(No Model.)

4 Sheets—Sheet 1.

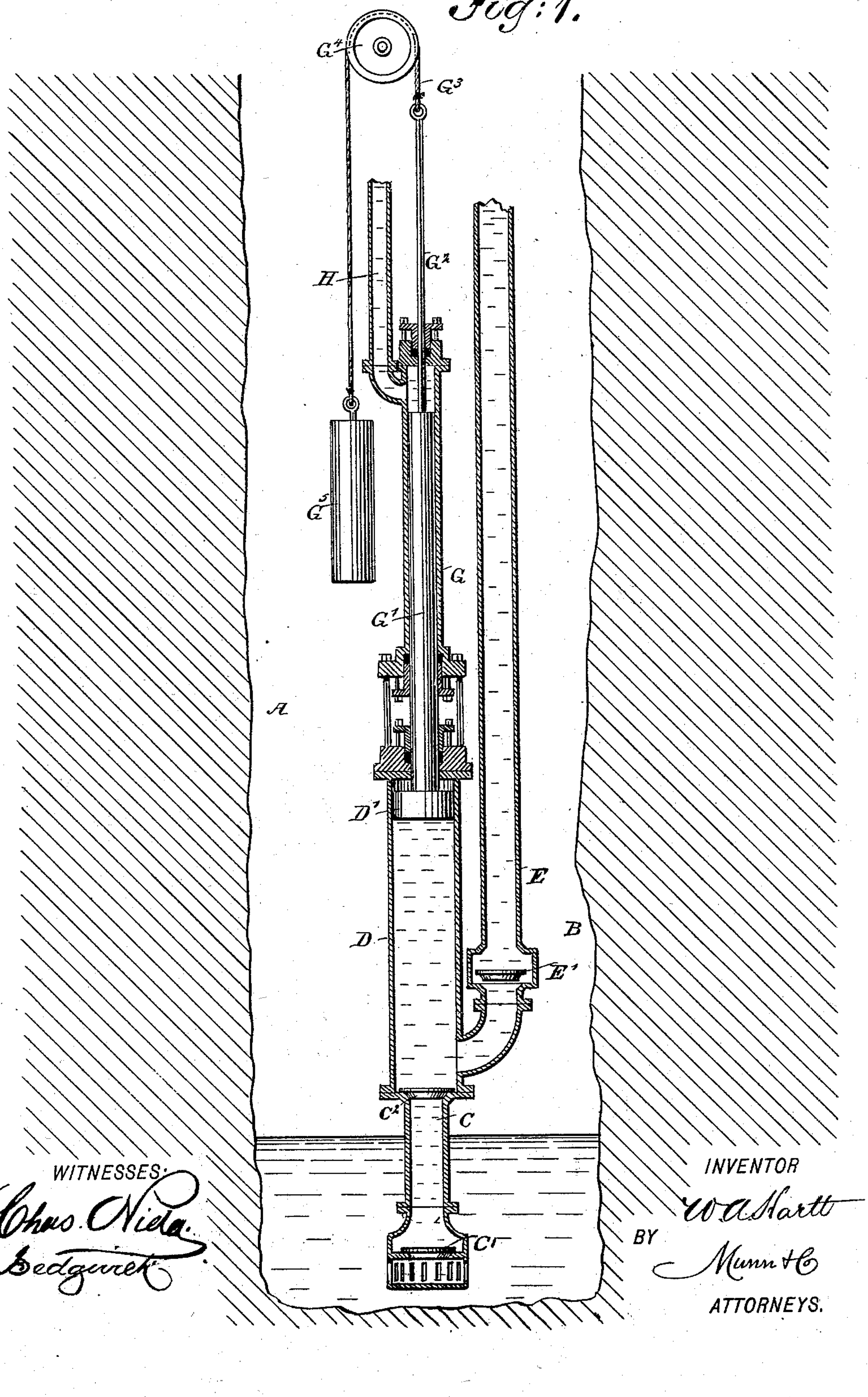
W. A. HARTT.

GRAVITY PUMP.

No. 504,922.

Patented Sept. 12, 1893.

Fig: 1.



WITNESSES:

Chas. Nida.

C. Sedgwick

INVENTOR

W. A. Hartt

BY Munn & Co

ATTORNEYS.

(No Model.) 4 Sheets—Sheet 2.

