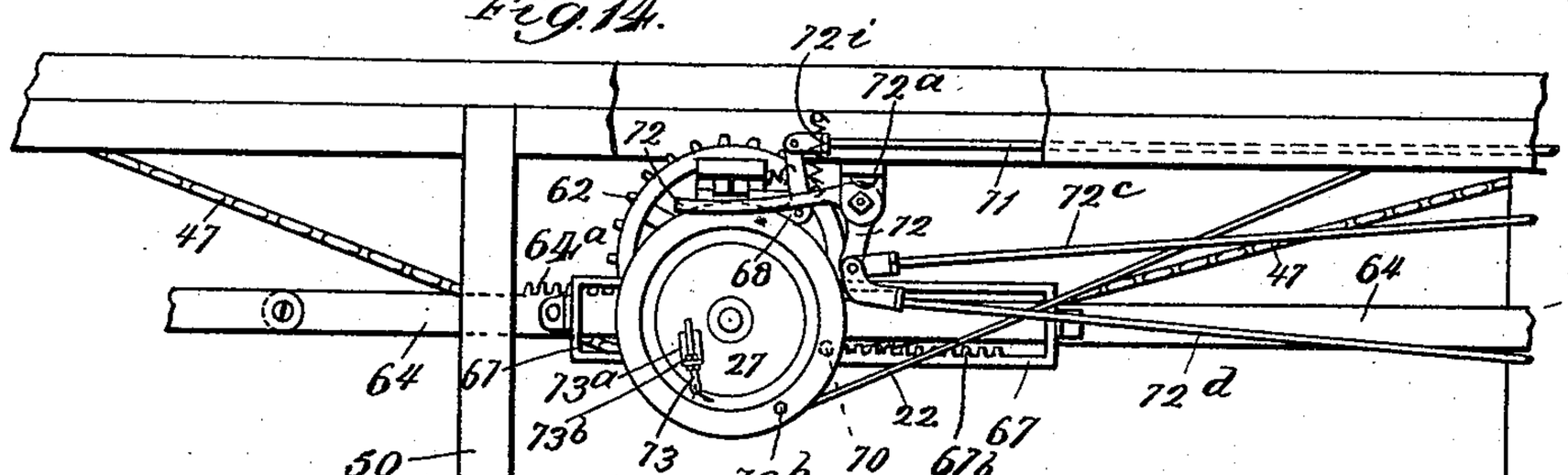

Fig. 15.

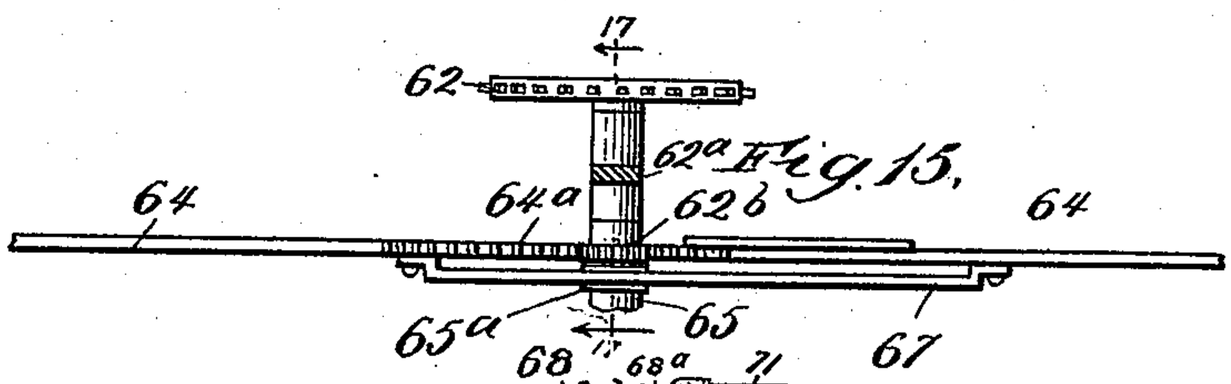

Fig. 16.

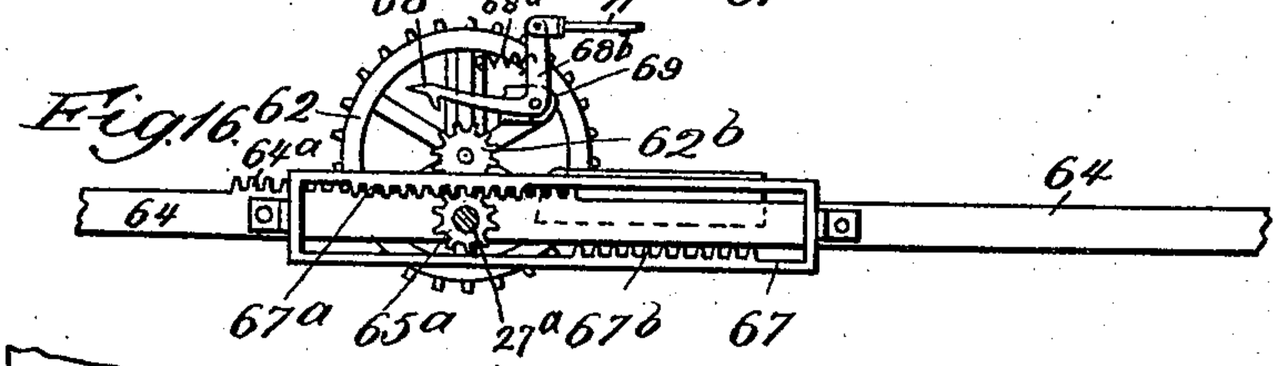

Fig. 17.

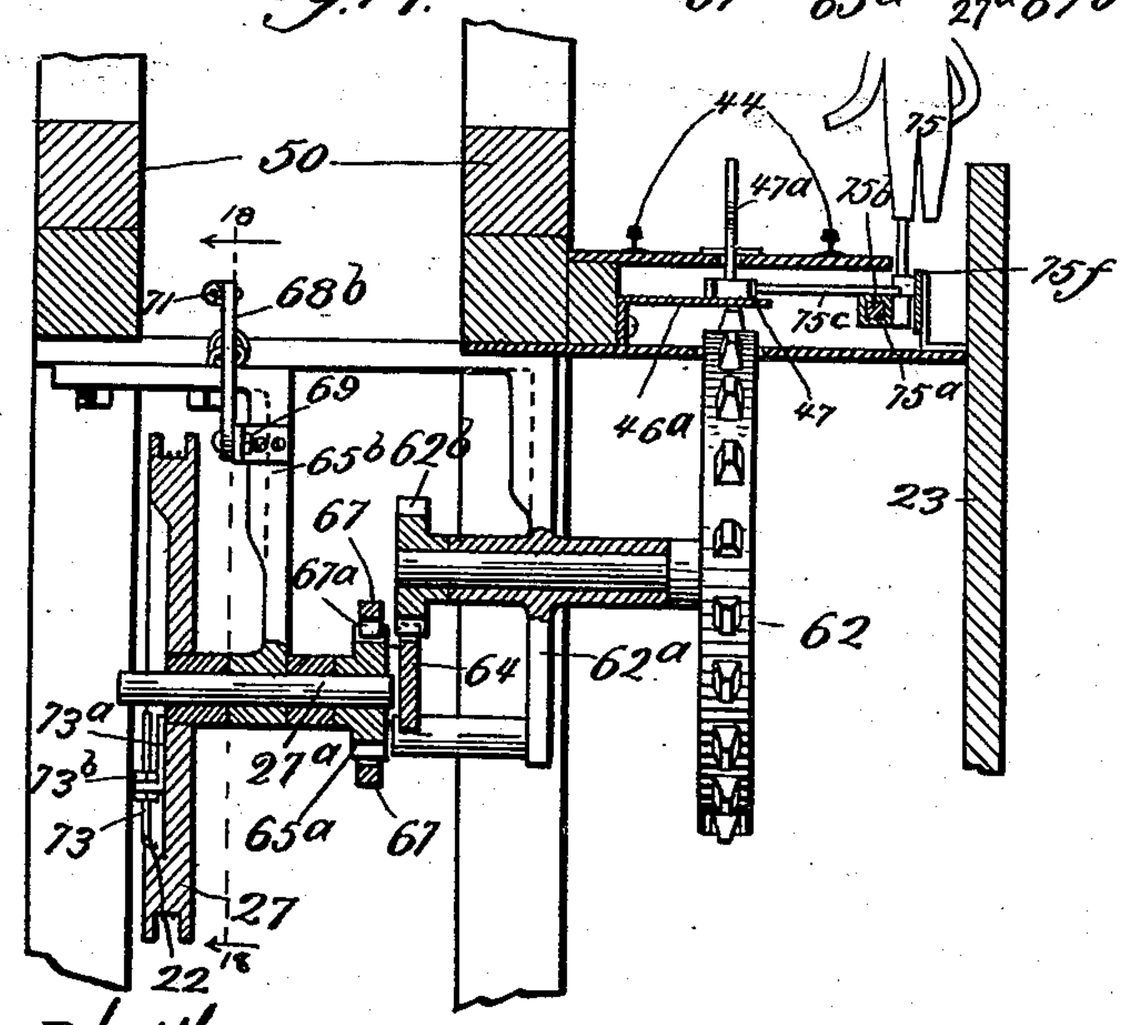

Fig. 18.

