

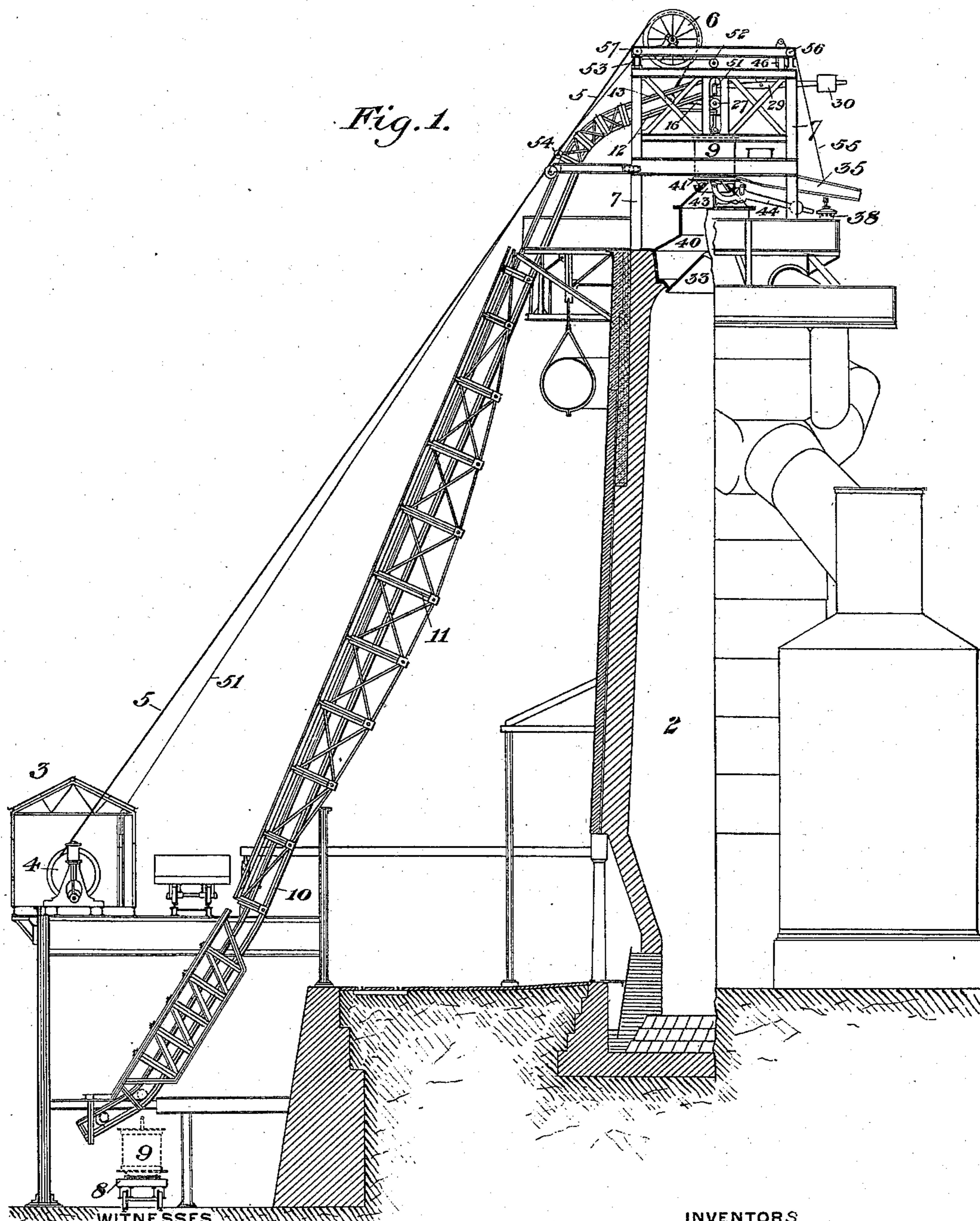
(No Model.)

5 Sheets—Sheet 1.

W. ROTTHOFF & M. A. NEELAND.  
BLAST FURNACE HOISTING AND CHARGING APPARATUS.

No. 579,011.

Patented Mar. 16, 1897.



WITNESSES  
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*G. J. Holdship*

INVENTORS  
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*Morvin A. Neeland*  
*by Babcock & Babcock*  
*their attys.*

(No Model.)

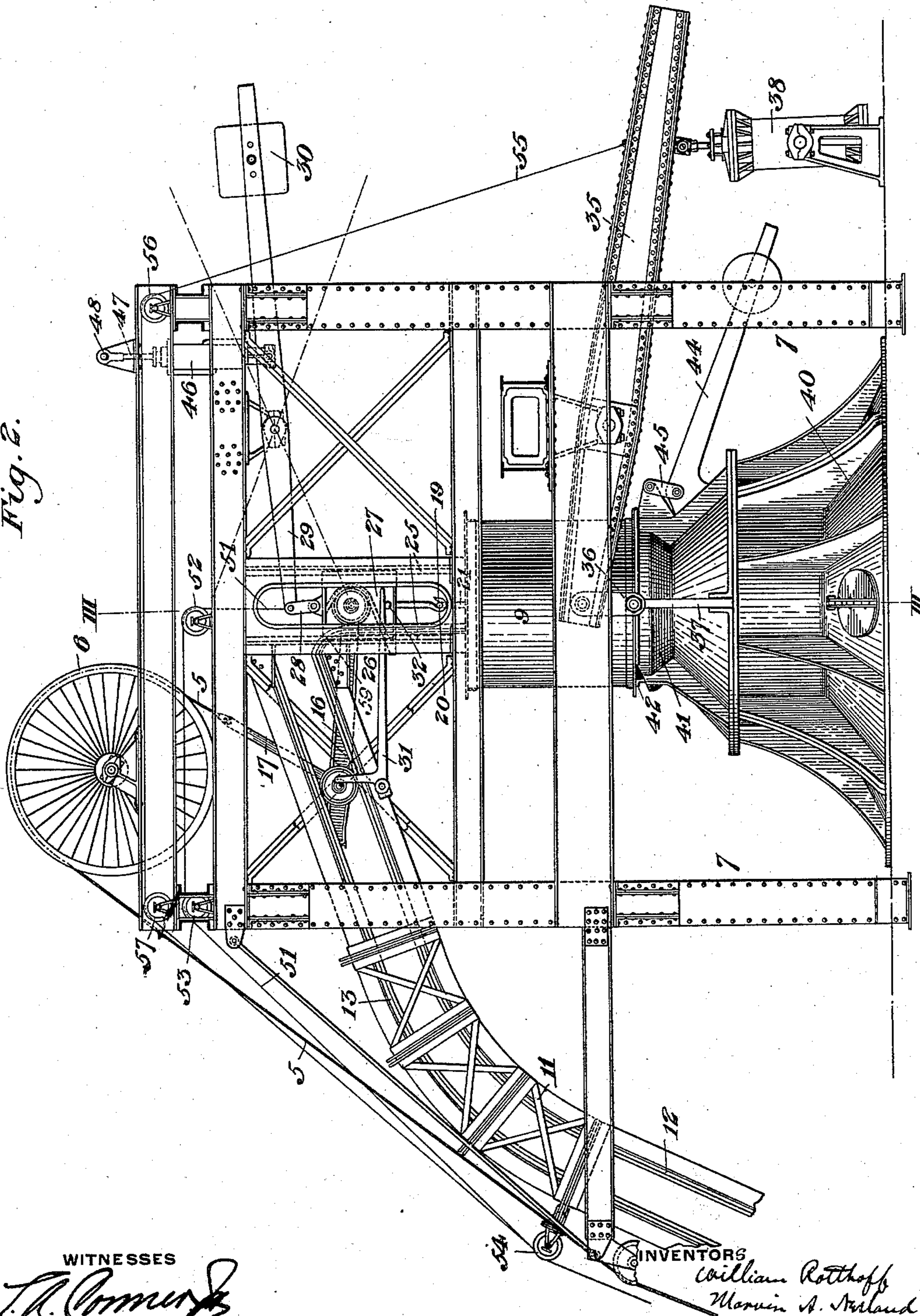
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Fig. 2.



