(No Model.) 2 Sheets—Sheet 1.

N. B. ELDRED.

HYDRAULIC METHOD AND MACHINERY.

No. 354,112. Patented Dec. 14, 1886.

Fig. 1.

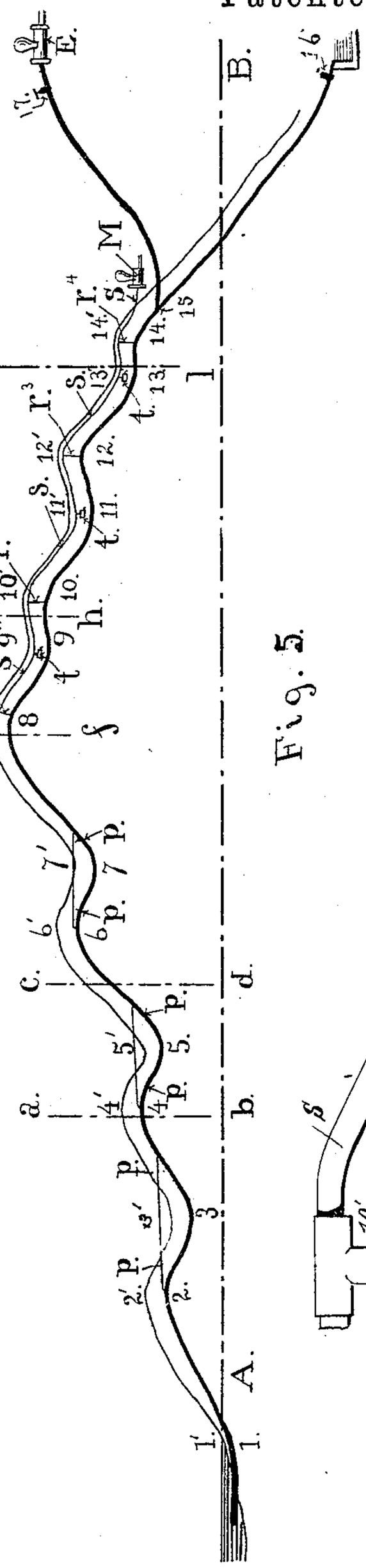
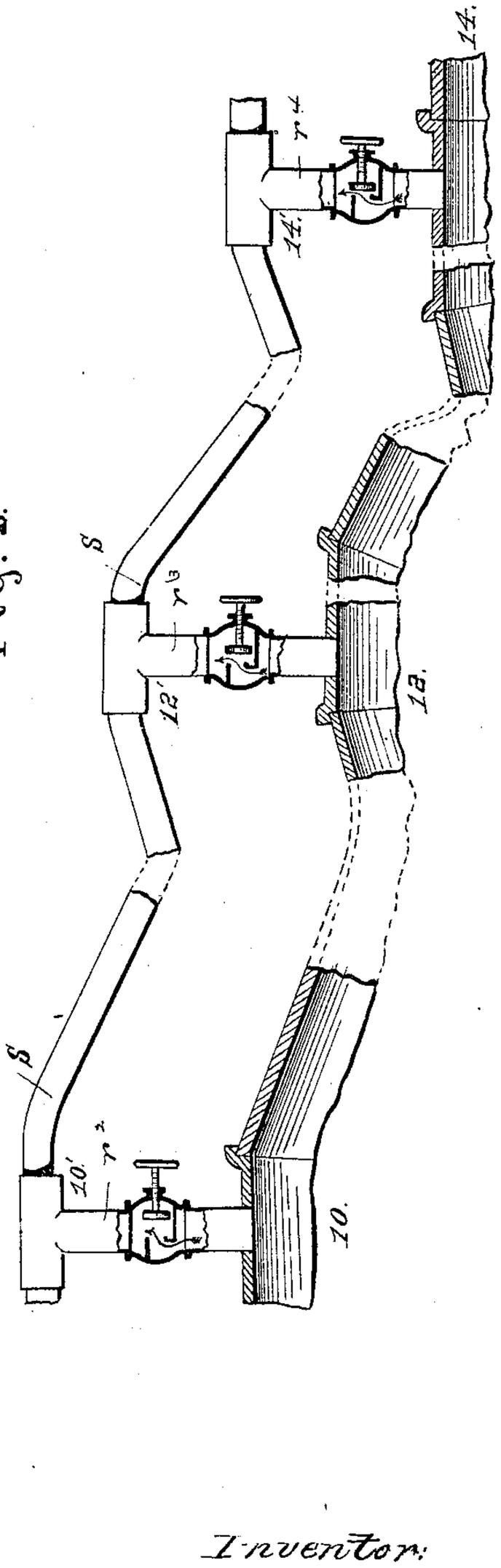


Fig. 5.