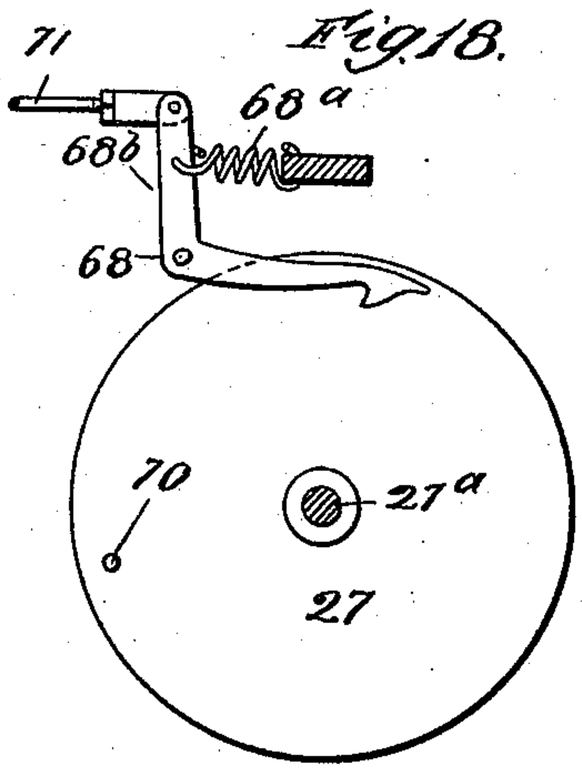

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Fig. 20.

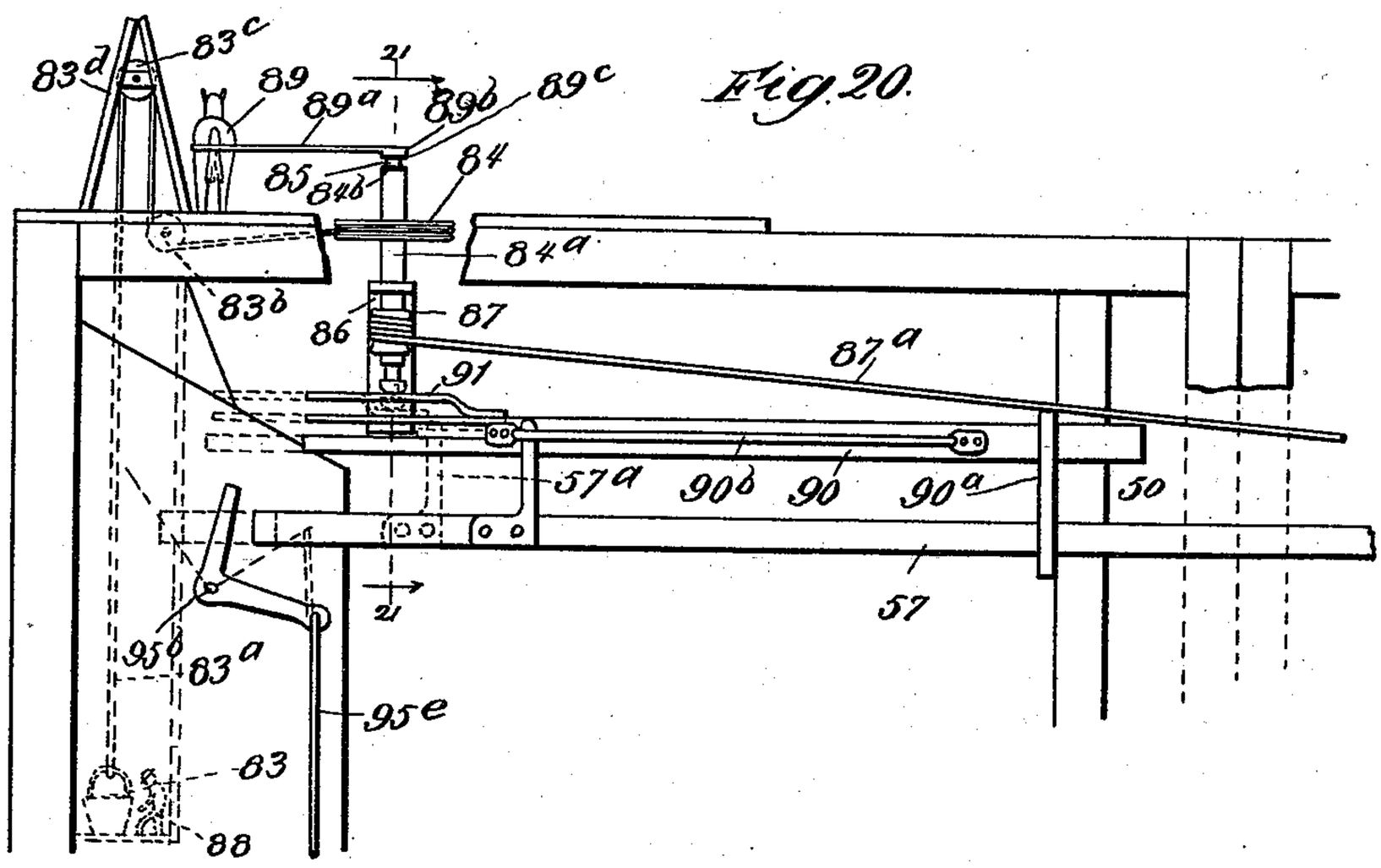


Fig. 21.

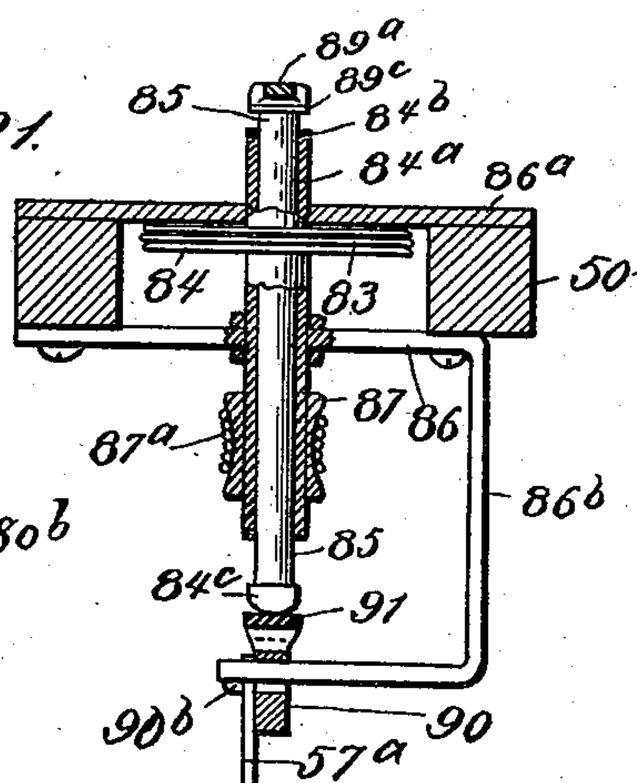


Fig. 22.