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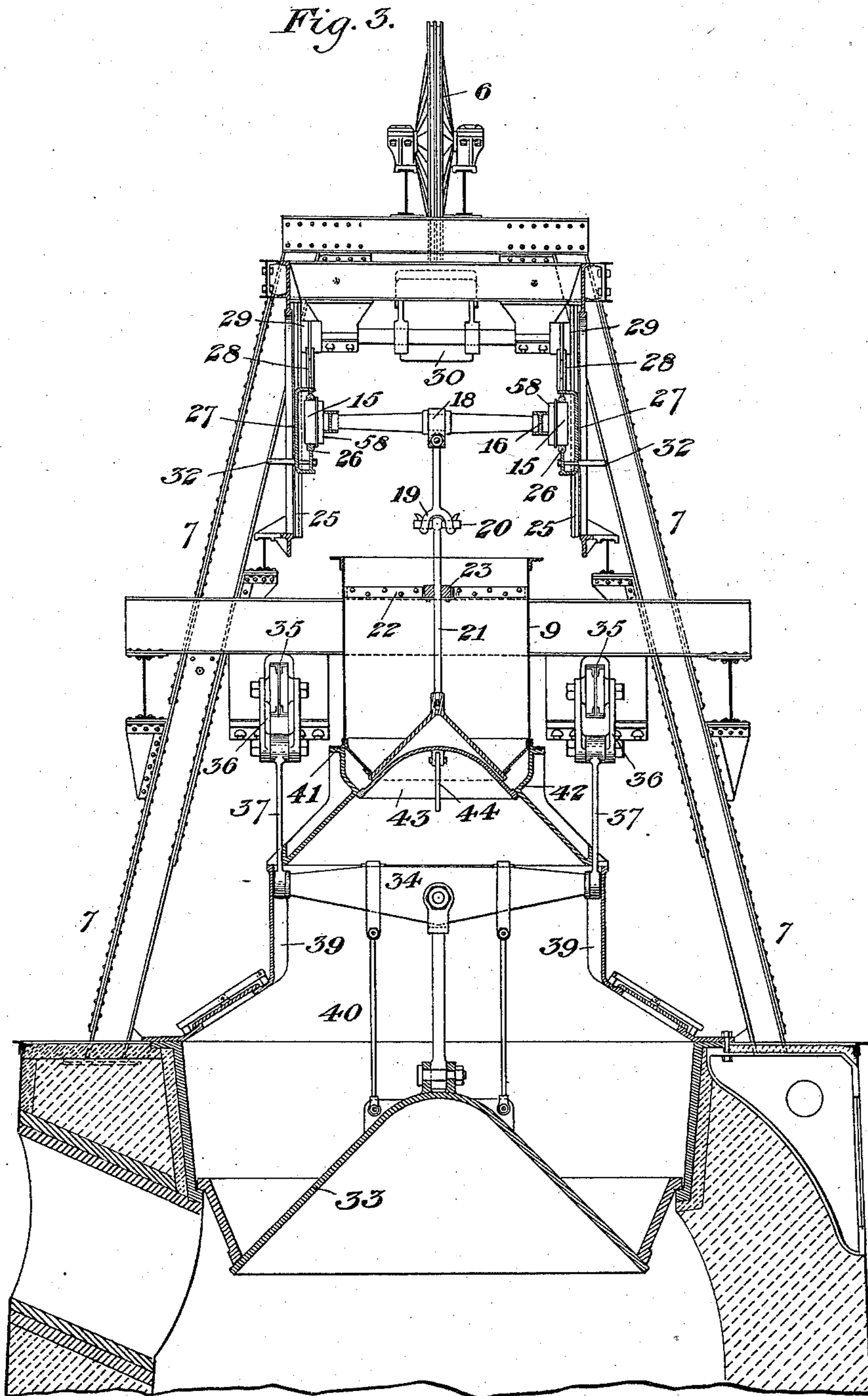
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(No Model.)

