No. 871,321. PATENTED NOV. 19, 1907.

E. F. CASSEL.

RELIEF MECHANISM FOR HYDRAULIC NOZZLES.

APPLICATION FILED JULY 31, 1906.

Fig. 1.

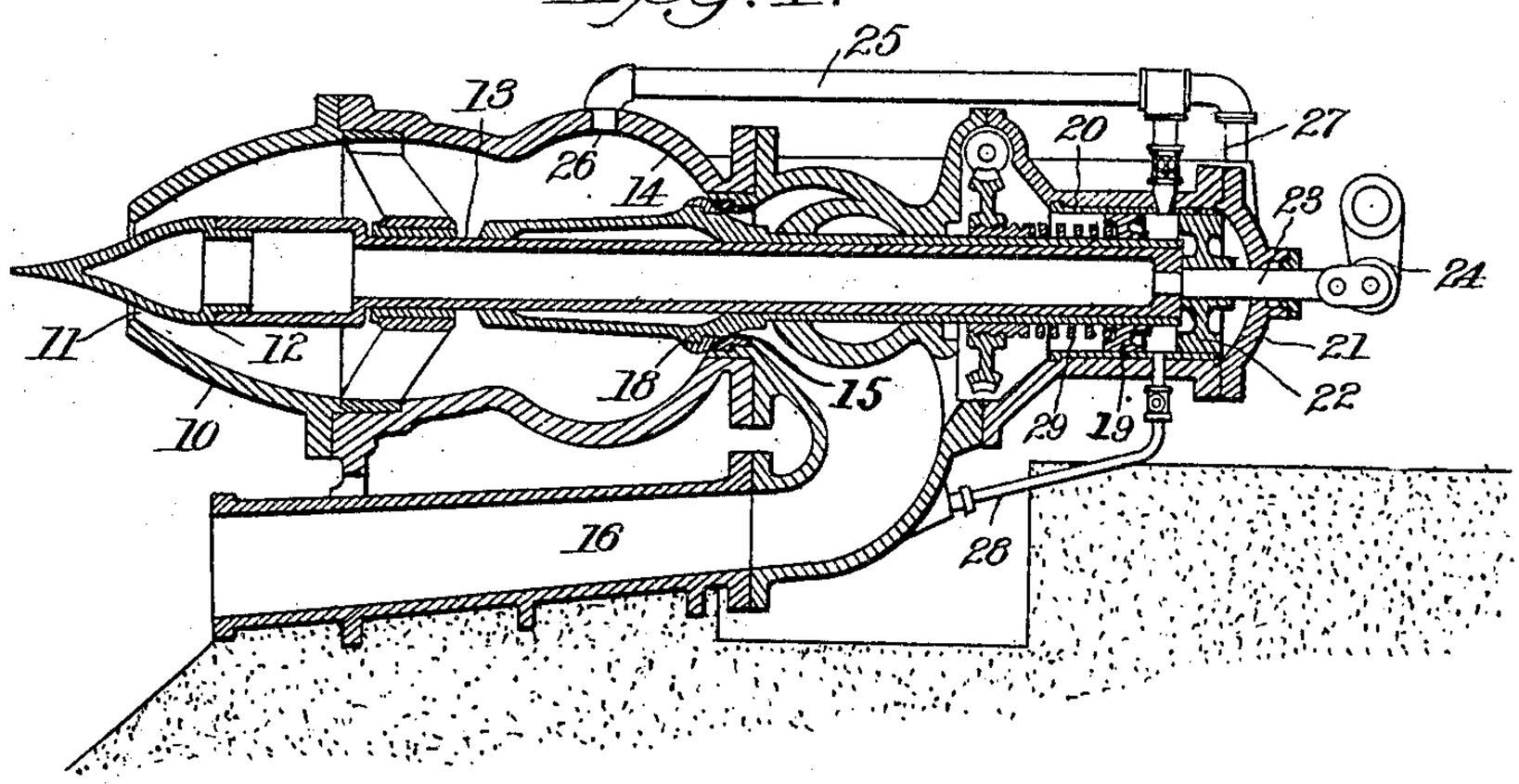
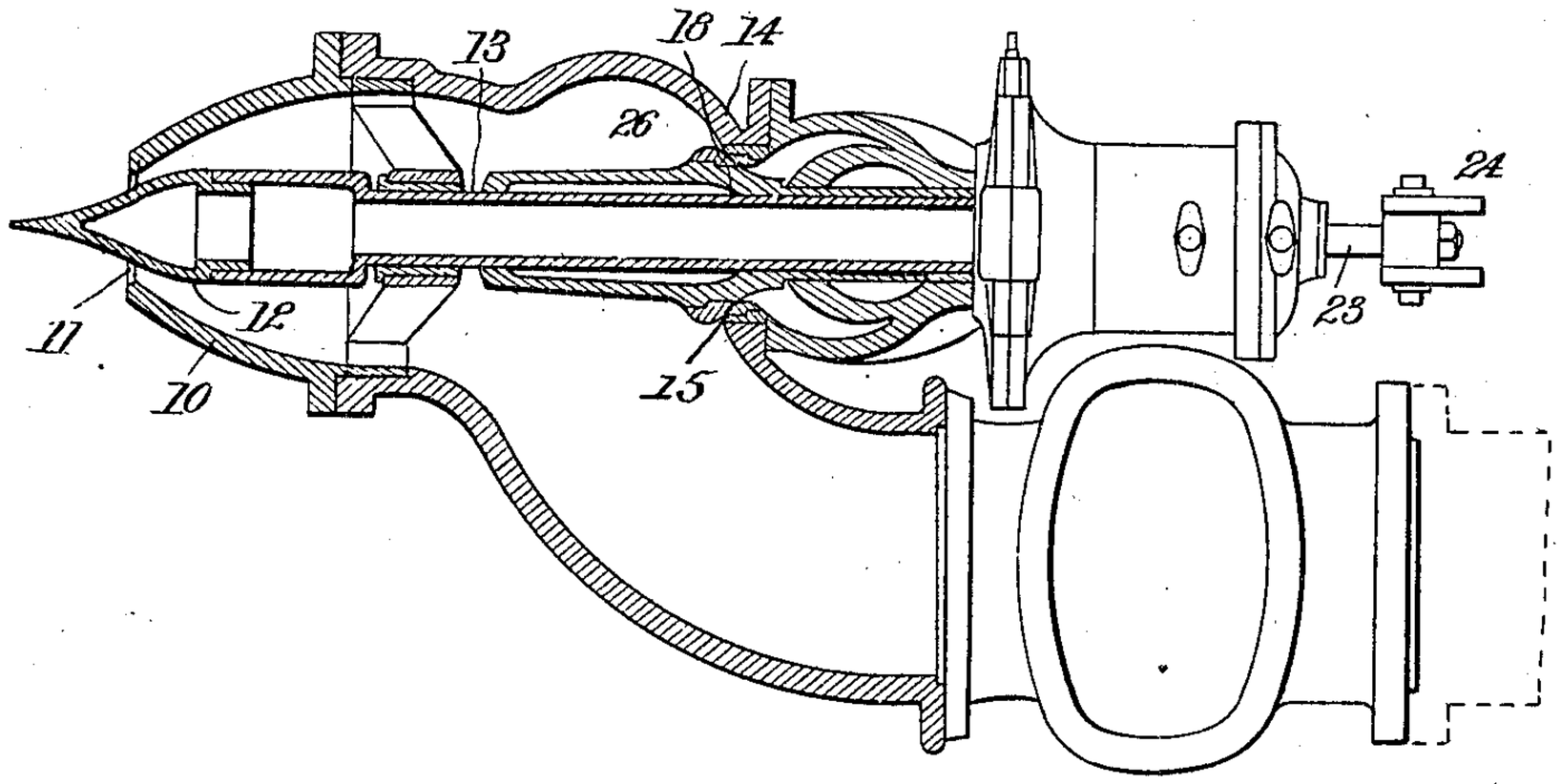


Fig. 2.



