March 4, 1952 E. A. POIRIER 2,587,760

AUTOMATIC CONSISTENCY REGULATOR FOR PULP AND PAPER STOCKS

Filed Nov. 8, 1947 2 SHEETS—SHEET 1

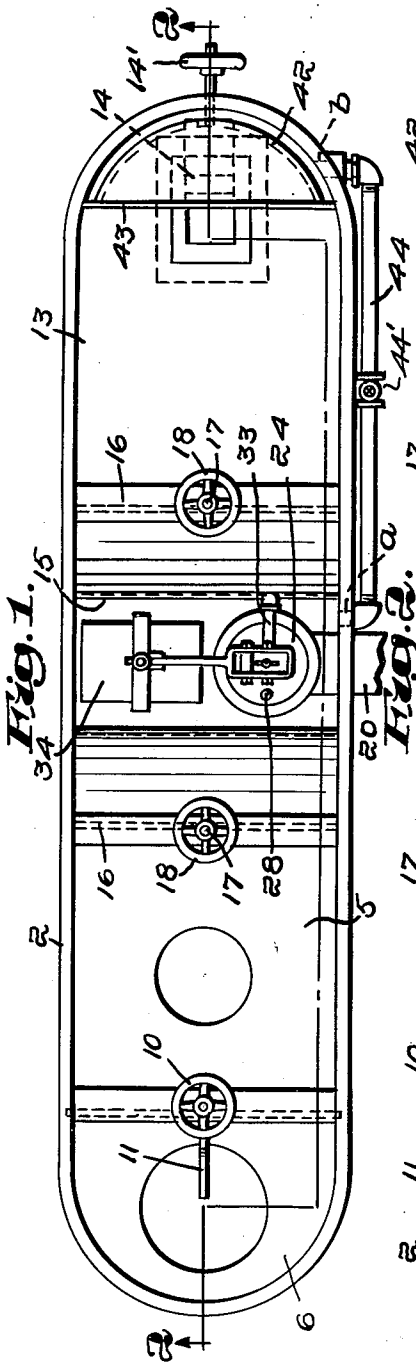


Fig. 1.

