No. 629,576. Patented July 25, 1899.

H. C. LOWRIE.

EXCAVATING APPARATUS.

(Application filed Jan. 17, 1899.)

(No Model.) 8 Sheets—Sheet 1.

Fig. 1.

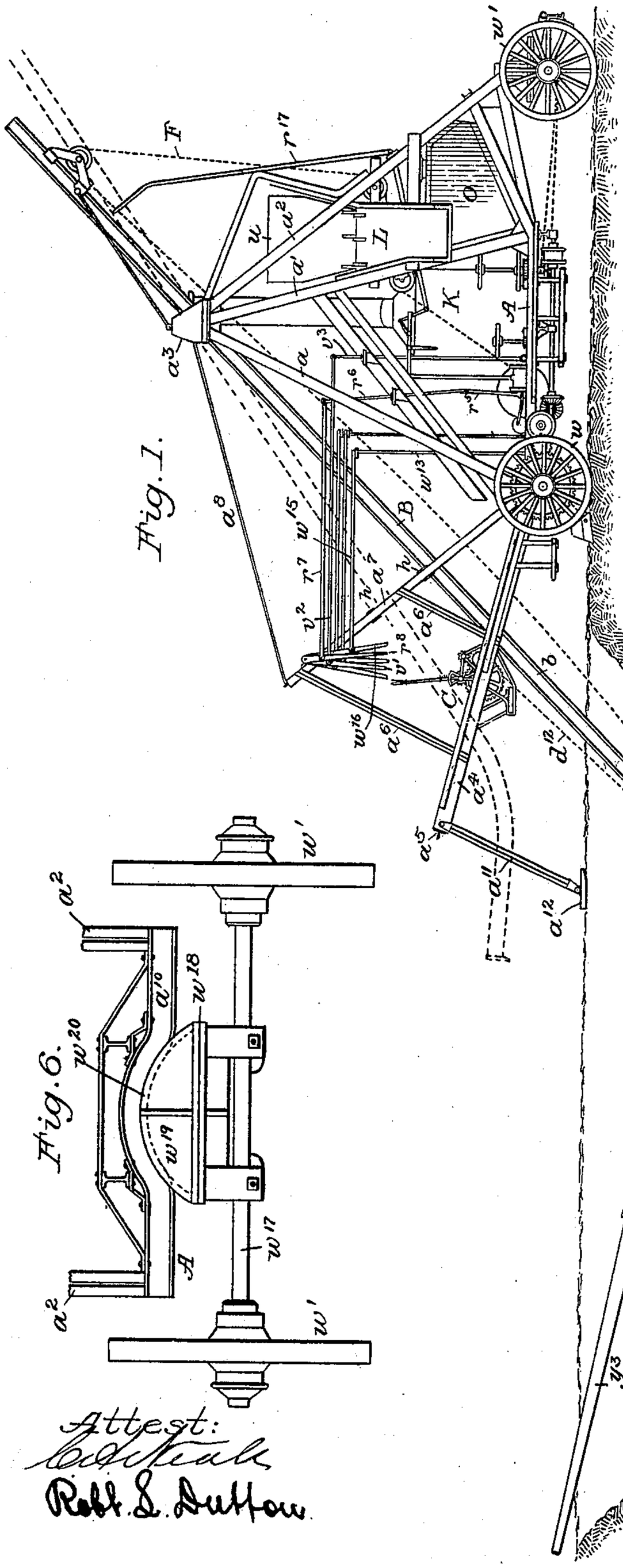

Fig. 5.

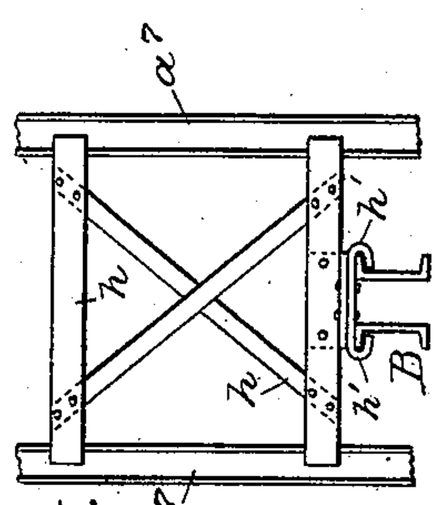

Fig. 7.

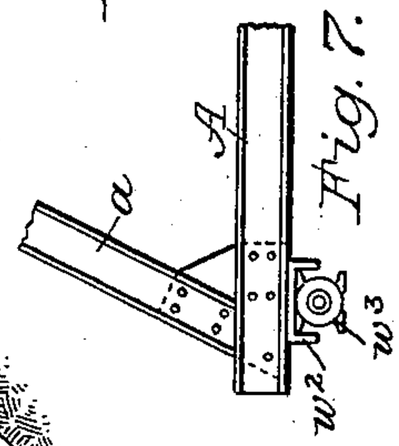

Fig. 4.

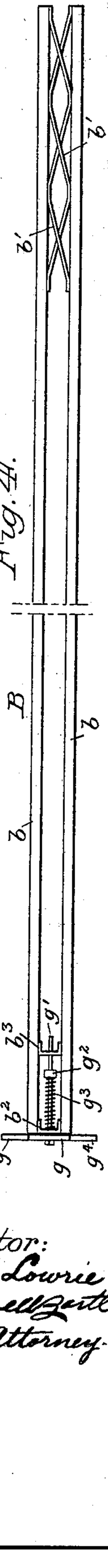

Fig. 6.

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No. 629,576. Patented July 25, 1899.

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(No Model.) 8 Sheets—Sheet 2.

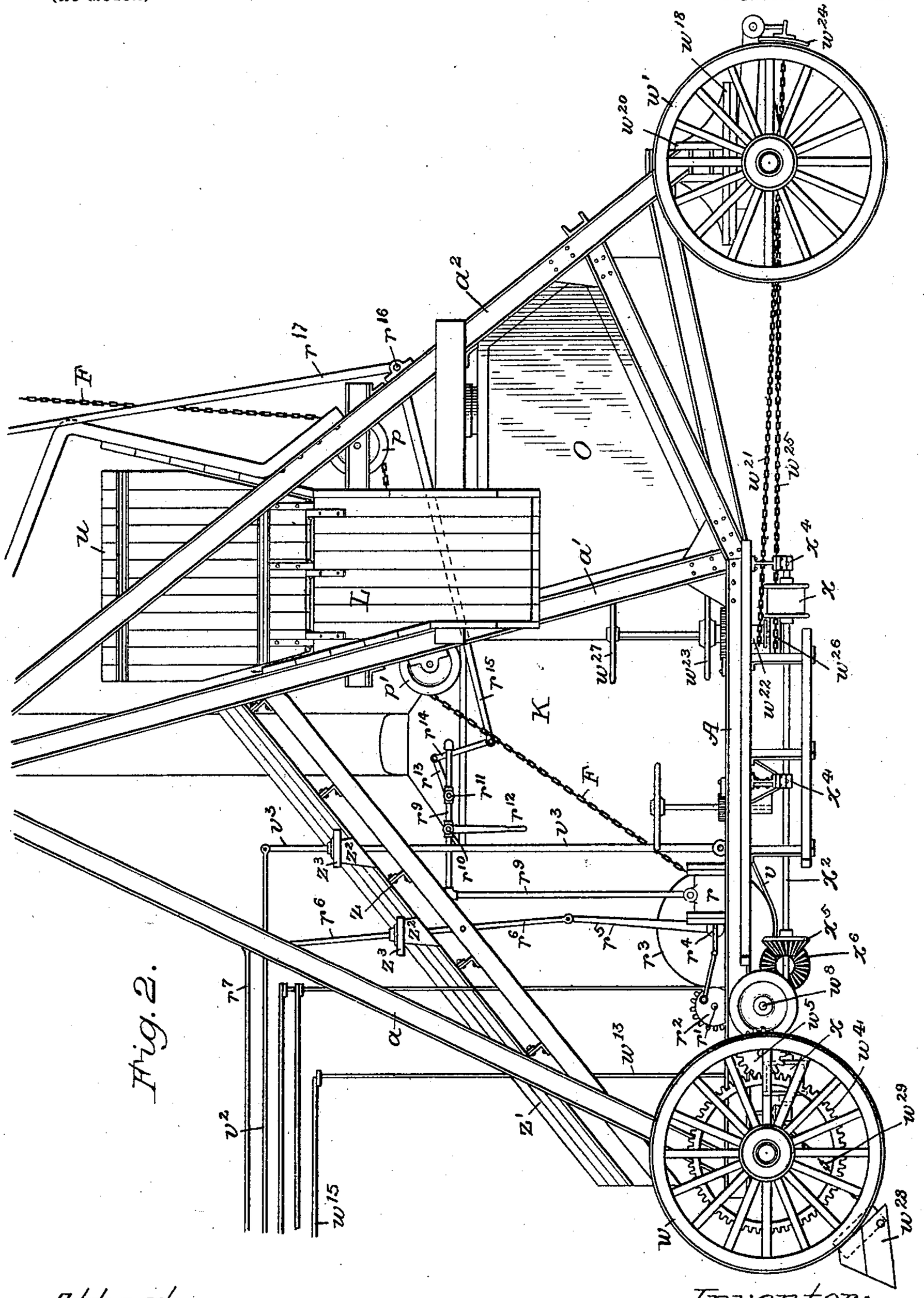

Fig. 2.

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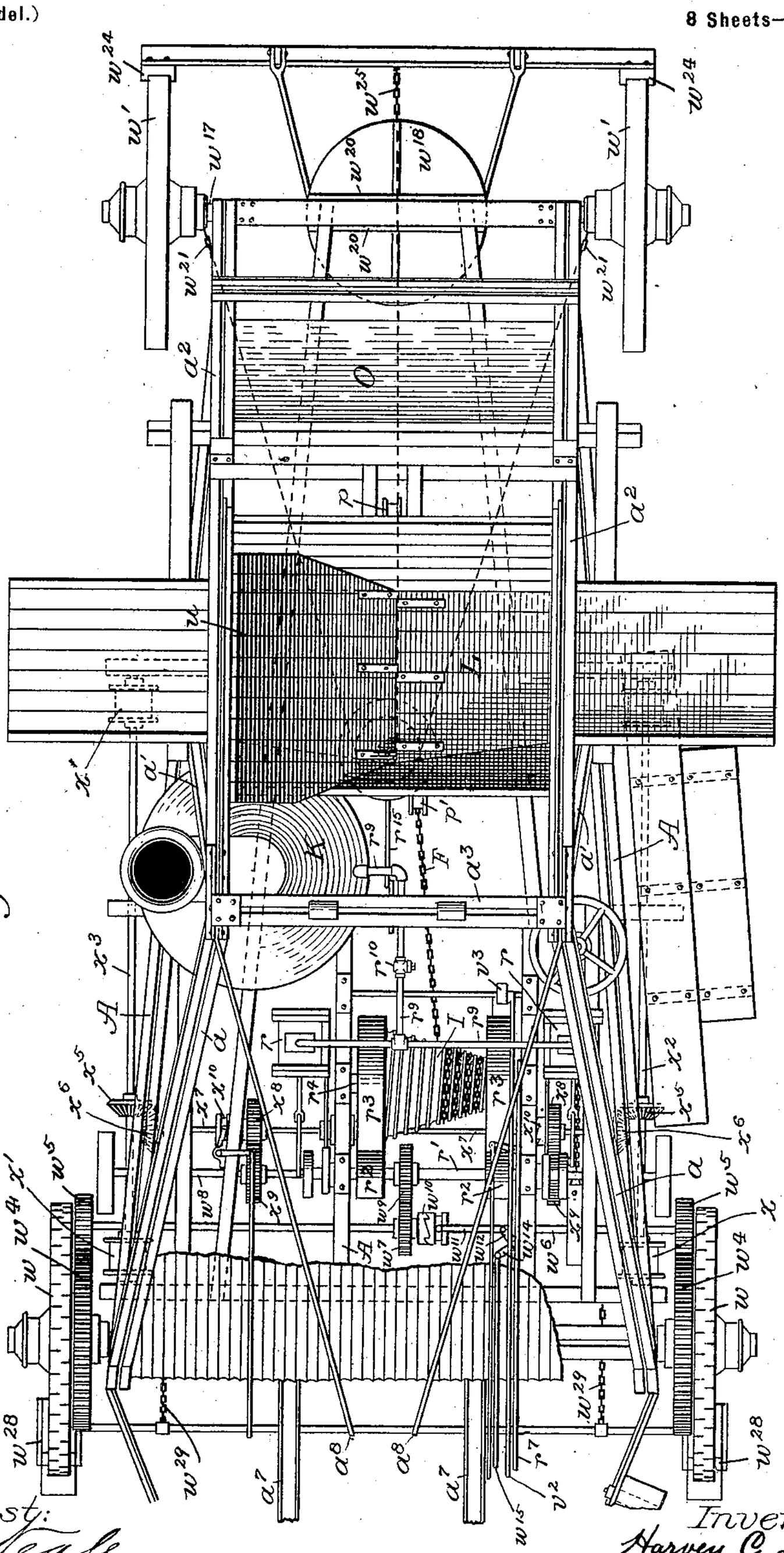
(No Model.) 8 Sheets—Sheet 3.

