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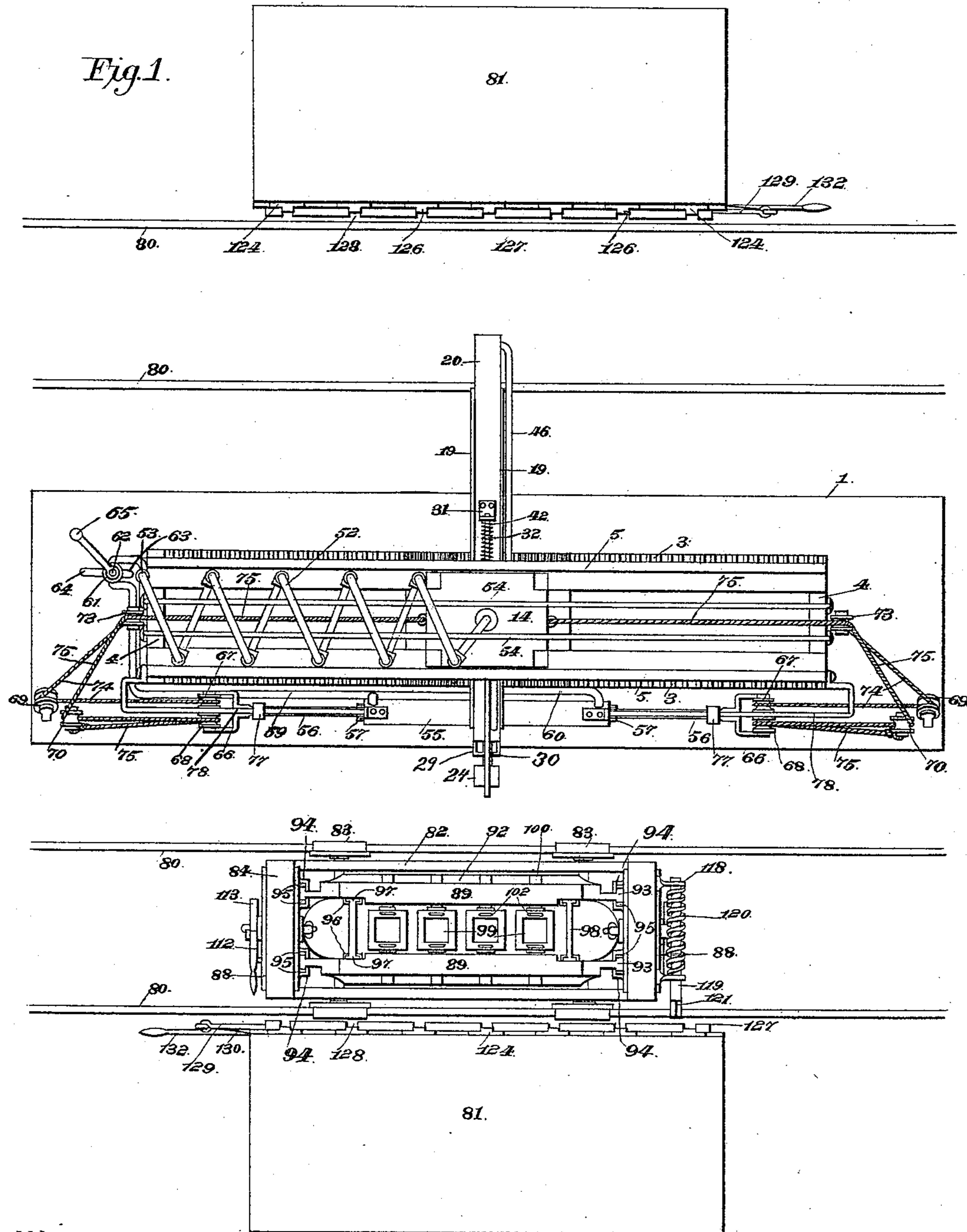
8 Sheets—Sheet 1.

T. BRADY.  
DEVICE FOR HANDLING INGOTS.

No. 440,219.

Patented Nov. 11, 1890.

Fig. 1.



Witnesses

*M. Fowler*

*Wm. Baggers*

Inventor

*Thomas Brady*

By his Attorneys.

*C. A. Snow & Co.*

(No Model.)

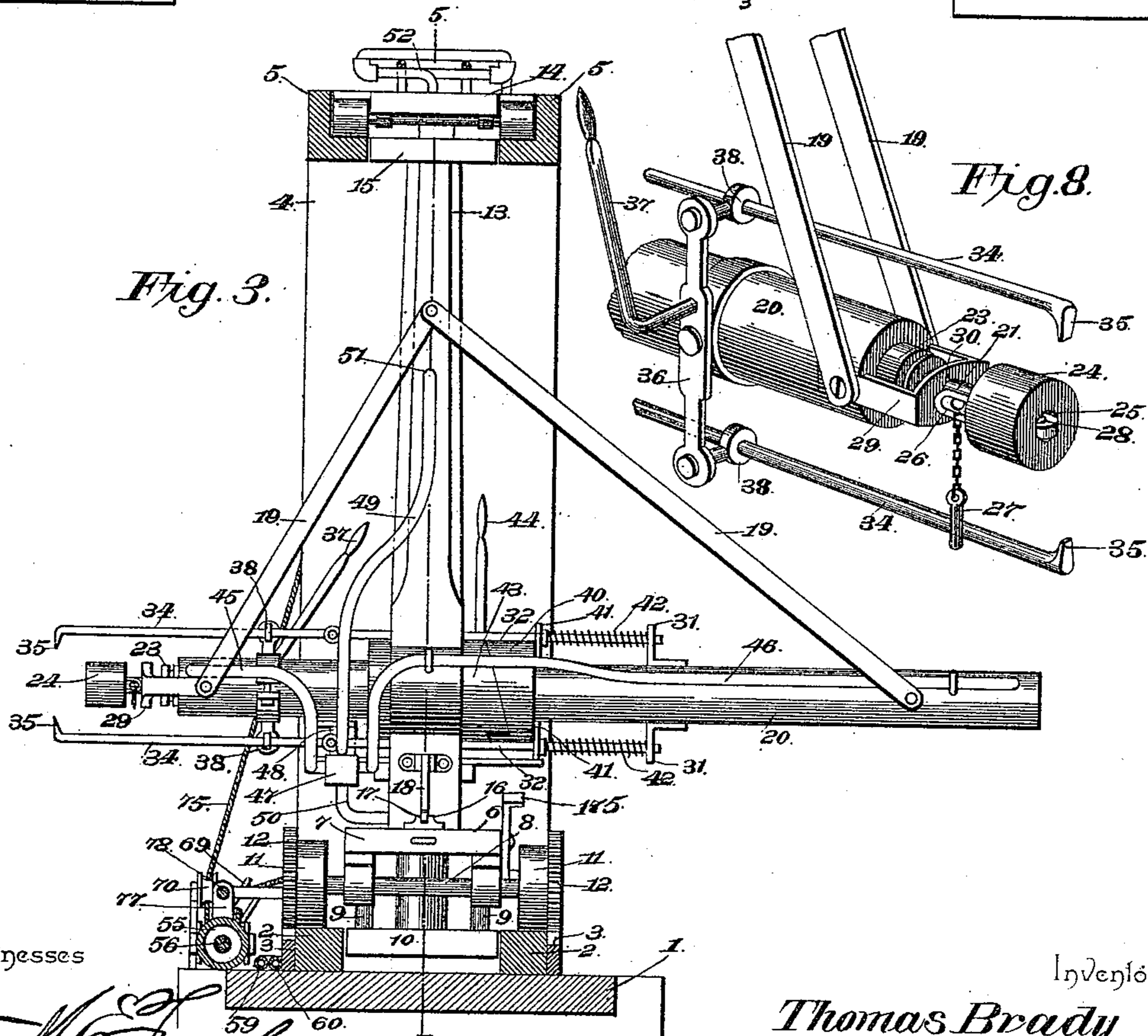
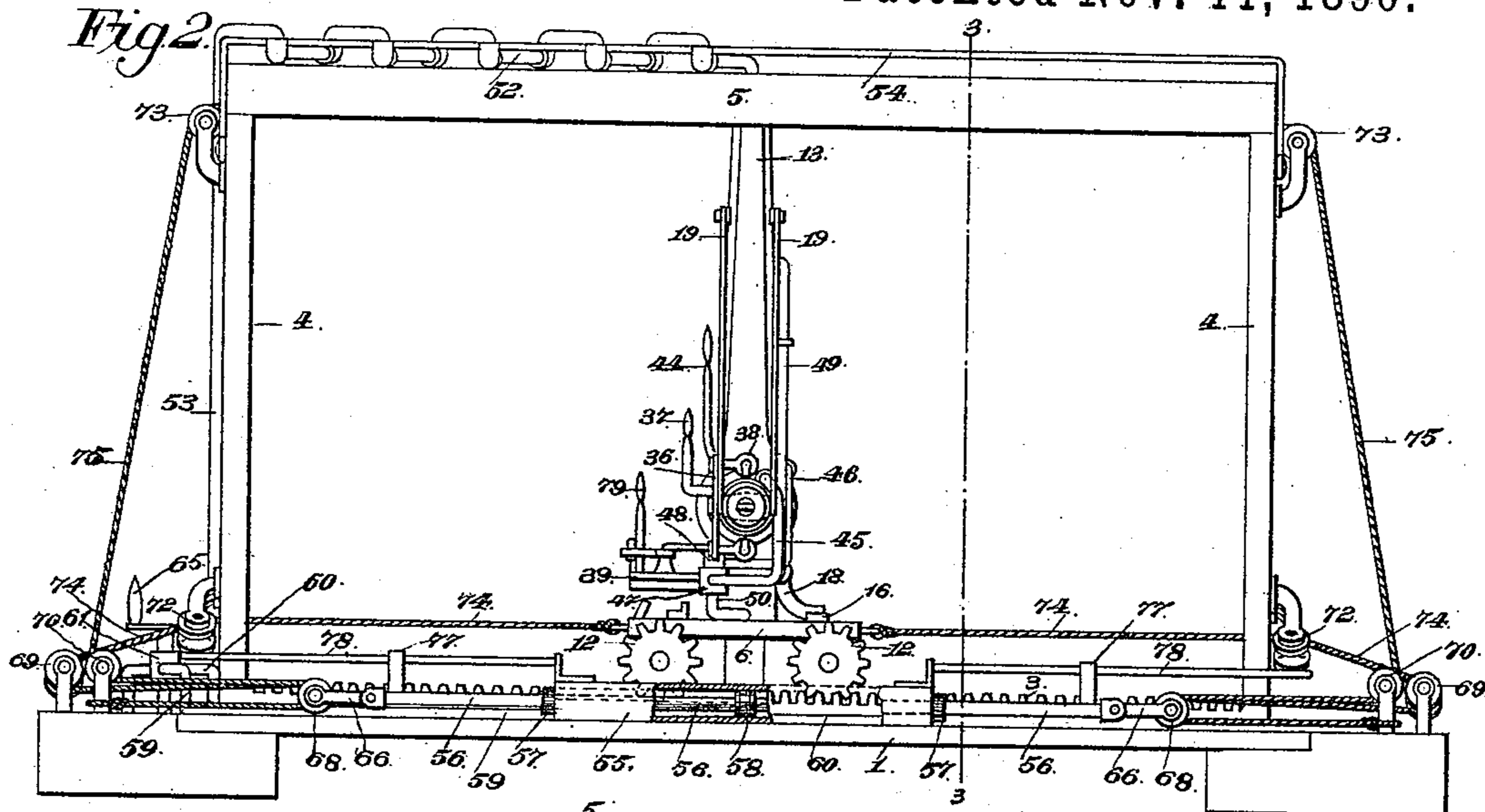
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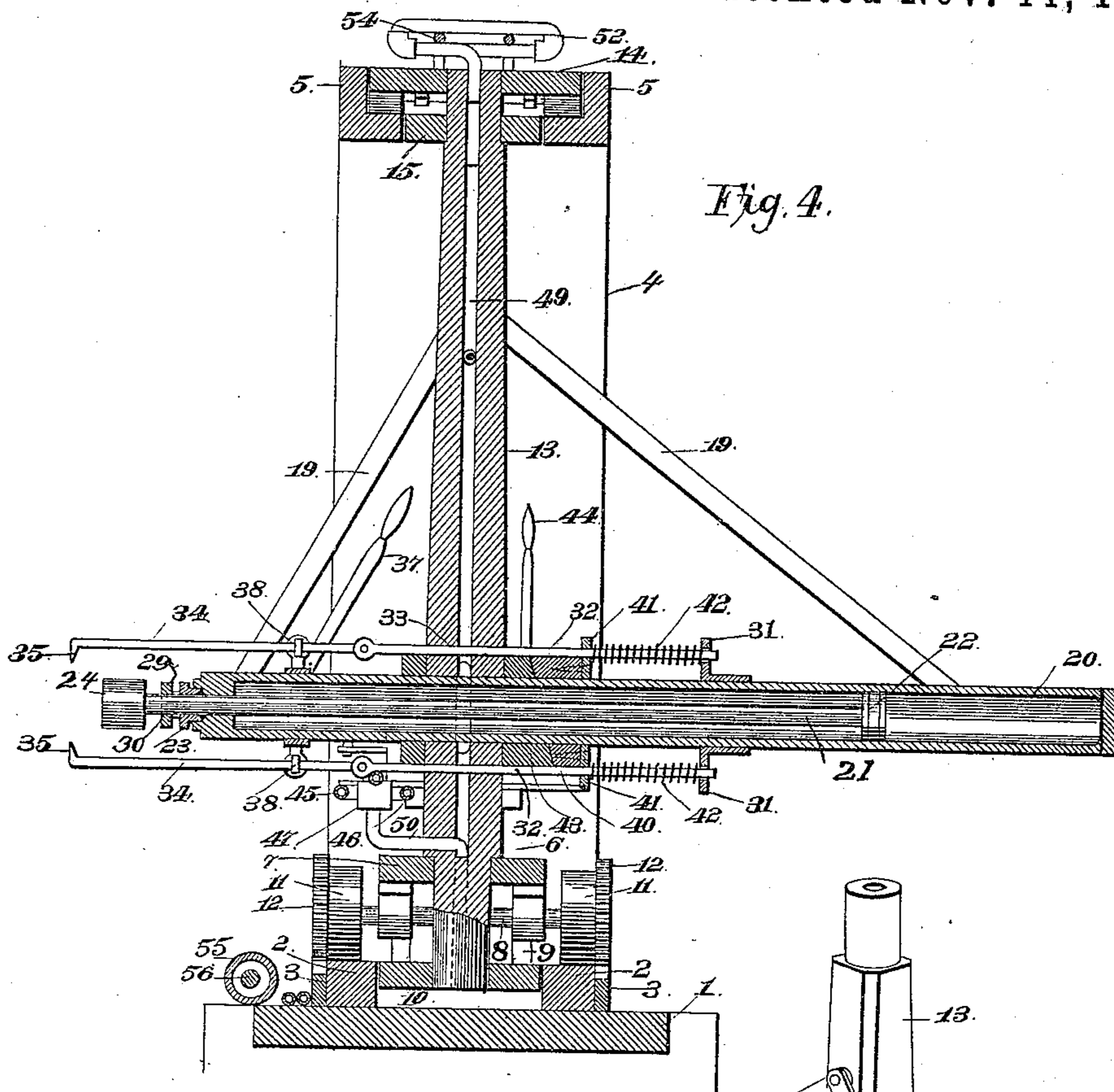


Fig. 4.