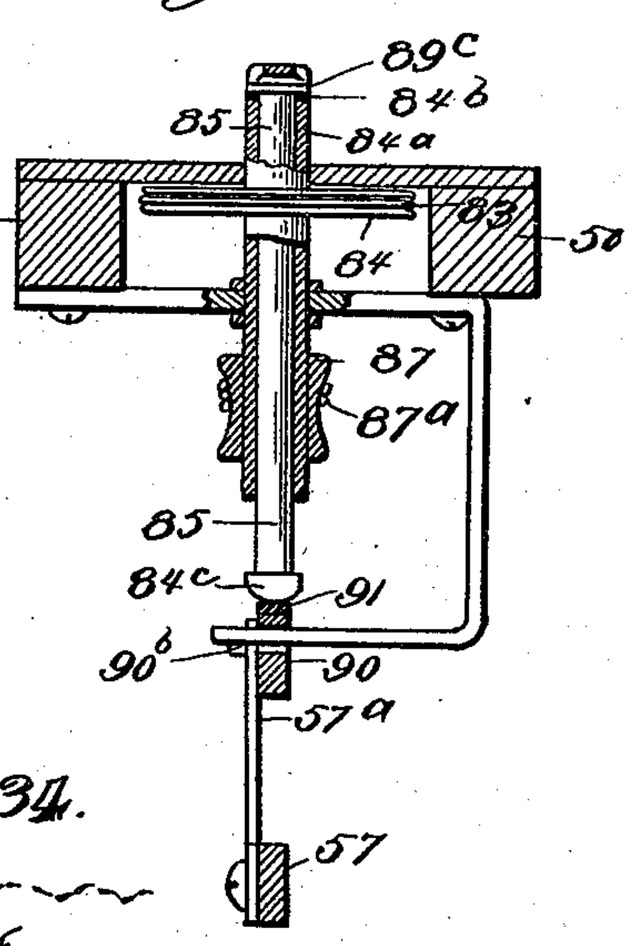


Fig. 33.

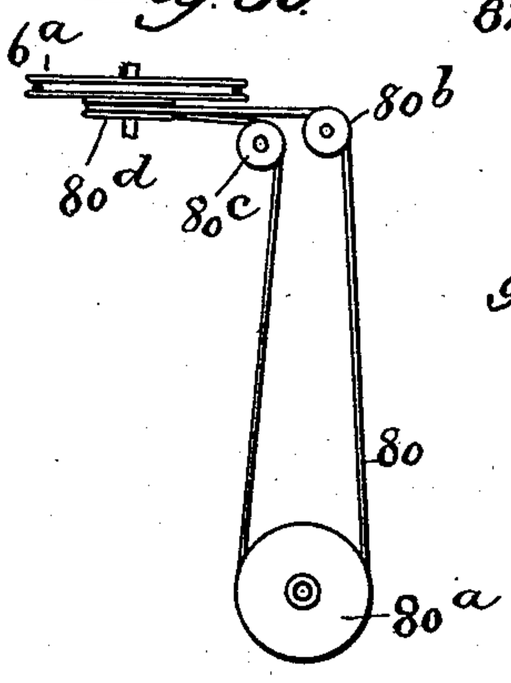
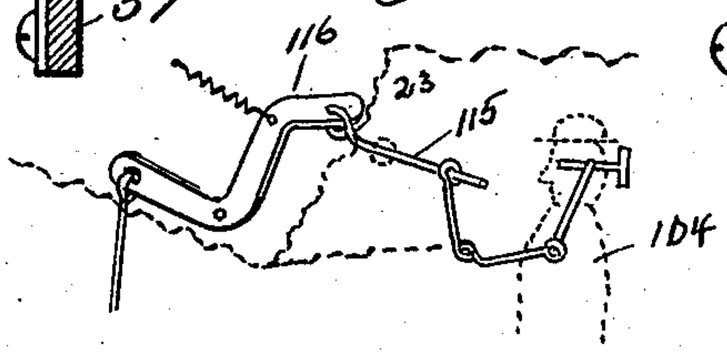


Fig. 34.



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By Louis K. Gillson
Atty

UNITED STATES PATENT OFFICE.

WILLIAM KEAST, OF CENTRAL CITY, COLORADO.

MECHANICAL SCENIC EXHIBIT.

SPECIFICATION forming part of Letters Patent No. 548,879, dated October 29, 1895.

Application filed November 10, 1893. Serial No. 490,601. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM KEAST, a citizen of the United States, residing at Central City, in the county of Gilpin and State of Colorado, have invented certain new and useful Improvements in Mechanical Exhibits; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

My invention relates to mechanical exhibits. Its object is to supply a mechanical scenic exhibit of a gold or silver mine in operation and the various methods employed in developing the mine and taking out the ore.

The invention consists of mechanism for showing the various operations performed in mining for gold or silver on a fissure-vein. The shafts, levels, and other excavations of such a mine are represented in a sectional model of a mountain. The miners and mining appliances are represented by working models, and mechanism is provided for communicating the necessary and appropriate motions to all of the moving parts.

The sectional representation of the mine consists of a vertical frame or wall, of wood or other material, having one of its surfaces covered with powdered rock to represent the rock through which the shafts are sunk. The various openings are shown by depressions in the face of the wall, and within these depressions are located the miners, cars, buckets, elevators, drills, and other appliances. Above the representation of the rock, in section, are located mechanical representations of the buildings and machinery used for handling and manipulating the ore. The mechanism for operating these figures is located upon the opposite or reverse side of the wall and will be described in detail. The extreme thickness of the entire structure is but a few inches.

In the accompanying drawings, Figures 1 and 1ª represent a front elevation of the exhibit. Figs. 2 and 2ª show a rear elevation of the exhibit. Fig. 3 is an enlarged view of a portion of the front elevation. Figs. 4 and 5 are vertical sections showing the shafts, being taken on the line 4 4 of Fig. 7. Fig. 6 is a plan section of one of the shafts taken on the line 6 6 of Fig. 5. Fig. 7 shows a portion of the rear elevation of the exhibit. Figs. 8 to 34 are details of the operating mechanism, Fig. 11 being taken on the line 11 11 of Fig. 8, Fig. 13 on the line 13 13 of Fig. 7, Fig. 17 on the line 17 17 of Fig. 15, and Fig. 18 on the line 18 18 of Fig. 17.

The models used in the device of the appliances employed in mining are merely for the purpose of representing these parts in form and general aspect, but do not, except in one or two instances, partake of the same construction in detail, nor do they actually perform the functions of the parts represented. For convenience, however, they are referred to by the names of the parts they represent.

Described in detail the drawings show at 1 1, Fig. 1 the sectional representation of the rock through which the fissure extends and within which the mine is being operated.

At 1ª are shown cross-sections of feeders or spurs, being small veins leading into the large one. The line 1ᵇ indicates the depth of the oxidation of the rock.

At 2 2 is shown the surface of the mountain, upon which are located the shaft-houses 3 4, the ore-bin 5ª, and powder-magazine 5, the ropeway-conveyer 6 for transporting the ore down the mountain side, the stamp-mill 7, and various other appurtenances hereinafter described.

Two shafts 8 9 are shown extending vertically downward from the shaft-houses 3 and 4, respectively. Levels are shown at 10 and 11, the shaft 9 extending below the latter, the shaft 8 being shown as not having reached the lower level, the intervening space being represented by the casing 8ª, Figs. 1 and 4, appearing on the surface as rock.

Two winzes are shown at 12 and 12ª. A whim-shaft is shown at 13.

At 14 14 are shown stulls in the levels 10 and 11, excavations in the form of stopes having been made above these levels, as shown at 15 15, and refuse rock having been piled up on the stulls, as shown at 16 16. Chutes 17 17 for the ore pass down through the waste rock 16, opening through the stulls 14 14, so that the cars 18 18 in the levels 10 11 may run

under them and be filled. The entrance to a cross-cut leading laterally from the level 11 is shown at 19.

Within the several shafts 8 9 13 are shown ladders 20 20 20, Figs. 1, 5, and 6, and in one of the chutes through the waste rock 16 is shown a ladder 17ª to enable the stopers to reach their work from the level 10.

