G. W. NISTLE.

PRESSURE EQUALIZING MECHANISM FOR CYLINDERS.

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Fig. 1.

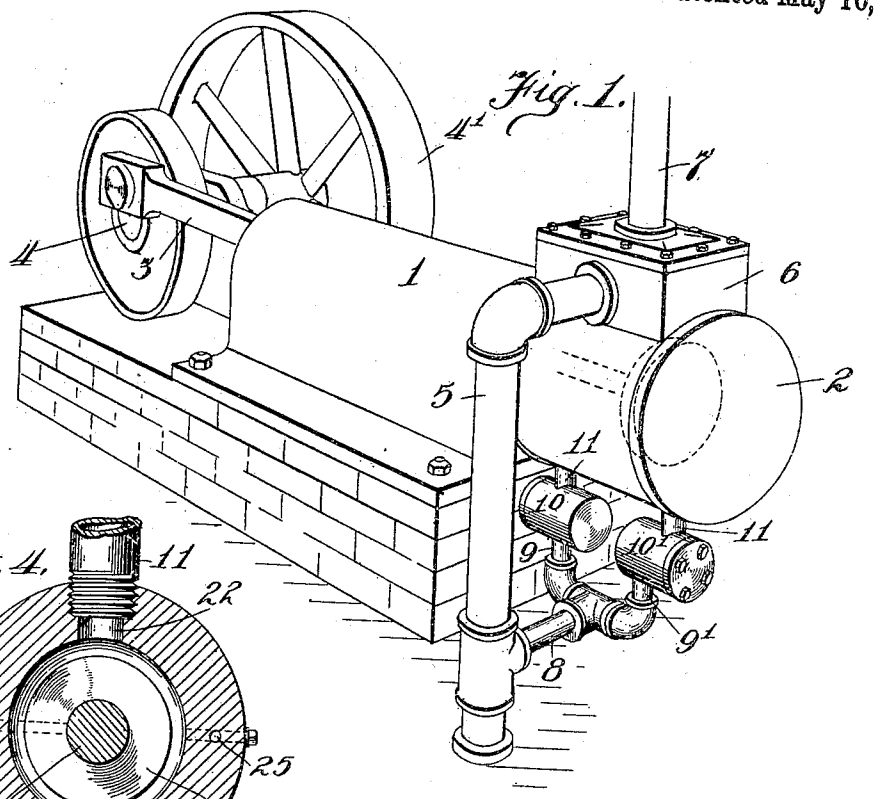


Fig. 4.

Fig. 2.

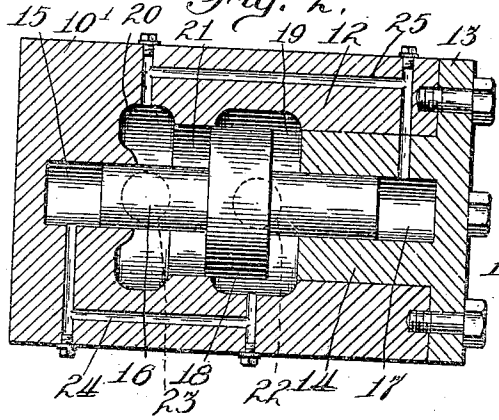
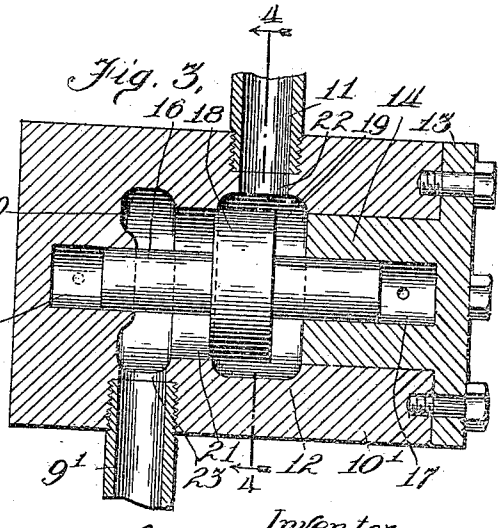


Fig. 3.



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PRESSURE-EQUALIZING MECHANISM FOR CYLINDERS.

957,241. Specification of Letters Patent. Patented May 10, 1910.

