No. 802,985. PATENTED OCT. 31, 1905.

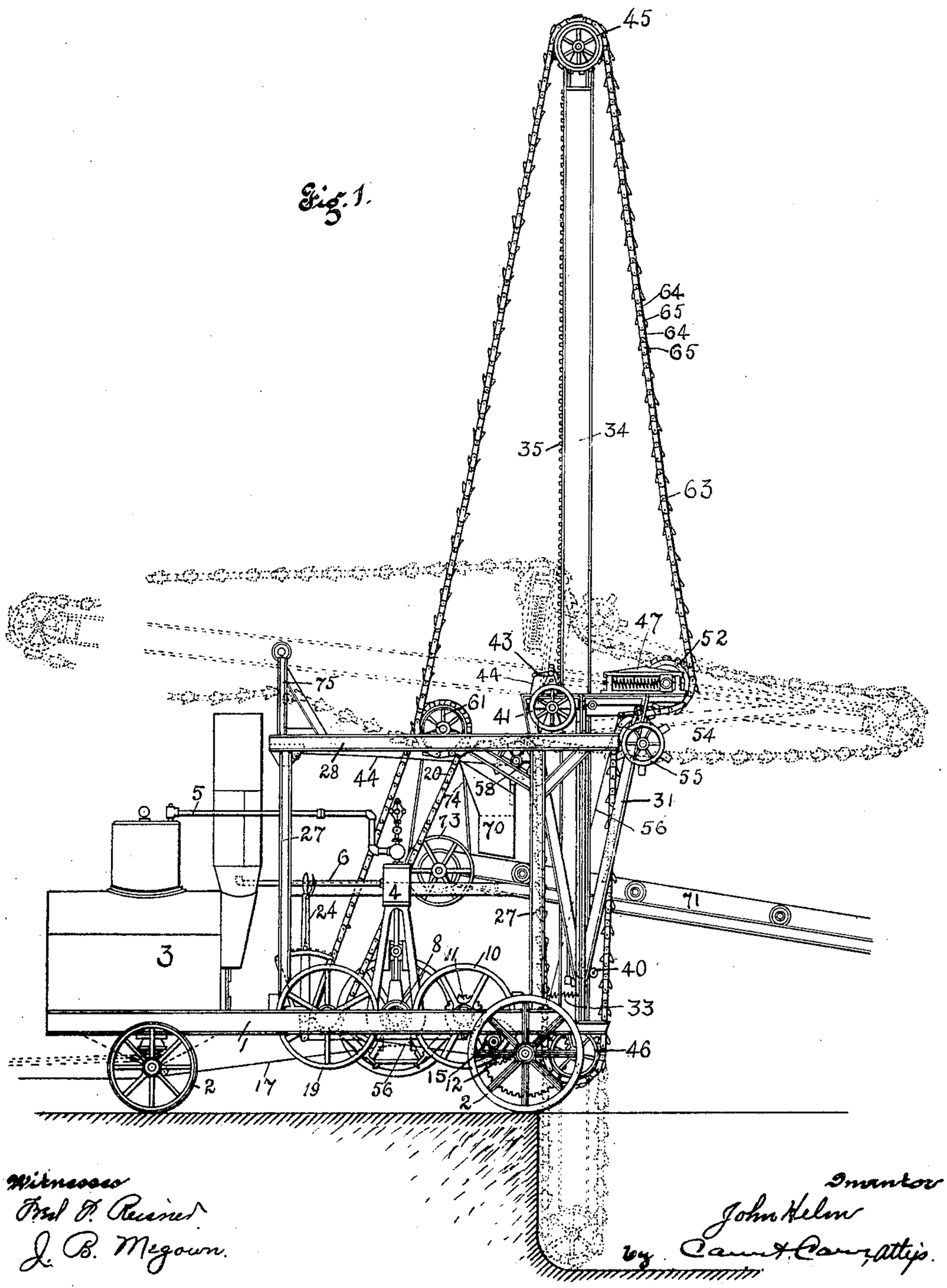
J. HELM.

EXCAVATING MACHINE.

APPLICATION FILED OCT. 5, 1904.

6 SHEETS—SHEET 1.

Fig. 1.



Witnesses
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L. B. Megown.

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by Cann & Cann, Attys.

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6 SHEETS—SHEET 2.