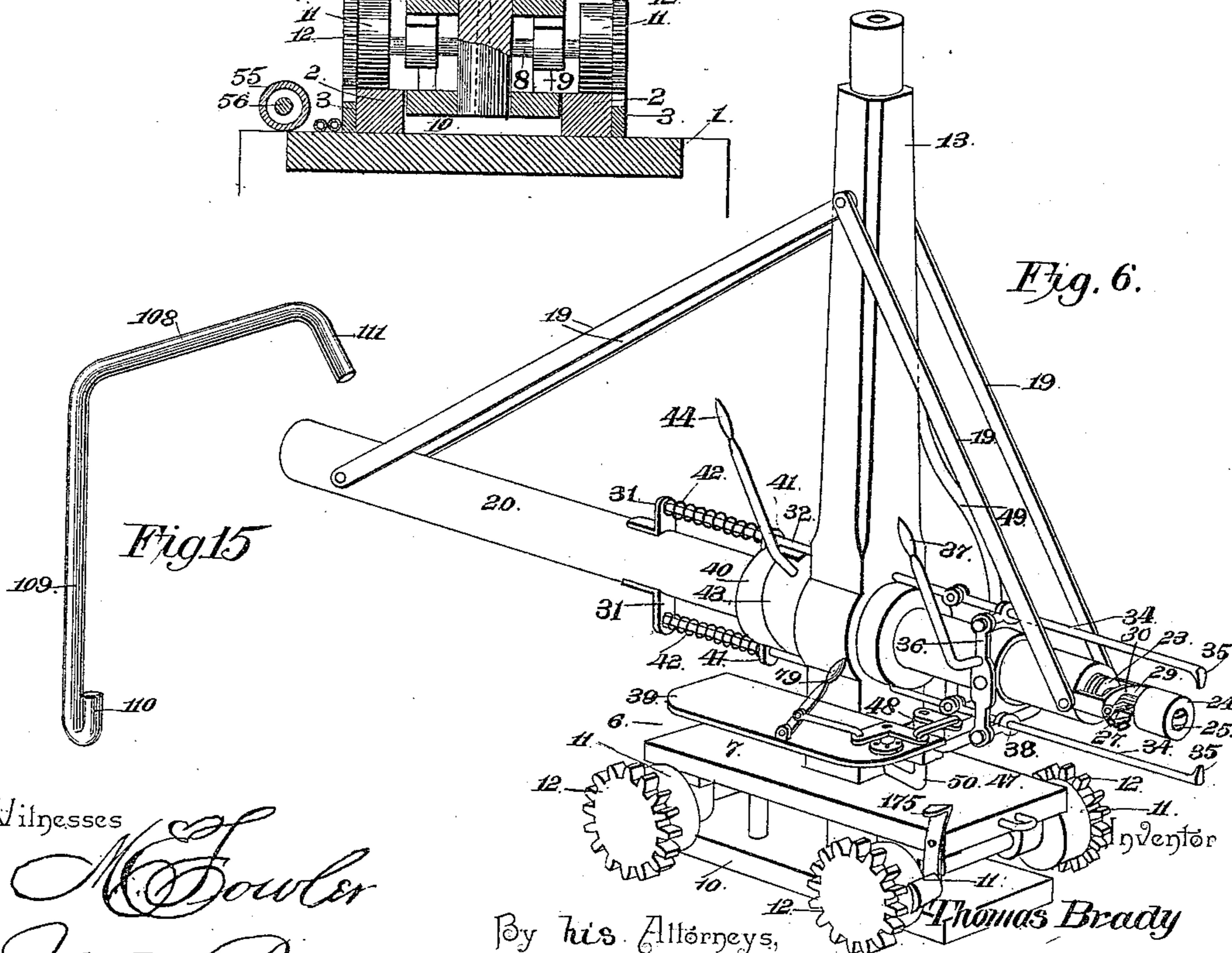


Fig. 6.

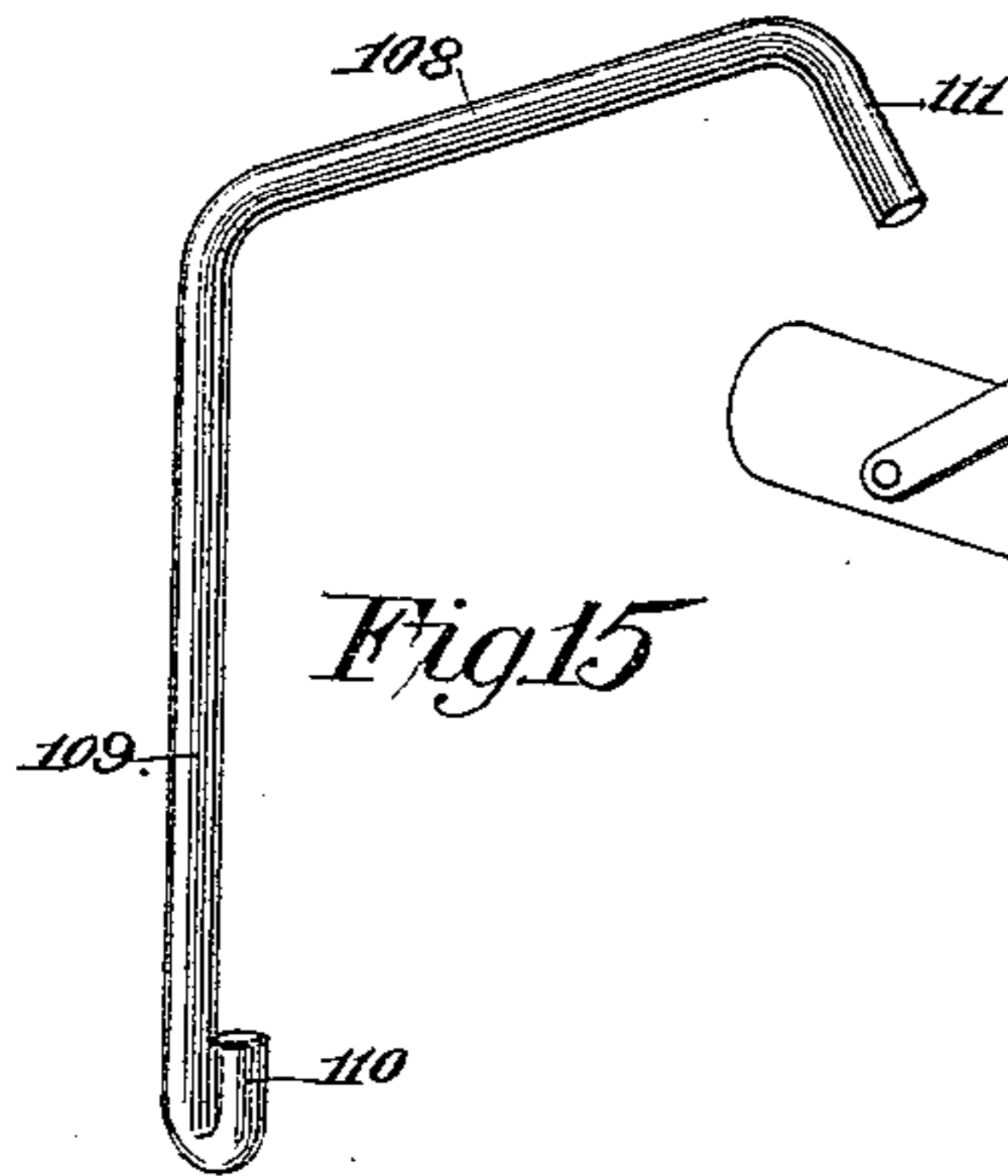


Fig. 15.

Witnesses

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(No Model.)

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Fig. 5.

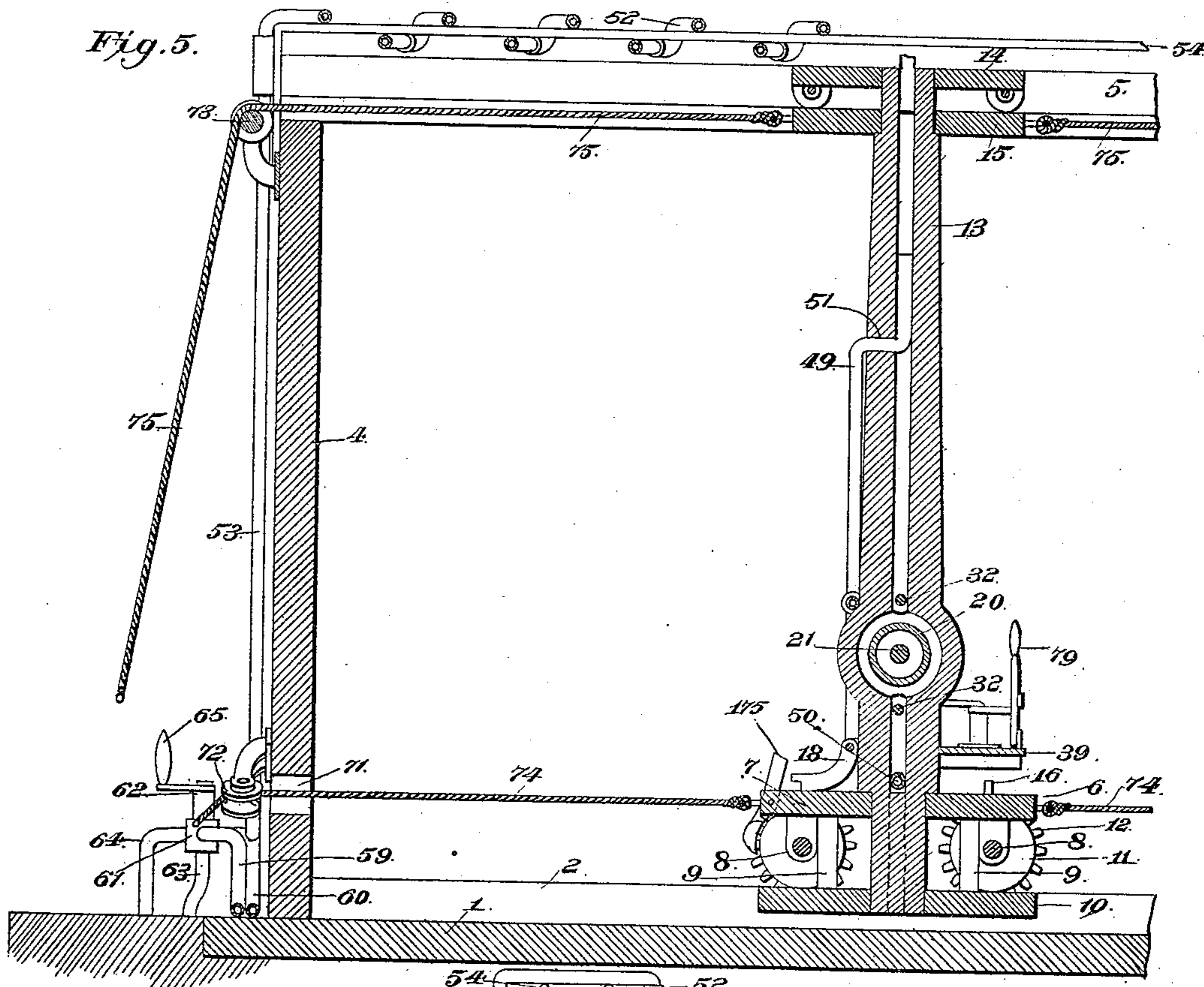
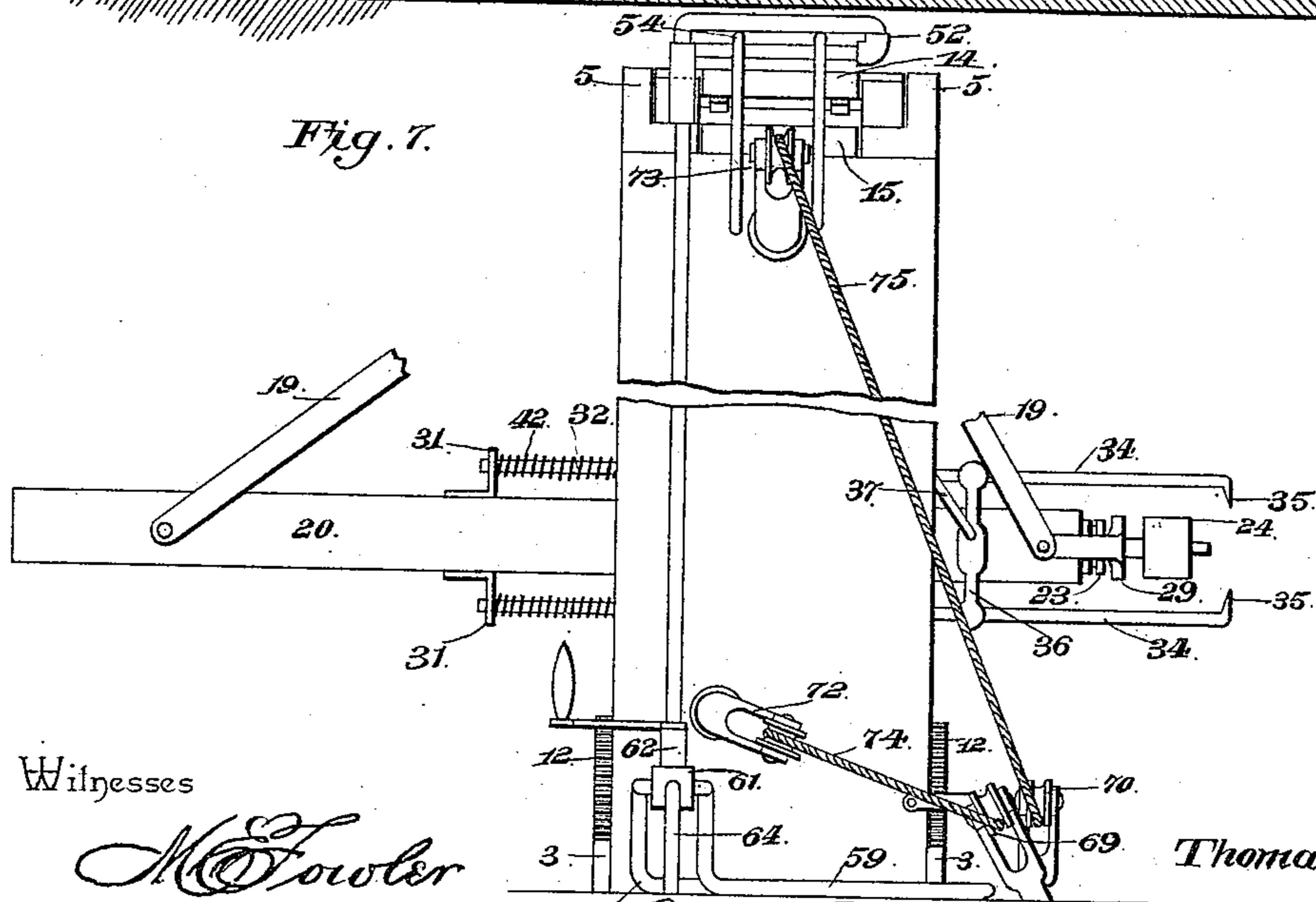


