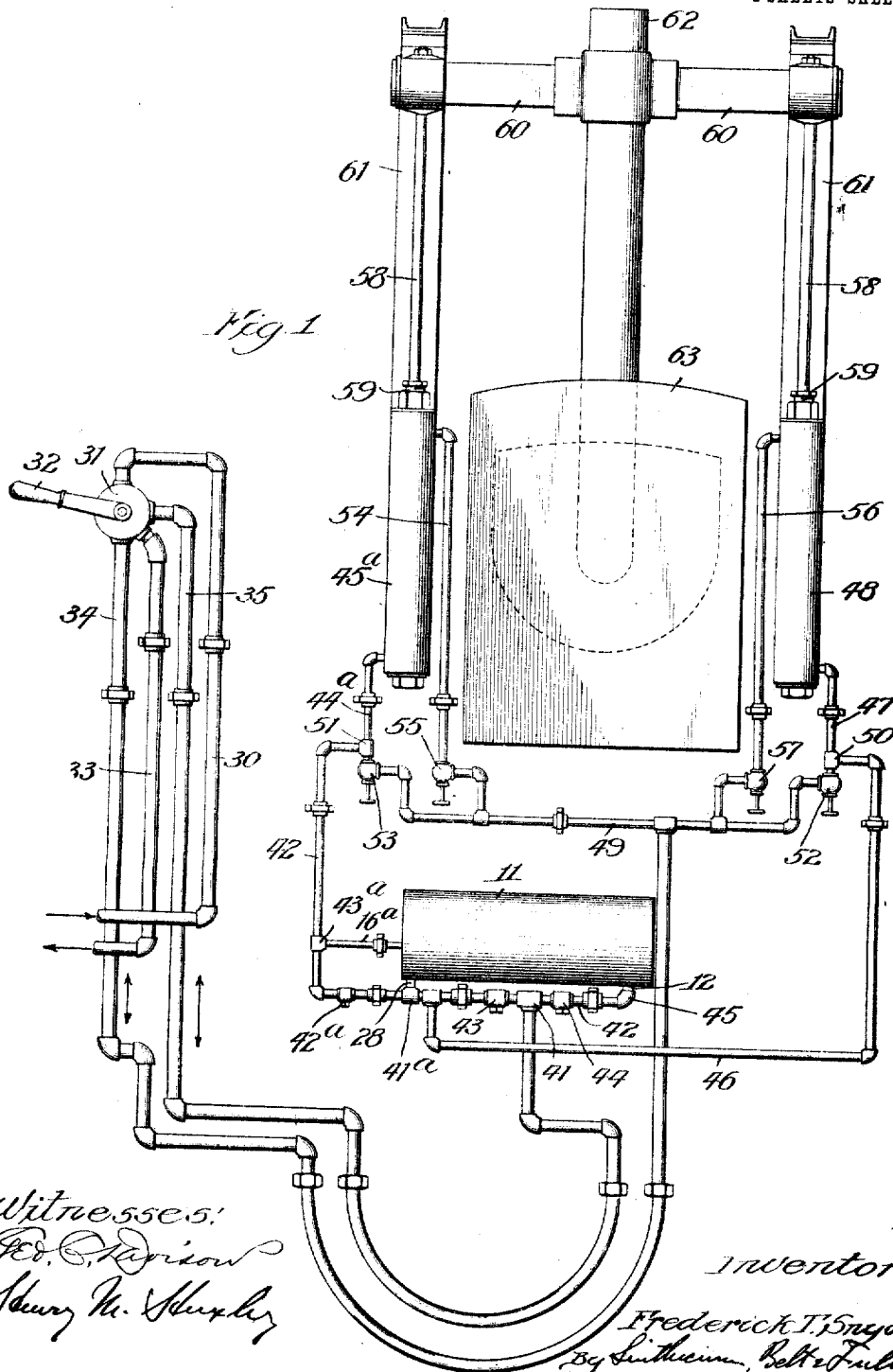


F. T. SNYDER.
HYDRAULIC EQUALIZER.
APPLICATION FILED JUNE 3, 1910.

1,010,000.

Patented Nov. 28, 1911.