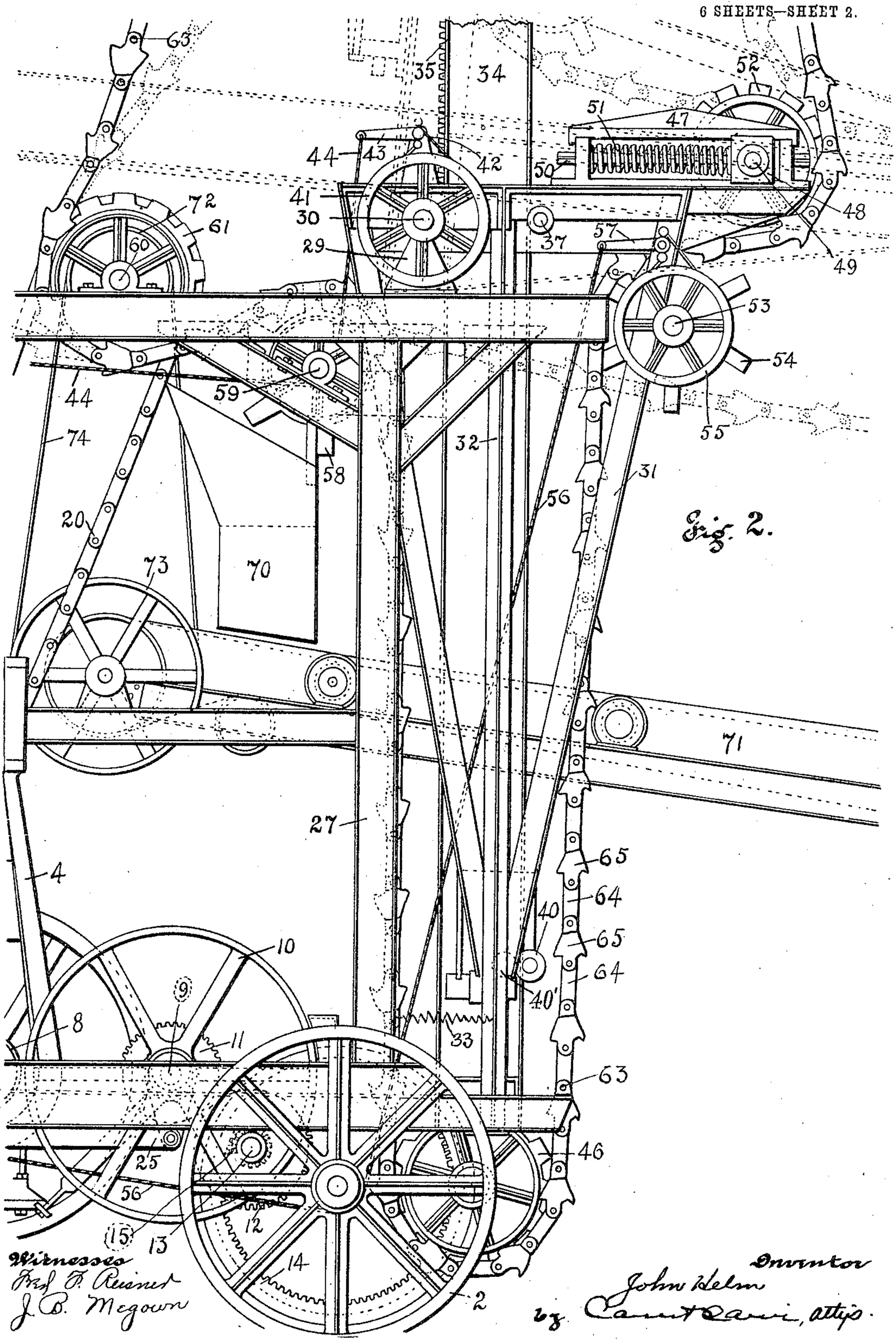

Fig. 2.

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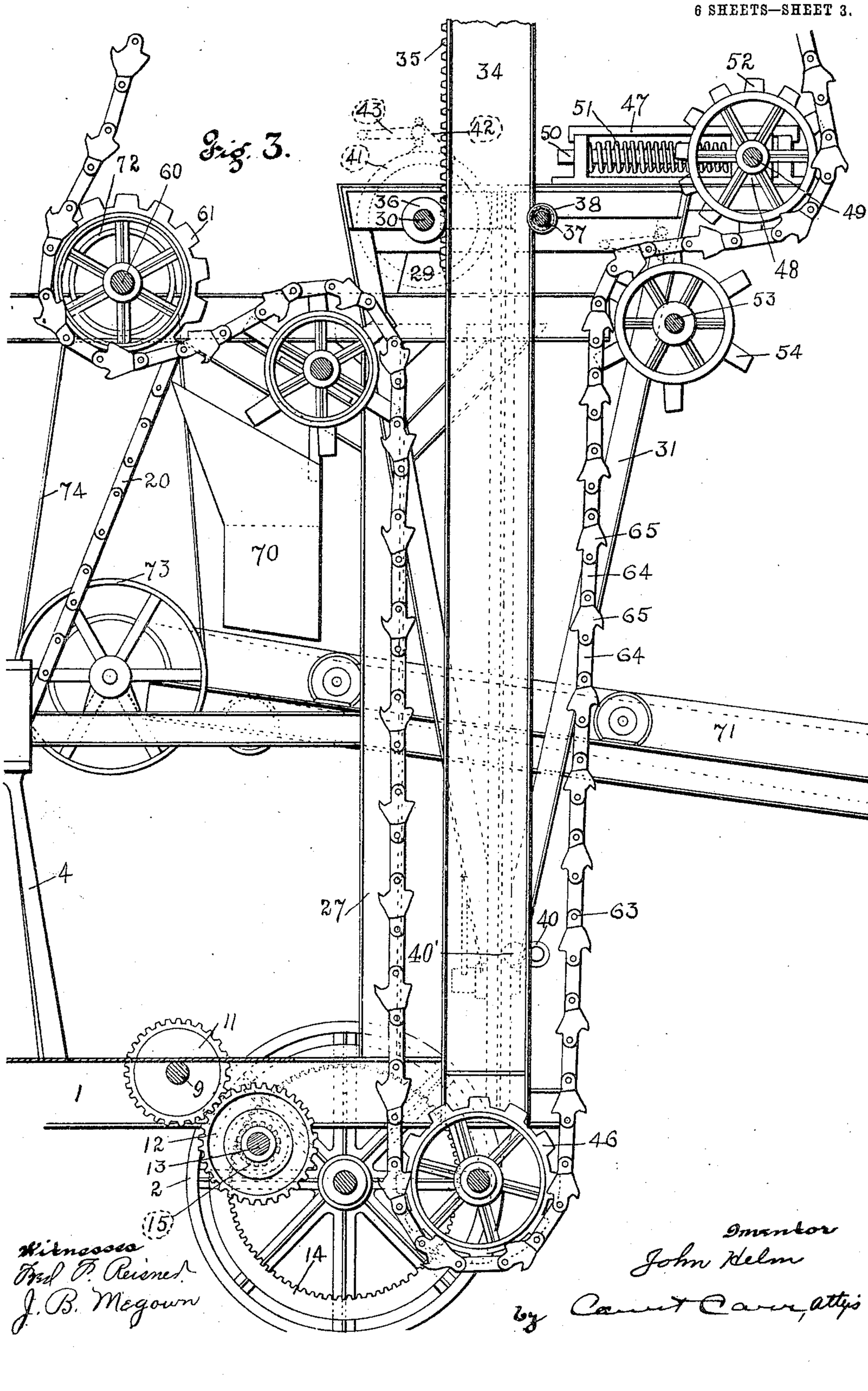
6 SHEETS—SHEET 3.