Fig. 7.



Witnesses

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(No Model.)

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Fig. 9.

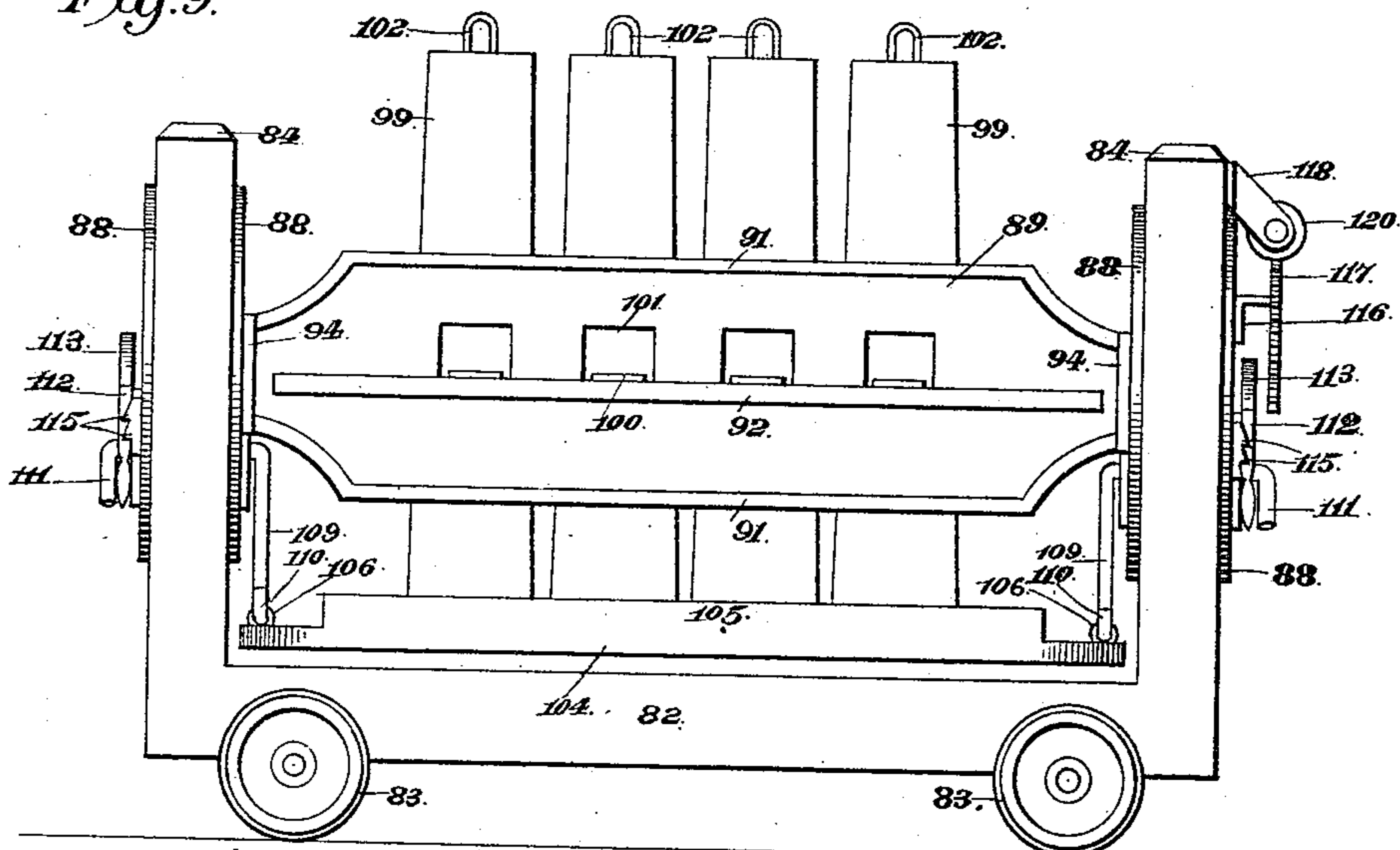


Fig. 10.

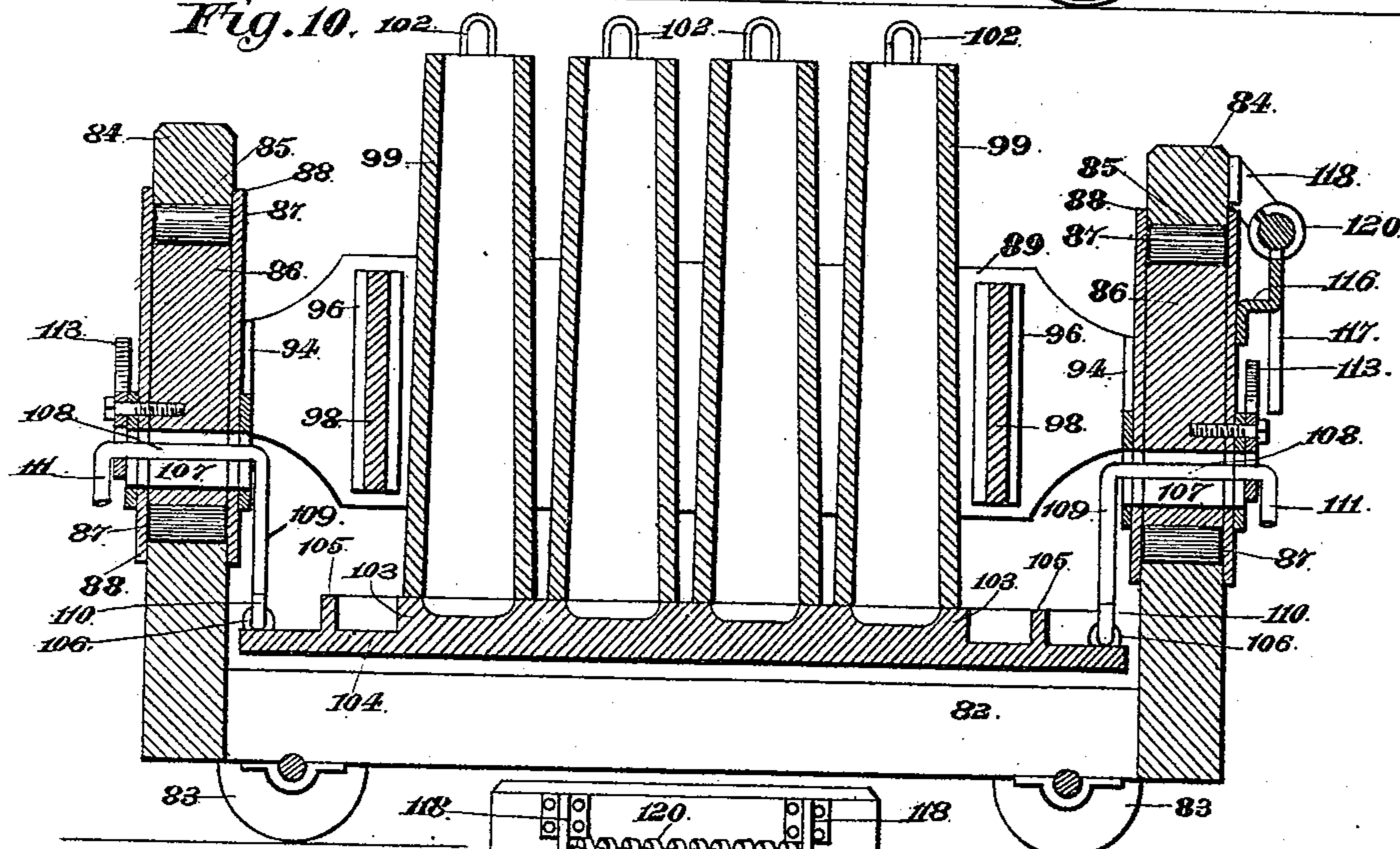
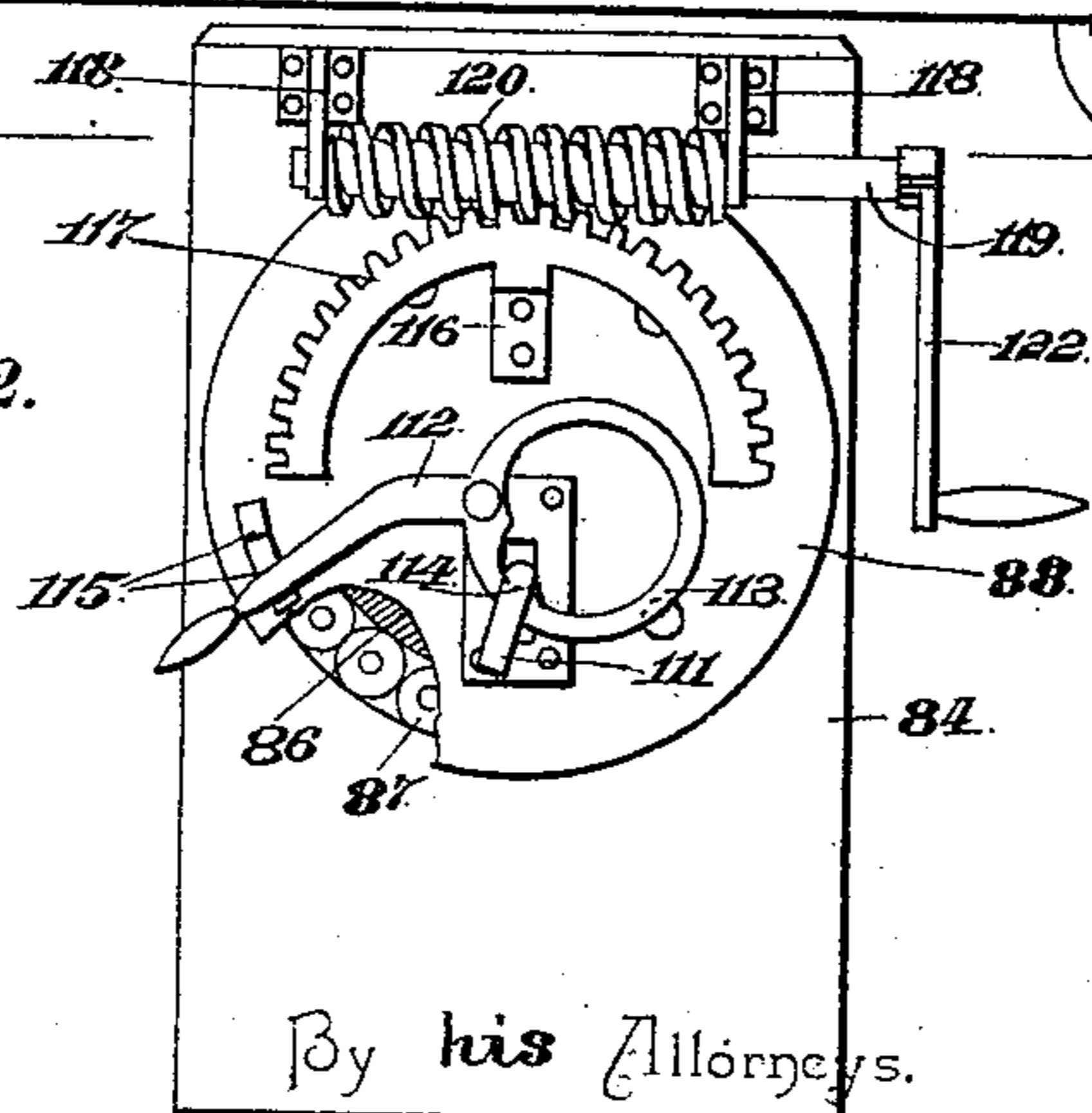


Fig. 12.