Witnesses
C. H. Walker.
J. T. Walker.

Inventor
Elmer F. Cassel
By Wm. B. Hodges
Attorney

UNITED STATES PATENT OFFICE.

ELMER F. CASSEL, OF SEATTLE, WASHINGTON.

RELIEF MECHANISM FOR HYDRAULIC NOZZLES.

No. 871,321. Specification of Letters Patent. Patented Nov. 19, 1907.

Application filed July 31, 1906. Serial No. 328,589.

To all whom it may concern:

Be it known that I, ELMER F. CASSEL, of Seattle, in the county of King, State of Washington, have invented certain new and useful Improvements in Relief Mechanism for Hydraulic Nozzles, of which the following is a specification.

This invention relates to certain new and useful improvements in relief mechanism for hydraulic nozzles and pertains more particularly to that class of mechanism designed to control the pressure of water in hydraulic penstocks when affected by the movement of the governing apparatus or from other causes.

In the regulation of a hydraulic motor by means of reducing the flow of water applied to the motor either by closing the valve or introducing a pin in a nozzle, or by any other means which reduces the flow of water in the penstock, an increase of pressure is temporarily established in the penstock, which increase of pressure is not only objectionable but ofttimes dangerous. Heretofore hydraulic relief valves have been produced which are operated to open or close by the increase or reduction of pressure in the penstock acting upon a pilot or auxiliary valve, or directly against a weighted relief valve. Owing to the danger arising from the failure of such relief valves to operate promptly and reliably, other hydraulic relief valves have been produced which are mechanically connected to the governing apparatus of the motor in such a way that a closing movement of the hydraulic valve mechanically and positively operates to simultaneously open the relief valve in proportion to the movement of the hydraulic valve. The latter form of relief valve, however, does not permit of the relief valve being opened promptly in case of an excess pressure arising in the penstock from causes other than the rapid closing of the governing valve. In fact it has been found in the practical use of water-power, that an object floating on the water is sometimes drawn into the regulating valve and becomes jammed therein, causing dangerous pressures in the penstock which a relief valve positively connected to the governing mechanism is unable to take care of.

My present invention is designed to overcome these objections by providing a relief valve which is entirely free to act independently of the closing or opening movements of the governing valve, but which at the same time, must positively open with any closing movement of the governing valve sufficiently rapid to set up an increase of pressure in the penstock.

The invention will be hereinafter fully set forth and particularly pointed out in the claims.

In the accompanying drawing:—Figure 1 is a vertical sectional view of a nozzle or penstock with my improved relief mechanism applied thereto. Fig. 2 is a horizontal sectional view thereof.

Referring to the drawing, 10 designates a hydraulic penstock of the form commonly employed in connection with impulse water wheels working under high heads, said penstock being preferably of S-shape and provided with a nozzle opening 11. A hydraulic or governing valve 12 carried by the usual centrally located pin 13 is located opposite the nozzle opening 11, the extended shaft of the nozzle pin 13 projecting through the penstock at a point immediately opposite the nozzle opening. At the point where the nozzle pin shaft 13 passes through the wall 14 of the nozzle is located the relief valve opening 15 having a valve seat formed inside of the penstock. Said relief opening 15 communicates with a discharge pipe 16. The relief valve is preferably in the form of a sleeve surrounding the shaft 13 and provided at its forward end with an enlargement or valve 18. To the other end of said sleeve is attached a piston 19 which works in the bore of a cylinder 20 supported in any suitable manner and provided with a closed end wall 21. The shaft 13 projects beyond piston 19 and at a suitable distance from said piston, said shaft is provided with a piston 22 also operating in cylinder 20. The piston 22 is provided with a piston rod 23 in prolongation of shaft 13 and extending through the cylinder head 21 for connection with the governing mechanism 24. The rod 23 is preferably of a smaller diameter than shaft 13 in order that the area of the piston 22 on the side of rod 23 will be slightly greater than the area on the opposite side of the said piston, so that if the pressure per square inch be equal on both sides of said piston 22 the effect will be to move valve 12 to closing position.

