

(No Model.)

8 Sheets—Sheet 1.

W. S. LOCKHART.

ART OF WASHING AND SEPARATING MINERALS.

No. 509,818.

Patented Nov. 28, 1893.

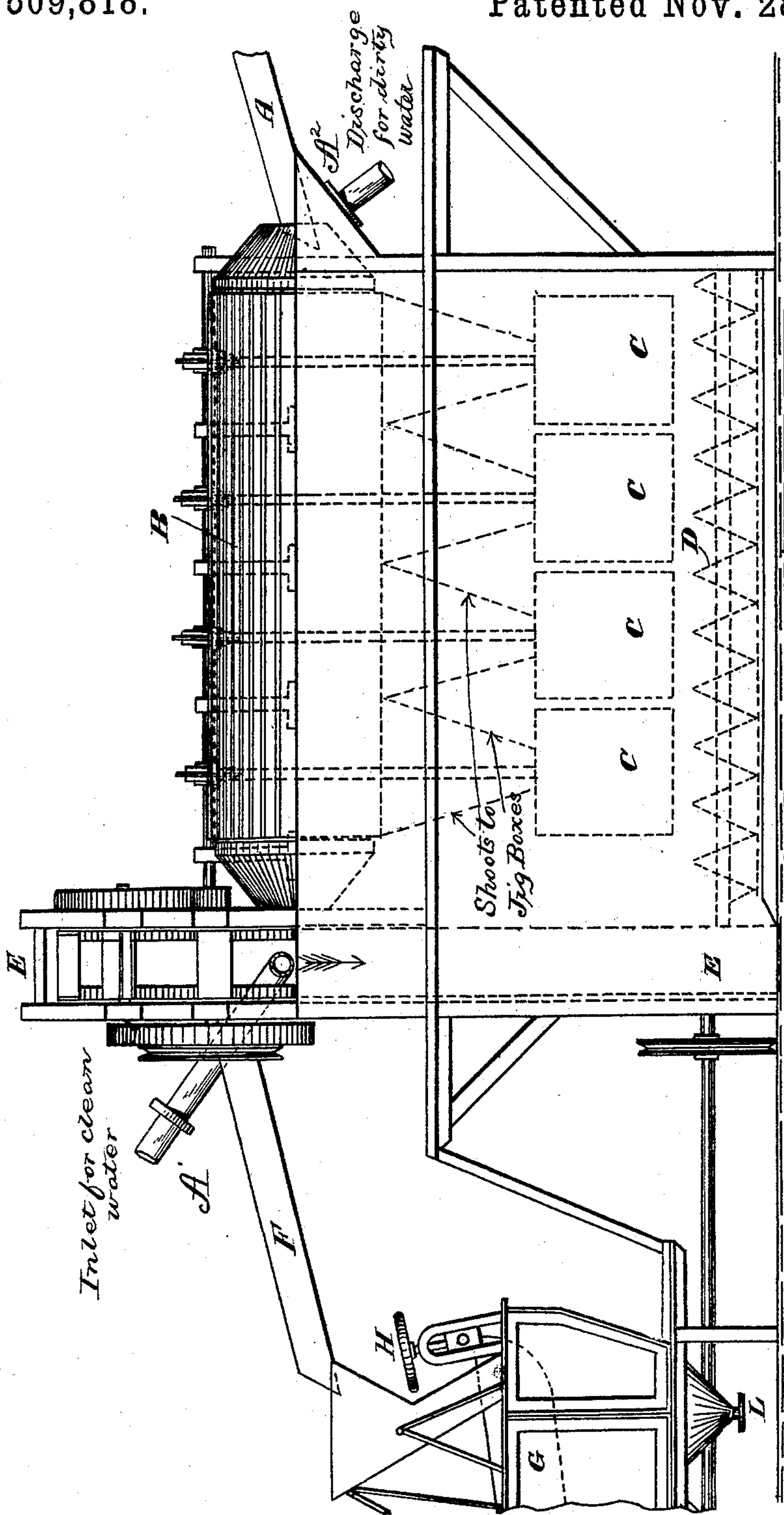


Fig. 1.

Witnesses:
E. B. Bolton
E. H. Sturtevant

Inventor:
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By *Richardson & R.*
his Attorneys.

(No Model.)

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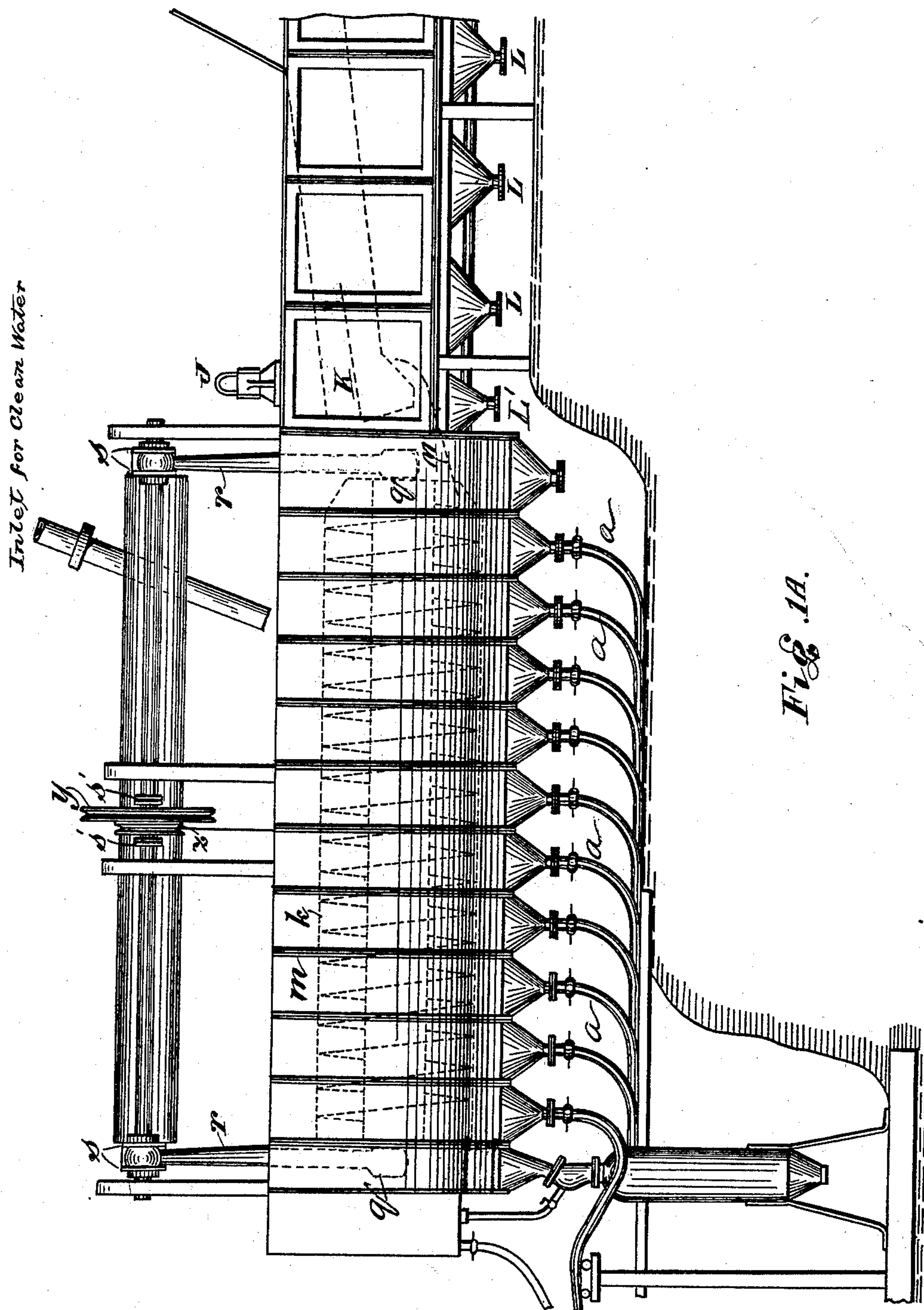