An elevator car or cage 21 is shown in the shaft 8 for elevating the cars 18 and is suspended from a wire rope 22, which passes over sheaves 22ª 22ᵇ, Fig. 4, in the shaft-house 3 down to a drum behind the wall 23.

A bucket 24, Fig. 1, moves up and down in shaft 9, being carried by a wire rope 25, extending over the sheave 25ª, Fig. 5, in the shaft-house 4 and down over the sheave 25ᵇ to a drum 26, Fig. 2, behind the wall 23.

A pump 28 is located in the sump at the bottom of the shaft 9, discharging through the pipe 29 and a trough 29ª into a tank 30 half-way up the shaft. A pump 31 elevates the water from the tank 30 through the pipe 32 to the surface where it is discharged through a tube 31ª. Both pumps 28 and 31 are operated by the rod 33, which reaches directly to the lower pump, an offset 33ª leading to the upper one. This pump rod is actuated by a walking-beam 34, Fig. 5, pivoted to the framework at the top of the shaft and connected by a pitman 34ª with the crank-pin of a gear-wheel 35, which represents the crank-wheel of the model of the engine 35ª designed to drive the pumps. The gear-wheel 35 is driven by a belt 35ᵈ, leading from a pulley 35ᶜ, located behind the wall 23 and more fully described hereinafter, Figs. 2, 5, and 19.

At 35ᵉ and 35ᶠ are shown idler-pulleys for carrying the belt 35ᵈ to the most convenient positions for providing openings for it through the framework of the structure. The idler 35ᶠ is mounted upon the shaft of a gear-wheel 35ᵇ, which meshes with the gear 35 and represents a part of the machinery in the shaft-house 4.

The machinery for hoisting, pumping, and air-compression is not intended to be correctly represented, but is placed in the building merely to show that machinery is used in that situation.

It has not been deemed necessary to show or describe in detail the pumps 28 31, for the reason that they are of the ordinary form of Cornish pumps.

At 38 is shown a compressed-air pipe, Figs. 1 and 6, supposed to lead from a compressor (not represented) in the shaft-house 4 down to the shaft 9, through the level 11 to an air-drill 39, being operated by two men 40 below the end of the shaft 8, for the purpose of extending the shaft to the level. A second air-drill is represented at 41, Fig. 1, being apparently supplied by the pipe 42, leading from shaft-house 3, and supplied by an air-pump therein. (Not represented in the device.) The two representations of air-drills 39 41, Figs. 21, 27, and 32, are in fact mounted upon a spindle 43, which is driven by a belt running on a pulley 43ª on the spindle and leading from a pulley behind the wall 23, as hereinafter described. These representations of air-drills consist of short cylindrical blocks to show the general form of the drills, which serve as bearings for the spindle 43. The shaft 8 is shown as terminating above the level 11 and the two air-drills 39 41 are being operated to open connection between the two. The spindle 43 passes through a casing 8ª representing the intervening rock, and is therefore hidden from view throughout the greater part of its extent. The short portions of the spindle between the drill and the rock serve as representions of the drill-bit used with tools of the class represented.

The cars 18 18 run upon tracks 44, Figs. 4 and 8 located in the level 10 and upon the surface and leading in both directions in both instances from the shaft 8, also in the level 11, leading in one direction, but not shown, from the shaft 9. Upon these tracks the cars reciprocate, being moved by means of the sprocket-chains 45 46 47 48 49, whose construction and action are hereinafter more fully described, and which are driven, respectively, by the sprocket-wheels 60, 61, 62, 63, and 49ª and run over sprocket-sheaves 76 76, journaled in the frame 50, there being a pair of such sheaves to each chain, located one at each end of the travel of the cars 18 and directly under the track 44, upon which said cars run. The arrangement of these chains and sprocket-sheaves being the same in all instances I have deemed it necessary to show only one in detail, Fig. 8. Below the sprocket-chains and between their supporting-sheaves is located a shelf, as 46ª, Fig. 17, for supporting the chain and preventing it from sagging. These shelves are secured to the framework 50.

The mechanism for operating the various moving parts of the exhibit is carried upon the back surface of the wall 23 and by framework 50 of light beams, disposed as may be required for strength and to serve as bearings for the various shafts, &c. Power is applied by a belt 51, Fig. 7, leading from any desired source of power to a pulley 52, Figs. 2 and 7, mounted upon a shaft 52ª, journaled in uprights forming a part of the frame 50. For convenience this pulley and shaft are located at the lower right-hand corner of the wall 23. The shaft 52ª also carries a worm-gear 52ᵇ, which meshes with and drives a gear-wheel 53, lying in a plane parallel with the wall 23, and having mounted with it a small pinion 53ª, which meshes with a gear-wheel 54 of considerably-larger size, and which is provided with a crank-pin 54ª. A pitman 55 leads from the crank-pin 54ª, Figs. 2, 7, and 13, to one arm of a rocking lever 56, which is fulcrumed by a pivot-pin 56ª to a part of the frame 50 and reaches up to actuate the sprocket-chains 45 46, which move the cars 18 to and from the top of the shaft

8 and perform other functions hereinafter described. Motion is communicated to the sprocket-chains from the lever 56 through a horizontal slide-bar 57, carried by brackets 58 59, secured to the frame 50. The attachment of the lever 56 to the bar 57 is by means of a pin 57^a, set in the bar and engaging a longitudinal slot 56^b in the lever, so that the lever may pass through the arc of its movement without communicating angular motion to the bar. The brackets 58 59 also carry, respectively, the sprocket-wheels 60 61, which mesh with the chains 45 and 46. The hub of each of the wheels 60 61 carries a pinion 60^a 61^a, which meshes with the racks 57^b 57^c on the bar 57. The relative sizes of the gear-wheels 60 and 61 and of their respective pinions 60^a 61^a and the length of the racks 57^b 57^c are such that the movement of each rack through their entire length in contact with the pinion moves the car 18 exactly the length of its track, and the two racks are so disposed upon the bar 57 that the movement of one car from the shaft commences just before the movement of the other one to it ceases. Cars 18 on the level 10 are moved to and from the shaft 8 in the same manner by sprocket-chains 47 48, actuated by sprocket-wheels 62 63, respectively. These sprocket-wheels are journaled in brackets 62^a 63^a, secured to the framework 50, Figs. 2, 7, and 17. The shafts of the wheels 62 63 also carry pinions 62^b 63^b, which mesh with racks 64^a 64^b upon a slide-bar 64, carried by the brackets 62^a 63^a. The length of the racks 64^a 64^b and their disposition upon the bar 64 are such that the wheels 62 63 are actuated intermittently and relatively to each other in such manner that the removal of one car 18 from the shaft commences just before the other car is delivered to it. The slide-bar 64 is driven by a pitman 65, attached to a crank-pin 66^a on a pinion 66, Figs. 2, 7, and 13, which meshes with and is driven by the gear-wheel 54.

The drum 27, Figs. 2, 14 to 18, for carrying the cage 21 is mounted upon a shaft 27^a, journaled in a hanger 65^b, secured to the frame 50. The drum is of such size that it makes exactly two revolutions in raising the cage 21. It is actuated by a form of mangle-rack 67, carried by the slide-bar 64. This mangle-rack comprises a rectangular frame 67, having racks 67^a and 67^b upon the inner surfaces of its top and bottom sides, respectively. These racks are near opposite ends of the frame 67 and each extends less than half the length of the frame. The parts are so disposed that a pinion 65^a, mounted upon the shaft 27^a, lies within the frame 67 and is adapted to engage both racks 67^a 67^b. Each of these racks has twice as many teeth as the pinion, so that in moving its full length in engagement with the pinion each causes the two revolutions of the drum 27 necessary to raise or lower the cage 21. When the bar 64 has reached either of the limits of its movement, the cage 21 is at the top of the shaft 8 and the pinion 65^a is at one end of the rack-frame 67. As the bar 64 starts upon its next movement, the rack (either 67^a or 67^b) with which the pinion 65^a is engaged allows the cage 21 to slowly descend. It reaches the lower limit of its travel at the level 10 when the pinion 65^a is at the end of the rack. The bar 64 continuing to move in the same direction, the pinion 65^a comes into engagement with the rack upon the opposite side of the frame 67 and the drum 27 is rotated in the opposite direction, so as to again elevate the cage 21, the latter reaching the upper limit of its movement just after the pinion 65^a becomes disengaged at the farther end of the rack.