In the drawings I have illustrated a pipe 25 leading from the pressure chamber 26 of the penstock to cylinder 20 at a point between the pistons 19 and 22, a check valve 27 being provided to prevent back pressure in said

pipe. A leak valve 28 is also provided for cylinder 20, preferably in a pipe leading from said cylinder to the discharge 16, said valve being of any preferred form that can be set by hand or other means. The relief valve 18 is held normally to its seat by means of a spring, although it is obvious that a weight will accomplish the same purpose.

In practice the area of the piston 19 is in excess of the area of the relief valve inside the penstock, and the pressure exerted by this increase area tending to open the relief valve is counteracted by spring 29 which tends to keep the relief valve closed at normal or less than normal pressure in chamber 26. If, however, an increase of pressure occurs in chamber 26 there will be an increase of pressure between the pistons 19 and 22, whereupon the relief valve 18 is opened to such an extent as to bring the pressure in chamber 26 back to normal, at which point the spring or other force employed to close the relief valve will again become effective. The speed with which the relief valve will be seated is effectively controlled by the leak valve 28, but even though said leak valve should be opened too far thus tending to close the relief valve at too rapid a rate, this closing movement in shutting off the relief will cause a slight increase of pressure in the penstock which will arrest the closing of the relief valve. It is obvious that any rapid closing movement of the piston 22 under the influence of the governor 24 will be communicated through the fluid between the pistons 19 and 22 in such a way as to instantly unseat the relief valve. The closing movement having ceased the relief valve will commence to close provided the pressure in chamber 26 has not been increased by the governing action, otherwise it will not start to close until the pressure has again reached normal. Water under pressure is introduced in the rear of piston 22 by means of a branch or pipe 25, and this pressure, owing to the increased area on the rear of said piston 22, has a tendency to close valve 12. By this arrangement it is possible to arrange for a safety shut down governing action by merely disconnecting the rod 23 from the governor, whereupon the valve 12 will be seated. Should this closing action be too rapid, the increase in pressure in chamber 26 will open the relief valve as heretofore described and prevent any dangerous increase of pressure, even though the nozzle should be closed suddenly.

The advantages of my relief valve are apparent. It will be particularly observed that the same is always ready to act without the necessity of the governing apparatus being in operation, and also acts positively in connection with the closing movement of the governing mechanism when in operation. A further advantage is gained by transmitting the closing movement of the governing piston to the relief valve piston by means of an incompressible fluid. A further advantage is gained by placing the incompressible fluid under the control of the pressure within the penstock in such manner that the pressure of said fluid will vary to conform to the pressure in the penstock. In this connection it will be noted that while I have shown and described the pressure between the two pistons as derived by direct connection with the penstock, it is obvious that such pressure may also be secured by other means, such as pumping oil against the pressure of the penstock, or other similar means, arranged in such manner that the pressure of the fluid varies in proportion to the pressures in the penstock.

I claim as my invention:—

1. A relief mechanism of the character described comprising an inclosed chamber, a device for regulating the flow of fluid through said chamber, a device for regulating the pressure in said chamber, means for controlling the operation of said flow regulating device, means adjacent the first mentioned means for controlling the operation of said pressure regulating device, and means for introducing an incompressible fluid under pressure between the means for controlling the flow regulating device and the means for controlling the pressure regulating device, the pressure upon said fluid being varied in proportion to the variations in pressure in said chamber.

2. A relief mechanism of the character described comprising a nozzle, a valve located inside the nozzle to regulate the flow of fluid through the latter, means for operating said valve, a second valve located in said nozzle to regulate the pressure in the latter, means for controlling said valve and located adjacent said valve operating means, and means for introducing an incompressible fluid under pressure between the means for controlling the flow regulating valve and the means for controlling the pressure regulating valve, the pressure upon said fluid being varied in proportion to the variations in pressure in said chamber.

