No. 708,912. Patented Sept. 9, 1902.

P. F. ODDIE.

EQUALIZING DEVICE FOR STEAM PUMPS.

(Application filed Oct. 24, 1901.)

(No Model.) 4 Sheets—Sheet 1.

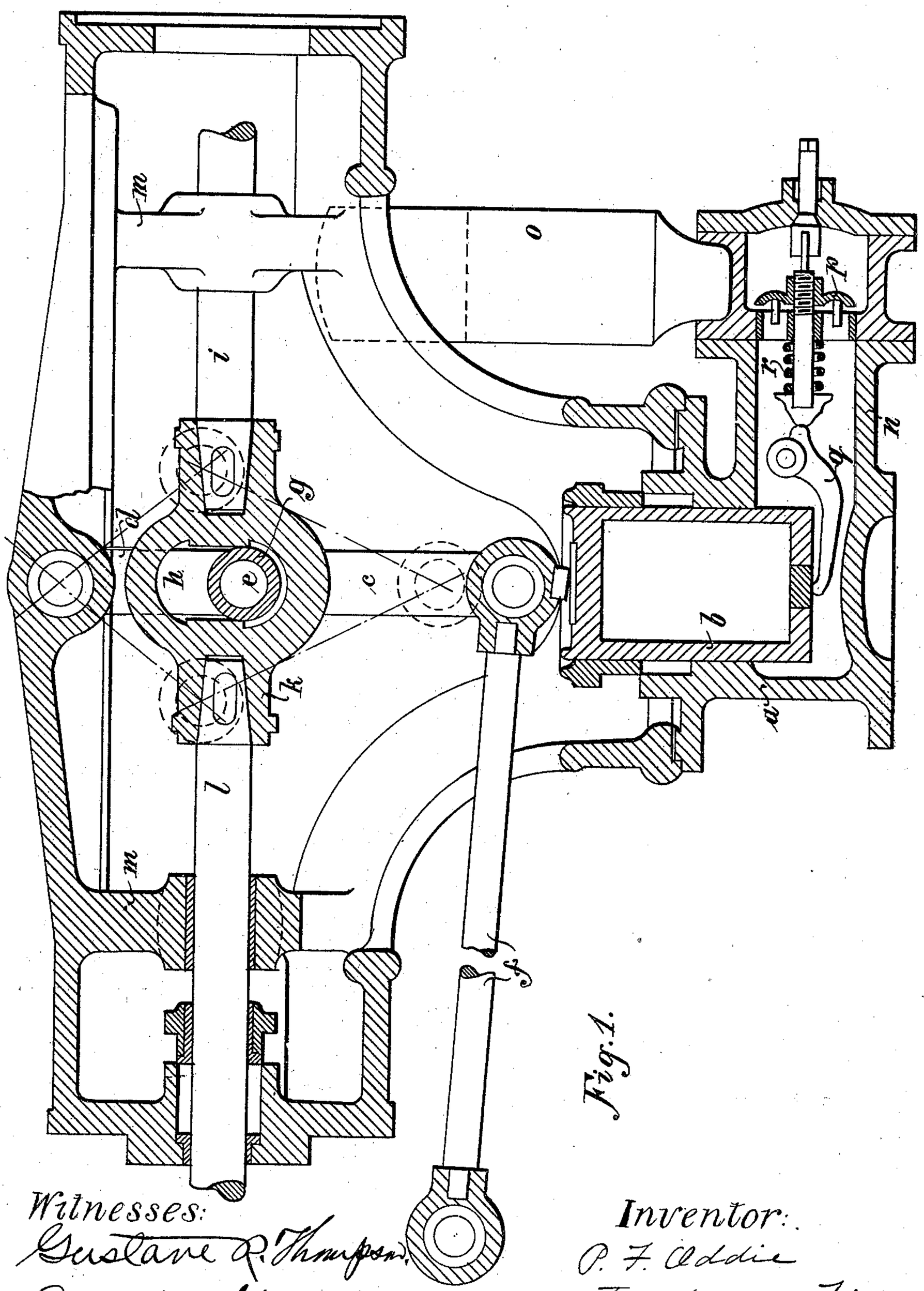

Fig. 1.