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To all whom it may concern:

Be it known that I, GEORGE W. NISTLE, a citizen of the United States, residing at North Muskegon, in the county of Muskegon and State of Michigan, have invented certain new and useful Improvements in Pressure-Equalizing Mechanism for Cylinders, of which the following is a specification.

This invention relates to improvements in pressure equalizing mechanism for cylinders, and is more particularly intended for saving or conserving part of the force which has heretofore been lost under certain conditions in driving the piston of fluid-driven engines, notably steam engines.

It is well known that in steam engine practice conditions commonly arise in which the charge of steam admitted to the cylinder or cylinders of the engine is insufficient to maintain an effective pressure on the piston throughout its entire stroke, which condition, of course, means that during the interval of no effective pressure the load is transferred to and carried by the fly-wheel. That is to say, after the admission of steam has been cut off, the charge in the cylinder will expand and the pressure on the piston decrease due to such expansion, and cooling and condensation. It frequently occurs that the pressure will thus be lowered to a point materially below the pressure in the opposite end of the cylinder, *i. e.* that pressure against which the cylinder is exhausting, and when this condition occurs it would, of course, be advantageous to equalize the pressure in the cylinder at the opposite sides of the piston, which may be done by providing a suitably controlled by-pass leading from one end of the cylinder to the other, or, in case the engine be non-condensing, might be practically accomplished by admitting atmospheric pressure behind the piston. In either event the piston would be thus relieved from advancing against an unnecessary and non-effective pressure.

It is the salient object of the present invention, therefore, to provide automatic mechanism for equalizing, or tending to equalize, the pressures upon the opposite sides of the piston of a fluid-actuated engine, when, during the advance of the piston, the pressure on the driving side falls below that at the opposite side.

The invention consists in the matters hereinafter described, and more particularly pointed out in the appended claims.

In the drawings—Figure 1 is a perspective view of a steam engine of the single cylinder type, showing the cylinder thereof equipped with a preferred embodiment of my invention; Fig. 2 is an axial sectional view taken in a horizontal plane of one of the valve casings controlling a by-pass leading from the pressure to the exhaust side of the engine; Fig. 3 is another axial sectional view taken in a plane at right angles to that of Fig. 2; Fig. 4 is a transverse sectional view taken on line 4—4 of Fig. 3 and looking in the direction of the arrows.

Referring to the drawings, 1 designates as a whole a steam engine, in which 2 designates the cylinder, 3 the connecting rod, 4 the crank shaft and 4′ the fly-wheel; these parts being of usual construction. The engine shown in this instance is of the double acting type, providing for the admission of steam at each end of the cylinder and corresponding exhaust therefrom, but the invention is applicable to engines of the single acting type.

5 designates the exhaust pipe which connects with a chest or valve casing 6, the latter containing any suitable valve mechanism, and exhaust ports controlled thereby, whereby each end of the cylinder is alternatively placed in communication with said exhaust pipe 5.

7 designates the steam inlet pipe which likewise communicates through suitable valve controlled ports within the casing 6 with the opposite ends of the cylinder.

Describing, now, the mechanism relating more particularly to the present invention, 8 designates a pipe connected at one end with the exhaust pipe 4 and at its opposite end provided with two branches 9 and 9′, which branches connect with the respective ends of the steam cylinder through valve mechanisms 10, 10′, and expansion branch pipes 11, 11. The two branch pipes 9 and 9′ serve as alternative by-passes leading from the corresponding ends of the cylinder through the pipe 8, exhaust pipe 5, and back to the opposite end of the cylinder.

Describing the details of construction of one of the valve mechanisms 10 and 10′, both being alike, and referring to Figs. 2, 3 and 4, 12 designates as a whole a thick walled cy-