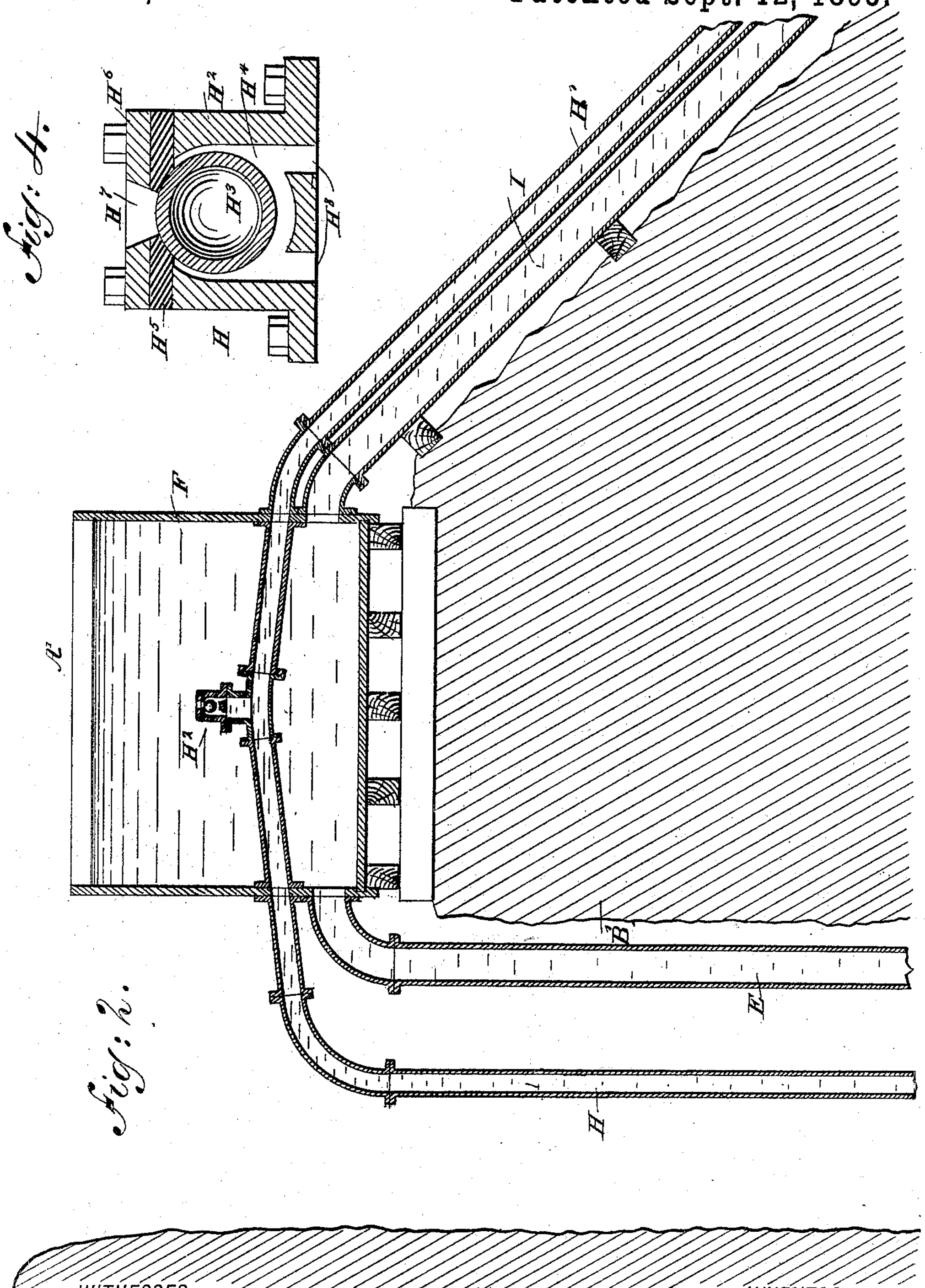
W. A. HARTT.

GRAVITY PUMP.

No. 504,922. Patented Sept. 12, 1893.

Fig: 4.

Fig: 2.



WITNESSES:

Chas. Nida

C. Sedgwick

INVENTOR

W. A. Hartt

BY Munn & Co

ATTORNEYS.

(No Model.)