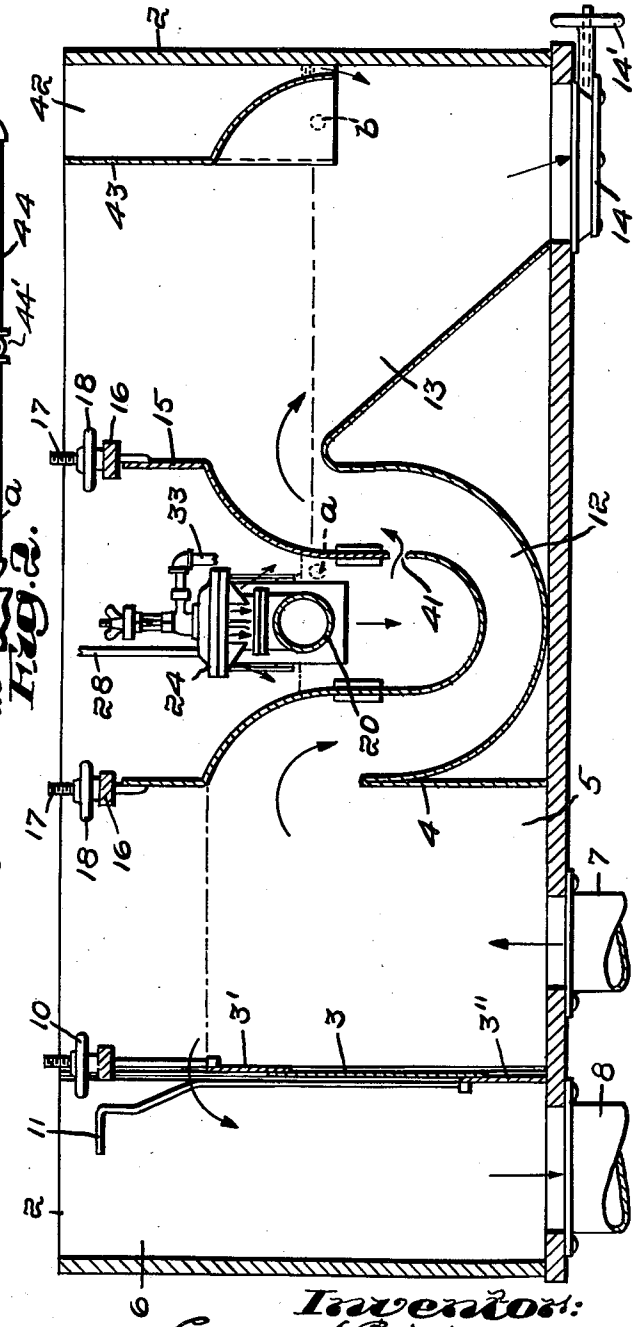


Fig. 2.

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Fig. 3.

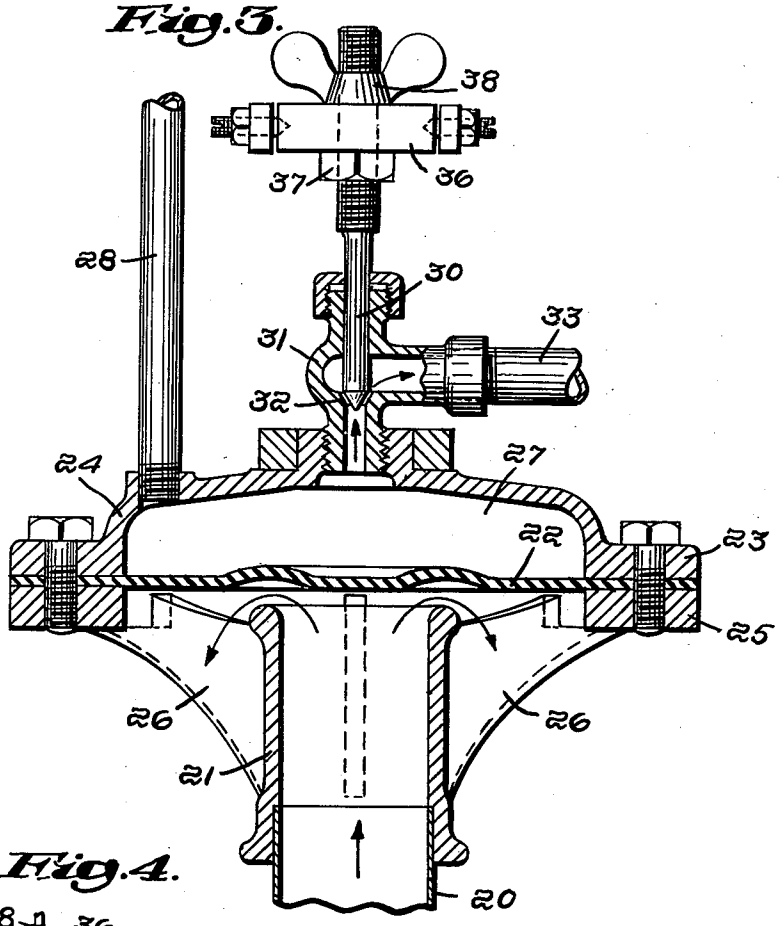
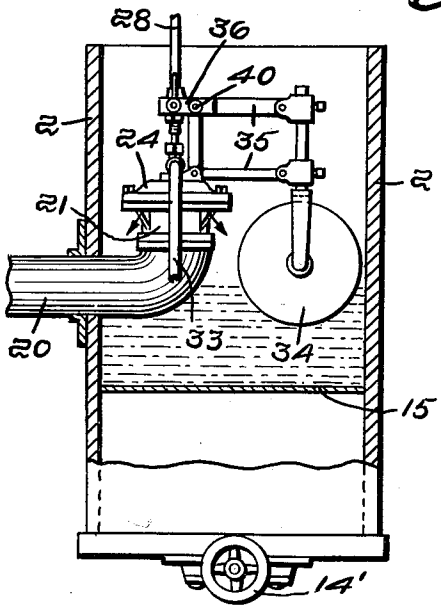


Fig. 4.