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(No Model.) 2 Sheets—Sheet 2.

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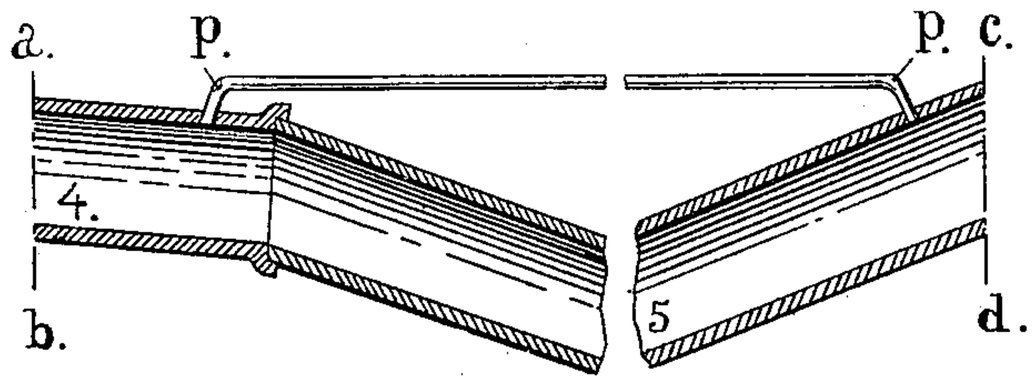

Fig. 2.

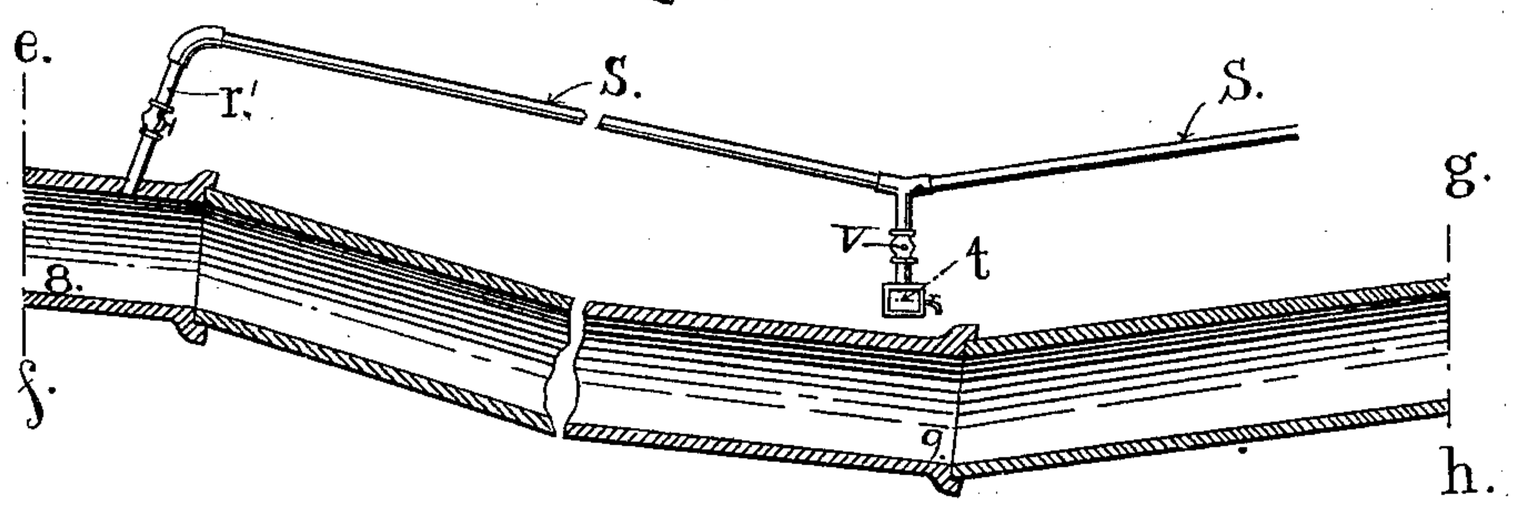

Fig. 3.

