(No Model.) 2 Sheets—Sheet 1.

L. D'AURIA.

NON ROTATIVE PUMPING ENGINE.

No. 493,153. Patented Mar. 7, 1893.

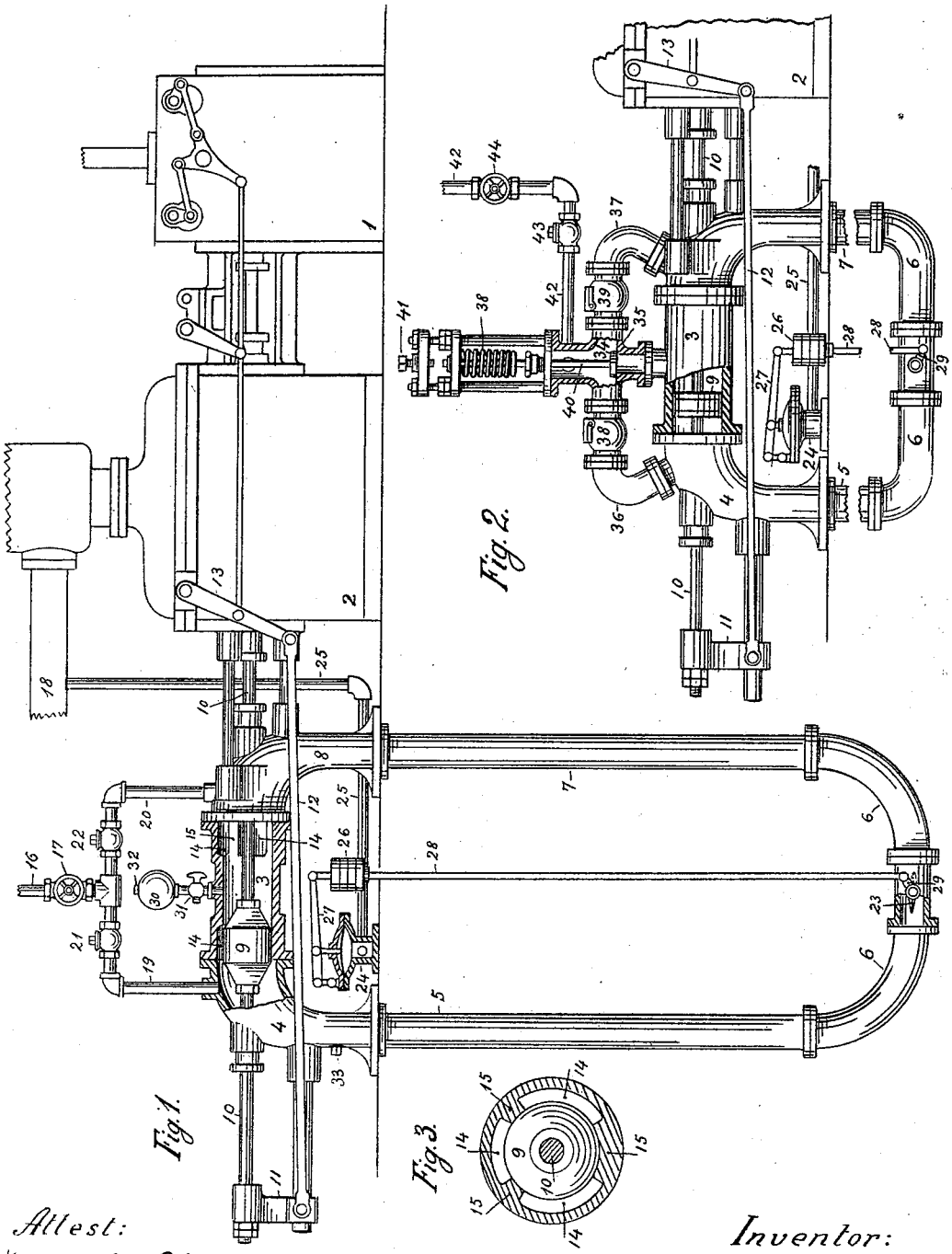

Fig. 1.

Fig. 2.

Fig. 3.

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Inventor:
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(No Model.) 2 Sheets—Sheet 2.

