(No Model.)

G. DE LAVAL.

DIRECT ACTING PUMPING ENGINE.

No. 520,237. Patented May 22, 1894.

Fig. 1.

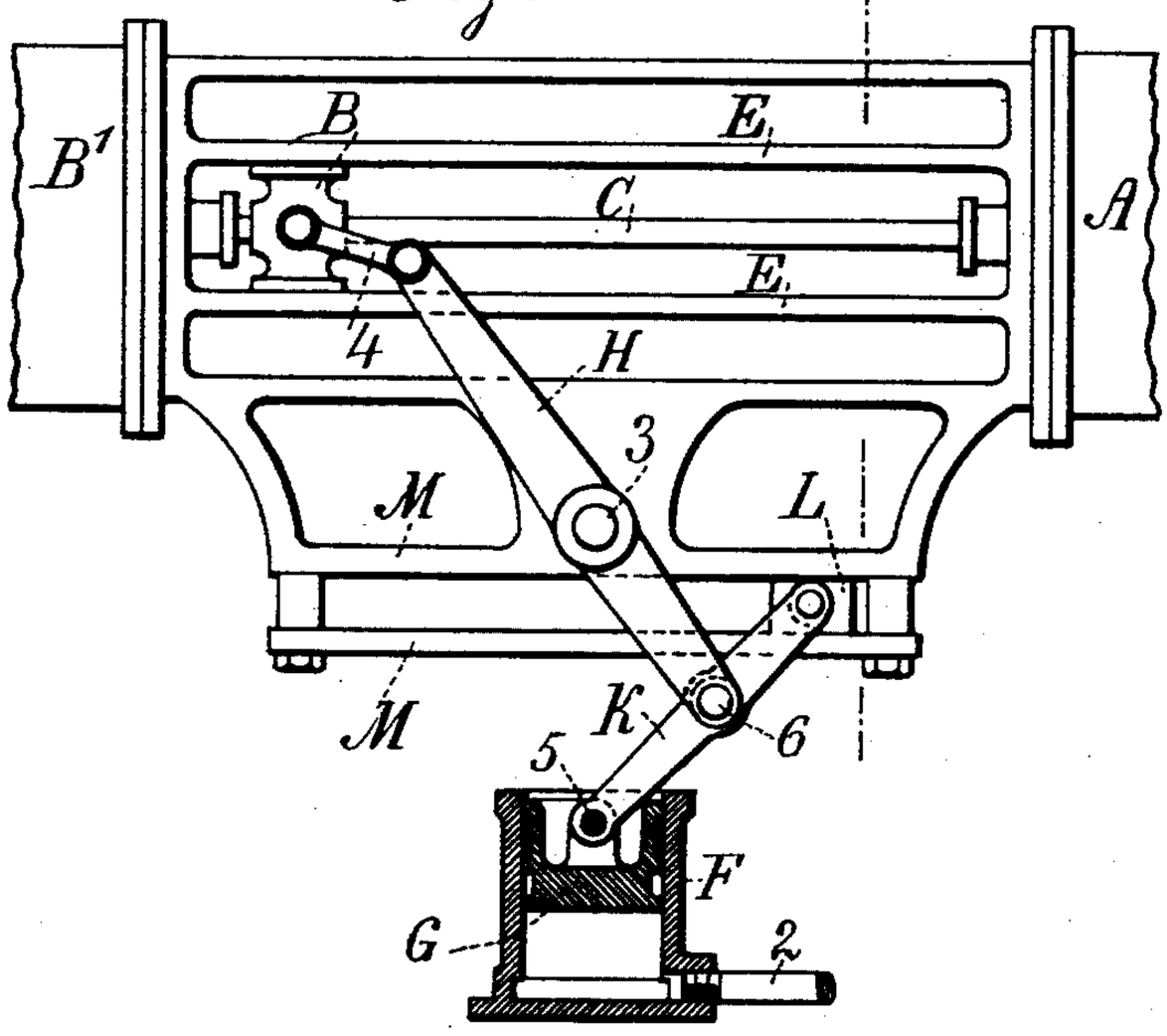
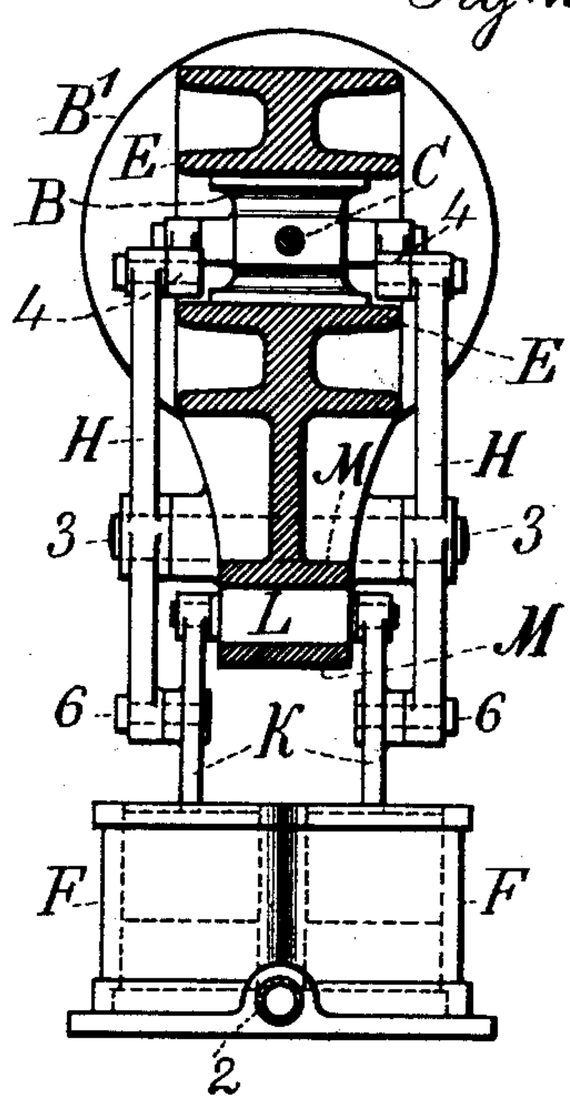