5 Sheets—Sheet 4.

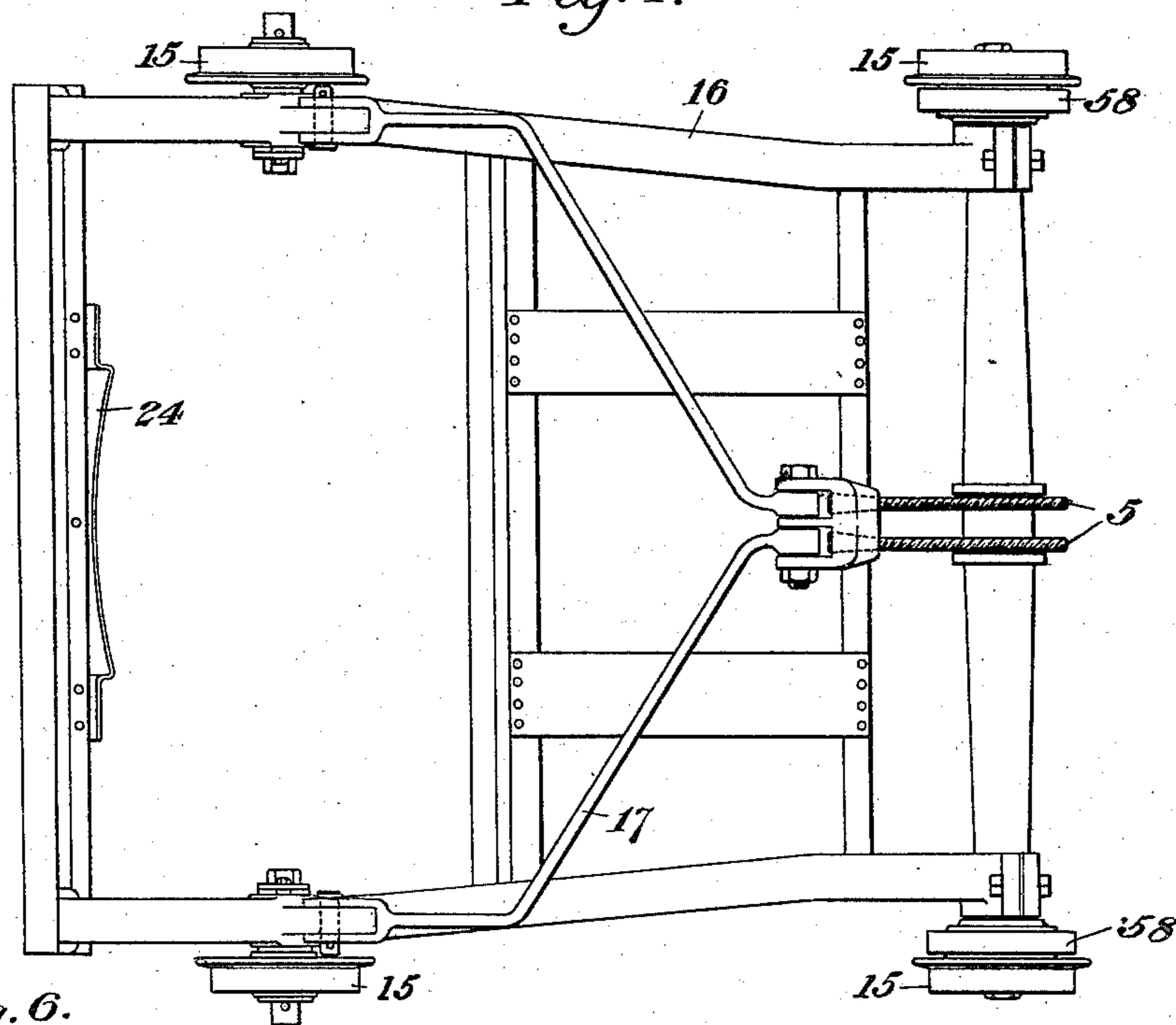
W. ROTHHOFF & M. A. NEELAND.

