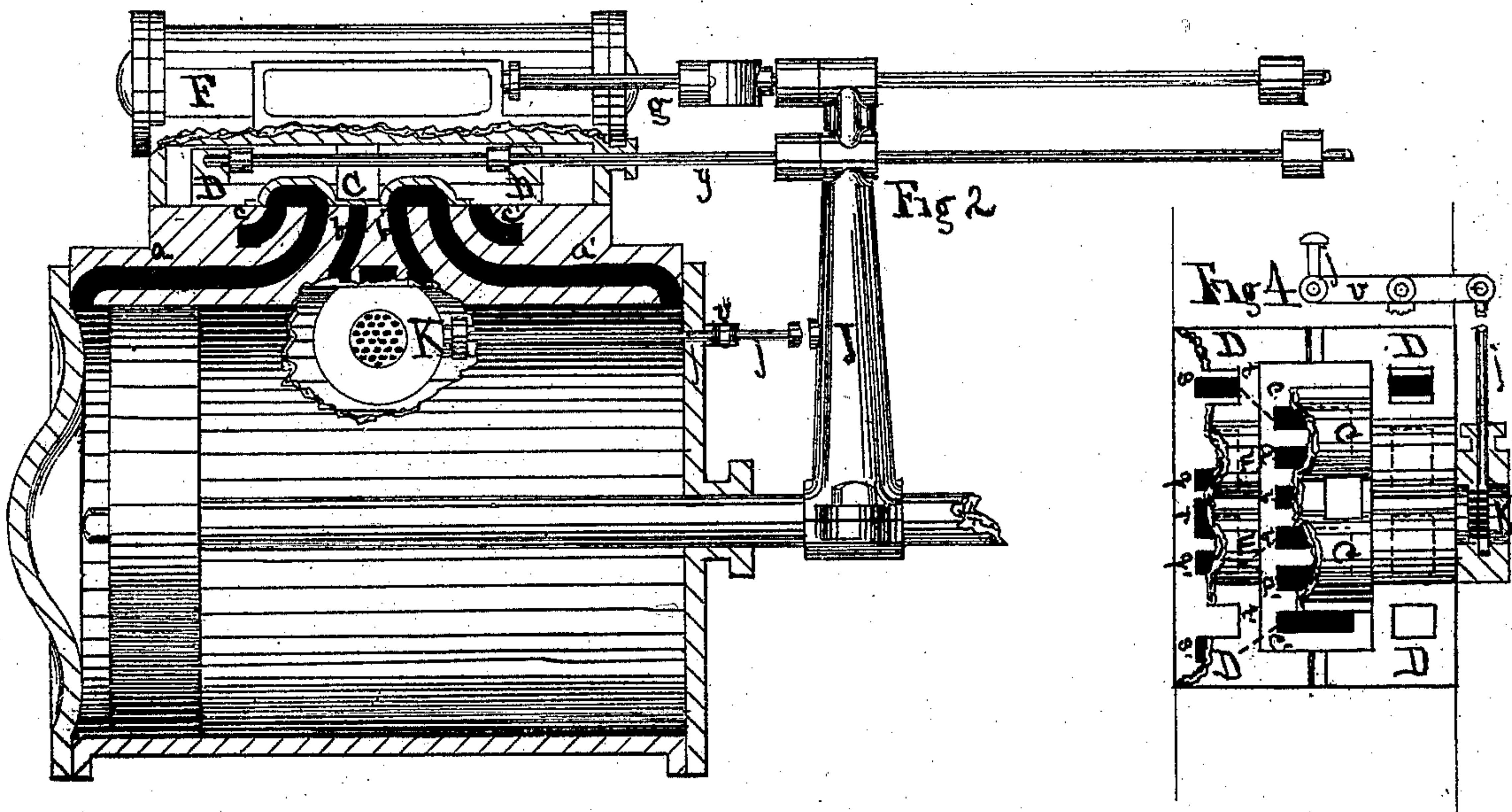
