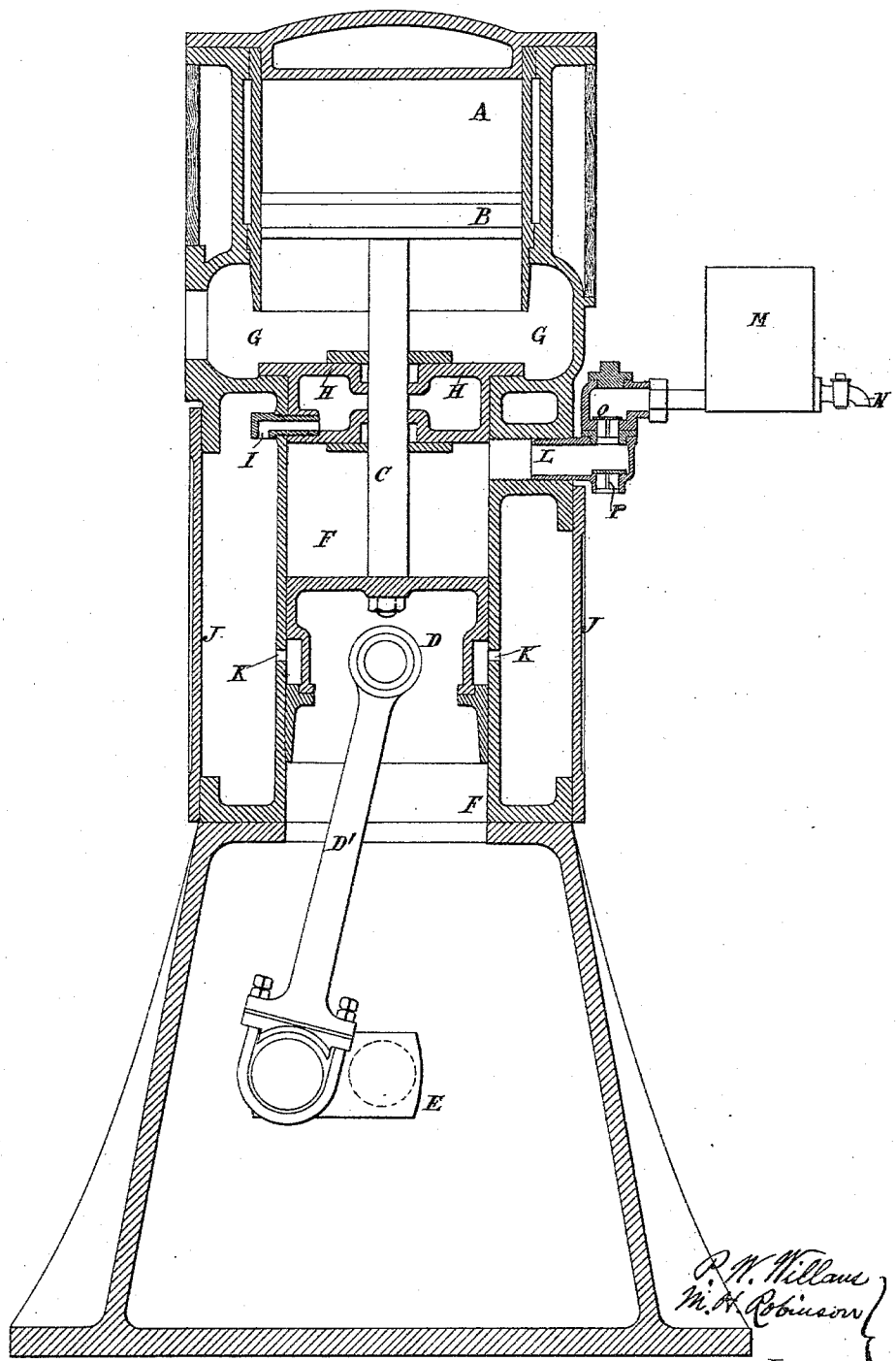
(No Model.) 2 Sheets—Sheet 1.

P. W. WILLANS & M. H. ROBINSON.

HIGH SPEED ENGINE.

No. 380,375. Patented Apr. 3, 1888.

Fig: 1.



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(No Model.) 2 Sheets—Sheet 2.

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Fig: 4.

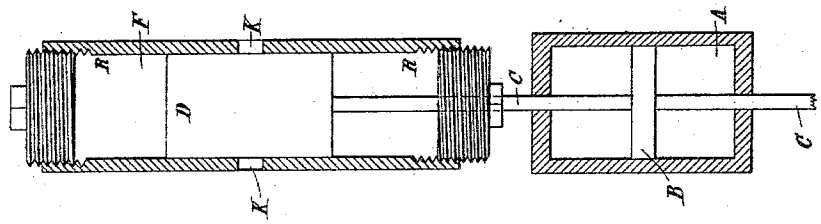


Fig: 3.