Witnesses

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Fig. 11.

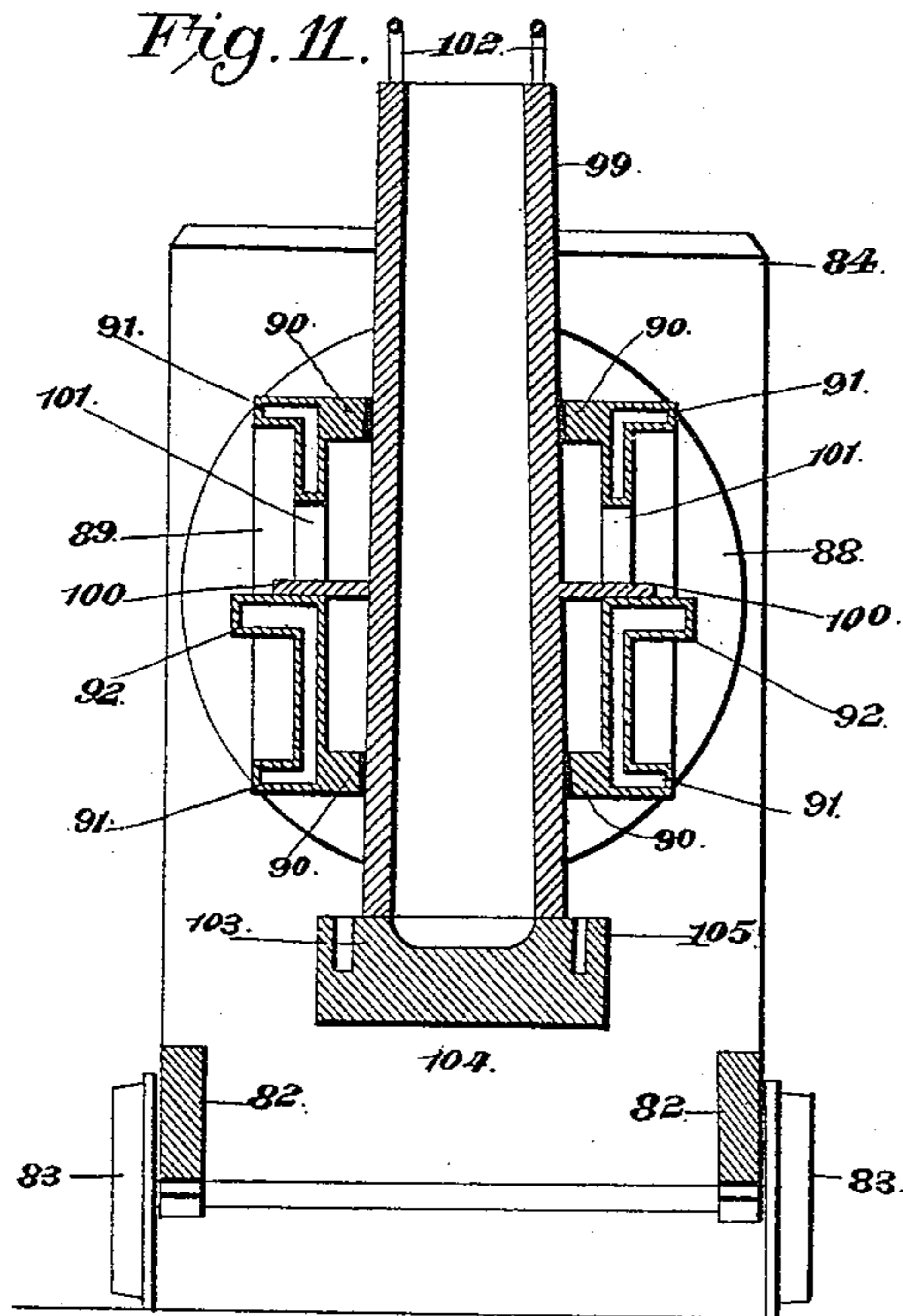


Fig. 14.

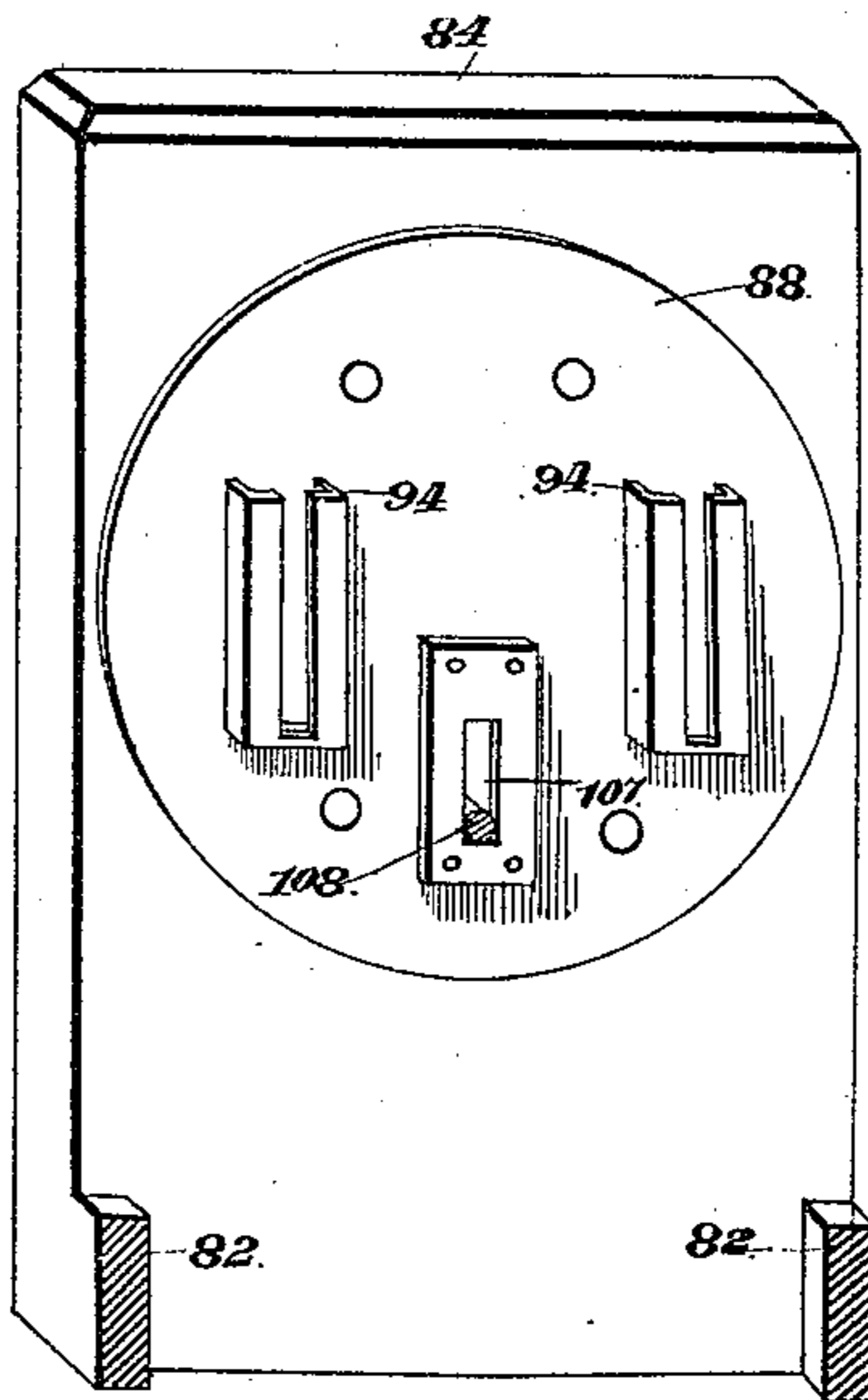
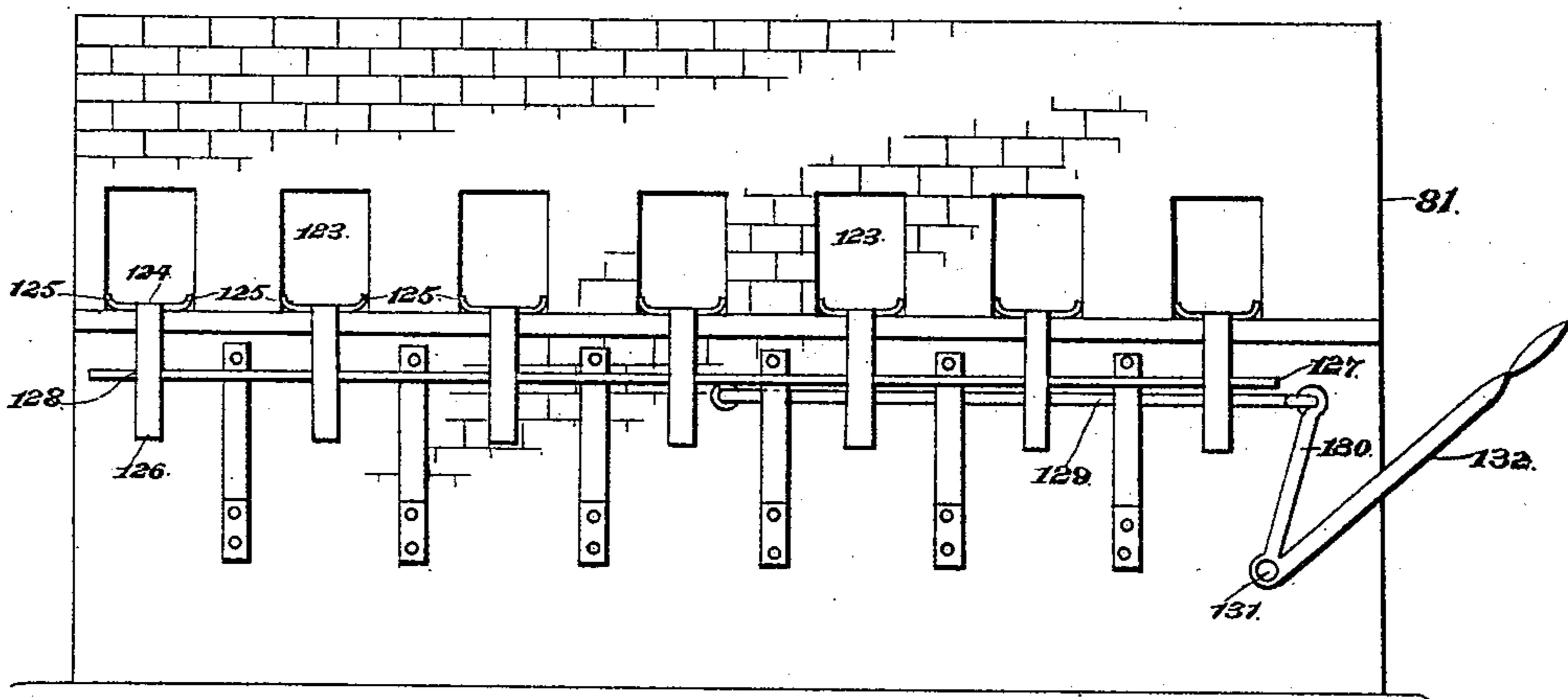


Fig. 16.



Witnesses

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(No Model.)