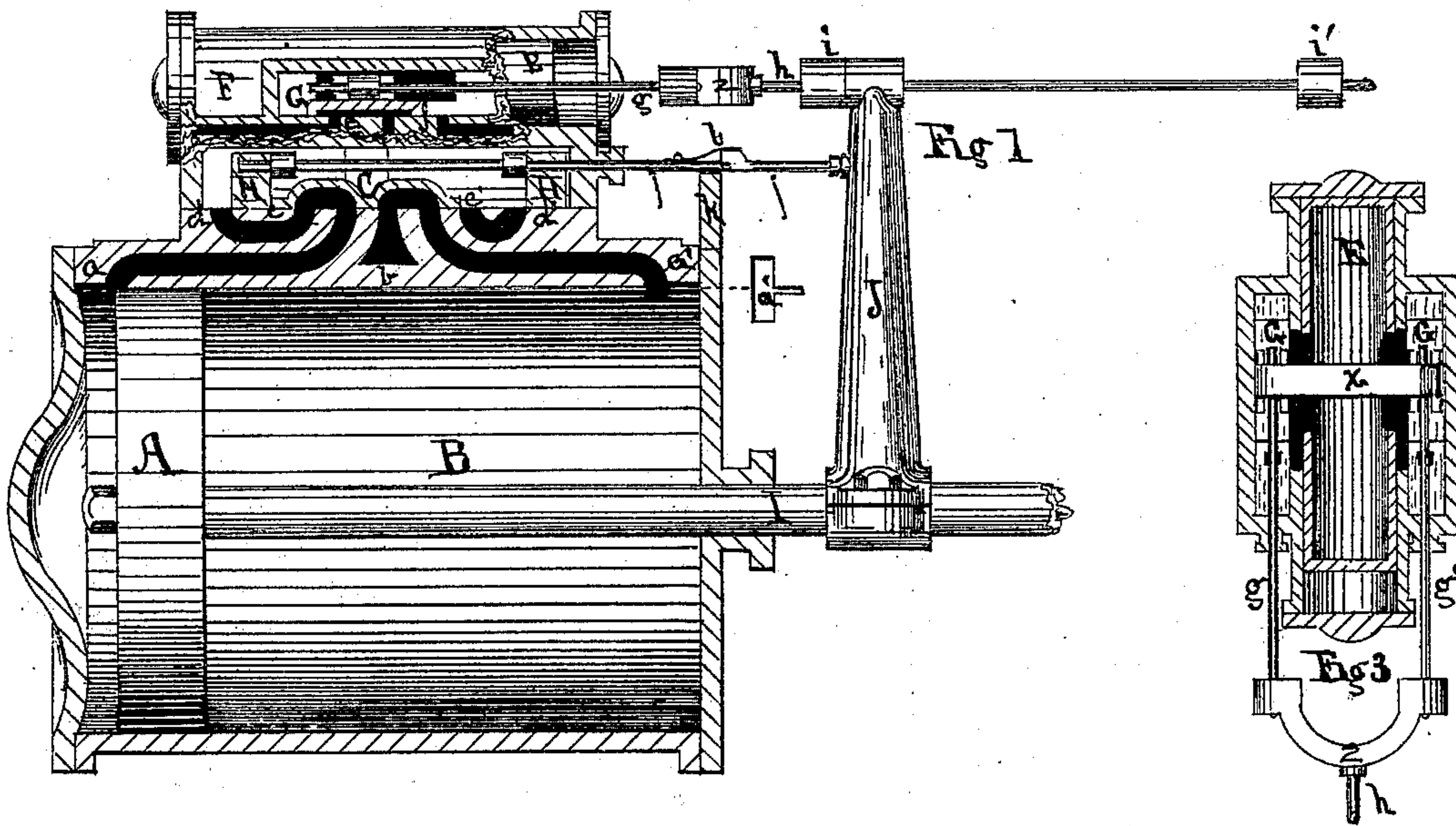