2 SHEETS—SHEET 1.

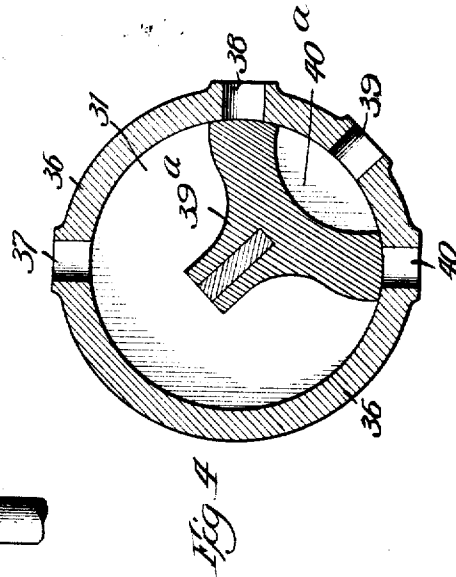
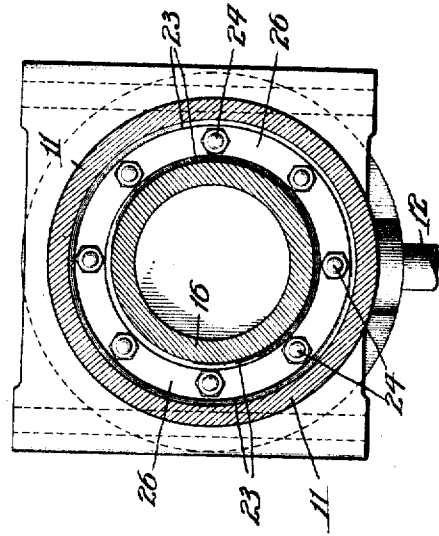
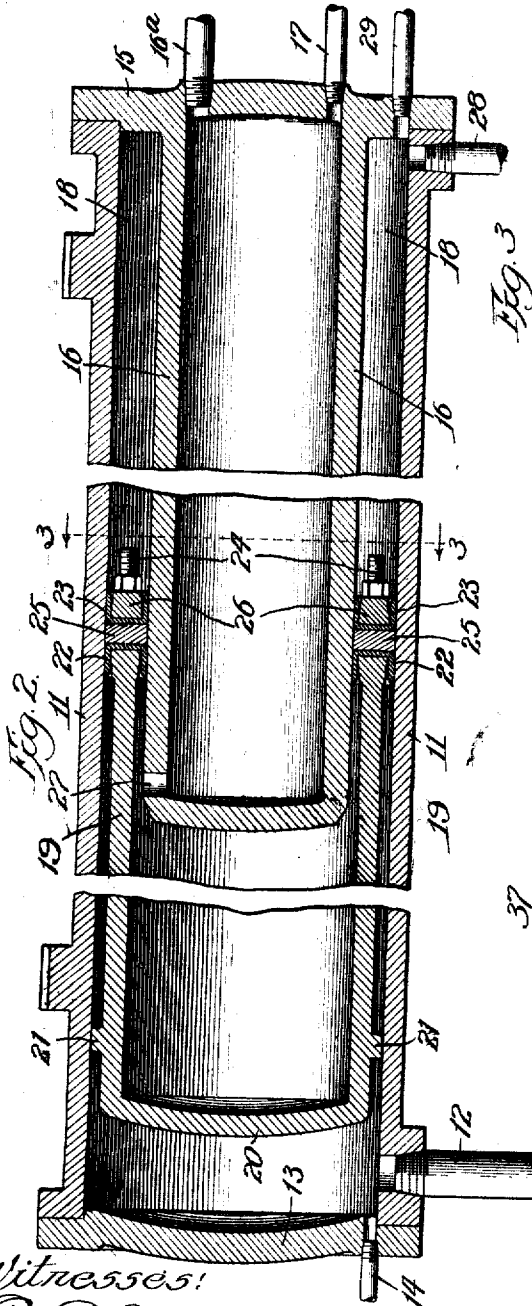


F. T. SNYDER.
HYDRAULIC EQUALIZER.
APPLICATION FILED JUNE 3, 1910.

1,010,000.

Patented Nov. 28, 1911.

2 SHEETS—SHEET 2.



Witnesses:
Geo. J. Davison
Henry H. Shupler

Inventor
Frederick T. Snyder
By Luthien, Belt & Fuller
Attys.

UNITED STATES PATENT OFFICE.

FREDERICK T. SNYDER, OF CHICAGO, ILLINOIS, ASSIGNOR TO AMERICAN STEEL
FOUNDRIES, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

HYDRAULIC EQUALIZER.

1,010,000.

Specification of Letters Patent. Patented Nov. 28, 1911.

Application filed June 3, 1910. Serial No. 564,900.