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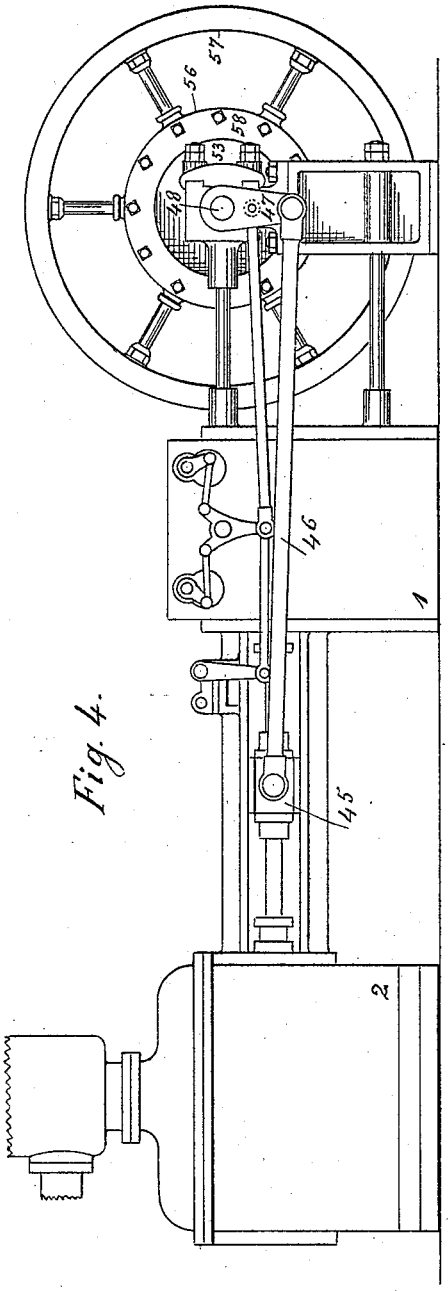

Fig. 4.

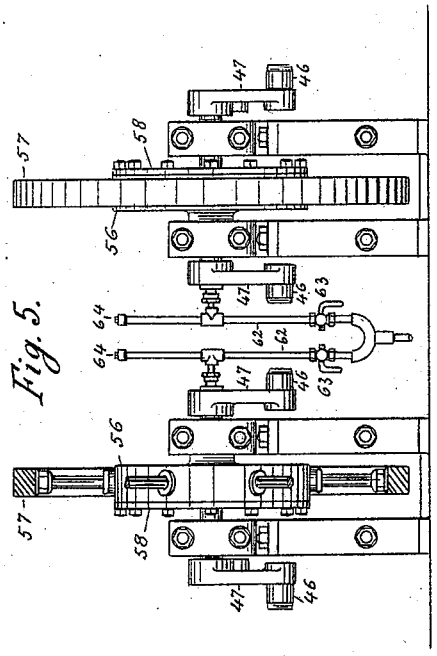

Fig. 5.

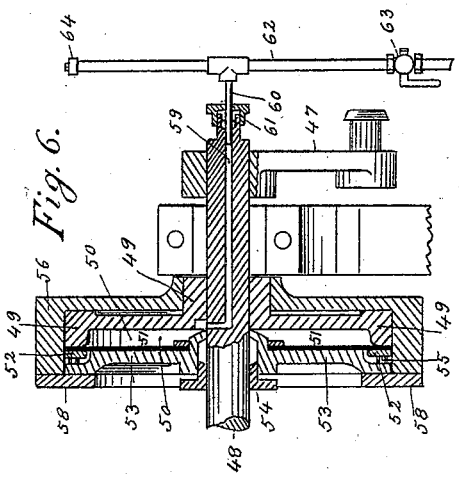

Fig. 6.

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UNITED STATES PATENT OFFICE.

LUIGI D'AURIA, OF PHILADELPHIA, PENNSYLVANIA.

NON-ROTATIVE PUMPING-ENGINE.

SPECIFICATION forming part of Letters Patent No. 493,153, dated March 7, 1893.

Application filed June 27, 1892. Serial No. 438,176. (No model.)

To all whom it may concern:

Be it known that I, LUIGI D'AURIA, a citizen of the United States, residing at Philadelphia, in the State of Pennsylvania, have invented new and useful Improvement in Non-Rotative Pumping-Engines, of which the following is a specification.

My invention relates to the general class of non-rotative pumping engines, single or duplex, simple or compound, and particularly to a pumping engine of this class in which, on account of steam being used expansively, an additional reciprocating weight is required as described and claimed by me in Letters Patent No. 446,435, granted February 17, 1891, in order to control the piston speed and keep it within safe limits.

