No. 757,173. PATENTED APR. 12, 1904.

A. BOSCHKE.

DREDGE.

APPLICATION FILED MAR. 25, 1903.

NO MODEL. 7 SHEETS—SHEET 1.

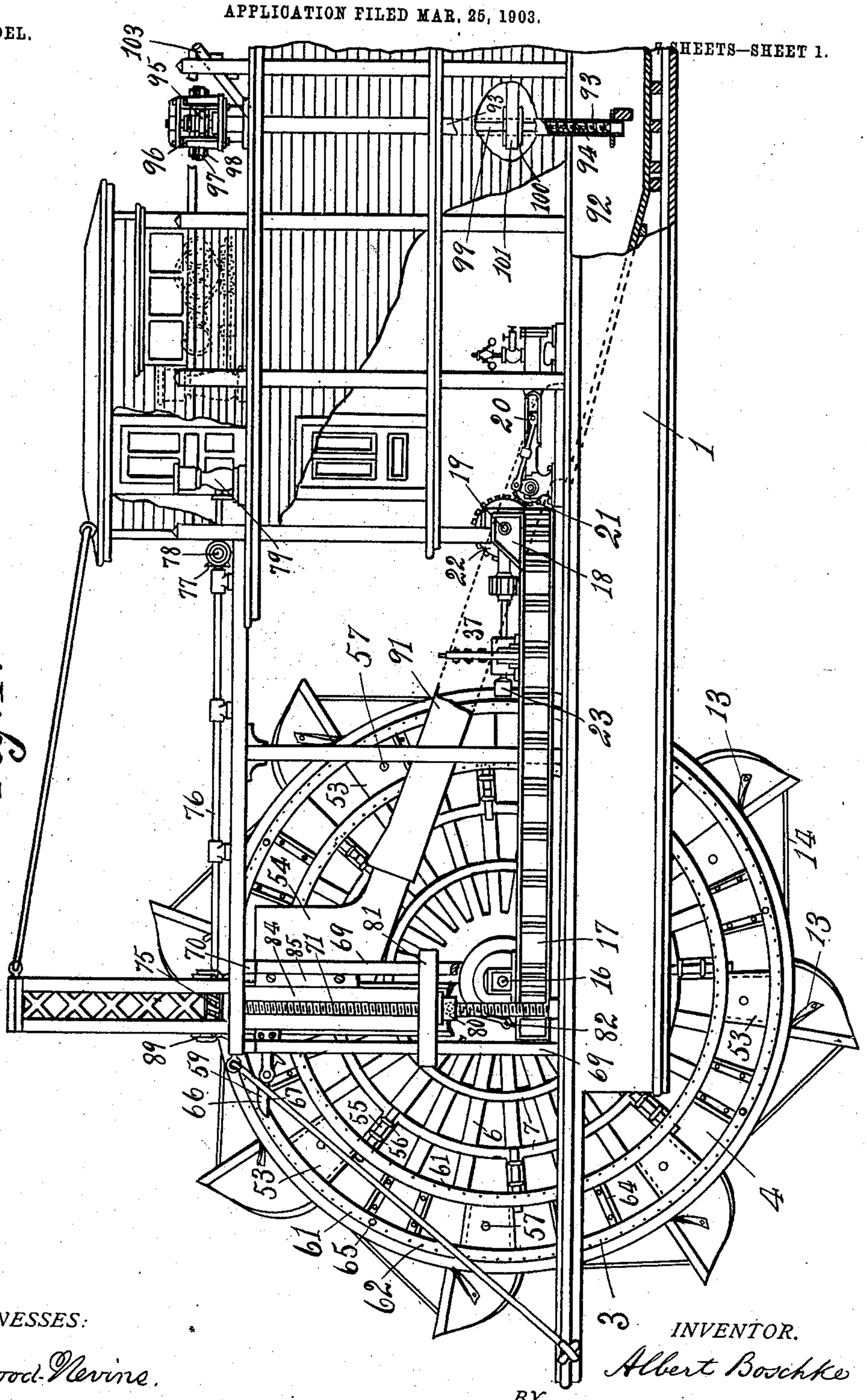

Fig. 1.

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NO MODEL. 7 SHEETS—SHEET 2.

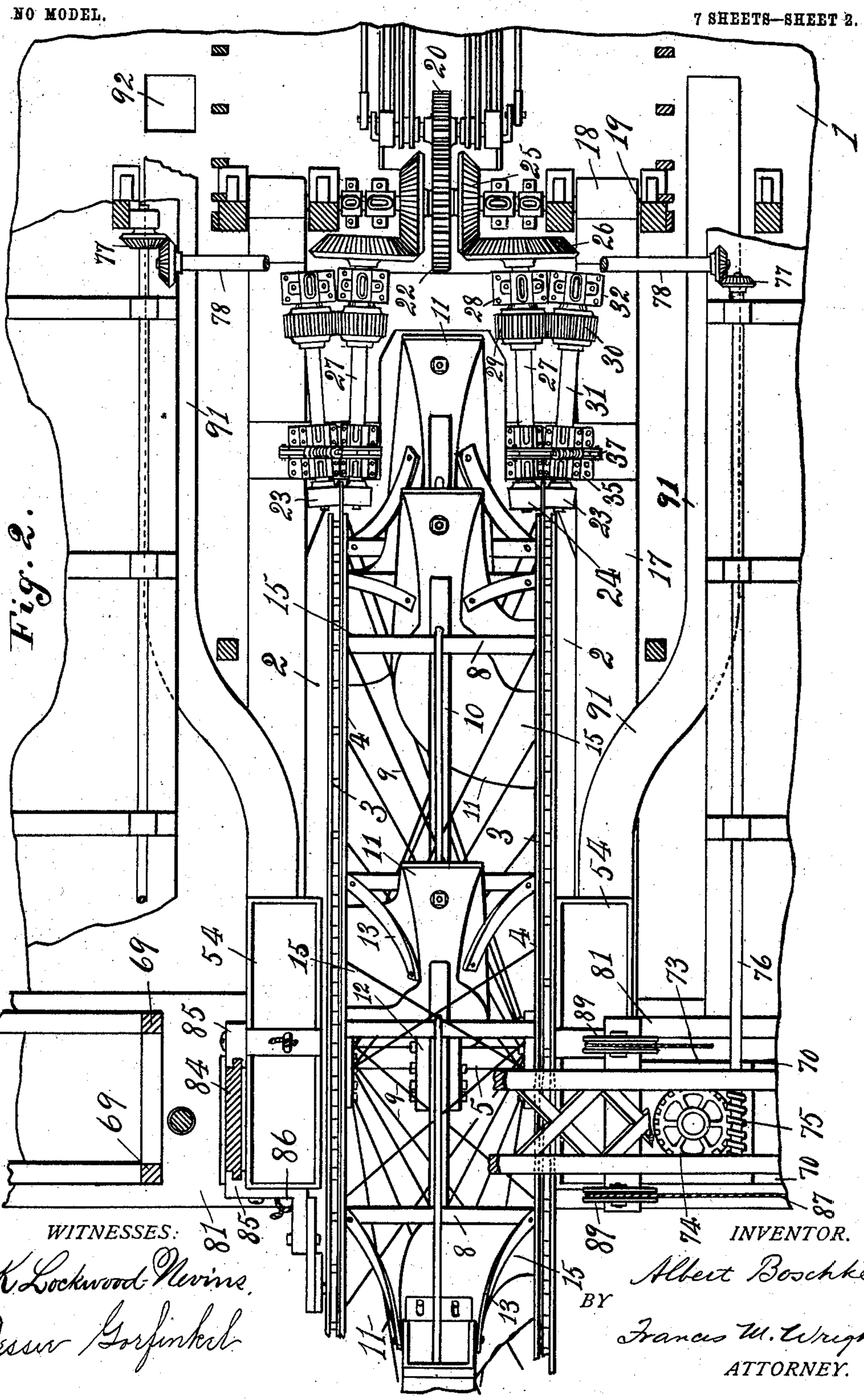

Fig. 2.

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NO MODEL. 7 SHEETS—SHEET 3.

Fig. 4.