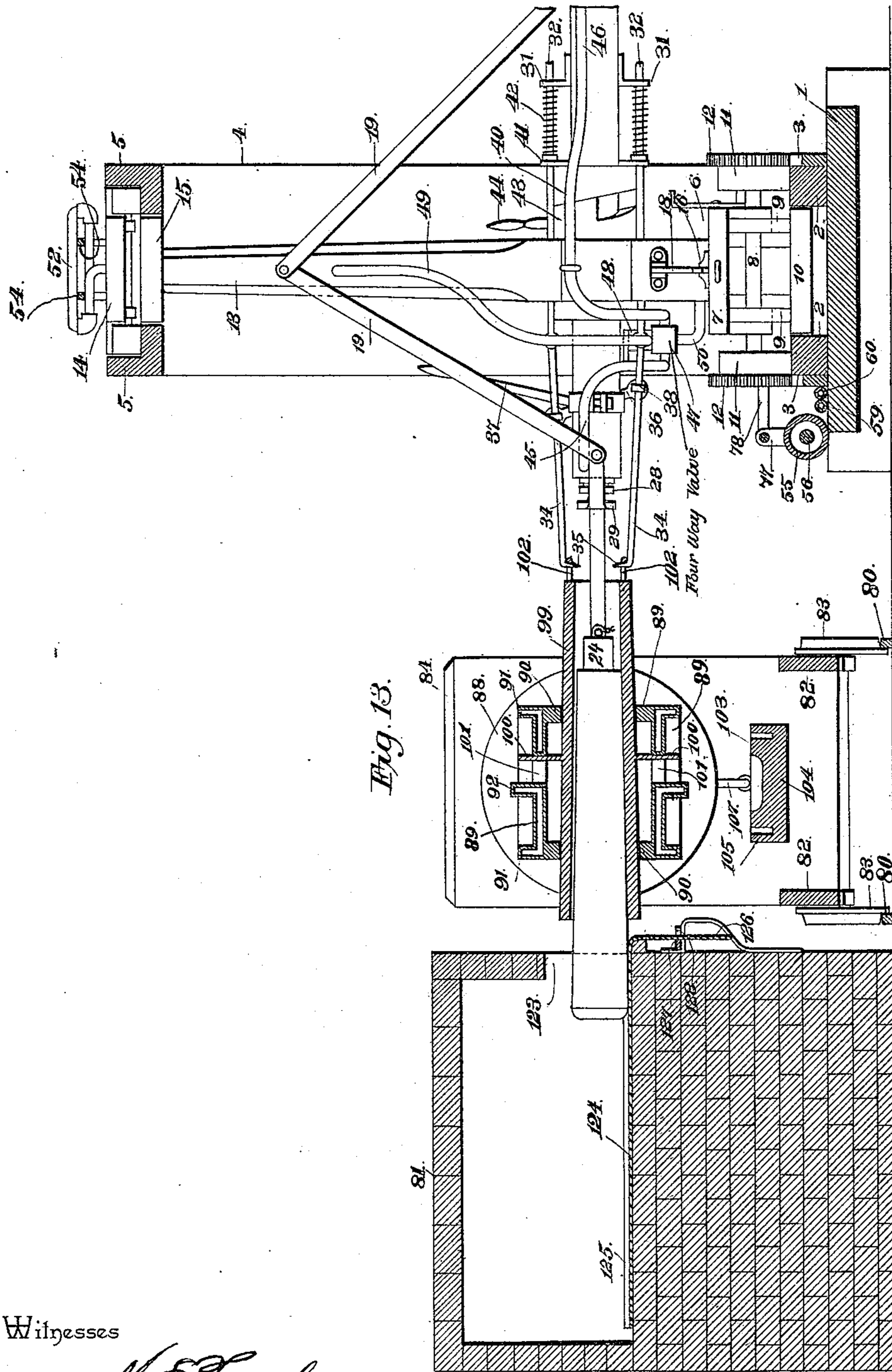
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Witnesses

M. E. Fowler  
Wm. Bagges

By *his* Attorneys,

Inventor

*Thomas Brady*

Cañon Viejo.

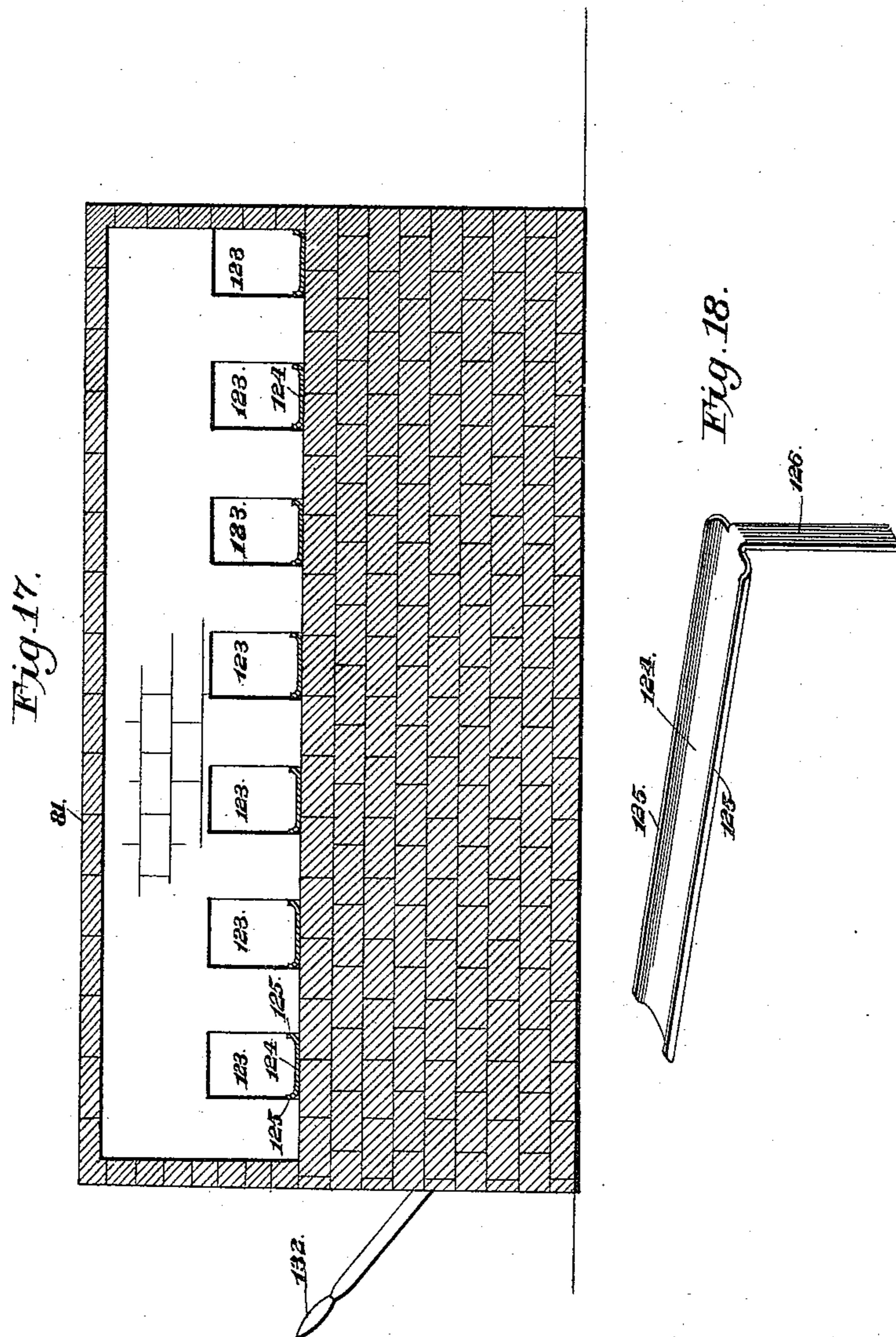
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Witnesses

Witnesses  
M. Fowler

Wm. Bagger

By his Attorneys,

Cash on h/o.

Inventör

*Thomas Brady*

# UNITED STATES PATENT OFFICE.

THOMAS BRADY, OF SOUTH CHICAGO, ILLINOIS.

## DEVICE FOR HANDLING INGOTS.

SPECIFICATION forming part of Letters Patent No. 440,219, dated November 11, 1890.

Application filed May 13, 1890. Serial No. 351,609. (No model.)

*To all whom it may concern:*

Be it known that I, THOMAS BRADY, a citizen of the United States, residing at South Chicago, in the county of Cook and State of Illinois, have invented a new and useful Device for Handling Ingots, of which the following is a specification.

This invention relates to devices for handling ingots in the process of manufacturing steel; and it has for its object to provide mechanism whereby the ingots may be handled more conveniently and rapidly than heretofore.

The invention consists in the improved construction, arrangement, and combination of parts, which will be hereinafter fully described, and particularly pointed out in the claims.

Heretofore in the manufacture of steel it has been customary to set the molds in a pit in the converting-mill to receive the molten metal from the ladle. After casting the ingots they have been stripped of the molds and loaded upon a special car to be transferred to the rolling-mill. This has been a laborious process, and it has been attended with the disadvantage that the ingots have been exposed to the air before being charged into the furnaces, thereby frequently causing the surfaces of the ingots to become cracked.

My invention has for its object to avoid, as nearly as possible the manual handling of the ingots, and this I accomplish, first, by mounting the molds or flasks upon a specially-constructed car, in which the molds remain while the molten metal is being poured into them, said car being provided with a pivoted frame, in which the said molds are mounted; secondly, in providing a pushing device by means of which the ingots may be pushed from the molds into the furnace, said pushing device being so constructed and arranged as to be capable of serving two or more furnaces.

My invention resides more particularly in the detailed construction of the said car and pushing mechanism, in the mechanism for adjusting and operating the latter, and in such other details of construction which will be hereinafter fully described with reference to the drawings, in which—

Figure 1 is a diagrammatic plan view of a

portion of a steel-manufacturing plant, comprising the furnaces, the ingot-pushing mechanism, and the mold-carrying car, showing the relative arrangement of the several parts. Fig. 2 is a side elevation of the ingot-pushing mechanism, showing the pusher-cylinder arranged in position for operation and looking toward the front end of said cylinder. Fig. 3 is a vertical sectional view taken on the line 3 3 in Fig. 2, and showing the pusher-cylinder in side elevation and the car upon which it is mounted in end view. Fig. 4 is a sectional view taken longitudinally through the pusher-cylinder and transversely through the car. Fig. 5 is a sectional view taken longitudinally through the frame of the push mechanism on the line 5 5 in Fig. 3. Fig. 6 is a perspective detail view of the pusher-cylinder and adjacent parts. Fig. 7 is an end elevation of the frame in which the pusher mechanism is mounted. Fig. 8 is a detail view, on an enlarged scale, of the front end of the pusher-cylinder. Fig. 9 is a side elevation of the mold-carrying car with the molds in position upon the same. Fig. 10 is a longitudinal sectional view of the said car. Fig. 11 is a transverse sectional view of the same. Fig. 12 is a perspective view of one end of the said car having the adjusting-worm and spur-wheel. Fig. 13 is a sectional view of the furnace, mold-carrying car, and pusher-frame, showing the pusher-cylinder partly in elevation and showing the several parts in position for operation. Fig. 14 is a perspective detail view of the inner side of one end of the mold-carrying car. Fig. 15 is a detail view of one of the supports for the bottom of the molds. Fig. 16 is a front view of the furnace. Fig. 17 is a longitudinal sectional view of the furnace. Fig. 18 is a perspective view of one of the peels.

Like numerals of reference indicate like parts in all the figures.

1 designates the base-plate, which is mounted upon a very substantial foundation of masonry, and which is provided on its upper side with longitudinal track-beams 2 2, which may be cast or formed integrally with the base-plate. Rack-bars 3 are formed upon the outer sides of the said track-beams.

At the ends of the base-plate 1 are mounted the vertical upright plates or standards 4 4,

the upper ends of which are connected by the longitudinal track-beams 5 5, which, as shown in the drawings, will be L-shaped or composed of plates having upwardly-extending flanges at their outer edges.

6 designates a car which is mounted to ride upon the longitudinal track-beams 2. Said car consists of the platform 7, which is mounted upon the trucks 8 8. The platform is provided with downwardly-extending arms 9, supporting a plate 10, that forms a slide fitting between the track-beams 2 2. The wheels 11 of the car 6 are provided with spur-wheels 12, that engage the longitudinal rack-bars 3, thereby preventing the wheels from dragging or sliding upon the track-beams. The slide-plate 10 serves to prevent lateral displacement of the parts in the device when in operation, as will be hereinafter described.

13 designates a mast which is mounted pivotally upon the platform of the car. The upper end of said mast is likewise mounted pivotally in a car or carriage 14, which is mounted to ride upon the upper longitudinal track-beams of the frame.

The car or carriage 14 is provided with wheels or rollers that ride upon the track-beams, and it has on the under side a slide-plate 15, that fits between said track-beams and prevents the car from being laterally displaced.

The car or carriage 6 is provided with a lug 16, having a notch 17, adapted to be engaged by a lever or catch 18, which is pivotally attached to the mast, which latter may thus be locked in position for operation.

The car-platform is provided with a notched lug at each end, with either of which the locking-lever may be placed in engagement.

The mast 13 carries the horizontally-arranged pusher-cylinder, both ends of which are connected with the mast near the upper end of the latter by means of inclined guys or braces 19. The cylinder, which is designated by 20, has the longitudinally-movable piston-rod 21, which is provided with a suitably-located piston 22. The front end of the piston-rod extends through a packing-box 23 at the front end of the cylinder.

24 designates a head which is mounted detachably at the front end of the piston-rod. Said head, which is cylindrical in shape, is provided with a longitudinal perforation 25, by means of which it is mounted slidingly upon the piston-rod, and it has at its rear end a staple or perforated lug 26, through which a key or pin 27 passes into a perforation in the piston-rod, upon which the said head may thus be locked. The front end of the piston-rod is also provided with a perforation 28 to receive the hook at the end of the drawing-tongs when the device is to be used for drawing the ingots from the furnace, as will be hereinafter described.

The front end of the pusher-cylinder is provided with a forwardly-extending U-shaped bail or bracket 29, having a perforation 30

for the passage of the piston-rod. The object of this is to support or partially support the weight of the front end of the piston-rod and to relieve the packing-box 23 of such weight, thereby preventing injury to said packing-box and avoiding the leakage which would otherwise in time result from such strain or wear.