To all whom it may concern:

Be it known that I, FREDERICK T. SNYDER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Hydraulic Equalizers, of which the following is a specification.

My invention relates to hydraulic equalizers, and is particularly adapted for use in connection with the electrode regulating means of electric furnaces, although it may be applied to a great variety of hydraulic mechanisms.

In the electrode feeding or regulating mechanism in connection with which my invention is particularly adapted for use, I employ a number of cylinders, within each of which a piston, with its attached piston rod, is adapted to operate. On the ends of the two piston rods is attached a cross-head which supports the electrode.

Each of the hydraulic cylinders is connected through suitable pipes with an equalizer, which serves to keep the pressure equal in the two cylinders, and in case one side of the cross-head, or one of the piston rods, meets with any obstruction in its operation, a greater amount of pressure is exerted on the piston which is thus obstructed. This equalizer, which forms the subject matter of my invention, comprises an outer cylinder, within which is a second cylinder of smaller diameter, which is fastened to or integral with one cylinder head of the larger cylinder. This inner cylinder is in direct communication with the supply pipe of one of the hydraulic cylinders, which operates the adjusting mechanism for the electrode. The annular space between the outside of the inner cylinder and the inside of the outer cylinder has a cross-sectional area the same as that of the inner cylinder. A third movable cylinder is located within the outer cylinder and its longitudinal wall is adapted to move in the annular space between the outer cylinder and the inner cylinder first mentioned. The edge of this longitudinal wall is provided with packing, which closely fits the annular space between the outer and inner cylinders.

Water is supplied to that portion of the equalizer which lies outside of the end of the cylinder, which operates within the annular space, above mentioned. The interior

of the intermediate cylinder and the interior of the inner cylinder are in communication through a suitable opening.

The annular space lying between the outer and inner cylinders is in direct communication with the second hydraulic cylinder, which is associated with the regulating mechanism of the electrode. It will now be apparent that when water is supplied to the equalizer, the intermediate cylinder will be moved, and, inasmuch as the cross-sectional area of the inner cylinder and the annular space are equal, equal pressure will be transmitted through the intermediate cylinder to the two hydraulic cylinders associated with the electrode regulating mechanism. On the other hand, if the piston rod of one of the hydraulic cylinders becomes obstructed in its operation, the intermediate cylinder of the equalizer will now exert all of its pressure on this cylinder, inasmuch as the water, which communicates with the other hydraulic cylinder, will not offer any resistance to the action of the intermediate cylinder of the equalizer.

These and other advantages of my invention will be more readily understood by reference to the accompanying drawings, which represent a preferred embodiment of my improvements, and in which—

Figure 1 is a diagrammatic representation of my equalizer as used in connection with an electrode regulating device, the system of piping being clearly shown. Fig. 2 is an enlarged vertical, longitudinal section through my equalizer. Fig. 3 is a transverse section on the line 2—3 of Fig. 2, and Fig. 4 is an enlarged vertical section of the regulating valve.

I will first describe the detailed construction of my equalizer and will then describe its use in connection with the regulation of the electrode.

The cylinder 11 is supplied with high pressure fluid through the pipe 12, which, as indicated in Fig. 2, opens into the left-hand end of the cylinder 11. The same end of the cylinder has the cylinder head 13, which is provided with the small drain pipe 14, in order to remove all water or other fluid from the cylinder 11 when occasion demands. The opposite end of cylinder 11 has a cylinder head 15 integral with which is formed the inner cylinder 16. Communi-

cating with the inner cylinder is the pipe 16^a and the drain pipe 17, having a similar function to the pipe 14 above mentioned. The annular space 18 formed between the inner surface of cylinder 11 and the outer surface of the inner cylinder 16 is equal in cross-sectional area to the inside of the inner cylinder 16. An intermediate cylinder 19, having the head 20, the outer surface of which is preferably parallel with the inner surface of the cylinder head 13, is adapted to operate in the annular space 18. This intermediate cylinder 19 has an annular ridge 21 in order to keep the intermediate cylinder 19 in its proper position within the cylinder 11. The edge of the intermediate cylinder 19 is provided with packing rings 22 and 23 which are held in position by means of the bolts 24 and the metallic rings 25 and 26. The packing rings 22 and 23 form a tight joint with the outside of the inner cylinder 16 and the inside of the outer cylinder 11, so that no fluid can pass from that portion of the annular space 18 located to the right of the edge of the intermediate cylinder 19 to the portion of the annular space 18 located to the left thereof. An opening 27 affords communication between the inside of inner cylinder 16 and intermediate cylinder 19. A pipe 28 communicates with the annular space 18 and the cylinder head 15 is also provided with a drain or drip pipe 29 for the same purpose as pipes 14 and 17.