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(No Model.) 4 Sheets—Sheet 2.

Fig. 5.

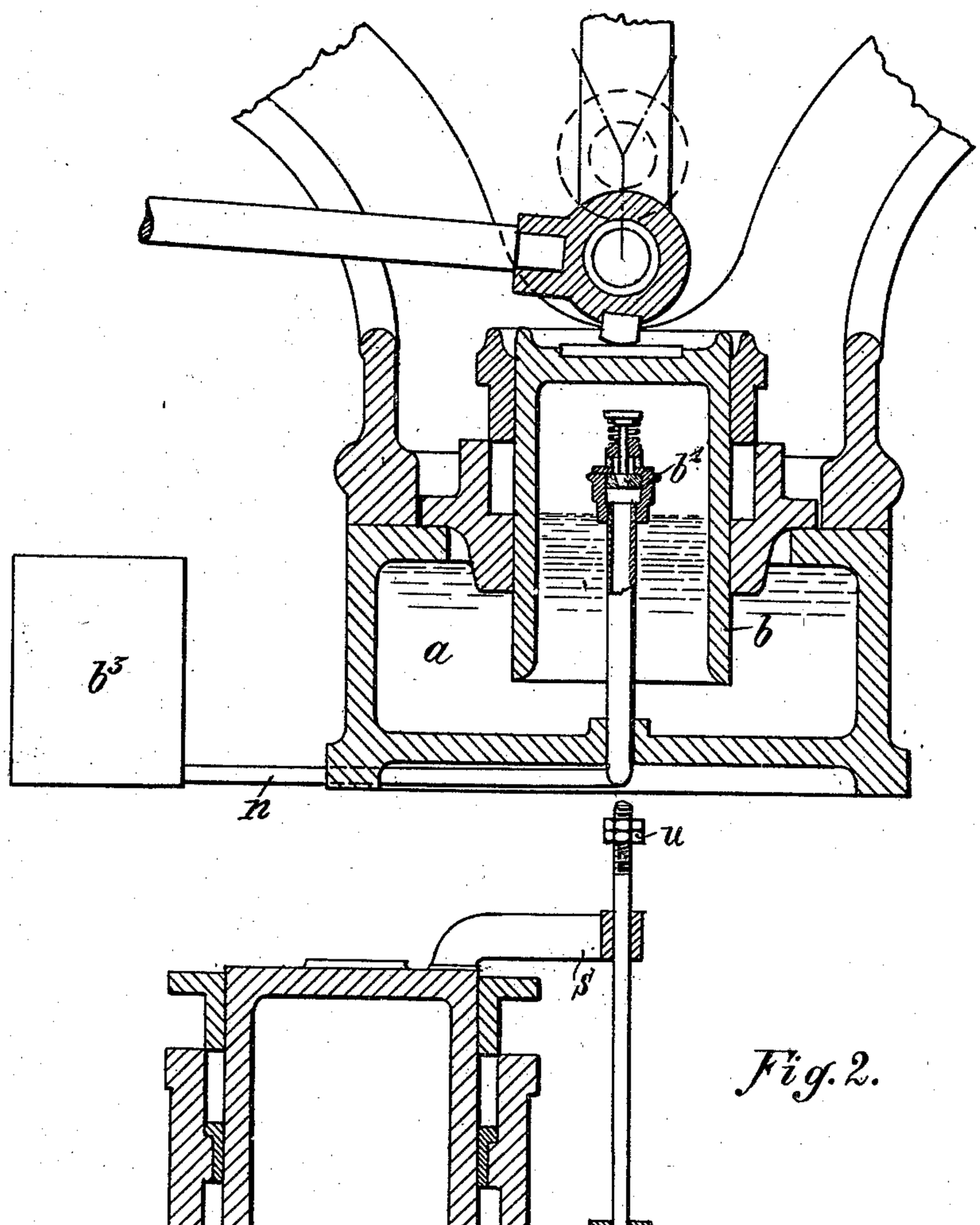

Fig. 2.