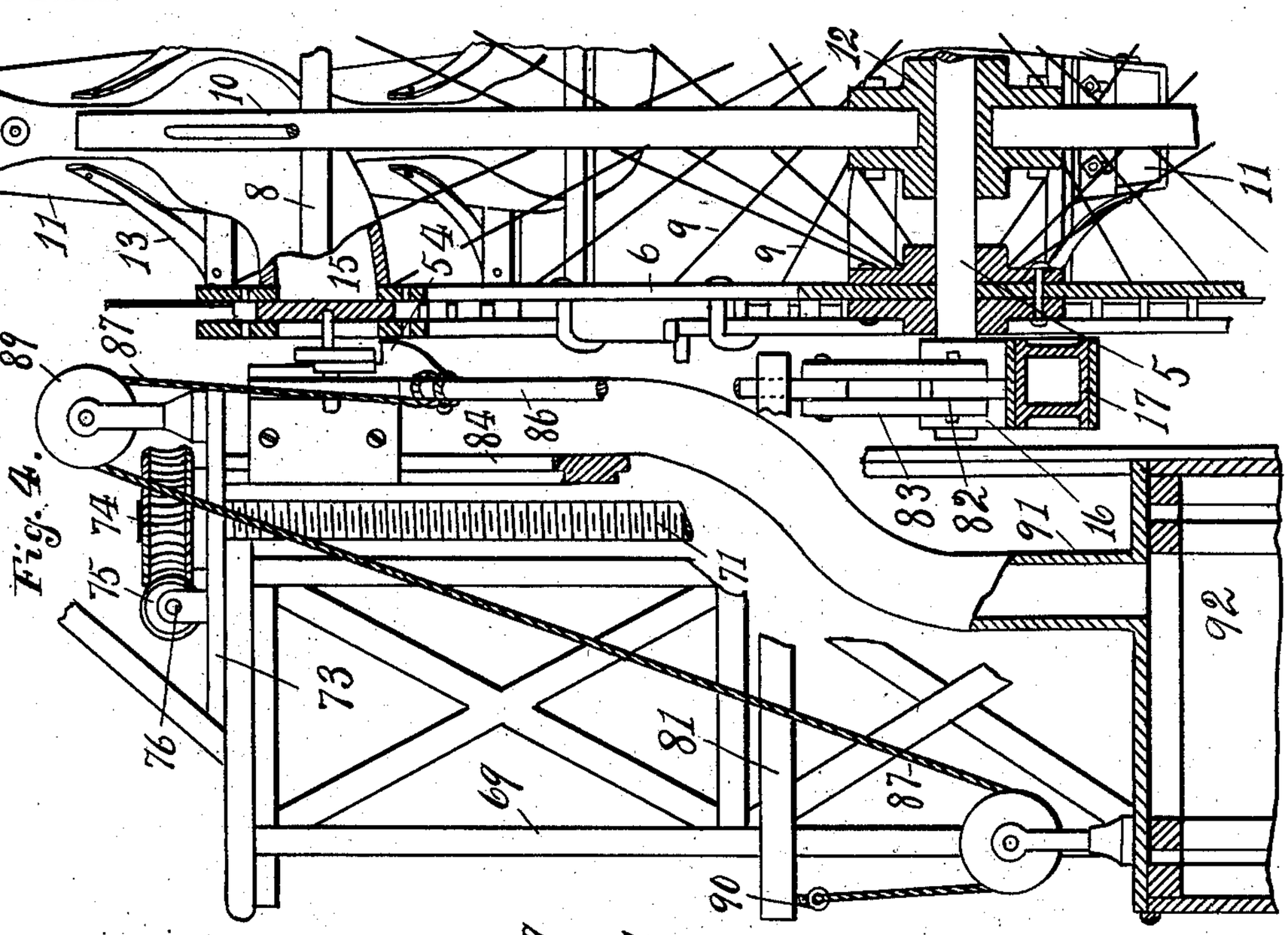
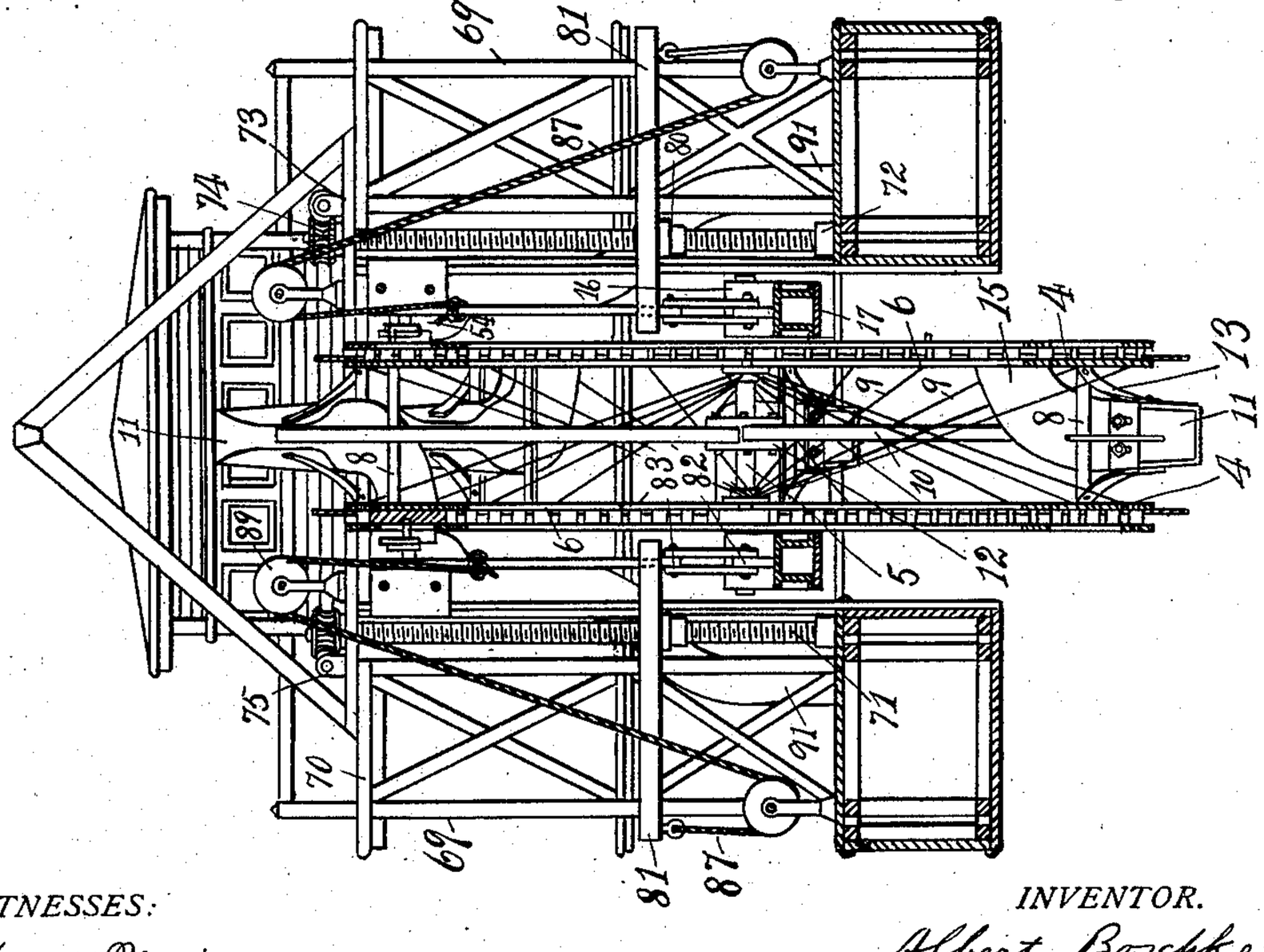


Fig. 3.



WITNESSES:

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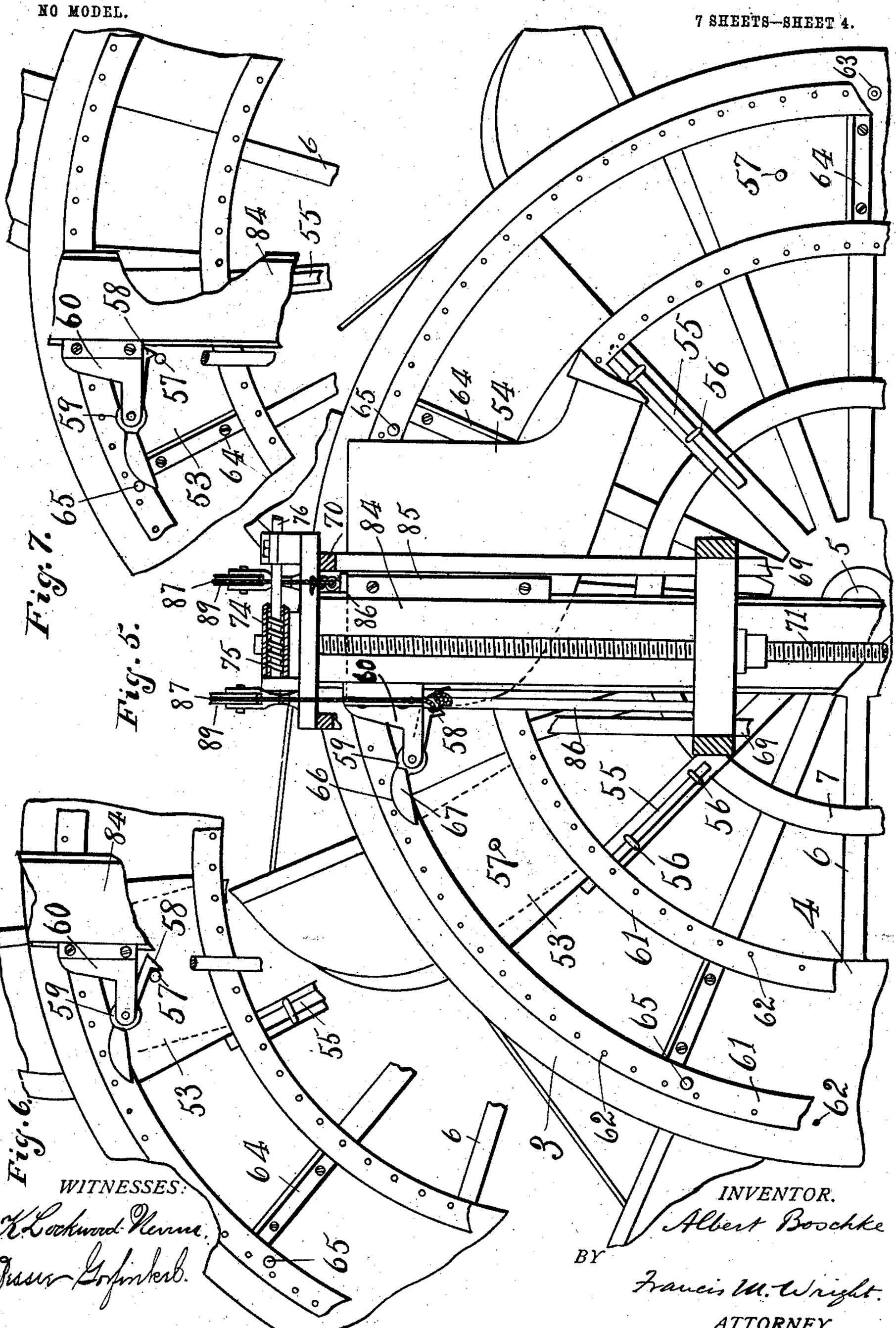
NO MODEL. 7 SHEETS—SHEET 4.