Fig. 3.



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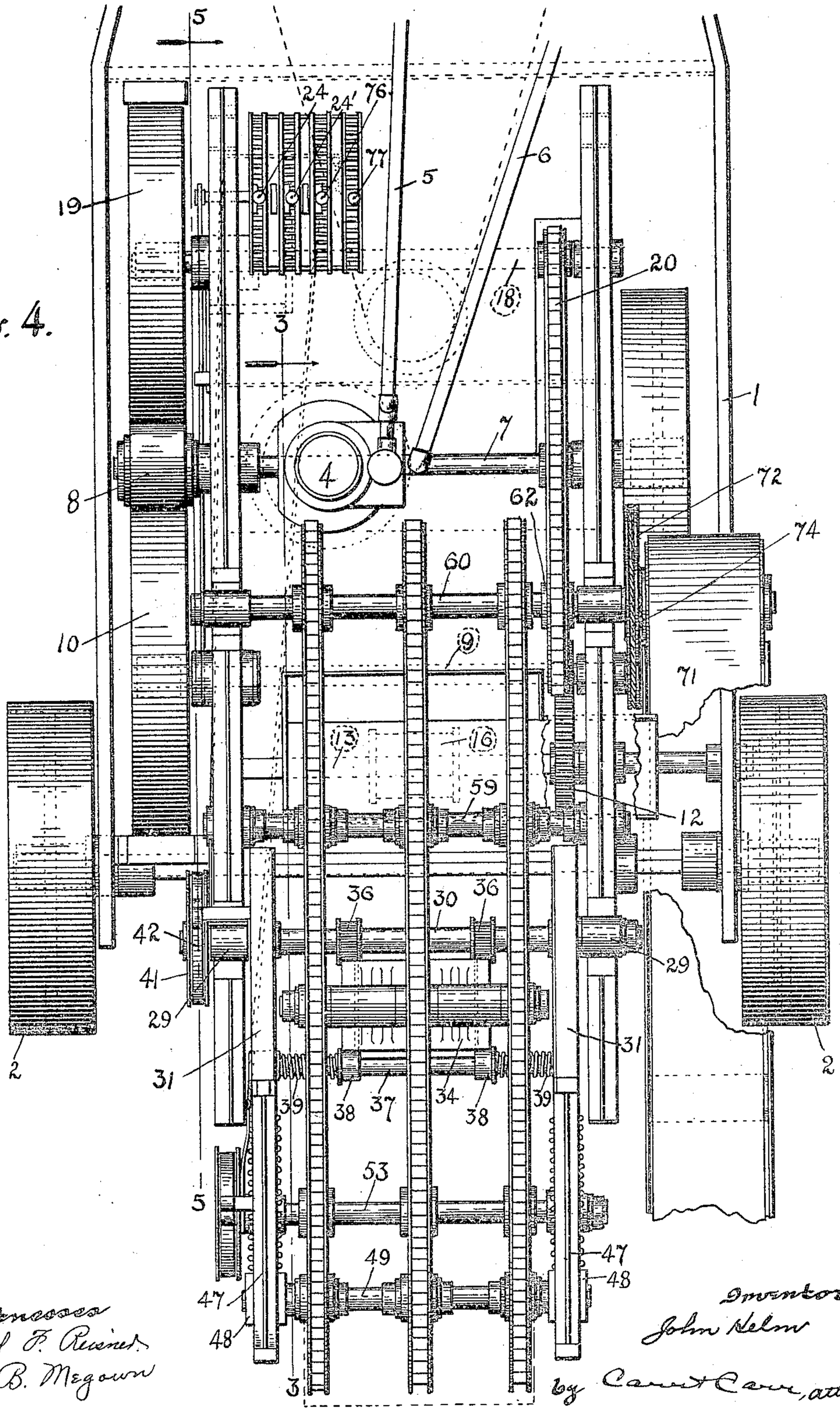
6 SHEETS—SHEET 4.

Fig. 4.



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6 SHEETS—SHEET 5.

