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W. D. SHERMAN.

AERIAL HOISTING AND TRANSFER APPARATUS.

No. 539,448. Patented May 21, 1895.

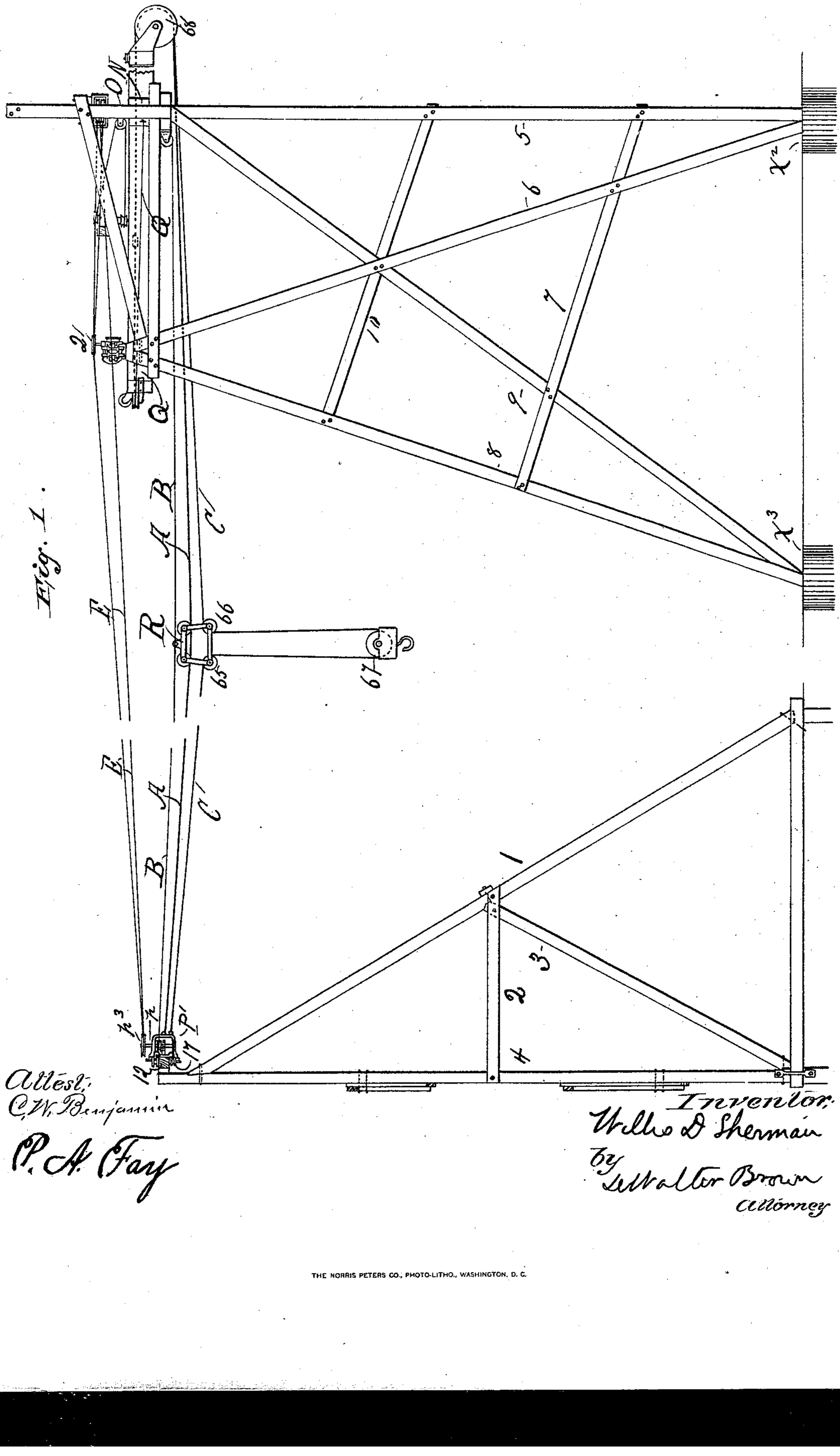

Fig. 1.

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Inventor:
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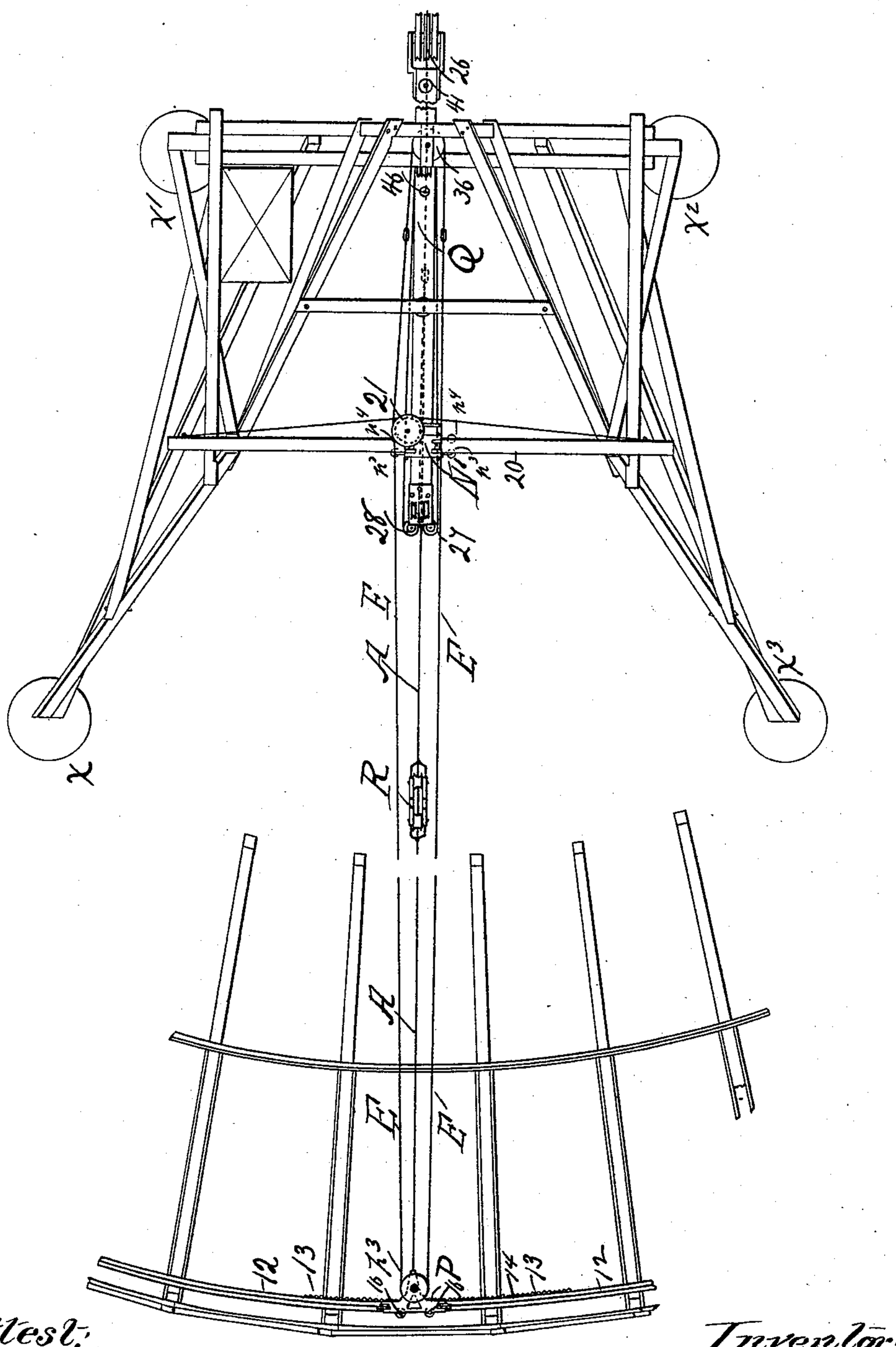

Fig. 2.