Fig. 1A.

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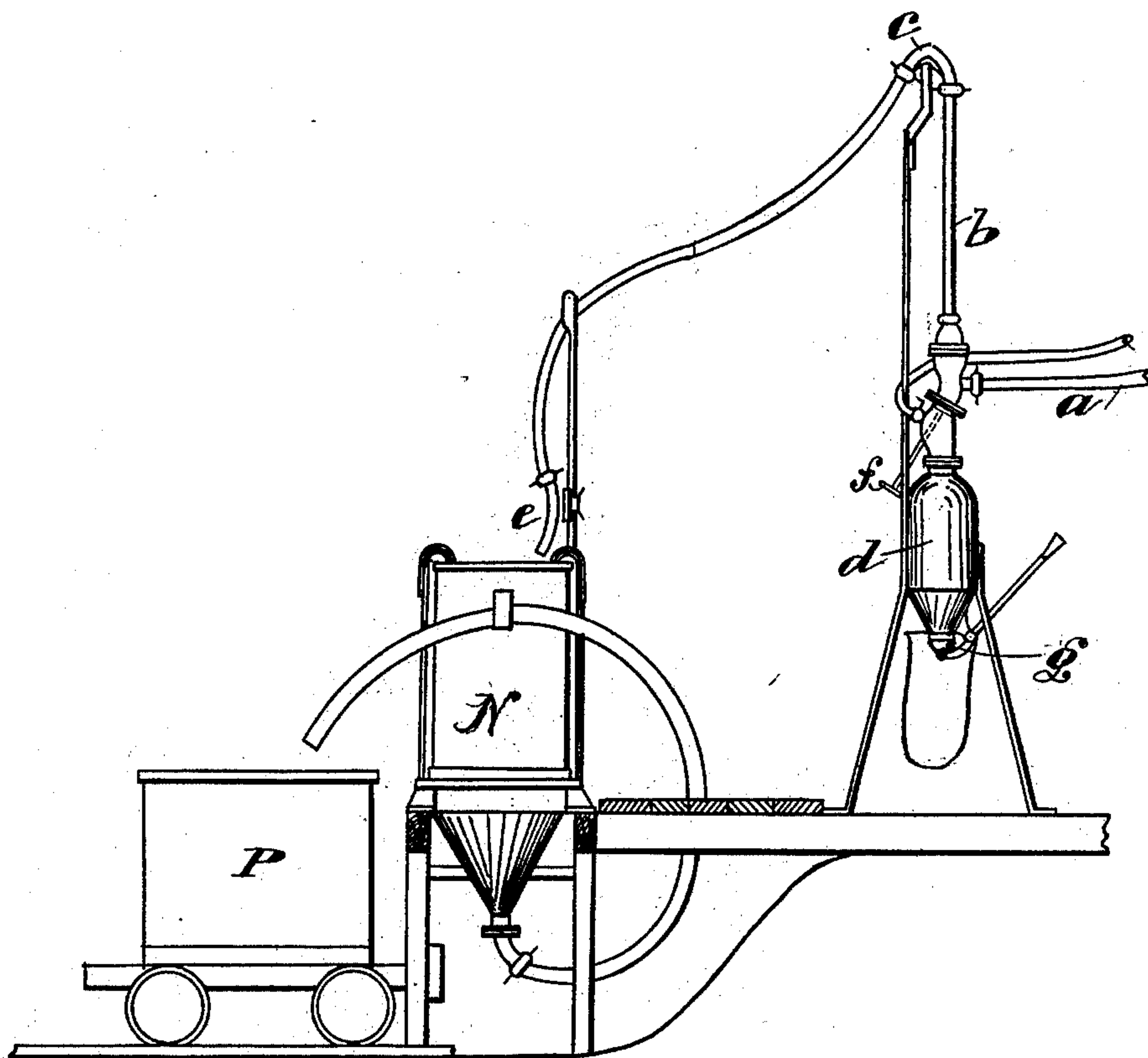


Fig 1 B.

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(No Model.)