Fig. 3.



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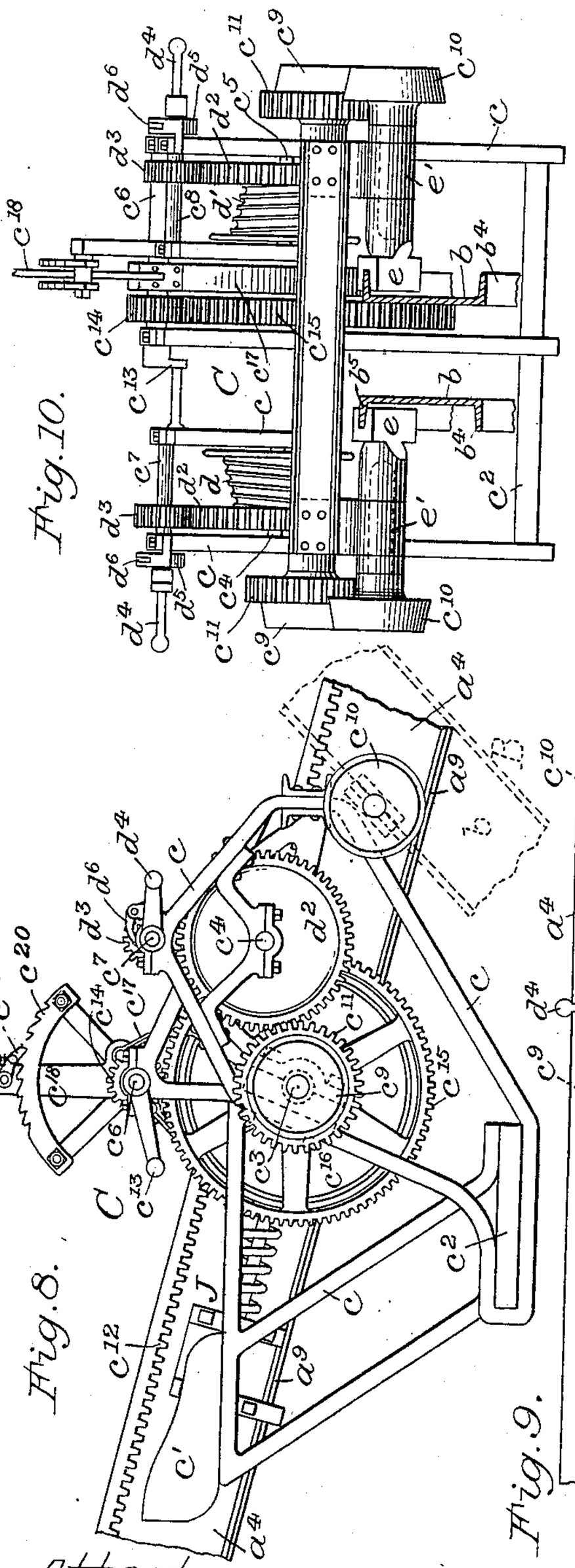

Fig. 10.

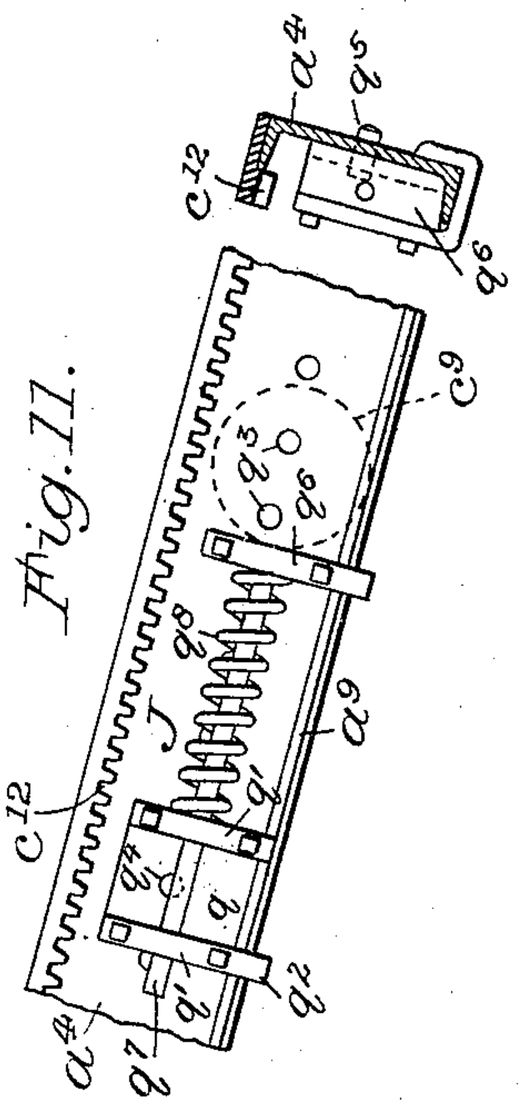

Fig. 11.

Fig. 8.

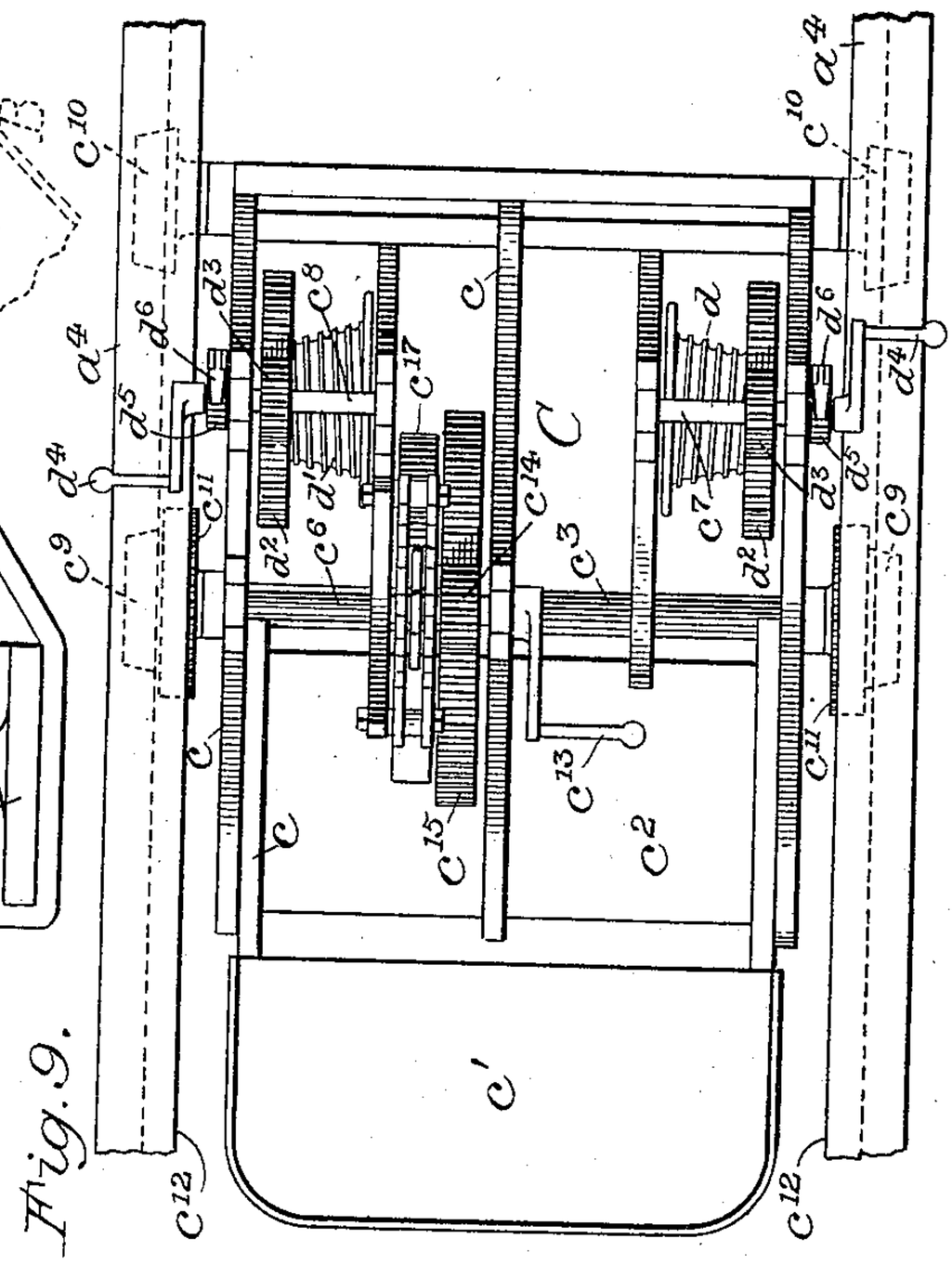

Fig. 9.

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Fig. 12.