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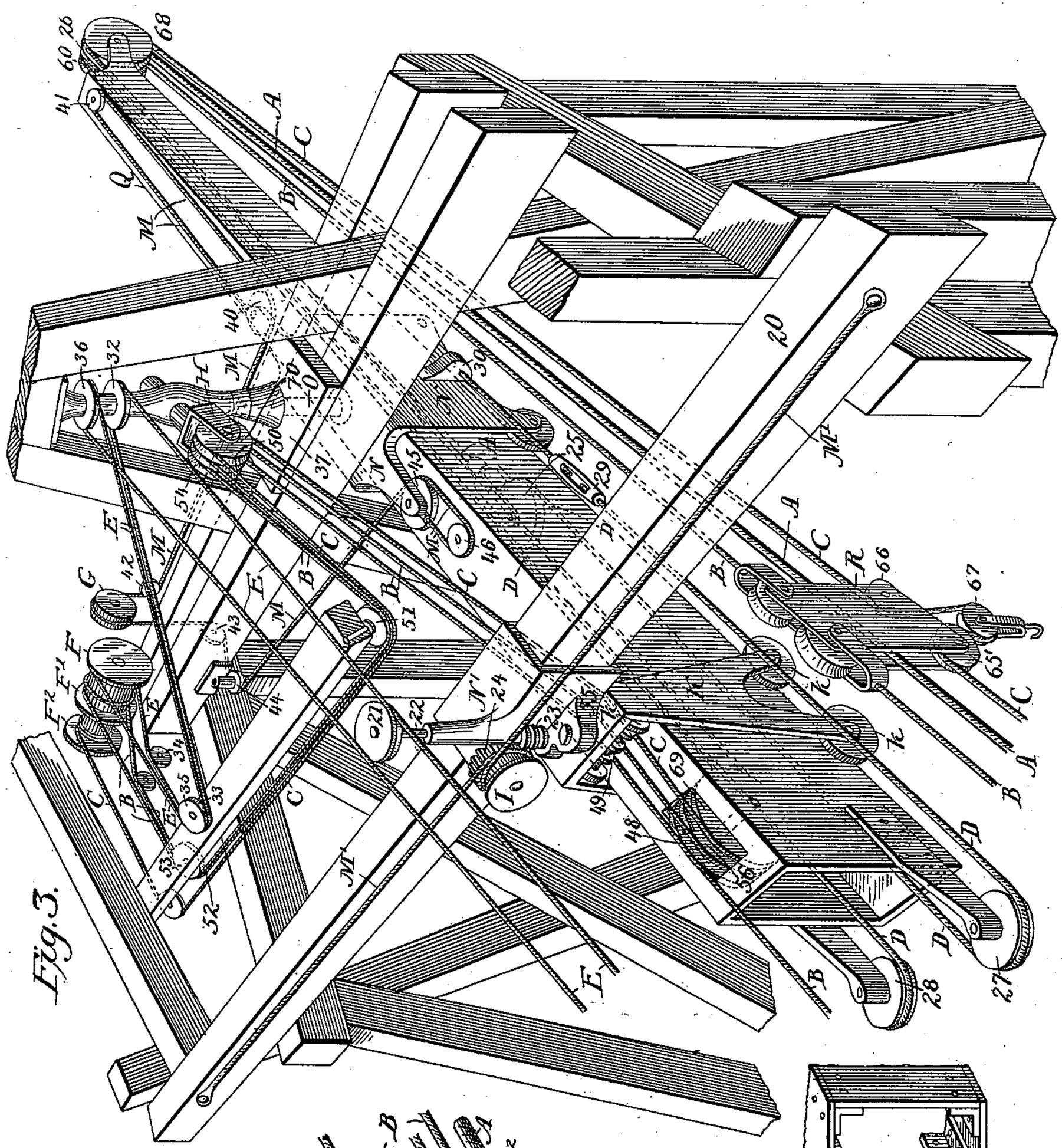

Fig. 3.

Fig. 3x.

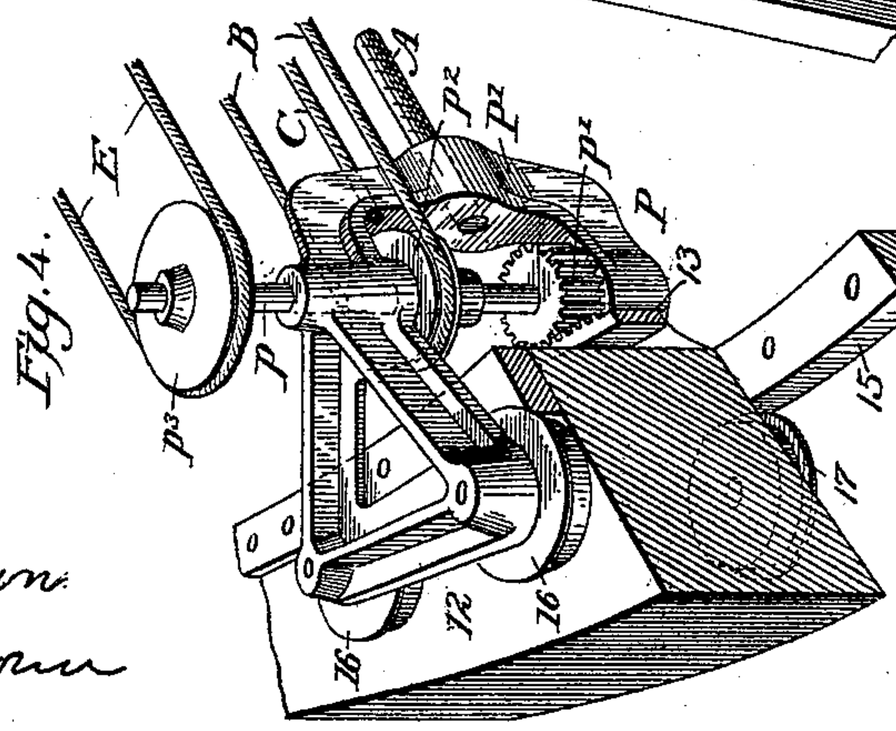

Fig. 4.

Witnesses.
Henry V. Brown.
David H. Brown

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(No Model.) 8 Sheets—Sheet 4.

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AERIAL HOISTING AND TRANSFER APPARATUS.