WITNESSES:

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APPLICATION FILED MAR. 25, 1903.

NO MODEL. 7 SHEETS—SHEET 5.

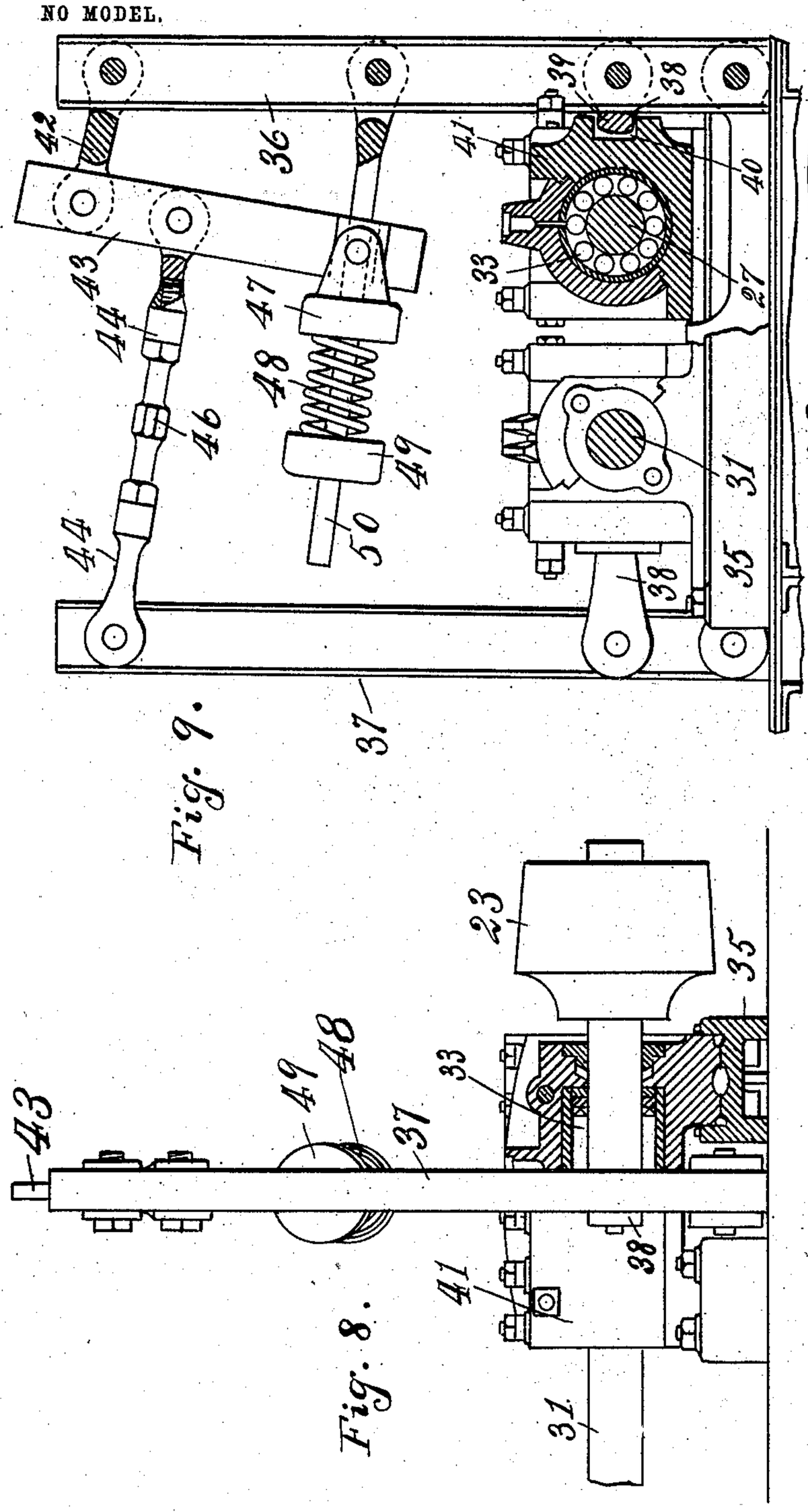

Fig. 9.

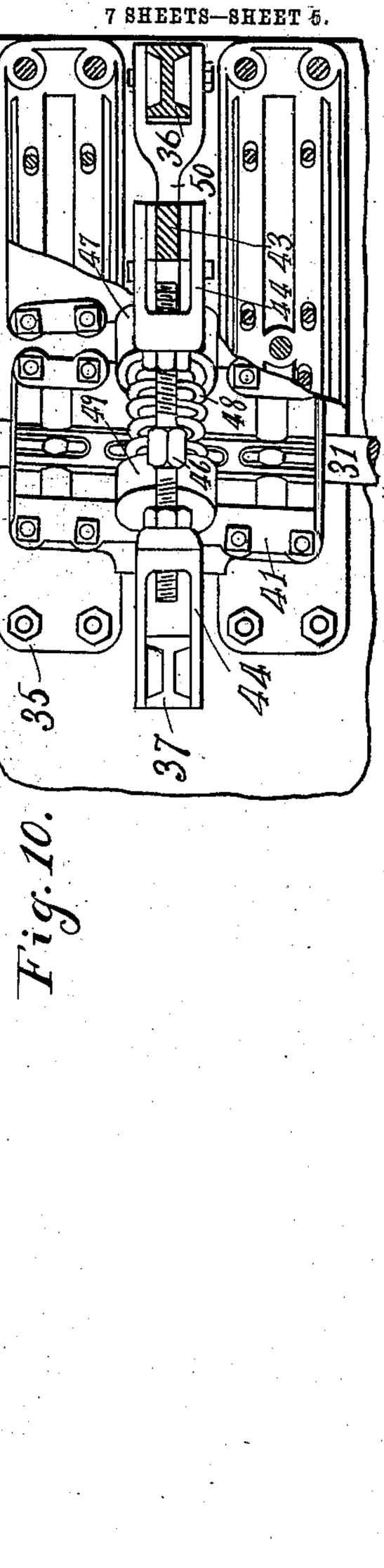

Fig. 10.

Fig. 8.

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APPLICATION FILED MAR. 25, 1903.

NO MODEL. 7 SHEETS—SHEET 6.

Fig. 11.