# BLAST FURNACE HOISTING AND CHARGING APPARATUS.

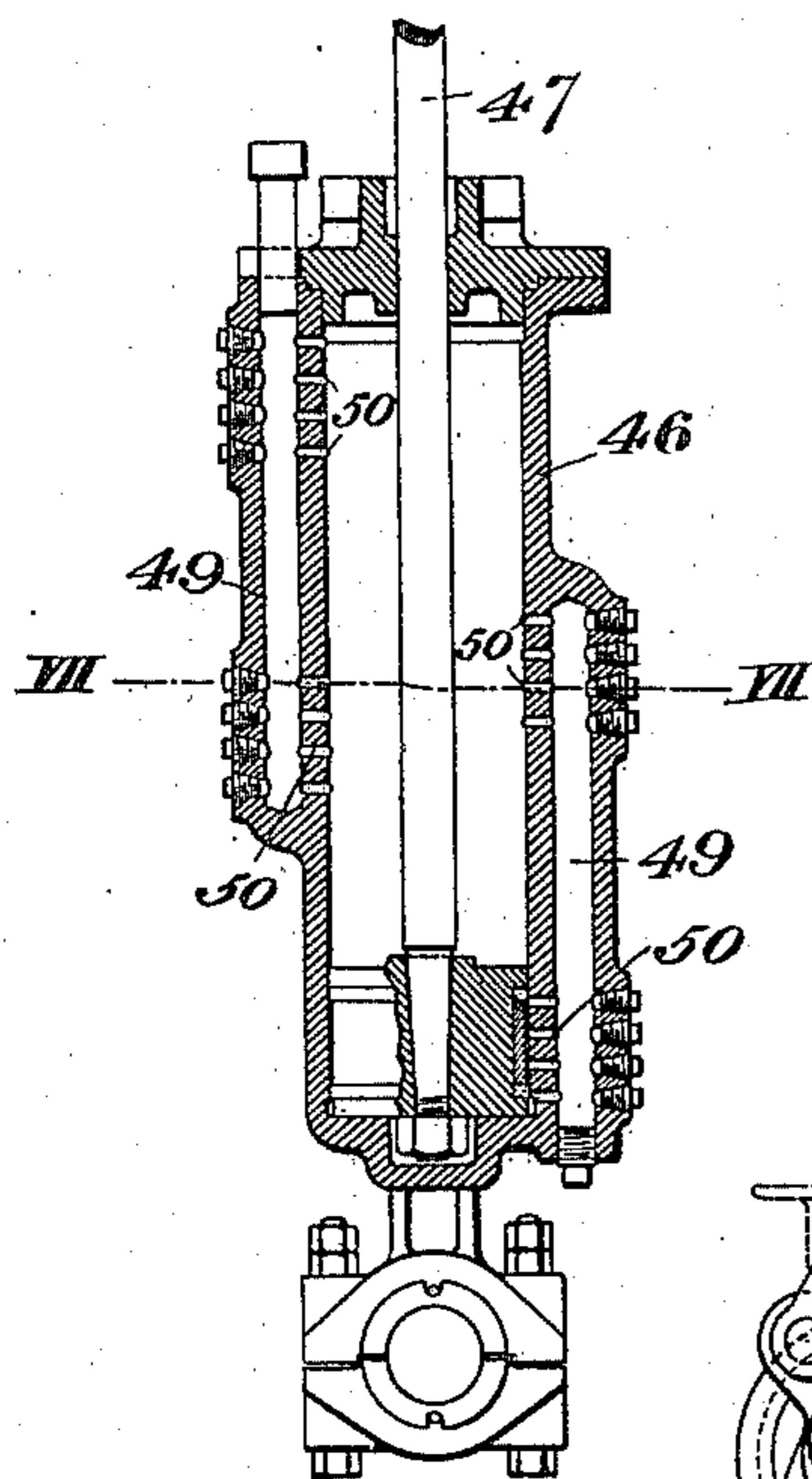
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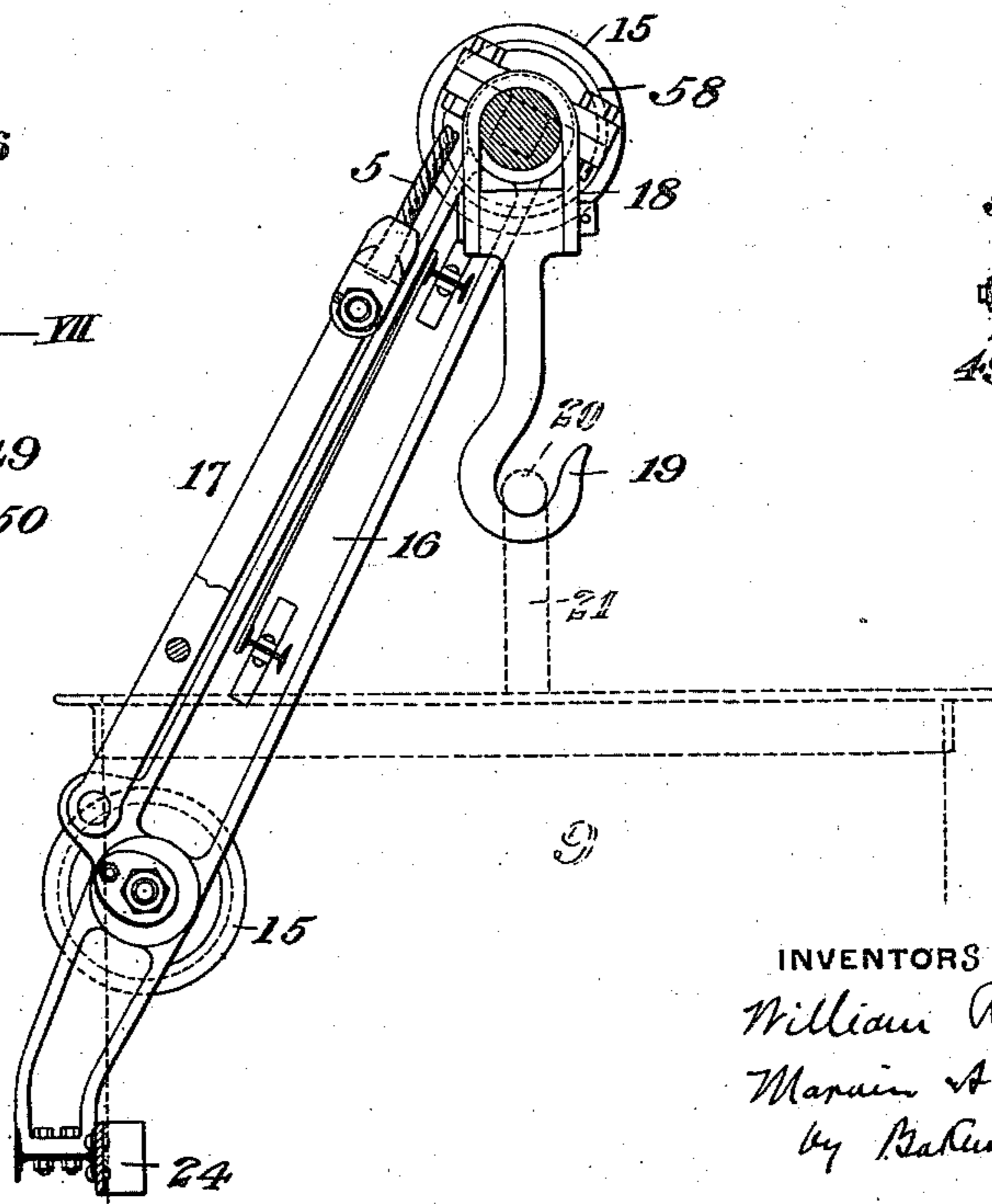
*Fig. 4.*



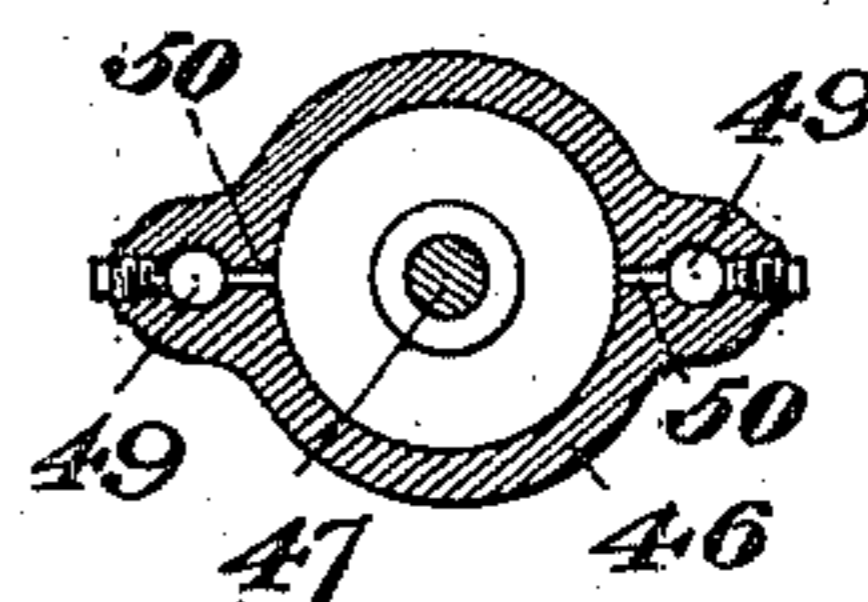
*Fig. 6.*



*Fig. 5.*



*Fig. 7.*



**WITNESSES**

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5 Sheets—Sheet 5.

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Fig. 9.