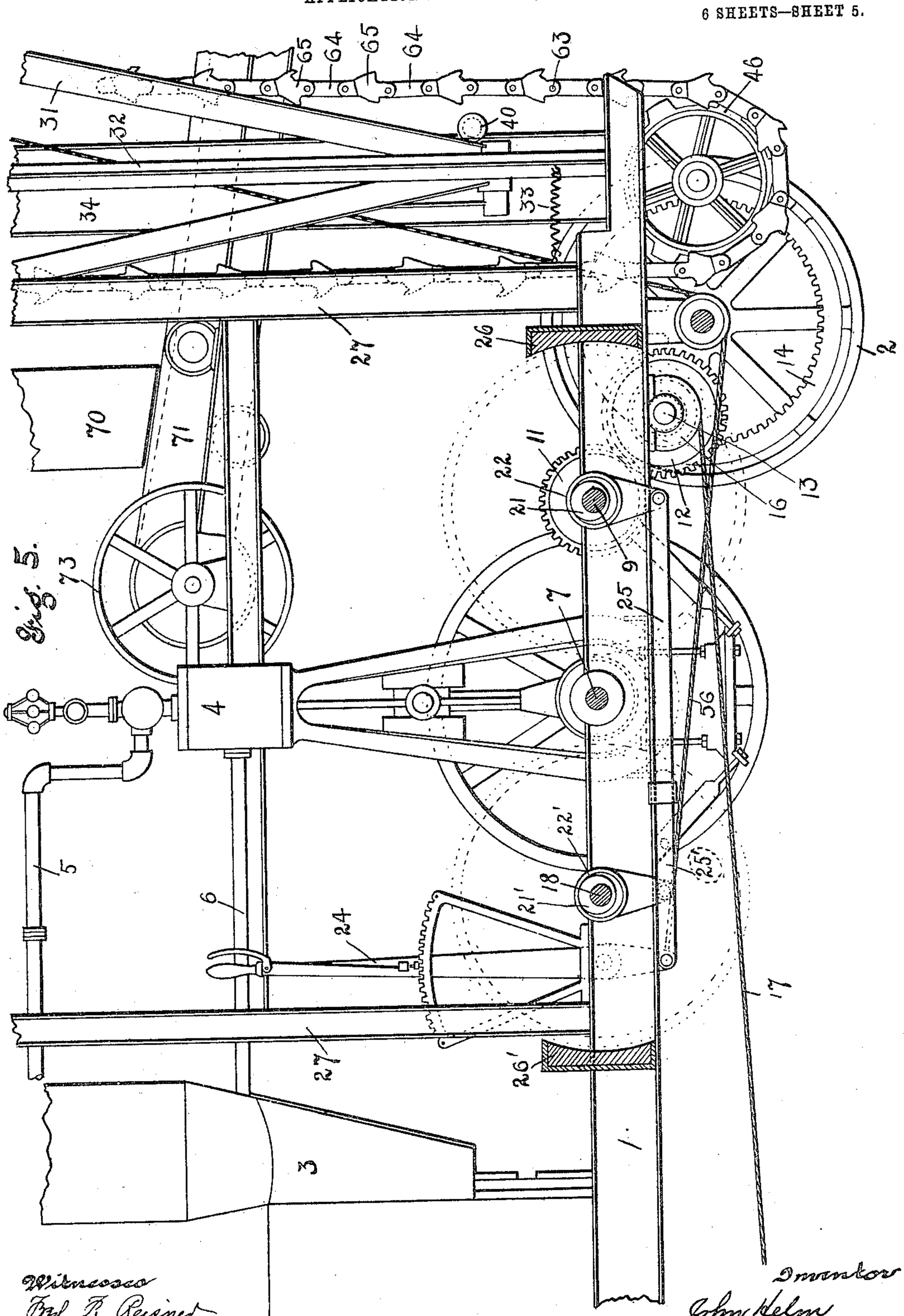

Fig. 5.

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No. 802,985. PATENTED OCT. 31, 1905.

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APPLICATION FILED OCT. 5, 1904.

6 SHEETS—SHEET 6.

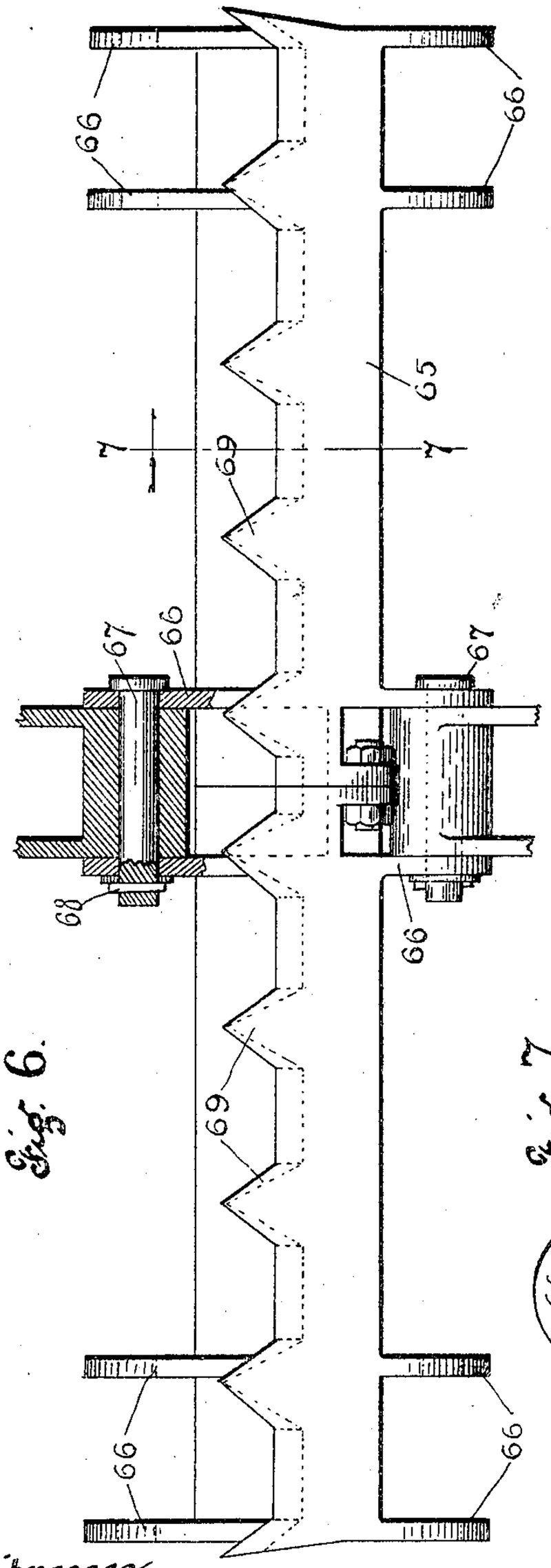

Fig. 6.