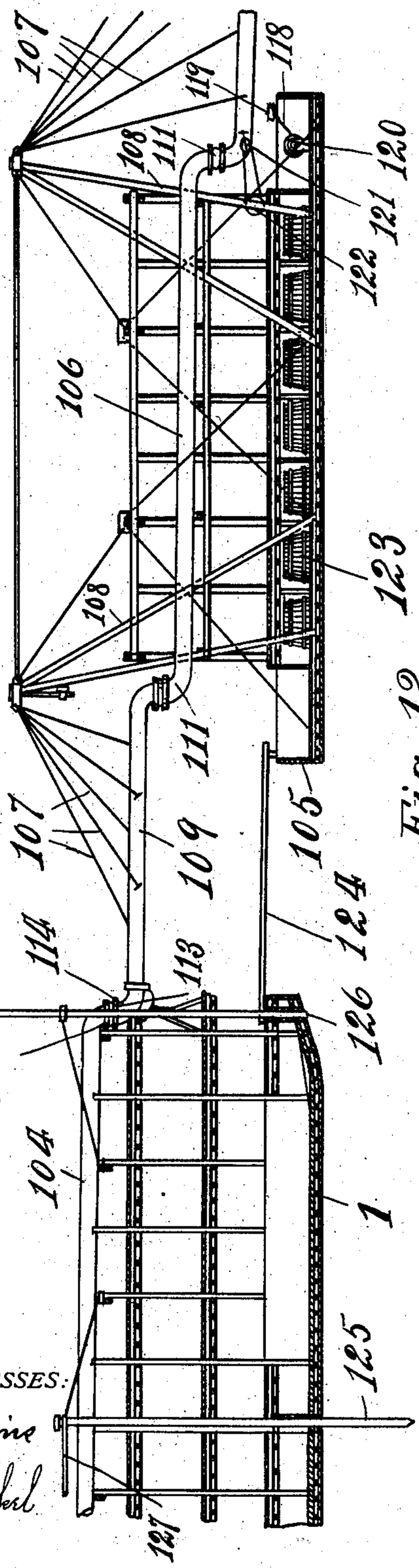
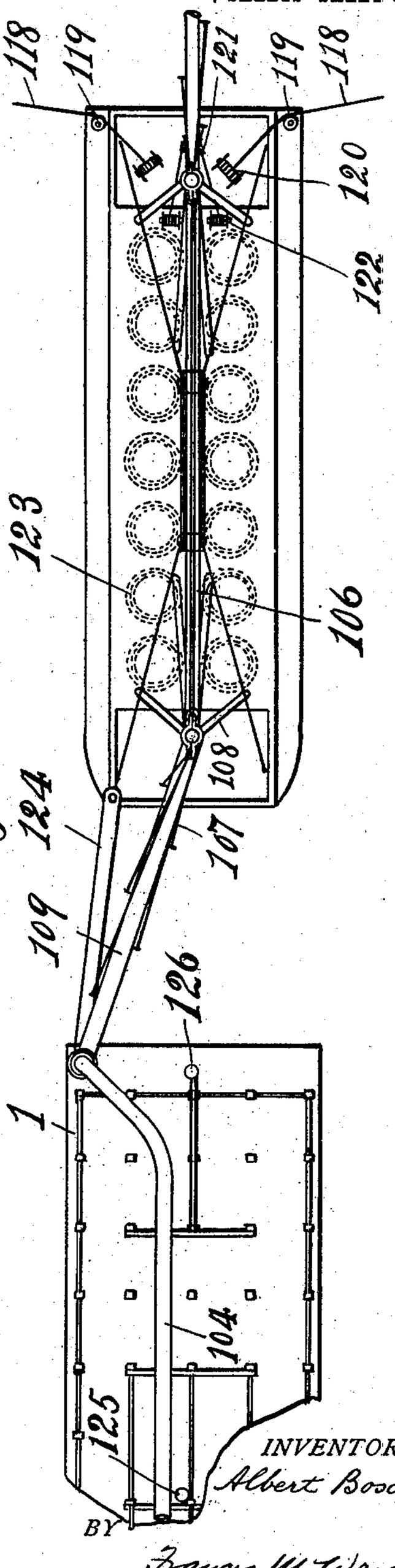


Fig. 12.



WITNESSES:

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No. 757,173. PATENTED APR. 12, 1904.

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DREDGE.

APPLICATION FILED MAR. 25, 1903.

NO MODEL. 7 SHEETS—SHEET 7.

Fig. 13.

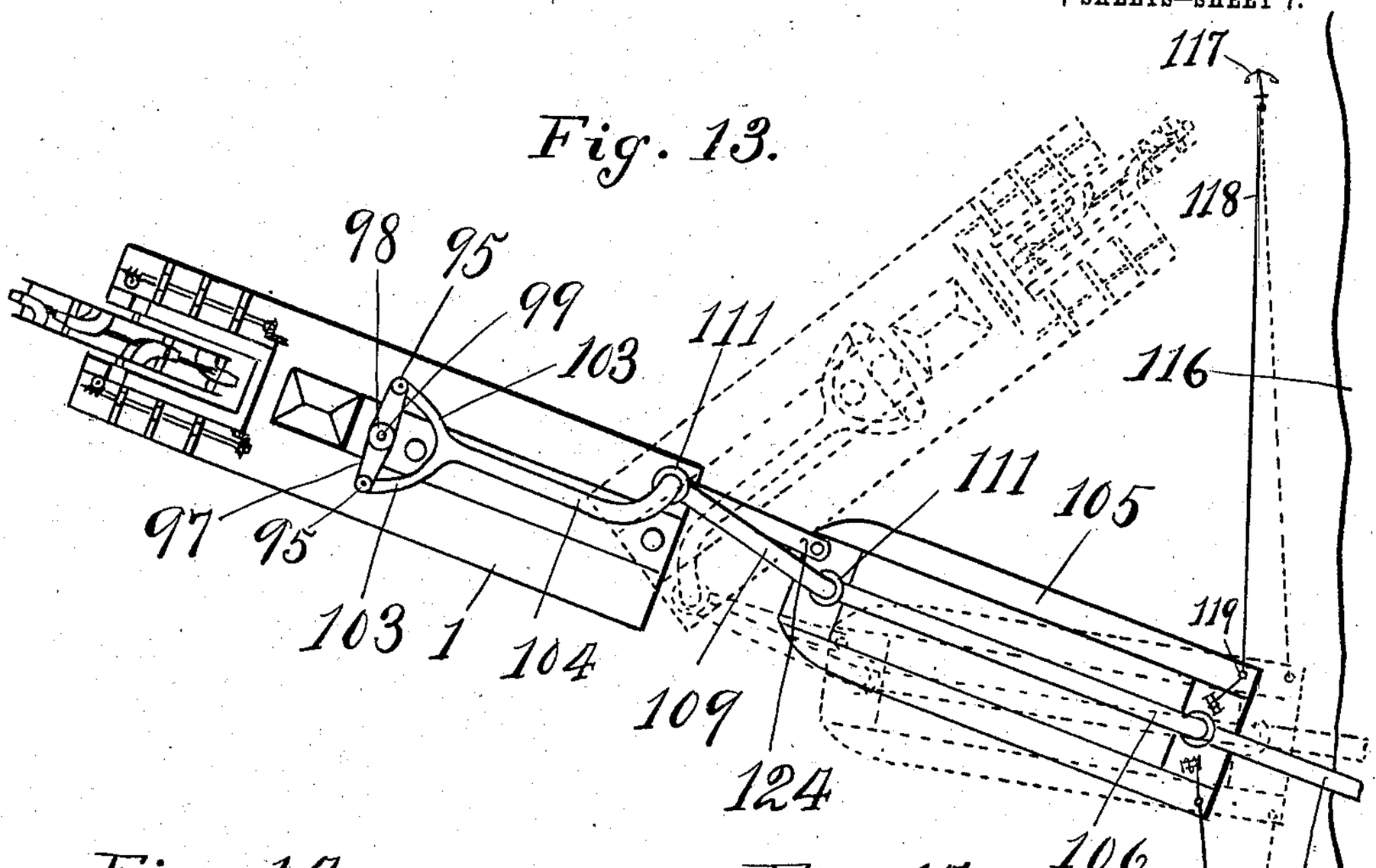


Fig. 14.