Having thus described the detailed construction of my equalizer, I will next describe the system of connections for the supply of high pressure fluid and the method of supplying fluid to the cylinders by means of which the adjustment of the electrode is effected.

A supply pipe 30 is connected with the three-way valve 31, operated by means of the lever 32, also connected with the same valve are the discharge pipe 33 and the pipes 34 and 35, the function of which will be described hereafter.

The construction of the three-way valve 31 is best shown in Fig. 4. The valve casing 36 is provided with openings 37, 38, 39 and 40, which are connected respectively with pipes 30, 35, 33 and 34. Operating within the casing 36 is the valve member 39^a, having the recess 40^a. This member 39^a is rotated by means of the lever 32. When valve member 39^a is in the position shown in Fig. 4, it will be apparent that no two of the openings 37, 38, 39 and 40 are in communication with each other, and for this reason no liquid will flow from inlet pipe 30, through opening 37, to any of the pipes 33, 34 or 35.

If the valve member 39^a is rotated in a contra-clockwise direction, the openings 38 and 39 are brought into connection with

each other through the recess 40^a. At the same time the valve member 39^a is moved away from opening 40 and in this way connection is established between inlet pipe 30 and pipe 34, and at the same time between outlet pipe 33 and pipe 35. If instead of rotating the valve member 39 in a contra-clockwise direction, it is rotated in a clockwise direction, communication may be established in a similar manner between openings 39 and 40, and thereby between pipes 33 and 34, and at the same time between pipes 30 and 35. It will now be evident that when the valve member 39^a is rotated in a contra-clockwise direction, as first specified, water or other fluid will flow from the inlet pipe 30 through the pipe 34; whereas, if the valve member is moved in a clockwise direction, the fluid from pipe 30 will flow through pipe 35, in the former case pipe 35 being connected with outlet pipe 33 and in the latter, pipe 34 being connected with the same outlet pipe. Pipe 35 communicates by means of T-coupling 41 with pipe 42, which has the valve 43 located on one side of the coupling 41 and the valve 44 located on the opposite side thereof. Pipe 42 is in direct communication through elbow 45 with the pipe 12 above mentioned. Pipe 42 is also connected through the T-coupling 41^a with pipe 28, which leads to the annular space 18 of the equalizer. Pipe 42 beyond the T-coupling 41^a has the valve 42^a and is also connected by means of T-coupling 43^a with pipe 16^a, which communicates with the inner cylinder 16. Pipe 42 leads finally to pipe 44^a, which is in direct communication with the lower end of the adjusting cylinder 45^a.

Connected with pipe 42, between the valve 43 and the T-coupling 41^a, is the pipe 46; which leads to pipe 47 communicating with the lower end of the adjusting cylinder 48. Pipe 49 is connected on one end by means of T 50 with the pipes 46 and 47, and on its opposite end by means of T 51 with the pipes 42 and 44^a. Valves 52 and 53 are placed on the two ends of pipe 49 so that its communication with pipes 46 and 47 and with pipes 42 and 44^a may be interrupted at will.

A pipe 54 leads from the upper end of adjusting cylinder 45^a to the pipe 49 and is supplied with valve 55. Similarly pipe 56 leads from the upper end of adjusting cylinder 48 to pipe 49, and has the valve 57. Pipe 34 leads from the three-way valve 31 to the pipe 49, being connected therewith between the points of connection of pipe 49 with pipes 54 and 56 respectively. Each of the adjusting cylinders 45^a and 48 is provided with a piston which is connected with piston rod 58, passing through stuffing box 59. The upper ends of each of these piston rods are connected with the cross-head 60

operating in connection with the guides 61, and supporting the electrode 62, which passes downwardly into furnace 63.