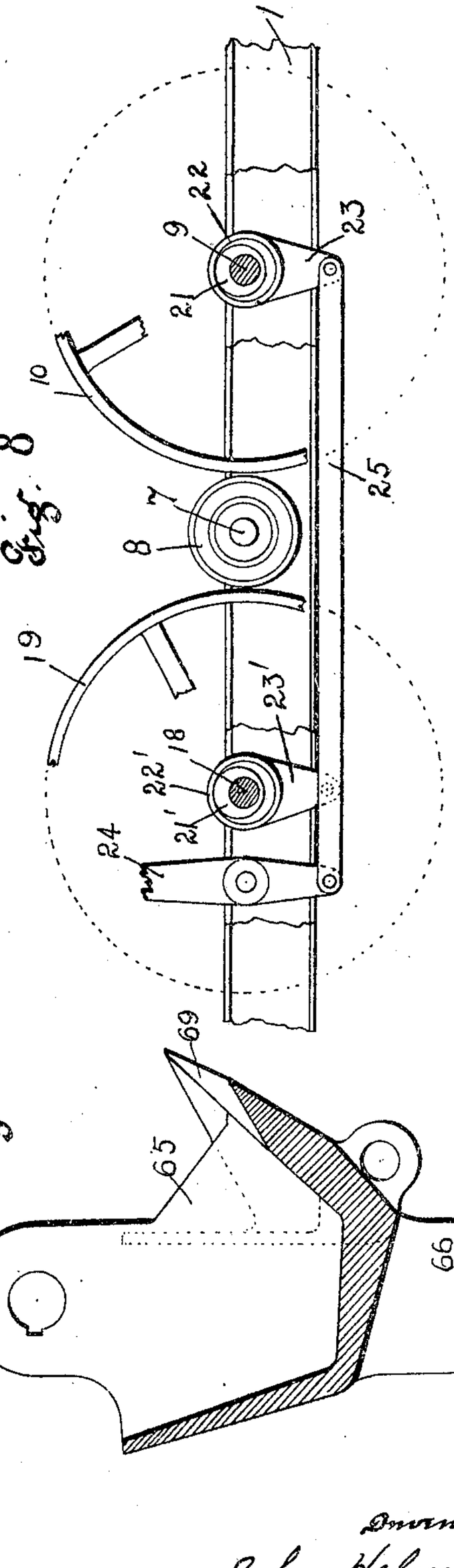

Fig. 8

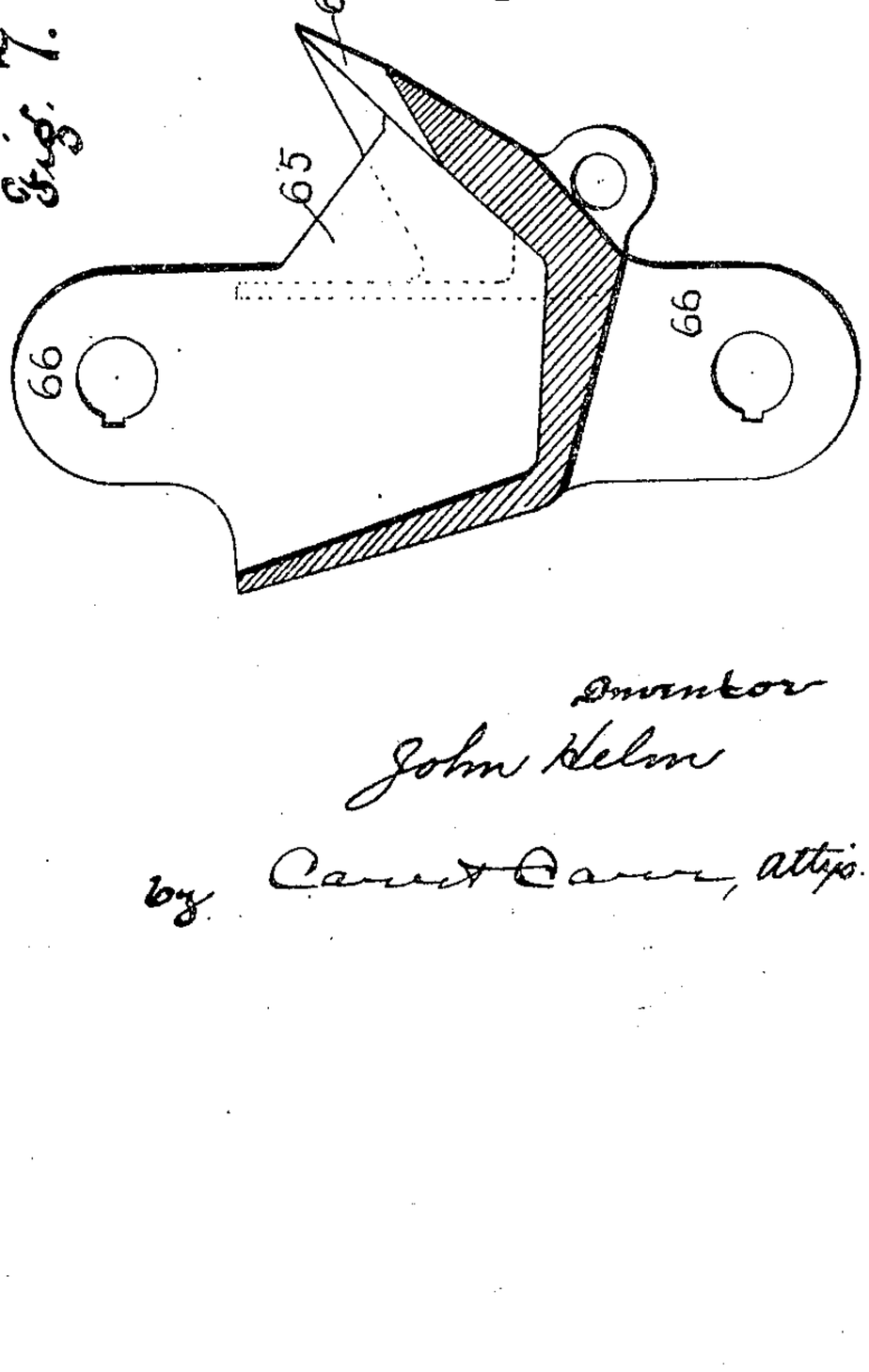

Fig. 7.

Witnesses
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UNITED STATES PATENT OFFICE.

JOHN HELM, OF ST. LOUIS, MISSOURI.

EXCAVATING-MACHINE.

No. 802,985. Specification of Letters Patent. Patented Oct. 31, 1905.

Application filed October 5, 1904. Serial No. 227,189.

To all whom it may concern:

Be it known that I, JOHN HELM, a citizen of the United States, and a resident of the city of St. Louis and State of Missouri, have invented a new and useful Improvement in Excavating-Machines, of which the following is a specification.