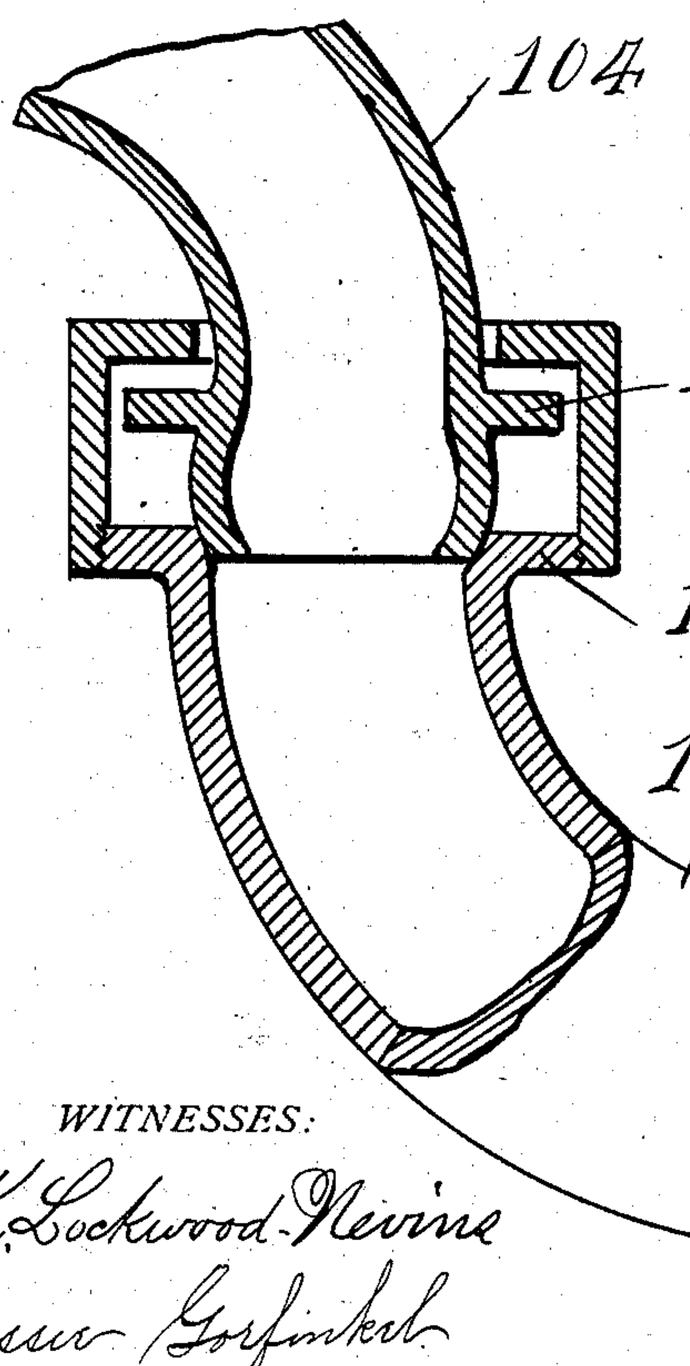
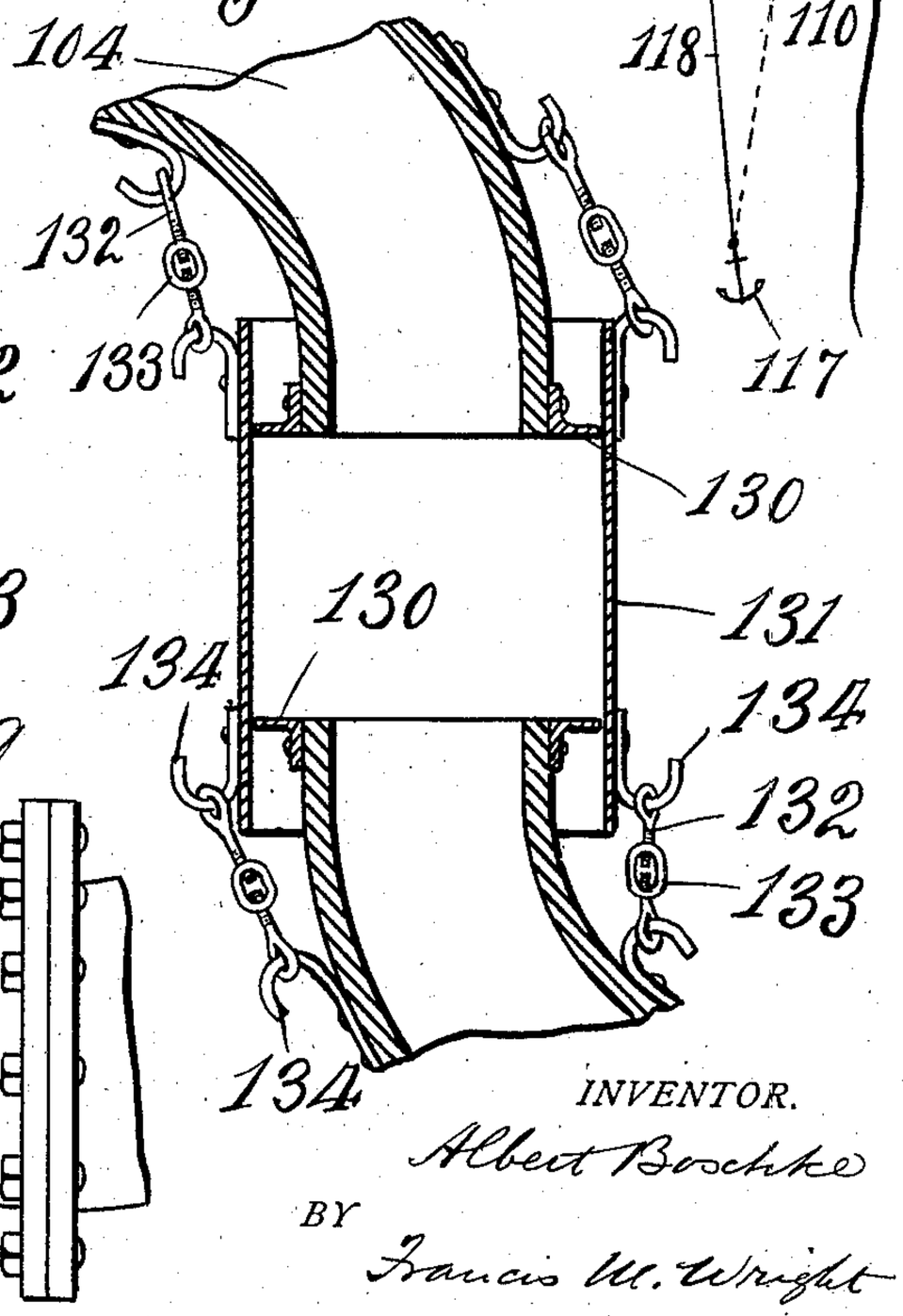


Fig. 15.



WITNESSES:

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Isser Gorfinkel

INVENTOR.

Albert Boschke

BY

Francis M. Wright

ATTORNEY.

No. 757,173. Patented April 12, 1904.

UNITED STATES PATENT OFFICE.

ALBERT BOSCHKE, OF SAN FRANCISCO, CALIFORNIA.

DREDGE.

SPECIFICATION forming part of Letters Patent No. 757,173, dated April 12, 1904.

Application filed March 25, 1903. Serial No. 149,604. (No model.)

To all whom it may concern:

Be it known that I, ALBERT BOSCHKE, a citizen of the United States, residing at San Francisco, in the county of San Francisco and State of California, have invented certain new and useful Improvements in Dredges, of which the following is a specification.

My invention relates to improvements in dredgers, the object of my invention being to provide a dredging-machine which shall be more economical, more durable, and of greater capacity and efficiency than those theretofore employed.

In my improved dredger I employ a wheel having a series of buckets rigidly secured thereon. One advantage of this construction over other forms of dredging-machines is that by this method an absolutely uniform depth of dredging can be obtained at any desired depth; also, such dredgers are much less liable to break than those in which the parts work loosely, as in buckets on endless chains or excavators on the ends of pipes. Further, the capacity of such a dredging-machine is greater than other forms, since it unites the advantages of the scoop-bucket with those of a continuous operation. Another important advantage is that the material dredged is thereby prepared so that it can be suitably transported by pumps and pipe-lines to the distant point of deposit. A further advantage is that the parts which operate under water have no relatively movable parts and are firmly secured, so that any necessary repairs, which would be rare, can be very easily made. In connection with such a wheel dredging-machine I have invented important improvements. These consist—

First, in the means for rotating the wheel and its series of rigid buckets, such means for rotating being designed to avoid breakage should an obstruction be met with, the connection between the power and the wheel being made by special forms of friction devices instead of by a positive connection. When the latter is used, then should an obstruction stop the rotation of the wheel, the power being continually applied, there must be a breakage either of the wheel or of some parts of the engine. The improvements in such friction devices insure that they will exert a constant grip upon the wheel notwithstanding any irregularities in its surface, the pressure being adjusted in the first place to insure the best results.

Secondly, in the means for insuring that both bearings of the wheel-shaft shall be raised or lowered with absolute uniformity.

Thirdly, in an equalizing arrangement for equalizing or balancing the weight or pressure upon the raising and lowering devices of the wheel and the resistance due to the work being done, so that the raising may take place with the least amount of necessary power.

Fourthly, the material is excavated or taken up by the dredging-machine at a constant and uniform rate, this being of great importance in connection with a pipe-line system for conveying it to a distance and there depositing it. When the material is not taken up uniformly, it is apt to choke at times in the pipe-line and at other times to be insufficiently supplied. With my construction the material is cut off by the buckets and taken to the pipe-lines at a substantially uniform rate.

Fifthly, provision is made that insures that the material is well diluted or mixed with water as it is cut off.

Sixthly, provision is made for automatically discharging the material from the buckets as they arrive at a fixed point in the path of the wheel. Said means for discharging the material are absolutely automatic and insure the discharge being regular at all times.

Seventhly, between the excavating device and the pipe-line are interposed one or more wells, into which the material is first discharged and from which it is then taken up and conveyed to the pipe-line, the advantage of this arrangement being that since the feeders to the pipe-line from said wells move at a constant rate of speed the wells act as a reservoir or equalizing device to furnish the material constantly to the pipe-lines, even though it should be supplied to said wells intermittently and irregularly.

Eighthly, improved means are provided for elevating the material to give it sufficient head to flow through the pipe-line, such means being absolutely positive in character as distin-

guished from those which depend upon centrifugal force for elevating it to the desired height. By this means the material can be raised to a much greater height, and therefore better results obtained in conveying it through the pipe-line, both as to greater certainty and to a greater distance.

Ninthly, an important feature of the invention resides in the arrangement of said pipe-line. For the purpose of insuring a constant operation and advance of the machine as the work progresses without interruption and also a uniform distribution of the spoils an auxiliary barge is provided, from one end of which extends a pipe for discharging the material upon the embankment or other place where it is proposed to discharge it, the other end being connected to the hull of the dredger by a flexible connection which will permit the dredger to swing freely to a very considerable arc, while the barge can swing through a much smaller arc, if desired, and can swing independently of the motion of the dredger. Means are also provided for swinging said barge through any desired arc, so as to insure the even distribution of the spoils and also to swing the discharge-pipe independently of the barge for the same purpose.

Tenthly, I provide an improved connection between the sections of pipes which is simple in construction and does not obstruct the flow of the material.