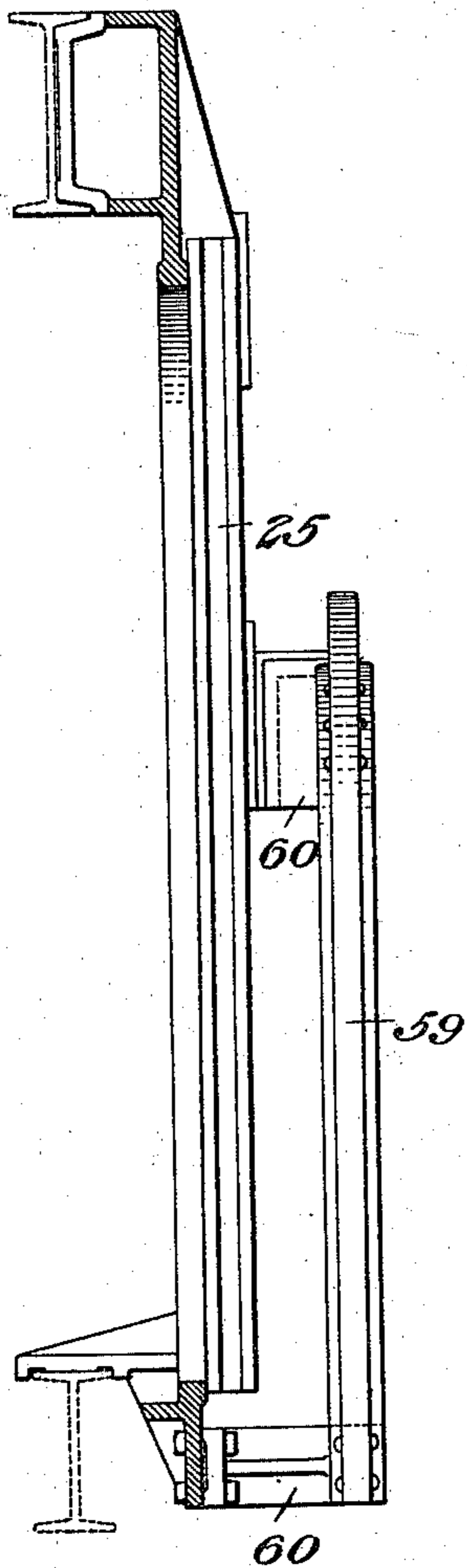


Fig. 8.

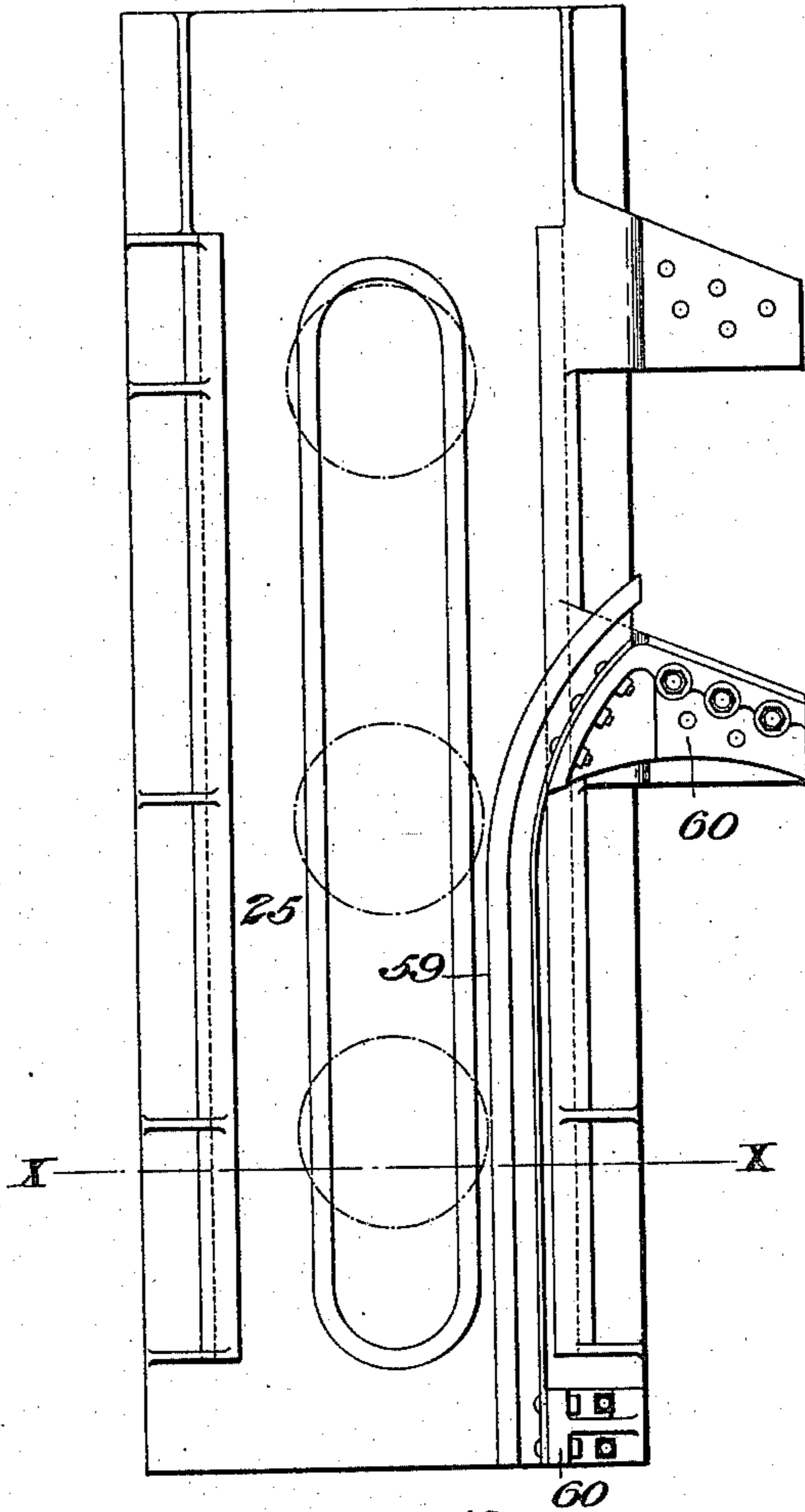


Fig. 10.