My invention relates to excavating-machines, and especially machines for excavating trenches. Its principal objects are to provide a machine which will continuously cut a trench to its full depth; to provide an excavating-machine provided with an endless carrier which simultaneously dislodges the earth and elevates it; to provide an endless carrier provided with elements which both dislodge the earth and carry it away; to provide an endless carrier the buckets of which are provided with teeth on their front edges, the sets of teeth on successive buckets being staggered with respect to each other; to provide a vertically-adjustable excavating-machine which is capable of excavating trenches of any depth to a limit determined by the dimensions of the particular machine; to provide means to keep the endless carrier taut notwithstanding vertical adjustment of the frame; to provide means for simultaneously propelling the machine and actuating the excavating mechanism; to provide means for propelling the machine which does not depend for its effectiveness upon the friction of a wheel or wheels upon the surface of the ground, and other objects hereinafter more fully appearing.

My invention consists in the parts and in the arrangements and combinations of parts hereinafter described and claimed.

In the accompanying drawings, forming a part of this specification, and wherein like symbols refer to like parts wherever they occur, Figure 1 is a side view of the improved excavating-machine. Fig. 2 is a side view, on an enlarged scale, of the lower front portion of the machine. Fig. 3 is a sectional view on the line 3 3 of Fig. 4. Fig. 4 is a plan view, on an enlarged scale, of the machine exclusive of the boiler, the excavating-chain being removed. Fig. 5 is a sectional view on the line 5 5 of Fig. 4. Fig. 6 is a front view of the earth dislodging and carrying bucket. Fig. 7 is a sectional view on the line 7 7 of Fig. 6, and Fig. 8 is a view of the means for shifting the friction-gears to be alternately driven by the motor.

The machine comprises a traveling truck having a frame 1, mounted upon wheels 2. All operative parts of the machine are mounted on this truck. Near the front of the truck a furnace and steam-boiler 3 are mounted. A steam-engine 4 of the vertical type is arranged near the center of the truck and connected with the steam-dome of the boiler by a steam-pipe 5, the exhaust-pipe 6 being led into the smoke-stack of the furnace. This engine is the motor from which the machine is actuated. While a steam-engine has been shown as the preferred motor, it is to be understood that a gas-engine, a compressed-air motor, an electric motor, or any other motor could be substituted, since the particular kind of motor used will in no way affect the operation of the machine. The motor has a shaft 7, which extends across the frame of the machine and is provided at its left end with a paper friction gear-wheel 8. The shaft 7 is hereinafter referred to as the "engine-shaft." A counter-shaft 9 is journaled in the frame to the rear of the shaft 7 and carries a large friction gear-wheel 10, which may engage the said friction gear-wheel 8. On its opposite end the counter-shaft 9 carries a gear-wheel 11, which meshes with a gear-wheel 12 on a shaft 13, parallel with and in the rear of the counter-shaft 9. The shaft 13 is hereinafter referred to as the "propelling-shaft." This shaft extends within the rim of the right rear wheel of the truck. This wheel is provided with an internal gear-wheel 14, which is secured to the spokes. A gear-wheel 15 is loosely mounted on the end of the propelling-shaft 13 and meshes with the gear-wheel 14 on the wheel. A clutch of any desired type is provided to clutch the gear-wheel 15 to the shaft when it is desired to have it rotate with the shaft. Thus when the friction-gears 8 and 10 are in engagement with each other and the gear-wheel 15 is clutched to its shaft the machine will be propelled by the engine. This mode of propulsion is used when it is desired to take the machine from place to place.

For the propulsion or feed movement of the machine while excavating a trench other means are employed. Upon the propelling-shaft 13 a drum 16 is loosely mounted. A clutch of any desired type is provided to clutch the drum on the shaft when it is desired to have the drum turn with the shaft. A rope or cable 17 has one end secured to the drum and may be wound thereon. Some distance ahead of the machine a pulley is secured on the ground in the line of the ditch. The rope 17 passes over this pulley and back to

the machine and is secured to the front thereof. Thus by rotation of the drum the rope will be wound thereon and the machine will be drawn forward. This mode of propulsion is preferable for the feed movement, as the traction effort does not depend upon the friction of the drive-wheel upon the ground. The machine can also be propelled or fed forward more nearly in a straight line. Of course the machine could be propelled by the drive-wheel alone; but the means described are preferred.

In front of the engine-shaft 7 a parallel counter-shaft 18 is journaled in the frame. Upon its left end it carries a large paper friction gear-wheel 19 in position to engage the small friction gear-wheel 8 on the engine-shaft. At its opposite end the counter-shaft 18 is provided with a sprocket-wheel, upon which runs a sprocket-chain 20, by means of which the excavating mechanism is driven.

The friction gear-wheels 10 and 19 may each be thrown into and out of gear with the friction gear-wheel 8 on the engine-shaft. The mechanism for this purpose will now be described.

The counter-shaft 9 is mounted eccentrically in a stub-shaft 21, which is journaled in a bearing 22 on the frame of the machine. An arm 23 is rigidly secured to the stub-shaft 21 and extends downwardly. This arm is connected with a control-lever 24 of ordinary form by means of a link 25. In the rear of the friction gear-wheel 10 a brake-shoe 26 is fixed on the frame in position to be engaged by the wheel when in its rearmost position. When the lever 24 is thrown forwardly, the friction gear-wheel 10 will also be thrown forwardly and will engage the friction gear-wheel 8 on the engine-shaft 7. When the lever 24 is thrown rearwardly, the friction gear-wheel 10 is thrown rearwardly out of engagement with the friction gear-wheel 8 on the engine-shaft 7 and into engagement with the brake-shoe 26.

The foregoing description applies to the means for controlling the friction gear-wheel 19 on the counter-shaft 18.

On the drawings the same reference-numbers with prime marks added have been used for the several parts of the shifting mechanism.