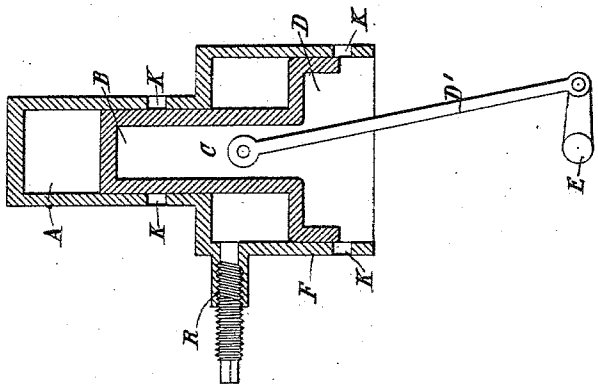
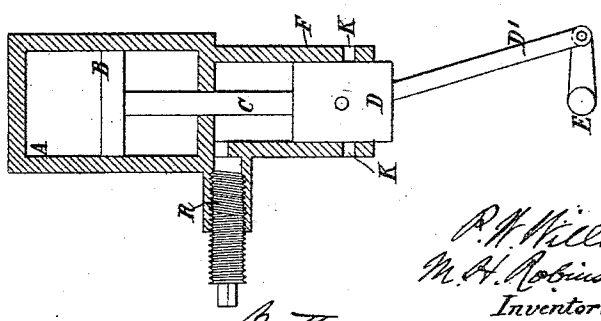


Fig: 2.



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UNITED STATES PATENT OFFICE.

PETER WILLIAM WILLANS, OF THAMES DITTON, AND MARK HEATON ROBINSON, OF KINGSTON-ON-THAMES, COUNTY OF SURREY, ENGLAND.

HIGH-SPEED ENGINE.

SPECIFICATION forming part of Letters Patent No. 380,375, dated April 3, 1888.

Application filed August 1, 1887. Serial No. 245,835. (No model.) Patented in England October 14, 1882, No. 4,901.

To all whom it may concern:

Be it known that we, PETER WILLIAM WILLANS, of Thames Ditton, in the county of Surrey, England, and MARK HEATON ROBINSON, of Kingston-on-Thames, in the county of Surrey, England, subjects of the Queen of Great Britain, have invented certain new and useful Improvements in High-Speed Engines, (for which we have received Letters Patent in Great Britain, No. 4,901, dated October 14, 1882,) of which the following is a specification.

In high-speed engines, where the ordinary compression of the steam in the cylinder itself during the latter part of the return-stroke of the piston cannot be advantageously used for checking the momentum of the piston and parts moving to and fro therewith, or is insufficient to check it, we use an independent cushion or buffer for the purpose. This buffer consists of a ram or piston rigidly connected with the reciprocating parts of the engine. This ram or piston works in a cylinder which at one part of the stroke is in communication with the atmosphere or any other elastic fluid (such as steam) which may be employed as a cushioning medium. At a certain part of the stroke of the ram or piston this way of communication is closed, and the ram compresses the air or other fluid contained in the cylinder until it reaches the end of its stroke. We so arrange the capacity of this cylinder and the clearance provided between the end of the cylinder and the piston or ram at the end of the stroke that by the time the ram or piston has reached the end of its stroke the pressure of air or other fluid has increased so much as to check to the desired extent the momentum of the moving parts. The power which is required to check their momentum is thus stored in the compressed air or other fluid and given out again on the return-stroke of the piston. The cylinder communicates with the atmosphere or reservoir of steam or other elastic fluid at some portion of each stroke, so that any leak past the ram or otherwise is made good. If the ram and cylinder could be made perfectly air-tight, this opening would not be necessary. The volume into which the air or other fluid is compressed at the end of the stroke may be regulated by making the end of the cylinder to communicate with a small chamber, the internal capacity of which can be increased or diminished by screwing more or less into it a screw-plug, or by providing the end or ends of the cylinder itself with a screw-plug which can be screwed more or less into the cylinder, so as to bring it nearer to or farther from the piston or ram at the ends of its travel.

With a single-acting engine a single-acting ram acting as above described is used. It may be a ram acting in a small cylinder at either end of the steam-cylinder and on the same piston-rod as the piston of this cylinder; or, if a piston in the form of a ram is working in the steam-cylinder an enlargement on the outer end of the ram may work in an enlargement of the cylinder, the annular space between this enlargement and the ram of the steam-cylinder forming the air-compressing chamber; or this may be reversed and the cylinder be for air-compressing and the annular space for steam.