My invention therefore resides in the novel construction, combination, and arrangement of parts for the above ends hereinafter fully specified, and particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a side elevation, parts being broken away, of the front portion of a dredging-machine equipped with my improvements. Fig. 2 is an enlarged plan view of the front end thereof, certain parts being broken away. Fig. 3 is a front end view, certain parts being shown in section. Fig. 4 is an enlarged front view of the end of the dredger, certain parts being broken away. Fig. 5 is an enlarged side view of the upper portion of the wheel. Fig. 6 is a similar view of a portion of the periphery of the wheel in a different position. Fig. 7 is a similar view in a third position. Fig. 8 is a side view of the friction-roller mechanism, certain parts being broken away. Fig. 9 is a rear view of the same. Fig. 10 is a plan view of the same. Fig. 11 is a vertical section of the rear end of the dredger and of the barge used in connection therewith. Fig. 12 is a plan view of the same. Fig. 13 is a plan view of the dredger and barge in operation, the dotted lines showing the same in a second position. Fig. 14 is a vertical section of one of the goosenecks. Fig. 15 is a similar view of a modified form of gooseneck.

1 represents the hull of the dredger, which is of the usual oblong form, but has its front end forked or cut out to form a recess or open well 2, in which revolves the dredging-wheel 3. Said wheel 3 comprises annular side plates 4, connected with the shaft 5 of the wheel by the spokes 6, said spokes being braced together by the rings 7, cross-pieces 8, and diagonal ties 9. Resting upon alternate cross-pieces 8 are the radial supports 10 for the buckets 11, these supports extending from a hub 12 around the shaft 5 and being sufficiently strong to resist the strain upon the buckets when the latter are cutting the material. Each bucket, also to withstand said cutting strain, and particularly the side strains, is secured to the cross-piece 8 above it by oblique bars 13. The front edge of the bucket is also connected to the cross-piece which supports the preceding bucket by a tie 14, which holds up the lip of the bucket when it is cutting the material. The buckets at their inner ends terminate in conduits 15, which open through the side plates 4 of the wheel alternately at opposite sides, thus discharging the material alternately to opposite sides of the wheel, as will be hereinafter more fully described. The shaft of the wheel revolves in bearings 16 upon the ends of girders 17, the inner ends of which girders are supported in bearings 18 in the line with the main shaft 19, so that they swing from the same center. Said shaft is driven from an engine 20 by a pinion 21 and a spur-gear 22 on the main shaft, said shaft 19 communicating its motion to the wheel by means of two pairs of friction-rollers 23 24, which engage the sides of each of the annular side plates of the wheel near the extreme periphery thereof. Said rollers are slightly conical, the inner surface thereof being normally parallel to correspond with the parallel sides of the wheel-blade. To impart rotation to said rollers, there are secured upon the main shaft bevel-wheels 25, which mesh with bevel-wheels 26 on roller-shafts 27, which extend forward through transverse bearings 28 in front of the main shaft, said shafts 27 having secured thereon in front of said bearings slightly-beveled gear-wheels 29, which engage similar wheels 30, secured upon shafts 31, similar to the roller-shafts 27, but outside thereof, revolving in bearings 32 outside of the bearings 28 for the inner roller-shafts 27. The roller-shafts 27 31 converge slightly forward and carry at their forward ends the friction-rollers 23 24. Near said rollers said roller-shafts revolve in ball-bearings 33 in boxes which slide to and from each other upon a slideway 35, secured upon the girders 17. The object of permitting them to so slide is to permit of a yielding pressure by the rollers 23 24 upon the rim of the wheel-plate. For this purpose there are pivotally secured upon said girders upright levers 36 37, which have pivoted thereto near their fulcra the compression-pins 38, whose heads 39 enter recesses 40 in the boxes 41 for the roller-shafts. Therefore

when said upright levers are moved together the effect will be to press said rollers toward each other. Upon one of said upright levers 36 is pivotally secured a short link 42, jointed at its upper end to a lever 43, which is also pivotally jointed to the other upright lever 37 by means of links 44, connected upon a turnbuckle 46, as shown, for the purpose of adjustment. To the lower end of the lever 43 is secured a cup 47 for a compressed spring 48, the other end of which is contained in a cup 49 upon the end of a link 50, which passes through a hole in the end of the lever 43 and is jointed at its other end to the upright lever 36. The force of the compressed spring 48 will tend to separate said cups, and therefore to move the lower end of the lever 43 inward, thereby also drawing together the upper end of the upright levers 36 37, the effect of which will be to force together the boxes of the roller-shafts, and thus to press the wheel-plate between the rollers. The amount of such pressure can be adjusted by screwing in or out a cup 49, which compresses the spring 48 or allows it to expand. As it is impossible with a wheel of the size contemplated, which is from fifty to seventy-five feet in diameter, to construct such friction-plates of an absolutely uniform thickness, while it is absolutely necessary that the pressure shall be at all times sufficiently great to insure the advance of the wheel and that there shall be no slipping of the plates between the friction-rollers, the above construction accomplishes this result, as should a portion of the wheel-plate of greater thickness than usual pass between the friction-rollers they will be forced slightly farther apart, while should a portion of the friction-plate of slightly-less thickness pass therebetween said plate will still be effectively gripped and caused to revolve, the pressure of the spring being substantially unchanged.

It now having been seen how the wheel is given its rotary motion, the buckets will cut into the material to be dredged, and the material so cut is disposed of in the following manner. The material is sliced off by the side and front lip and drops into the bucket, which is already filled with water. Thus the material cannot pack, but is diluted with water and drops to the conduit 15, leading to the side of the wheel, as already described. Its progress is there momentarily arrested by a door 53, placed on the outside of the wheel-plate; but as the wheel is intended to operate at the rate of about two revolutions a minute the material only takes about twelve seconds from the time it first drops into the bucket until it is discharged therefrom. Its discharge is effected by the door being automatically opened when said door arrives exactly opposite to a hopper 54 at the side of the wheel. There are two such hoppers, one for the buckets opening on one side and the other for those opening on the other side. These hoppers move up and down with the wheel as it is adjusted to different depths in the manner which will be hereinafter described. They are so located that the discharge takes place when the buckets arrive at the highest point of the wheel. The door is normally held locked against rearward movement by means of a bolt 55, which slides radially in guides 56 on one of the spokes 6 until the bucket has reached such a height that said bolt falls down by its own weight when the door is allowed to drop back. Each door carries near its center a stud 57, which when the door arrives at the proper position to discharge the contents of the bucket engages a hook 58 on the front end of a lever 59, pivoted on an extension 60 from the front side of the hopper. Said stud 57 being engaged by said hook while the wheel advances, the door is necessarily held back, and the contents are permitted to discharge into the hopper. Said door has inner and outer curved edges, which slide between the wheel-plate and rings 61, secured by means of studs 62 upon the wheel-plates. The edges of the door moves between friction-rollers 63 upon the studs 62. The door is held back by the engagement of the stud 57 with the hook 58 until the rear edge of the door comes into contact with a radial rib 64, extending across the wheel-plate between the two rings 61. It is necessary at this time to remove said hook from said stud in order to allow the wheel to advance. This is done by means of a stud 65 upon the outer ring 61, engaging a cam-surface 66 upon a forwardly-extending arm 67 of the lever 59, the cam thereby lifting the hook 58 out of the path of the stud upon the door to allow the door to advance with the wheel. When the door has advanced and descended sufficiently, it will drop forward by its own weight and will be arrested by the abutment of its forward edge with the radial rib 64 in front and then will be in front of the aperture in the side plate, which will still be open. This aperture will remain open until the bucket has passed its lowest position, when the door will fall back. It will then be arrested, in a position to exactly close the opening, by its individual bolt 55, which will have dropped by gravity into the proper position to so arrest the door. The parts will now be in position to repeat the operation already described.

An important feature of my invention is the means for raising and lowering the wheel, and with it the hoppers, so as to adjust the same to any desired depth of cut. For this purpose I provide upon the end of the dredge, on opposite sides of the wheel, the frames 69, connected with the upper deck of the barge by the horizontal beams 70. These frames support the vertical screws 71, by means of which the wheel is raised or lowered. Said screws are mounted at their lower ends in step-bearings 72 upon the dredge and at their

upper ends have bearings in overhanging plates 73, secured upon the upper ends of the frames 69, and are driven by worm-gears 74, operated by worms 75 on longitudinal shafts 76, extending rearwardly and there driven by means of miter-gearing 77 by a transverse shaft 78, operated by a reversible engine 79. It follows from this construction that the motion of both screws is absolutely identical. This is of importance in order to insure a regular vertical movement of the wheel. The motion of the screws is transmitted by nuts 80 on said screws, which nuts support vertically-movable carriers 81, which extend inward to overhang the girders and are connected to said girders by means of said hangers 82 and links 83. The links allow a vibrating movement to be given to the girders from a reciprocating movement of said frames. To the overhanging plates 73 are secured rails 84, extending downward to the inner sides of the well-room, upon which slide rails 85, attached to the hoppers, said rails 85 being attached in pairs, so that the head of the rail 84 enters between the heads of the pairs of rails 85 and secures the hopper against lateral movement. Said hopper is attached to the carrier 81 by standards 86 at the corners, so as to move therewith. The carriers 81 are suitably cut out to slide over the frames 69, the screws 71, and the rails 84. It will be seen that by the above construction the hoppers and the wheel-shaft are compelled to move vertically in unison.