The upper and lower sides of the cylinder are provided with brackets 31, having bearings for a pair of longitudinally-sliding rods 32, which rods also extend through transverse openings 33 in the mast or derrick.

Pivotally connected to the front ends of the sliding rods 32 are the grappling-arms 34, the front ends of which are provided with hooks 35, adapted to engage perforated lugs or staples at the upper ends of the molds, as will be hereinafter described. Connected pivotally to one side of the cylinder is a lever 36, having a handle 37, by means of which it may be conveniently manipulated. The ends of said lever are provided with swiveled eyes 38, encircling the grappling-arms 34 and serving when the lever is manipulated to bring the outer or free ends of said grappling-arms together or apart, as may be desired.

39 designates a table or platform which is secured near the lower end of the mast or derrick at one side of the pusher-cylinder. This platform is for the accommodation of the operator whose duty it is to attend to the manipulation of the lever-handle 37 and other parts of the pusher-cylinder, which are to be hereinafter described.

40 designates a clutch member which is mounted to slide longitudinally upon the cylinder, and which is provided with perforated lugs or brackets 41 for the passage of the longitudinal rods 32, which are secured in said brackets. Springs 42 are coiled upon the rods 32 between the brackets 41 and 31 and serve to force the clutch member 40 and the rods 32 normally in a forward direction. A clutch member 43 is arranged revolvably upon the cylinder between the clutch member 40 and the mast. The clutch member 43 is provided with a handle 44, by means of which it may be manipulated to force the clutch member 40 in a rearward direction. This is for the purpose of drawing the molds containing the ingots up against the head at the front end of the piston-rod when the device is to be operated for pushing the ingots out of the molds, as will be hereinafter described, thereby relieving the mast and other parts of the machine of excessive and unequal strain, which might prove injurious.

The piston-rod in the pusher-cylinder is operated by hydraulic power, the water being supplied under pressure to the ends of the cylinder through pipes which are designated by 45 and 46. Both of these supply-pipes are connected with a valve-casing 47, containing an ordinary four-way valve 48. Suitably connected with said valve-casing are also the supply-pipe 49 and the exhaust or discharge

pipe 50, the latter extending through a vertical perforation in the lower end of the mast. The valve itself forms no part of my present invention, it being simply so constructed that the supply may be connected with either end of the cylinder, while the exhaust is connected with the other end, or that the supply and the exhaust may both be cut off at will. The supply-pipe 49 extends from the valve-casing up alongside the mast 13 and through an opening 51 in the side of the latter, and thence in an upward direction through the top of the mast and through the car or carriage 14, above which the said supply-pipe 49 is connected with a swivel-jointed pipe 52, composed of any desired number of sections having their meeting ends connected by swivel-joints, so as to admit of said swivel-jointed pipe being extended or contracted, according to the position of the car carrying the pusher-cylinder. The end of the swivel-jointed pipe 52 is connected with the main supply-pipe 53, which is mounted adjacent to one of the end plates 4 of the frame. A pair of longitudinal track- rods 54, having their ends attached to the upper ends of the end plates 4 of the frame, serve to support the swivel-jointed supply-pipe.

The cars carrying the pusher-cylinder and its attachments are operated or carried along their respective tracks by means of mechanism, as follows:

55 designates a hydraulic cylinder, which is arranged alongside of one of the track-beams 2 upon the base-plate, and which is provided with a piston-rod 56, extending through packing-boxes 57 at both ends of the cylinder. The piston-rod 56 has a centrally-located piston 58. Pipes 59 and 60, for supplying water under pressure, are connected with the ends of the cylinder and with the casing 61 of a four-way valve 62, which is also connected with the main supply and discharge pipes 63 and 64 in such a manner that water may be supplied to either end of the cylinder while it is being discharged from the opposite end, or that both the supply and discharge may be simultaneously cut off. The valve 62 is operated by means of a lever or handle 65. To the ends of the piston-rod 56 are attached the brackets 66, each of which is provided with bearings for two pulleys 67 and 68. Guide-pulleys 69 and 70 are suitably arranged near each end of the bed-frame. The frame-plates 4 are provided near their lower ends with perforations 71, adjacent to which guide-pulleys 72 are arranged, and similar guide-pulleys 73 are arranged near the upper end of each of said bed-plates 4. To the bearing-frame of each of the guide-pulleys 69 is attached a wire cable 74, which passes over the pulley 67 at the adjacent end of the piston-rod 56, thence under the guide-pulley 69, thence over the guide-pulley 72 and through the perforation 71, and to the adjacent end of the car or carriage 6, where it is securely attached in any convenient manner. To the

bearing-frame of each of the pulleys 70 is attached a similar wire cable 75, which passes over the guide-pulley 68 at the adjacent end of the piston-rod 56, thence under the guide-pulley 70, and over the guide-pulley 13 to the adjacent end of the car or carriage 14, to which it is suitably attached.

It will be seen that by the foregoing arrangement of parts when the piston-rod 56 is caused to move in either direction the cars or carriages 6 and 14, supporting the mast 13, with the pusher-cylinder and all its attachments, will be moved in the opposite direction. It will also be seen that the upper and lower cars are moved at precisely the same rate of speed, thereby preventing the possibility of any of the parts of the machine getting out of alignment. It may here be stated that the lower car 6 is to be provided with suitable brake mechanism 175, the special construction of which, however, is not considered a part of my present invention. This brake mechanism is considered desirable for the purpose of effectually preventing any possibility of the machinery being displaced while in operation, and it will be seen that such brake mechanism, serving to lock the wheels of the car, having spur-wheels intermeshing with the rack-bars upon the longitudinal track-beams, will effectually and positively prevent longitudinal displacement of the car, while its lateral displacement is quite as efficiently prevented by the arrangement between the longitudinal track-beams of the slide-plate 10, which forms a part of the car structure.

The piston-rod 56 is provided near each end with an upwardly-extending yoke or bail 77, which rides upon guide-rods 78, which are suitably attached at the ends of the cylinder to the frame-plates 4 at the ends of the frame structure. By this means the weight of the ends of the piston-rod carrying the pulley-frames 66 is taken off the packing-boxes at the end of the cylinder, the advantages of which will be readily understood.

The parts of my invention thus far described, and which constitute the mechanism for pushing the ingots from the molds into the furnaces and for drawing the ingots from the furnaces may be operated by two attendants, one of whom is stationed at the valve-lever 65, controlling the mechanism for causing the cars to travel in either direction, and the other of whom is stationed upon the table or platform 39, whereby they may conveniently manipulate the lever-handle 37, whereby the grappling-rods 34 are actuated, the lever-handle 44, by means of which the clutch member 43 is operated, and a lever-handle 79, which is suitably connected by means of links and connecting-rods with the stem of the valve 48, which latter may thus be manipulated so as to cause the piston-rod to be operated in either direction.

The ingot pushing and drawing mechanism, which has been described in the forego-

ing, is in practice to be arranged longitudinally between two furnaces, which may be of any suitable construction and dimensions. I prefer this arrangement, for the reason that  
 5 owing to the fact that the mast or derrick carrying the pusher-cylinder is swiveled in the manner described, it may be employed to serve two furnaces or sets of furnaces as well as one. Consequently a considerable econ-  
 10 omy in the initial cost of the plant may be effected by arranging the pushing and drawing mechanism to serve two furnaces, one on each side, as described.

I shall now proceed to describe the structure of the car carrying the ingot-molds, in which the ingots are transported from the converting-mill and to the furnaces. I desire in this connection to call attention to the patent granted to me in the United States on  
 20 the 15th day of October, 1889, No. 412,832, for improvements in devices for casting ingots. This device is the one which it is intended to use in connection with my present invention, and it provides for the casting or pouring of  
 25 the molten metal from the ladle directly into the molds, which are described as being supported upon suitable cars. The special structure of said cars, however, I purposely omitted to show or describe in the Letters Patent  
 30 above referred, for the reason that the said car-structure is more properly a part of the present invention.

I make the foregoing statement merely to show that I have provided means whereby  
 35 the ingots may be cast in molds supported upon a traveling car structure.

Arranged or constructed alongside the bed-plate 1 and parallel to the track-beams 2 on said bed-plate are the tracks 80, which extend  
 40 at one end to the frames upon which the ladles are supported while casting ingots and at the other end to the rolling-mills. The said tracks 80 are arranged intermediately between the base-plate 1 and the furnaces, which  
 45 latter are designated by 81.

The mold-supporting car is composed of the longitudinal frame pieces or sills 82, supported upon the wheels 83 and supporting the heavy vertical end frames 84. The latter are provided with bearings 85, of large diameter, for  
 50 the trunnion-plates 86, between which and the bearings the friction-rollers 87 are interposed for the purpose of enabling the mold-carrying frame to be conveniently manipulated and adjusted to its proper position. The  
 55 trunnion-plates and the anti-friction rollers are retained in the bearings by means of the annular flange-plates 88, which are suitably secured to the outer and inner sides of the  
 60 trunnion-plates.

The mold-carrying frame is composed of two heavy side pieces or girders 89, which are provided on their inner sides with flanges 90 to support the molds when the latter are in a  
 65 horizontal position and on their outer sides with longitudinal strengthening-ribs 91 and 92, formed, respectively, at their upper and

lower edges and longitudinally along the center. The side pieces or girders 89 are cast hollow, in order to admit of their being filled  
 70 or charged with water for the purpose of preventing the heat from the ingots from warping or otherwise injuring them. The ends of the girders are provided with flanges 93, adapted to engage supporting-cleats 94 upon  
 75 the inner sides of the trunnion-plates. The side pieces or girders are secured firmly in the said supporting-cleats by means of keys 95, driven into the said cleats alongside of the flanges 93. The inner sides of the side  
 80 pieces or girders are provided with vertical supporting-cleats 96 to receive flanges 97, formed at the ends of transverse brace-plates 98, by means of which the said side pieces or  
 85 girders are securely connected. It will be observed that by this construction and arrangement the parts constituting the mold-carrying frame may be very conveniently and securely put together or taken apart for repairs, while at the same time great strength  
 90 and firmness of the various component parts are attained, which is obviously important, owing to the heavy weight which has to be sustained and the circumstances under which the ingots are to be handled.

The molds or flasks, which are designated by 99, are in the main of ordinary construction, but are provided with laterally-extending supporting plates or flanges 100, that extend through the vertical slots or port-holes  
 101, which are formed in the side pieces or girders 89 directly above the central strengthening-ribs 92 of the latter. The slots 101, it will be seen, will admit of a limited movement of the molds or flask 99 in the direction of the  
 105 length of the latter. Said molds or flasks are provided at their upper edges with perforated lugs or staples 102, adapted to be engaged by the grappling-rods 34 of the pushing mechanism, which has been hereinbefore described.

In the drawings hereto annexed I have shown the mold-carrying frame as supporting a series of four molds; but it is obvious that a greater or less number of molds may be used when desired. The molds are open at their lower ends, and the bottoms for the  
 110 said molds consist of a series of blocks 103, mounted upon or formed integrally with a plate 104, which is provided with an annular upwardly-extending flange 105, surrounding the individual mold-bottoms. The bottom plate 104 is provided on its upper side near its ends with perforated lugs or staples  
 115 106, by means of which said bottom plate may be suspended under the molds in such a manner as to be capable of being disengaged from the latter for the purpose of enabling the ingots to be pushed out after the molds have been adjusted to an approximately-horizontal position.

The trunnion-plates 86 at the ends of the car are provided with radial slots 107, in which are mounted the supporting devices for the  
 120 bottom plate of the molds. Each of said

supporting devices comprises a shaft 108, extending through the slot 107 and having at its inner end a downwardly-extending arm 109, provided at its lower end with a hook 110.

5 The outer end of each of the shafts 108 is provided with an arm 111.

Connected pivotally to the outer side of each of the trunnion-plates 86 at a point near the upper end of the slot 107 is an arm or lever 112, having an eccentric-ring 113, through which the outer end of the shaft 108, having the arm 111, extends. The eccentric-rings 113 are provided near the fulcrums of the levers 112 with notches 114. It will be seen that by 15 manipulating the said levers the shafts 108 may be raised or lifted upwardly in the slots 107, thereby lifting the mold-bottom, which has been previously mounted by its lugs or staples 106 upon the hooks 110 up into contact with the lower ends of the molds. The mold-bottom may be retained in this position by placing the ends of the operating-levers 112 under studs 115, attached to the trunnion-plates.

25 It will be seen that the mechanism for adjusting the mold-bottom is wholly connected with the trunnion-plates. Hence the latter may be turned so as to adjust the molds to any desired position without changing the position of the mold-bottom, which is important, for reasons which will be hereinafter made apparent.

The trunnion-plate 86, at one end of the car, is provided with a bracket 116, to which is 35 attached a segmental gear or rack 117, which is concentric with the upper half of the trunnion-plate. Brackets 118, secured to the upper end of the end plate 84, are provided with bearings for a shaft 119, provided with a worm 120, engaging the segmental rack 117. 40 The shaft 119 has a square end 121, upon which a crank 122 may be placed for the purpose of manipulating said shaft. It will be seen that by this mechanism the trunnion-plates and the mold-carrying frame may be 45 swung or tilted in an arc of one hundred and eighty degrees, thus enabling the molds to be tilted to either side into a horizontal position.

It is obvious that the parts of the mold-carrying car and the pushing mechanism are to 50 be so proportioned with relation to each other that the molds when occupying a horizontal position shall be practically in horizontal alignment with the piston-rod of the pusher-cylinder.