Fig. 2.



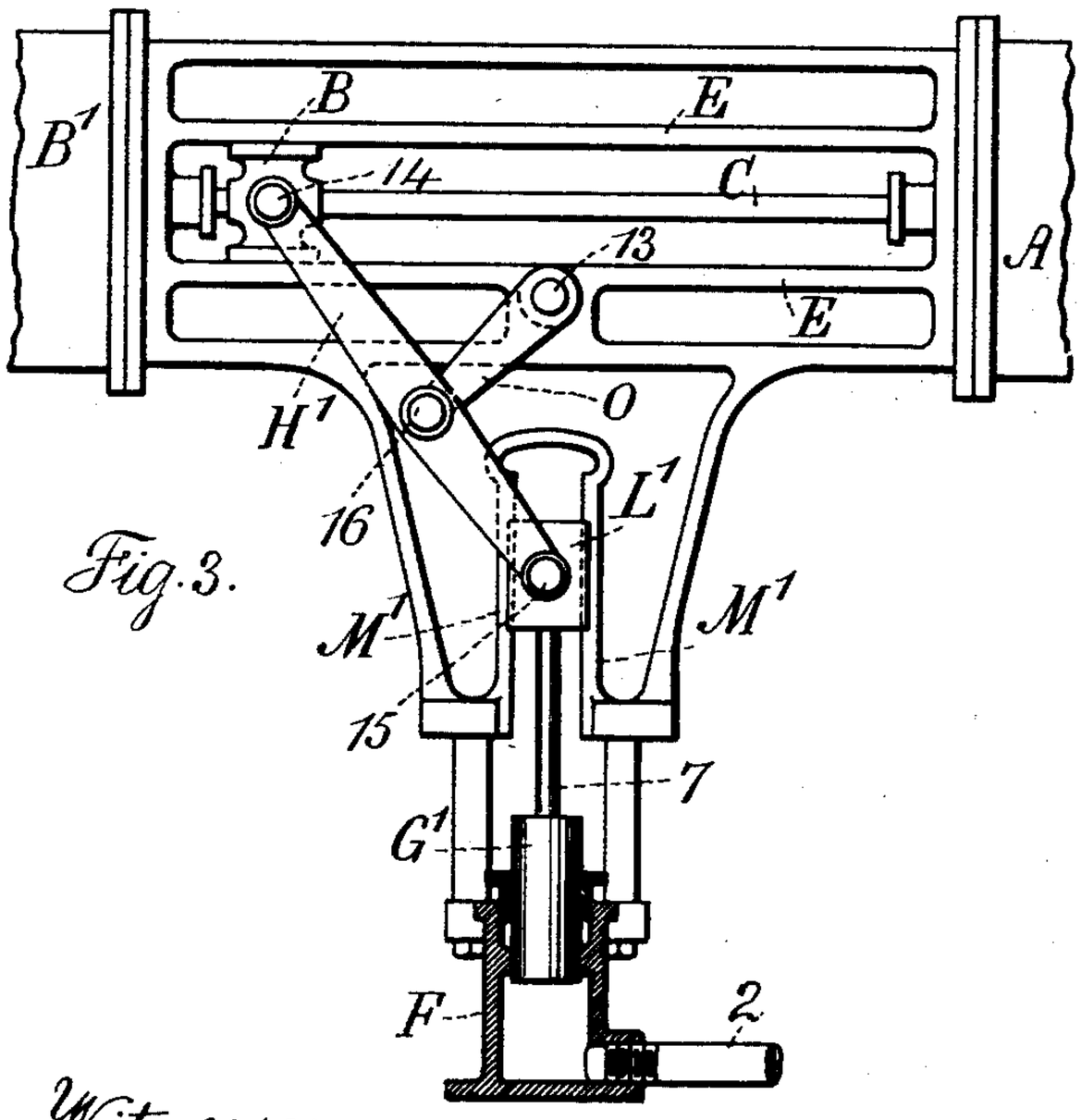