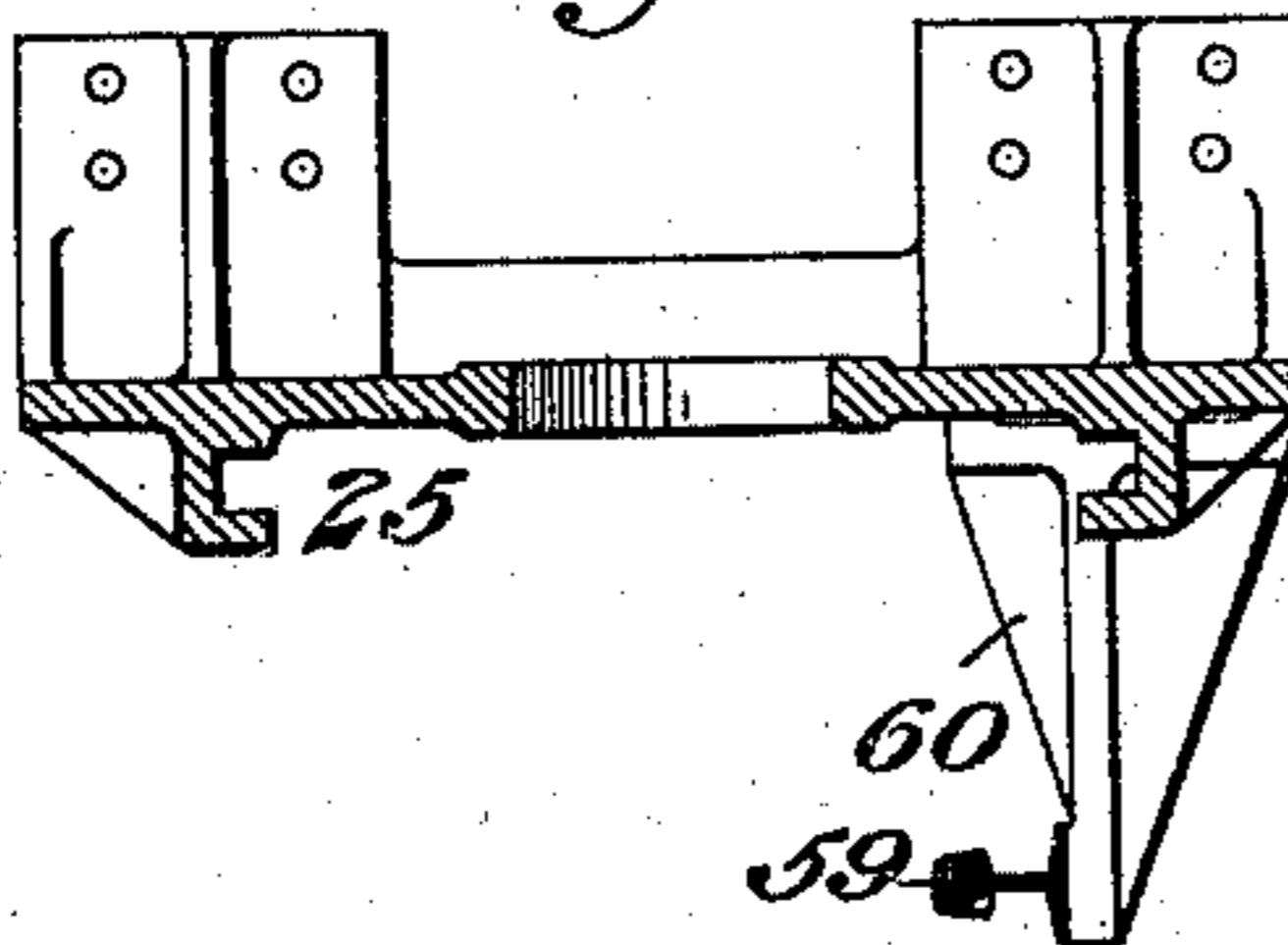
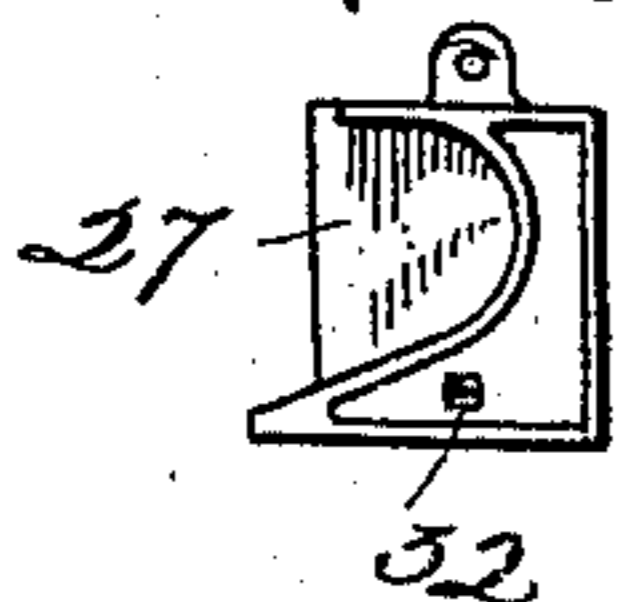


Fig. 11.



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# UNITED STATES PATENT OFFICE.

WILLIAM ROTHOFF AND MARVIN A. NEELAND, OF DUQUESNE, PENNSYLVANIA.

## BLAST-FURNACE HOISTING AND CHARGING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 579,011, dated March 16, 1897.

Application filed February 29, 1896. Serial No. 581,355. (No model.)

*To all whom it may concern:*

Be it known that we, WILLIAM ROTHOFF and MARVIN A. NEELAND, of Duquesne, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Blast-Furnace Hoisting and Charging Apparatus, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a side elevation, partly in section, of a blast-furnace provided with our improved hoisting and charging apparatus. Fig. 2 is a similar view, on a larger scale, showing the apparatus supported upon the top of the furnace. Fig. 3 is a vertical section on the line III III of Fig. 2. Fig. 4 is a top plan view of the bucket-carrying truck or carriage. Fig. 5 is a longitudinal section of the carriage in position. Fig. 6 is a sectional view of the dash-pot cylinder we employ, and Fig. 7 is a cross-section on the line VII VII of Fig. 6. Fig. 8 is an interior elevation of one of the side plates of the guide-frame at the top of the furnace. Fig. 9 is a longitudinal central section of such side plate. Fig. 10 is a cross-section on the line  $x x$  of Fig. 8, and Fig. 11 is a detail inner face view of the sliding frame at the top of the furnace.

Like symbols of reference indicate like parts in each.

Our invention relates to the automatic hoisting and charging of stock in blast-furnaces and is designed to afford an improved receptacle for the stock and improved means for lifting the same to a point above the top of the furnace and for lowering and dumping the receptacle, also to an improved construction of the bell of the furnace and means for indicating the movements of the bell and the charging-receptacle.

In the drawings, 2 indicates the blast-furnace; 3, the engine-house; 4, the winding-drum therein, and 5 the hoisting-cable, leading from the drum to and over the pulley-wheel 6, mounted in the frame 7, supported upon the top of the furnace. Below the engine-house is the car 8, movable upon a track on the level of the stock-yard, this car carrying the receptacle or bucket 9, which is filled

with the ore, coke, or limestone and then moved to a point beneath an inclined track 10, which extends to and over the top of the furnace, being supported upon suitable truss-work 11. The track consists of upper and lower rails 12 and 13, suitably supported upon trusswork, as shown, and between which rails travel the wheels 15 of the hoist-carriage 16. (Shown in Figs. 4 and 5.) This carriage consists of a four-wheeled truck, having pivoted to its rear portion a swinging bail 17, to which the cable 5, which is preferably a double cable, as shown, is secured. Pivoted about the front axle of this truck is a yoke 18, which is provided with the depending bifurcated hook 19, arranged to engage the handle 20 of the bucket. This handle is secured at the upper end of a rod 21, carrying at its lower end the bell-shaped bottom of the cylindrical bucket 9. In the bucket is secured by arms 22 the central collar 23 for the rod, which serves as a guide for the same in its vertical movements. When the handle is engaged by the hook upon the truck, the body of the bucket contacts with a rest 24 upon the truck, which prevents swinging of the bucket as it is carried up the incline.