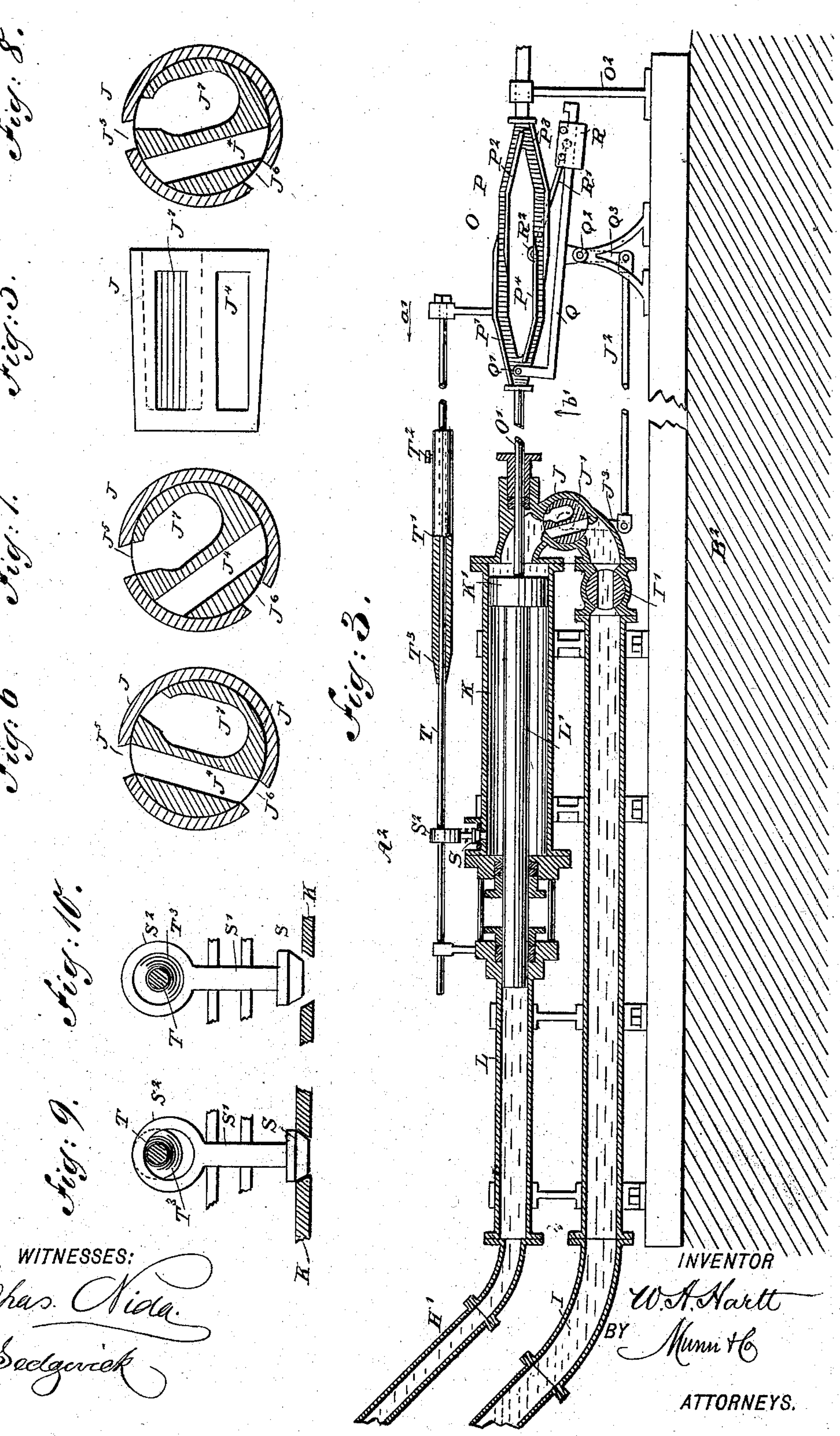
4 Sheets—Sheet 3.

W. A. HARTT.

GRAVITY PUMP.

No. 504,922.

Patented Sept. 12, 1893.



WITNESSES:

Chas. Nida.

C. Sedgwick

INVENTOR

W. A. Hartt

BY Munn & Co

ATTORNEYS.

(No Model.)