In using this additional reciprocating weight in such a pumping engine, I have found that when such weight at the end of the stroke, still possesses a considerable aomunt of surplus energy, or momentum, which cannot with safety and without rebound be disposed of by ordinary steam cushioning, the result is a shock upon the parts of the engine and pump.

The object of my invention is to so construct the additional reciprocating weight in non-rotative pumping engines that any surplus energy possessed by said weight at the end of the stroke shall expend itself without causing shocks upon the engine and pump.

To that end the invention consists in so arranging the reciprocating weight, whether liquid or solid, that at the end of the stroke said weight, or a part of it, is allowed to continue in motion when there is a residual or surplus energy and thus expend said energy in overcoming frictional resistance.

This invention can be carried into practice in various ways, but the following two methods are preferred:—First.—By utilizing for the additional reciprocating weight a column of liquid of sufficient dimensions inclosed in a pipe and made to reciprocate by the action of a piston adjusted in a barrel forming part of said pipe, and provided with means whereby the said liquid column at the end of the stroke is allowed to expend its surplus energy in overcoming frictional resistance through contracted passages. Second.—By using a reciprocating wheel whose rim is secured to the shaft or hub by means of a friction clutch.

In the accompanying drawings I have illustrated only two of the various ways in which a liquid column can be used to carry my invention into practice, and only one way in which the rim of a reciprocating wheel can be secured to its hub so as to fulfill the requirements of said invention, but I do not confine myself to the details thereof.

Figure 1 is a side elevation of a direct-acting duplex pumping engine with a liquid reciprocating weight attached thereto, according to my invention. Fig. 2, is a modification of the same. Fig. 3, is a cross-section through one of its parts. Fig. 4, is a side elevation of the same duplex engine with reciprocating wheels attached according to my invention. Fig. 5, is a rear view of said wheels and attachments. Fig. 6, is an enlarged longitudinal section of the friction clutch connecting the rim of said wheels to the hub.

Referring to Fig. 1, 1 is a steam cylinder of a high duty pumping engine with cut-off valves and cut-off mechanism; 2 is the pump proper; 3 is a cylindrical chamber forming part of the closed system of pipes or apparatus 3, 4, 5, 6, 7, 8, filled with a liquid which is made to reciprocate by the piston 9 adjusted in said chamber and connected with the pump plunger by means of the piston rod 10, 10, passing through stuffing-boxes at both sides of 3. At the outer end of this piston rod is a cross-head 11 to which is attached the connecting rod 12 which imparts the motion to the valve mechanism of the engine through the reciprocating arm 13.

At each end of the cylindrical chamber 3 there are three recessed passages 14, 14, 14, shown in cross-section in Fig. 3, which passages are formed by three longitudinal ribs 15, 15, 15, which are extensions of the cylindrical surface of the chamber 3 into a chamber of larger diameter. The piston 9 at the end of its stroke when it just begins to uncover the inner ends of the passages 14, 14, 14, to the column of liquid following it, is supported by said ribs. If this liquid column, which constitutes the additional reciprocating weight claimed in Letters Patent No. 446,435 above referred to, reaches the end

of its stroke without any surplus energy there will be no circulation through the passages 14, 14, 14, but if said liquid column reaches the end of its stroke with any considerable amount of surplus energy, then the piston 9 is forced beyond the ordinary limit of its stroke, the passages 14, 14, 14, are more or less opened by it, and the liquid column is allowed to circulate and expend its surplus energy in overcoming the frictional resistance through said passages without shock upon the engine and pump.

To keep the apparatus 3, 4, 5, 6, 7, 8, always full of liquid against waste by leakage, said apparatus is provided with an automatic feeding device which consists in a supply pipe 16, connected either with the main 18 or with any other source, said supply pipe being provided with a stop valve 17, and communicating with each end of the chamber 3 by means of the pipes 19 and 20 provided with ordinary check valves 21 and 22 to prevent the liquid being forced back by the piston 9. To guard against the danger of a sudden fall of pressure in the main, as in the case the main should break, for instance, the apparatus 3, 4, 5, 6, 7, 8, is provided with a disk and pivot throttle valve 23 which is operated by an ordinary diaphragm-regulator 24 acted upon by the pressure in the main 18, through the pipe 25 on one side, and a weight 26 at the end of the lever 27 on the other side, said weight being connected with said valve by means of the rod 28 and arm 29. When the pressure in the main falls suddenly, the weight 26 drops and causes the valve 23 to throttle the reciprocating liquid column in the apparatus 3, 4, 5, 6, 7, 8, thus preventing the speed of the engine from becoming dangerous. When desired, the diaphragm-regulator 24 can be connected with the steam throttle of the engine in such manner that the dropping of the weight 26 causes also the steam being cut-off from the engine.