A frame is built upon the frame 1 of the truck to support the part of the excavating mechanism. The frame consists of vertical columns 27 and horizontal girders 28. Upon the top girders brackets 29 are mounted. In the brackets a shaft 30 is journaled. A guide-frame, having substantially triangular side frames 31, is pivoted on the shaft 30. Each of the side frames 31 has a medial member 32 extending from the top down below its apex. A spring 33 connects the medial member of the side frame with the rear vertical member of the frame. Its connection with the medial member is such that it can be readily disconnected. When connected, the spring constitutes a yielding means to hold the guide-frame in a vertical position. A frame 34 is reciprocatingly mounted in the guide-frame. The front sides of the side members of the frame are provided with teeth-forming racks 35. Gear-wheels 36 are mounted on the shaft 30 in position to engage the racks 35. Back of the frame a shaft 37 is mounted in the guide-frame and carries loosely-mounted flanged rollers 38. Helical springs 39 surround the shaft 37 and hold the flanges of the roller against the sides of the frame 34. The frame 34 is further guided by pairs of rollers 40 40′ upon the lower end of the guide-frame, which engage the rear flanges of the side members of the frame 34. A brake-drum 41 is mounted on the end of the shaft 30 and is surrounded by the strap 42 of the ordinary strap-brake. The lever 43, to which the ends of the strap is connected, is pulled down to set the brake by means of a rope 44, the other end of which is carried down to a control-lever 76 at the front of the machine near the control-levers 24 24, so as to be within easy reach of the engineer. When the frame 34 is to be raised or lowered, the brake is released; but when the frame is to be held stationary the brake is set, whereby the shaft 30 is held against rotation and the frame can neither ascend nor descend. This frame 34 is hereinafter referred to as the "chain-frame," except in the claims, where it is sometimes referred to as a "conveyer-frame."

Sprocket-wheels 45 46 are mounted at the upper and lower ends, respectively, of the chain-frame 34. At the rear upper corners of the guide-frame a take-up for the chain is arranged. It comprises slideways 47, rigidly mounted on the side frame of the guide-frame. Bearing-blocks 48 are mounted in the slideways and an idle shaft 49 is journaled in the bearing-blocks. A guide-rod 50 extends forwardly from each bearing-block and through a hole in the front vertical member of its respective slideway. A coiled spring 51 surrounds each guide-rod and bears at one end upon the bearing-block and at the opposite end upon the vertical member of the slideway. Thus the shaft is yieldingly held in its rearmost position. Sprockets 52 are mounted on the idle shaft 49. A shaft 53 is mounted upon the rear of said guide-frame below said idle shaft 49. It carries sprockets 54 in line with the sprockets 52 on the shaft 49 and on its end a brake-drum 55. The brake is a strap-brake and is set by means of a rope 56, which is connected at one end to the brake-lever 57. The rope is led down around a pulley on the rear axle of the truck and upwardly and forwardly to a control-lever 77, located near the control-levers 24, 24′, and 76, where it will be in convenient reach of the engineer. Idle sprockets 58 are mounted on a shaft 59, which is journaled in the main frame near the front of the guide-frame, where it is in its vertical position.

Above and in front of the sprockets 58 an actuating-shaft 60 is journaled in bearings on the top horizontal members of the frame. This shaft carries sprockets 61 in line with the sprockets 58. A driving-sprocket 62 is secured on the end of the shaft 60 and is engaged by the sprocket-chain 20, which connects it with the counter-shaft 19, described above.

An excavating-chain 63 runs below and up in front of the sprockets 61, over the sprockets 45 at the top of the chain-frame, down behind and beneath the sprockets 52, over and down in front of the sprockets 54, around the sprockets 46 at the lower end of the chain-frame, and around the sprockets 58. This chain is called an "excavating-chain," because it both dislodges the earth and carries it away. It is hereinafter particularly described.

The operation of the parts just described will now be set forth. When the strap-brake for the chain-frame is set, the chain-frame will be held against vertical movement. The brake on the shaft 53 being released, the chain may be driven by the actuating-shaft 60. When it is desired to permit the chain-frame to descend, its brake may be released, when it will descend of its own weight. The rapidity of the descent of the chain-frame can always be controlled by the brake. When it is desired to raise the chain-frame, the chain-frame brake is released, and the brake on the shaft 53 is set. The actuating-shaft is permitted to run. The setting of the brake fixes the sprockets 54, and so the chain is held at that point. The running of the actuating-shaft, however, continues to drive the chain upwardly, thus shortening the portion below the shafts 53 and 60. Hence the chain-frame will be raised by the mechanism that drives the chain. The chain is kept taut whatever the elevation of the frame by means of the take-up described above.

The excavating-chain consists of alternate links 64 and bucket-links 65. A three-strand chain has been illustrated, but it is of course understood that the construction is equally applicable to a two-strand chain. The links 64 do not differ from well-known forms of links. The bucket-links consist of buckets proper having upwardly and downwardly extending ears 66. The ears are spaced so as to fit with the chain-links 64, as indicated in Fig. 6. Pivot-pins 67, held in place by cotter-pins 68, secure the ears 66 and links 65 together. The bucket has walls which diverge upwardly from the bottom, the rear wall being higher than the front wall. The latter wall has a series of pointed projections 69, which extend beyond the upper edge of the wall and dislodge the earth. At each corner the bucket has a projection which extends laterally beyond the side of the bucket, so that the channel cut by the chain shall be wider than the body of the chain, and thus friction of the chain on the walls of the trench will be obviated. Between the sets of ears the rear wall of the buckets are set forwardly to accommodate the sprocket-wheels. The bucket shown in Fig. 6 is made in two sections, and this is preferred though it is not necessary. Alternate buckets of the chain have their dislodging-points staggered with respect to each other. Thus the entire surface operated on is engaged by dislodging-points. As the earth is dislodged it falls into the buckets and is carried up thereby. In passing from the sprockets 58 to the sprockets 61 the buckets are turned over and discharge their contents. A chute 70 is arranged below this portion of the chain. This chute discharges to one side of the machine. A belt conveyer 71 is arranged beneath the discharge end of the chute 70 and may be extended to any desired point. The belt conveyer is driven by a rope-drive from the actuating-shaft 60. The latter shaft carries a pulley 72, which is connected with a pulley 73 of the conveyer by a rope 74. This conveyer can be dispensed with when it is desired to dump the dirt by the side of the trench.