It is necessary that the cage 21 remain at rest between each trip long enough for the transfer of the cars 18. This period of inactivity is provided for when the cage is up by extending the frame 67 a little beyond the rack, so that the pinion 65^a passes out of engagement with the rack. It is provided for when the cage is down by spacing the adjacent ends of the racks 67^a 67^b apart, so that the pinion 65^a is disengaged from the one before engagement with the other. The pinion 65^a being disengaged from the rack when the cage 21 is up and suspended by the cord 22, it is necessary that means be provided for preventing its fall until, the motion of the bar 64 having been reversed, the rack again engages the pinion. This is accomplished by means of the latch-hook 68, pivoted to a bracket 69 secured to the hanger 65^b, and having a laterally-projecting arm 68^b, which is connected to a portion of the frame 50 by a spring 68^a in such manner that the hook is held normally in position for engagement with a pin 70, fixed in the side of the drum 27. The nose of the hook 68 is formed to act as a cam, so that the contact with it of the pin 70 will force it back to allow the pin to pass. The position of the hook is such that the pin 70 passes it just as the cage 21 reaches the limit of its upward movement.

In order to release the pin 70 from the latch-hook 68 to allow the cage 21 to descend, a rod 71 is pivotally connected to its arm 68^b and to one arm of a bell-crank 71^a, pivoted to a portion of the frame 50 in such position as to be engaged by pins 71^b, set in the side of the gear-wheel 66, Figs. 12 and 13, whereby the arm 68^b of the latch-hook 68 is drawn back against the resistance of the spring 68^a.

It will be seen that when the cage 21 is descending the rotation of the drum 27 will tend to bring the pin 70 directly into engagement with the hook 68, and it is necessary that the hook be drawn back to allow the pin to pass. For this purpose two or more pins 71^b are set in the side of the wheel 66 in such position as to insure the withdrawal of the hook at the proper moment.

For the purpose of preventing the cage 21 from dropping between the disengagement of the rack 67^a or 67^b from the pinion 65^a and

the engagement of the hook 68 with the pin 70, and for other purposes hereinafter explained, a bell-crank lever 72, Figs. 2 and 14, is used. This lever is pivoted at its angle to a hanger 72^a, attached to the frame 50 in such position as to swing at the side of the drum 27 opposite to the side supporting the pin 70, and a pin 72^b is set in the side of the drum to co-operate with it. The lever 72 is normally held back from engagement with the pin 72^b by a spring 72^i, connecting it with a portion of the frame 50. A rod 72^c is pivotally connected with the lateral arm of the lever 72 and to one arm of a bell-crank 72^e, pivoted to the frame 50 in such position that its other arm engages pins 72^g, set in the side of the wheel 66 opposite to the pins 71^b. The pressure of the pins 72^g against the bell-crank 72^e draws the lever 72 down across the path of the pin 72^b. The relative position of the pins 70 and 72^b and the adjustment of the various parts co-operating with them, as already described, are such that the lever 72 is drawn down behind the pin 72^b by the action of one of the pins 72^g as the cage 21 approaches the limit of its upward movement and insures the forward movement of the drum 27 to a point where the hook 68 will certainly drop behind the pin 70. This provision admits of the racks 67^a and 67^b being made short enough to become disengaged from the pinion 65^a before the cage 21 has quite reached the limit of its movement. Just before the hook 68 is released from engagement with the pin 70 to allow the cage 21 to descend the lever 72 is again brought down against the pin 72^b and slowly withdrawn, the pin following it. This action takes place as the motion of the bar 64 is reversed, and the pinion 65^a comes again into engagement with the rack before the pin 72^b is freed from contact with the arm 72. This is accomplished by means of a cam-lever 72^f, pivoted to the frame 50 and co-operating with studs 72^h 72^h, set in the side of the gear-wheel 54 and pivotally connected with the lateral arm of the lever 72 by means of the rod 72^d, the face of the cam 72^f being so formed as to secure the desired action of the lever 72 and the studs 72^h being so placed as to properly time this action. This mechanism also controls the adjustment of the pinion 65^a to the racks and prevents undue wear of the teeth of the latter.

The length of the rope 22 is accurately adjusted by passing its end through the side of the drum 27 and attaching it to a screw-bolt 73, which is screwed into a suitable socket in a plate 73^a, secured to the drum 27. A nut 73^b, turned up on this bolt against the plate 73^a, affords means for adjusting the length of the rope.

One of the terminals of travel of the cars 18, co-operating with the elevator-cage 21, is at the cage itself, a section of the track 44 being laid thereon, Figs. 4 and 8. The sprocket-gear is timed to stop as the car takes its place upon the cage. The means of attachment of the cars to the sprocket-chains 45, 46, 47, and 48 is such that the ascent and descent of the cage 21 makes and breaks it. An eye 18^a, Fig. 8, projects from the end of the car. The chains 45 46 each carries a downwardly-opening hook 45^a for engaging the eye 18^a. The chains 47 48 each carries an upwardly-opening hook 47^a for the same purpose. When the cage starts, either descending or ascending, the car 18 is disengaged from the hook 45^a or 47^a, and the sprocket-chain carrying the hook thus left does not again move until a car returns and is attached to it by the engagement of the eye 18^a with its hook.

A figure 75, Figs. 1 and 8, representing a man attends each car 18 as it recedes from and returns to the shaft 8. These figures represent the men who in practice push the cars. In this exhibit they are each carried by a block 75^a, adapted to slide upon a bar 75^b, located beside and parallel with the track 44. This block 75^a is moved on the bar by means of a finger 75^c, carried by the sprocket-chain and projecting laterally therefrom, so as to engage upwardly-projecting lugs 75^d 75^d, carried by the block 75^a. The lugs 75^d are spaced apart, so that the man is not caused to move until the car has passed him, when he immediately follows it. The man 75 is pivotally mounted upon the block 75^a and an arm 75^e projects laterally from his pivot-pin. A cam 75^f is fixed beside the bar 75^b in such position as to engage the arm 75^e at the commencement of the movement of the block 75^a and swing it outwardly, causing the man to face about. This cam 75^f is in the form of a strip of sheet metal standing on edge parallel with the bar 75^b and having its ends bent inwardly toward that bar. The strip 75^f, being continuous, serves to steady the man 75 and prevent him from being turned by the jar of the machinery. It is alike at both ends, so that when moving in either direction the car is followed by the man, who turns about face at the commencement of his movement. Stop-pins 75^g 75^g are set one upon each side of the pivot-pin of the figure 75 to limit the throw of the arm 75^e. Their position is such that the end of the arm 75^e is normally outside of the end of the cam 75^f. As the arm 75^e passes the cam 75^f after the figure 75 has been turned, the cam and the arm both yield a little, resuming their normal position as they become disengaged. This mechanism for showing the car as being attended by a man is repeated in connection with the car moving to and from the shaft 9 in the level 11 and, being in all respects the same as that used in connection with the shaft 8, is not shown or described, except to show the figure of the man 18^a, Fig. 1.

The drum 26, Fig 2, carrying the bucket 24, which plays in the shaft 9, is mounted upon a shaft journaled in a bracket 26^a, attached to the frame 50. Upon the same shaft is mounted a pinion 26^b, meshing with a rack 76, reciprocating in suitable guideways carried by the frame 50 and being actuated by

a rocking lever 77, fulcrumed upon the frame 50 and pivoted to the slide-bar 64, its pivotal attachment thereto being by means of a pin in the bar 64 and a longitudinal slot in the lever 77. The rack-bar 76 is jointed, as shown at 76ª, to allow of the flexure incident to the curved path of the end of the rocking-lever 77.

The movements of the bucket 24 succeed each other regularly, only such time being allowed between them as would suffice for the filling and dumping of the bucket. The parts are so adjusted that a complete rotation of the wheel 66 causes a cycle of the bucket 24, which is at the limits of its travel when the crank-pin 66ª is on the centers. The passage of these centers affords the necessary time between the movements of the bucket. The rack 76 also drives the sprocket-wheel 49ª, a pinion 49ᵇ being mounted upon the shaft of the sprocket-wheel, so as to mesh with the rack.