In order to supply a certain amount of yielding to the liquid column, the chamber 3 is furnished with a small air-vessel 30 provided with a stop-cock 31 and a plug 32. When more power is required from the engine, as in the case of fire, for instance, the chamber 3 can be readily drained by opening the plug 33 furnished for such purpose, and then the engine can be worked without expansion and without additional reciprocating weight in the usual manner.

With reference to Fig. 2, the chamber 3 in the apparatus 3, 4, 5, 6, 7, 8, has no circulating passages at its ends, and the circulation of the liquid column in said apparatus is obtained by means of a relief valve 34 located in the middle of said chamber said valve opening into a T 35 connecting the pipes 36, 37, which communicate with the ends of the chamber 3. The valve 34 is kept upon its seat by the pressure of a spring 38 which can be regulated so as not to allow said valve to lift until the pressure of the liquid column against the piston 9 reaches a certain limit beyond the greatest pressure which occurs under normal conditions during the stroke. When such limit is reached the liquid column is enabled to circulate and expend its surplus energy in overcoming frictional resistance through the opening of said valve and through the pipes 36, 37. These pipes are provided with check valves 38, 39, which prevent circulation while the valve 34 remains upon its seat. The pipe, 42, provided with a check valve, 43, and stop valve, 44, serves to feed the apparatus, 3, 4, 5, 6, 7, 8, and keep it always full against leakages. The stem, 40, of the valve, 34, is extended outside through a stuffing-box and is brought against the end of a screw, 41, which allows the regulation of the lift of said valve and the amount of throttling during the circulation of the liquid column through the opening of said valve. It is obvious that instead of one throttle valve in the apparatus, 3, 4, 5, 6, 7, 8, two or more such valves may be used and also instead of one relief valve in the middle of cylindrical chamber, 3, one or more such valves may be used at each end of said chamber beyond the piston, 9. The piston, 9, and piston rod, 10, 10, instead of being directly connected with the pistons of the engine and pump, as shown, may also be indirectly connected with them without departing from the spirit of the invention. The pipe, 5, 6, 7, is made smaller in diameter than the piston, 9, and therefore the velocity of the liquid in said pipe is greater than the velocity of the piston in the inverse proportion of the squares of the diameter. This arrangement according to the principle set forth in Letters Patent No. 446,435, requires less weight of liquid and of pipe than if the diameter of said pipe were equal to that of the piston. In practice the diameter of the pipe can be one-half that of the piston without causing considerable loss by friction.

Referring to Fig. 4, 1 and 2 represent, as in Fig. 1, the steam cylinder and pump of a high duty duplex pumping engine. The piston rod of each cylinder and pump is furnished with a cross-head, 45, carrying at each side a connecting rod, 46, attached at the other end to a crank and shaft, 47, 48, reciprocating with the pistons without turning the dead point, the angle of oscillation being considerably less than one hundred and eighty degrees. To the shaft, 48, is permanently fixed a hub, 49, shown in section in Fig. 6. This hub consists of a short cylindrical chamber, 50, made water tight by means of a diaphragm, 51, secured to the hub by a ring, 52. Said diaphragm is also secured to a lid, 53, fitting the shaft, 48, by means of a stuffing box, 54, and said lid is so arranged that while it can slide upon said shaft longitudinally, it cannot revolve around it, this being prevented by pins as 55. The hub and lid, 49, 53, are inclosed in a casing, 56, which is adjusted concentrically around the hub, 49, and can re-

volve around it. This casing carries the rim, 57, by means of spokes and both casing and rim are made of such dimensions as to constitute substantially the additional reciprocating weight of the engine and pump. The lid, 53, abuts against the annular plate, 58, bolted to the casing, 56. The shaft, 48, is furnished with a central channel, 59, opening into the chamber, 50, and communicating with a small pipe, 60, fitted to the shaft by means of a stuffing-box, 61. This pipe is connected by a T to a vertical pipe, 62, furnished with stop cock, 63, and relief cap, 64, and it communicates with the main or with an accumulator in such manner that when the cock, 63, is open either the pressure of the main or that of the accumulator is transmitted into the chamber, 50. This pressure forces the lid, 53, against the annular plate 58, and the casing 56 against the hub, 49, at the same time, and under such pressure the apparatus, 49, 56, 53, 58, becomes a powerful friction clutch which secures the wheel, 57, to the shaft, 48. The amount of friction produced by this clutch is so proportioned that under ordinary conditions the casing, 56, and plate, 58, will not slide at any point of the stroke. But when there is residual energy in the reciprocating wheel said casing and plate will slide, and said energy expends itself in overcoming the frictional resistance of the clutch without causing shocks upon the engine and pump. So too the casing, 56, will slide at any point of the stroke when the difference between the propelling force of the engine and the resisting force of the pump at said point of stroke exceeds the greatest difference between the same forces occurring at any point of the stroke in normal conditions.