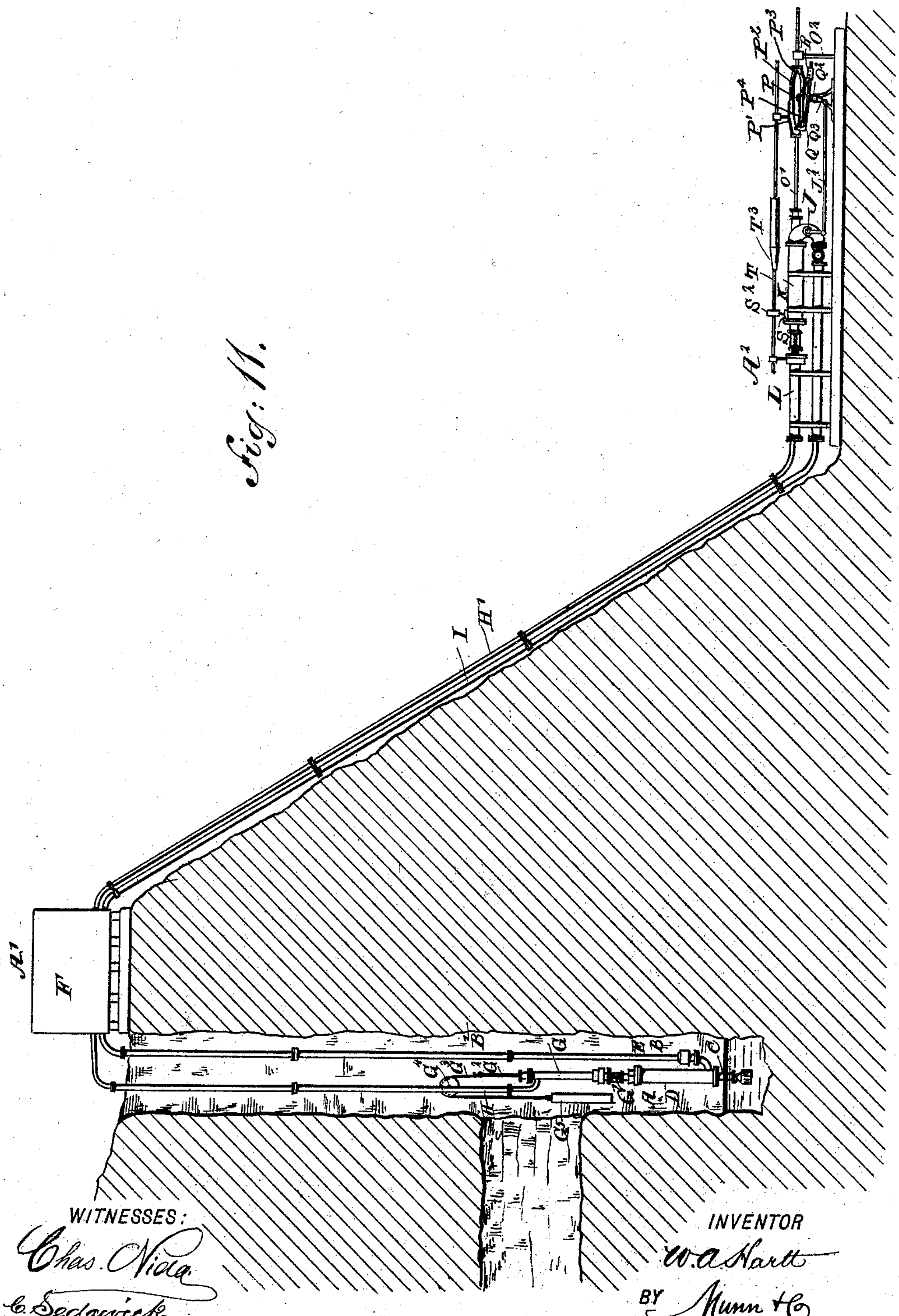
4 Sheets—Sheet 4

W. A. HARTT.

GRAVITY PUMP.

No. 504,922.

Patented Sept. 12, 1893.



WITNESSES:

Chas. Nida

C. Sedgwick

INVENTOR

W. A. Hartt

BY Munn & Co

ATTORNEYS.

UNITED STATES PATENT OFFICE.

WILLIAM ALLEN HARTT, OF TUCSON, ARIZONA TERRITORY.

GRAVITY-PUMP.

SPECIFICATION forming part of Letters Patent No. 504,922, dated September 12, 1893.

Application filed February 15, 1893. Serial No. 462,510. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM ALLEN HARTT, of Tucson, in the county of Pima and Territory of Arizona, have invented a new and Improved Gravity-Pump, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved gravity pump which operates automatically and is more especially designed for raising water or other liquids out of mines, reservoirs, lakes, rivers, &c., and depositing the discharge at a point lower than the level from which the liquid is raised.

The invention consists of two sets of cylinders, each set containing two cylinders of different diameters, one set being located beyond the other, connected pistons of different diameters traveling in each set of cylinders, and pipes of varying diameters and length connecting said two sets of cylinders with each other.

The invention also consists of certain parts and details, and combinations of the same, as will be hereinafter described and then pointed out in the claims.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a sectional side elevation of the inner or supply end of the improvement. Fig. 2 is a like view of the upper part of the improvement. Fig. 3 is a like view of the outer end of the improvement. Fig. 4 is an enlarged sectional side elevation of the air valve for the upper part of the improvement. Fig. 5 is an enlarged side elevation of the valve plug for establishing communication between the larger cylinder of the outer set of cylinders, and the main or discharge pipe. Figs. 6, 7 and 8 are cross sections of the same in different positions; and Figs. 9 and 10 are enlarged transverse sections of an air valve for one of the outer cylinders. Fig. 11 is an elevation, partly in section, showing the arrangement and connections of the several parts of my improved gravity pump.

The improved machine is operated by two columns of liquid of different weights, and is capable of being operated at a greater depth than a siphon or other contrivance, depending on atmospheric pressure.

The pump, as shown in Figs. 1, 2 and 3, is applied to a mine and consists principally of the three parts A, A′, and A^2, of which the part A is located in the bottom of the mine shaft B, as illustrated in Fig. 1, the top part A′ is located at the upper end B′ of the mine shaft, as illustrated in Fig. 2, and the part A^2 is located on the outside of the mine at the point B^2, which is below the bottom of the mine shaft B. The part A (see Fig. 1) is provided with a suction pipe C, extending into the liquid accumulating in the bottom of the mine shaft B, and in this suction pipe C are arranged two suction valves C′ and C^2, of which the latter opens into the lower end of a vertically-disposed cylinder D connected near its lower end with an upwardly-extending pipe E passing through the mine shaft B and opening at its upper end into a tank F located on the upper end B′ of the mine shaft as shown in Fig. 2.

In the lower end of the pipe E is a check valve E′ for disconnecting the pipe E and the cylinder D. In the latter is mounted to travel a piston D′ provided with a piston rod forming the piston G′ for a cylinder G, arranged above the cylinder D, but in alignment with the same, as plainly illustrated in Fig. 1. The piston G′ passes through suitable stuffing boxes in the adjacent ends of the cylinders D and G so as to prevent leakage. From the upper end of the piston G′ extends a small rod G^2 passing through a suitable stuffing box in the upper end of the cylinder G, the outer end of this rod being connected with one end of a rope G^3 passing over a pulley G^4 and supporting at its other end a weight G^5.

From the upper end of the cylinder G leads a small pipe H which extends upward through the mine shaft B and passes into and through the tank F to then extend downward, as at H′, on the outside of the mine to the point B^2 located below the lower point of the mine shaft B, as previously mentioned.