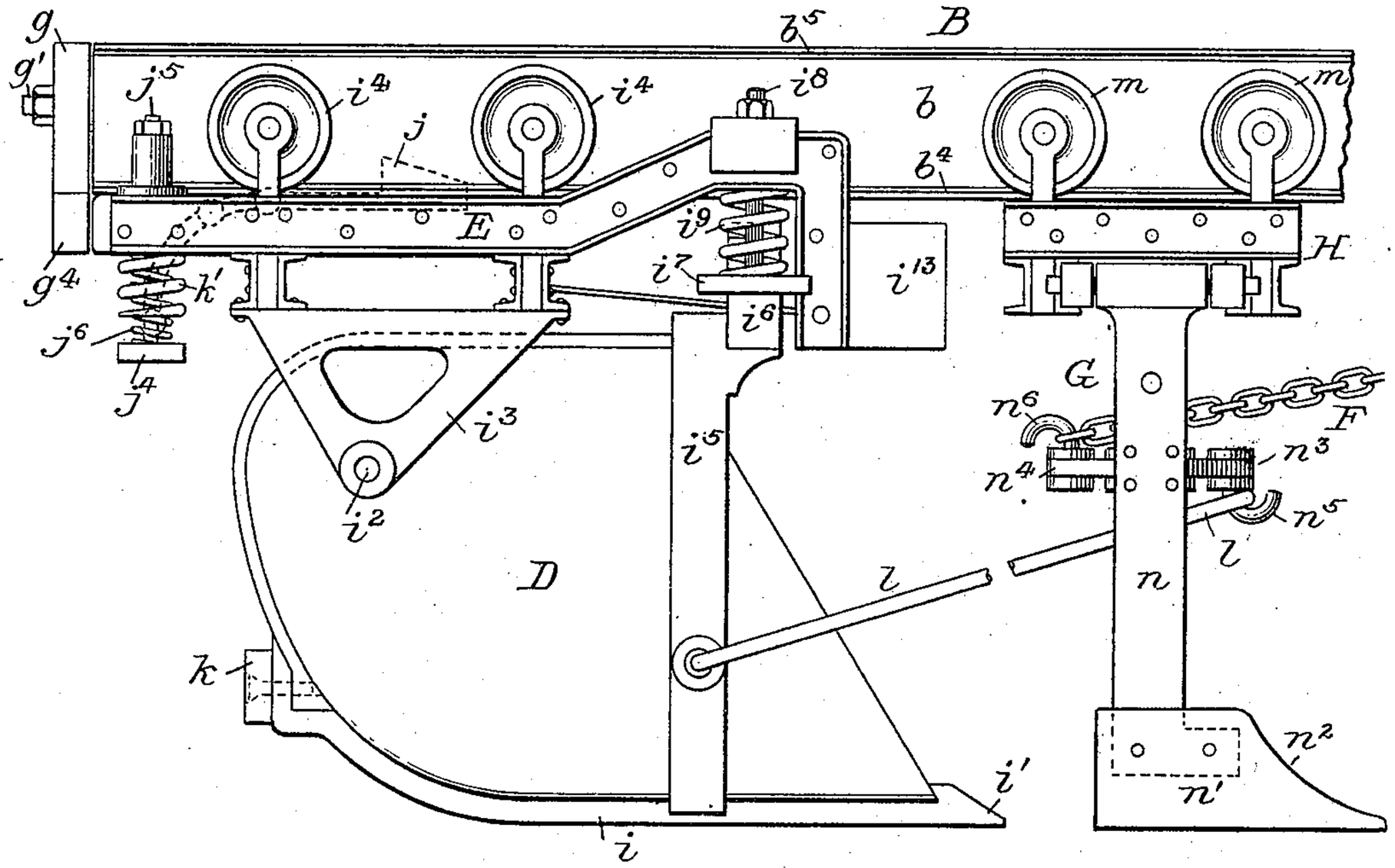
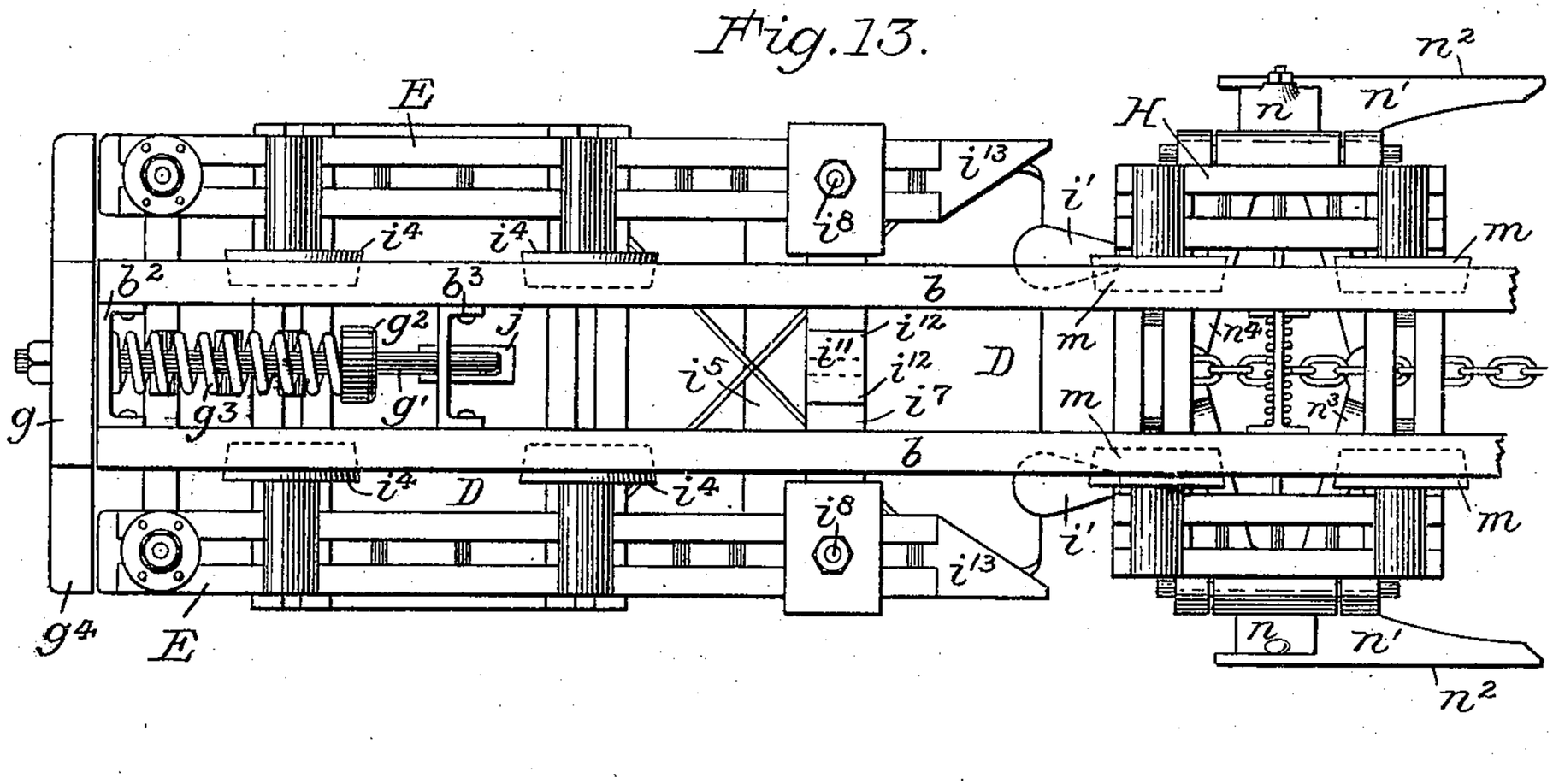


Fig. 13.



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(Application filed Jan. 17, 1899.)

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Fig. 14.

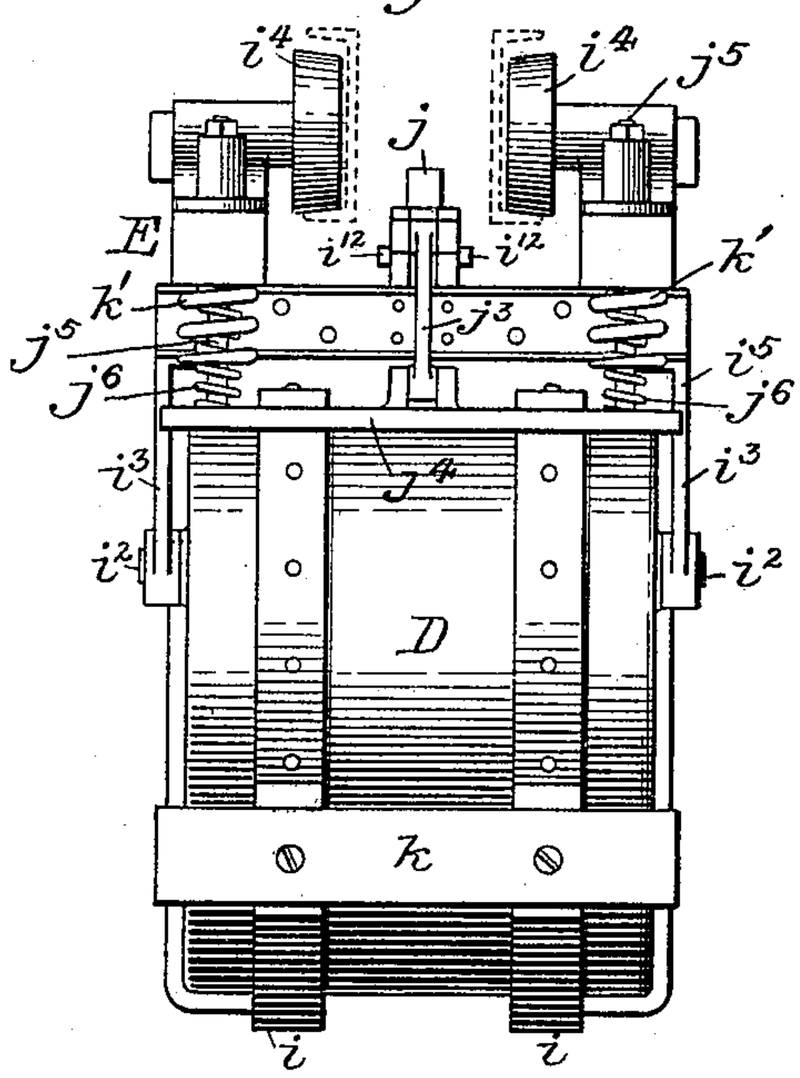


Fig. 15.

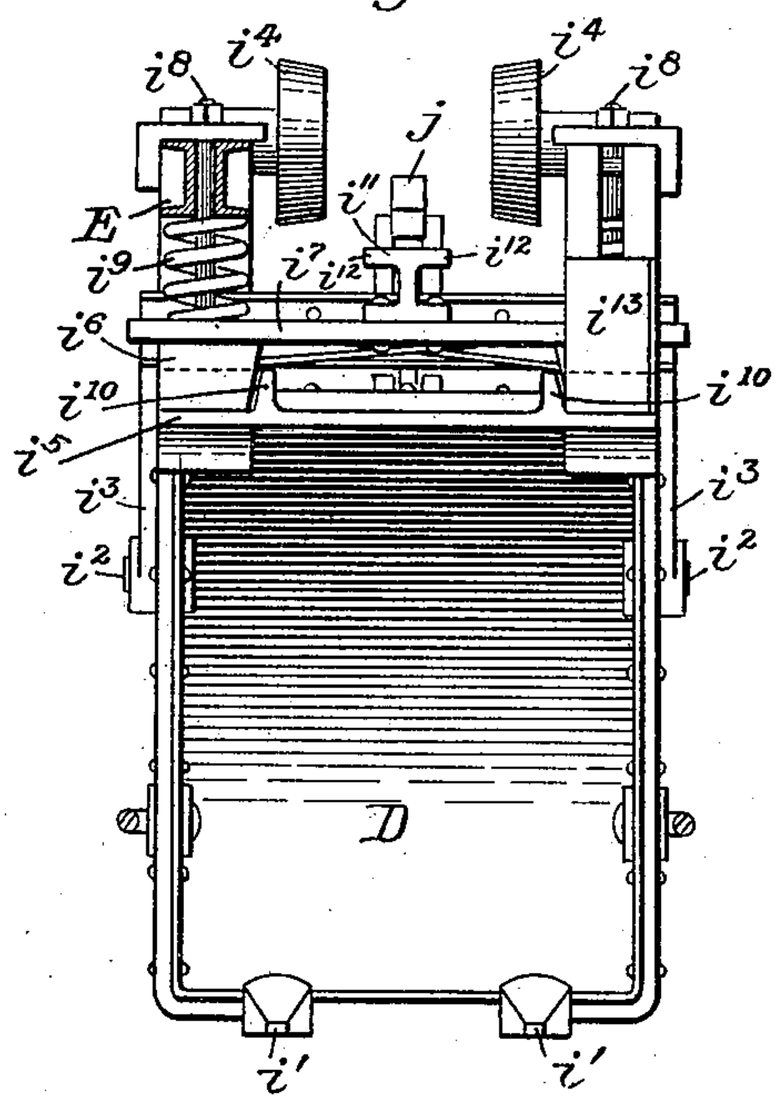


Fig. 16.