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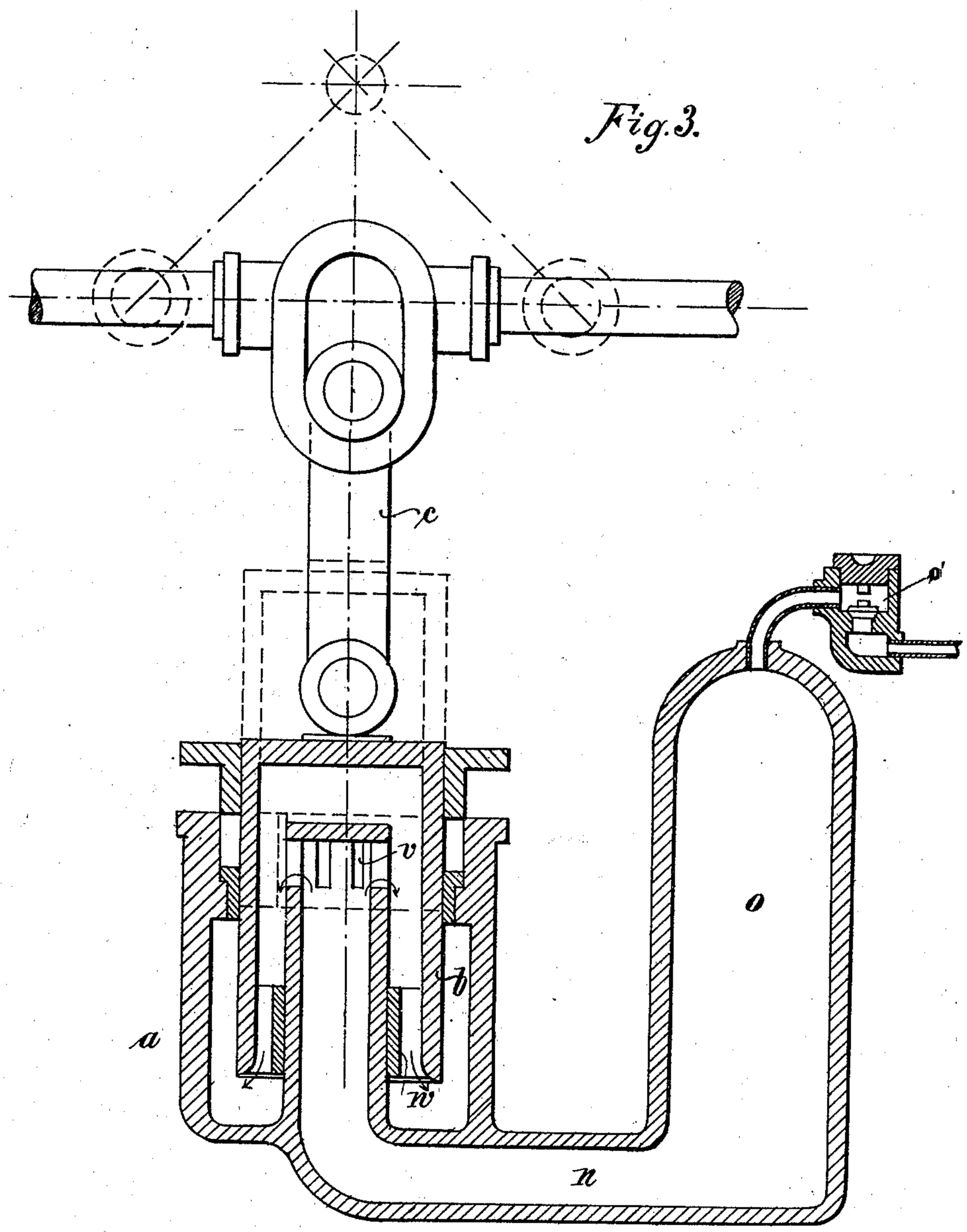
4 Sheets—Sheet 3.