From the bottom of the tank F leads a pipe I which extends alongside the pipe H′ on the outside of the mine to the point B^2, as will be readily understood by reference to Figs. 2 and 3. In the lower end of this pipe I which is about of the same size as the pipe E and consequently larger than the pipes H, H′, is arranged a regulating valve I′ for controlling the outflow of the liquid from the lower end of the said pipe I. The valve I′ discharges into an elbow J containing a valve J′ and connecting with a cylinder K disposed horizontally and provided with a piston K′ having a piston rod which forms the piston L′ for a cylinder L arranged in line with the cylinder K, but considerably smaller in diameter than the latter, as will be readily understood by reference to Fig. 3. The outer end of this cylinder L is connected with the lower end of the pipe H′.

In order to control automatically, the movement of the valve J′ arranged in the elbow J, and shown in detail in Figs. 5, 6, 7 and 8, I provide a shifting mechanism O presently to be described and actuated from the piston K′. For this purpose, the piston K′ is provided with a rod O′ extending through suitable stuffing boxes in the end of the cylinder K and having its bearing near its outer end in a suitable bracket O^2.

On the rod O′ is secured a cam P formed with four steps P′, P^2, P^3 and P^4 adapted to be engaged by a friction roller Q′ held on a lever Q pivoted at Q^2 on a suitable bracket, the said lever being formed with a downwardly-extending arm Q^3 pivotally-connected by a link J^2 with an arm J^3 secured to the stem of the valve J′, as plainly illustrated in Fig. 3.

On the lever Q is mounted to slide a weight R pivotally connected by an arm R′ with the cam P at R^2 so that when the cam is moved forward or backward, the weight R is shifted on the lever Q for the purpose hereinafter fully described. The valve J′ is formed with a port J^4 adapted to connect with the ports J^5 and J^6 to establish communication between the pipe I and the cylinder K. In the valve J′ is also arranged an outlet port J^7 leading to the outside of the valve, as indicated in dotted lines in Fig. 5, the said port being adapted to register with the port J^5, so that the water in the cylinder K can be discharged through the valve J at the time the latter is in the position shown in Fig. 7. Now, when the cam P is carried to the left in the direction of the arrow a' by the piston K′ moving in the same direction, then the friction roller Q′ follows the raised part P′ as the said roller is held against the latter by the weight R pressing on the outer end of the lever Q. As the cam P travels in this direction, the forward end of the lever Q swings upward in the direction of the arrow b', so that the arm Q^3 pushes the link J^2 to the left whereby the valve J′ is turned to move its port J^4 in register with the ports J^5 and J^6 in the elbow J. Thus communication is established between the pipe I and the cylinder K, so that the piston K′ therein is forced forward in the direction of the arrow a' slowly at first, then gradually increasing in speed until the roller Q′ has reached a point near the center of the cam P. At this point the valve J is opened to its fullest extent, as indicated in Fig. 6. When the roller Q′ has reached the center of the cam P the weight R has also reached the center or fulcrum point of the lever Q and when the weight has passed this point then the roller Q′ is caused to bear down onto the cam part P^2 as the weight R is then on that side of the lever Q between its fulcrum and the roller Q′. The friction roller Q′ traveling on the cam part P^2 causes a swinging of the lever Q in the inverse direction of the arrow b', so that the valve J′ is gradually rotated back as the friction roller Q′ nears the right hand end of the cam part P^2. Now, when the friction roller has reached this point the valve J′ is back to its original position, as illustrated in Fig. 3, and is admitting only a small stream of water from the pipe I to the cylinder K. The piston K′ is then moving very slowly near the inner end of its stroke. The weight R has now about reached the forward end of the lever Q near the friction roller Q′ so that the latter suddenly drops off the right hand end of the cam part P^2, whereby the valve J is suddenly thrown over from the position shown in Fig. 3 to that shown in Fig. 8, whereby the port J^4 is entirely disconnected from the ports J^5 and J^6 and the outlet port opens a very small discharge by registering slightly with the port J^5. As soon as the water begins to discharge from the cylinder K through this outlet port J^7 the piston K′ returns on its back stroke by virtue of the weight of the water in pipe H′. The friction roller Q′ now follows the cam parts P^3 and P^4 until the valve again assumes the position shown in Fig. 8, it being understood that the valve opens fully to the exhaust as shown in Fig. 7, while the friction roller Q′ travels along the cam part P^3 and again commences to close during the time the friction roller Q′ travels along the cam part P^4. When the friction roller finally slips off the left hand end of the cam part P^4, then it moves in contact with the under side of the cam part P′, whereby the valve J′ is moved back to its original position shown in Fig. 3, thus establishing a very slight communication between the pipe I and the cylinder K, to start the piston K′ therein on its return stroke. This contrivance does away with the shock caused by reversing the heavy column of water too suddenly and at the same time leaves no dead center to be overcome by balance wheels or other means.

The speed of the gravity pump depends on the discharge of the water. Consequently the valve I′ can be set to admit more or less water to the valve J′, thereby increasing or diminishing the speed of the pump.

