R. D. JOHNSON.

MEANS FOR CUSHIONING HYDRAULIC PRESSURE IN FEED PIPES.

APPLICATION FILED JUNE 19, 1908.

962,355. Patented June 21, 1910.

Fig. 1.

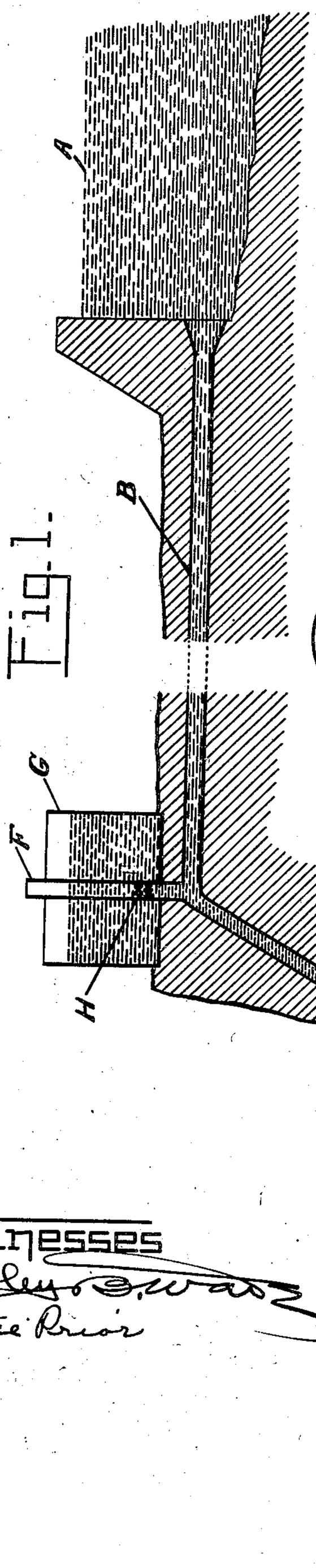
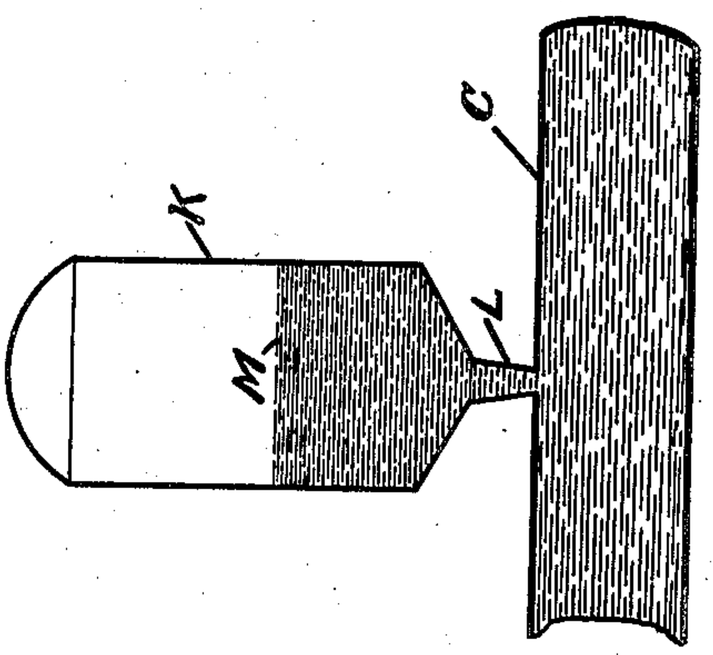


Fig. 2.



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MEANS FOR CUSHIONING HYDRAULIC PRESSURE IN FEED-PIPES.

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Application filed June 19, 1908. Serial No. 439,319.

To all whom it may concern:

Be it known that I, RAYMOND D. JOHNSON, a citizen of the United States, residing at the city of Albany, in the county of Albany and State of New York, have invented certain new and useful Improvements in Means for Cushioning Hydraulic Pressure in Feed-Pipes, of which the following is a specification.

My invention relates to devices for assisting turbine speed regulation by pressure control in water powers with long pressure pipes and high velocities, and the object of my invention is to provide a means for cushioning hydraulic pressure in feed pipes, together with such other elements and combinations as are hereinafter more particularly described. I accomplish these objects by means of the apparatus diagrammatically illustrated in the accompanying drawings, in which:

Figure 1 is a sectional view of a reservoir, supply pipe, surge tank with internal stand pipe, power house and discharge, with parts broken away. Fig. 2 is a section of a tank connected with the supply pipe near the power house used without internal stand pipe.

Similar letters refer to similar parts throughout the several views.

When the power is generated by a turbine or other mechanical device put in motion by water fed thereto by pipe or aqueduct from a reservoir, usually at a considerable distance from the power house, a difficulty arises when the load on the turbine changes, when the demand for an increase of water is made. The sudden requisition made on the feeder for an additional supply, which can only be obtained by accelerating the velocity of the water in the aqueduct, causes a "wave" or "surge" to be transmitted through the aqueduct, resulting in water hammer or other disagreeable and objectionable phenomena. The action of the wave interferes with the steady discharge of the water and causes an intermittent explosive discharge, depending, of course, in its occurrence and intensity, upon the degree of the demand made on the feeder by the turbine. After the wave has passed through the aqueduct and sufficient time has elapsed to enable the velocity to pick up, the inflow will continue to increase above the demand therefor, and the result is a tremendous variation in pressure, and if by-pass pipes are employed or other escapement devices used, a discharge will take place through these by-pass pipes and escaping ducts which is not only extravagantly wasteful, but also so slow in correcting evil as to injuriously affect the turbine speed regulation.