8 Sheets—Sheet 4.

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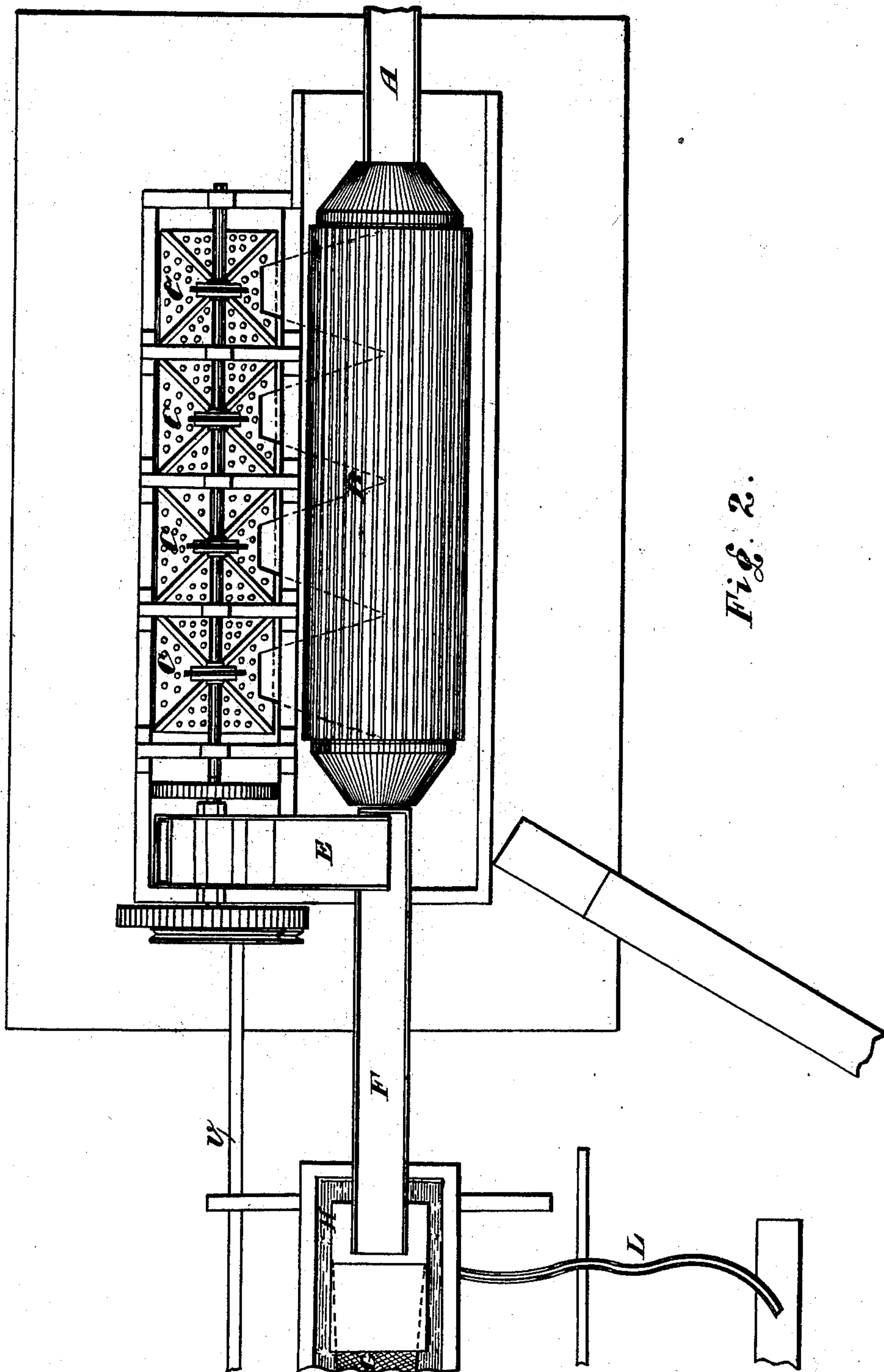


Fig. 2.

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(No Model.)

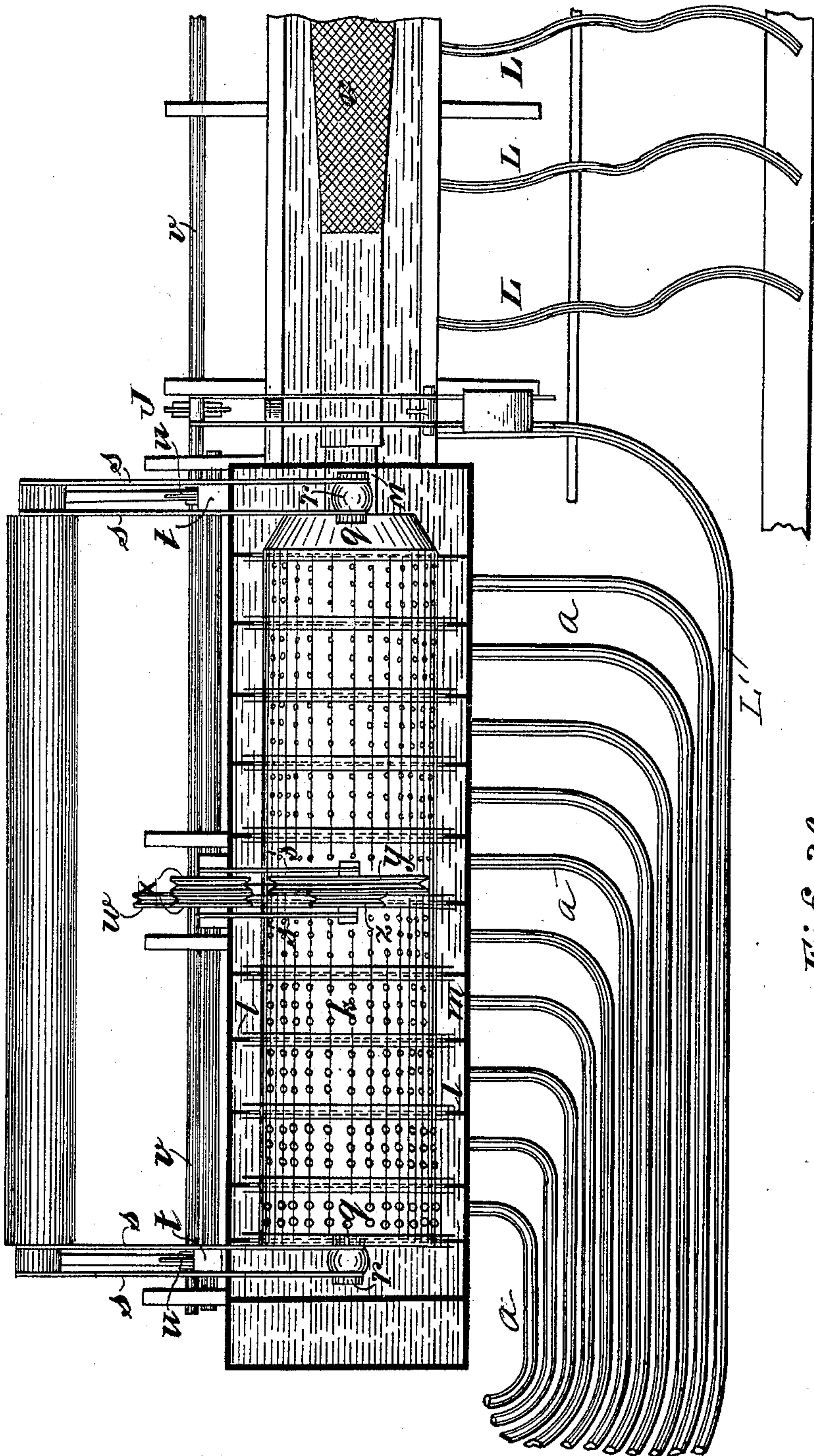
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W. S. LOCKHART.