In a double-acting engine a double-acting buffer would be used consisting of a piston or plunger on a continuation of the piston-rod of the steam-cylinder working to and fro in a cylinder, the clearance at the ends of which at the ends of the stroke can be controlled as hereinbefore described.

Instead of controlling the cushioning at the end of the stroke by controlling the space capacity into which the air or other controlling fluid is compressed at the end of the stroke, the cushioning might be controlled by varying the point in the stroke at which the air or fluid admission into the cylinder is closed.

Having thus described the nature of our invention, we will proceed to describe more fully the manner of performing the same.

In the drawings, Figure 1 is a vertical section through the cylinder of a single-acting quick-running steam-engine provided with an elastic buffer of air or other elastic fluid, as above described. Fig. 2 is a similar view showing a modified way of controlling the amount of compression in the buffer at the end of the stroke. Fig. 3 is a similar view showing how the buffer may be applied in a trunk-engine. Fig. 4 is a similar view showing a double-acting buffer used in combination with a double-acting steam-cylinder.

A single-acting quick-running steam-engine such as shown at Fig. 1 may be formed with only a single cylinder as shown in the drawings, or there may be any desired number of such cylinders with their pistons working onto the one crank-shaft, as in steam-engines heretofore commonly constructed by us and by others. In this case we provide each cylinder of the engine with an air-cushion or buffer in the manner shown.

A is the steam-cylinder; B, the piston; C, the piston-rod, having at its end a second piston or plunger, D, to which is jointed a connecting-rod, D', that works onto a crank on the crank-shaft E. The second piston, D, works to and fro in a cylinder, F, which not only serves as a guide for it, but also the air-compressing cylinder acting as a buffer for checking the momentum of the piston at the end of its backward or return stroke.

The lower end of the cylinder A opens into a chamber, G, which communicates with the condenser or exhaust-passage. The piston-rod C passes through this chamber and through a stuffing-box in a cover, H, which closes the top of the lower cylinder, F, from the chamber G. The cover H is shown to be made hollow and with two separate stuffing-boxes for the piston-rod to pass through. The hollow interior of the cover H is by a passage, I, open to the atmosphere, in order that if on the return-stroke of the piston any air under pressure should leap past the lower stuffing-box into the hollow interior of the cover it may not force its way past the upper stuffing-box, and so find its way to the condenser.

J is a cover inclosing the cylinder F, and at a distance from it. A small air-passage is formed at any convenient point through this cover.

K K are openings by which air can enter the cylinder F when the piston is at the lower end of its stroke. The upper end of the cylinder F is by a passage, L, put into communication with a closed air-vessel, M, provided with an air-cock, N.

O is valve in the passage L, which prevents the return of air from the air-vessel M into the cylinder F. The air-vessel and air-cock are to facilitate the starting of the engine.

When starting the engine, the air-cock is opened and steam admitted to the top of the cylinder, and the piston thereby caused to make its stroke. The momentum thereby imparted to the fly-wheel on the crank-shaft causes the piston to make its return-stroke. The air in the upper part of the cylinder F is then somewhat compressed and forced into the air-vessel M, and so at each return-stroke of the piston a certain amount of compressed air is driven into the air-vessel. As the engine gains in speed the air-cock N is closed gradually, and the pressure in the air-vessel consequently rises. When it has been entirely closed, the pressure in the air-vessel rises until the air contained in it is at a pressure equal to the pressure of air in the cylinder F at the end of each return-stroke. No more air then passes into the air-vessel, and it so goes out of action. At each forward stroke of the piston the connecting-rod thrusts against the crank-pin. On the return-stroke the pin thrusts against the rod to force the piston back. As it does so it compresses air behind the piston D, so that at the end of the return-stroke this compressed air, acting upon the piston D, may keep the connecting-rod still thrusting against the crank-pin, although the momentum of the moving parts would otherwise separate them, and so long as the engine runs at a uniform speed no strap would be required at the end of the connecting-rod to embrace the crank-pin. The strap is only of service when starting or stopping the engine or in the event of racing.

P is an air-inlet valve by which air is admitted freely to the cylinder F at all times during the forward stroke should the pressure in this cylinder get below atmospheric pressure. If the engine is a three-cylinder engine, no fly-wheel is needed.

In the drawings we have not thought it necessary to show the valves for admitting steam to the top of the cylinder A or allowing steam to pass from this cylinder to the exhaust, as these valves may be of any ordinary construction. The position of the air-openings K in the cylinder F will depend upon the speed at which the engine is required to run. The quicker the speed the nearer would the openings K have to be to the lower end of the cylinder, or the smaller the clearance at the end of stroke. Holes closed by plugs might be provided in the cylinder at different heights, to allow of the exit of air from the cylinder F being closed, either at an earlier or later portion of the return-stroke, according to the speed at which the engine is required to run.