3. A relief mechanism of the character described comprising a nozzle, a regulating valve therefor provided with a piston, a relief valve also provided with a piston, and means for introducing an incompressible fluid under pressure between said pistons the pressure upon said fluid being varied in proportion to the variations in pressure in said nozzle.

4. A relief mechanism of the character described comprising an inclosed chamber, a device for regulating the flow of fluid through said chamber, a device for regulating the pressure in said chamber, means for controlling the operation of said flow regulating device, means adjacent the first mentioned

means for controlling the operation of said pressure regulating device, and means for conducting fluid under pressure from said chamber and introducing the same between the means for controlling the flow regulating device and the means for controlling the pressure regulating device, the pressure upon said fluid being varied in proportion to the variations in pressure in said chamber.

5. A relief mechanism of the character described comprising a nozzle, a regulating valve therefor provided with a piston, a relief valve also provided with a piston, and means for introducing fluid under pressure from said nozzle between said pistons.

6. A relief mechanism of the character described comprising a nozzle, a regulating valve therefor provided with a shaft, and means mounted upon said shaft for controlling the pressure in said nozzle.

7. A relief mechanism of the character described comprising a nozzle, a regulating valve therefor provided with a shaft, a relief valve controlling the pressure in said nozzle and mounted on said shaft and concentric with said regulating valve, and means for operating said relief valve.

8. A relief mechanism of the character described comprising a nozzle, a regulating valve therefor provided with a shaft, a relief valve controlling the pressure in said nozzle and slidably mounted on said shaft, and means for operating said relief valve.

9. A relief mechanism of the character described comprising a nozzle, a regulating valve therefor provided with a shaft, a sleeve mounted on said shaft and provided with a relief valve to control the pressure in said nozzle, and means for operating said relief valve.

10. A relief mechanism of the character described comprising a nozzle, a regulating valve therefor, a shaft for said valve provided with a piston, a relief valve mounted upon said shaft and also provided with a piston, and means for introducing fluid under pressure from said nozzle between said pistons.

11. A relief mechanism of the character described comprising a nozzle, a regulating valve therefor provided with a shaft, a relief valve mounted on said shaft and concentric with said regulating valve, and means controlled by the pressure within said nozzle for operating said relief valve.

12. A relief mechanism of the character described comprising a nozzle, a regulating valve therefor provided with a shaft, a sleeve mounted on said shaft and provided with a relief valve, and means controlled by the pressure within said nozzle for operating said relief valve.

13. A relief mechanism of the character described comprising a nozzle, a regulating valve therefor provided with a shaft, a piston for said shaft, a sleeve slidably mounted upon said shaft and also provided with a piston, and means for introducing fluid under pressure from said nozzle between said pistons.

14. A relief mechanism of the character described comprising a nozzle, a regulating valve therefor provided with a piston, a relief valve also provided with a piston, the area of the outer face of said regulating valve piston being greater than the inner face thereof, and means for introducing fluid from said nozzle between said pistons and also on the outer side of said regulating valve piston.

15. A relief mechanism of the character described comprising a nozzle, a cylinder adjacent thereto, a regulating valve for said nozzle provided with a piston working in said cylinder, a relief valve for said nozzle also provided with a piston working in said cylinder, and a pipe or conduit leading from said nozzle to said cylinder.

16. A relief mechanism of the character described comprising a nozzle, a cylinder adjacent thereto, a regulating valve for said nozzle provided with a shaft, a piston mounted on said shaft and working in said cylinder, a relief valve mounted on said shaft and also provided with a piston working in said cylinder, and a pipe or conduit leading from said nozzle to said cylinder.

17. A relief mechanism of the character described comprising a nozzle, a cylinder adjacent thereto, a regulating valve for said nozzle provided with a piston working in said cylinder, the area of the outer face of said piston being greater than the area of the inner face, a relief valve also provided with a piston working in said cylinder, and a pipe or conduit leading from said nozzle and communicating with said cylinder on both sides of said regulating valve piston.

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

ELMER F. CASSEL.

Witnesses:
M. T. McAneny,
J. H. Yeo.