ART OF WASHING AND SEPARATING MINERALS.

No. 509,818.

Patented Nov. 28, 1893



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THE NATIONAL LITHOGRAPHING COMPANY,
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(No Model.)

8 Sheets—Sheet 6.

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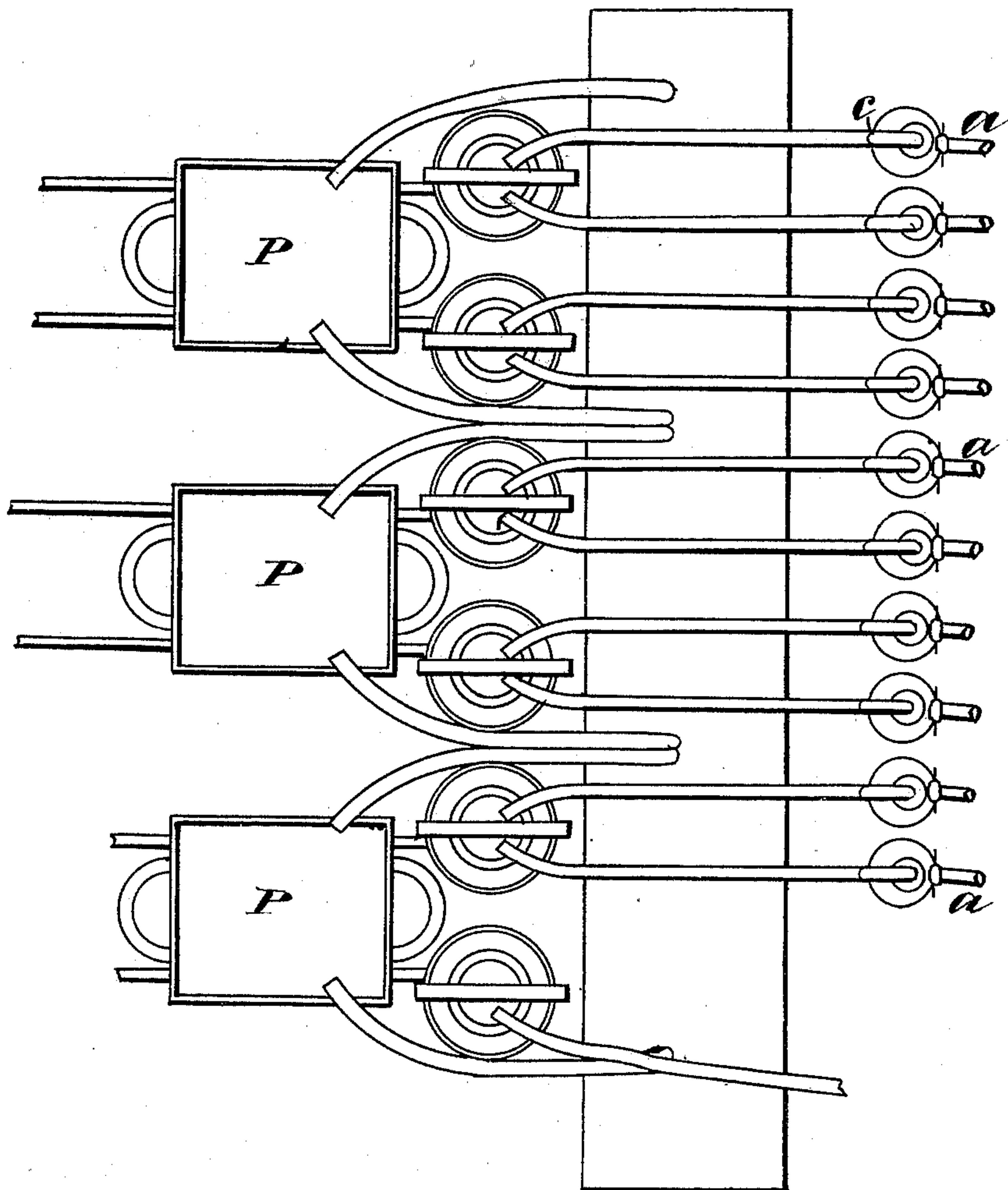


Fig. 2 B.

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8 Sheets—Sheet 7.