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AUTOMATIC CONSISTENCY REGULATOR FOR PULP AND PAPER STOCKS

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13 Claims. (Cl. 137—78)

1

In earlier patents I have disclosed various methods and apparatus for treating a stream of paper-making stock to minimize the variations in its consistency. The present invention is especially concerned with the solution of the problems to which prior methods and apparatus of this general type have been directed, and it aims to improve such methods and apparatus with a view to simplifying both. In other words, it aims to devise a method of correcting the consistency of successive portions of a stream of paper-making stock which can be practiced with the aid of an extremely simple form of apparatus, and to devise an apparatus for practicing that process.

The nature of the invention will be readily understood from the following description when read in connection with the accompanying drawings, and the novel features will be particularly pointed out in the appended claims.

In the drawings,

Fig. 1 is a plan view of an apparatus embodying features of this invention;

Fig. 2 is a vertical, sectional view taken approximately on the lone 2—2, Fig. 1;

Fig. 3 is a vertical, sectional view of a valve forming part of the apparatus for maintaining the diluting water at a constant level; and

Fig. 4 is a vertical, sectional view transversely of the casing showing the apparatus for maintaining a constant level of diluting water in the tank provided for that purpose.

Referring first to Figs. 1 and 2, the construction there shown comprises an elongated tank or casing 2. Near the left-hand end of the casing the space in it is partly divided by an adjustable weir structure 3 and by a stationary dam 4 into the intake and overflow compartments 5 and 6, respectively. A supply pipe 7 conducts stock into the former, while an overflow pipe 8 carries away the surplus. The weir includes an upper section 3', adjustable by means of the hand wheel 10, and a lower section 3'' which may be raised and lowered by means of a handle 11. The former controls the normal level or head maintained in the supply or intake compartment 5, while the latter is opened only to flush out these sections of the casing.

The compartment 5 forms one element of a conduit which conducts the stock through the entire casing, the other elements being a restricted U-shaped passage 12 which leads the stock into a chamber 13 and an adjustable delivery gate 14 through which the stock is discharged from the apparatus. Diluting water,

2

which may consist either of clear or "white water," with certain ingredients added if desired, is supplied from a tank 15, the lower portion of which has walls curved to extend approximately parallel with those which form the bottom of the restricted section 12. This tank fits snugly between the upright lateral walls of the casing and is suspended from beams 16—16 extending across the casing by means of bolts 17—17 on which hand nuts 18—18 are threaded. Consequently, the entire tank can be adjusted vertically to make the restriction 12 narrower or wider, as may be necessary to produce the desired degree of resistance to the flow of stock through it.

With this arrangement the level of stock that will be maintained in the chamber or "pond" 13 will vary inversely with variations in the degree of consistency of the stock. That is, if the stock becomes thicker, the effect of the resistance 12 would be to reduce its flow into the chamber 13, while a change to a lower consistency will produce the reverse effect, so that the level in the pond 13 will rise with a reduction in consistency and will fall with an increase in that characteristic.

For the purposes of the present invention the level of the supply of diluting water in the tank 15 is maintained substantially constant, and thus under a predetermined hydrostatic head. While this could be done with various devices for maintaining a constant head on a supply of water as, for example, a head box, a float valve, or the like, the former would be cumbersome and the latter would not work well with white water which carries considerable fiber and fillers in suspension.

In order to avoid both of these objections, therefore, I have devised a special construction which is best shown in Figs. 3 and 4. As there illustrated, the supply of diluting water is led into the tank through a pipe 20 which, after passing through the wall of the casing, is turned upwardly and has a special tubular end fitting 21 secured to it and forming a continuation of it, as clearly shown in Fig. 3. This fitting forms both the delivery end of the pipe and also the intake element of a control valve which governs the delivery of diluting water to the tank 15. As illustrated in Fig. 3, the upper end of the pipe section 21 is rounded and made smooth to cooperate with a flexible circular diaphragm 22, the margins of which are clamped between the lower face of the annular rim 23, integral with the dome 24 of the valve casing, and a similar

annular portion 25 of the lower body section of the valve. The latter section includes the parts 21 and 25 and a series of arms 26 integral with these two elements and connecting them rigidly together. This entire lower unit is cast in a single piece.