On the forward end of the cylinder K is arranged a small air valve S which serves to prevent a vacuum in the cylinder K and also permits the escape of any water that may leak past the piston K′. It will be seen that when the piston K′ moves in the inverse direction of the arrow a', a vacuum will be formed behind it and the resistance of this vacuum per square inch will depend on the point of the stroke at which the valve S closes, and the total resistance will be the difference in the area of the pistons K′ and L′ multiplied by the resistance per square inch. Now, in order to prevent this vacuum, I automatically open the valve S at the proper time, and for this purpose I form the stem S′ of the valve with a ring S^2 (see Figs. 9 and 10), through which passes a rod T mounted to slide longitudinally and attached at its outer end to a bracket projecting from the cam P. On this rod T is fitted a sleeve T′ adapted to be secured in place on the rod by a set screw T^2 or other means. The forward end T^3 of the sleeve T′ is cone-shaped so as to enter the ring S^2 and thereby raise the latter, the stem S′ and the valve S, at the time the piston K′ moves forward in the direction of the arrow a' and nears the end of its forward stroke. It will be seen that when the sleeve T′ enters the ring S^2, the valve S is raised and held off its seat until the sleeve is withdrawn at the time the piston K′ is on its return stroke. It will further be seen that the valve S can be lifted at any time in case water accumulates in front of the piston K′, so that this water is forced out through the open valve.

On the pipe H in the tank F is arranged a filling valve H^2 for admitting water lost by leakage, into the pipes H and H′. This valve H^2 is shown in detail in Fig. 4 and is provided with a hollow metallic ball H^3 preferably made of aluminum so as to be sufficiently light to float on the water. This ball H^3 is confined within a metallic casing H^4 provided on its top with an elastic valve seat H^5 held in place by the apertured cap H^6 of the casing H^2. The inlet opening H^7 in the cap H^6 and seat H^5 is preferably cone-shaped with the apex end inward, the inward end being adapted to be closed by the ball H^3. In the bottom of the casing H^2 are outlet openings H^8 which discharge into the pipes H, H′. The space around the upper part of the ball H^3 is made very narrow, the object being to float the ball, or seat the same with as little water as possible. Now, it will be seen that if a very small quantity of water should escape from the pipes H and H′, the ball H^3 will fall as soon as the pressure is removed which occurs at the end of every discharge or right hand stroke if any water be lacking in H and H′, so as to allow a sufficient quantity of water to enter the pipes H, H′, to refill the same, whereby the ball H^3 will again rise upward and close the opening H^7.

The operation is as follows: When the several parts of the machine are in the position shown in the drawings and the pipes and cylinders are filled with water, as shown, then the valve J′ is just opening to permit water to flow from the lower end of the pipe I to the cylinder K, the piston K′ of which is then at the outer end of the cylinder. Now, suppose for illustration, that the mine shaft B has a depth of two hundred feet from which it is desired to raise the water and deposit it at the point B^2 located three hundred feet down the hill from the top B′. The figures given are supposed to represent the perpendicular depth below the tank F to the water level in the shaft B on the one hand, and from the tank F to the discharge port J^7 in the valve J′ on the other. Now, we will further suppose that the approximate available area of each of the pistons L′ and G′, is fifty inches or eight inches in diameter. The area of the piston K′ is three hundred and fourteen inches or about twenty inches in diameter, and that of the piston D′ is, say three hundred and thirty inches, or twenty and one-half inches in diameter. The object of the difference between the pistons D′ and K′ is to give a surplus of water in the tank F for a purpose hereinafter stated. The dead weight G^5, shown in Fig. 1 and previously described, is supposed to weigh slightly more than the combined weight of the pistons D′ and G′, and the weight exerted by the water in the suction pipe and also the weight exerted by the water in the pipe H from the tank F to the piston G′. The object of the dead weight G^5 is to raise the pistons D′ and G′ with their load whenever the pressure is released from the pipe H′, and to displace the water in the cylinder G through the pipe H when the vacuum caused in the cylinder D below the piston D′ will cause the water to enter the suction pipe C at the lower end or foot valve C′, and thence into the cylinder D, where it is retained by the valve C^2.

It will be obvious that the motive power and resistances are as follows: The motive power is composed first of the pressure exerted on the piston K′ by the water in pipe I and secondly of the pressure exerted on the piston G′ by the water in pipe H. The components of the resistance acting against the said motive power are, first, the pressure exerted on the piston D′ by the water in pipe E, secondly the weight G^5, and thirdly, the pressure exerted on the piston L′ by the water in pipe H′. I will now proceed to ascertain the numerical values of these components. There is in the pipe I, a column of water three hundred feet high, which when the valve J′ is open, exerts a pressure on the piston K′, as follows: three hundred and fourteen square inches multiplied by .434 (which is the weight of one square inch of water one foot high) equals one hundred and thirty-six pounds multiplied by three hundred feet equals forty thousand eight hundred pounds, total pressure on the piston K′. This pressure is transferred to the piston L′ as the latter is rigidly connected with the piston K′. The length of the pipe H being say one hundred and seventy feet, the pressure on the piston G′ exerted by the water in the said pipe will amount to one hundred and seventy feet multiplied by .434 equals 73.78 pounds per square inch multiplied by fifty square inches equals three thousand six hundred and eighty-nine pounds. The total motive power therefore amounts to forty thousand eight hundred plus three thousand six hundred and eighty-nine equals forty-four thousand four hundred and eighty-nine pounds.