Fig. 3.

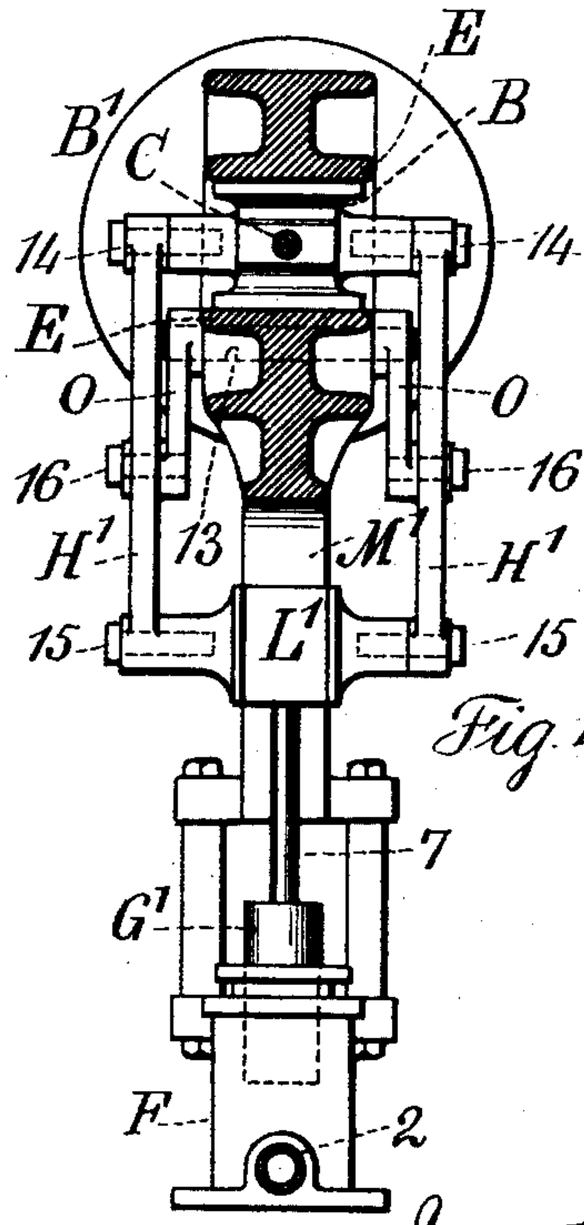


Fig. 4.