Control of the flow of liquid through this valve structure is achieved hydraulically or pneumatically, either fluid being conducted into the chamber 27 above the diaphragm by means of a pipe 28. This fluid is under pressure, and the degree of such pressure utilized is controlled by a pilot valve 30, slidable in the valve casing 31 mounted on top of the dome 24, the lower tapered end of this valve cooperating with a correspondingly tapered seat 32 to control the escape of fluid from the dome 27 and into the exhaust or discharge pipe 33. Preferably water is used for this purpose, a very small quantity being required and, consequently, the exhaust water is delivered into the tank 15. The operating movement of the valve plunger 30 is produced by a float 34, Fig. 4, resting in the supply of diluting water in the tank 15, the stem of this float being connected through parallel motion levers 35 with a yoke 36 adjustably secured on the plunger 30 between a lower nut 37 and an upper thumb nut 38, as shown in Fig. 3. The upper of the levers 35 is fulcrumed at 40, Fig. 4.

Consequently, as the diluting water is led through the pipe 20 from a source under sufficient pressure to make it overflow the upper end of the fitting 21, the float 34 will be raised if the level of the liquid in the tank 15 is sufficiently high, thus seating the valve plunger 30 and preventing the escape of fluid from the dome 27. The pressure then builds up in the dome to the full value in the pipe 28 which should be made sufficient to hold the diaphragm 22 seated firmly on the upper end of the fitting 21 at this time, thus preventing the flow of additional water into the tank 15. When, however, the level of the diluting water drops in said tank, the float also will drop, thus cracking the valve 30 open slightly and allowing some escape of fluid from the dome 27. This reduces the pressure on the diaphragm 22, and when that pressure is overcome by that in the supply pipe 20, the diaphragm will be lifted sufficiently to permit a controlled flow of diluting water into the tank 15.

With this arrangement, therefore a substantially constant level of diluting water is maintained in said tank and that level may be adjusted by raising or lowering the yoke 36 on the valve plunger 30.

It will be seen from an inspection of Fig. 2 that the diluting water in the tank 15 is always in free communication with the stock flowing through the restriction 12 due to the presence of the slot 41 formed horizontally in the right-hand lower portion of the wall of the tank. Normal levels for the stock in the compartment 5, chamber 13, and the diluting water in the tank 15 are indicated by the dot and dash lines, and the directions of flow are indicated by the arrows. As above indicated, the head of water in the supply chamber 15 and the position of the delivery gate 14 are so adjusted (the latter by the hand screw 14') that the level of the stock in the delivery chamber 13 and, consequently, the hydrostatic pressure which forces the stock through the gate 14, will vary inversely with changes in the consistency of successive portions of the stock flowing through the apparatus. In other words, if the consistency increases, the resistance to its flow through the restriction 12 will also be increased, the level of stock in the chamber 13 will drop and the rate of discharge or delivery through the gate 14 will be reduced. On the other hand, if the consistency becomes thinner, the flow assumes more nearly the nature of that of water, the resistance in the restricted area 12 is reduced, the level of stock in the chamber 13 rises and the rate of discharge increases. The result is a tendency to deliver a constant weight of solids through the gate 14 notwithstanding variations in consistency.

Because diluting water is always free to flow through the port 41 into the stream of stock entering the chamber 13, such flow will occur automatically in response to the relation between the hydrostatic pressure of the diluting water and that of the stock at said port 41. In other words, when the hydrostatic pressure of the diluting water is higher than that of the stock, the water will flow into the stream of stock and dilute it, and the extent of that dilution will depend primarily upon the degree to which the hydrostatic pressure of the diluting water exceeds that of the stock at the port 41.

Thus the apparatus formerly relied upon in consistency regulating mechanisms to control the discharge of diluting water into the stock is eliminated and conditions are provided which make this flow take place entirely automatically, simply in response to the difference in hydrostatic pressures of the two liquids. In this way a more instantaneous response to conditions calling for diluting water is maintained, those factors which have been troublesome due to the presence of fiber in the stock being operated upon are eliminated, and the mechanism formerly required for this purpose is also eliminated.

As above indicated, if the diluting liquid consists of water only, then the head maintained in the diluting tank 15 may be governed by a head box, or some simpler form of apparatus than that shown. However, the construction illustrated in Figs. 3 and 4 has proved to be extremely reliable and substantially trouble-free even when white water is used. This is partly due to the fact that the proportion of fiber in white water is very small, it is well distributed, the fiber is short, and it does not cause the same difficulties that occur with a stock which has not gone through a paper-making machine. Moreover, the valve shown in Fig. 3 is so constructed as to eliminate those features of the orthodox valves which also contribute to these difficulties.