For the purpose of doing away with the objections, inconvenience and wastefulness of the present system I have provided an effective, efficient and economical means for taking care of the change in the demand for water made by the power generating apparatus and supplying or storing the same gradually, speedily and constantly without the objectionable water hammer accompanying.

I illustrate by the drawing one means of accomplishing this result in which the reservoir, A, is tapped by the feeder pipe or aqueduct, B, which has the drop portion, C, leading to the power house D and discharge E. The proportions shown in the drawing are not intended to be necessarily correct as some parts are exaggerated for the purpose of illustration. I place in the equeduct, B, just above the drop portion, C, a stand pipe, F, which projects into a surge tank, G, in which the water is below the height of the water in the reservoir by an amount equal to the friction loss in the aqueduct, B. The stand pipe, F, extends above the water in the surge tank. In the stand pipe, F, near the bottom of the surge tank I place a series of restricted openings, H. The stand pipe may, however, be either within or without the tank, or may sometimes be omitted altogether without affecting the principle of the invention. As thus arranged when a demand is made on the aqueduct by the power generating apparatus for more water it will be registered at once in the surge tank and a suction will immediately occur through the openings, H, by which the water in the surge tank, G, will be delivered to the power house. At the same time a wave will proceed through the feeder, B, toward the reservoir, A, but it will be subjected to the quieting or reacting influence of the supply delivered constantly and in the proper proportions to

the demand made by the power house through the restricted openings, H, in the stand pipe. Before the water in the surge tank has reached the top of the openings, H, in the stand pipe, (the openings, H, being arranged regarding their size and number in proper proportion to the length of the feeder, the velocity of the water supply therethrough and the area of the surge tank), the velocity of water in the aqueduct will be fairly constant and suitable to the increased demand. Any increase of water occasioned by the increased velocity, resulting from the demand for more water, will be delivered through the said restricted openings, H, properly proportioned, as aforesaid, to the surge tank and when the surge tank has again reached its normal level the flow of water through the feeder will be normal, and there will have resulted no loss of fluid, injury to apparatus or annoyance of any kind, occasioned by the irregular, intermittent explosive action, caused by surging of the water. When water is rejected at the power house the reverse operation will take place, and the excess water will be automatically, quietly stored for future demands.

I have shown in Fig. 2 a tank, K, connected with the feeder, C, near the power house, D, in which I do not place a stand pipe necessarily, but arrange for the restricted passage of the water in the tank through the discharge, L, in the feeder, C. The tank, K, is supplied with water, M, and air under pressure. It is apparent that the same effect may be produced on the water in the feeder, C, and in the surge tank by the action of the proportioned discharge from tank, K, that is produced on the water in the feeder, B, and in the reservoir by the action of the proportioned discharge from the tank G, and the same beneficial results will be attained in the use of the tank K for the feeder C that could be obtained in the use of the tank G for the feeder B. In either case the action on the contents of the tank occasioned by the sudden demand made by the power generating apparatus or a sudden rejection of water due to a drop in the power demand will be like that of a dashpot.

It will be noted that in each of the devices G and K, the properly proportioned discharge openings from the surge tank into the feeder, will provide a quantity of water sufficient to supply the demand produced by an additional load at the power-house during the period that the velocity of flow in the main feeder is accelerating because of the difference of head caused by the sudden lowering of level in the stand-pipe F, or of pressure in the conduit adjacent to tank K. It will be further noted that when there is, at the power-house, a rejection of water due to decrease of load, then provision is made, not only for storing excess water, but for retarding the velocity of flow in the feeder by an increase of pressure head in either form of surge tank at a rate more rapid than the rate of change of water level in the tank. Thus in the tank K, owing to the shape given to the discharge L, there is permitted a much more rapid inflow from the feeder C to the tank K, than outflow from the tank K to feeder C, and in the tank G the excess water will rise freely and rapidly in the comparatively small stand-pipe F. There is thus a differentiation between what may be termed "pressure water" and "stored water" in the same receptacle, the "stored water" being permitted to flow from the surge tank into the feeder at a rate sufficient to supply all temporary demands, while the "pressure water" can rapidly and efficiently establish in the surge tanks the necessary differences of level relative to that of the water-supply, to accelerate or retard to the desired degree the velocity of water in the feeder by the time when the capacity of the tank is used up and without the possibility of dangerous surging. By the use of this differential principle there results not only an efficient damping of the "surge" waves, but a surge tank may be used of much smaller dimensions than an ordinary stand-pipe, and without the danger of continued surging in the system.

What I claim as my invention and desire to secure by Letters Patent is:

1. The combination with an elevated reservoir, a water-wheel, and a conduit connecting the same, of a surge tank having an open connection to the conduit, means for permitting a restricted flow therethrough from the tank to the conduit, and means arranged to permit a relatively rapid variation of pressure-head in such conduit as compared to the rate of change of water level in such tank.

2. The combination with a conduit adapted to convey fluids under pressure-head, of a surge tank having an open connection to the conduit, means for permitting a restricted flow therethrough from the tank to the conduit and means arranged to permit a relatively rapid variation of pressure-head in such conduit as compared to the rate of change of water level in such tank.

3. A surge tank having an opening adapted for connection to a conduit, means for permitting a restricted flow therethrough from the tank to the conduit and means arranged to permit a relatively rapid variation of pressure-head in such conduit as compared to the rate of change of water level in such tank.

4. The combination with a conduit of a

stand-pipe connected thereto and a surge tank connected to the stand-pipe.

5. The combination with a conduit, of a stand-pipe connected thereto, and a surge tank surrounding the stand-pipe, said stand-pipe having ports connecting it with the surge-tank.

In testimony whereof I have affixed my signature in presence of two witnesses.

RAYMOND D. JOHNSON.

Witnesses:
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LOTTIE PRIOR.