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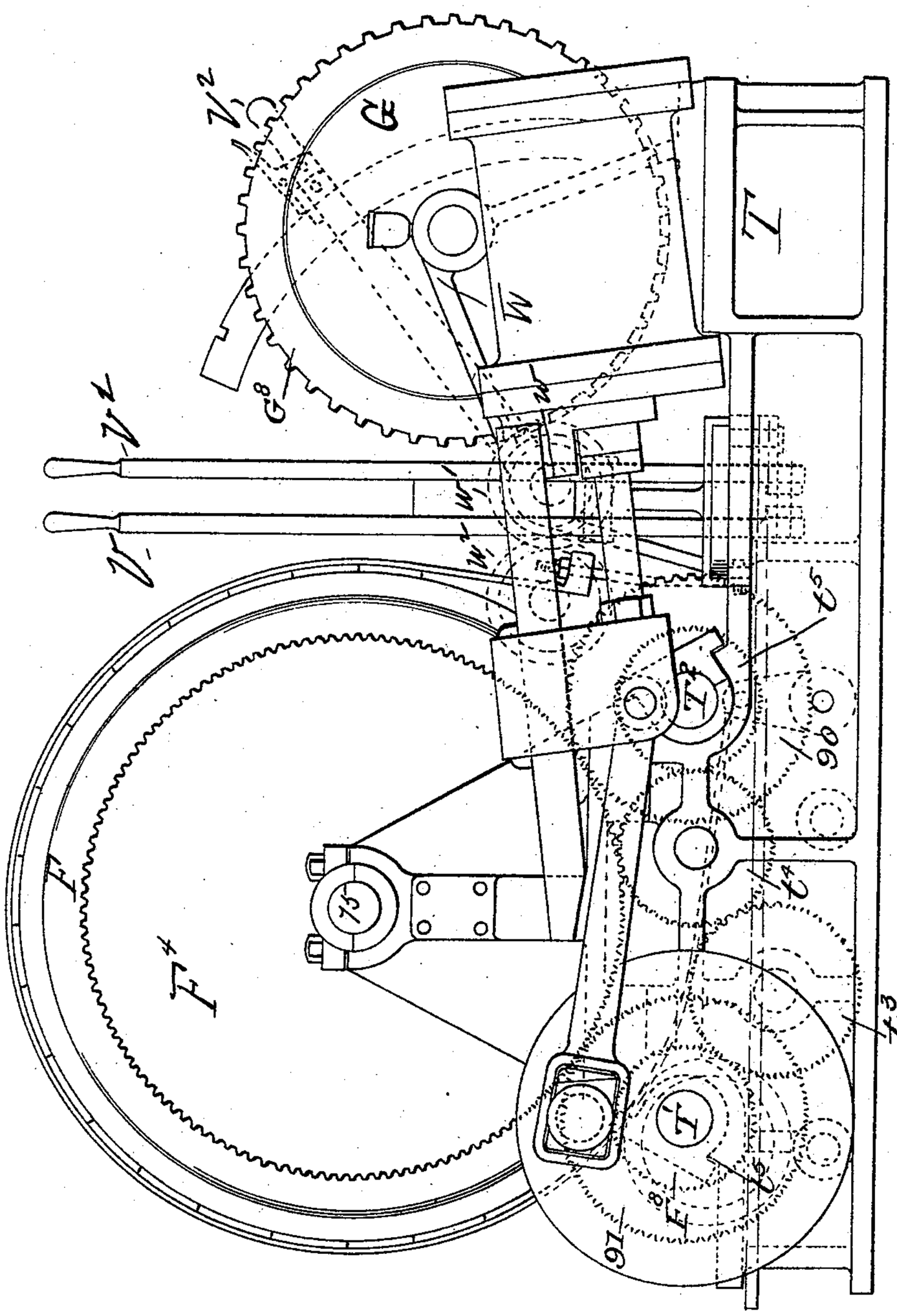

Fig. 5.

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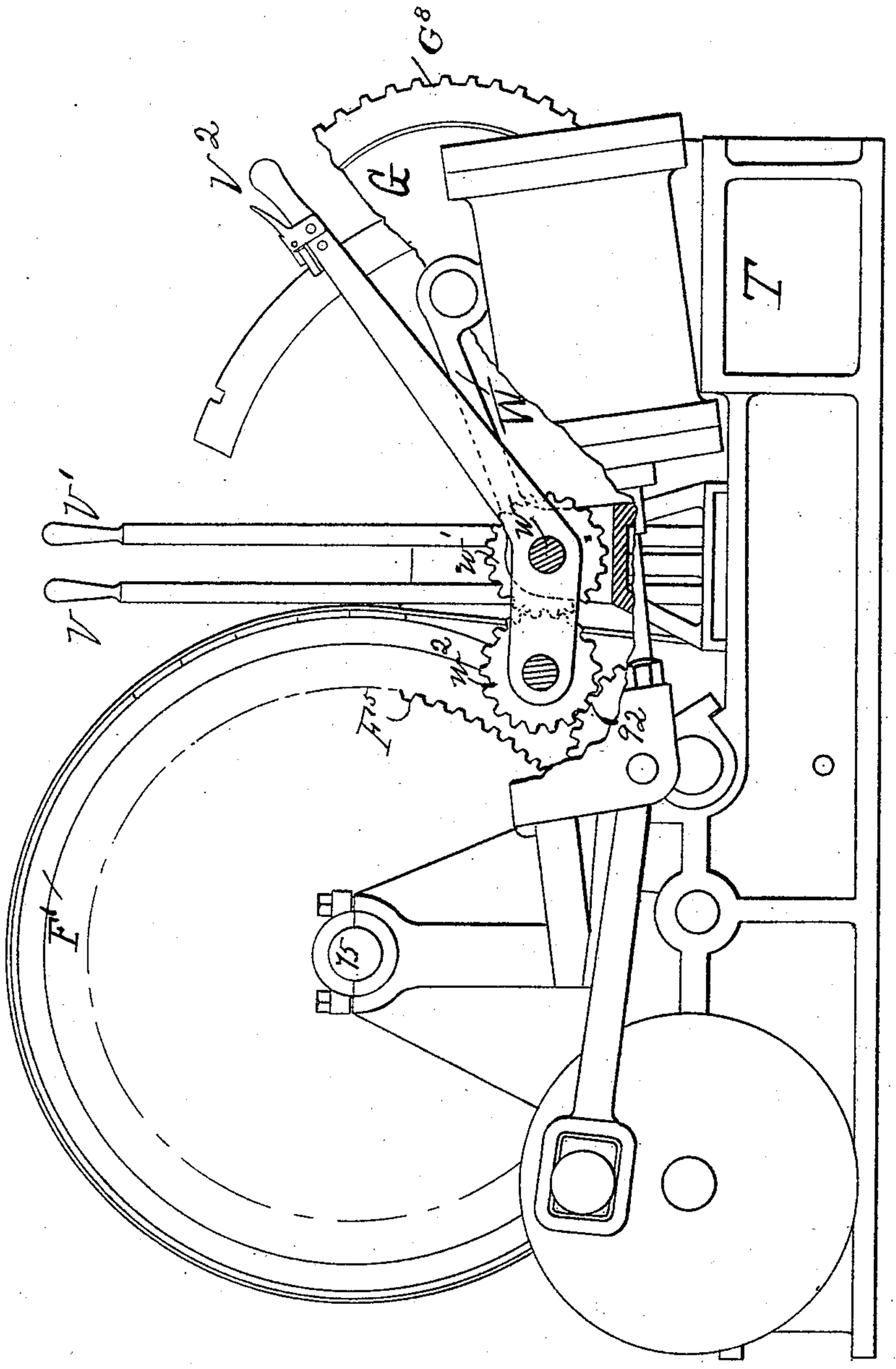

Fig. 5.

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(No Model.) 8 Sheets—Sheet 6.

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AERIAL HOISTING AND TRANSFER APPARATUS.