An important feature of my invention is the contrivance which I provide for preventing binding of the nuts 80 upon the screws 71, which would otherwise be caused by uneven balance of said carriers 81 upon said nuts. Since the weight of the wheel is supported by the two carriers at points close to their inner ends and necessarily at points inside the nuts, it follows that without provision of this kind the weight of the wheel would tilt the outer ends of the carriers upwardly and correspondingly tilt the nuts and cause them to bind upon the screws, so that by no possibility could they be rotated. In order then to equally distribute the weight of the wheel, so that it will be borne evenly upon the nuts, I attach to the upper ends of the standards 86, which support the hoppers, cables 87, which pass over pulleys 89 to the hull at the extreme edges thereof and then upwardly, being there secured to the outer ends of the carriers. There is one such cable 87 for each of the standards 86—that is, four such cables in all—two on each side of the wheel, of which one is in the front and two behind the vertical frame 69. The tension upon these cables, due to the weight of the wheel, is transmitted by said cables to the outer ends of the carriers, so that said outer ends will be drawn down thereby as well as the inner ends. The weight of the wheel will be carried by both ends of the carriers instead of the inner end only, and the pressures on the nuts are balanced. The attachment of the outer end of the cables to the carriers is made by securing said cables to the lower ends of threaded eyebolts 90, working in suitably-threaded apertures in the carriers. By screwing said bolts up or down the tension may be adjusted. It will also be observed that with this construction the balancing of the weight will not be interfered with by reason of a variation of the height of the wheel relatively to the vertical frames, for any take-up in one side of the cable will be compensated for by an equal letting out at the other side.

The excavated material falling into the hoppers is carried from said hoppers by the chutes 91 into pump-wells 92, which serve as reservoirs, equalizing the feed to the pipe-line. To a point near the bottom of each well extends a vertical pipe 93, in which rotates a screw-propeller 94, operated by a pulley 95 at the top within the pump-head 96, said pulleys at the opposite sides of the dredger being driven by belts 97 from a pulley 98 upon the upper end of a vertical shaft 99, extending down through the center of the dredger and carrying on its lower end a pulley 100, driven by a belt 101 from a suitable engine. (Not shown.) From the upper ends of said pipes 93 extend the outlet-tubes 103, which are directed diagonally upward and then horizontally, but converging toward the rear end into a single pipe 104.

105 represents an auxiliary barge which is interposed between the dredger and the shore and which carries an intermediate pipe 106, which at its rear end is connected by a coupling-pipe 109 with the forward end of the pipe 104 and at its front end with the discharge-pipe 110. The coupling-pipe 109 and the discharge-pipe 110 are suspended by means of wire cables 107 from **A**-frames 108, erected upon the ends of the barge. The connections between these pipes are made by goosenecks 111, identical in construction, which may be explained by reference to either of them. The forward end of the pipe 104 is bent downward through a right angle, and near the extreme end thereof is formed an annular flange 112. Below said flange 112 the pipe is made globular in form. The rear end of the coupling-pipe 109 is bent upward through a right angle, and thereupon is formed an annular horizontal flange 113. Above said flange the pipe 109 is made cylindrical in form, and into it enters the end of the pipe 104. Said flanges 112 113 limit the extent of relative movement of the pipes 109 104. By this construction each pipe can turn freely horizontally relatively to the other, and there is also permitted a slight vertical movement of either pipe relatively to the other without breaking the connection between them. On account of the downward discharge of the rear pipe into the forward

pipe there is no tendency of the water and material to escape through the joint, and thus the two pipes may have a comparatively loose connection without disturbing the connection. This joint is cheap and effective, and, which is of the greatest importance, permits a free and uninterrupted opening for the passage of the material.

One of the most important considerations in the construction of dredging-machines is the saving of the power required to force the material through the pipe-line to great distances. Much difficulty has heretofore been experienced on account of the loss of power due to the necessity of forcing the material through a contracted or obstructed opening or passage between portions of the pipe-line, especially when the pipe-line is bent or crooked. Not only is a loss of power thus occasioned, but the obstruction to the material causes it to settle at these points and still further increases the power required to overcome the obstruction. The above construction provides a cheap and simple method of avoiding such loss of power. It will also be observed that in each of these joints the material makes a drop in passing from one pipe to the next. This assists the passage of the material through the joint—the part in its flow where it would otherwise be liable to meet with the greatest obstruction on account of the change of direction.

From the end of the discharge-pipe the material is discharged upon the embankment, (shown at 116 in Fig. 13.) From an inspection of said figure it will be seen that provision is made for excavating a wide cut by the dredger while distributing the material so dredged evenly over the embankment. For this purpose the ends of the barge nearest the shore are secured to anchors 117 by ropes 118, which after passing around pulleys 119 are wound around windlasses 120, which may be wound up or let out at pleasure, thus swinging the end of the barge next the shore to any desired degree or into any desired position. The discharge-pipe may also be swung independently by means of ropes attached to the side of the pipe passing around pulleys 121 and thence to friction-drums 122 upon the end of the barge. When it is desired to distribute the dirt upon the embankment on any particular spot, the pipe-line may be directed to the desired spot, and as the dredge advances in the channel the end of the barge next the shore will be correspondingly moved by means of the cables 118, the anchors 117 being shifted at longer intervals. The barge is utilized to store the fuel for operating the dredger, and I have in the present instance shown the oil-tanks 123 for this purpose. The outer end of the barge is connected with the adjacent end of the dredger by a coupling 124, which permits free rotary movement relatively to each other while holding them at a proper distance apart. The coupling may be attached to the barge and dredge at either corner thereof, as may be desired. The dredge swings upon a spud, of which two are provided, one, 125, in the center and the other, 126, at the end, the choice of which would be according to the width of the channel to be cut. If a narrow channel is to be excavated, the spud 125 in the center would be employed. If a wide channel and a greater swing of the dredge is required, the spud 126 at the end would be employed. These spuds are raised or lowered in the manner known in the art, and frames 127 on the barge are provided for that purpose.

In Fig. 15 is shown a modified form of goose-neck. In this construction the ends of the pipes are each formed with an outwardly-extending annular flange 130, around which extends a short tube or collar 131. The ends of said tube are attached by means of short rods 132, having trow-buckles 133, to hooks 134, secured on the outside of the pipes and tubes. By shortening or lengthening the rods on the one side or the other the two pipes may be given a slight inclination to each other. The annular space within the tube between the two flanges very soon becomes packed with sediment, leaving a straight channel through the sediment of the same diameter as the tubes, and this sediment serves as a packing to prevent the escape of the water and spoils.

I claim—

1. In a dredger, the combination of a wheel, dredging-buckets secured on the periphery thereof, said wheel having an annular plate, a pair of friction-rollers engaging the sides of said plate, shafts carrying said rollers, bearings for said shafts, a transverse slideway for said bearings, and means for exerting a yielding pressure toward each other upon said bearings, substantially as described.

2. In a dredger, the combination of a wheel, a series of dredging-buckets carried on the periphery of said wheel, said wheel having annular side plates, two pairs of friction-rollers engaging said side plates, shafts carrying said rollers, bearings for said shafts in pairs, a transverse slideway for said bearings and means for exerting a yielding pressure upon each pair of bearings toward each other, substantially as described.

3. In a dredger, the combination of a wheel, a series of dredge-buckets secured upon the periphery of said wheel, said wheel having an annular friction-plate, a pair of friction-rollers engaging said plate, shafts movable to and from each other carrying said rollers, means for driving said shafts in unison, and means for resiliently forcing said shafts toward each other, said means comprising compound levers engaging the bearings of said shafts, and a spring between said compound levers to operate the same, substantially as described.

4. In a dredger, the combination of the dredging-wheel, and dredging-buckets said

dredging-wheel having a friction-plate, of a pair of friction-rollers, and means for forcing said rollers toward each other, said means comprising a pair of levers extending substantially parallel from their pivots, an intermediate lever, links connecting said intermediate lever with each of the other levers, one of said links being at the end of said lever and the other at an intermediate point thereof, a spring upon the other end of said intermediate lever, and a link connected with the opposite end of said spring and with the lever to which the other terminal link is connected, substantially as described.

5. In a dredger, the combination with the wheel having a series of dredging-buckets and a friction-plate, of a pair of friction-rollers for applying power to said plate, and means for forcing said rollers toward each other to press the plate therebetween, comprising the levers 36, 37 operatively connected with said rollers, the link 42, the lever 43 to which said link is jointed, means for pivotally connecting said lever 43 with the lever 37, the spring 48 engaging the other end of the lever 43, and the link 50 engaged by the other end of said spring, substantially as described.

6. In a dredger, the combination with the wheel having a series of dredging-buckets and a friction-plate, of a pair of friction-rollers for applying power to said plate, and means for forcing said rollers toward each other to press the plate therebetween, comprising the levers 36, 37 operatively connected with said rollers, the link 42, the lever 43 to which said link is jointed, means for pivotally connecting said lever 43 with the lever 37, means for varying the length of said pivotal connection.

7. In a dredger, the combination with the wheel having a series of dredging-buckets and a friction-plate, of a pair of friction-rollers for applying power to said plate, and means for forcing said rollers toward each other to press the plate therebetween, comprising the levers 36, 37 operatively connected with said rollers, the link 42, the lever 43 to which said link is jointed, means for pivotally connecting said lever 43 with the lever 37, the spring 48 engaging the other end of the lever 43, and the link 50 engaged by the other end of said spring, and means for varying the amount of compression of said spring.