Fig. 3.



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EQUALIZING DEVICE FOR STEAM PUMPS.

(Application filed Oct. 24, 1901.)

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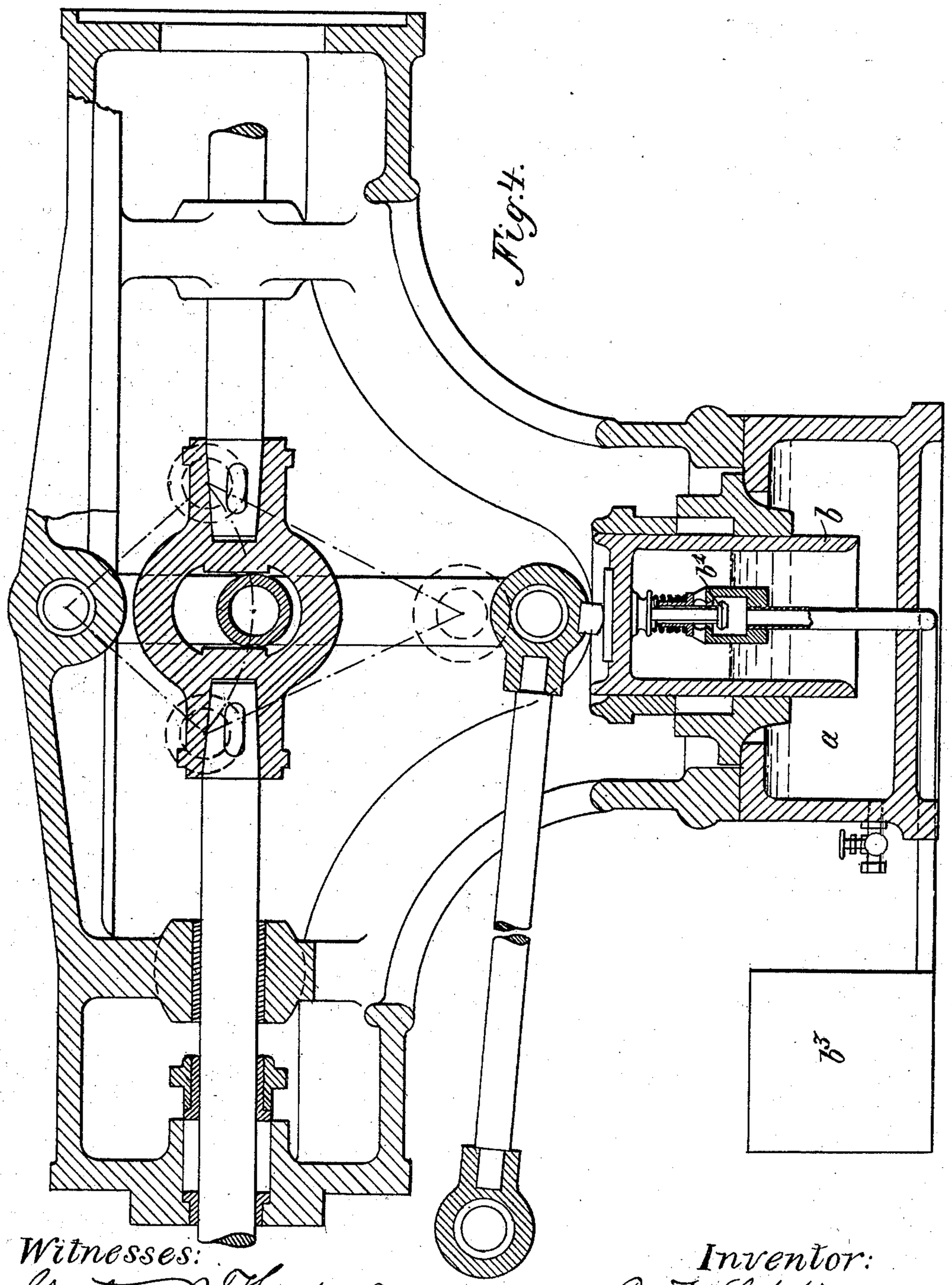

Fig. 4.