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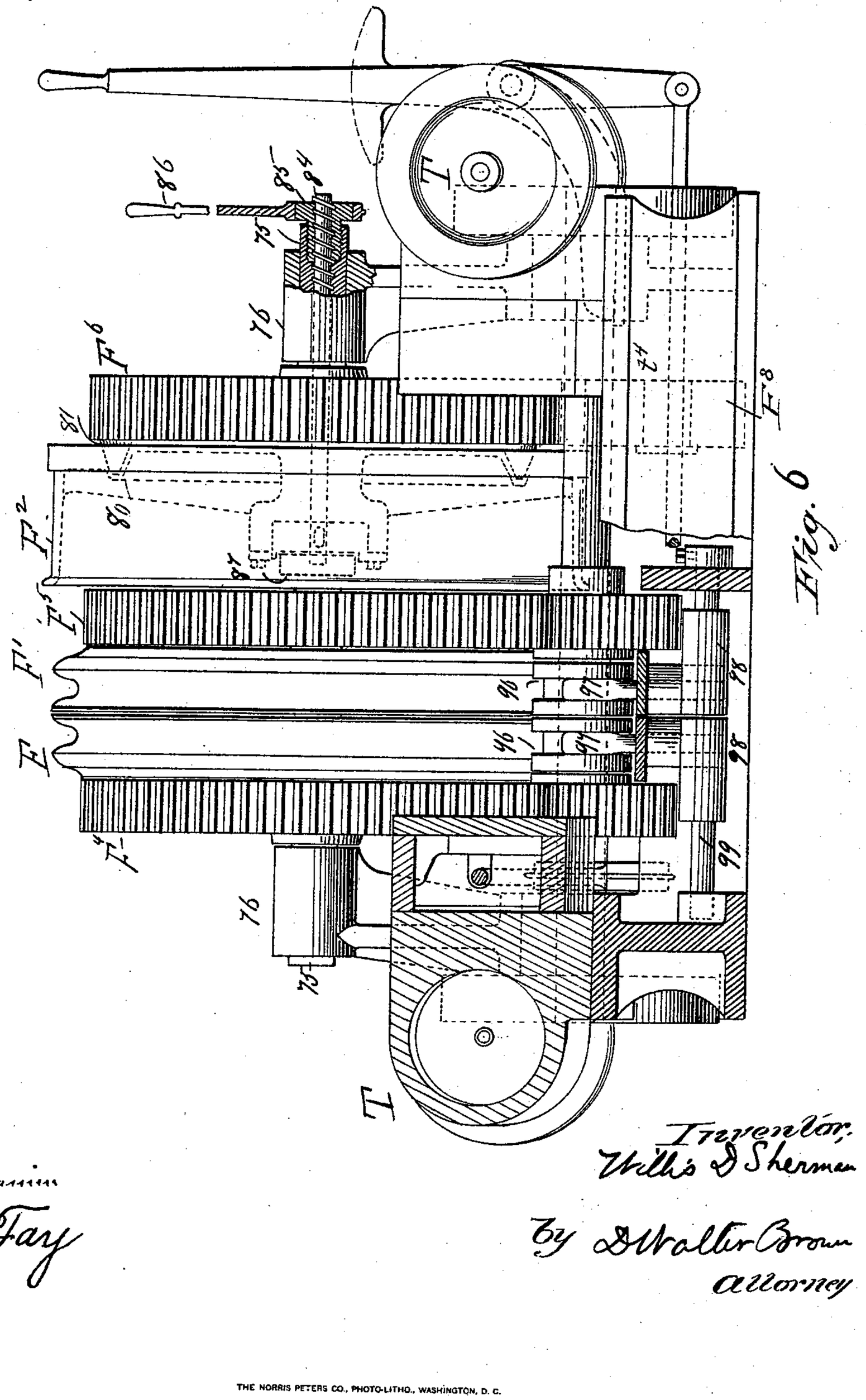

Fig. 6.

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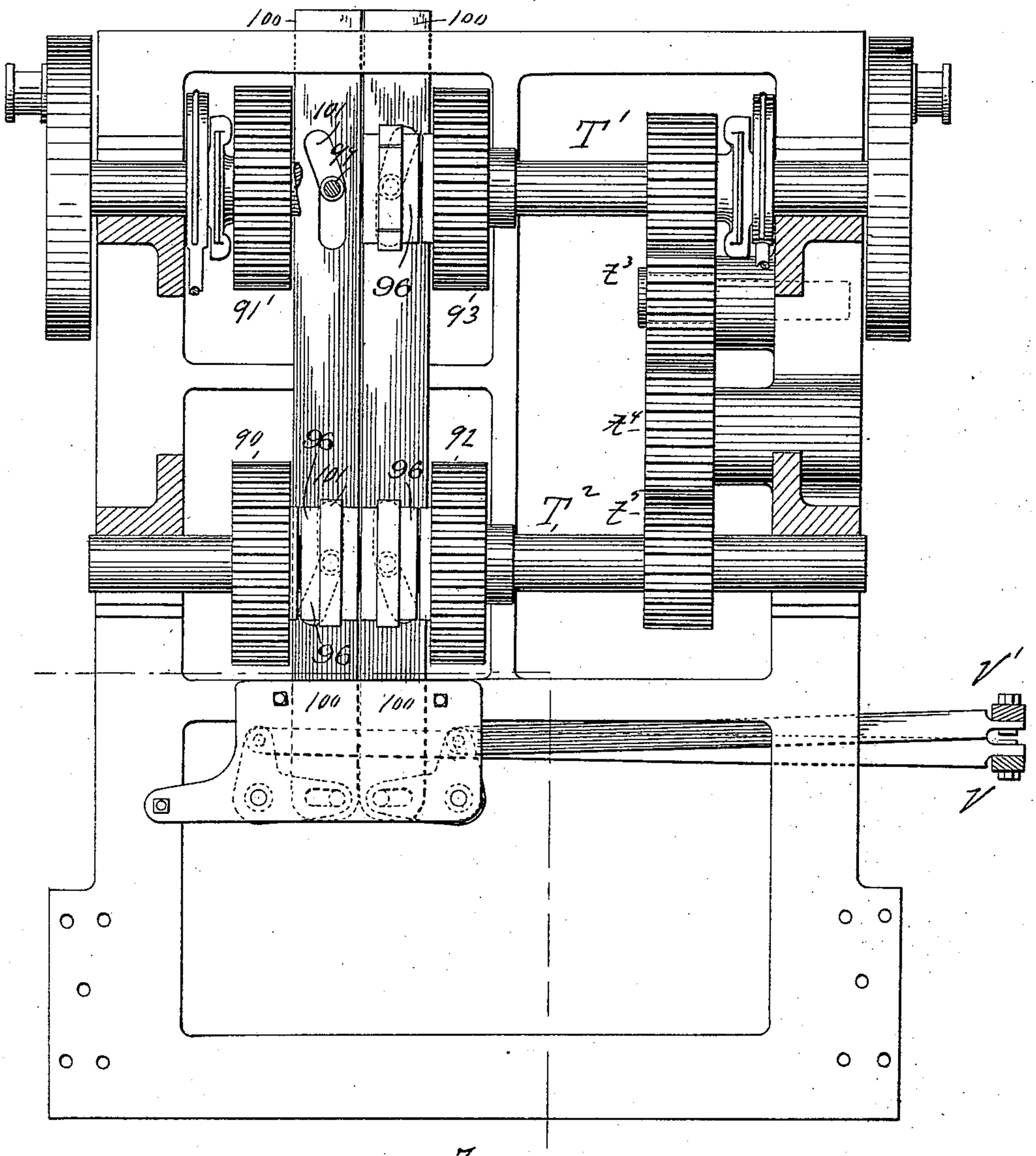

Fig. 1.