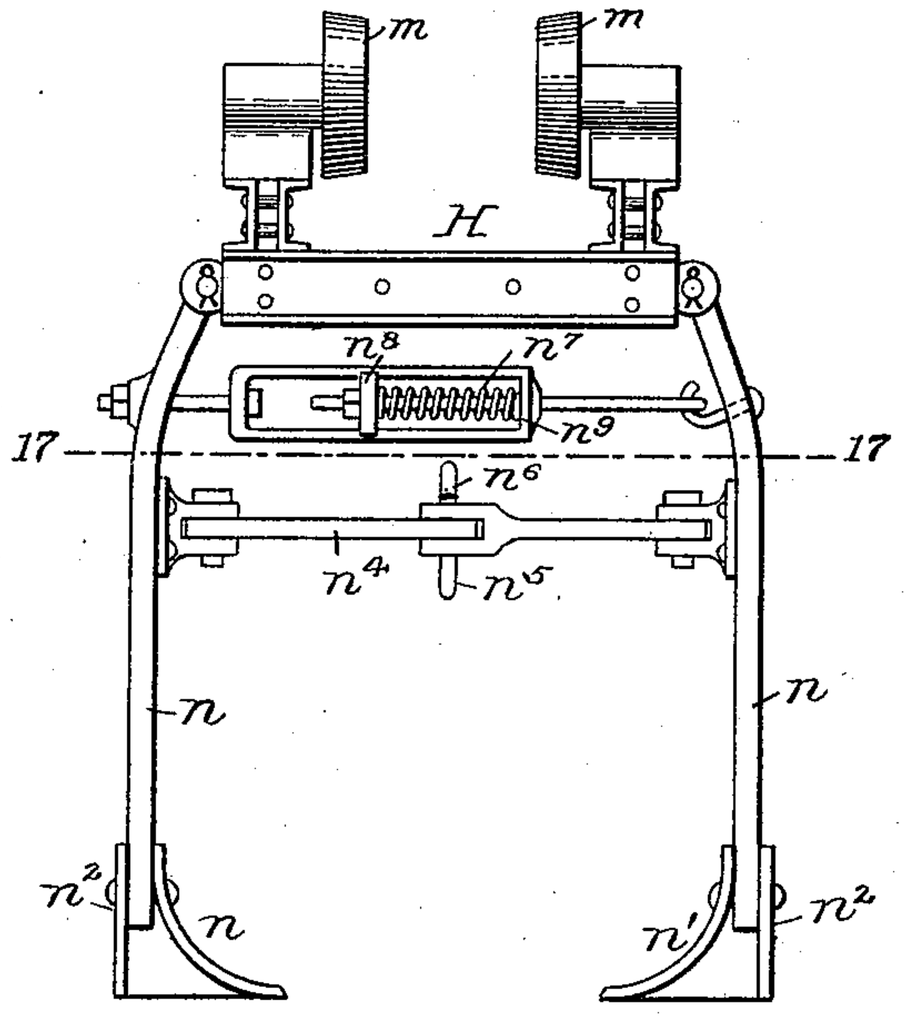
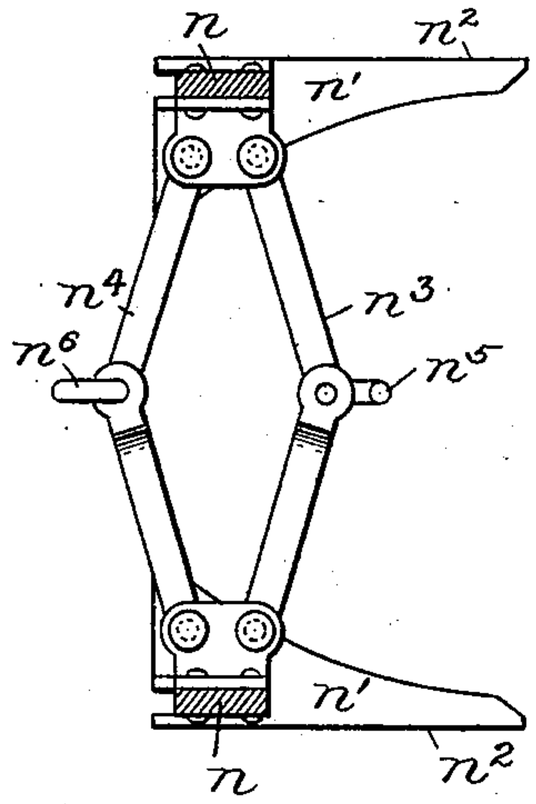


Fig. 17.



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No. 629,576. Patented July 25, 1899.

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EXCAVATING APPARATUS.

(Application filed Jan. 17, 1899.)

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Fig. 19.

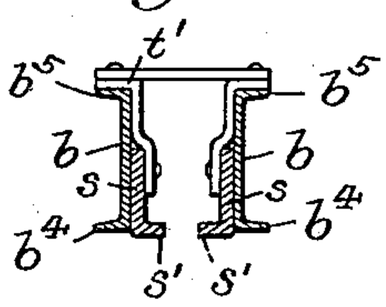
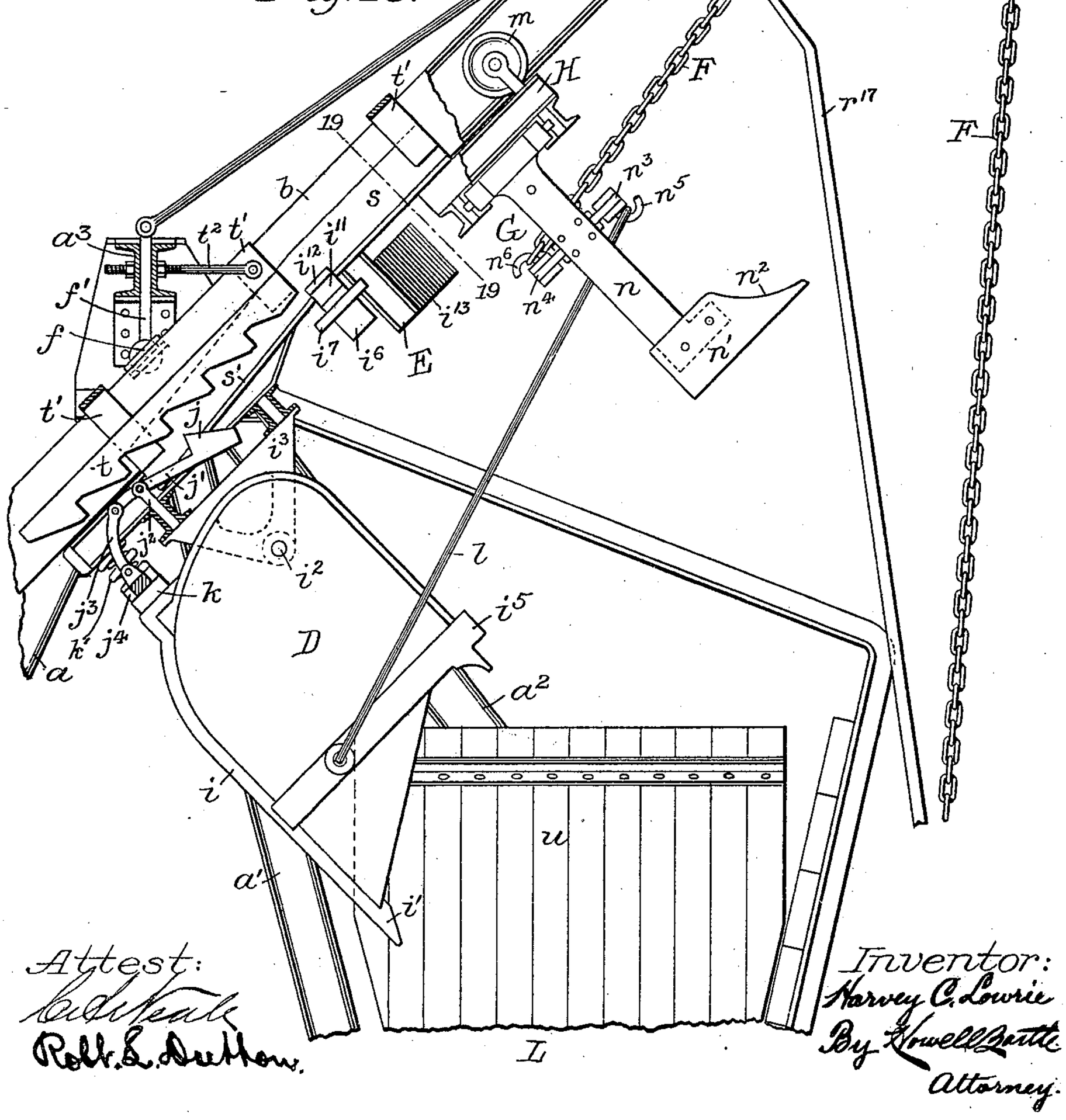


Fig. 18.



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EXCAVATING APPARATUS.

(Application filed Jan. 17, 1899.)