At the upper end the track extends to a vertical guideway 25, in which moves the V-shaped continuation 26 of the track, this extension being part of a sliding frame having channel-shaped side webs, the frame 27 having suitable guides. To the frame 27 is secured by the link 28 a lever 29, having a counterweight 30, which is sufficient to overcome the weight of the frame 27 and hold it normally in elevated position, where its track registers with the track 12, but is overbalanced by the weight of the filled bucket when the forward wheels of the truck enter the track 26. As the pull of the cable when the truck is in its uppermost position is upward and would tend to hold the sliding frame 27 in its upper position by jamming it against the guideway, we provide two bell-crank levers 31, one at each side of the track, the upper arms of these levers being contacted with by the protruding ends of the rear axle of the truck as soon as the forward wheels enter the section 26 of the track. The other longer arms of these levers bear upon pins 32, projecting

from the sides of the sliding frame 27, so that as the truck is pulled forward the levers force the frame 27 positively downward.

To prevent the front wheels of the carriage from moving down the inclined track 26 as the operator releases the cable in order to allow the bottom of the bucket to rise, thus allowing the bucket to swing out of registry with its bottom, we provide upon the inside of the front wheels of the truck the idler-wheels 58, these wheels moving over vertical rails 59, secured inside the guideway, as the front portion of the truck moves within it. These rails, as shown in Figs. 8, 9, and 10, are secured to the inside of the opposite side plates of the guideway by brackets 60, and their upper ends are curved outwardly so as to register with the ends of the lower rails upon the inclined track, as shown in Fig. 2. The bucket is thus held from swinging out of position laterally, while the motion of the truck and its wheels is not interfered with.

The furnace is provided with the usual charging-bell 33, supported from a cross-head 34, which is reciprocated by the pivoted levers 35, having pivoted yokes 36, connecting them to links 37, pivoted to opposite ends of the cross-head. These levers 35 are actuated by a pivoted motive cylinder 38, having its piston-rod pivoted to a cross-bar connecting the two levers, this cylinder having fluid-supply and exhaust pipes leading to a suitable valve in the engine-house. The cross-head 34 moves within guides 39, secured to the casing 40, and at its upper end this casing is provided with an annular flange 41, upon which the lower edge of the bucket rests. Below this flange the casing is provided with an inner seat 42, against which a bell-shaped gas-valve 43 seats, this valve being normally held to its seat by a counterweighted lever 44, pivoted to the casing by a link 45.

To prevent the weight 30 from injuring the frame 27 or adjacent parts as it moves the same upwardly after the bucket is emptied, I secure to the lever 29 a dash-pot cylinder 46, (shown in Figs. 6 and 7,) the piston-rod 47 of this cylinder being pivoted to the framework at its upper end at the point 48. In the wall of this cylinder are provided longitudinal passages 49, these passages being on opposite sides and extending from either end to a point beyond the center of the cylinder. Into each end of these passages extend a series of ports 50, leading from the interior of the cylinder, through which the liquid, such as oil, with which the cylinder is filled, passes as the cylinder reciprocates over the piston. Thus as the cylinder moves downwardly the oil from above the piston passes through the upper ports of the lower passage and flows back through the lower ports of this passage into the lower part of the cylinder. As the piston nears the center of the cylinder it passes the lower ports of the upper passage and then cuts off the upper ports of the lower passage one after the other, thus slowing up the move-

ment of the cylinder, thereby allowing the bottom of the bucket to seat easily upon the lower end of the bucket, after which the speed increases. When the piston nears the top of the cylinder, it begins to cut off the upper ports one after the other, and thus gradually slows up and stops the movement of the piston. The same action takes place on the down movement, the speed of the cylinder increasing until the piston nears the center thereof, it then decreasing to allow the bucket to seat easily upon the casing, and then increasing in speed up to the end of the stroke, when it is again gradually checked and stopped by the cutting off of the ports.

To show the operator in the engine-house the movement of the bucket, we secure at the inner end of the lever 29 a cord 51, which extends thence over pulleys 52, 53, and 54 on the framework to and over a pulley in the engine-house, a small weight being secured to its lower end which moves over a scale and enables the movement of the sliding frame and the bucket to be clearly seen by the operator. For the same purpose, in showing the movement of the charging-bell, we attach to the bar connecting the levers 35 a cord 55, passing over pulleys 56, 57, and 54 to another pulley in the engine-house, it also having a weight showing the movement of the charging-bell.

The bucket for the ore is of the same external diameter as that for the coke and limestone, but is made smaller in inner area by an inner lining or jacket.

The action is as follows: A car having a filled bucket thereon being moved under the inclined track, the carriage is drawn upward, and as it passes the bucket its forwardly-projecting bifurcated hook engages the handle of the bucket, which, contacting with the rest upon the carriage, is carried up the inclined track. As the forward wheels of the carriage enter the section 26 of the track the levers 31 begin to move the sliding frame 27 downward and the filled bucket overcoming the counterweight 30 the frame continues its downward movement, controlled by the dash-pot, until the bottom of the bucket rests upon the flange 41 of the casing. As the handle is secured to the bell-bottom of the bucket the weight of the contained material then moves this bottom downwardly, carrying with it the gas-sealing valve 43, until the sliding frame containing the front axle and wheels of the truck reaches the end of the guides and the piston in the dash-pot cylinder reaches the end of the cylinder. The charge is thus released and sliding over the lowered bell-shaped bottom is distributed evenly around the charging-bell, being further distributed by striking upon the gas-sealing bell. As soon as the charge is emptied the weight 30 begins to move the bell-bottom upwardly, the lever 44 carrying the gas-seal 43 with it, and the bottom entering the bucket the sliding frame returns to its normal position, carrying back

the front axle of the truck and the suspended empty bucket. The operator then releasing the cable allows the carriage to move back down the incline to its original position. The operation is then repeated, alternating the charges of ore, coke, and limestone as desired, the charging-bell being operated as desired to feed the stock into the furnace.

The advantages of our invention will be apparent to those skilled in the art, since the whole operation is under the control of a single attendant in the engine-room. The bell-bottom of the bucket gives an even distribution of the charge and the securing of the carrying-handle to this bottom allows its automatic downward movement with the portion of the truck, the truck seizes the bucket automatically as it passes it, and the lowering of the bucket as it reaches the top of the track is automatic and beyond the control of the operator, as is also the raising of the bell-bottom and the empty bucket.