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W. D. SHERMAN.

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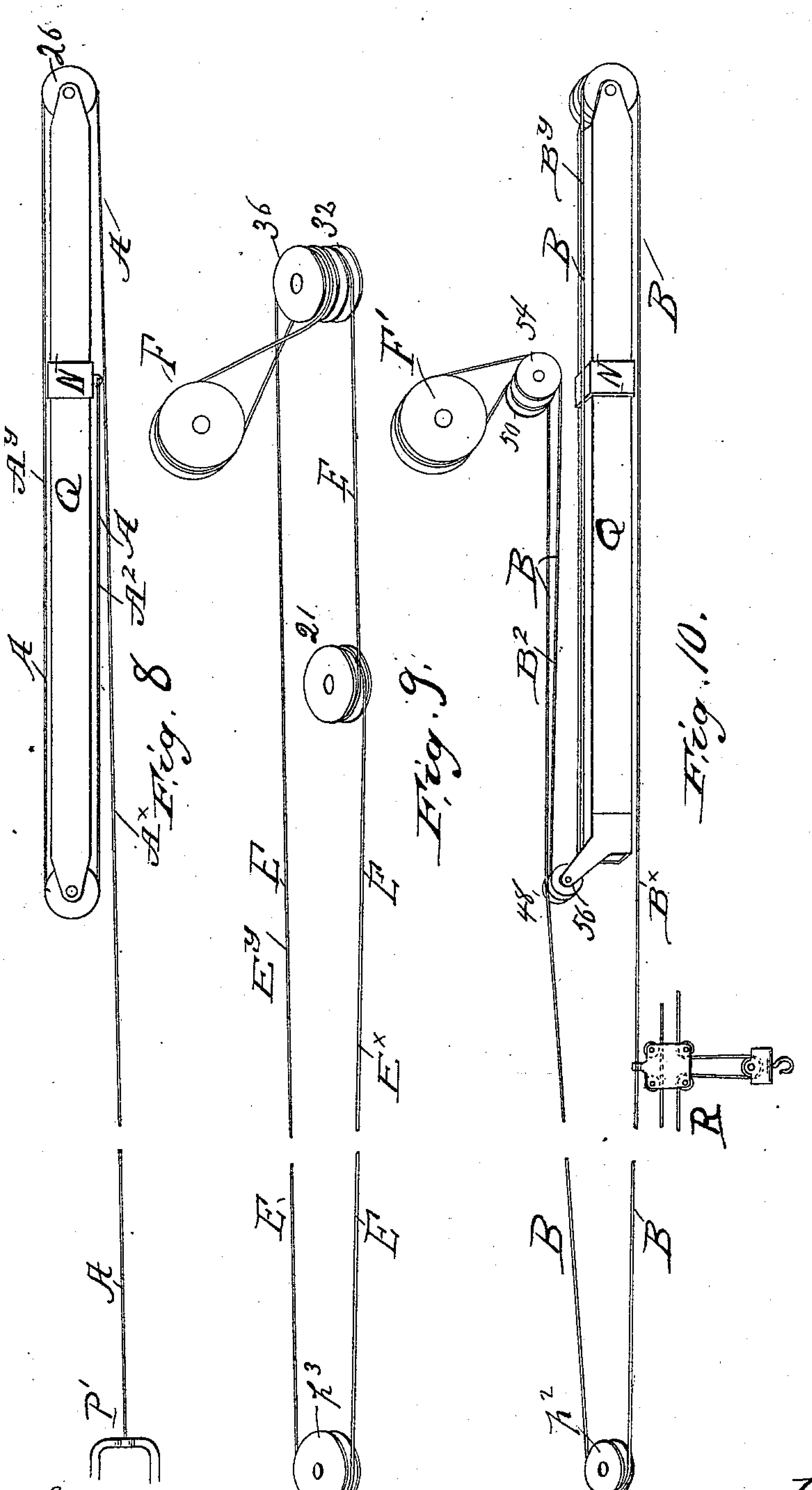

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UNITED STATES PATENT OFFICE.

WILLIS D. SHERMAN, OF BROOKLYN, NEW YORK, ASSIGNOR TO HIMSELF, CHARLES B. JOHNSON, JOHN J. WILSON, ELLIS H. BAILLIE, FRANK B. JOHNSON, AND ELBERT SNEDEKER, OF SAME PLACE.

AERIAL HOISTING AND TRANSFER APPARATUS.

SPECIFICATION forming part of Letters Patent No. 539,448, dated May 21, 1895.

Application filed March 20, 1894. Serial No. 504,473. (No model.)

To all whom it may concern:

Be it known that I, WILLIS D. SHERMAN, a citizen of the United States, and a resident of Brooklyn, in the county of Kings, State of New York, have invented a certain new and useful Improvement in Aerial Hoisting and Transfer Apparatus, of which the following is a specification.

My invention relates to improvements in aerial, hoisting and transfer apparatus of the general type described and claimed in my United States Patents, numbered 494,389 and 518,901, respectively dated March 28, 1893, and April 14, 1894, and it relates especially to the combination in apparatus of that type with the hoisting and transfer apparatus proper of an extensible boom for carrying the load to a given point, as over a hatchway of a vessel, which said boom oscillates about the center of the movement of the carriage which operates the main cable or bridge.

The invention also relates to the combination with the apparatus of a hoisting mechanism proper whereby the cables or ropes which actuate the carriage of the main cable, the trolley, the fall and the boom may be each controlled independently of the movements of the other ropes or cables, so that the load may be raised or lowered, the main cable swung to and fro about its center, the trolley impelled backward or forward, and the boom thrown in or out or oscillated about the center of its movement independent of the movement of the other portions of the apparatus. This independence of movement gives very perfect and complete control to the movements of the load, is of very great practical utility and is, so far as I know, entirely novel in hoisting engines of this kind.

Referring to the drawings which accompany the specification to aid the description, Figure 1 is a side elevation, partly broken, of the apparatus, showing the relative position of the carriage, trolley, and boom. Fig. 2 is a plan view of the same parts as shown in Fig. 1. Fig. 3 is a perspective, on a very large scale, of the boom and the several ropes or cables, Fig. $3^{\times}$ being a detail showing the construction of the boom, and Fig. 4 is a similar view of the carriage which actuates the main cable. It will be noticed that the ropes or cables indicated in Fig. 3 extend to the carriage shown in Fig. 4, being represented in each view by the same letters. Fig. 5 is a side elevation of the hoisting apparatus proper, illustrating the relative position of certain of the drums and winches. Fig. 5^{a} is a side elevation, partly broken and sectioned, of the same parts as are shown in Fig. 5; but the drum F and its gear are removed for clearness. Fig. 6 is an elevation of the front of certain drums and winches. Fig. 7 is a plan view of the gearing for operating the carriage-rope and trolley-rope. In order to show the gearing and clutches clearly, the drums and winch are removed from this view. Figs. 8, 9, and 10 are respectively diagrammatic representations of the main cable, the carriage-rope, and the trolley-rope; and Figs. 8 and 9 represent their respective ropes in the simplest form in which the same can be rove, illustrating the principle of my invention in this respect.