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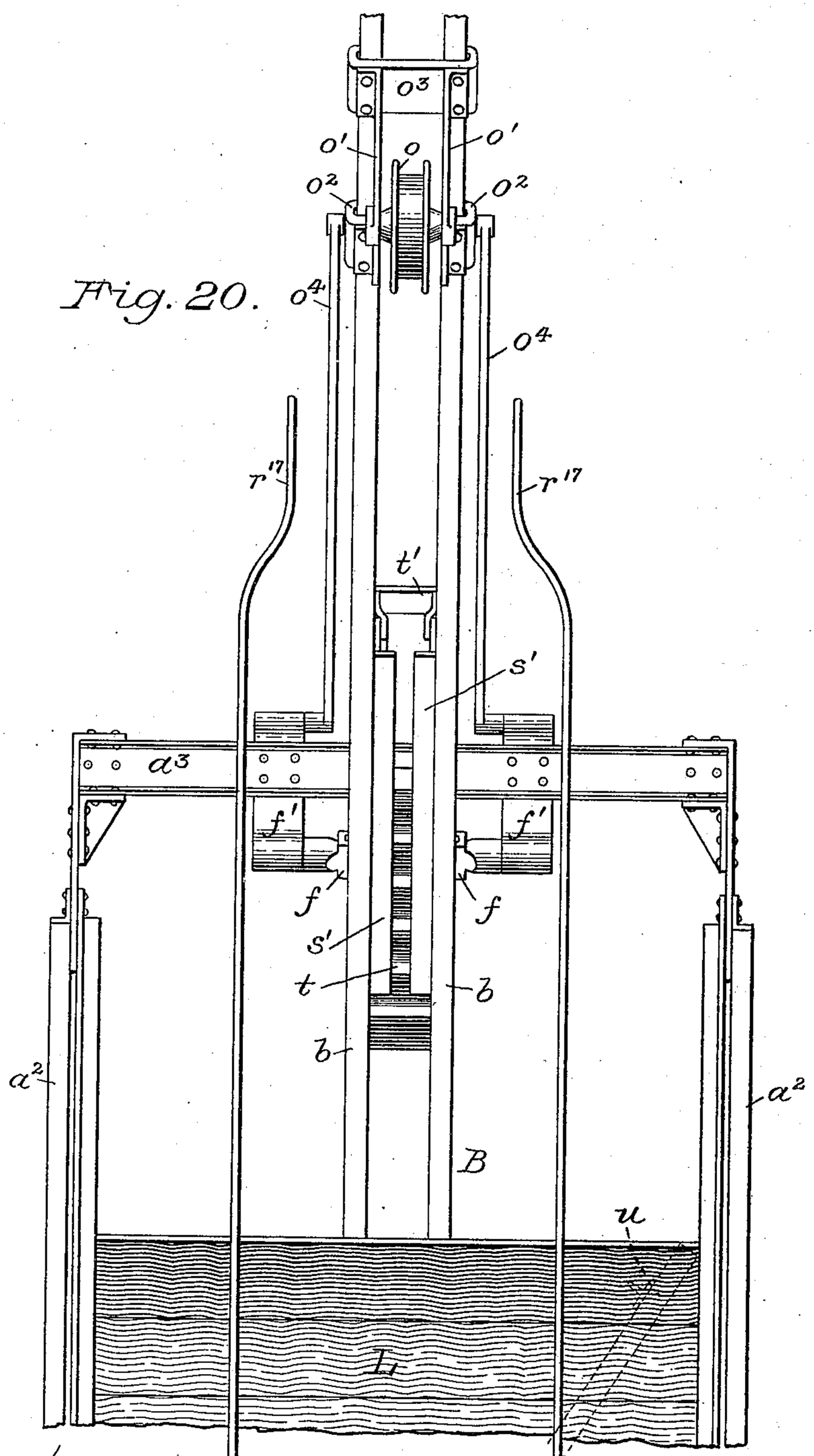
Fig. 20.



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UNITED STATES PATENT OFFICE.

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EXCAVATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 629,576, dated July 25, 1899.

Application filed January 17, 1899. Serial No. 702,393. (No model.)

To all whom it may concern:

Be it known that I, HARVEY C. LOWRIE, a citizen of the United States, residing at Denver, in the county of Arapahoe and State of Colorado, have invented new and useful Improvements in Excavating Apparatus, of which the following is a specification.

My invention relates to improvements in excavators, and particularly to the construction and mode of operation of what are known as "dipper-shovel" excavators. In apparatus of this class the dipper or scoop is usually mounted upon the end of an arm required to be alternately depressed and elevated and swung from side to side in the operation of loading and discharging, and the space necessary for a proper working of this apparatus and the variety of strains incident to the form of construction require a weight and cost of plant inapplicable to many kinds of work, particularly trenchwork and the excavation of small areas inaccessible to railway connections. The object sought by me is a dipper-shovel excavator capable of being constructed at comparatively small cost and applicable to excavating generally without regard to the extent or character of the work. With this in view I have constructed an apparatus in which the scoop or shovel travels up and down an inclined trolley-way readily adjustable to a breast of material and also to varying depths of excavation. The scoop is actuated from a hoisting-engine or other source of power by means of a draft rope or chain and when traveling up the incline gathers its load of material, which is automatically dumped at a predetermined point in its travel after the power has been released, the scoop then being returned to the bottom of the incline by gravity. As the scoop leaves the excavation on its upward passage the incline is automatically moved rearwardly and upwardly away from the breast of material, so that the scoop may descend into the excavation without contact therewith, and after each descent of the scoop the incline is automatically advanced, so that the entire apparatus is only advanced at intervals during the progress of the work.

For use in trenchwork I have devised a novel form of plow. This plow is trolley-mounted upon the inclined trolley-way in front of the scoop and so arranged and constructed that when it ascends the incline it will trim the sides of a trench to a width greater than the width of the scoop and when it descends the incline it will contract to a width less than that of the trench, so that both scoop and plow descend the incline without contact with the sides of the trench.

The entire apparatus is mounted in a suitable frame supported upon carrying-wheels for both longitudinal and lateral travel, and said wheels are arranged to be propelled by means of gearing adapted to be thrown into or out of engagement with the driving-shaft of an engine provided for operating the working parts of the apparatus.

After a detail description of an apparatus embodying my invention the features deemed novel will be duly specified in the claims hereunto annexed.

Referring to the drawings, Figure 1 is a side elevation of an apparatus embodying my invention. Fig. 2 is a view of the lower portion of Fig. 1 on a somewhat larger scale. Fig. 3 is a plan view of the apparatus, the rear portion being broken away and the main incline and roof removed. Fig. 4 is a plan view of the main incline removed from the apparatus. Fig. 5 is a view of a sliding yoke employed for preventing lateral movement of the main incline. Fig. 6 is a view illustrating the mounting of the front carrying-wheels. Fig. 7 is a side view of a portion of the base of the frame, illustrating the mounting of the rear carrying-wheels. Figs. 8, 9, and 10 illustrate the operator's carriage in side, top, and front views, respectively. Fig. 11 is a view illustrating the adjustable stop for limiting the rearward movement of the main incline. Fig. 12 is a side view of the scoop and plow and a portion of the main incline. Fig. 13 is a plan view of Fig. 12. Figs. 14 and 15 illustrate the scoop in rear and front views, respectively. Fig. 16 is a rear view of the plow. Fig. 17 is a sectional view of the plow on line 17 17 of Fig. 16. Fig. 18 is a side elevation of the upper portion of the apparatus, showing the scoop in its dumping position, a portion of the frame and of the main incline being broken away for disclosing the dumping mechanism. Fig. 19 is a cross-section of

the main incline on line 19 19 of Fig. 18, and Fig. 20 is a rear view of the upper portion of the apparatus.

While I have illustrated my apparatus in what I now consider to be its best form, it is to be understood that I do not limit myself to the details of construction nor to the particular form of frame shown, as these may be widely varied without departure from the main features of my invention.

In the apparatus illustrated in the drawings the main frame is made up chiefly of channel-beams, I-beams, and other forms incident to the use of structural steel, and the parts are united by gusset-plates or other well-known methods of connections. The base A is mounted upon carrying-wheels, and at each side thereof are erected three inclined struts a a' a^2, connected together at their upper ends and to a cross-piece a^3, the latter affording support for the upper end of an inclined trolley-way, hereinafter referred to as the "main incline." Extending rearwardly from the base A and rigidly secured thereto are two parallel inclined channel-beams a^4 a^4, the lower flanges of which afford a track for the support of the operator's carriage C. The beams a^4 a^4 are rigidly connected together at their outer ends by a cross-piece a^5 and are supported by means of rods or angle-irons a^6, secured to I-beams a^7 a^7, extending rearwardly from the base A at an angle thereto of about forty-five degrees. The beams a^7 a^7 are supported by tie-rods a^8, secured to their upper ends and to the cross-piece a^3, as clearly shown.

The operator's carriage C consists of a frame c, affording support for a seat c', foot-board c^2, driving-shaft c^3, windlass-shafts c^4 c^5, and crank-shafts c^6 c^7 c^8. The frame c is mounted upon carrying wheels or rollers c^9 c^9 and c^{10} c^{10}, supported upon the lower flanges a^9 a^9 of the beams a^4 a^4. The rear wheels or rollers c^9 c^9 are keyed to the driving-shaft c^3, the latter also carrying two gears c^{11} c^{11}, one at each side of the frame c. The gears c^{11} c^{11} engage with racks c^{12} c^{12}, mounted upon and projecting beyond the inner upper edges of the beams a^4 a^4. The driving-shaft c^3 is rotated for propelling the carriage C along the supporting-beams by means of a hand-crank c^{13}, secured to a shaft c^6, carrying pinion c^{14}, meshing with a gear c^{15}, keyed to the driving-shaft. The gears c^{11} c^{11} engaging with the racks c^{12} c^{12} move the carriage in one direction or the other, according to the direction of rotation of the hand-crank c^{13}. For locking the carriage in any position to which it has been moved I provide the driving-shaft c^3 with a well-known form of band-brake, consisting of a drum c^{16}, engaged and disengaged by a friction band or strap c^{17}, controlled by a hand-lever c^{18}, carrying a hand-operated pawl c^{19}, engaging a segmental rack c^{20}, as will be readily understood. In front of the driving-shaft c^3 are two windlass-shafts c^4 c^5, carrying spirally-grooved drums d d'. These drums are rotated by means of gears d^2 d^2, meshing with pinions d^3 d^3 on shafts c^7 c^8, having hand-cranks d^4 d^4, ratchet-wheels d^5 d^5, and locking-pawls d^6 d^6, all as clearly shown. The forward carrying wheels or rollers c^{10} c^{10} are mounted in brackets e' e', secured to the forward end of the frame c, the brackets e' e' also carrying clips e e, to be hereinafter referred to.

The main incline B is constructed of two parallel channel-beams b b, arranged back to back and rigidly secured together at their upper ends by cross-braces b' and at their lower ends by cross-pieces b^2 b^3, affording a space between the beams for mechanism to be hereinafter described. The lower end of the incline is made curved, as shown, in order to maintain an even depth of excavation, or occasionally vary the same, as may be required, as well as to facilitate locking the scoop in its working position by means of the draft-chain F. The lower flanges b^4 b^4 of the channel-beams b afford a track for the support of trolley-carriages carrying the earthworking-tools, and the upper flanges b^5 b^5 are utilized for supporting the incline, as will be presently explained. The upper end of the main incline is slidably and pivotally supported by means of clips f f at each side thereof provided with jaws which embrace the upper flanges b^5 b^5 and pivotally mounted in hangers f' f', secured to the cross-piece a^3, as illustrated in Figs. 18 and 20. The lower end of the main incline is suspended from the operator's carriage by chains d^{12}, secured to the windlass-drums d d' and to the incline, as illustrated in Fig. 1. At the extreme lower end of the incline is a spring-buffer provided for easing and breaking the fall of the scoop. This buffer consists of a lateral bar g, held in place by a bolt g', passing through the cross-pieces b^2 b^3 and provided with a collar g^2, affording an abutment for a spiral spring g^3, encircling the bolt and interposed between said collar and the cross-piece b^2, as clearly shown in Figs. 4 and 13. The cross-piece g is provided with lateral extensions g^4 below the edges of the beams b b in line with the rear ends of the scoop trolley-carriage E. The bolt g' being round, the bar g may be turned so that the trolley-carriages carrying the earthworking-tools may be readily removed from the incline.