W. S. LOCKHART.

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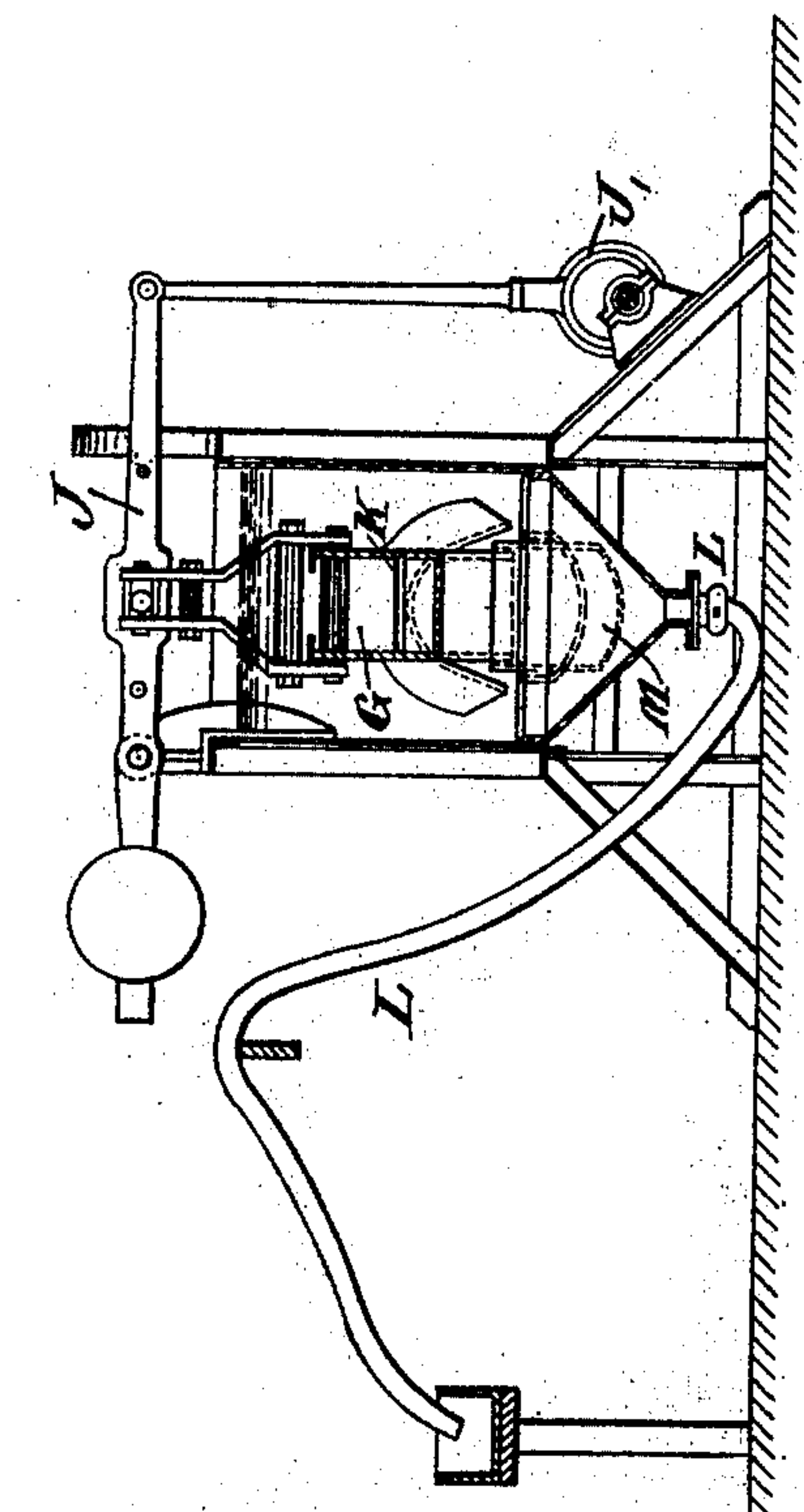


Fig. 4.