The air-drills 39 41, Fig. 1, are actuated by a belt 78 running from the cone-pulley 82, mounted on the shaft of the pinions 53 53ª, Fig. 13, this belt being turned over sheaves 78ª, carried by the wall 23 and passed through an aperture in said wall, so as to drive a pulley 43ª, mounted upon the spindle 43 of the air-drills. This pulley 43ª is hid from view by the representation of the rock separating the shaft 8 from the level 11 and indicated at 8ª in Fig. 1.

At 79 is shown a belt leading from a pulley 79ª, behind the wall 23, to a drum 79ᵇ, Fig. 4, representing the drum for operating the elevator-cage 21 in actual practice. This drum performs no function in connection with the other parts in the exhibit, except to drive the piston-rod 79ᶜ, which is connected to the shaft of the drum by a crank and with the cylinder 79ᵈ, into which it plays, representing the engine for running the elevator-cage.

The ropeway 6 for conveying buckets of ore down the mountain side to the stamp-mill 7 consists of an endless cable running upon sheaves 6ª 6ᵇ 6ᶜ 6ᵈ, supported upon scaffolding 6ᵉ 6ᶠ 6ᵍ and supporting buckets 6ʰ 6ⁱ 6ᵏ, Figs. 1 and 2. The ropeway 6 is driven by a belt 80, Figs. 2ª and 33, running from a pulley 80ª behind the wall 23 to a pulley 80ᵈ within the scaffolding 6ᵉ, and being turned over sheaves 80ᵇ 80ᶜ.

The stamp-mill 7 is shown, Figs. 2ª and 27, as containing batteries of stamps 7ª, operated by a belt 81, leading from the cone-pulley 82. The belt 81 drives a representation of a water-wheel 7ᵇ, mounted in the frame of the stamp-mill 7, and which turns the cam-shaft actuating the pestles of the batteries 7ª. The mechanism of the stamp-mill being the same in miniature as that used in actual practice it is not shown in detail, except as in Fig. 27.

A bucket 83, Figs. 1 and 20, is carried up and down in the whim-shaft 13 by means of a rope 83ª, turned over a sheave 83ᶜ, hung from the crotch of a tripod 83ᵈ and carried under a sheave 83ᵇ at the top of the shaft and wound upon a drum 84, carried by a sleeve 84ª, mounted upon the vertical spindle 85, for which it furnishes a journal-bearing. The sleeve 84ª is journaled in plates 86 86ª, secured to portions of the frame 50, and has no vertical movement. This sleeve also carries a drum 87, upon which is wound a rope 87ª, leading from the slide-bar 57, so that the reciprocation of this bar unwinds the rope from the drum, thereby drawing up the bucket by winding the rope 83ª upon its drum. The relative sizes of the drums 84 and 87 are such that the bucket is raised out of the shaft by a part only of the movement of bar 57, so that after it has been lowered to the bottom of the shaft and the rotary motion of the drum ceases the rope 87ª slackens and remains loose until the bar 57 has reached the same point on its return stroke. While the rope is thus slackened, the bucket is of course at the bottom of the shaft and the man 88 is supposed to fill it with a shovel.

The whim is represented as being operated by horse-power, and the horse 89 is represented as moving only while the bucket is coming up and as standing still while it is being lowered and filled. This action is secured in the following manner: The horse is attached to a crank-beam 89ª, which is secured to the head 89ᵇ of the spindle 85. This spindle has some vertical play, so that the head 89ᵇ may rest upon the upper end of the sleeve 84ª, or it may be raised above it. The contact-surfaces of the head 89ᵇ and the sleeve 84ª are armed with friction-plates 89ᶜ and 84ᵇ, pieces of sandpaper being used for that purpose. When these plates are in contact, as shown in Fig. 22, the rotation of the sleeve 84ª causes the horse to revolve. The foot-piece 84ᶜ of the spindle 85 rests upon a slide-bar 90, located parallel with and directly above the slide-bar 57, which is supported at one end by a guide-loop 90ª, attached to the frame 50, and at the other end by a hanger 86ᵇ, formed by extending the plate 86. A rod 91 is attached to the upper edge of the bar 90 and has an offset near its point of attachment, so as to raise it from the bar, the rod, however, extending parallel with the bar from this offset. A cam is thus formed whereby the spindle 85 may be raised. This bar 90 is provided with stops formed by attaching the loop 90ᵇ to its side. A lateral finger 57ª projects upwardly from the bar 57 through the loop 90ᵇ, within which it freely moves as the bar 57 travels. The length of the loop 90ᵇ is such that the finger 57ª reaches one of its ends just before the bar 57 reaches the limit of its movement in either direction. As the bar 57 approaches the spindle 85, it moves the cam 91 from under it, so that the spindle falls and its friction-plate comes in contact with that at the top of the sleeve 84ª. The horse 89 is now so connected with the mechanism for elevating the bucket 83 that as the rope 87ª is drawn taut and unwound from the drum 87 by the return movement of the bar 57 it is caused to revolve about the spin-

dle. Just before the bucket reaches the top of the shaft the finger 57ª reaches the end of the loop 90ᵇ and the cam 91 is drawn under the spindle 85, raising it and stopping the horse, which remains disconnected from the bucket-elevating mechanism until the bar 57 again approaches the opposite limit of its movement, when the cam 91 is moved from under the spindle 85, as before, and the operation is repeated.

A bucket 92, Figs. 1 and 28, is operated in the winze 12 by means of a cord 92ª running over and around a windlass 93 at the top of the winze and leading through an aperture in the wall 23 to the upper end of the lever 77 to which it is attached, Figs. 2 and 7. The movement of the lever raises the bucket and allows it to fall. Two men 94 94 are shown as appearing to operate the windlass 93 by its handles. These men are jointed at the hips and shoulders, Fig. 29, so that the rotation of the windlass by the action of the cord 92ª causes them to move in simulation of the action of men in turning a crank. The bucket 92 is at rest both at the top and bottom of the winze as the crank-pin to which the pitman 65 is attached is passing the centers, thus representing the delay incident to the emptying and filling of the bucket.

Figures of men appear at various places on the front of the wall 23 and in connection with the shaft-houses 3 4. Most of these figures are jointed and connected with the mechanism behind the wall 23 in such manner as to represent the various occupations of miners.

At 75 75 are represented men for pushing the cars 18 to and from the shaft 8 in the level 10. At 102 102 are represented men for pushing these cars to and from the shaft 8 at the surface, these cars going in one direction to the ore-bin 5ª and in the other to a refuse-dump 5ᵇ.

At 18ª is represented a man co-operating with the car 18 in the level 11. The men 18ª and 102 are mounted and operated the same as the men 75 already described.

At 3ª is a fixed figure of a man in shaft 3, (shown as a blacksmith,) and at 4ª is a fixed figure of a fireman seeming to be at work about the furnace in the shaft-house 4.

At 103 103ª 103ᵇ, Figs. 1 and 3, are shown men using shovels, in connection with the chutes 17; at 92ᵇ, a man shoveling, in connection with the bucket 92.

At 104, 104ª, 104ᵇ, 104ᶜ, and 104ᵈ are represented men working with drills in overhead stoping.

At 106 is shown a party of men, represented as in the act of examining samples of rock.

At 105 105ª are shown men engaged in using picks.

Various other figures are represented in different parts of the mine engaged in the same occupations as those already enumerated, but are not shown or described in detail.

In Figs. 1 and 1ª are shown representations of trees, mountains, and a cabin. In the exhibit these are merely painted upon canvas hung back of the mechanical portions and form simply an ornamental part of the device.