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GEORGE DE LAVAL, OF WARREN, MASSACHUSETTS.

DIRECT-ACTING PUMPING-ENGINE.

SPECIFICATION forming part of Letters Patent No. 520,237, dated May 22, 1894.

Application filed January 29, 1894. Serial No. 498,279. (No model.)

To all whom it may concern:

Be it known that I, GEORGE DE LAVAL, a citizen of the United States, residing at Warren, in the county of Worcester and State of Massachusetts, have invented an Improvement in Direct-Acting Pumping-Engines, of which the following is a specification.

This improvement is specially adapted to duplex water pumping engines, but it is also available with air compressors and with both single and duplex pumping engines that are direct acting.

In direct acting pumping engines it is generally advantageous to employ the steam expansively, and efforts have heretofore been made for equalizing the power exerted by combining with the engine a compensating mechanism to equalize or nearly so the power exerted throughout the entire stroke; that is to say, the steam engine acts directly upon the pump and also upon a compensating device while the pressure is maintained in the cylinder, and when the cut-off operates and the pressure commences to decrease, the compensating mechanism acts to augment the force of the steam while the piston finishes the stroke.

My present improvements apply to pumping engines of this general character, and I combine with the cross-head of the direct acting pumping engine, toggle levers, a cylinder and fluid pressure acting upon the piston, so that when the steam pressure is acting upon the piston, piston rod and cross-head, the fluid pressure in the cylinder is augmented and becomes the resistance to the movement of the engine, and after the cut-off takes place the fluid pressure acting through the toggle levers compensates the loss of efficient force as the steam acts expansively, thereby equalizing the stroke and movement of the direct acting pump.

When this improvement is applied with a duplex pumping engine, the valve of one engine receives its motion in connection with the movement of the other engine; but I remark that the valve motion and valve may be of any desired character and the cut-off may be operated as usual, as these parts form no necessary portion of my present invention.

In the drawings Figure 1 is a side view partially in section and Fig. 2 a cross section representing my compensating device in which the slide-block of the toggle mechanism moves horizontally. Fig. 3 is a side view partially in section, and Fig. 4 a cross section of the frame and elevation of the toggle mechanism with the slide-block moving vertically.

A represents part of one end of a steam cylinder, and B′ part of one end of a pump in which cylinders pistons are employed as usual that are connected by the rod or rods C, and B is the cross-head which may be of any desired character and preferably provided with slideways E, although these may be dispensed with, and F is a cylinder in which a fluid under pressure is provided for acting upon the piston G or plunger G′, and at 2 is represented a pipe passing off to a cylinder or other vessel containing air or gas under pressure, or to a suitable column of head for water or other liquid under the desired pressure.

The compensating lever H, Fig. 1, is pivoted at 3 upon a suitable connection to the frame of the engine, and one end of the compensating lever H is connected to the cross-head B by a link 4, and the other end of the compensating lever H is connected to the toggle lever K that is pivoted at 5 to the piston G. It is advantageous to make the toggle levers of about the same length between the fulcrums 3 and 5 and the joint 6 of the respective parts; and in Fig. 1 the lever K is connected at its upper end to the slide-block L in the ways M; and it will now be apparent that when the cross-head B is moved in either direction by steam acting in the cylinder A, the fluid in the cylinder F is compressed by the piston G until the centers 3, 5 and 6 come into line, which is at the half of the stroke of the piston, and during this part of the movement the power of the steam has been partially consumed in compressing the fluid in the cylinder F, and during the remainder of the stroke the expansion or pressure of the fluid in the cylinder F acts upon the piston G, and by the toggle levers H K the force is exerted in completing the movement of the cross-head B; and it is advantageous to regulate the fluid pressure acting in the cylinder F upon the piston G with reference to the steam pressure acting in the cylinder A and

according to the point at which the steam is cut off, so as to equalize as nearly as possible the resistance to the movement of the steam piston during the first half of the stroke and the compensating and equalizing action of the piston G in completing the stroke of the direct acting pump.