Describing first the structure and the several cables and means for actuating the same, I prefer to illustrate the apparatus on timber trestles constructed as indicated by the timbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 in Fig. 1, the trestles being supported upon any suitable foundation as X, X′, X^2, X^3. At one side the trestle carries horizontal timbers, 12, shaped on an arc of a circle from the center of oscillation O of the boom, and 13 is a rack on the face of timber 12, engaged by a pinion on the carriage, as hereinafter described, 14, 15, being rails on the upper and lower sides of said timber, which are engaged by the wheels 16, 17 of said carriage. The said carriage P, consists of a yoke P′, carrying the aforesaid wheels 16, 17, and a vertical shaft p, provided with the pinion p' meshing in said rack 13 and having a loose sheave p^2, and a fast sheave p^3. The boom Q, slides to and fro through a housing N, pivoted on the framework by the pin O, and provided with anti-frictional rollers, as shown. The rear end of said boom passes through a rear housing K, provided with anti-frictional rollers k, which housing is in turn pivotally supported from a housing N′, which slides on the cross-timber 20, as indicated in Fig. 3, said housing

N′ being provided with a sheave 21 on a shaft 22, carrying the worm 23, meshing in the gear 24 on the shaft of a vertical drum I, by which the rope which oscillates the boom is operated, as will be hereinafter described. Said boom may be constructed of wood or metal in any suitable manner, but I prefer, for the sake of lightness, to form it of sheet metal plates, strengthened at the corners with angle iron, as shown in Fig. 3×, and said boom may be arranged to be oscillated directly by the main cable.

The main cable or bridge A, being fixed in the yoke P′, is carried to and around a sheave 26, at the front end of the boom Q, preferably through the interior of the boom and to a becket of a sheave 25, as shown in Fig. 3. Around this sheave 25, is passed a smaller rope or cable D, the branches or whips of which extend to and around sheaves 27, 28, to the rear end of the boom, thence to turnbuckles 29, and are finally fastened in ears 30, which are practically in the line of the center of oscillation of the boom, on the housing N. It will thus be seen that the said main cable A, considered from the rear end of the boom Q to the front thereof, and thence around to its ears 30, has one length or whip A^x extending forward parallel to the boom; thence a length A^y extending backward parallel to the boom and thence a third length A^2 extending forward parallel to the boom to the center of oscillation. This is clearly shown in the diagram Fig. 8, which illustrates the simplest arrangement of reaving the main cable; the sheave 25, and the small rope D, being only made use of to equalize the strain of the main cable on each side of the boom and do not affect the principle of reaving the cable as will be apparent when Fig. 3 is compared with Fig. 8.

It will be evident that the trolley R travels only on the length A^x, and which length I therefor term the "cable tramway," and it is also evident that the effective length of this cable tramway increases or decreases according to the motion of the boom, without altering the total length of the cable A. Moreover I term the points where the ends of the cables A and D are respectively fastened to the yoke P′ and housing N the "anchorages" of the cable. By my arrangement of the main cable with the three lengths or whips, as described, the strain of the main cable is equalized, and no matter what the weight on the trolley may be, there is no tendency to move the boom either backward or forward, and, moreover, the main cable remains taut notwithstanding the motion of the boom.

The carriage rope E, is carried around the sheave p^3 on the carriage P with a turn around the same, if necessary, and one length or whip of said rope E is led forward parallel to the boom and around the sheave 21 on the housing N′, thence around guide sheaves 32, 33, 34, and around the drum F, being wound thereon as often as necessary; thence back and around a sheave 35, preferably on the same shaft as sheave 33, around a sheave 36 on the same shaft as sheave 32 but in the direction opposite to that in which it rounded said sheave 32, and thence back into itself to the sheave p^3. The aforesaid sheaves 32, 36, are mounted on a shaft which is practically in the line of the center of oscillation O, as is apparent in Fig. 3, and said shafts are conveniently supported in a casting which is pivoted on a base plate 37, at said center of oscillation, as shown in the figure. Examining Fig. 3 and comparing the same with the diagram of Fig. 9, it will be apparent that from the carriage P to the sheaves 32, 36, and back again to the carriage, the said rope E, E, has two lengths E^x, E^y respectively, each extending substantially parallel to the motion of the boom from the carriage to the center of oscillation thereof, and it is this arrangement of the said carriage rope which permits the said rope to remain taut under all conditions, notwithstanding the movements of the carriage and the boom.

The arrangement and position of the sheaves 33, 35, and the drum F are not essential and exert no effect upon the operation of the said rope E, E, but I have shown them in Fig. 3 arranged in a convenient manner which I adopt in the construction of the apparatus.

The longitudinal boom rope M, by which the boom is thrown forward and backward, starts from the becket of the sheave 40, goes thence to and around the sheave 41, at the front end of the boom, thence back around the sheave 40, which is secured in the housing N; thence to and around any guide sheave 42, being wound on the drum G; thence to and around any suitable guide sheaves 43, 44, and around a guide sheave 45, on the rear end of said housing N, thence around a sheave 46, near the rear end of the boom and back to a fastening in the becket of said sheave 45. From this arrangement it will be observed that the revolving of the drum G, in the one direction will move the boom out forward, and the revolving of the said drum in the opposite direction will move the boom in backward, and that the rope M will remain taut, notwithstanding the forward and backward movement of the boom and the oscillation of the same about the center O, the deviation of the sheaves 40, 45, being too slight to be of practical consequence.

The transverse boom rope M′ is fixed to each end near the extremities of the cross timber 20, and goes thence to and around the aforesaid drum I. Thus it will be observed that the rotation of the said drum I, effected through the carriage rope E, and the sheave 21, and the worm 23, will move the housing N′ to the one side or the other on the timber 20, carrying the rear end of the boom in the corresponding direction and thereby oscillating the boom about its center O. Now the said worm gear, 23, 24, and the pinion p' are so related to each other, that the motion of the

carriage P, as effected through the motion of the rope E, and the motion of the housing N′, as effected through the rope M′, shall be in the same direction and through equal arcs, and I find, in experience, that the variation of the distance traveled by the housing N′ on the timber 20, from the length of the arc of the rack 13, is too little to be of any practical importance.

The trolley rope B, starting from the frame of the trolley R, going thence around the loose sheave p^2 of the carriage P, proceeds thence over a sheave 48, to the rear end of the boom Q, under guide sheave 49, to and around a sheave 50, mounted at practically the center of oscillation O, thence around guide sheaves 51, 52, to and around drum F′, being wound thereon as often as necessary; thence back and around the sheave 53 on the same axis as sheave 52 to and around a sheave on the same axis as sheave 51, around a sheave 54 on the same axis as sheave 50, back and around a sheave 55 on the same axis as sheave 49, around a sheave 56 on the same axis as sheave 48, preferably forward through the boom to a sheave 60, at the front end thereof and thence back parallel to the boom to the trolley where it is fastened. Now, considering the said trolley rope B, from where it leaves the trolley to extend forward to the front end of the boom, and from thence to the center of oscillation O, we perceive that it consists, first, of a whip or length B^x extending forward parallel to the boom; thence of a length B^y which extends backward from the front to the rear end thereof; thence of a length B^2 which extends forward from the rear end of the boom to the center of oscillation, the position of the drum F′ and of the guide sheaves between the center of oscillation and said drum being immaterial. The essential element of the reaving of the trolley rope is the three whips or lengths B^x B^y B^2 aforesaid, each of which is parallel to the length of the boom Q, and on this arrangement of the rope depends the operation of the trolley. Under all circumstances, and notwithstanding the position of the boom or carriage, the trolley rope will be taut and its drum will not be required to take up any slack. Moreover, the trolley rope can move in one direction or the other, notwithstanding the motions of the boom and without affecting the boom, and the boom can move in any direction, notwithstanding the motions of the trolley rope and without affecting the same; and this feature of the reaving of the trolley rope in the manner described constitutes a very important element of my invention.