The shoveling, pick, drill, and windlass men are jointed, as shown in Fig. 29, and are each (with the exception of the windlass-men 94) attached to a spindle, as 107, Figs. 30 and 31, which passes through and is journaled in the wall 23. This spindle passes through the body of the figure at the shoulders and is bent laterally to form one of the arms and terminates at the handle of the tool. The other arm is formed by running a piece of wire from the spindle to the tool at the opposite side of the body. In the case of the men using shovels 103 103ª 103ᵇ the spindle is bent to form a crank-arm after passing through the wall and before entering the body of the figure, that portion which passes through the figure being, in fact, the crank-pin, so that the rotation of the spindle causes flexure of the body at the hips. These spindles 107 have at their inner ends, behind the wall 23, crank-arms 108, which are linked by the rods 110 to bell-cranks 109, Figs. 23 and 24, which are pivotally attached at their angles to the wall 23 and in some instances to slide-bars 111, carried in guide-loops 111ª, Figs. 25 and 26, attached to the wall 23, and having lateral arms 111ᵇ. The free ends of the bell-cranks 109 and the lateral arms 111ᵇ of the bars 111 are adapted to be engaged and depressed by cams 112 113, respectively, carried by and rotating with the shafts 96, 97, 98, 99, 100, and 101. Springs, as 114, connect the crank-arms 108 with the wall 23 in such manner as to resist the action of the cams 112 113. The cams 112 co-operate with figures representing shovelers whose motions are comparatively slow and regular. The cam is therefore so formed as to gradually depress the bell-crank 109 and as gradually release it. The depression of the bell-crank causes the figures to execute the movement of raising the shovel. The raising of the bell-crank by the action of the spring 114 simulates the movement of lowering the shovel. The interval between two engagements of the cam with the bell-crank represents the time occupied in filling the shovel. The form of the cam is such that the bell-crank is not immediately released from depression, the figure remaining at rest long enough to represent the time consumed in emptying the shovel. The bar 111 and cam 113 co-operate with figures representing the men 104, &c., engaged in hand drilling. These men strike short blows in rapid succession. The action is slow as the hammer is drawn back and quick as the blow is struck. The cam is made with three arms, that the action may be more rapid than that of the shovelers, who are actuated from the same shaft. The arms of the cam 113 are substantially of the same form as that of the cam 112, but directed oppositely. Bearing down upon the lateral arm of the bar 111 by their curved surfaces they depress it gradually. Leaving it ab-

ruptly as their ends pass it, the springs cause a quick return to the normal position.

At 88 is shown a man filling the bucket in the whim-shaft 13 with a shovel. This man is in action only when the bucket is at the bottom of the shaft. The crank for actuating him is shown at 88^a, Fig. 2^a, and is linked to a bell-crank 88^b, which in turn is linked to a bell-crank 88^c, one arm of which is normally held to a rotating cam 88^d by the action of a spring 88^e. The form of the cam 88^d is the same as that of the cam 112, (shown in Fig. 24 and already described,) the bell-crank 88^c being slowly depressed and released. The suspension of work by this figure is accomplished by fixing a button 95 upon the link connecting the bell-cranks 88^b and 88^c and locating a spring-actuated lever 95^a so that it will bear down upon the button and force the bell-crank 88^c away from contact with the cam 88^d. This lever 95^a is pivoted at one end to the wall 23, and the spring 95^b, which controls it, is of greater tension than the spring 88^e, which tends to hold the bell-crank 88^c to the cam. A connecting-rod 95^c leads from the lever 95^a to one arm of a bell-crank 95^d, which is pivoted to the wall 23 in such position that its other arm is in the path of the slide-bar 57 and adapted to be struck by its end and forced back as the bar reaches the last part of its travel and held back until the bar again recedes. This action of the bell-crank 95^d lifts the lever 95^a from the button 95 and allows the bell-crank 88^c to come into play with the cam 88^d.

As already described, when the bar 57 is in that part of its travel the bucket is at the bottom of the shaft. The adjustment of the parts is such that the bell-crank 95^d is released from contact with the bar 57 before the rope 87^a is drawn taut, so as to commence to elevate the bucket, giving the man time to signal for the bucket to be hoisted.

The hand-drill men 104, &c., use their arms independently. The action of the hammer-arm has been already described. The other arm is jointed at the elbow and is secured to the drill, which seems to enter a hole in the rock, but which, in fact, is a thrust-rod 115, passing through the wall 23 and pivotally secured to one arm of a bell-crank 116, pivoted at the back of the wall 23 and co-operating with a cam similar to the cam 113 and having a spring for resisting the cam. The motion communicated to the drill 115 and arm holding it simulates the action of the operator in slightly withdrawing the drill to turn it between blows of the hammer. The action of the two arms is so timed that they move alternately.

I have not endeavored to represent minutely the construction of each figure and its particular operating mechanism, for the reason that these figures may be varied in number and position, as desired.

The shafts 96 to 101 are driven from a main shaft 117, journaled in the frame 50 and driven by a belt 118, leading from the cone-pulley 82.

I claim as my invention—

1. In the mechanical exhibit of a gold or silver mine the combination with a wall representing a vertical section of the mine through its shafts, as 8 and 9, and levels, as 10 and 11, and a portion of the surface, an elevator cage 21, adapted to reciprocate in the shaft 8, between the surface and the level 10, tracks 44, extending in each direction from the shaft on the floor of the level 10, and on the surface, a section of said track being laid across the floor of the cage 21, and with cars adapted to run on said tracks, with a rope for suspending the cage 21, a drum 27, on which the rope is adapted to be wound and sheaves, as 22^a, 22^b, for carrying the rope, a pinion 27^a, on the drum shaft and a reciprocating mangle rack 67, for engaging the pinion, whereby the cage 21, is caused to ascend and descend at regular intervals, substantially as described and for the purpose specified.

2. In the mechanical exhibit of a gold or silver mine the combination with a wall representing a vertical section of the mine through its shafts, as 8, 9, and levels as 10, 11, and representing also a portion of the surface, of an elevator cage 21, adapted to reciprocate in the shaft 8, tracks 44, on the floor of the cage and extending in two directions from the shaft both at the surface and on the floor of the level 10, cars 18, adapted to run on the tracks and being transferable by the cage 21, to and from the tracks at the surface and in the level, eyelets 18^a projecting from the ends of the cars, hooks 45^a, and 47^a, for engaging such eyelets as the car approaches the top or bottom of the shaft respectively, sprocket chains for carrying the hooks and adapted to run below the tracks 44, sprocket wheels for driving the chains, pinions mounted with the sprocket wheels and reciprocating rack bars for driving the pinions, whereby the cars are drawn away from and returned to the shaft, substantially as described and for the purpose specified.

3. In the mechanical exhibit of a gold or silver mine the combination with a wall representing a vertical section of the mine through its shafts, as 8, 9, and levels as 10, 11, and representing also a portion of the surface, of an elevator cage 21, adapted to reciprocate in the shaft 8, a rope for suspending the cage, a drum 27, upon which the rope is wound for raising the cage, rack and pinion mechanism for intermittently rotating the drum to raise and lower the cage, tracks 44, on the floor of the cage and extending in two directions from the shaft both at the surface and on the floor of the level 10, cars 18, adapted to run on the tracks and being transferable by the cage 21, to and from the tracks at the surface and in

the level, eyelets 18ª, projecting from the ends of the cars, hooks 45ª, and 47ª, for engaging such eyelets as the car approaches the top or bottom of the shaft respectively, sprocket chains for carrying the hooks and adapted to run below the tracks 44, sprocket wheels for driving the chains, pinions mounted with the sprocket wheels and reciprocating rack bars for driving the pinions, whereby the cars are drawn away from and returned to the shaft, the several racks for moving the cars and the rack for actuating the elevator cage being so timed in their movements that a car is withdrawn from the cage and carried in one direction and another car moved upon the cage from the opposite direction during each interval of rest of the cage, substantially as described and for the purpose specified.

4. In the mechanical exhibit of a gold or silver mine the combination with a wall representing a vertical section of a mine through its shafts and levels, an elevator cage 21, adapted to reciprocate in one of the shafts, a rope for carrying the cage, sheaves at the top of the wall for carrying the rope over the same, a drum behind the wall upon which the rope is adapted to be wound and a pinion carried upon the shaft of the drum, of a reciprocating mangle rack for actuating the pinion, said rack comprising a frame for inclosing the pinion and having racks 67ª, 67ᵇ, upon opposite sides and near opposite ends whereby the drum is caused to rotate alternately in opposite directions, said racks being so disposed that the pinion is free from both after each engagement whereby the cage is caused to remain inactive a short period at each terminal stop, substantially as described.