In Fig. 2, I have represented two cylinders F side by side, two toggle levers K and two compensating levers H, and one slide-block L to which the upper ends of the toggle levers K are connected. This arrangement allows for balancing the action of the parts, but it will be apparent that only one cylinder F may be employed if desired; and I remark that under all circumstances the pressure exerted by the piston G is taken through the toggle portions of the levers H and K upon the pivot or rock shaft 3, so that there is but little friction upon the slide-block L, and the movement of the parts is with but little friction, and the pressure upon the piston G exerts a power in moving the cross-head B that is augmented toward the end of the stroke as the toggle levers approach toward a right angle to each other.

In Figs. 3 and 4, the compensating mechanism acts in the same manner as in Figs. 1 and 2, but I am enabled to dispense with the links 4 by placing the slider block L′ in vertical ways instead of horizontal, so that the piston rod 7 of the plunger or piston G′ is connected directly to the slider block L′ in the vertical slideways M′, and with this arrangement the pivot 14 at the upper end of the compensating lever H′ can be connected directly to the cross-head B and at the lower end 15 directly to the slider block L′, and the pivot or rock shaft 13 is provided with a link O forming one half of the toggle, the lower end of the link O being connected at 16 to the middle portion of the compensating lever H′, and the operation of these parts is the same as before described with reference to Figs. 1 and 2, the lower end of the lever H′ and the link O forming the toggle and the cross shaft or pivot 13 forming the resistance to the pressure, so that the parallelism of the cross-head B in its movement is not disturbed, and the expansive pressure acting in the cylinder F exerts the greater force near the end of the movement to compensate or equalize the less force of the steam as it acts expansively.

By reference to Fig. 4, it will be seen that it is advantageous to employ two compensating levers H′ and two links O upon the rock shaft 13, so that the action may be equal at each side of the frame, and in this case it is more convenient to make use of only one cylinder F in which the confined pressure acts for compensating or equalizing the movements of the parts.

I have preferably shown the compensating rig attached between the steam and pump cylinders, but the same can also be arranged at the end of the pump cylinder which will be the preferable way when in an old engine of the direct acting type for using steam the full stroke is to be changed into a high duty pump and cutting off the steam at a part of the stroke.

I claim as my invention—

1. The combination with the steam cylinder and direct acting pump and piston rods and cross head, of slides and a connecting frame between the cylinders, a piston or plunger and cylinder in which a fluid under pressure acts on the piston or plunger, a compensating lever at one side of the frame and a link forming a toggle to compress the fluid at the middle of the stroke of the engine and a fixed pivot for the toggle on the connecting frame substantially as specified.

2. The combination with the steam cylinder and direct acting pump and piston rods and cross-head, of slides and a connecting frame between the cylinders, a piston or plunger and a cylinder in which a fluid under pressure acts on the piston or plunger, two separate compensating levers, one at each side of the frame and jointed at their upper ends to the cross-head, links forming with the levers toggles to compress the fluid at the middle of the engine stroke, and fixed pivots on the frame for the toggles, substantially as specified.

3. The combination with the steam cylinder A, pumping cylinder B′, connecting rod C and cross-head B, of the compensating lever H, the link 4 connecting the upper end of the compensating lever to the cross-head, the pivot 3, the cylinder F in which a fluid under pressure is provided, the piston G, toggle lever K pivoted to the compensating lever, and the slide-block L in the slideways M, substantially as set forth.

4. The combination with the steam cylinder, pumping cylinder, connecting-rod and cross-head, of the compensating lever, a connection between the upper end of the compensating lever and the cross-head, the pivot for the lever, a cylinder in which a fluid under pressure is provided, a piston therein and a toggle lever pivoted to the compensating lever, and a slide-block in the slideways, substantially as set forth.

5. The combination with the steam cylinder A, pumping cylinder B′ and the connecting frame, of the piston rod C, cross-head B, the compensating levers H, one at each side of the connecting frame, the rock shaft forming a pivot and connecting the two levers, the compensating cylinders F and pistons G, the toggle levers K connecting the pistons G and compensating levers H, the slide-block L and slideways M for the same, substantially as set forth.

Signed by me this 20th day of January, 1894.

GEO. DE LAVAL.

Witnesses:
GEORGE P. ABORN,
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