In beginning to excavate a trench the chain-train is raised to about the position shown in Fig. 1. The excavating-chain is actuated and the chain-frame brake is released. The chain-frame will then descend and its weight will force the cutters into the earth. The dislodging-points on the bucket loosen the earth and the buckets carry it up and discharge it into the chute 70. After a hole to the desired depth of the trench has been excavated two methods of procedure may be followed. If the earth is comparatively soft and easy to dislodge, the chain-frame brake will be set. The winding-drum 16 will be actuated slowly and will wind up the cable 17, thus feeding the entire excavator along. The excavating-chain will operate on the entire face of the trench and the cutting operation will be continuous. In case a considerable resistance, as when a stone is struck, is suddenly encountered the spring 33 will permit the guide-frame to rock on its pivots, and thus serious injury to the chain will be prevented. This yielding pressure on the face of the trench is also much more advantageous than a steady non-resilient pressure would be. The latter arrangement would be subject to frequent breaks. Operating in this manner the trench will be continuously cut to its full depth. If the earth is hard and difficult to dislodge, the brake on the shaft 53 is set and the chain-frame is raised to its initial position. Then the winding-drum 16 is actuated and the machine moved forward a distance equal to the length of cut made by the excavating-chain. The chain-frame is then allowed to descend and a second cut like the first is made. This operation is repeated as often as necessary. By following this step-by-step method a less powerful machine is re-

quired than for the continuous method. With any given machine it will be possible to follow one method in some places and necessary to follow the other method in other places.

When it is desired to move the machine from one place to another, the chain-frame and guide-frame are turned into the horizontal position indicated by the dotted lines at the upper part of Figs. 1 and 2. A rest 75 is provided on the upper horizontal member of the main frame and supports the chain-frame in its reclining position.

Obviously the machine is capable of considerable modification within the scope of my invention, and therefore I do not wish to be limited to the specific construction shown and described.

The bucket-chain herein shown and described is claimed in my copending application, Serial No. 254,631, filed April 10, 1905.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. An excavating-machine comprising a main frame, sprockets on said main frame, a guide-frame pivotally mounted on said main frame, yieldingly-mounted sprockets on said guide-frame, a shaft mounted on said guide-frame and provided with sprockets and a brake, a conveyer-frame reciprocatingly mounted on said guide-frame and a conveyer passing over all of said sprockets, said sprockets on said main frame engaging the ascending side of said conveyer, and said sprockets on said guide-frame engaging the descending side of said conveyer, said yieldingly-mounted sprockets engaging said conveyer at a point behind the point of engagement of said sprockets on the shaft provided with a brake with said conveyer.

2. An excavating-machine comprising a main frame, a chain-frame reciprocatingly mounted in said main frame, a bucket-chain on said chain-frame, and a take-up engaging said bucket-chain whereby said chain will be held taut for all positions of said chain-frame.

3. An excavating-machine comprising a main frame, a chain-frame reciprocatingly mounted in said main frame, yieldingly-mounted sprockets, and a bucket-chain on said chain-frame and running over said yieldingly-mounted sprockets, whereby said bucket-chain will be held taut for all positions of said chain-frame.

4. An excavating-machine comprising a main frame, a chain-frame reciprocatingly mounted in said main frame, means to hold said chain-frame in any desired position, a shaft provided with sprockets and a brake, a chain on said chain-frame and running over said sprockets and means to actuate said chain.

5. An excavating-machine comprising a main frame, a chain-frame reciprocatingly mounted in said main frame, a shaft provided with sprockets and a brake, an excavating-chain on said chain-frame and running over said sprockets, and means to actuate said chain whereby said chain-frame may be elevated by said means to actuate said chain.

6. An excavating-machine comprising a main frame, a chain-frame reciprocatingly mounted in said main frame, guide-sprockets, actuating-sprockets, a chain on said chain-frame and passing over said guide and actuating sprockets, and means to prevent rotation of one of said sets of guide-sprockets in engagement with the side of said chain running downwardly.

7. An excavating-machine comprising a main frame, a conveyer-frame reciprocatingly mounted in said main frame, parallel shafts carrying pulleys mounted on said main frame, a conveyer mounted on said conveyer-frame and the return side passing over said pulleys, said pulleys being so located that the conveyer in passing from one shaft to the other will travel in a substantially horizontal direction and a chute beneath said horizontal section of said conveyer.

8. An excavating-machine comprising a main frame, a guide-frame pivoted on a horizontal axis in said main frame, a chain-frame mounted in said guide-frame to reciprocate vertically, actuating means on said main frame provided with sprockets, and a bucket-chain on said chain-frame and running over said sprockets.

9. An excavating-machine comprising a main frame, a guide-frame pivotally mounted in said main frame, excavating means reciprocatingly mounted in said guide-frame and comprising a frame provided with a rack, a shaft journaled in said guide-frame and provided with gear-wheels engaging said rack, and a brake on said shaft whereby said excavating means may be held at any desired position of adjustment.

10. In an excavating-machine an actuating-shaft, a gear-wheel on said shaft, a relatively movable counter-shaft, a gear-wheel on said counter-shaft, a fixed brake-shoe, and means to move said second-mentioned gear-wheel into engagement with said first-mentioned gear-wheel or with said brake-shoe, said parts being so arranged that said second-mentioned gear-wheel will at all times be in engagement with one or the other of said parts.

11. An excavating-machine comprising a main frame, a conveyer-frame reciprocatingly mounted in said main frame, an endless conveyer on said conveyer-frame, and a take-up engaging said conveyer whereby said conveyer will be held taut for all positions of said conveyer-frame.

12. An excavating-machine comprising a main frame, a guide-frame pivotally mounted on said main frame, a conveyer-frame reciprocatingly mounted in said guide-frame, sprockets mounted on said main frame, sprockets mounted on said guide-frame, and a con-

veyer on said conveyer-frame and running over said sprockets, certain of said sprockets being yieldingly mounted, whereby said conveyer is held taut for all positions of said conveyer-frame.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 3d day of October, 1904, at St. Louis, Missouri.

JOHN HELM.

Witnesses:
FRED F. REISNER,
J. B. MEGOWN.