The fall rope C, having one end fixed in the yoke of the carriage, as shown in Fig. 4, goes thence to sheaves 65, 66 on the trolley R, making a loop to and around the fall block 67, as shown, and by sheave 66 leads forward to a sheave 68, on the front end of the boom; thence back, preferably through the boom, and around the sheave 69, at the rear end thereof under a guide sheave on the same axis as the aforesaid sheave 49, around a sheave 70, which is practically at the center of oscillation of the boom and around guide sheaves which are respectively on the axes of the aforesaid sheaves 51, 52, and to the hoisting winch F^2, to which it is secured and on which it is wound as often as necessary. It will thus be observed, that the fall rope again has three principal whips or lengths, which are parallel to the boom and go to the center of oscillation thereof, the position of the winch F^2 and guide sheaves between the center of oscillation and the said winch being immaterial. It is this arrangement of the fall rope C, which keeps the said rope taut in all positions of the carriage and the rope and obviates the necessity of taking up any slack when operating the load.

The hoisting apparatus proper.—The aforesaid trolley rope B, the fall rope C, and the carriage rope E, are led respectively around the drum F′, the winch F^2, the drum F, and the boom rope M is led around the drum G, as hereinbefore mentioned. Said drums and winches F, F′, F^2, G, constitute the hoisting apparatus proper which I arrange as follows: The said drums F, F′ and winch F^2, are preferably each set loosely on a fixed shaft 75, mounted in bearings 76 (Fig. 6). The said drums F, F′ are each provided with gears F^4, F^5, respectively which may be cast integral with said drums. The winch F^2 is provided with an annular V-shaped groove 80, adapted to engage a corresponding annular V-rib 81, which is formed on the gear F^6. Said gear F^6 meshes with a gear F^8, which is ultimately driven from the engine T, by a suitable train of gearing, said engine being of any suitable type, but preferably provided with a counterpoise of the kind described and claimed by me in my applications, Serial Nos. 504,474, 504,741, and 504,815, and now pending in the Patent Office.

The clutch mechanism of the winch F^2 is operated by means of the sliding rod 84 which threads in the differential nut 85, provided with handle 86, the end of the said rod 84 engaging by means of a washer 87, with the hub of the winch F^2, as indicated by dotted lines in Fig. 6. Evidently as the nut 85 is revolving in the one direction or the other, the rod 84 is moved longitudinally to and fro, in the one case forcing the groove 80 upon the V-rib 81, and thereby causing the winch to revolve with the gear F^6, in the other case, withdrawing the groove from the V-rib 81, and allowing the winch to remain stationary, or turn back when the load is lowered. Said winch may be provided with any suitable brake in the manner well understood in hoisting engines. The gear F^4 of the drum F, meshes with the gears 90, 91, (compare Figs. 5 and 7) which are respectively loose on the main shaft T′ and counter-shaft T^2, said shaft T^2, being connected by a train of gearing t^3, t^4, t^5, with the main shaft T′. The

gear F^5 of the drum F′ meshes with gears 92, 93, which are respectively loose on the aforesaid shafts T′, T^2.

The arrangement of the gears F^4, F^5 and the gears 90, 91, 92, 93, will be understood by comparing Figs. 5 and 7, the latter figure presenting a plan view of said gears 90, 91, 92, 93, as they appear when the drums F, F′ and gears F^4, F^5 are removed. In order to stop and start the said drum F, the following construction is employed: The said gears 90, 91, are each provided with one part of a coupling, the other part of which is secured to collars 96, the one of said collars 96 having a sliding fit on the shaft T′, the other on the shaft T^2, as seen in Fig. 6. Each of said collars 96 is engaged and moved lengthwise of its own shaft by a finger 97. Said finger 97 (there being a separate finger for each of said collars) is pivoted in a slot 101, of a horizontal sliding beam 100, said beam 100 being secured to a collar 98 which slides on a guide-rod 99. The said beam 100 is moved lengthwise by the lever V, the other by the lever V′. The aforesaid slot 101, is provided with a portion that is parallel to the motion of the beams and with a portion making an angle therewith and toward the gears 90, 91, as clearly indicated in Fig. 7. Thus the movement of the said beam 100, in the one direction, will connect the gear 91 with its corresponding collar, at the same time disconnecting the gear 90 from its collar, and the drum F will be revolved in the one direction, while the reverse movement of the said beam 100 will connect the gear 90 with its corresponding collar and disconnect the gear 91 from its collar, and the drum F will revolve in the opposite direction. When the said beam is in the middle position, indicated in Fig. 7, both gears 90, 91, will be disconnected from their corresponding collars, and the drum F will be stationary.

In a similar manner, and with the agency of the gears 92, 93, the drum F′ is started and stopped. The drum G is hung on an axle that is carried by a frame W. A lever V^2 is pivoted at *w*, and carries a train of gears *w′*, w^2, of which the gear *w′* revolves on the said pivot *w*, or in line therewith, and the gear w^2 is carried at the end of said lever V^2. By depressing the lever V^2 the gear w^2 will mesh with the gear on the drum F′ and by elevating said lever V^2 the gear w^2 will mesh with the gear 92.

It will be observed on examining Figs. 5 and 5^a that the gear *w′*, being at the center of oscillation of the lever V^2 remains in mesh with the gear G^8 of the drum G in all positions of the lever V^2. Fig. 5^a shows said lever in such position that the gear w^2 is meshing with the gear 92. By depressing said lever V^2 the gear w^2 will be raised to mesh with the gear F^5, and the motion of the drum G will be reversed. In the middle position of said lever V^2, said gear w^2 will be out of mesh with both the gears 92 and F^5, and the drum G will not be revolved in either direction. Thus the said drum G may be revolved in either direction at will, or may be left at rest, independently of the motion of the drums F′ F and winch F^2.

In operation, supposing the engine T to be running continuously and the several drums and winch to be at rest and it is desired to operate the fall rope, then the attendant will bring the winch F^2 into operation by means of the handle 86, which affects the clutch 80, 81, as before described, and the said drum will raise the load. To operate the carriage rope in the one direction the beam 100 will be moved by its lever in the direction to engage the gear 90 with its corresponding collar, and then the drum F will be revolved in the desired direction. The motion of the drum F′ is effected similarly.

It will be apparent from the foregoing description, that the winch F^2 and the drums F, F′, G, are each independent of the other, and that the motion forward or backward of either one of said drums can be effected without arresting or reversing the motion of either of the other drums or the winch, and thus the load can be raised or lowered, the carriage oscillated in the one direction or the other, the trolley can be moved out or in, the boom thrust out or drawn back without affecting any one of the other movements, and consequently the load is under perfect control. No slack has to be taken up, and no one of the movements of any one part of the apparatus has to wait on the movements of the others. This organization of the hoisting engine proper, in relation to the several ropes and cables, is of very great practical utility and greatly facilitates the handling of a load, and shortens the time in performing a given work, and is an important element of my invention.