It is obvious that instead of the pressure of a liquid any other pressure can be used between the hub, 49, and the lid, 53, as for instance the pressure of a gas or that of springs, and any other kind of clutch can be used to secure the wheel to the hub without departing from the spirit of the invention; but the pressure of the liquid in the main is preferred, either acting directly in the chamber, 50, or through an accumulator, on account of the following advantages it possesses: first, the pressure of the clutch can be relieved at any time; second, said pressure adjusts itself to the various conditions of head against which the pump is made to work; and third, in case of a break in the main the reciprocating wheel becomes suddenly detached from the hub.

Instead of the rim, 57, any other kind of mass may be secured to the casing, 56, for the additional reciprocating weight.

I am aware of the fact that the use of any kind of additional reciprocating weight whether solid or liquid is fully covered by Letters Patent No. 446,435, and therefore the use of a liquid column made to reciprocate in a continuous system of pipes by means of a piston moving in a cylindrical chamber, or the use of a reciprocating wheel is not here claimed.

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

1. The combination in a pumping engine of an additional reciprocating mass, with means substantially as described whereby said mass is allowed at the end of the stroke to continue in motion and expend its surplus energy in overcoming frictional resistance, thus saving the engine and pump from shocks which would otherwise be caused by said energy.

2. In a pumping engine, in combination with an additional reciprocating weight consisting of a liquid reciprocated by a piston connected with the engine and adjusted in a cylindrical chamber forming part of a closed system of pipes filled with said liquid, means whereby when said piston reaches the end of its stroke said liquid is allowed to circulate and expend its residual energy in overcoming its frictional resistance, for the purpose set forth.

3. In a pumping engine, in combination with an additional reciprocating weight consisting of a liquid reciprocated by a piston connected with the engine and adjusted in a cylindrical chamber forming part of a closed system of pipes filled with said liquid, an automatic feeding device whereby said system of pipes is kept filled with liquid against losses caused by leakage.

4. In a pumping engine, in combination with an additional reciprocating weight consisting of a liquid reciprocated by a piston connected with the engine and adjusted in a cylindrical chamber forming part of a closed system of pipes filled with said liquid, provided with means whereby when said piston reaches the end of its stroke said liquid is allowed to circulate and expend its residual energy in overcoming its frictional resistance, an automatic feeding device whereby said system of pipes is kept filled with liquid against losses caused by leakage.

5. In a pumping engine, in combination with an additional reciprocating weight consisting of a liquid reciprocated by a piston connected with the engine and adjusted in a cylindrical chamber forming part of a closed system of pipes filled with said liquid, a throttle valve placed in said system of pipes and connected with a safety device actuated by the pressure in the delivery main in such manner that when said pressure diminishes said valve is made to throttle more or less the liquid in said system of pipes, substantially as and for the purpose set forth.

6. In a pumping engine, in combination with an additional reciprocating weight consisting of a liquid reciprocated by a piston connected with the engine and adjusted in a cylindrical chamber forming part of a closed system of pipes filled with said liquid, provided with means whereby when said piston reaches the end of its stroke said liquid is allowed to circulate and expend its residual

energy in overcoming its frictional resistance, a throttle valve placed in said system of pipes and connected with a safety device actuated by the pressure in the delivery main in such manner that when said pressure diminishes said valve is made to throttle more or less the liquid in said system of pipes, substantially as and for the purpose set forth.

7. In a pumping engine, in combination with an additional reciprocating weight consisting of a liquid set in motion by a piston reciprocating with the engine and adjusted in a cylindrical chamber forming part of a closed system of pipes filled with said liquid, an air vessel provided with means whereby the quantity of air in said vessel can be regulated, as and for the purpose set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

LUIGI D'AURIA.

Witnesses:
HENRY M. ROBERT,
HENRY N. DARLING.