Instead of providing for closing the exit of air from the cylinder F at an earlier or later period of the return-stroke, as above described, the volume into which the air is compressed at the end of the return-stroke may, as above stated, be regulated by making the end of the cylinder F to communicate, as shown in the diagram view Fig. 2, with a small chamber, R, the internal capacity of which can be increased or diminished. In the diagram the capacity of the chamber R is shown to be regulated by screwing more or less into its end a long screw; but other arrangements might be adapted for increasing or diminishing the capacity of the chamber R.

Instead of the air-cylinder F being between the steam-cylinder and the crank-shaft, it might be at the opposite end of the steam-cylinder, a continuation of the piston-rod being then carried through the end cover of the cylinder A.

Fig. 3 shows a diagram view of another form in which the single-acting engine may be arranged. In this case a ram B is made to work into the cylinder A, and a piston D on the outer end of the ram is made to work in

the second cylinder F. The forward stroke may be made by steam admitted either to the cylinder A or to the annular space between the interior of the cylinder F and the ram. If it is effected by steam admitted to A, then the annular space forms the air-buffer on the return-stroke and air is admitted to the annular space at the commencement of the return-stroke through openings K. If, on the other hand, the forward stroke is effected by steam admitted to the annular space, then the cylinder A forms the air-buffer, and air is admitted to it at the commencement of the return-stroke through openings K.

In double-acting engines the air-buffer has also to be double acting. Fig. 4 shows a diagram view of a double-acting steam-cylinder and double-acting air-buffer used in connection therewith. A is the steam-cylinder; B, its piston. The piston-rod is prolonged and carries a plunger D, which works to and fro in the air-cylinder F. Air is admitted to the center of the cylinder F through openings K. The plunger D is somewhat shorter than the length of the stroke of the piston; consequently at the end of each stroke air is admitted to one or other end of the cylinder F. The diagram shows that the volume into which the air is compressed at the end of each stroke may be adjusted by setting the end covers nearer to or farther away from one another, so as to increase or diminish the capacity of the chamber or space R left between the plunger D and the end cover at the end of the stroke. The diagram shows the end covers screwing into the ends of the cylinders to allow of this being done; or, in place of this, rings or washers might be interposed between the covers and the ends of the cylinder. The covers could then be bolted on in the ordinary way; or the volume into which the air is compressed may be adjusted in the manner shown at Figs. 2 and 3. The details hereinbefore given with reference to the position of the air-openings and the other details described with reference to single-acting engines are all applicable to double-acting engines.

Having thus described the nature of our invention and the manner of performing the same, we would have it understood that we claim—

1. The combination of the steam-cylinder, the piston working therein, the piston rod or trunk extending therefrom, the buffer-piston having connection with said rod or trunk and with the crank-shaft of the engine, and the buffer-cylinder containing elastic fluid, closed at the end away from which its piston travels when the piston of the steam-cylinder is making its effective stroke, and provided with the side inlet or inlets, by way of which to admit elastic fluid between the closed end of the cylinder and its piston at or near the end of the effective stroke, substantially as and for the purpose set forth.

2. The combination of the steam-cylinder, the piston working therein, the piston rod or trunk extending therefrom, the buffer-piston having connection with said rod or trunk and with the crank-shaft of the engine, the buffer-cylinder containing elastic fluid, closed at the end away from which its piston travels when the piston of the steam-cylinder is making its effective stroke, and the inlet-valve P, by way of which to admit elastic fluid to the buffer-cylinder at its closed end, substantially as and for the purpose set forth.

3. In a high-speed engine, the combination of a single-acting steam-cylinder, its piston, a piston rod or trunk extending therefrom, the buffer-cylinder closed at one end, its piston connected with the steam piston rod or trunk, the connecting-rod, the crank-shaft, the side inlet or inlets of the buffer-cylinder admitting elastic fluid thereto at or near the end of the effective stroke of the piston of the steam-cylinder, and the inlet-valve, by way of which to admit elastic fluid to the buffer-cylinder at its closed end, substantially as and for the purpose set forth.

4. The combination of the steam-cylinder, its piston, the rod or trunk extending therefrom, the buffer-cylinder closed at one end, its piston, the crank-shaft, the connecting-rod, and the chamber M, provided with the cock N and communicating with the closed end of the buffer-cylinder by way of the valve-passage, substantially as and for the purpose set forth.

5. The combination of the steam-cylinder, its piston, the piston rod or trunk thereof, the buffer-cylinder, its piston, the inlet or inlets by which elastic fluid is admitted to the buffer-cylinder at or near the end of the effective stroke of the piston of the steam-cylinder, and the chamber or space at the closed end of the buffer-cylinder adapted to have its capacity adjusted to control the degree of compression of the elastic fluid in the buffer-cylinder, substantially as and for the purpose set forth.

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