55 The furnaces 81 are arranged, as above described, alongside of the tracks 80 and parallel to and at a suitable distance from the frames of the ingot pushing and drawing mechanism. The said furnaces are in the 60 main of ordinary construction—a suitable number of charging-doors 123, which are located a suitable distance apart, so as to enable two ingots to be charged through each one of the doors, means being provided, as 65 will be presently described, for tilting the ingot, which is first charged to either side of

the charging-door, so as to leave room for the next one. For the purpose of thus tilting the ingots out of alignment with the charging- 70 doors, I avail myself of the peels 124, each of which consists of a plate of suitable dimensions having slightly upturned or curved side edges 125 and provided at its front end with a downwardly-extending arm 126. 75

The front of the furnace is provided with bearings for a longitudinally-sliding dump-bar 127, which is provided in its front edge with a series of notches 128 to register with the charging-doors 123. One end of the dump- 80 bar is connected by means of the pivoted rod 129 with one arm 130 of a bell-crank lever, which is fulcrumed at 131, and the other arm 132 of which serves as a handle by means of which it may be manipulated to impart a lon- 85 gitudinally-sliding movement to the dump-bar 127. When the ingots are pushed or charged into the furnace, as will be hereinafter described, the peels 124 are first placed in position, it being unnecessary, however, to 90 slide the said peels into the furnace until the arms or handles 126 engage the notches of the dump-bar. When the ingots are afterward pushed into the furnace, they will carry the peels with them until the handles 126 of said 95 peels engage the notches 128 in the dump-bar. It will thus be seen that by manipulating the bell-crank lever in such a manner as to slide the dump-bar in either direction the peel will be tilted, thus rolling or tilting the ingots supported thereon to either side of the charging- 100 doors of the furnace.

In the practical operation of my invention the car carrying the ingot-molds filled with the molten metal is transported upon the tracks 105 80 from the converting-mill and to the furnace. The car is so arranged as to bring the molds or flasks into alignment with the charging-doors of the furnace, and the cars 6 and 14, carrying the mast 13 and the pusher-cyl- 110 inder with its attachments, are then manipulated to bring the said pusher-cylinder into alignment with one of the molds and furnace-doors. The adjustment of the pushing mechanism may be very quickly and easily effected 115 by means of the operating mechanism actuated by the hydraulic cylinder 55. The mold-carrying frame of the car is then tilted by means of the worm and segmental rack to bring the molds into a horizontal position with 120 their upper ends toward the pusher-cylinder. While the mold-carrying frame is being tilted to bring the molds in a horizontal position the bottom plate of the molds is suffered to remain in contact with the lower ends of the 125 latter, which are thereby closed, this being obviously necessary for the purpose of preventing the ingots from dropping out of the molds by gravity. When the mold-carrying frame has been sufficiently tilted to bring the 130 molds into a horizontal position, or nearly so, the eccentric-rings 113 are operated by their levers or handles 112, which are released from under the studs 115 to permit the shafts 108,

having the supporting-hooks 110, to move outwardly in the slots 107, thereby releasing the bottom plate from the lower ends of the molds and permitting the said bottom plate to swing down between the ends of the car-frame. The lever-man or operator, who is stationed upon the platform 39, now manipulates the pivoted grappling-arms 34 by means of the lever 36 and handle 37 to cause the hooks 35 at the front or outer ends of said grappling-arms to engage the lugs or staples 102 at the upper ends of the holes or flasks 99. This having been done, he next operates the clutch member 43 by means of the lever or handle 44 to force the clutch member 40 and the rods 33, to the front ends of which the grappling-rods are journaled, in a rearward direction against the tension of the springs 42, thus drawing the mold containing the ingot up into contact with the head 24 at the front end of the piston-rod 20 in the pusher-cylinder and serving to hold the said mold securely while the ingot is being pushed out. The sliding movement of the mold just described is made possible by the presence of the vertical slots or port-holes 101 in the mold-carrying frame in which the said molds are supported by their flanges 100. The lever-man now manipulates the operating rod or handle 79 of the valve 48 to so adjust said valve as to cause water under pressure to be admitted through the pipe 46 into the rear end of the cylinder, thus causing the piston-rod to move in a forward direction and to push the ingot out of the mold and into the furnace through the charging-door with which it is in alignment. By reversing the valve 48 the piston is next caused to recede, and by manipulating the valve controlling the supply of water into the cylinder 58, the carriages supporting the pushing mechanism may now be adjusted to place the piston into alignment with the next mold, after which the operation may be repeated. When all the ingots have been pushed into the furnace, the mold-carrying frame is restored to its normal position and conveyed back into the converting-mill to receive a new charge, while the pushing mechanism is held ready to operate upon the next car-load of ingots that may arrive from the converting-mill. After all the furnace-doors have received their first charges the dump-bar 127 is manipulated to tilt the ingots into the spaces between the charging-doors of the furnace, and the peels may then be withdrawn, leaving the furnaces in readiness to receive the second charge. After having served the furnace on one side of the pushing mechanism the pushing-cylinder is reversed and made to serve the furnace on the opposite side. When the ingots have remained in the furnaces for a sufficient length of time to raise them to the desired degree of heat, they may be drawn by using drawing-tongs of ordinary construction provided with hooks to engage the perforation 28 in the front end of the piston-rod.

The head 24 of the piston-rod is meanwhile slid in a rearward direction upon the rod, so as to expose the said perforation 28, this being done by simply releasing the key 27 from engagement with the recess or opening in the piston-rod. By the use of the grappling-tongs the ingots are drawn out upon a suitably-constructed car, which, inasmuch as it forms no part of my present invention, has not been illustrated in the drawings, and upon which they may be conveyed along the tracks 80 to the rolling-mill.

The advantages of my invention will be readily understood from the foregoing description, taken in connection with the drawings hereto annexed, by those skilled in the art to which it appertains. By the ordinary method of manipulating ingots it has been customary to strip the ingots from the molds in the converting-mill, where the molds are set for casting in a pit under the pouring-ladle. The process of stripping the ingots has necessarily been slow and laborious, requiring the assistance of numerous operators, the services of many of whom may be dispensed with by my invention. In addition to this the steel is kept in a far better condition than heretofore, owing to the fact that it is at no time between the casting of the ingots and the charging of the ingots into the furnace exposed to the drafts of cold air, which have heretofore been instrumental in cracking and injuring the surfaces of the ingots, frequently entailing considerable loss, owing to the inferior quality of the product.

Another important advantage certain to be derived from my invention is the facility with which the ingots may be handled in a highly-heated state, thereby effecting a considerable saving in the fuel necessary to raise them to the necessary degree of heat for rolling.

Other advantages might be mentioned; but it is thought that the foregoing will be sufficient to illustrate the superiority of my improved devices for handling ingots over the methods ordinarily employed.

In the detailed construction of the various parts of my invention I have aimed not only at so constructing the various parts of the mechanism as to facilitate the actual handling of the ingots, but I have had specially in mind the difficulties to be overcome owing to the heavy weights to be handled and the highly-heated condition of the ingots.

It is obvious that all of the structural parts of the device must be so constructed as to gain the greatest possible strength and to avoid the possibility of breakage, while at the same time simplicity of construction is important, not only for the purpose of reducing the initial expense of the plant, but also to facilitate the assembling and putting together of the parts, many of which are necessarily heavy and cumbersome. I believe that I have attained these objects by the construction and arrangement of parts herein described, and illustrated in the drawings hereto an-

nexed; but I desire to have it distinctly understood that I reserve the right to any changes and modifications which may be resorted to without departing from the spirit of my invention.

I also desire it to be understood that while for various reasons I consider hydraulic pressure to be preferable as a motive and actuating power in connection with my invention I reserve the right to use any other fluid-pressure.

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

1. In a device for handling ingots, the combination, with a car or carriage mounted to travel on a suitable track alongside of the heating-furnace, of a hydraulic cylinder swiveled or mounted revolubly upon such carriage or car, a piston-rod mounted to reciprocate in said cylinder, and means for connecting the ends of said cylinder with the source of fluid-pressure and the exhaust, substantially as set forth.

2. In a device for handling ingots, the combination of a frame, the upper and lower longitudinal parallel tracks, the cars or carriages mounted upon said tracks, and a mast or derrick swiveled in said carriers and supporting a hydraulic cylinder having a piston-rod, substantially as set forth.

3. In a device for handling ingots, the combination, with suitable supporting-tracks, of a lower and an upper car or carriage, a vertical mast or derrick swiveled in said carriages and carrying the hydraulic cylinder, the piston-rod of which forms a pusher, and means for simultaneously operating said cars or carriages, substantially as set forth.

4. In a device for handling ingots, the combination of the bed-plate having the longitudinal track-beams, the car or carriage mounted upon said track-beams and supporting a hydraulic cylinder, and a slide-plate depending from the platform of said car and fitting between the track-beams of the bed-plate, substantially as set forth.

5. The combination of the bed-plate, the longitudinal track-beams, the rack-bars upon the outer side of said track-beams, the car or carriage having wheels mounted to ride upon the track-beams, and spur-wheels to engage the rack-bars, substantially as set forth.

6. The combination of the bed-plate having the longitudinal track-beams, the rack-bars upon the outer sides of the latter, the car or carriage supporting the hydraulic cylinder and having wheels that ride upon the track-beams and spur-wheels that engage the rack-bars, and a slide-plate depending from the platform of said car and fitting between the longitudinal track-beams, substantially as set forth.

7. The combination of the longitudinal track-beams, the rack-bars on the outer sides of the latter, the car having wheels mounted to ride upon the track-beams and spur-

wheels engaging the rack-bars, a slide-plate depending from the platform of said car and fitting between the track-beams, suitable brake mechanism for retaining said car at any desired adjustment, and the hydraulic cylinder and operating mechanism mounted upon said car, substantially as set forth.

8. The combination of the frame, the upper and lower longitudinal tracks, the upper and lower cars or carriages mounted upon the said tracks and having slide-plates that fit between the frame-beams to prevent lateral displacement of said cars, the vertical mast or derrick swiveled in said cars and carrying the hydraulic cylinder and operating mechanism, and means for imparting motion to said cars or carriages simultaneously in the same direction, substantially as set forth.

9. The combination, with the hydraulic-cylinder mounted upon a car, of a swivel-jointed pipe for supplying fluid under pressure to said cylinder, substantially as set forth.

10. The combination of the upper and lower cars or carriages mounted upon suitable tracks, the vertical mast or derrick swiveled in said cars and carrying the hydraulic cylinder, a vertical supply-pipe extending through the mast and connected with a valve-casing which is in turn connected with the ends of the cylinder and with the exhaust or discharge, and a swivel-jointed pipe connecting the upper end of said vertical supply-pipe with the source of supply of fluid under pressure, substantially as set forth.

11. The combination of the bed-plate having the longitudinal tracks, the car or carriage mounted upon said tracks and supporting the pusher-cylinder, means, such as the swivel-jointed pipe, for supplying fluid under pressure to a valve-casing mounted upon the carriage and thence to either end of the cylinder, and an exhaust or discharge pipe extending from said valve-casing through the lower end of the swiveled mast and discharging upon the bed-plate between the track-beams, substantially as set forth.

12. The combination, with the cars or carriers mounted upon suitable tracks, of the vertical swiveled mast carrying the pusher-cylinder, the guys or braces connecting the ends of said cylinder with the said mast near the upper end of the latter, the valve-casing mounted upon a platform attached to the mast adjacent to the pushing-cylinder, a swivel-jointed pipe for supplying fluid under pressure to said valve-casing, a discharge-pipe extending from said valve-casing through the lower end of the swiveled mast, pipe connecting the said valve-casing with the ends of the cylinder, the piston-rod mounted in the latter and having a suitably-located piston, and a suitably-constructed valve and operating mechanism, substantially as set forth.

13. The combination of the pusher-cylinder having a packing-box at its front end, a yoke or bail secured to and extending forwardly from said pusher-cylinder, and the piston-rod

mounted in the latter and extended through the packing-box and through a perforation in the yoke or bail at the front end of said cylinder, whereby the packing-box is relieved of the weight of the projecting end of the piston-rod, substantially as set forth.

14. The combination of the pusher-cylinder, the piston-rod having a perforation at its front end, and a cylindrical head mounted slidingly upon the front end of said piston-rod, substantially as set forth.

15. The combination of the pusher-cylinder having the packing-box at its front end, the piston-rod, the front end of which projects through said packing-box, the head mounted slidingly upon the front end of said piston-rod, and a perforated yoke or bail attached to the front end of said cylinder for the passage of the piston-rod and to support the weight of the projecting end of the latter, substantially as set forth.

16. The combination of the pusher-cylinder, the piston-rod extending through a packing-box at the front end of said cylinder and through a perforation in a yoke or bail attached to the latter, said piston-rod being provided with a perforation at its front edge, the head mounted slidingly upon the front end of said piston-rod and provided with a rearwardly-extending perforated lug or staple, and a key adapted to extend through the latter and to engage an opening in the piston-rod, thereby connecting the sliding head to the latter, substantially as set forth.

17. The combination, with the pusher-cylinder having the longitudinally-reciprocating piston-rod, of a pair of longitudinally-movable pivoted grappling-rods having hooks at their front ends, substantially as and for the purpose set forth.

18. The combination, with the pusher-cylinder having the longitudinally-reciprocating piston-rod, of a pair of longitudinally-movable rods, and the grappling-rods pivoted to the front ends of said longitudinally-movable rods and having hooks at their front ends, substantially as set forth.

19. The combination of the pusher-cylinder having the longitudinally-reciprocating piston-rod, the longitudinally-movable pivoted grappling-rods having hooks at their front ends, and mechanism for moving the front ends of said grappling-rods toward or apart from each other, substantially as set forth.