The operation of my equalizer and the various parts associated therewith may now be readily understood. When it is desired to move the electrode 62 in an upward direction, the valve member 39^a is moved in a clockwise direction by means of handle 32, so that connection is established between the supply pipe 30 and pipe 35. The high pressure water, therefore, passes through pipe 35 to pipe 42. The valve 44 is normally open and valve 43 is normally closed, so that the water passes next through pipe 12 into the end of the outer cylinder 11 of the equalizer. Pressure is thus exerted on the end or head 20 of intermediate cylinder 19, which is thereby moved to the right, as shown in Fig. 2. The fluid within the left hand end of intermediate cylinder 19 is thereby forced through opening 27 into the inner cylinder 16 and thence through pipe 16^a, while at the same time the fluid in the annular space 18 is forced outwardly through pipe 28. It will be apparent that inasmuch as the cross-sectional area of the annular space 18 is the same as that of the inner cylinder 16, the pressure of the water or other fluid passing through 16^a and 28 will be the same. The fluid passing outwardly through pipe 16^a reaches the pipe 42, and inasmuch as valve 42^a is normally closed, this fluid passes upwardly into pipe 44^a and thence into the bottom of the adjusting cylinder 45^a, thereby forcing the piston connected with piston rod 58 in an upward direction. The fluid within the cylinder 45^a above the piston is thereby forced outwardly through pipe 54. Valve 55 is normally open so that the fluid next passes into pipe 49. Inasmuch as valves 52 and 53 are normally closed, the fluid will next pass through pipe 34 and to valve 31, and then through the outlet pipe 33. In a similar manner the fluid passing through pipe 28 first enters pipe 42, and inasmuch as valves 43 and 44 are normally closed, it next passes through pipe 46 into pipe 47, and thence into the bottom of adjusting cylinder 48. The piston is thereby forced upwardly and fluid is forced out of the upper part of adjusting cylinder 48, through pipe 56 into pipe 49, and thence through pipe 34 to the valve 31, from which it passes into the outlet pipe 33. When the electrode 63 is thus moved upwardly to its desired position, the valve member 39^a is moved into the position shown in Fig. 4, and further upward movement is thereby stopped.

Let us now assume that it is desired to move electrode 62 in a downward direction. Valve member 39 is moved by handle 32 in a contra-clockwise direction, so that communication is established between supply pipe

30 and pipe 34, and between pipe 35 and outlet pipe 33. The water or other fluid flowing through pipe 30 passes through pipe 34 and thence through the course which we have just traced to the upper ends of adjusting cylinders 48 and 45^a. The pistons between these cylinders are thereby forced in a downward direction, water being forced outwardly through pipes 44^a and 47 into the inner cylinder 16 and the annular space 18 respectively. The intermediate cylinder 21 is thereby forced to the left, as indicated in Fig. 2, and fluid flows outwardly through pipe 12 into pipe 42, and then through pipe 35 to valve 31, from which it finally passes through outlet pipe 33. When the electrode 63 is being moved in an upward direction, let us assume for example that one end of the cross-head, associated with the piston rod 58 of the adjusting cylinder, 45^a, becomes obstructed. In its movement to the right, as shown in Fig. 2, the intermediate cylinder 19 must exert pressure simultaneously on the fluid within the annular space 18 and the inner cylinder 16. The piston within the adjusting cylinder 48, which is connected through the pipe 28 with the annular space 18, is in no way obstructed, so that in order to move the intermediate cylinder 19 farther to the right, pressure will be transferred more and more to the fluid within the inner cylinder 16, which is connected with adjusting cylinder 45, and proportionately less pressure will be exerted on the fluid within the annular space 18. This being the case, the obstruction to the upward movement of the end of the cross-head 60, associated with the piston rod 58 of the adjusting cylinder 45, will be overcome and an equal upward movement of the two ends of the cross-head will result. On the other hand, if there should be an obstruction in the downward movement of the electrode 62, the piston whose operation is not obstructed will exert more pressure on the fluid within the inner cylinder 16 or the annular space 18, as the case may be, than the piston which is obstructed, thereby causing the resistance of the fluid within the annular space 18, or the inner cylinder 16, connected with the adjusting cylinder in which the obstructed piston operates, to be lessened and thus causing the pressure of fluid supplied to the upper part of the adjusting cylinder, in connection with which the obstruction occurs, to become more effective and so overcome the effect of the obstruction.

If for any reason it is desired to cut out the equalizer, valve 44 is closed and valves 43 and 42^a are opened. In this way fluid entering through pipe 35 will pass through pipes 42 and 44^a to adjusting cylinder 45^a, and through pipes 42, 46 and 47 to adjusting cylinder 48. If it is desired to cut out both of the adjusting cylinders 45^a and 48 for the

purpose of flushing the pipes, or the like, the valves 52 and 53 are opened and valves 55 and 57 are closed. The fluid from pipe 42 will now pass into pipe 49 and thence into pipe 34, and, similarly, the fluid from pipe 46 will pass into pipe 49 and thence into pipe 34. When it is desired to supply inner cylinder 16 and annular space 18 with additional water, valves 55 and 57 are closed and valves 53 and 52 are opened, the valve member 39^a being moved into position so that water will flow inwardly through pipe 34 into pipe 49. This water now flows through pipes 42 and 16^a into inner cylinder 16 and through pipes 46, 42 and 28 into the annular space 18, thus causing the intermediate cylinder 19 to be moved to the left as indicated in Fig. 2, and causing water to flow outwardly through pipe 12 into pipe 42, and thence into pipe 35 through valve 31 into outlet pipe 33, the valve 44 being open and valve 43 being closed.