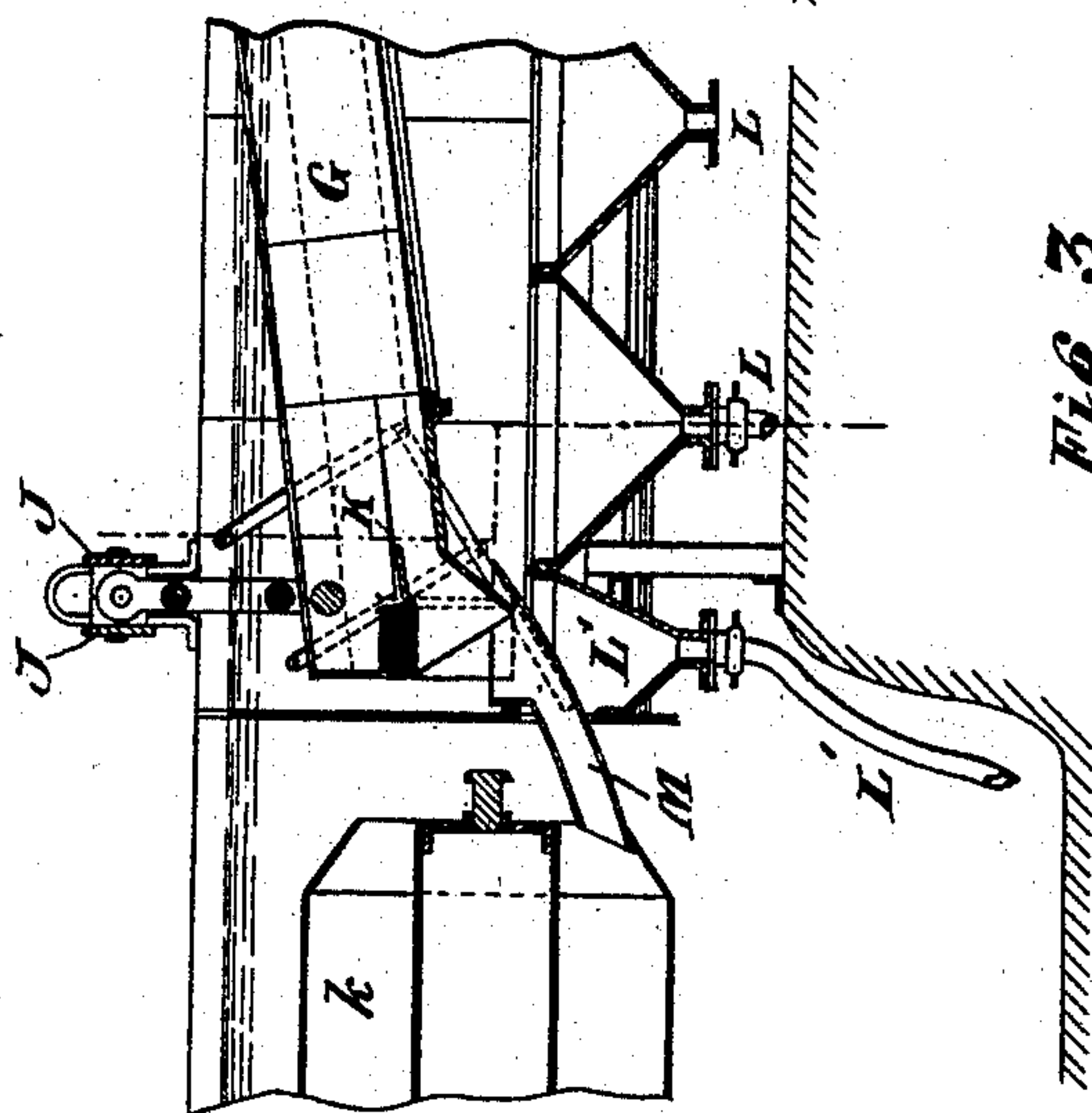


Fig. 3.

Attest
F. L. Maddison

Inventor
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by Richard S. B.

(No Model.)

8 Sheets—Sheet 8

W. S. LOCKHART.

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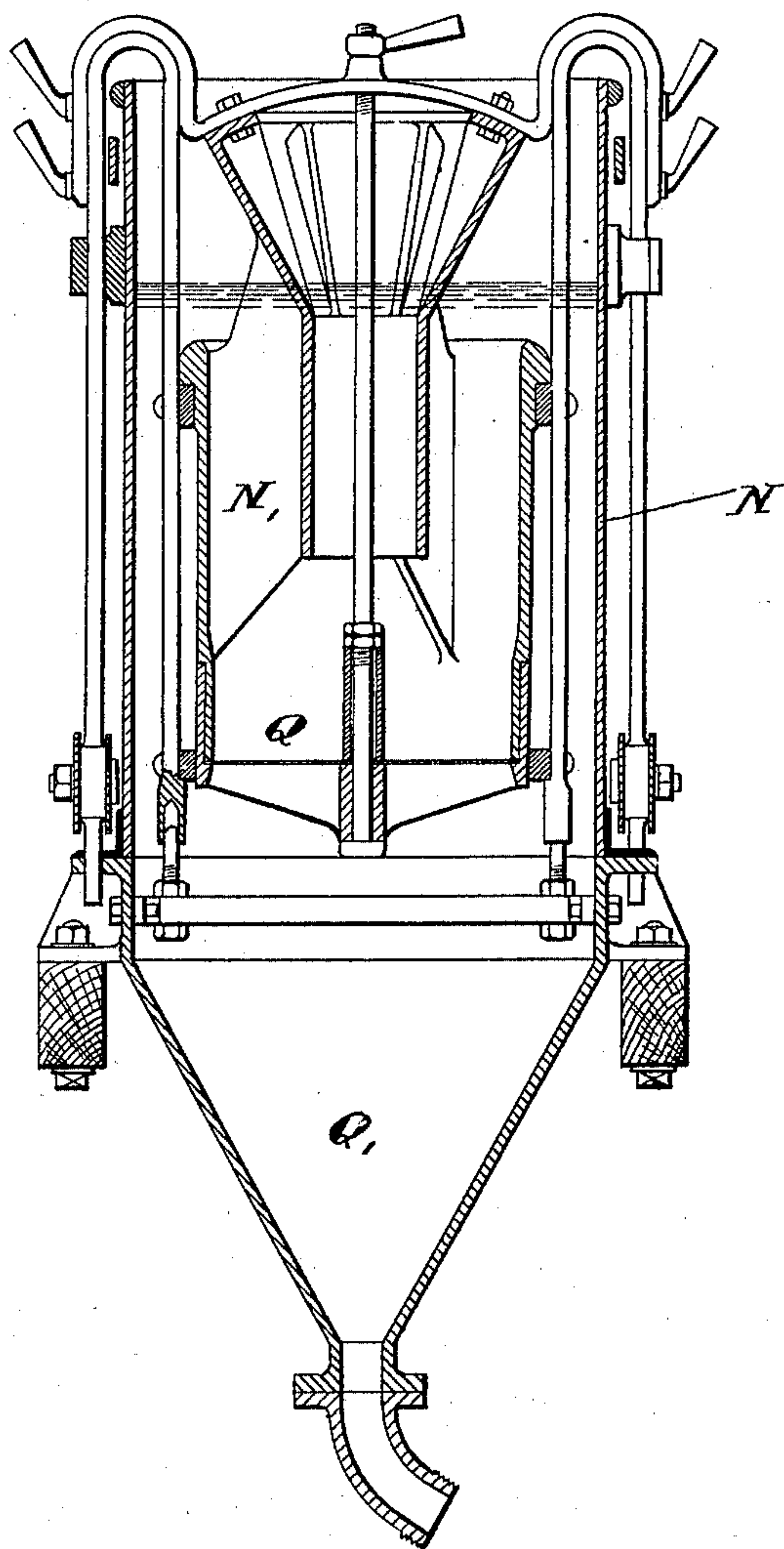


Fig. 5.

Attest
Richard Muddleton
F. L. Muddleton

Inventor
William S. Lockhart
by Richard Muddleton
F. L. Muddleton

THE NATIONAL LITHOGRAPHING COMPANY.
WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

WILLIAM STRONACH LOCKHART, OF LONDON, ENGLAND, ASSIGNOR TO
THE AUTOMATIC GEM AND GOLD-SEPARATOR SYNDICATE, LIMITED,
OF SAME PLACE.

ART OF WASHING AND SEPARATING MINERALS.

SPECIFICATION forming part of Letters Patent No. 509,818, dated November 28, 1893.

Application filed February 1, 1893. Serial No. 460,585. (No specimens.)

To all whom it may concern:

Be it known that I, WILLIAM STRONACH LOCKHART, residing at London, England, have invented Improvements in the Art of Washing and Separating Minerals, of which the following is a specification.