It will be understood, that I do not restrict myself to the particular form of friction clutches shown. Any other suitable device, for connecting and disconnecting the several drums and the winch from their respective driving gears, may be applied to my invention without material change of the same.

I prefer to place the hoisting apparatus proper on the trestle at about the same level from the ground as the boom, this being the most convenient position for the ropes, and giving the operator a survey of the entire yard, and my improved engine, which I have described and claimed in my other applications for patents, hereinbefore referred to, is admirably adapted to such a position since the vibration of the engine is reduced to a minimum, but I do not intend to limit my invention to any such position or type of driving engine, and I can operate my apparatus from an engine placed at or near the ground level, although such an arrangement would not possess the advantages of an engine at or near the level of the boom.

I can provide anti-friction rollers n^3, n^4, at the housing N′, to work on the vertical faces

of the cross timber 20, as indicated by dotted lines in Fig. 2.

Now, having described my improvement, I claim as my invention—

1. In hoisting and transfer apparatus, the combination with a main cable or bridge and a trolley, of an extensible boom adapted to carry an end of the main cable, and to reciprocate in a straight line which is parallel with the main cable, whereby the effective length of the said cable can be increased or diminished as described.

2. In hoisting and transfer apparatus, the combination of a track arranged on a circular arc, a carriage adapted to travel thereon, a main cable or bridge carried by said carriage, and an extensible boom arranged to oscillate about the center of said track, to reciprocate in a straight line parallel to said main cable or bridge, and carry an end of the same toward and from the said circular arc, substantially as described.

3. In hoisting and transfer apparatus, the combination of a track arranged on a circular arc, a carriage adapted to travel thereon, a cable carried by said carriage, a boom adapted to carry an end of said cable, and housings for said boom, one of which is arranged to oscillate about the center of said track and the other to move laterally in the plane of said track, substantially as described.

4. In hoisting and transfer apparatus, and in combination with a cable bridge, a linearly reciprocating boom formed as a hollow tube equipped with sheaves 26, 27, 28, and adapted to permit said cable bridge to pass through said tube, substantially as described.

5. In hoisting and transfer apparatus, the combination with the timber 20, the boom and the operating rope E of a housing N′ supporting said boom and supported by and sliding on said timber, a sheave 21 journaled in said housing and adapted to be operated by the rope E, sheave I, and connections for driving sheave I from sheave 21, and a stationary boom cross rope wound on sheave I, substantially as described.

6. In hoisting and transfer apparatus, the combination of a circular track, a carriage adapted to travel on said track, an extensible boom adapted to oscillate about the center of the track, and a main cable led from said carriage to the fore end of the boom, thence to the rear end thereof, and thence to the center of said track, substantially as described.

7. In hoisting and transfer apparatus, the combination of a circular track, a carriage adapted to travel thereon, an extensible boom adapted to oscillate about the center of the track an auxiliary cable on said boom the lengths of which lead to the rear end of the boom and thence to points at the center of oscillation to either side of the boom, a block in a loop of said auxiliary cable, and a main cable led from said carriage to the fore end of said boom and thence to said block, substantially as described.

8. In hoisting and transfer apparatus, the combination of a track shaped on a circular arc, a carriage adapted to travel thereon, and an endless rope for operating said carriage led with parallel lengths from said carriage to the center of the track, and a drum for moving said rope, substantially as described.

9. In hoisting and transfer apparatus, the combination of a track, a carriage adapted to travel thereon, an oscillatory boom, a cable or bridge carried by the carriage and boom, a trolley adapted to travel on said cable or bridge, a rope for operating the trolley rove therefrom back to the carriage thence forward substantially parallel to the boom and to the center of oscillation thereof, thence to a drum and back to the said center of oscillation thence forward to the fore end of the boom and thence backward substantially parallel to the boom to the trolley, substantially as described.

10. In hoisting and transfer apparatus, the combination with a track, carriage adapted to travel thereon, oscillatory extensible boom, and winch, of a fall rope led from the carriage through the trolley by the front end of the boom thence to the rear end thereof thence to the center of oscillation of the boom and thence to the winch, substantially as described.

11. In hoisting and transfer apparatus, the combination with a track, an oscillatory extensible boom, a carriage, and a trolley, of a main cable, a trolley rope, and a fall rope, and said cable and ropes each leading to the center of the boom's oscillation and being provided with three whips or lengths which are substantially parallel to the boom, substantially as described.

12. The combination with the extensible boom, the carriage, the trolley, and the main cable or bridge supported by said boom and carriage, of the fall rope, the trolley moving rope, the carriage moving rope, and the boom extending rope, a winch for the fall rope and drums for the other ropes which said winch and drums are each arranged to be driven independently of the others, substantially as described.

13. The combination with the extensible boom, the carriage, the trolley, and the main cable or bridge supported by said boom and carriage, of the fall rope, the trolley moving rope, the carriage moving rope, and the boom extending rope, of a constant motion main shaft, and a winch for the fall rope and drums for the other ropes, said winch and drums being each arranged to be independently driven from said main shaft, substantially as and for the purpose described.

14. The combination in hoistang and transfer apparatus of the main shaft, gear trains driven therefrom and actuating a counter

shaft in the reverse direction from the main shaft, loose gears on said main and counter shafts arranged to operate the drums for the carriage and the trolley rope, and clutch mechanisms on said main and counter shafts for engaging and disengaging said loose gears, substantially as described.

15. In a hoisting and transfer apparatus, the combination with the main cable or bridge, the carriage supporting one end of said cable or bridge, the trolley, the fall rope, the rope for moving the trolley, and the rope for moving the carriage, of the drums for said trolley rope and carriage rope, a winch for the fall rope, a shaft, and clutch mechanism for clutching said winch to said shaft so that it may be driven independently of said drums, substantially as described.

16. In hoisting and transfer apparatus, the combination with a main shaft and gearing for actuating the drums of the several ropes, of a drum for operating the boom rope journaled in a frame adjacent to the gearing of one of the aforesaid drums, and said frame being pivotally supported, a train of gearing on said frame meshing with the gear of said boom rope drum, and one gear in said train being journaled in line with the pivot of said frame, and a lever for oscillating said frame about said pivot, substantially as described.

17. In hoisting and transfer apparatus, the combination with a track, a carriage, and an extensible oscillatory boom, of a cable tramway suspended from said carriage and from the center of oscillation of said boom and having a whip parallel to the boom and carried thereby and also a whip from the rear end of the boom to the center of oscillation thereof, substantially as described.

18. In hoisting and transfer apparatus the combination with an extensible tramway having a loop carried by a traveling boom, of a trolley rope having a length which extends from a sheave at one anchorage of the tramway to the outer end of the traveling support, and from thence has parallel whips or lengths that extend to a sheave at the other anchorage of the tramway, whereby the effective length of the tramway can be increased or diminished without changing the length of the trolley rope, substantially as described.

19. In a hoisting and transfer apparatus the combination with an extensible cable tramway having a loop carried by a traveling boom of a fall rope which extends from an anchorage adjacent to one of the anchorages of the tramway to the outer end of the traveling support and from thence has parallel lengths or whips that extend to a sheave at the outer anchorage of the tramway, whereby the effective length of the cable can be increased or diminished without changing the length of the fall rope, substantially as described.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 13th day of March, 1894.

WILLIS D. SHERMAN.

Witnesses:
WILLIAM H. S. CARLILE,
FRANK B. JOHNSON.