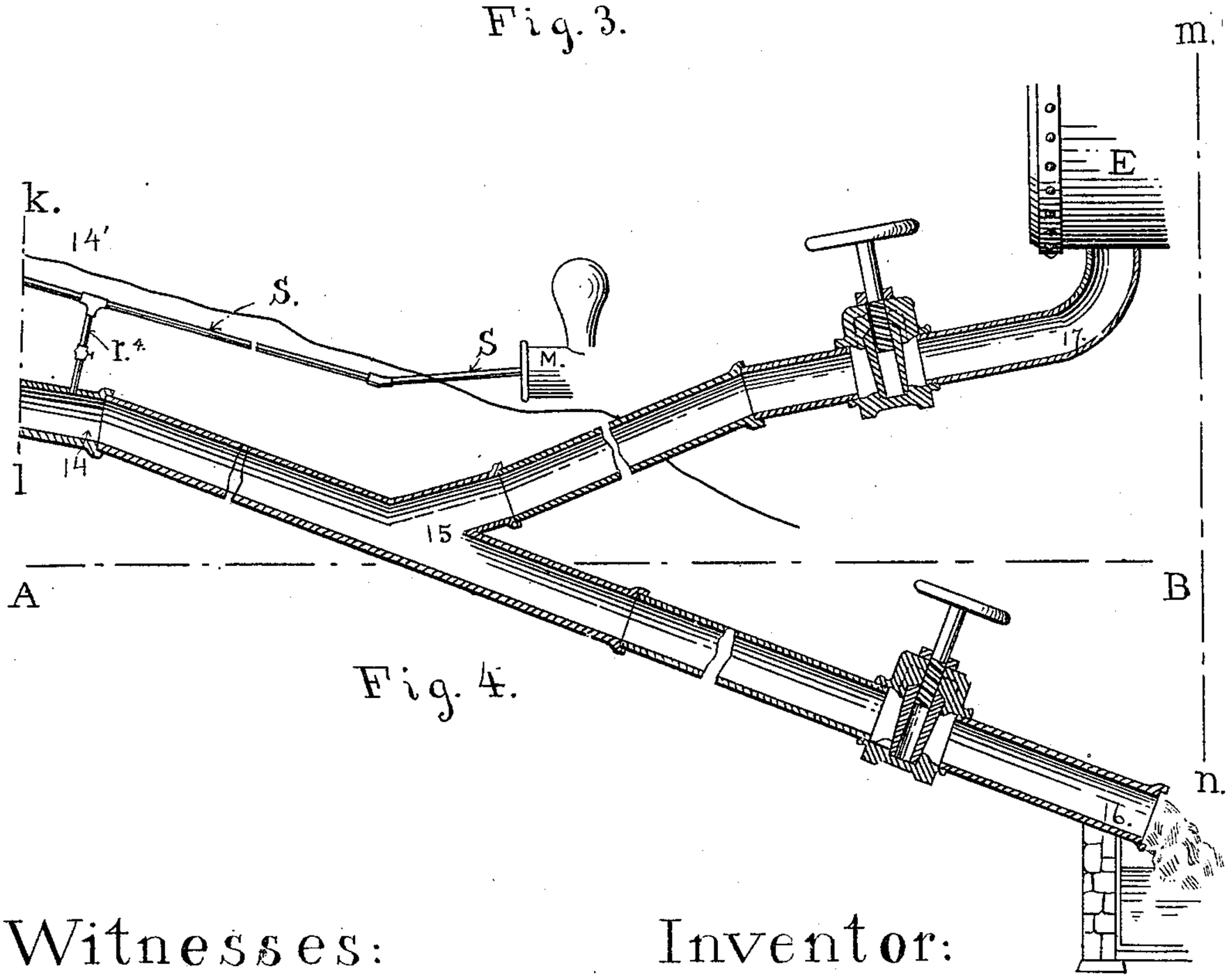

Fig. 4.

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UNITED STATES PATENT OFFICE.

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HYDRAULIC METHOD AND MACHINERY.

SPECIFICATION forming part of Letters Patent No. 354,112, dated December 14, 1886.

Application filed February 12, 1885. Serial No. 155,689. (No model.)

To all whom it may concern:

Be it known that I, NELSON B. ELDRED, of the city of Auburn, New York, have invented certain new and useful Improvements in Pipe Systems for Liquids, of which the following is a description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a diagrammatic view of a system of pipes by which my invention may be carried into effect. Figs. 2, 3, 4, and 5 illustrate, on enlarged scales, certain portions of the pipe system shown in Fig. 1.

The object of my invention is to prevent the flow of liquids in pipes from being interfered with or checked by the presence of air or other gases within such pipes.

Although my invention may be used with other liquids than water, and to avoid trouble with other gases than air, I shall hereinafter speak of the liquid to be carried as "water" and the disturbing gas as "air," because I believe that the most extended use of my invention will be in connection with that liquid and gas.