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UNITED STATES PATENT OFFICE.

PHILIP FRANCIS ODDIE, OF OSCHERSLEBEN, GERMANY.

EQUALIZING DEVICE FOR STEAM-PUMPS.

SPECIFICATION forming part of Letters Patent No. 708,912, dated September 9, 1902.

Application filed October 24, 1901. Serial No. 79,868. (No model.)

To all whom it may concern:

Be it known that I, PHILIP FRANCIS ODDIE, civil engineer, a subject of the King of Great Britain and Ireland, residing at Oschersleben, near Magdeburg, Germany, have invented new and useful Improvements in Compensating or Equalizing Devices for Direct-Acting Steam-Pumps, of which the following is a specification.

My invention relates to a compensating or equalizing device for direct-acting steam-pumps.

The value of my invention lies in the method employed for increasing the effective power of the compensator in the middle of the stroke.

The invention is illustrated in the annexed drawings, in which—

Figure 1 represents the arrangement of the rods or links operated by the cross-head, whereby the excess of power of the pump-piston is transmitted to an equalizing-piston, and the arrangement of the valve controlled by the compensating piston. Fig. 2 is a modified arrangement of the valve. Fig. 3 shows the valve arranged within the hollow compensating piston. Fig. 4 is a modified form of my invention. Fig. 5 is another modified form.

The improved arrangement affords a very good equalization of pressure, the pressure means behind the piston being either water or air under variable pressure, or air and water or other liquid can be employed simultaneously. The pressing medium acting upon the equalizing-piston can, according to the present invention, by means of convenient valves, be closed at certain times, whereby the piston is prevented from acting upon the pump-piston at inconvenient times.

a is the compensating cylinder, and b the compensating piston or plunger. c and d are links or levers pivoted together at e. The lower end of the lower lever c is guided by a lateral rod f and rests freely upon the equalizing-piston b without being connected thereto. The two levers c and d are pivoted together by means of a bolt e, upon which is rotatably mounted a roller g, which can slide in a slot h in the cross-head k of the pump-piston rod i. The cross-head k is connected with the steam-piston and pump-piston rods l and i, which are guided in convenient bearings m, mounted upon the engine-frame. The space beneath the equalizing-plunger b is connected through a conduit n with an air chamber or vessel o. The latter is partly filled with oil or other liquid. The remaining space is filled with compressed air, which is maintained under constant pressure. In Fig. 1 I have not shown any means for accomplishing this end. It is obvious, however, that this may be accomplished in numerous ways. For instance, a suitable compressed-air reservoir, as shown at b^3, Fig. 4, could be connected by a branch pipe to the top of the reservoir o, a suitable valve o' being arranged in the branch pipe to control the delivery therethrough, as shown in Fig. 3. The power acting in the first half of the stroke upon the equalizing-plunger is given back to the engine during the second half of the stroke, when the pressure acting upon the steam-piston is reduced in consequence of the expansion of the working fluid.

In order to regulate the length of the stroke of the steam and water pistons and to prevent the compensating plunger from driving the pump-pistons against the cylinder-covers, a valve p is arranged in the conduit n, which connects the air vessel o with the interior of the compensating cylinder a, said valve being positively closed before the pistons finish their stroke. The pressure acting below the plunger is cut off by closing the valve, and consequently the piston is put out of action. The valve can be controlled in various manners. It can, for instance, be operated by means of a pivoted lever q, one end of which constantly bears against the inner face of the plunger, while its other and shorter end engages a projection on the valve-spindle, provided with a valve-closing spring r.