When it is desired to introduce the diluting water at some other point in the stock, that object may be accomplished in some such manner as illustrated, for example, in Figs. 1 and 2, where a pocket 42 is provided at the right-hand end of the tank by means of a partition 43, the lower end portion of this partition being so shaped that it is spaced by only a narrow disstance from the adjacent end wall of the casing. This narrow space is always open. Consequently, the pulp stock will rise to the same level in the pocket 42 that it does in the chamber 13. If, therefore, a pipe, such as that shown at 44, is provided to connect these two spaces, opening into the chamber 15 at *a* and into the pocket 42 at *b*, then diluting water will flow through the pipe 44 and into said pocket in response to variations in hydrostatic pressure existing at the points *a* and *b*. This water will be dis-

charged in to the stock in the float chamber near the delivery gate.

Other forms of restrictors such, for example, as those shown in one or more of my earlier applications, can be substituted for that shown at 12.

The diaphragm 22 preferably is made of rubber, either natural or synthetic, and reinforced, if desired, with fabric, or equivalent sheet material, so that it will have the degree of flexibility required to operate in the manner above described while also being impervious to the pasage therethrough of liquids or gases. It need not have any great degree of elasticity. Such diaphragms are sold commercially for use in pressure-reducing and other valves.

In the construction above described the resistance section 12 is located up-stream from the chamber 13 in which the variation in hydrostatic pressure of the stock in response to changes in consistency occurs. Also, the delivery of diluting water to the stock through the port 41 is down-stream from the point of maximum resistance, while its delivery at *b* is down-stream from the entire resistance area. As a general rule it is preferable to deliver the diluting water to a part of the stream which is down-stream from the "pond" which the variable head is created, because any danger of having the delivery of diluting water interfere with the response of the variable head to the changes in consistency thus is eliminated. But the practical conditions met in many installations make it expedient, in some situations, to depart from this general rule, and suitable modifications can easily be made to deliver the diluting water at some other desired point or points.

While I have herein shown and described preferred embodiments of my invention, it will be evident that the invention may be embodied in other forms without departing from the spirit or scope thereof.

Having thus described my invention, what I desire to claim as new is:

1. That improvement in methods of regulating the consistency of a stream of paper-making stock, comprising the steps of creating a flow of said stock under an approximately constant head and in a confined stream, interposing a resistance to said flow in a part of said stream so that variations in consistency of the stock will produce corresponding variations in hydrostatic pressure in another portion of said stream, and maintaining a supply of diluting water under a constant head where it is in communication constantly with a part of said stream in which the head varies with changes in consistency, so that diluting water will flow automatically into said stock from said supply whenever its head exceeds that of the stock in the part of said stream in which the head varies with changes in its consistency.

2. That improvement in methods of regulating the consistency of a stream of paper-making stock, comprising the steps of creating a flow of said stock under an approximately constant head and in a confined stream, interposing a resistance to said flow in a part of said stream so that variations in consistency of the stock will produce corresponding variations in hydrostatic pressure in another portion of said stream, and maintaining a supply of diluting water under a constant head where it is in communication constantly with a part of said stream in which the head varies with changes in consistency, but

which is down-stream from the point of maximum resistance, whereby the diluting water is free to flow into said stock in response to the degree to which the hydrostatic pressure of said diluting water exceeds that of said stock in the part of said stream in which the head of stock varies with its changes in consistency.

3. That improvement in methods of regulating the consistency of a stream of paper-making stock comprising the steps of flowing said stock under a constant head through a conduit to a discharge outlet of predetermined dimensions, interposing a resistance to said flow in a part of said conduit between said head and said outlet, so that variations in consistency of the stock will produce corresponding inverse variations in hydrostatic pressure in another portion of said conduit from which said outlet opens, with a consequent discharge of the stock through said outlet at a rate varying inversely with changes in the consistency of the stock flowing through said resistance, and maintaining a supply of diluting water under a constant head where it is free to flow into said stock whenever the hydrostatic pressure of the water is greater than that of the stock at a predetermined point in the part of said stream in which the head of stock varies with changes in its consistency.