5. In the mechanical exhibit of a gold or silver mine the combination with a wall representing a vertical section of the mine through its shafts and levels, an elevator cage 21, for reciprocating in one of the shafts, a rope for supporting the cage, sheaves for carrying the rope, a drum upon which the rope is adapted to be wound for raising the cage, a pinion on the shaft of the drum, and a reciprocating mangle rack for engaging the pinion whereby the drum is rotated alternately in opposite directions, said rack being so arranged that the pinion is out of mesh therewith after each action, of a pin 70, set in the side of the drum, a hook 68, for engaging the pin and holding the drum from being rotated by the weight of the bucket when the pinion is out of engagement with the rack, a spring for holding the hook in the path of the pin, and means for disengaging the hook from the pin to allow the cage to descend, substantially as described.

6. In the mechanical exhibit of a gold or silver mine the combination with a wall representing a vertical section of the mine through its shafts and levels, an elevator cage adapted to reciprocate in one of the shafts, a rope for carrying the cage, a drum upon which the rope is wound, rack and pinion gear for driving the drum the rack being adapted to disengage the pinion as the cage approaches the top of the shaft, of a bell crank lever 72, for carrying the drum to the end of its movement, a pin in the side of the drum for engaging the lever, cam mechanism for thus actuating the lever, cam mechanism for holding the lever in receding contact with the pin as the cage commences to descend, a hook for supporting the cage at the top of the shaft, a pin in the drum for engaging the hook, and cam mechanism for releasing the hook and holding it out of contact with the pin while the cage descends, substantially as described.

7. The combination with a reciprocating bar 57, a windlass 84ª, a cable leading from the windlass drum to the bar, and a weighted cable wound oppositely upon the windlass, of a longitudinally movable vertical spindle passing through the drum as a loose shaft, a crank arm or sweep mounted upon the upper end of the spindle, a figure of a horse attached to the outer end of the sweep, a clutch for locking the spindle and windlass together, and a cam connected with the bar 57, and adapted to support and vary the elevation of the spindle and thereby engage and release the clutch, the action of the cam being so timed that the spindle is locked to the drum only while the weight is rising, substantially as described and for the purpose specified.

8. In a mechanical representation of a gold or silver mine the combination with a wall representing a vertical section of the mine through its shafts, of a bucket adapted to reciprocate in a whim shaft, a rope 83ª, for carrying the same, sheaves over which the rope runs, a drum 84, upon which the rope is adapted to be wound mounted upon a vertical shaft 84ª, a second drum 87, mounted on the same shaft, a rope 87ª, adapted to be wound upon the drum 87, a reciprocating bar 57, to which the rope 87ª, is attached, the parts being so adjusted that the rope 83ª, is wound upon the drum 84, as the rope 87ª, is unwound from the drum 87, a vertically adjustable post passing longitudinally through the shaft 84ª, a crank beam 89ª, secured to the top of the post, a figure representing a horse attached to the crank beam, and means for locking the shaft 84ª, and the post together so that the horse is caused to revolve around the post, such locking mechanism being so timed that the horse is in motion only while the bucket is being elevated, substantially as described and for the purpose specified.

9. In the mechanical representation of a gold or silver mine the combination with a wall representing a vertical section of the mine through its shafts, of a bucket adapted to reciprocate in a whim shaft, a rope 83ª, for carrying the same, sheaves over which the rope runs, a drum 84, upon which the rope is

adapted to be wound, mounted upon a vertical shaft 84ª, a second drum 87, on the same shaft, a rope 87ª, adapted to be wound upon the drum 87, a reciprocating bar 57, to which the rope 87ª, is attached, the parts being so adjusted that the rope 83ª, is wound upon the drum 84, as the rope 87ª, is unwound from the drum 87, a vertically adjustable post passing longitudinally through the shaft 84ª, a crank beam 89ª, secured to the top of the post, a sliding cam for supporting and imparting vertical motion to the post, friction pads on the shaft and post adapted for contact when the post is lowered, connection between the bar 57, and the cam whereby the post is lowered and the horse caused to revolve as the bucket is raised, and the post is elevated and the horse is stationary at all other times, substantially as described and for the purpose specified.

10. In the mechanical representation of a gold or silver mine the combination with a wall representing a vertical section of the mine through its shafts, of a bucket adapted to reciprocate in a whim shaft, a reciprocating bar for actuating the bucket, rope connection between the bucket and the bar, a jointed figure of a man located at the bottom of the shaft and adapted to move in simulation of the act of shoveling, a spindle extending through the wall and having a crank arm and a crank pin extending through the figure, a crank for the spindle at the opposite side of the wall, a rod or link leading from such crank arm to a bell-crank, a rotating cam for rocking the bell-crank and thereby imparting motion to the figure, a spring for holding the bell-crank to the cam, a more powerful spring for throwing the bell-crank out of contact with the cam, and mechanical connection between the reciprocating bar and the stronger spring whereby such spring is thrown out of action while the bucket is at the bottom of the whim shaft, substantially as described.

11. In a mechanical representation of a gold or silver mine the combination with a wall representing a vertical section of the mine through its shafts and galleries, of a jointed figure representing a man in the act of shoveling and located within the galleries of the mine, a spindle extending through the wall and having crank arms at each end, a crank pin extending from one crank arm through the body of the figure, a link or rod connecting the other crank arm with a bell crank, a rotating cam adapted to rock the bell-crank and a spring for holding the bell-crank to the face of the cam, substantially as described and for the purpose specified.

12. In a mechanical representation of a gold or silver mine the combination with a wall representing a vertical section of the mine through its shafts and galleries, of a jointed figure representing a man in the act of using a hand drill, one arm of the figure being jointed at the elbow and secured to a rod extending through the wall to represent the drill, a bell-crank pivotally secured to the back of the wall and connected with the drill whereby it imparts a reciprocating motion thereto, a cam for rocking the bell-crank intermittently, a spring for holding the bell-crank against the cam, a spindle extending through the wall and having one of its ends in the form of a crank-arm and so related to the figure as to represent one of his arms wielding a hammer, a crank arm on the opposite end of the spindle, a bell-crank, a rod or link uniting the crank arm to the bell-crank, a rotating cam for slowly depressing and abruptly releasing the bell-crank and a spring reacting against the cam, whereby motion is communicated to the hammer arm of the figure in simulation of the slow lifting of the hammer and the quick striking of a blow, the mechanism for actuating the two arms being so adjusted relatively that the drill is moved before the blow is struck, substantially as described and for the purpose specified.

13. The combination with railway tracks at differing elevations, an elevator adapted to reciprocate between such tracks, and with a car adapted to run upon the tracks and therefrom upon the elevator, of a reciprocating chain parallel with and adjacent to each track and being adapted to transfer the car from the elevator to and along the track and to return it to the elevator, and means for automatically attaching the chain and the car as the elevator approaches the track and for detaching the same as the elevator leaves the track, substantially as described and for the purpose specified.

14. The combination, with the mechanical exhibit of a gold or silver mine comprising a wall adapted to represent a vertical section of the mine through its shafts and levels, of tracks in the levels and at the surface and leading from the shaft, cars adapted to run upon the tracks, mechanical means for moving the cars upon the tracks, a rod, 75ᵇ, parallel with each of the tracks, a sleeve, 75ª, adapted to slide upon the rod and having stop lugs, spaced apart, a finger, 75ᶜ, attached to the car moving mechanism and playing between and adapted to engage the lugs, a figure representing a man in attendance upon the car and being pivotally mounted upon the sleeve, an arm, 75ᵉ, projecting laterally from the figure, and a fixed stop at each limit of the travel of the figure for engaging the arm and changing its angular position with reference to the sleeve, substantially as described and for the purpose set forth.

15. In the mechanical representation of a gold or silver mine the combination with a wall representing the vertical section of a mine through its shafts and galleries, of a figure representing a man in the act of using a pick and located within the galleries of the mine,

a spindle extending through the wall and through the figure at its shoulders, a crank arm at the inner end of the spindle, a rotating cam, a bell crank cooperating with the cam and rocked thereby, a link or rod connecting the said crank arm with the bell crank, crank arms upon the outer end of the spindle and located upon opposite sides of the figure and adapted to carry the pick, substantially as described and for the purpose set forth.

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

WILLIAM KEAST.

Witnesses:
LIZZIE A. GARDINER,
LOUIS K. GILLSON.