According to the modified arrangement in Fig. 2 the valve is constructed as a piston-valve and is controlled by an arm s, secured to the upper side of the plunger. The valve-spindle passes freely through this arm and is constantly pressed downward by a spring t, so as to maintain the valve in its open position. If, however, the plunger has reached the permissible limit of its outer stroke, the arm on the plunger comes in contact with a nut or projection u on the valve-spindle. On

the further ascent of the plunger the piston-valve is raised and closes the connection between the cylinder and the compressor and reservoir, thus preventing the pressure medium from entering the cylinder. The nut *u* can be adjusted so as to operate the valve at any desired point of the stroke.

A further modification in the valve consists in the conduit being in the form of a pipe extending into the equalizing-cylinder. This pipe is closed at the top and provided, however, with lateral slots *v* near thereto. The plunger is hollow and provided in its inner end with a sleeve *w*, which fits tightly upon the pipe. Consequently the fluid passes from the pipe through the slots and into the pistons and cylinder. When, however, the plunger moves outward toward the end of its stroke, the sleeve passes over the slots and closes the latter, thereby preventing the driving medium from further entering the compensating cylinder.

According to a modified construction the operation is effected by the cross-head in such a way that while the latter reciprocates in a straight line the driven end of the lower lever connected to the cross-head can move in an arc described from its fulcrum or pivotal point arranged in the axial line of the equalizing-cylinder. The upper lever is extended beyond its pivotal point, and to its extension is linked a rod which is used as an operating means for the valve-gear of the steam-cylinders. To insure safety, usually double levers are arranged, in which case if distribution and expansion valves or slides are used the extension of the second lever serves for operating the expansion-slides. It has been practically proved that the ratio of motion of the links is very favorable for the operation of the valve-gear. The equalizing-cylinder can of course be arranged either above or below the cross-head of the steam cylinder and pumps, or at the side if the latter are arranged vertically.

Fig. 4 shows a simple and convenient method of producing a perfect equalization. The compensating cylinder, piston, rods, cross-head, and leverage are the same as shown in Fig. 1. The chamber *a* is filled with oil, water, or other liquid to a certain height, while the plunger of the compensator is hollow and forms in its upper portion an air vessel. The end of a pipe *b*, to which is attached the small valve *b'*, passes into the air-space of the compensating plunger. The other end of the pipe is in communication with an air-reservoir b^3, which is kept at the required constant pressure by means of a small air-compressor or by some other convenient source. At the middle of the stroke the compensating plunger is in its lowest position and is made to open this valve. Consequently air is admitted to the air vessel in the plunger at the pressure of the reservoir. As the stroke proceeds the plunger rises, the valve is closed, and the air inclosed in the hollow plunger expands and decreases in pressure until the end of the stroke is reached. On the return stroke the reverse action takes place. The air is compressed and increases in pressure as the plunger descends until the middle of the stroke is again reached, when the valve is again opened and communication made with the air-reservoir. Thus the pressure in the middle of the stroke is always maintained the same as that in the reservoir. The liquid in the chamber *a* serves two objects—first, by altering the level of the liquid the size of the air-chamber or clearance-space can be reduced or enlarged at will, and consequently the difference of pressure between the middle and the ends of the stroke exactly regulated to suit any given steam-pressure and ratios of expansion in the main steam-cylinders; secondly, the liquid forms a seal around the plunger, and thus prevents air-leakage through the stuffing-box gland.

I can of course without departing from the principle of the invention also arrange that the pressure at the extreme ends shall be the pressure of the reservoir. It is then only necessary to supply in place of the valve *b* an automatic valve, which shall open and supply air whenever the pressure in the plunger shall have fallen slightly below that of the reservoir. Such an arrangement is shown in Fig. 5. In this case the air at the end of the stroke is practically the same as the pressure in the reservoir; but as the stroke proceeds the air in the compensating plunger descends until the middle of the stroke is reached, when the pressure is at its maximum. After this the plunger begins to ascend, the air expanding and falling in pressure to the end of the stroke. The amount of this compression is regulated, as before, by the height of the oil in the chamber *a*.