4. That improvement in methods of regulating the consistency of a stream of paper-making stock comprising the steps of flowing said stock under a constant head through a conduit to a discharge outlet of predetermined dimensions, interposing a resistance to said flow in a part of said conduit between said head and said outlet, so that variations in consistency of the stock will produce corresponding inverse variations in hydrostatic pressure in another portion of said conduit from which said outlet opens, with a consequent discharge of the stock through said outlet at a rate varying inversely with changes in the consistency of the stock flowing through said resistance, and maintaining a supply of diluting water under a constant head and in constant communication with the stock at a part of said stream in which the hydrostatic pressure varies with changes in consistency so that diluting water will flow into said stock when its consistency is above a predetermined value and the rate of such flow will vary with changes in its consistency.

5. A consistency regulator for paper-making stock, comprising a conduit for a stream of said stock, a fluid container located at one side of the conduit, means for supplying stock to said conduit under a substantially constant head, means in said conduit for creating a resistance to the rate of flow through a localized portion of it, whereby a hydrostatic head will be created in another portion of said stream included in the said fluid container which will vary with changes in the consistency of said stock, and means for maintaining a supply of diluting water under a substantially constant head where it is free to flow into said stream at a point where said hydrostatic head varies inversely with changes in the consistency of the stock, so that said diluting water will flow into said stock whenever its hydrostatic head is greater than that of the stock at the area where said water is discharged into the stock, and the rate at which diluting water will be so delivered will vary with the differences in hydrostatic pressure of the diluting water as compared with that of said paper-making stock.

6. A consistency regulator for paper-making stocks, comprising parts providing a chamber for

the flow of a stream of said stock therethrough, a restricted passage through which said stream flows into said chamber, means operable to produce a flow of stock into said passage under a substantially constant head, means adjustably controlling the discharge of stock from said chamber, the two foregoing means being coordinated to cause the resistance to the flow of stock through said restricted passage to produce a head of stock in said chamber which varies inversely with changes in the consistency of the stock, and means for conducting diluting water from a supply having a constant head to a point in the regulator at which the hydrostatic head varies inversely with said changes in consistency, the diluting water-supplying means being continuously in communication with said stream of stock and free to flow into the latter whenever its own hydrostatic head exceeds that of said stock.

7. A consistency regulator for paper-making stock, comprising a conduit for a stream of stock, means for supplying stock to said conduit under a predetermined head, resistance means in said conduit for creating a localized frictional resistance to the flow of said stream and so impeding said flow that an hydraulic head will be created in another part of said stream, which head will vary inversely with changes in the consistency of the stock, means for holding a supply of diluting water under a constant head, the last named means being provided with an outlet opening into the part of said stream at which the hydrostatic head varies with said changes in consistency so that said diluting water will flow into said stock whenever its hydrostatic head is greater than that of the stock at the area where the diluting water is discharged into the stock.

8. A consistency regulator according to preceding claim 5, in which said means for creating resistance to the flow of said stock through a localized portion of the conduit is located upstream from the portion of said conduit in which said variable hydrostatic pressure is created.

9. A consistency regulator according to preceding claim 5, in which said means for maintaining the supply of diluting water where it is free to flow into said stream of stock includes a container positioned in the stream of stock flowing through said regulator.

10. A consistency regulator according to preceding claim 5, in which said means for maintaining the supply of diluting water where it is free to flow into said stream of stock includes a container positioned in the stream of stock flowing through said regulator and forms a part of said means for creating a resistance to the rate of flow of a localized portion of said stream of stock through the conduit.

11. A consistency regulator according to preceding claim 5, in which said means for maintaining the supply of diluting water where it is free to flow into said stream of stock includes a container positioned in the stream of stock flowing through said regulator and forms a part of said means for creating a resistance to the rate of flow of a localized portion of said stream of stock through the conduit, and means operable to adjust said container to change the degree of said resistance.

12. A consistency regulator according to preceding claim 5, in which said means for maintaining the supply of diluting water where it is free to flow into said stream of stock includes a container positioned in the stream of stock flowing through said regulator, means for conducting diluting water into said container, and means for maintaining the diluting water therein at an approximately constant level.

13. A consistency regulator according to preceding claim 5, in which said means for supplying diluting water to said stream of stock delivers the water to said stream at a point down-stream from said resistance means.

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