8. In a dredger, the combination of a wheel, a series of peripheral buckets secured thereto and having lips arranged to cut the material, said wheel having side plates with openings therein alternately at opposite sides of the wheel registering with alternate buckets, circumferentially-sliding closures for said openings, hoppers at opposite sides of the wheel into which the material is discharged through said openings, and means automatically operated by the advance of the wheel for withdrawing said closures from said openings as the openings arrive at the hopper, substantially as described.

9. In a dredger, the combination of a wheel, a series of peripheral buckets secured thereto and having lips arranged to cut the material, said wheel having side plates with openings therein alternately at opposite sides of the wheel registering with alternate buckets, circumferentially-sliding doors closing said openings, hoppers at opposite sides of the wheel into which the material is discharged through said openings, and means automatically operated by the advance of the wheel for withdrawing each door in succession as its opening arrives at said hopper, substantially as described.

10. In a dredger, the combination of a dredging-wheel having a series of buckets constructed to cut the material to be dredged and having annular side plates, said buckets having conduits leading to openings in said side plates, the hoppers, doors for closing said openings, a radially-movable bolt for each door normally holding said door against rearward movement, and means for automatically arresting said door as the wheel advances when the opening arrives opposite to the hopper, substantially as described.

11. In a dredger, the combination of a wheel, a series of dredging-buckets carried thereby, having conduits leading to opposite sides of the wheel alternately, wheel-plates at opposite sides of the wheel having openings to which the conduits lead, rings secured upon said wheel-plates, doors sliding between said rings, hoppers, and means for withdrawing the doors from the openings to permit the material to discharge into the hoppers, substantially as described.

12. In a dredger, the combination of a wheel, a series of dredging-buckets carried thereby, having conduits leading to opposite sides of the wheel alternately, wheel-plates at opposite sides of the wheel having openings to which the conduits lead, rings secured upon said wheel-plates, studs connecting said rings with said plates, friction-rollers on said studs.

13. In a dredger, the combination of a wheel, having annular side plates, a series of dredging-buckets secured thereto, each plate having a series of openings through which the buckets discharge, doors closing said openings, a hopper on each side of the wheel, and means for automatically withdrawing each door as the corresponding opening arrives at the hopper, said means comprising a projection upon the door, and a pivoted hook upon the hopper, said wheel having means for disengaging said hook from said projection to permit said door to advance with the wheel when the door has been sufficiently withdrawn, substantially as described.

14. In a dredger, the dredging-wheel having the annular side plates, the rings secured thereon, the buckets, and the doors between

the rings, said side plates having the radial ribs 64 for limiting the movements of the doors, substantially as described.

15. In a dredger, the wheel having the annular side plates, the buckets discharging through openings in said side plates, and the doors suitably guided upon the sides of said plates, said plates having means for limiting the movements of the doors while permitting the door to move either in advance or behind a corresponding opening to allow the opening to be open in either case, substantially as described.

16. In a dredging-machine, the wheel having the side plates with openings, the doors sliding over said openings, and the individual bolts for said doors, said bolts moving radially of said wheel, substantially as described.

17. In a dredger, the combination of a wheel, the swinging girders, the bearings on the ends of the girders for the shaft of the wheel, a vertical screw on each side of the wheel, means for rotating said screws in unison, nuts on said screws moving vertically with the rotary movement of the screws, and connections between said nuts and girders to support the latter, substantially as described.

18. In a dredger, the combination of the wheel having dredging-buckets, the swinging girders, the bearings for the wheel-shaft on the ends of said girders, the vertical screws on opposite sides of the wheel, the worm-gears on the upper end of the screws, the longitudinal shafts having worms engaging said worm-gears, means for rotating said longitudinal shafts in unison, nuts on said screws and connections between said nuts and girders to support the latter from the former, substantially as described.

19. In a dredger, the combination of the wheel, the swinging girders, the bearings on the ends of the girders for the shaft of the wheel, a vertical screw on each side of the wheel, means for rotating said screws in unison, nuts on said screws moving vertically with the rotary movement of the screws, and connections between said nuts and girders to support the latter, hoppers into which the material is discharged and connections between said hoppers and nuts whereby the hoppers rise and fall with the wheel, substantially as described.

20. In a dredger, the combination of the wheel, the swinging girders, the bearings on the ends of the girders for the shaft of the wheel, a vertical screw on each side of the wheel, means for rotating said screws in unison, nuts on said screws moving vertically with the rotary movement of the screws, and connections between said nuts and girders to support the latter, hoppers into which the material is discharged vertical rails, and guides for said hoppers engaging said rails to guide the hoppers in their vertical movement, and connections between said hoppers and nuts whereby the hoppers rise and fall with the wheel, substantially as described.

21. In a dredger, the combination of a wheel, dredging-buckets carried thereby, vertically-swinging girders, bearings carried at the free ends of said girders for the shaft of the wheel, vertical screws on opposite sides of the wheel, means for rotating said screws in unison, nuts on said screws vertically-movable carriers supported by said nuts, hangers and links connecting said carriers with said girders, hoppers at the sides of the wheel for discharging the material cut by the buckets, supports for said hoppers on said carriers, vertical guide-rails, and means secured upon the hoppers for guiding said hoppers on said rails, substantially as described.

22. In a dredger, the combination of the wheel, the dredge-buckets secured thereon, the vertically-swinging girders, the bearings on the ends of the girders for the shaft of the wheel, a vertical screw on each side of the wheel, means for rotating said screws in unison, nuts on said screws moving vertically with the rotary movement of the screws, carriers supported upon said screws and moved therewith, means for supporting the ends of the girders upon said carriers, and equalizing means for equalizing or balancing the weight upon the carriers, substantially as described.

23. In a dredger, the combination of the wheel, the dredge-buckets secured thereon, the vertically-swinging girders, the bearings on the ends of the girders for the shaft of the wheel, a vertical screw on each side of the wheel, means for rotating said screws in unison, nuts on said screws moving vertically with the rotary movement of the screws, carriers supported upon said screws and moved therewith, said carriers extending to the outside of the nuts, and means for supporting the weight of the girders upon the carriers both at the inside and at the outside of the nuts, substantially as described.

24. In a dredger, the combination of the wheel, the dredge-buckets secured thereon, the vertically-swinging girders, the bearings on the ends of the girders for the shaft of the wheel, a vertical screw on each side of the wheel, means for rotating said screws in unison, nuts on said screws moving vertically with the rotary movement of the screws, carriers supported upon said screws and moved therewith, said carriers extending to the outside of the nuts, cables attached to said carriers on opposite sides of the nuts, and fixed pulleys above and below said carriers around which said cables are carried, thereby equalizing or distributing the weight of the carriers and girders upon the nuts, substantially as described.

25. In a dredger, the combination of a wheel, a series of peripheral buckets secured thereon and having lips arranged to cut the material,

conduits from said buckets discharging alternately on opposite sides of the wheel, circumferentially-sliding closures for said conduits, hoppers at opposite sides of the wheel into which the material is discharged from said conduits, and means automatically operated by the advance of the wheel for withdrawing said closures from said openings as the openings arrive at the hoppers, substantially as described.

26. In a dredger, the combination of a wheel, bearings for the shaft thereof, carriers for said bearings, means for balancing the weight of the bearings on said carriers, nuts supporting said carriers, vertical screws on said side of the wheel through said nuts and means for rotating said screws in unison to raise and lower the wheel, substantially as described.

27. In a dredger, the combination of a wheel, bearings for the shaft thereof, carriers for said bearings, means for balancing the weight of the bearings on said carriers, said means comprising cables attached to said carriers on opposite sides of the nuts, and fixed pulleys above and below said carriers around which said cables are passed, nuts supporting said carriers, vertical screws on each side of the wheel through said nuts and means for rotating said screws in unison to raise and lower the wheel, substantially as described.

28. In a dredger, the combination of a dredging-wheel having buckets, and hoppers at the sides of said wheel into which the material is discharged, chutes leading from said hoppers, pump-wells into which said chutes discharge the material, pipes extending vertically upward from near the bottom of each well, screw-propellers in said pipes, and a pipe-line into which the material is discharged by said screw-propellers, substantially as described.

29. In a dredger, the combination of a wheel having a series of excavating-buckets on its periphery, a hopper into which the material so excavated is discharged, a pump-well, a conduit from said hopper to said pump-well, a pipe leading from near the bottom of said pump-well, a screw-propeller in said pipe, and a pipe-line into which the material is discharged by said screw-propeller, substantially as described.

30. In a dredger, the combination of a wheel having a peripheral series of dredging-buckets, hoppers at the sides of the wheel into which the material is discharged from said buckets, pump-wells, conduits from said hoppers to said pump-wells, pipes leading vertically from near the bottom of said pump-wells, screw-propellers in said pipes, outlet-tubes directed diagonally upward and then horizontally and converging toward the rear end, and a single pipe into which they discharge, said pipe conveying the spoil to the place of deposit, substantially as described.

31. In a dredger, the combination with the dredger proper, provided with means for excavating the material, means for elevating the material so excavated, and a pipe for conducting the material to the rear end, of a barge having an intermediate pipe thereon, and a rigid coupling flexibly connecting a corner of the barge with a corner of the dredger, substantially as described.

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

A. BOSCHKE.

Witnesses:
FRANCIS M. WRIGHT,
BESSIE GORFINKEL.