20. The combination of the pusher-cylinder having the longitudinally-reciprocating piston-rod, the longitudinally-movable pivoted grappling-rods having hooks at their front ends, an operating-lever suitably fulcrumed, and having swiveled eyes for the passage of the said pivoted grappling-rods, and a handle attached to said operating-lever, substantially as set forth.

21. The combination of the pusher-cylinder having the longitudinally-reciprocating piston-rod, the longitudinally-movable pivoted grappling-rods having hooks at their front

ends, the operating-lever having swiveled eyes for the passage of said grappling-rods, springs for forcing the latter normally in a forward direction, and mechanism for forcing the said grappling-rods in a rearward direction against the tension of said springs, substantially as set forth.

22. The combination of the pusher-cylinder having the longitudinally-reciprocating piston-rod, a pair of longitudinally-movable rods mounted in bearings on the upper and lower sides of said cylinder the grappling-rods connected pivotally with the front ends of said sliding rods, the operating-lever having swiveled eyes for the passage of said grappling-rods, a clutch member mounted to slide longitudinally upon the cylinder and connected with the longitudinally-sliding rods, springs to force said clutch member and sliding rods normally in a forward direction, and a clutch member mounted to oscillate upon the cylinder and having an operating handle or lever to force the longitudinally-sliding rods and the clutch member connected therewith in a rearward direction against the tension of the springs, substantially as set forth.

23. The combination of the pusher-cylinder, the longitudinally-movable rods, the pivoted grappling-rods attached to the front ends of the latter, means for adjusting the said grappling-rods, and a clutch one of the members of which is mounted to slide longitudinally upon the cylinder and is connected with the sliding rods, and the other of whose members are mounted to oscillate upon the cylinder, whereby by the oscillation of said clutch member the longitudinally-movable rods with their attachments shall be forced in a rearward direction, substantially as set forth.

24. The combination, with the pusher-cylinder, of the longitudinally-reciprocating piston-rod, the yoke or bail attached to the front end of said cylinder and having a perforation for the passage of said piston-rod, the longitudinally-pivoted grappling-rods, and mechanism for manipulating the latter, substantially as set forth.

25. The combination of the frame having the upper and lower parallel tracks, the cars or carriers mounted upon said tracks, the vertical swiveled mast carrying the pusher-cylinder and its operating mechanism, the notched lugs attached to the platform of the lower car in front and in rear of the swiveled mast, and a lever or catch connected pivotally to one side of the latter and adapted to engage the said notched lugs, substantially as set forth.

26. The combination of the frame having the upper and lower parallel tracks, the cars or carriers mounted upon said tracks, the vertical mast swiveled in said cars or carriers and carrying the pusher-cylinder and operating mechanism, the swiveled jointed pipe connected with a vertical supply-pipe extending through the mast for supplying fluid un-

der pressure to the pusher-cylinder, and the longitudinal guide-rods supporting alternate sections of the said swivel supply-pipe, substantially as and for the purpose set forth.

27. The combination of the frame, the upper and lower longitudinal tracks, the cars or carriers mounted upon said tracks, the vertical mast swiveled in said cars or carriers and carrying the pusher-cylinder, a hydraulic cylinder having a longitudinally-reciprocating piston-rod extending through packing-boxes at both its ends, and cables passing over suitable guide-pulleys and connecting the ends of said piston-rod with the ends of the longitudinally-movable cars or carriers, substantially as set forth.

28. The combination, with suitable tracks, of the upper and lower cars or carriers, the vertical mast swiveled in the latter and carrying the pusher-cylinder, a hydraulic cylinder having a longitudinally-reciprocating piston-rod extending through packing-boxes at both its ends, the frames mounted at the ends of said piston-rod and having guide-pulleys journaled therein, guide-pulleys located at the ends of the frame and attached to the end uprights of the same, and the wire cables having their ends attached, respectively, to the pulley-frames at the ends of the bed-plate and to the ends of the upper and lower cars, said cables being passed over the guide-pulleys at the ends of the piston-rod, at the ends of the bed-plate, and upon the end plates of the frame, all substantially as and for the purpose herein set forth.

29. The combination, with the hydraulic cylinder having the longitudinally-reciprocating piston-rod extending through packing-boxes at both its ends and provided at both ends with frames in which guide-pulleys are journaled, of the supporting-rods attached to the end plates of the frame, and the supporting-yokes attached to the ends of the piston-rod and mounted to ride upon said supporting-rods, substantially as set forth.

30. The combination of suitable longitudinal tracks, the upper and lower cars or carriages mounted upon said tracks, the vertical mast or standard swiveled in said cars or carriages and carrying the longitudinal pusher-cylinder having a longitudinally-reciprocating piston-rod, a swivel-jointed pipe connecting with a supply-pipe extending vertically through the mast for supplying fluid under pressure to a suitable valve-casing and thence to the ends of the pusher-cylinder, the hydraulic cylinder arranged alongside the lower track and having the longitudinally-reciprocating piston-rod extending through packing-boxes at both its ends, cables connecting the ends of said piston-rod with the ends of the upper and lower carriages, said cables being passed over suitably-arranged guide-pulleys and having their opposite ends attached to fixed points, and means for supplying fluid under pressure to either end of

the said hydraulic cylinder while the other end of said cylinder is connected with the exhaust, substantially as herein set forth.

31. In a device for handling ingots, a transfer-car having a pivoted mold-carrying frame, substantially as and for the purpose set forth.

32. In a device for handling ingots, a transfer-car having a frame mounted pivotally in the ends of said car and carrying a series of molds or flasks, in combination with a separable bottom for said molds, substantially as set forth.

33. In a device for handling ingots, a mold-carrying car having a frame mounted pivotally in the ends thereof, in combination with a series of molds mounted vertically in said frame and capable of a limited movement in the direction of their length, substantially as set forth.

34. The mold-carrying car consisting of the sills, the end plates, the trunnion-plates mounted pivotally in said end plates, and the mold-carrying frame having its ends connected to the inner sides of said trunnion-plates, substantially as set forth.

35. The mold-carrying car having the sills, the end plates, the trunnion-plates mounted pivotally in said end plates, the mold-carrying frame having its ends connected to the inner sides of said trunnion-plates, and the molds mounted in said frames, in combination with the bottom plate and means for adjusting the latter, substantially as set forth.

36. The mold-carrying car having the pivoted frame, in combination with the molds mounted in said frame and capable of longitudinal movement in the direction of their length, said molds being provided at their upper edges with perforated lugs or staples adapted to be engaged by grappling-rods attached to the pusher-cylinder, substantially as set forth.

37. The mold-carrying car having the pivoted mold-carrying frame, said frame being composed, essentially, of the side pieces or girders provided with strengthening ribs or flanges and cast hollow, so as to be capable of receiving charges of water to prevent it from warping, in combination with the end braces, substantially as set forth.

38. The mold-carrying car having the end plates provided with circular openings, in combination with the trunnion-plates, the anti-friction rollers interposed between the latter and their bearings, the annular plates or flanges secured to the inner and outer sides of the trunnion-plates to keep the latter and the anti-friction rollers in position, and the mold-carrying frame having its ends connected to the inner sides of the trunnion-plates, substantially as set forth.

39. The mold-carrying car having the end plates provided with circular openings, in combination with the trunnion-plates having supporting-cleats on their inner sides, and the mold-carrying frame having the side beam

or girders provided at their ends with flanges seated in said supporting-cleats, substantially as set forth.

40. The mold-carrying frame composed of the side beams or girders having flanges at their ends and provided with supporting-cleats on their inner sides, in combination with the end braces or connecting-pieces having flanges to engage the supporting-cleats on the inner sides of said girders, and the trunnion-plates mounted pivotally in the end plates of the transfer-car and having supporting-cleats to receive the flanges at the ends of the girders, substantially as set forth.

41. The mold-carrying car having the pivoted frame, the sides of which are provided with vertical slots or port-holes, in combination with the molds or flasks having supporting-flanges extending through said slots and provided with perforated lugs or cleats at their upper edges, substantially as set forth.

42. The mold-carrying car having the pivoted frame, the sides of which are provided with slots or port-holes, in combination with the molds or flasks having supporting-flanges extending through said slots and provided with perforated lugs or flanges at their upper edges, the bottom plate mounted upon swinging hooks radially adjustable with relation to the axis of the pivoted mold-carrying frame, and means for adjusting the said bottom plate, substantially as and for the purpose set forth.

43. The combination of the car having end plates provided with circular openings, the trunnion-plates mounted pivotally in said openings, the mold-carrying frame having its ends connected to the inner sides of said trunnion-plates, the molds mounted in said frame, the bottom plate provided at its ends with lugs or staples, the shafts mounted in radial slots and the trunnion-plates and provided at their inner ends with hooks to engage the staples of the bottom plate and to support the latter, and means for adjusting the shafts having the hook-supporting arms in the slots in which they are mounted and for retaining them at the proper adjustment, substantially as set forth.

44. The combination, with the transfer-car, of the trunnion-plates mounted in the ends of said car, the mold-carrying frame having its ends connected to the inner sides of said trunnion-plates, the bottom plate, and mechanism for adjusting said bottom plate, said adjusting mechanism being connected with or mounted in the trunnion-plates so as to be unaffected by the operation of the latter, substantially as set forth.

45. The combination, with the car, of the pivoted mold-carrying frame, the side beams or girders of which are provided with flanges on their inner sides at their upper and lower edges, and the molds mounted in said frame and adapted to rest upon said flanges when the said frame is swung or tilted so as to

bring the molds into a horizontal position, substantially as set forth.

46. The combination, with the car, the end plates of which have the pivoted trunnion-plates, of the mold-carrying frame, the ends of which are attached to the inner sides of said trunnion-plates, the molds mounted in said frame, the bottom plate provided at its ends with perforated lugs or staples, the shafts mounted in radial slots in the trunnion-plates and provided at their inner ends with hooked arms to support the bottom plate and at their outer ends with radial arms, the levers pivoted to the trunnion-plates and having eccentric-rings engaging the said arms, and studs extending from the trunnion-plates and adapted to engage the said levers to retain them in position when adjusted, substantially as set forth.

47. The combination of the car having the end plates, the trunnion-plates mounted pivotally in the latter, the mold-carrying frame having its ends attached to the inner sides of said trunnion-plates, a toothed segment attached to one of said trunnion-plates, and a shaft journaled in brackets or bearings upon one of the end plates of the car and having a spiral flange or worm engaging said toothed segment, substantially as set forth.

48. The combination of the car having the end plates, the trunnion-plates journaled in said end plates, the mold-carrying frame having its ends attached to the inner sides of said trunnion-plates, the bottom plate, the supporting-hooks for said bottom plate mounted in radial slots in the trunnion-plates, mechanism attached to the latter for the radial adjustment of said supporting-hooks, a toothed segment attached to one of the trunnion-plates, and a spirally-flanged shaft or worm journaled upon one of the end plates and meshing with said toothed segment, substantially as and for the purpose set forth.

49. In a device for handling ingots, the combination, with a transfer-car having a pivoted mold-carrying frame and mechanism for adjusting the latter, of the pusher-cylinder having a longitudinally-reciprocating piston-rod, the supporting cars or carriages for said pusher-cylinder, and operating mechanism for said cars or carriages, substantially as set forth.

50. In a device for handling ingots, the combination of the transfer-car having the pivoted mold-carrying frame, the molds mounted in said frame and capable of a limited movement in the direction of its length, means for adjusting the said mold-carrying frame, the pusher-cylinder attached to a mast or derrick swiveled in suitable cars or carriages, the longitudinally-reciprocating piston-rod, the longitudinally-movable grappling-rods connected to the pusher-cylinder and adapted to engage perforated lugs or staples at the upper edges of the molds, mechanism for operating said grappling-rods, and mechanism for mov-

ing the cars carrying the pusher-cylinder into alignment with the molds, substantially as set forth.

51. In a device for handling ingots, the combination of the transfer-car having the pivoted mold-carrying frame, the pusher-cylinder attached to a vertical mast or derrick swiveled in an upper and a lower car or carriage mounted to ride upon suitable longitudinal tracks, the longitudinally-reciprocating-piston-rod mechanism for operating the cars carrying the pusher-cylinder and the piston-rod of the latter, grappling-rods connected to the pusher-cylinder and adapted to engage the molds when the latter are in a horizontal position, the bottom plate mounted upon suitable supporting-hooks in the mold-carrying car, mechanism for adjusting the said bottom plate, and the furnace or furnaces arranged parallel to the longitudinal tracks upon which the mold-carrying car and the cars supporting the pusher-cylinder are mounted, substantially as and for the purpose set forth.

52. The combination of the furnace, the peels having slightly-curved edges and pro-

vided with downwardly-extending arms at their front ends, the dump-bar mounted to slide longitudinally in bearings upon the front furnace-wall and having notches to receive the downwardly-extending arms of the peels, mechanism for operating the said dump-bar, the mold-carrying car having the pivoted mold-carrying frame and mechanism for adjusting the latter, the molds and the adjustable mold-bottom, mechanism for adjusting the latter independently of the mold-carrying frame, the longitudinally-movable cars or carriages, the mast or derrick swiveled in the latter and carrying the pusher-cylinder having a longitudinally-reciprocating piston-rod and mechanism for operating the latter, and the cars carrying the pusher-cylinder, all constructed and arranged substantially as and for the purposes herein shown and specified.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in presence of two witnesses.

THOMAS BRADY.

Witnesses:

CHARLES C. McLAUGHLIN,  
WARREN E. COLBURN.