The components of the resistance are as follows: In the pipe E we have a column of water two hundred feet high, less the length of the suction pipe C, say fifteen feet equals one hundred and eighty-five feet. This forms a resistance against the piston D', as follows: Three hundred and thirty square inches multiplied by .434 equals one hundred and forty-three pounds multiplied by one hundred and eighty-five feet equals twenty-six thousand four hundred and fifty-five pounds equals the weight to be lifted in the pipe E. In addition to this there is to be raised the dead weight G^5 which weighs as much as the pistons G' and D' plus the weight of the water in the suction pipe, and the column of water in the pipe H plus a certain amount to aid in overcoming friction. The weight of the suction column exerted on the piston D' is three hundred and thirty multiplied by .434 equals one hundred and forty-three multiplied by fifteen feet equals two thousand one hundred and forty-five pounds plus the weight of the water in H which is three thousand six hundred and eighty-nine pounds, plus say one thousand four hundred pounds, as weight of pistons and surplus to move the pistons equals to seven thousand two hundred and thirty-four pounds, which is the amount of the dead weight G^5 and added to the previous twenty-six thousand four hundred and fifty-five pounds, makes thirty-three thousand six hundred and eighty-nine pounds. In addition there is the pressure of the column of water in the pipe H' exerted against the piston L', and amounts to fifty multiplied by .434 equals 21.7 multiplied by three hundred equals six thousand five hundred and ten pounds, which added to the thirty-three thousand six hundred and eighty-nine pounds equals forty thousand one hundred and ninety-nine pounds. This is the total resistance against the forces tending to move the pistons K' and G'. Now, when the valve I' is opened as illustrated in Fig. 3 and water is admitted to the cylinder K, as previously described there is an aggregate motive power acting on the pistons K' and G' of forty-four thousand four hundred and eighty-nine pounds. There is also an effective aggregate resistance against the pistons L' and D' of forty thousand one hundred and ninety-nine pounds, thus leaving a surplus of four thousand two hundred and ninety pounds. This surplus overcomes all friction and forces the pistons K' and L' ahead, which in turn force the pistons G' and D' downward, the same distance, so as to cause a displacement of the water in the cylinder D through the check valve E' in the lower end of the pipe E.

When the water is cut off by the valve J' as previously explained and a discharge commences through the port J^7, then the pistons L' and K' move on the return stroke in the inverse direction of the arrow a' by the surplus weight of the column of water in the pipe H'. This amount is as follows: Allowing that the valve S is set so as to form a vacuum at the end of the stroke of the piston K' of twelve pounds per square inch, the weight of the column of water in the pipe H' is calculated to be six thousand five hundred and ten pounds exerted on the piston L' and the vacuum holding back the piston K' will amount to three hundred and fourteen square inches less fifty square inches equal to the two hundred and sixty-four square inches multiplied by twelve pounds equals three thousand one hundred and sixty-eight pounds. This amount will leave a surplus of six thousand five hundred and ten minus three thousand one hundred and sixty-eight equals three thousand three hundred and forty-two pounds to cause a discharge through the port J^7 and at the same time this vacuum also gives three thousand one hundred and sixty-eight pounds toward starting the column of water on the return stroke over and above the figures previously stated. But this force is not continuous and falls off to nothing as soon as the column acquires momentum. The dead weight G^5 draws the pistons G' and D' upward at the time the pressure is relieved from the pipe H, thereby raising the water in the pipe the distance equal to the contents of the cylinder G and also drawing another cylinder full of water through the suction pipe C into the lower end of the cylinder D. The operation is then repeated as before described. If, through any cause, a small quantity of water should escape from the pipes H and H' by leakage through the pistons, then inasmuch as the pistons K' and L' must make a full stroke of a given length and the up piston stroke of the pistons D' and G' always terminate at the same point, this would cause a vacuum at the valve H^2 in the tank F. As soon as this takes place the ball H^3 falls and the water rushes from the tank F in and through the casing H^2 and ports H^8 into the pipes H and H' to refill the same at each discharge stroke. From this it will be understood why the cylinder D is made of sixteen square inches greater capacity than the cylinder K. On a ten foot stroke it will pump nineteen hundred and twenty cubic inches or about eight and one-half gallons more than cylinder K would use at every stroke and still leave the surplus working power above mentioned. In cases where long lengths of pipes are used more surplus weight can be given to the dead weight G^5 by deducting it from the surplus of four thousand two hundred and ninety pounds on the other stroke and which amount is far in excess of what is needed, or greater proportionate fall can be given on the outside.

Having thus fully described my invention, I claim as new and desire to secure by Letters Patent—

1. A gravity pump comprising two sets of cylinders, each set containing two cylinders of different diameters and one set being located below the other, connected pistons of different diameters traveling in each set of cylinders, pipes of varying diameters and length connecting the said two sets of cylinders with each other and a valve automatically controlling the inlet to and outlet from the largest lowermost cylinder from the lower end of the largest outermost pipe, substantially as shown and described.