My invention relates to a complete and continuous process, and to the combined apparatus used therein, for the washing and separation of gems, from the clay and earthy materials containing them and their further sorting and separation from the insoluble minerals or other substances with which they may be mixed, and consists in a continuous process whereby the clay and earthy matters are removed from the gems and mineral matters contained therein by attrition, without crushing or pulverization (which would be destructive to the gems) and to the after separation of the remaining gems and minerals, the whole various processes being combined by the automatic delivery of the selected materials after each step of the process, so that the apparatus may be inclosed under lock and key if desired to prevent the handling of the material, while under treatment, and the stealing of gems therefrom.

Each of the steps of the process as described are necessary in their described place and action, to effect a perfect and final automatic delivery of gems into a locked receptacle, free from their attendant clay, earth, and large and small sand, gravel, or other minerals.

The various steps of my process may be defined as follows: first, the washing in water and attrition by large stones or added material of the clay and earthy matters containing the gems and other materials—a delivery by chutes of screened materials into jigging boxes; second, jigging the mixed gems and other small minerals in water to further remove, by attrition, clay and earth with the larger particles or added material—a collection of jigged materials by creeper screw, and delivery by bucket elevator and chute to jigging screen; third, jigging the mixed gems and other small minerals and sand on a fine screen to allow sand and all small particles

to pass away; fourth, a concentrating process by knife whereby the bulk of the lighter materials are separated from those of greater density, thus reducing the amount to be subsequently treated—a delivery by gravity chute of heavier particles into sizing screen; fifth, a sizing treatment for the heavy particles of gems and other minerals to obtain division into bodies of fairly uniform size; sixth, a hydraulic separation for each division of approximately uniformly sized gems or other heavy minerals from lighter ones by their specific density under the action of an ascending current of water, or, equivalently step five may follow instead of preceding step six; seventh, a jigging process of the lighter or waste minerals from hydraulic separator, by which the denser particles are settled down and accumulated, while the lighter particles are carried away; eighth, the removal of waste material from the settling tank in the course of above steps of process by means of siphonage with a suitable supply of liquid.

My above process may be carried out as follows, and in order that my invention may be the better understood, I now proceed to describe the same in relation to the drawings hereunto annexed, reference being had to the letters and figures marked thereon.

Figure 1 is a side elevation of attrition cylinder, jigging boxes, and automatic elevator, and part of jigging trough. Fig. 2 is a plan of the same. Fig. 1^A is a continued side elevation of part jigging trough and knife, and a jigging and rotating “classifier” or sorting machine. Fig. 2^A is a plan of the same. Fig. 1^B is a continued side elevation of upward current separators and waste jigging boxes. Fig. 2^B is a plan of the same. Fig. 3 is a sectional elevation of end of jigging trough, knife and exit chutes. Fig. 4 is a transverse section through the same. Fig. 5 is a sectional elevation of the waste jigging boxes.

The clay or other earthy material passes by a trough A into a machine provided with a revolving screen B with interstices of any predetermined size so that the nodules of clay, stones, or pieces of any material of a consid-

erable size are retained in it, or if desired lumps of hard metal or other material may be added, and by its continued revolution, the lumps of clay or other soft material are gradually reduced by washing, or by the attrition with the hard stones and other pieces, retained from the material treated, or added if desired, or by both washing and attrition, and so soon as they have become smaller than the openings in the screen they naturally pass through. This part of the process is preferably carried on, in or under water. The larger stones and other pieces which cannot so pass through this screen are discharged by the removal of several of the longitudinal bars forming the periphery of the screen, when required, and should be picked over for any lumps of gem or other suitable material which may be among them. The particles whether of clay, stone, or other material, which pass through the screen, are conducted by chutes from the outside of the various sections of the screen, into one or more but preferably several jig boxes C, where they are jigged in water or other liquid either by the motion of the jig boxes themselves, or by pulsations of the liquid in which they are immersed imparted by any suitable means.

At the lower part of the jig boxes holes or openings are provided of a somewhat smaller size than those in the screen already described, so that some of the stones or other hard pieces, either from the material treated, or added thereto if required, are retained in the boxes, where they serve by the rubbing action to further reduce any clay or other soft material that may find its way among them. Thus the small particles which can find their way between the interstices of the larger particles gravitate downward, and when small enough pass out through the openings in the boxes, and to the next part of the process.

The jig boxes are provided with suitable means for discharging their contents, so that the pieces they have for a time detained may be either picked over for valuable particles or pass on to another stage of the process.

The material that finds its way through or past the jig boxes is conveyed or guided by a screen feed D or in any suitable manner to an elevator E, raised out of the water in which they have been so far washed, and passed on to the next machine by a trough F.

The supply of water or other liquid of the process so far, is so arranged that its inlet A' is near the point at which the washed material is extracted, and the outlet or discharge A² of the water or other liquid, is at a point where it is most likely to be most highly charged with clay or other matter in suspension, the object being that the material to be washed may meet with cleaner water or other liquid as it advances, and that the matter in suspension in the water may be carried away as quickly as possible.

The washed material may, if desired, be

passed through the process so far described a second time, or as many times as may be considered desirable, and then passed to a machine provided with a jigging trough G into which it is introduced. This trough G which is immersed in water, is preferably hung or pivoted at the end H (by a sliding adjustable bearing), at which the material is introduced, and is inclined downward toward the other end. It is provided with a bottom of screening material of any description, the openings being the size which may be determined on as representing worthless gems or minerals, and at which the sand, small gems, or other material may go to waste, so far as the present process is concerned, though of course such material may, if desired, be passed through a subsequent screening or separating process. The trough G already mentioned is made wide by preference at the upper end and narrower at the lower end, and it is jigged by any suitable means, viz: by an eccentric J' Fig. 4, and rocking lever J, so that the small materials which can pass through the openings in the bottom are screened out of it, and the material retained in it is crowded into a deeper bed as it gradually descends the incline of the trough; and at the same time the particles on it become by the jigging and pulsating action so arranged, that the denser ones take their place at the bottom of the advancing bed and the lighter ones toward the top. At a certain point in the trough a horizontal division of the nature of a knife K, is introduced, which may be adjustable or not as desired and which is intended to be set at such a level that all or the majority of the heavier particles may pass under it, and are thus separated from the lighter materials which pass over it. The shape of the trough is graduated in width so that the bed of material may be rendered deeper or less deep as may be desired, and the speed of the jigging or pulsating motion may be adjusted as desired. This motion may according to convenience be imparted to the trough or to the water or other liquid in which it is immersed.