The dash-pot cylinder is of extremely simple and effective construction, no valves being used therein.

Many changes may be made in the form and arrangement of the parts by the skilled mechanic without departing from our invention, since

What we claim as new, and desire to secure by Letters Patent, is—

1. The combination with a blast-furnace having an inclined track leading to its top, of a carriage movable upon the track, a pivoted hanger depending from the carriage and a bucket suspended therefrom, said bucket having a movable bottom; substantially as described.

2. The combination with a blast-furnace, having an inclined track leading to its top, of a carriage movable upon the track, a pivoted hanger depending from the carriage and a bucket suspended therefrom, said bucket having a downwardly-movable bell-shaped bottom; substantially as described.

3. The combination with a blast-furnace, having an inclined track leading to its top, of a carriage movable upon the track, a hanger depending from the carriage, and a bucket having a movable bottom provided with a handle engaged with said hanger; substantially as described.

4. The combination with a carriage, having a depending hook, of a bucket having a movable bottom provided with a handle engaged by said hook; substantially as described.

5. The combination with a blast-furnace having an inclined track leading to its top, of a carriage movable upon said track and provided with a depending hook, and a support below the lower portion of the track having a bucket resting thereon, the hook being arranged to engage a handle upon the bucket as the carriage passes over the same; substantially as described.

6. The combination with a blast-furnace having an inclined track leading to its top, of

a carriage movable upon the track, a bucket suspended from the carriage and having a movable bottom, and means for lowering the bucket when the carriage reaches a point above the furnace; substantially as described.

7. The combination with a blast-furnace, having an inclined track leading to a point above its top, of a carriage movable upon said track and having a bucket suspended from its forward portion, and a section of track carried in a vertically-movable frame and registering with the inclined track when in normal position; substantially as described.

8. The combination with a blast-furnace, having an inclined track leading to its top, of a carriage movable upon the track, a bucket suspended from the carriage and having a movable bottom, and a vertically-movable frame over the furnace, having a track arranged to register with the inclined track when in normal position; substantially as described.

9. The combination with a blast-furnace having an inclined track leading to its top, of a carriage movable upon the track, a bucket suspended from the carriage and having a movable bottom, and a section of track carried in a vertically-movable counterweighted frame above the furnace, said frame being arranged to move downwardly automatically as the carriage enters it; substantially as described.

10. The combination with a blast-furnace having an inclined track leading to its top, of a carriage movable upon the track, and having a depending hanger, a bucket having a movable bottom provided with a handle engaged by said hanger, and means for lowering the bucket when the carriage reaches a point above the furnace; substantially as described.

11. The combination of a blast-furnace, having an inclined track leading to a point above its top, a carriage movable upon said track, a sliding frame above the furnace which the forward portion of the carriage enters, and means for moving said frame; substantially as described.

12. The combination with a blast-furnace, having an inclined track leading to a point above its top, of a carriage movable upon said track, a sliding frame above the furnace which the forward portion of the carriage enters, and means arranged to be actuated by the carriage for moving said frame; substantially as described.

13. The combination of a blast-furnace, having an inclined track leading to a point above its top, a carriage movable upon said track, a sliding frame above the furnace which the forward portion of the carriage enters, and levers operated by the carriage and arranged to start the frame downwardly; substantially as described.

14. The combination with a blast-furnace, having an inclined track leading to a point above its top, of a carriage movable upon said track and having a depending bucket, a slid-

ing frame above the furnace which the forward part of the carriage enters, and a counterweight for said frame arranged to hold it normally in elevated position, but which is overcome by the weight of the charged bucket; substantially as described.

15. The combination with a blast-furnace, having an inclined track leading to a point above its top, of a carriage movable upon said track, a sliding frame above the furnace which a portion at least of the carriage enters, and a counterweighted lever pivoted to said frame; substantially as described.

16. The combination with a blast-furnace, having an inclined track leading to a point above its top, of a carriage movable upon said track, a sliding frame above the furnace which a portion at least of the carriage enters, and a counterweighted lever pivoted to said frame, and having a dash-pot cylinder attached thereto; substantially as described.

17. The combination of a hoist-carriage, having at least two axles and provided with a swinging hook pivoted about its front axle, and a bucket having a movable bottom provided with a handle engaged by said hook; substantially as described.

18. A hoist-carriage having pivoted to its frame a bail to which the hoisting-rope is secured, said carriage having a pivoted depending hook arranged to support a bucket; substantially as described.

19. A hoist-carriage having pivoted to its frame a bail to which the hoisting-rope is secured, said carriage having a pivoted depending hook arranged to support a bucket, and being provided with a rest for the side of the bucket; substantially as described.

20. The combination with a blast-furnace, having a cylindrical upper casing, of a bucket having a movable bottom and arranged to seat upon said casing; substantially as described.

21. The combination with a blast-furnace, having a counterweighted gas-sealing bell, of a bucket having a movable bottom arranged to force the bell downwardly; substantially as described.

22. The combination with a blast-furnace,

having a gas-sealing bell, of a bucket having a movable bottom and arranged to seat upon the casing of said bell; substantially as described.

23. The combination with a blast-furnace, having an inclined track leading to its top and a car movable on said track, of a movable frame at the upper end of the track and arranged to receive a portion of the car, and a cord arranged to indicate the movements of said frame; substantially as described.

24. The combination with a blast-furnace, having an inclined track leading to its top and a carriage movable thereon and having a hanger, of a track passing beneath said inclined track, and having cars carrying buckets provided with handles arranged to be engaged by said hanger; substantially as described.

25. The combination with a blast-furnace, having an inclined track leading to a point above its top, of a sliding frame having an inclined section of track and mounted in a guideway upon the top of the furnace, a truck upon the inclined track, a bucket carried upon the forward portion of the truck and having a movable bottom, and guides within the guideway arranged to prevent the front portion of the truck from moving down the inclined track upon the sliding frame by the action of gravity; substantially as described.

26. The combination with a blast-furnace, having an inclined track leading to a point above its top, of a truck movable upon said track and having idle-wheels, a bucket suspended from the truck and having a movable bottom, a guideway mounted upon the top of the furnace, a sliding frame within the guideway carrying a section of inclined track, and guide-rails within the guideway arranged to be contacted with by the idle-wheel of the truck; substantially as described.

In testimony whereof we have hereunto set our hands.

WILLIAM ROTTHOFF.  
M. A. NEELAND.

Witnesses:

G. I. HOLDSHIP,  
H. M. CORWIN.