2. A gravity pump comprising two sets of cylinders, one located below the other and each set containing two cylinders of different diameters, connected pistons of different diameters traveling in each set of cylinders, pipes of varying diameters and length connecting said two sets of cylinders with each other a valve automatically controlling the inlet to and outlet from the largest lowermost cylinder from the lower end of the largest outermost pipe, and a tank located above the said sets of cylinders, and connected with the said sets of pipes, substantially as shown and described.

3. A gravity pump comprising two sets of cylinders located one below the other and each set containing two cylinders of different diameters, connected pistons of different diameter traveling in each set of cylinders, pipes of varying diameter and length connecting the said two sets of cylinders with each other a valve automatically controlling the inlet to and outlet from the largest lowermost cylinder from the lower end of the largest outermost pipe, a tank located above the said sets of cylinders, and connected with the two larger pipes, and an inlet valve arranged in the said tank at the junction of the two smaller pipes, substantially as shown and described.

4. A gravity pump comprising two sets of cylinders, one located below the other and each set containing two cylinders of different diameter, connected pistons of different diameter traveling in each set of cylinders, pipes of varying diameter and length connecting said two sets of cylinders with each other a valve automatically controlling the inlet to and outlet from the largest lowermost cylinder from the lower end of the largest outermost pipe, a tank located above the said sets of cylinders and connected with the said sets of pipes, and a suction pipe connected with the largest cylinders of the uppermost set of cylinders, substantially as shown and described.

5. A gravity pump comprising two sets of cylinders, each set containing two cylinders of different diameter and one set being located below the other, connected pistons of different diameter traveling in each set of cylinders, pipes of varying diameter and length connecting the said two sets of cylinders with each other, and an outlet valve operated automatically and located between one of the cylinders of the lowermost set of cylinders and the lowermost end of the largest pipe, substantially as shown and described.

6. A gravity pump comprising two sets of cylinders, one located below the other and each set containing two cylinders of different diameter, connected pistons of different diameter traveling in each set of cylinders, pipes of varying diameter and length connecting said two sets of cylinders with each other, a tank located above the said sets of cylinders and connected with the said sets of pipes, a suction pipe connected with the largest of the cylinders of the uppermost set of cylinders, and a check valve arranged in the lower end of the said suction pipe, substantially as shown and described.

7. A gravity pump comprising two sets of cylinders, one located below the other and each set containing two cylinders of different diameter, connected pistons of different diameter traveling in each set of cylinders, pipes of varying diameter and length connecting said two sets of cylinders with each other, a tank located above the said sets of cylinders and connected with the said sets of pipes, and a valve automatically controlling the inlet to and outlet from the largest lowermost cylinder from the lower end of the largest outermost pipe, substantially as shown and described.

8. A gravity pump comprising two sets of cylinders, one located below the other and each set containing two cylinders of different diameter, connected pistons of different diameter traveling in each set of cylinders, pipes of varying diameter and length connecting said two sets of cylinders with each other, a tank located above the said sets of cylinders and connected with the said sets of pipes, a valve automatically controlling the inlet to and outlet from the largest lowermost cylinder from the lower end of the largest outermost pipe, and an automatic device controlled from the piston in the largest outermost cylinder and adapted to actuate the said valve, substantially as shown and described.

9. A gravity pump comprising two sets of cylinders, one located below the other and each set containing two cylinders of different diameter, connected pistons of different diameter traveling in each set of cylinders, pipes of varying diameter and length connecting said two sets of cylinders with each other, a tank located above the said sets of cylinders and connected with the said sets of pipes, a valve automatically controlling the inlet to and outlet from the largest lowermost cylinder from the lower end of the largest outermost pipe, and an air valve arranged in the largest outermost cylinder and adapted to be actuated from the piston therein, substantially as shown and described.

10. A gravity pump comprising two sets of cylinders, one located below the other and each set containing two cylinders of differ-

ent diameter, connected pistons of different diameter traveling in each set of cylinders, pipes of varying diameter and length connecting said two sets of cylinders with each other, a tank located above the said sets of cylinders and connected with the said sets of pipes, a valve automatically controlling the inlet to and outlet from the largest lowermost cylinder from the lower end of the largest outermost pipe, an air valve arranged in the largest outermost cylinder and adapted to be actuated from the piston therein, and means, substantially as described, for actuating the said valve from the piston of the said largest outermost cylinder, substantially as shown and described.

11. A gravity pump comprising two sets of cylinders, each set containing two cylinders of different diameter and one set being located below the other, connected pistons of different diameter traveling in each set of cylinders, pipes of varying diameter and length connecting the said two sets of cylinders with each other, an outlet valve operated automatically and located between one of the cylinders of the lowermost set of cylinders and the lowermost end of the largest pipe, and a dead weight connected with the pistons of the innermost set of cylinders, substantially as shown and described.

WILLIAM ALLEN HARTT.

Witnesses:

W. M. DAVIS,

S. E. BROWN.