The sand and other material which pass through the trough is extracted from the tank or box in which the trough is immersed by means of an elevator or other suitable means, but preferably by means of one or more siphon pipes L Fig. 4 so arranged as to carry off the dirty water and sand or other material. The light material, which has passed over the dividing knife K described, may be extracted by an elevator or other similar means or by a siphon pipe or by a gravity discharge through chute L' and carried on or not as may be expedient to a final sifting process. The heavier portion of the material presumably containing the gems or other particles of high density is passed on under the knife K by the chute M to any suitable sizing apparatus (but preferably to the following) to be divided for size into any predeter-

mined number of grades, say for example, ten grades or sizes of particles, irrespective of their density.

A suitable sizing machine has a screen *k* 5 either cylindrical or polygonal perforated with holes of various sizes in the various sections which are divided from one another by diaphragms *l* in an outer case *m*. These diaphragms are pierced with a central hole to 10 admit the screen and are sufficiently large to admit a reciprocating movement of the screen. Flanges are provided on the said screen *k* embracing the said diaphragms and covering the space between the cylinder and the 15 fixed diaphragms. Within the said screen is a helix *p*, so that the material to be screened shall be fed by the said helix from end to end so as to pass over the entire periphery of the screen as it revolves below the material. The 20 said screen is immersed in water and mounted on an axis *q* which is supported by connecting rods *r* from one end of rocking levers *s* pivoted on bearings on fixed standards or frames *t* the other end of the said rocking levers being connected to eccentrics *u* on a prime rotating shaft *v*. The rotation of the said screen is effected by rope, chains or bands from a pulley *w* on the said driving shaft *v*, the gut or band passing over fixed pulleys *x*, and 30 thence to a pulley *y* on the shaft supported by the rocking ends of the levers *s'*, and thence by pulleys *z* from the said shaft to the screen *k*. This sizing or sorting machine is the subject matter of a separate patent application under Serial No. 460,587, filed February 1, 1893. In this and the preceding machine the water or other supply of liquid is so arranged as to meet the outcoming material and pass out mainly with the outgoing or rejected material. From the sizing process the particles pass to an hydraulic separator either by the flow of water or by collection by an elevator from receptacles into the hopper of an hydraulic separator, where the denser particles are separated from the lighter ones as 45 may be desired. I may employ a stream of liquid supplied at a suitable head from any convenient source into the tank *M*, and the downward flowing stream carrying the said 50 mixed minerals or other materials is introduced by pipes *a* into a series of vertical or approximately vertical columns or stand pipes *b* of any suitable section, so that the suspended material in its various assorted sizes, 55 is subjected to the upward flow of the ascending current, from the pipes *a* and up the pipes *b*; the liquid with the lighter mineral substances passing over the summit *c* of the said vertically flowing stream or stand pipe, and 60 the heavier minerals, such as metals or precious stones, failing to travel the full height of the said vertical stream, fall down into a suitable locked receptacle or receptacles *d* for their collection. The ascending column or stand pipe may be conveniently made of 65 glass, or other material so arranged with sight holes or windows, for observation of the be-

havior of the materials within it. The velocity of the upward current may be simply regulated by turning over a stand pipe *b* as a 70 siphon, and adjusting the end *e* of the said outer siphon pipe at any height. The collecting receptacle or pockets are arranged so that by means of a suitable valve or cock *f* above the receptacle, and a valve or controllable orifice or door *g*, the collected minerals may be 75 withdrawn from time to time without interfering with the continuous action of the apparatus. This hydraulic separator is the subject of a separate patent applied for by me under 80 Serial No. 429,642 and dated April 18, 1892, which has been issued under No. 489,538 and dated 10th day of January, 1893; or the sizing process may be introduced after instead of before the passage through the separator 85 or separators. From the separation process, in whatever order it is carried out, the waste material passes on to a final sifting process, carried out by one or more jigs *N* into which the material is introduced. 90

The jigs may, for the purposes of description, take the form of a cylinder or box *N* with an internal cylinder *N'* having a perforated bottom *Q* (Fig. 5) through which 95 water or other liquid, in which it is immersed may find its way; and the jigging or pulsating action may be either imparted to the cylinder *N'* by suitable pivoted levers, or to the water or other liquid. The action of the jig is that the particles of great density such 100 as gems, or more valuable minerals, find their way to the bottom of the cylinder or box *N'*, while the lighter particles such as quartz and the like fall over the upper edge and pass away by means of siphons, elevators, or by gravity, through the discharge 105 hopper *Q'*, to trucks *P* or chutes as may be arranged. In this way the bulk of the lighter particles passes away while the heavy ones are retained to be picked over or be passed through 110 the process again, or on to a subsequent process.

Having now described my invention, what I claim, and desire to secure by Letters Patent, is— 115

A process for the washing and separating of gems from the clay and other materials containing them, consisting of a continuous automatic treatment, without handling, or pulverization comprising the following steps: 120 first, the washing and attrition of the clay and earthy matters, and a delivery by gravity to jigging boxes; second, the jigging of the washed gems and other minerals together, to further remove clay and earth, and a delivery 125 of sieved minerals by elevator to jigging and concentrating trough; third, the jigging of sieved gems, minerals, and sand, to remove sand and smallest particles therefrom; fourth, a concentrating process by knife separating 130 the bulk of lighter materials from those of greater density, and a delivery by gravity of selected denser materials to sizing screen; fifth, a sizing treatment in revolving and

reciprocating screen, to obtain division into particles of fairly uniform size, and a delivery of classified particles by water to a hydraulic separator; sixth, a hydraulic upward water current separation of particles (classified as to uniformity of size) according to their specific density, and delivery of gems to a locked receptacle; seventh, a final accumulative jiggling of lighter waste particles, from upward current separator for automatically settling and accumulating the denser particles; eighth, the removal of waste

materials from their settling tanks in the course of above steps of process by siphonage with a suitable supply of liquid, substantially as herein described. 15

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM STRONACH LOCKHART.

Witnesses:

RICHARD A. HOFFMANN,
CHARLES H. CARTER.