The operator's carriage C and the main incline B are slidably connected together by the clips e e, pivotally mounted to the brackets e' e' and provided with jaws embracing the upper flanges b^5 b^5 of the incline, as shown in Figs. 8 and 10. It will now be understood that an operator seated upon the carriage C may raise or lower the incline by turning the hand-cranks d^4 d^4 and winding in or paying out on the supporting-chains d^{12}. The angular adjustment of the incline is varied by moving the carriage C forward or backward along its supporting-tracks by rotating the hand-crank c^{13} and operating the band-brake before re-

ferred to for holding the carriage in its position of adjustment. The longitudinal adjustment of the main incline is in reality a vertical adjustment with reference to the excavation, and the depth of cut may be thus varied without changing the angular adjustment of the incline, and the latter adjustment may also be varied without changing the depth of cut.

The main incline is held against lateral movement by a traveling yoke h, mounted between the channel-beams a^7 a^7. This yoke is slidably connected to the flanges of the beams a^7 a^7 and is provided with clips h' h', having jaws embracing the upper flanges of the incline, as shown in Fig. 5. The yoke g follows the swinging movements of the incline, but prevents lateral movement thereof without interfering with its longitudinal or vertical adjustment.

The scoop D is provided with runners i i and plow-points i' i' and is mounted upon trunnions i^2, rotating in brackets i^3, secured to the trolley-carriage E. The trolley-carriage E is built of channel-steel and is provided with rollers i^4, supported by and upon the lower flanges b^4 at each side of the main incline B. The trunnions i^2 i^2 are located at each side of the scoop and to the rear of its center of gravity, so that the scoop normally hangs in its dumping position illustrated in Fig. 18. At the front of the scoop is an arched cross-tie i^5, the front edge of which is engaged by bolts or latches i^6 i^6 at each side of the trolley-carriage for maintaining the scoop in its upright or working position. (Illustrated in Fig. 12.) These bolts i^6 i^6 are square-faced and project in the path of the cross-tie i^5, and they are mounted upon the under side of a cross-bar i^7, suspended from the trolley-carriage by bolts i^8 i^8 and backed by springs i^9 i^9, surrounding the bolts i^8 i^8, between the trolley-carriage frame and the cross-bar i^7, as clearly shown in Figs. 12 and 15. The cross-tie i^5 is provided with vertical ears i^{10} i^{10}, which engage the inner sides of the bolts or latches i^6 i^6 and prevent lateral deflection of the scoop and consequent strain upon the supporting-brackets i^3. On top of the bar i^7 and projecting upwardly between the channel-beams b b of the main incline is a lug i^{11}, provided with lateral projections i^{12} i^{12}, which when the scoop reaches the dumping-point at the upper end of the incline are engaged by flanges for raising the bolts i^6 and permitting the scoop to swing upon its trunnions and discharge its load. At the front of the trolley-carriage E, at each side thereof, are deflectors i^{13} i^{13}, these being provided to guard against impingement should material pile too high in front of the scoop in traveling up the incline. At the rear of the trolley-carriage E and projecting upwardly between the channel-beams of the main incline is a latch j, which engages with a toothed or notched bar l at the upper portion of the incline and prevents the scoop from descending until it has been discharged of its load, as will be hereinafter described. The latch j is formed upon the forward end of a lever j', pivoted in a bracket j^2 and connected at its rear end by a curved link j^3 to a cross-bar j^4. The cross-bar j^4 serves as a buffer to break the fall of the scoop in dumping and also to release the latch j, and it is suspended from the rear of the trolley-carriage E by means of bolts j^5 j^5 and backed by light spiral springs j^6 j^6, encircling the bolts, as clearly shown. At the rear of the scoop is a contact-bar k, which when the scoop swings to discharge its load strikes the cross-bar j^4 and raises the same, and as the blow is at times quite violent I provide additional springs k' k' at the rear of the bar j^4, encircling the springs j^6 j^6 and much heavier and somewhat shorter than the latter, so that the cross-bar will be raised sufficiently to release the latch j before coming in contact with the heavy springs, which arrest and ease the fall of the scoop. At the front of the scoop is a pivoted bail l, which when a plow or other earthworking-tool is not required is attached directly to the draft-chain F; but as here shown it is connected to the rear of a plow-frame G, mounted upon a trolley-carriage H, having rollers m, which travel upon the lower flanges of the main incline in the same manner as the rollers of the scoop trolley-carriage E before described.

The plow-frame G consists of two arms n n, pivoted to the trolley-carriage H to swing in lines transverse to the line of draft. At the ends of the arms n n are plows n' n', provided with outer cutting edges n^2 n^2 for trimming the sides of a trench. The arms n n are connected together by a pair of toggle-joints n^3 n^4. The forward toggle-joint n^3 is provided with a hook n^5 at its knuckle or joint, to which the bail l of the scoop is attached, and the rear toggle-joint n^4 is similarly provided with a hook n^6, to which the draft-chain F is attached. Above the toggle-joints is a spring n^7, which tends to draw and hold the arms n n together. This spring is interposed between abutments n^8 n^9, oppositely connected to the arms n n, in a manner well known and clearly shown in Fig. 16. It will now be understood that when power is applied to the draft-chain F the resistance of the scoop and plows while in engagement with the material being excavated will cause the toggle-joints n^3 n^4 to be drawn together, and the arms n n, carrying the plows n' n', will in consequence be thrust apart and the latter brought in proper position for trimming the sides of the trench wider than the width of the scoop. After the scoop has ascended the incline and discharged its load the spring n^7 exerts its force to draw the arms n n together, so that both scoop and plows descend the incline free from contact with the sides of the trench.

The draft-chain F passes over a pulley o, connected to the main incline at or near its upper end and above its pivotal support, and thence downwardly over pulleys p and p' to

the windlass I of the hoisting-engine supported upon the base A. The pulley *o* is mounted in brackets *o' o'*, secured to two yokes o^2 o^3, embracing the lower flanges of the main incline, and pivoted to the yoke o^2 are bars o^4 o^4, pivotally connected at their other ends to the cross-piece a^3 of the main frame, as clearly illustrated in Figs. 18 and 20. It will be seen that the pulley *o* although mounted upon the main incline will always maintain the same relative position to the pivotal point of the main incline regardless of the longitudinal adjustment thereof. It is also to be noted that the pulley *o* is located some distance beyond the point at which the upper end of the main incline is supported by the frame of the apparatus and that the pull upon the draft-chain F from said pulley is in a downward direction. This downward pull upon the pulley *o* tends to raise the lower end of the incline away from the breast of the excavation, and this is an important feature in the working of my apparatus. The band-brake upon the operator's carriage being released and power being applied to the draft-chain the lower end of the main incline will be held down by the engagement of the plows and the scoop with the material being excavated; but as soon as the plows and scoop leave the excavation the lower end of the incline will immediately raise and push the operator's carriage back upon its supporting-tracks, and if before the power is released upon the draft-chain the band-brake be operated to hold the operator's carriage in the position to which it has been moved the incline will be held in its rearward or raised position and the scoop and plows will be free to descend into the excavation without contact with the breast thereof. Upon one or both of the beams a^4 a^4 composing the support and tracks for the operator's carriage I provide an adjustable stop J. (Specially illustrated in Fig. 11.) This stop consists of a plate *q*, resting upon the lower flange of the beam a^4 and provided with upright projections or flanges *q' q'* and a jaw q^2, the latter embracing the beam a^4 for holding the plate *q* in place, while at the same time permitting it to be moved back and forth thereon. A series of holes q^3 are provided in the beam a^4 in line with a hole q^4 in the plate *q*, so that said plate may be locked in different positions of adjustment along said beam by a pin q^5, as clearly shown. In front of the plate *q* is a stop-plate q^6, secured to the end of a rod q^7, sliding in the upright flanges of the plate *q*, and said plate q^6 is backed by a spring q^8. This stop J is placed in the rear of the operator's carriage, in line with the rear wheels thereof, and is engaged thereby for limiting the upward movement of the lower end of the main incline caused by the downward pull upon the upper end thereof, before explained.

The hoisting-engine is of a type well known as "double friction-hoist," and consists of a pair of cylinders *r r*, the pistons of which are connected to a driving-shaft *r'*, the latter carrying friction-wheels r^2 r^2, engaging with friction-wheels r^3 r^3 on a parallel shaft r^4, carrying the hoisting-drum I. As is usual with this form of hoist, the friction-wheels r^3 r^3 are eccentrically mounted upon their supporting-shaft, so that a partial rotation of the latter will cause the friction-wheels carried thereon to be moved toward or from the driving-shaft *r'* for engagement with or disengagement from the friction-wheels r^2 r^2, as will be readily understood. The drum-shaft r^4 is rotated by a lever r^5, secured to the end of the shaft and connected by a second lever r^6 and rod r^7 to a hand-lever r^8, pivoted to one of the beams a^7 directly over and within reach of an operator seated upon the carriage C. The windlass-drum I is spirally grooved and made tapering, as shown, and the pulleys *p* and *p'*, supporting and guiding the chain F, are slidably mounted upon their supporting-shafts to follow the lateral movements of the draft-chain in winding upon or unwinding from the windlass. Steam is supplied to the cylinders *r r* from an upright boiler K through pipes r^9, provided with cut-off valves r^{10} and r^{11}, the former having a hand-lever r^{12} and the latter a lever r^{13}, connected by link r^{14} with an arm r^{15}, fixed to a shaft r^{16}, the latter carrying two upright arms r^{17} r^{17}, lying in the path of the scoop or other earthworking-tools traveling upon the main incline. The arms r^{17} lean to the rear of the apparatus, and the weight of these arms, together with the weight of the arm r^{15} and link r^{14}, hold the valve r^{11} in its open position and open the same after it has been closed by the earth working-tools, as will be explained.

Between the channel-beams composing the main incline B, at a point closely adjacent to its pivotal support, are two iron plates *s s*, provided with flanges *s' s'*, separated from each other by a space sufficient for the passage of the scoop-releasing lug i^{11} before referred to. The flanges *s' s'* are below the lower edge of the incline at the forward ends of the plates *s s* and extend upwardly on a gradual incline to a point about even therewith. Above the flanges *s' s'* and extending somewhat beyond the forward ends thereof is a notched or toothed bar *t*, with which the latch *j* on the scoop trolley-carriage engages for preventing descent of the scoop until after it has discharged its load into the hopper L. The plates *s s* and toothed bar *t* are secured to hangers *t' t' t'*, resting loosely upon the upper edges of the beams *b b*. The plates *s s* and the toothed bar *t* are permanently and pivotally connected to the main frame of the apparatus by a rod t^2, pivotally connected to one of the hangers *t'* and adjustably connected to the cross-piece a^3, so that the notched bar *t* and the plates *s s* always occupy the same relative position to the main frame and the hopper L regardless of the longitudinal adjustment of the main incline.

The scoop discharges into a hopper L, sup-

ported by and between the struts a' a' and a^2 a^2 of the main frame. The bottom of the hopper inclines downwardly from the center toward the sides of the apparatus and is formed at each side into a chute sufficiently high above the ground to admit of discharging into carts or upon any of the well-known mechanical conveyers. At the center or apex of the bottom of the hopper is a hinged partition u, which is swung from side to side for controlling the discharge of material wholly to the one side or the other of the apparatus, as may be necessary or desirable. Beneath the hopper L is a water-tank O for supplying the boiler K.