Fig. 1 shows an instance of the use of my invention when it is desired to carry water from the point 1 to point 16 or 17.

A B is the datum-line, which is the level of the water at the source, as a lake or reservoir. The heavy line 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 represents a main or pipe through which the water is to be delivered either to a pump, E, into which the branch 15 17 opens, or to a reservoir at 16 through the branch 15 16, being controlled by suitable gates at the points 16 and 17. These gates appear more clearly in Fig. 4. It has been customary heretofore in laying such mains or pipes to expend large sums of money in the effort to keep to a regular grade-line, either ascending or descending, as the case might require; but by the use of my invention I am enabled to lay such mains at will in relation to the surface to be traversed, rising and falling with the inequalities of the surface, as shown in Fig. 1, and thus causing in such a main or pipe the "high points," or "crests," as I term them, shown at 2 4 6 8 10 12 14. The contour of the earth along the line is represented by the light line 1′ 2′ 3′ 4′ 5′ 6′ 7′ 8′ 9′ 10′ 11′ 12′ 13′ 14′. Such a main is best constructed of cast-iron pipe laid with lead joints, and of sufficient size to deliver the required quantity of water without serious loss by reason of friction. Having such a pipe, whether it be attempted to obtain a supply of water through it by the suction of the pump E, which may be above the water-level A B, or by forcing water through it by a force-pump at the point 1, or whether it be attempted to have the pipe flow as a siphon, discharging at a point below the water-level A B, as at 16, in any of these cases it will be found that the quantity of water delivered will soon be lessened and its delivery interfered with by the presence of air at the crest or crests, which, lodging there, becomes a serious impediment to the flow of the water. This air may leak into the pipe, or it may be taken in at one end, or it may be disengaged from the water in the pipe. There may be one or many crests in the pipe, their number being immaterial and merely involving a repetition of the application of my invention. The length of the pipe is also immaterial, excepting as the loss by friction becomes excessive at great lengths.

The height of the highest point in the pipe above the level of the water at the source must not exceed the height to which a low atmospheric pressure will sustain a column of water and less the friction-head of the pipe for the quantity sought to be delivered.

With a pipe, as hereinbefore described, which may rise from the fountain-head at 1, with one or more crests, as 2 4 6, to its highest point 8, (where it may terminate, if desired, the pump E being connected to it at that point,) or continuing in a descending course with one or more crests, as 10 12 14, and discharging into a reservoir, as shown at 16, below the level of the source, or into a pump, as shown at E, situated above the fountain-head within the limit of its lifting capacity, it is found that the flow of the pipe, whether as a siphon or when responding to the suction of the pump E, is soon interfered with more or less, sometimes to its complete stoppage, by the accumulation of air at one or more of the aforesaid crests. I proceed to remove this impediment in the following manner: If the crest at which the air has lodged has near it another and higher crest, as the crest 2 is succeeded by the crest 4, crest 4 by crest 6, and crest 6 by crest 8, I insert a loop of pipe, as shown by *p*

p p p p p, of suitable size to afford an air-passage from the crest 2 to the nearest point of the back slope of the crest 4, that will enable said loop to maintain a slightly-ascending grade, and at such a point I connect it into the main pipe again, as is shown on a larger scale in Fig. 2. If this crest, as 4, is succeeded by a higher one, as 6, I repeat the same operation, and so on, providing for as many similar cases as may arise by mere repetition of the same means, until the highest crest of the line is reached, as 8.

The operation is as follows: Air having lodged at 2, because it could not follow the water down to the subsequent depression 3, and having been carried by the current to the front side of the crest 2, is passed through the loop *p p* to the back slope of crest 4, and thence rises to that crest and is carried by the current to its front side, and is then passed by another loop *p p* to the back slope of the crest 6, and thence by repetition of the aforesaid means is finally delivered at the crest 8.

If the main pipe opens into the pump E at the crest 8, the air at that point may be pumped with the water into the pump E, or it may be removed by an air-pump opening into the crest 8; but if the main pipe follows a descending course from the crest 8, as shown in Fig. 1, I apply the suction of an air-pump at crest 8 and remove the air at that point.