lindric-shaped valve casing provided at one end with a detachable end closure 13 which has an axial cylindric plug-like extension 14 which fits into the main bore of the valve casing. The opposite end of the valve casing is axially counterbored, as indicated at 15, to receive the end of a closely fitting valve stem 16, and similarly the plug member 14 is axially bored, as indicated at 17, to receive the opposite end of the valve stem 16. The ends of the valve stem fit these bores within which they extend with such accuracy as to act as pistons under certain conditions, as will hereinafter be described. Upon the intermediate portion of the valve stem is fixed a piston member 18 which accurately fits the main bore of the casing, and the latter bore is annually enlarged to provide two port chambers 19 and 20, communication between which is controlled by the piston 18. The piston 18 is shown in its normal position in which it lies chiefly within the port chamber 19 but extends into the intermediate portion 21 of the main bore of the cylinder sufficiently to close communication between the chambers 19 and 20. The chamber 19 communicates through a port 22 and extension pipe 11 with one end of the steam cylinder, while the port-chamber 20 communicates through a port 23, branch pipe 9 or 9′ and connecting pipe 8 with the exhaust pipe 5. Obviously during the principal part of the advance stroke of the piston of the main cylinder, the valve piston 18 of the valve mechanism which communicates with that end of the cylinder will be forced from the port chamber 19 toward the chamber 20, its advance in this direction being limited by the end of the valve stem approaching the end of the counterbore or chamber 15, and being cushioned by the steam in the latter. Should the pressure in that end of the cylinder with which the chamber 19 communicates fall below the exhaust pressure, and therefore below the pressure in the chamber 20, which is in direct communication with the exhaust, it will be obvious that the piston 18 will be shifted toward its opposite limit of movement, and in so shifting will be carried fully into the chamber 19 and thus place the chambers 20 and 19 in communication, which thus places the end of the main steam cylinder in communication with the exhaust pipe and permits such inflow of exhaust steam as will equalize the pressures in both sides of the piston. The valve mechanism is, therefore, essentially a check-valve, though of special construction.

In order to provide for the cushioning of the piston valve and its stem, a steam passage 24 of restricted size leads from the chamber 19 through the body of the casing to, and communicates with, the chamber 15 at a point slightly removed from the outer end of the latter chamber, and similarly a passage 25 leads from the chamber 20 to, and communicates with, the chamber 17 at a point slightly removed from the outer end of that chamber. Under normal conditions the chambers 15 and 19 will be in communication and therefore under the same pressure, and similarly the chambers 17 and 20 will be in communication and under the same pressure. As the piston valve moves in one direction or the other it will cut off the passage leading into the cushioning chamber into which it is advancing, and during the remainder of its advance cushion against the trapped steam. This trapped and compressed steam will, of course, aid in returning the piston valve to its normal intermediate position. In this connection, it is to be noted that the arrangement by which the chamber 19 is normally in communication with the chamber 15, and the chamber 20 normally in communication with the chamber 17, makes of the piston valve with its stem as a whole a differential piston, since the pressure in each cushioning chamber opposes the movement of the piston in the direction in which it tends to move under the action of the port chamber which communicates with that cushioning chamber.

While I have herein shown and described what I deem to be a preferred embodiment of the invention, yet it is to be understood that in the broader sense the invention is not limited to the particular arrangement or construction of mechanism shown and described.

I claim as my invention:

1. In a motive fluid engine, the combination with a cylinder and piston therein, of a conduit communicating directly with the driving side of the piston head at one end and at its other with the exhaust side of the engine, and a pressure operated check valve mechanism interposed in and controlling said conduit comprising a valve member, one side of which is subject to the varying working pressure in the cylinder and the other side of which is subject to the pressure from the exhaust side of the engine whereby the valve is controlled by cylinder pressure only and is shifted to open the conduit to admit fluid to the driving side of the cylinder from said other source whenever the pressure on the driving side of the piston head falls below the pressure on the exhaust side of the conduit.

2. In a motive fluid engine, the combination with a steam chest, of a cylinder and a piston therein, a conduit communicating at one end directly with the driving side of the piston head independently of any connection with the steam chest, and at its other with the exhaust side of the engine, and a pressure operated check valve mechanism

openable inwardly and operable to admit an equalizing fluid to the cylinder from the exhaust side of the engine whenever the pressure on the driving side of the piston head falls below the pressure in the exhaust side of the engine.

3. In combination, a valve casing, a piston reciprocating therein and dividing said casing member into two chambers, a cushioning chamber at each end of the piston rod sealed from communication with the adjacent main chamber, main conduits leading into said main chamber on opposite sides of the piston head and other conduits leading from the respective sides of the main chamber to the respective cushioning chambers, said latter conduits being cross connected so that each affords constant communication between this cushioning chamber and that part of the main chamber remote therefrom.

4. In a motive fluid engine, the combination with a cylinder and piston therein, of a conduit communicating directly with the driving side of the piston made independent of any connection with the steam chest, and also communicating with another source of pressure, and a check valve mechanism openable inwardly and operable to admit an equalizing fluid to the cylinder.

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