The operation of the working parts of the apparatus as thus far described is as follows: The driving-shaft r' of the hoisting-engine being in continuous operation and the earth-working-tools being at the bottom of the main incline the operator, seated upon the carriage C, pushes the lever r^8, which rotates the windlass-shaft r^4. The friction-wheels r^3 r^3 being eccentrically mounted upon said shaft are thus brought into contact with the friction-wheels r^2 r^2 on the driving-shaft r' and the windlass I operated for winding in on the draft-chain F. The plows and scoop being attached to the end of the draft-chain ascend the main incline, the plows cutting a path for the scoop and the latter slicing off and gathering up a load of material from the sloping breast to which the main incline has been adjusted. As the plows and scoop start up the incline the operator releases the band-brake holding the operator's carriage, and as the plows and scoop leave the excavation and no longer offer resistance to the upward movement of the lower end of the incline by their hold upon the breast of material the downward pull of the draft-chain upon the upper end of the incline causes its lower end to move outward and upward away from the breast of the excavation. The operator's carriage being connected to the incline by the clips e e and free to travel upon its supporting-tracks is pushed back until the rear wheels c^9 are brought in contact with the stop J, which may be adjusted forward or backward along the beams a^4 for increasing or diminishing the upward movement of the lower end of the incline, as may be desired. After the incline has been raised and before the scoop has reached the end of its upward travel the operator locks the carriage C by means of the band-brake, and thus holds the lower end of the incline in its raised position, so that the scoop and plows in descending the incline will be free from contact with the breast of the excavation. It has already been explained that in ascending the incline the plows cut a trench wider than the width of the scoop and in descending the incline are drawn together, so that both scoop and plows will be free from contact with the sides of the trench. When the scoop reaches the dumping-point, the lug i^{11}, carried by the cross-bar i^7, to which the scoop-bolts i^6 i^6 are attached, enters the space between the flanges s' s' on the plates s s, and said flanges passing beneath the lateral projections i^{12} upon said lug raises the same and causes scoop to be released from the bolts i^6 i^6, free to swing upon its trunnions when permitted to do so by the slackening of the draft-chain F. At the same time the scoop-bolts are being raised the latch j on the trolley-carriage E engages with the notched or toothed bar t and prevents the scoop from descending the incline until its load has been discharged. When the scoop has reached the proper point, the operator is supposed to release the hoisting-windlass from engagement with its driving-shaft; but should he fail to do so the plow-frame G (or the scoop when the plows are not used) will come in contact with the arms or levers r^{17} and operate the valve r^{11} to cut off steam from the driving-engine; but it is obvious the scoop cannot dump until the operator frees the hoisting-windlass. The moment this is done the chain F unwinds from the windlass and the scoop discharges its load into the hopper L. The swinging of the scoop in dumping causes the contact-bar at the rear thereof to strike the bar j^4 at the rear of the trolley-carriage and raise the same sufficiently to release the latch j from the toothed bar t. The scoop and plows being now free descend by gravity to the bottom of the incline, and in order to prevent a too rapid descent and provide sufficient tension upon the draft-chain F to raise the forward end of the scoop I have provided a band-brake v, (shown in Fig. 2,) which operates against one of the friction-wheels r^3. This band-brake is under the control of the operator by means of a hand-lever v', connected by link v^2 with a lever v^3, attached to the band v in a manner well known. When the earth-working tools have descended to the bottom of the incline, the operator releases the band-brake upon the operator's carriage, which allows the lower end of the incline to descend and rest upon the scoop and plow-frame. The pull upon the draft-chain F at the next operation of the apparatus which is now repeated causes the forward end of the scoop to be drawn into locking engagement with the bolts for holding it in its operative position. It will be seen that as the work progresses the operator's carriage will be moved gradually forward by the gradually-advancing movement of the main incline, due to the removal of material from the breast of the excavation, and this advancing movement of the incline continues until the breast of the excavation has been cut away to a point necessitating a forward movement of the entire apparatus. When this point has been reached, the operator moves the carriage C rearwardly upon its supporting-tracks and by this means moves the main incline rearwardly, so that the entire apparatus may be advanced until the

main incline is again brought into proper working relation to the breast of the excavation.

To facilitate the movements of the entire apparatus, the base A is mounted upon carrying-wheels w w and w' w', and as these wheels are occasionally to be removed I have so mounted the apparatus upon the axles thereof that it may be raised bodily therefrom by the use of jacks or other means, the weight of the apparatus being relied upon for holding the axles and frame together. At the rear of the base A are open bearings w^2, Fig. 7, which rest upon the axle w^3, carrying the rear wheels w w. Attached to the inner sides of the wheels w w are gears w^4 w^4, meshing with smaller gears w^5 w^5, fixed upon a shaft w^6, mounted in suitable bearings secured to the base A. About midway of the shaft w^6 is a gear w^7, loosely mounted on said shaft and meshing with a gear (not shown) carried by a shaft w^8, the latter gear meshing with a gear w^9, carried by the driving-shaft r' of the engine, as illustrated in Figs. 2 and 3. The gear w^7 is secured to one member of a clutch w^{10}, the other member of the clutch rotating with the shaft and sliding thereon for coupling the gear and shaft in a manner well known. The clutch w^{10} is operated by a link w^{11}, coupled to a lever w^{12}, secured to the end of an upright rock-shaft w^{13}. At the upper end of said rock-shaft is a lever w^{14}, connected by rod w^{15} to a hand-lever w^{16}, located above the operator's carriage C. It will be readily understood that by pulling the hand-lever w^{16} the clutch w^{10} will be operated to lock the gear w^7 and shaft w^6, and thus put into operation the chain of gearing connecting the rear wheels with the engine driving-shaft r'. By this means the apparatus is moved backward or forward according to the direction of rotation of the engine driving-shaft.

The front carrying-wheels w' w' are mounted upon an axle w^{17}, secured to the lower member of a fifth-wheel w^{18}, the upper member thereof being provided with a curved saddle w^{19}, having flanges w^{20}, between which rests a cross-beam a^{10}, curved at its center and forming a part of the base A. It will be seen that by thus mounting the forward carrying-wheels I provide for considerable rocking movement of the axle w^{17} independent of the frame of the apparatus, and the apparatus may travel over quite uneven surfaces without tilting from side to side in response to the movements of the supporting-axle. The apparatus is guided by means of a chain w^{21}, attached to the ends of the axle w^{17} and passing around a sprocket or drum w^{22}, controlled by a hand-wheel w^{23}, as will be readily understood. The front wheels w' w' are also provided with a brake w^{24}, controlled by a chain w^{25}, sprocket-wheel w^{26}, and hand-wheel w^{27} in the usual way. At the rear of the carrying-wheels w w is a drag w^{28}, secured by chains w^{29} to the base A for preventing backward movement of the apparatus, and at the rear of the beams a^4 I show supporting-braces a^{11}, provided with a shoe a^{12}. The braces a^{11} are employed for preventing backward movement and steadying the rear portion of the apparatus, as occasion may require.

In excavating large areas it is necessary that the apparatus be moved laterally as well as longitudinally, and I have therefore provided lateral carrying wheels or rollers x x and x' x', designed to travel upon lateral tracks formed of timber or other material. The apparatus is transferred from the longitudinal traveling wheels to the lateral tracks by raising the entire apparatus by jacks or other means sufficiently to free the base A from the front and rear axles w^{17} and w^3, and these being removed the apparatus is lowered upon the lateral tracks previously placed in position beneath the lateral carrying-wheels. The wheels or rollers x x and x' x' are mounted upon shafts x^2 x^3, lying parallel with the right and left hand sides of the apparatus and secured in bearings x^4, bolted to the base A, as illustrated in Figs. 2 and 3. The shafts x^2 and x^3 each carry a beveled gear x^5, meshing with bevel-gears x^6 x^6 upon short lateral shafts x^7 x^7, also supported in bearings secured to the base A. Loosely mounted upon the shafts x^7 x^7 are gears x^8 x^8, meshing with gears x^9 x^9, carried by the shaft w^8, which is continuously driven by the engine driving-shaft r' and before referred to. The gears x^8 x^8 are each provided with a sliding clutch x^{10} x^{10} to throw the gears into or out of rotative engagement with their respective shafts, and these clutches are operated by rods and levers connected to hand-levers accessible from the operator's carriage in the same manner as the clutch before described for controlling the longitudinal travel of the apparatus.

If the direction of rotation of the several gears be traced in the plan view illustrated in Fig. 3, it will be seen that when the engine-shaft is rotating in the proper direction for operating the windlass-drum I, if the clutch x^{10} at the left-hand side of the apparatus be operated to couple the gear x^8 with its shaft x^7, the wheels or rollers x' x' will be rotated for moving the apparatus to the left, and if the clutch at the right-hand side of the apparatus be similarly operated the wheels or rollers x x will rotate for moving the apparatus to the right.

In excavating large areas the supporting-track for lateral travel should be thrown slightly forward at each end alternately after the apparatus has traversed the length of the track, so that a continuous forward movement will be effected and a large area covered without the aid of the longitudinal carrying-wheels.

In trench work, as for the laying of pipe, the rapid advance of my apparatus, together with the great advantage of making no deposits upon the banks of the trench, as is customary under usual methods, greatly lessens

the liability of dangerous caving or collapsing of the banks so usual in such work. By keeping the work of pipe-laying closely up behind the excavator the ordinary sheeting and shoring of the sides of the trench will be unnecessary. To guard against occasional cavings, however, I provide a hood or shield N to guard the workmen and the lower end of the main incline, as illustrated in Fig. 1. The hood or shield N is composed of steel or sheet-iron, arched at its top and open at its bottom and ends and braced by suitable ribs *y*. At the forward end of the shield is a U-shaped brace *y'*, which holds the sides of the shield rigidly apart, and said brace is provided with a runner y^2, bearing upon the bed of the trench and supporting the forward end of the shield. The rear end of the shield is adjusted and controlled by means of a long arm or handle y^3, extending upwardly and rearwardly therefrom to the surface line of the excavation. The hood or shield is made slightly tapering from front to rear, so that it may be readily disengaged should material cave upon it. Caves in advance of the shield will be infrequent and easily handled by the scoop and when behind or upon it no harm will be done. The shield is advanced by means of a chain y^4, connected to and readily disconnected from the main incline B. In traveling from place to place the shield is removed and the main incline adjusted to the position illustrated in dotted lines in Fig. 1.

In order to protect the hoisting-engine and gearing from water or dirt falling from the scoop, I have provided a roof *z*, composed of corrugated iron plates connected together and well turned up at the sides, as at *z'*, to form a trough, as illustrated in Fig. 2. Where the roof is pierced by levers, I provide boxes or flanges z^2, surrounding the lever-slots, and covers z^3, loosely secured to and moving with the levers, as clearly shown.

I have illustrated and described my apparatus as an excavating apparatus; but it is obvious that it may be mounted upon a boat instead of carrying-wheels and advantageously used as a dredging apparatus. The form of scoop employed in my apparatus and its mode of operation possess many advantages over the hinged-bottom scoop carried upon the end of a swinging arm or beam, usual in most forms of dredging-machines.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an excavating apparatus, the combination of an incline having a scoop or other earthworking tool or tools supported and guided thereby and adapted to travel thereon, means for controlling the said earthworking tool or tools, and means whereby the said incline may be adjusted longitudinally without varying its inclination, and its inclination varied without varying its longitudinal adjustment, substantially as described.