It will be apparent to those skilled in the art that many changes may be made in the detailed construction of the parts, which I have described, without departing from the spirit of my invention. Not only may my equalizer be used in connection with water but also with other fluids, and it may be applied to the regulation of many devices outside of electrodes for electric furnaces.

What I claim is:

1. In an equalizing device, the combination of an outer casing, an inner casing within said outer casing, thereby leaving an annular space between said casings and forming a pair of chambers, one within the other, each provided with an outlet therefrom, and means for simultaneously exerting pressure on the fluid within said chambers, obstruction to the out-flow of fluid from either of said chambers thereby causing increased pressure to be exerted on the fluid within said chamber, substantially as described.
2. In an equalizing device, the combination of an outer casing, an inner casing within said outer casing, thereby forming an inner chamber and an annular chamber outside of said inner chamber, each of said chambers provided with an outlet therefrom, a movable member adapted to reciprocate within said outer chamber, and simultaneously exert pressure on the fluid within said outer and inner chambers, obstruction to the out-flow of fluid from either of said chambers thereby causing a proportionately increased pressure to be exerted by said movable member on the fluid within said chamber, substantially as described.
3. In an equalizing device, the combination of an outer casing, an inner casing within said outer casing, thereby forming an inner chamber and an annular chamber outside of said inner chamber, each of said chambers provided with an outlet therefrom,

and a movable member adapted to reciprocate within said outer chamber, said inner chamber being provided with an aperture for establishing communication between the inside of the inner chamber and the inside of the movable member, reciprocation of said member within the outer chamber thereby causing pressure to be simultaneously exerted on the fluid within said outer and inner chambers, obstruction to the out-flow of fluid from either of said chambers causing a proportionately increased amount of pressure to be exerted on the fluid within said chamber, substantially as described.

4. In an equalizing device, the combination of an outer casing, an inner casing within said outer casing, the chamber in said inner casing being of substantially the same cross-sectional area as the outer chamber formed between the outer casing and the inner casing, a movable member adapted to reciprocate within said outer chamber and having its interior in communication with the interior of said chamber, and means for actuating said movable member, thereby causing pressure to be simultaneously exerted on the fluid within said outer and inner chambers, obstruction to the out-flow of fluid from either of said chambers thereby causing an increased amount of pressure to be exerted on the fluid within said chamber, substantially as described.

5. In an equalizing device, the combination of an outer cylinder, an inner cylinder within said outer cylinder, an annular chamber thereby being formed between said inner and outer cylinders, said outer and inner cylinders provided with outlets therefrom, an intermediate cylinder adapted to move within the annular chamber between said outer and inner cylinders, said inner cylinder having an aperture affording communication with the inside of said intermediate cylinder, and means for actuating said intermediate cylinder, thereby simultaneously exerting pressure on the fluid within the inner cylinder and the annular chamber between the inner and outer cylinders, obstruction to the out-flow of fluid from either of said chambers, thereby causing a proportionately increased amount of pressure to be exerted on the fluid within said chamber, substantially as described.

6. In an equalizing device, the combination with an outer cylinder, of an inner cylinder within said outer cylinder, the cross-sectional areas of the chamber within said inner cylinder and of the annular chamber formed between said outer and inner cylinders being substantially the same, an intermediate cylinder closed at one end and adapted to reciprocate within said annular chamber, packing means on the edge of said intermediate cylinder within said annular chamber, the inside of said intermediate

5 cylinder being in communication with the chamber within said inner cylinder through an aperture in the latter, and fluid means for actuating said intermediate cylinder, thereby causing pressure to be exerted on the fluid within said inner and annular chambers, obstruction to the out-flow of fluid from either of said chambers thereby

causing a proportionately greater pressure to be exerted on the fluid within said chamber, substantially as described. 10

FREDERICK T. SNYDER.

Witnesses:

HENRY M. HUXLEY,
MILTON MILLER.