Having now particularly described and ascertained the nature of the said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In a compensator for direct-acting engines, the combination with the main piston-rod provided with a cross-head, links pivoted together in said cross-head, and one of said links being also pivoted to a guide-rod, of a piston working in a compensating cylinder for transmitting to the main piston-rod in the second half of the stroke, through the medium of said links, the power stored up in the first half of the stroke, and means for arresting the action of said compensating piston at predetermined points, substantially as described.

2. In a compensator for direct-acting engines, the combination with the main piston-rod provided with a cross-head, links pivoted together in said cross-head, and one of said links being also pivoted to a guide-rod, of a piston working in a compensating cylinder for transmitting to the main piston-rod in the second half of the stroke, through the medium of said links, the power stored up in the first half of the stroke, and means operated by

said compensating piston for relieving the pressure thereon at predetermined times, substantially as described.

3. In a compensator for direct-acting engines, the combination with a main piston-rod, provided with a cross-head, links pivoted together in said cross-head, and one of said links being also pivoted to a guide-rod, of a piston working in the compensating cylinder for transmitting to the main piston-rod in the second half of the stroke, through the medium of said links, the power stored up in the first half of the stroke, a compressor-flask in communication with said compensator-cylinder, and a valve between said flask and cylinder, and means operated by said compensating piston for controlling the admission of pressure to said compensating cylinder, substantially as described.

4. In a compensator for direct-acting engines, the combination with the main piston-rod provided with a cross-head, links pivoted together in said cross-head, and one of said links being also pivoted to a guide-rod, of a piston working in the compensating cylinder for transmitting to the main piston-rod in the second half of the stroke, through the medium of said links, the power stored up in the first half of the stroke, a compressor-flask in communication with said compensator-cylinder, means for maintaining a constant pressure in said flask, a valve between said flask and cylinder, and means operated by said compensating piston for controlling the admission of pressure to said compensating cylinder, substantially as described.

5. In a compensator for direct-acting engines, the combination with the main piston-rod, a compensating cylinder, a piston in said cylinder, and means for transmitting motion from said second piston to the first, of a compressor-flask, a valve between said flask and cylinder, a lever having one arm engaging said valve and another arm operated by said second piston for controlling the admission of pressure to said cylinder, substantially as described.

6. In a compensator for direct-acting engines, the combination with the main piston-rod, a compensating cylinder, a piston in said cylinder, and means for transmitting motion from said second piston to the first, of a compressor-flask, a valve between said flask and cylinder, and an arm on said piston engaging a stop on the valve-stem for controlling the action of said valve, substantially as described.

7. In a compensator for direct-acting engines, the combination with the main piston-rod, a compensating cylinder, a hollow piston in said cylinder, and means for transmitting motion from said second piston to the first; of a compressor flask or reservoir, a pipe or conduit provided with apertures on the sides thereof, extending from said reservoir into said hollow piston, and a sleeve on said piston adapted to close said apertures, substantially as described.

8. In a compressor for direct-acting engines, the combination with the main piston-rod, a compensating cylinder, a hollow piston in said cylinder, and means for transmitting motion from said second piston to the first; of a compressor flask or reservoir, a pipe or conduit extending from said reservoir into said hollow piston, and a valve on the end of said pipe adapted to be operated by said piston, substantially as described.

9. In a compensator for direct-acting engines, the combination with the main piston-rod, a compensating cylinder, a hollow piston in said cylinder, and means for transmitting motion from said second piston to the first, of a compressor flask or reservoir, a pipe or conduit extending from said reservoir into said hollow piston, and a valve on said pipe operated when the pressure in said compensating cylinder falls below that in the reservoir, substantially as described.

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

PHILIP FRANCIS ODDIE.

Witnesses:

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HERMANN HOPPE.