2. In an excavating apparatus, the combination of an inclined trolley-way, a scoop or other earthworking tool or tools supported and guided thereby and adapted to travel thereon, the said trolley-way being slidably and pivotally supported at its upper end and suspended at its lower end by means of a rope or chain controlled by a windlass longitudinally movable with relation to the apparatus, whereby the said trolley-way may be raised or lowered without varying its inclination, or its inclination varied without varying its vertical adjustment, substantially as described.

3. In an excavating apparatus, the combination of an inclined trolley-way, a scoop or other earthworking tool or tools supported and guided thereby and adapted to travel thereon, the said trolley-way being slidably and pivotally supported at its upper end and slidably connected at its lower end to a movable support, and means for supporting and moving said trolley-way longitudinally, substantially as described.

4. In an excavating apparatus, the combination of an inclined trolley-way having a scoop or other earthworking tool or tools supported thereby and adapted to travel thereon, means for controlling the movements of said earthworking tool or tools, and means for automatically moving the lower end of said trolley-way rearwardly during the ascent of the earthworking tool or tools, substantially as described.

5. In an excavating apparatus, the combination of an inclined trolley-way having a scoop or other earthworking tool or tools supported thereby and adapted to travel thereon, means for controlling the movements of the earthworking tool or tools, and means for automatically advancing the trolley-way after each operation of the earthworking tool or tools, substantially as described.

6. In an excavating apparatus, the combination of an inclined trolley-way pivotally supported near its upper end and flexibly supported at its lower end so that a downward pull upon its upper end will correspondingly raise its lower end, a scoop or other earthworking tool or tools supported by and traveling upon said trolley-way, a pulley connected to the trolley-way above its pivotal support, a draft chain or rope attached to the earthworking tool or tools passing over said pulley and thence downwardly to a source of power, substantially as described.

7. In an excavating apparatus, the combination of a main frame, a longitudinally-adjustable inclined trolley-way pivotally supported at its upper end and flexibly supported at its lower end, a scoop or other earthworking tool or tools supported by and traveling upon said trolley-way, a pulley slidably connected to the upper end of the trolley-way above its pivotal support, and a draft chain or rope attached to the earthworking tool or

tools passing over said pulley and thence downwardly to a source of power, substantially as described.

8. In an excavating apparatus, the combination of an inclined trolley-way slidably and pivotally supported at its upper end, a scoop or other earthworking tool or tools supported by and adapted to travel upon said trolley-way, a carriage slidably connected to the trolley-way and supported upon tracks above the lower end and in line with the swinging movements thereof, means for moving and locking said carriage upon its supporting-tracks, a windlass or windlasses located upon said carriage, a chain or its equivalent connecting said windlass or windlasses with the lower end of the trolley-way, a draft chain or rope attached to the earthworking tool or tools, the said draft-chain passing over a pulley connected to the trolley-way above its pivotal support and thence downwardly to a source of power, substantially as described.

9. In an excavating apparatus, the combination of an inclined trolley-way having its upper end slidably supported in pivoted bearings, a carriage located above the lower end of said trolley-way and slidably connected thereto, means for moving the carriage in lines practically parallel with the swinging movements of said trolley-way, a windlass on said carriage, and a chain or rope connecting the windlass and the lower end of the trolley-way, and a scoop or other earthworking tool or tools adapted to travel on said trolley-way, substantially as described.

10. In an excavating apparatus, the combination of an inclined trolley-way slidably and pivotally supported at or near its upper end, a carriage located above the lower end thereof and slidably connected thereto, means for moving said carriage in lines practically parallel with the swinging movements of the trolley-way and locking it against movement, means for supporting said trolley-way longitudinally, a scoop or other earthworking tool or tools mounted upon said trolley-way and adapted to travel thereon, and means for controlling the movements of said earthworking tool or tools, substantially as described.

11. In an excavating apparatus, the combination of an inclined trolley-way pivotally supported near its upper end, a movable carriage connected to said incline below its pivotal support, a scoop or other earthworking tool or tools mounted upon said trolley-way and adapted to travel thereon, a pulley connected to the trolley-way above its pivotal support, a draft chain or rope attached to said tool or tools passing over said pulley and thence downwardly to a source of power, and a stop for limiting the backward movement of the carriage connected to the trolley-way, substantially as described.

12. In an excavating apparatus the combination of an inclined trolley-way pivotally supported at or near its upper end a movable carriage connected to said trolley-way below its pivotal support, means for locking said carriage against movement, a scoop or other earthworking tool or tools mounted upon said incline and adapted to travel thereon, a pulley connected to the upper end of the trolley-way above its pivotal support, a draft chain or rope attached to said earthworking tool or tools passing over said pulley and thence downwardly to a source of power, substantially as described.

13. In an excavating apparatus, the combination substantially as hereinbefore described, of a main frame, a longitudinally-adjustable trolley-way mounted in said frame, a self-dumping scoop mounted on said trolley-way and adapted to travel thereon, mechanism for releasing the scoop-dumping mechanism slidably mounted on said trolley-way and permanently connected to the main frame of the apparatus, whereby the scoop will be dumped at a fixed point with relation to the main frame, regardless of the longitudinal adjustment of the trolley-way.

14. In an excavating apparatus, the combination substantially as hereinbefore described, of a main frame, a longitudinally-adjustable trolley-way mounted in said frame, a self-dumping scoop mounted upon said trolley-way and adapted to travel thereon, a hopper also mounted in said frame, and mechanism for releasing the dumping mechanism of the scoop slidably connected to the trolley-way and permanently connected to the main frame of the apparatus in proper relation to said hopper, whereby the scoop will discharge into said hopper regardless of the longitudinal adjustment of the trolley-way.

15. In an excavating apparatus, the combination of an inclined trolley-way, a self-dumping scoop adapted to travel thereon, means carried by the scoop for maintaining it in its working position, a draft chain or rope for hauling the scoop up the trolley-way, a latch for holding the scoop at the upper end of the trolley-way adapted to be released by the action of the scoop in dumping, and means for releasing the dumping mechanism of the scoop, substantially as described.

16. In an excavating apparatus, the combination of plows adapted to travel back and forth upon a suitable support and trim the sides of a trench, and means for moving and holding the plows in proper working position when traveling in one direction and withdrawing and holding the same away from the sides of a trench when traveling in an opposite direction, substantially as described.

17. In an excavating apparatus, the combination of a scoop adapted to travel back and forth upon a suitable support, plows traveling with said scoop in advance thereof adapted to trim the sides of a trench, and means for automatically moving and holding said plows in position to trim the sides of a trench wider than the width of the scoop during the forward movement of the latter, and automatically withdraw the same away from the sides

of the trench when traveling in the opposite direction, substantially as described.

18. In an excavating apparatus, the combination of a trolley-way, a scoop supported thereby and adapted to travel back and forth thereon, plows traveling with said scoop in advance thereof adapted to trim the sides of a trench, and means for automatically moving and holding said plows in working position during the advance movement of the scoop and automatically moving the same away from the sides of the trench during the return movement thereof, substantially as described.

19. In an excavating apparatus, the combination with a scoop or other earthworking-tool adapted to travel back and forth upon a suitable support, plows mounted in advance of said scoop or other earthworking-tool and adapted to trim the sides of a trench, the said plows being carried by arms pivoted to swing in lines transverse to the line of draft, a pair of toggle-joints connecting said arms and moving in opposite directions, a draft chain or rope connected to the knuckle of one of said toggle-joints, the other of said toggle-joints being connected to the scoop or other earthworking-tool, whereby a pull upon said draft chain or rope will cause the arms carrying the plows to be thrust apart, and a spring for drawing said arms together, substantially as described.

20. In an excavating apparatus, the combination of a trolley-way, a trolley-carriage adapted to travel thereon, a scoop carried by said trolley-carriage adapted to swing in a line parallel to the line of draft and to normally hang in its dumping position, latching mechanism for maintaining the scoop in its working position, mechanism for releasing said latching mechanism and a draft chain or rope attached to said scoop at or near its lower front portion, whereby a pull upon said draft-chain will cause the scoop to be engaged by its latching mechanism, substantially as described.

21 In an excavating apparatus, the combination of an inclined trolley-way, a trolley-carriage adapted to travel back and forth thereon, a scoop carried by said trolley-carriage adapted to swing in lines parallel to the line of draft and to normally hang in its dumping position, latching mechanism for maintaining the scoop in its working position, a latch carried by the trolley-carriage, a keeper at the upper end of the trolley-way for engaging said latch, means whereby said latch is automatically released by the action of the scoop in dumping, and means for releasing the dumping mechanism of the scoop, substantially as described.

22. In an excavating apparatus, the combination of a main frame, an inclined trolley-way slidably and pivotally supported at its upper end, means for varying the inclination and longitudinal adjustment of said trolley-way, and a yoke slidably mounted in the main frame at right angles to the trolley-way and slidably connected therewith for preventing lateral motion thereof, substantially as described.

23. In an excavating apparatus, the combination of a trolley-way having a scoop or other earthworking tool or tools supported thereby and adapted to travel thereon, a windlass, a draft-chain attached to said earthworking tool or tools and to said windlass, an engine for driving said windlass, and a lever or levers mounted in the path of said tool or tools for controlling the supply of steam to the engine, substantially as described.

24. In an excavating apparatus, the combination of an inclined trolley-way, a scoop or other earthworking tool or tools supported thereby and adapted to travel thereon, and a hood or shield connected to the lower end of said trolley-way for preventing the path of the scoop from becoming clogged at the bottom of the trolley-way by a caving in of the side walls of a trench, substantially as described.

25. In an excavating apparatus the combination of an inclined trolley-way having an outwardly-curved lower end, a trolley-carriage adapted to travel back and forth thereon, a scoop suspended from said trolley-carriage adapted to swing in a line parallel to the line of draft and normally hang in its dumping position, latching mechanism for engaging and holding said scoop in its working position, and a draft chain or rope working in a line practically parallel to the trolley-way and attached to the scoop below its pivotal point, substantially as described.

26. In an excavating apparatus, the combination with a main frame, of two sets of carrying-wheels arranged at right angles to each other, one set being readily detachable from said frame and having their tread-surface below that of the other set, an engine mounted upon said frame, and means for operatively connecting and disconnecting the wheels of either set with the driving-shaft of said engine, substantially as described.

27. In an excavating apparatus, the combination of a main frame, an inclined trolley-way slidably and pivotally supported at its upper end, a carriage slidably connected to said trolley-way supported upon tracks located above the lower end of said trolley-way in line with the swinging movements thereof, racks secured to said tracks, a driving-shaft mounted in said carriage carrying pinions meshing with said racks, a hand-lever for operating said driving-shaft, a brake for locking said shaft against rotation, a windlass carried by said carriage, means for operating said windlass, a chain or rope connected to the lower end of the trolley-way and to said windlass, a self-dumping scoop trolley-mounted upon said trolley-way, scoop-dumping mechanism slidably connected to the trolley-way and permanently connected to the frame of the apparatus, a hopper located in proper relation to the scoop-dumping mechanism, a

pulley slidably connected to the trolley-way above its pivotal support and permanently connected to the main frame, and a draft chain or rope attached to said scoop and passing over the pulley at the upper end of the trolley-way and downward to a source of power, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

HARVEY C. LOWRIE.

Witnesses:

FREDERIC S. WATKINS,

FRED. LOCKWOOD.