If the pipe has a uniform descent from its highest point to the point of attachment of the pump E, or to a point where it will flow as a siphon in accordance with the natural laws governing the flow of siphons, it will only be necessary to remove the air at crest 8, for any air in the pipe will find its way to the crest 8. If, however, the main pipe descends in an irregular manner, so as to afford one or more crests, as 10, 12, and 14, between the crest 8 and the pump E, or the siphon-outlet 16, if there be such an outlet, these crests 10, 12, and 14 may afford a lodgment for air and interfere with the flow of water in the same manner as the crests 2, 4, and 6. In such a case the crest 14 may be looped back to crest 12, crest 12 to crest 10, and crest 10 to crest 8 by loops similar to *p p*, Fig. 2, and all the air may be removed by an air-pump suitably located and which applies its suction to the air in the crest 8. I prefer, however, not to loop back these crests to crest 8, but to apply the suction of an air-pump to them, and to remove the air at each of them either by independent air-pumps suitably situated with reference to them, and each operating upon one crest; or, when the proximity of these crests permits of it, I prefer to operate one air-pump at some convenient station, as M, Figs. 1 and 4, and carry back a single pipe, S, which I call a "secondary pipe," which is connected into each of the crests by short connecting-pipes, as r' r^2 r^3 r^4, Figs. 1, 2, and 4. If such a secondary pipe is used, it is advisable to make the part near the pump M larger than the more remote parts, in order to reduce the loss of vacuum by friction therein. This loss is the more important, as, owing to the height above the fountain-head, the most complete vacuum may be required at the crest most remote from the air-pump, as at crest 8, Fig. 1. In order when drawing the last air from the highest crest to avoid drawing much, if any, water from the lower or nearer crests, I put valves or cut-offs in the pipes r' r^2 r^3 r^4, and by nearly closing the nearer and lower ones and the higher or more remote ones proportionately less (see Fig. 5) I can cut off a portion of the suction of the air-pump M at any crest where a less suction is required than at the highest. A little experience will enable any one to so adjust these cut-offs upon any line of pipe as to draw all the air with but very little, if any, water from any of the crests.

If it be desirable that water shall never be drawn at one or more of the crests, the pipes r' r^2 r^3 r^4, or any of them, may be carried to the height above the fountain-head represented by the barometric pressure, and then be recurved and connected to its air-pump or to the secondary pipe S. I prefer, however, to use the cut-offs, by opening which I can at any time flood the pipe S, in order to clear it of frost or ice, or even draw a quantity of water constantly with the air to the air-pump, when in cold weather there is danger from the frost or ice forming in the pipe S.

In order to avoid forming water-traps in the pipe S, if it be laid irregularly in regard to grade, I connect the drip-pots *t t*, Figs. 1 and 3, to it at such points as seem adapted to catch and hold water, provided with suitable valves, V, Fig. 3, whereby they may be cut off when it is necessary, in order to empty them. These drip-pots may be dispensed with if the secondary pipe S is laid upon a regular grade from one crest to the next; but it will usually be found more convenient to lay it disregarding a grade-line and to use them.

I am aware that it is not new to remove the accumulated air from the crest or highest point of a siphon-pipe by means of an air-pump, and I do not therefore wish to be understood as claiming such a feature, broadly; but,

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

1. The combination, with a liquid-conveying pipe or main rising from the fountain-head or source of supply of the liquid to a certain height or crest, then descending to a lower level, and then again rising to a point above the first high point or crest, of an air-conveying pipe connecting the lower crest to the back slope of the pipe rising to the adjacent crest, substantially as set forth.

2. The combination, with a liquid-conveying pipe or main laid at varying heights, so that it alternately rises and descends, of air-conveying pipes connecting the crests or high points of the said liquid-conveying pipe or main with the back slopes of the adjacent crests, substantially as set forth.

3. The combination, with a liquid-convey-

ing pipe or main having an irregular descent from a high point, said pipe alternately descending, rising, and again descending, thus forming several crests, of a secondary or air-conveying pipe, short connecting-pipes forming connections between the said secondary pipe and the said main at the said crests, and an air-pump for exhausting the air from the crests of the said main through the said secondary and connecting pipes, substantially as set forth.

4. The combination, with a liquid-conveying pipe or main having an irregular descent from a high point, said pipe alternately descending, rising, and again descending, thus forming several crests, of a secondary or air-conveying pipe, short connecting-pipes between the said secondary pipe and the said main at the said crests, said connecting-pipes being provided with regulating-valves, and an air-pump for exhausting the air from the crests of the said main through the said secondary and connecting pipes, substantially as set forth.

5. The combination, with a liquid-conveying pipe or main having an irregular descent from a high point, said pipe or main alternately descending, rising, and again descending, thus forming several crests, of a secondary or air-conveying pipe provided with drip-pots, short connecting-pipes between the said pipe or main and the said secondary pipe at the said crests, and an air-pump for exhausting the air from the crests of the said main through the said secondary and connecting pipes, substantially as set forth.

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