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Improvement in Reciprocating-Engines.

No. 127,154.

Patented May 28, 1872.



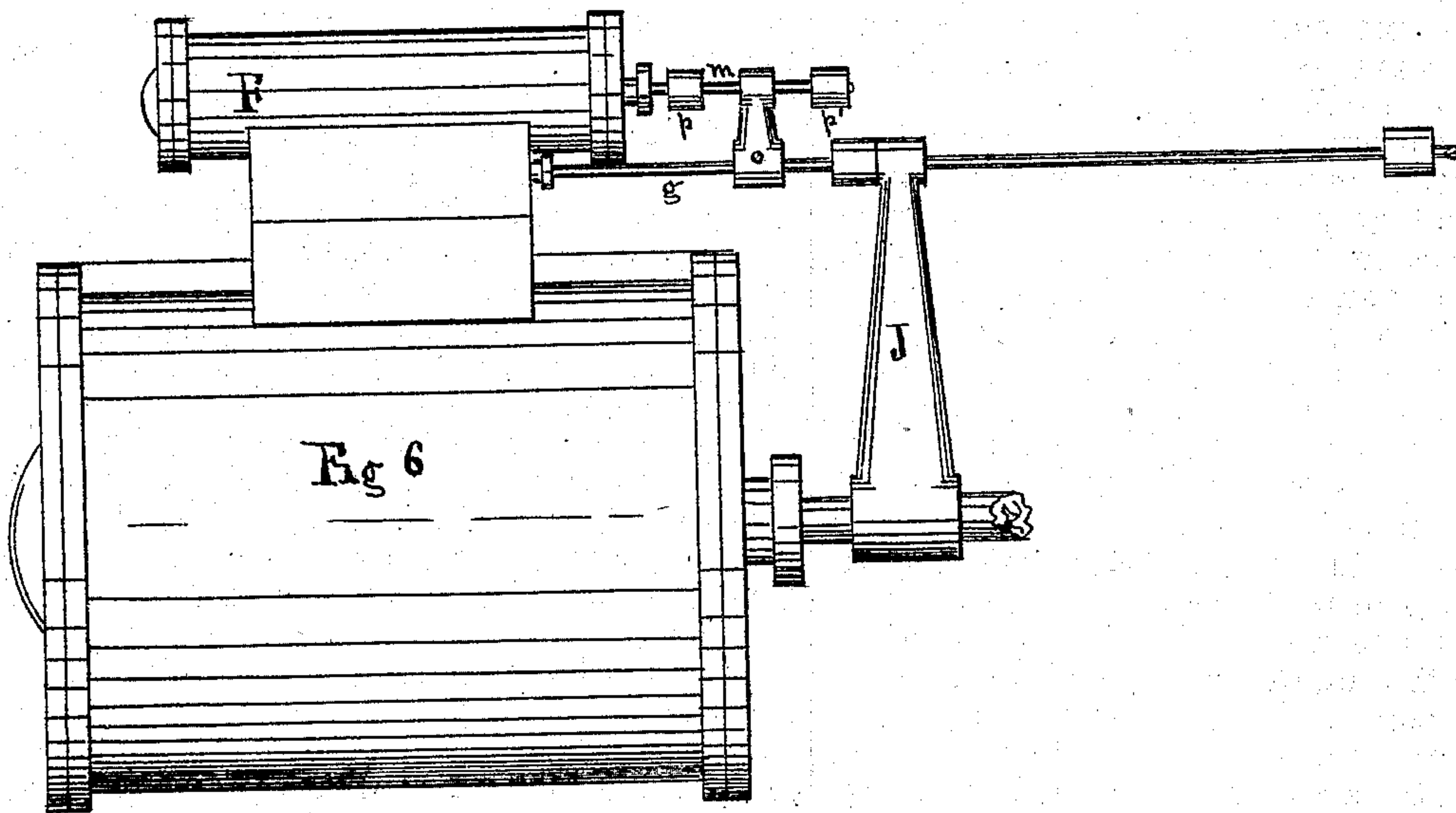
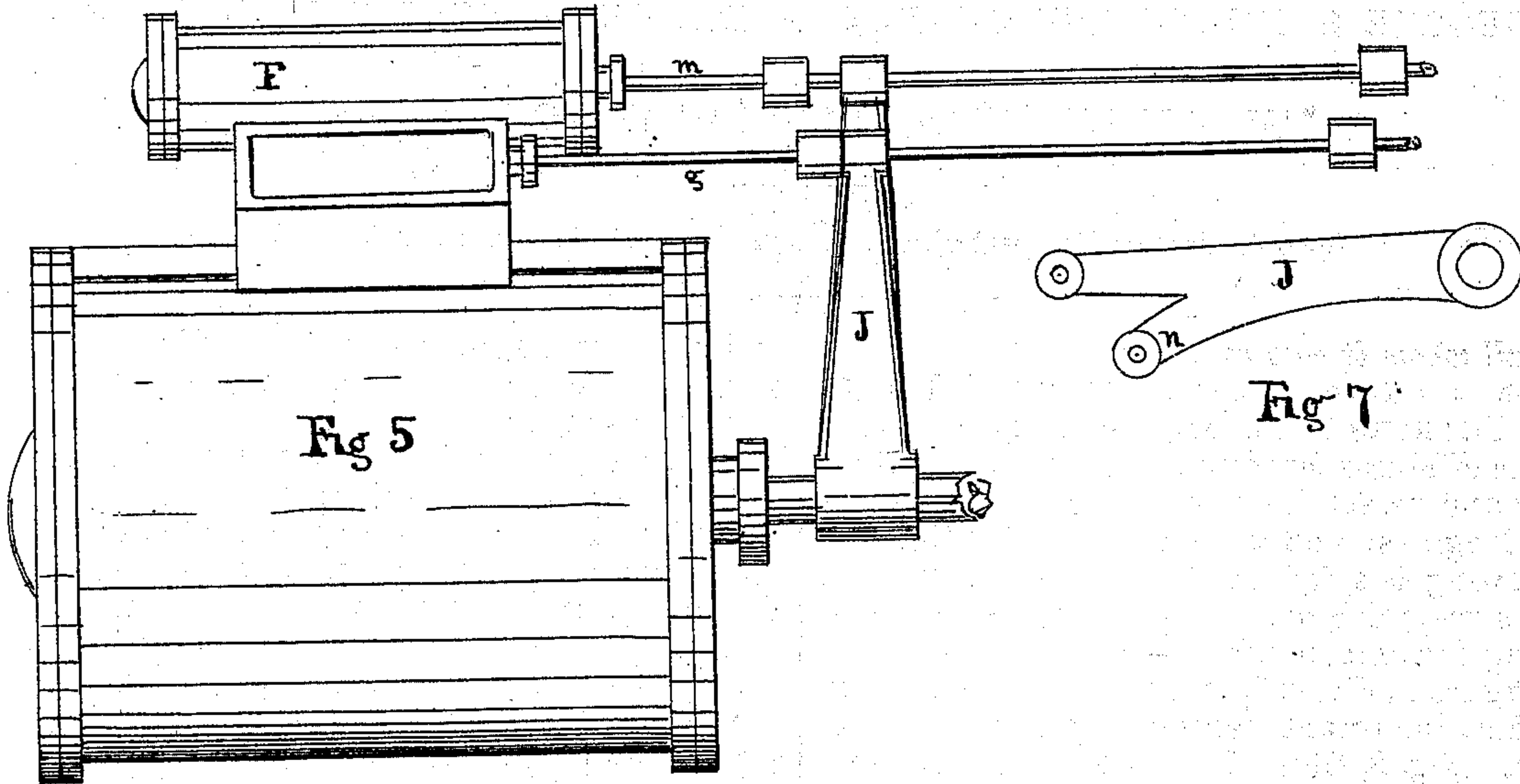
Witnesses *E. Dudley Chapin.*
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Inventors *Groff, Drake*
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Charles P. Deane

UNITED STATES PATENT OFFICE.

GEORGE H. DEANE AND CHARLES P. DEANE, OF SPRINGFIELD, MASS.

IMPROVEMENT IN RECIPROCATING ENGINES.

Specification forming part of Letters Patent No. 127,154, dated May 28, 1872.

To all whom it may concern:

Be it known that we, GEORGE H. DEANE and CHARLES P. DEANE, of Springfield, in the State of Massachusetts, have invented certain new and useful Improvements in Direct-Acting Engines; and we hereby declare that the following is a full and correct description of the same, reference being had to the accompanying drawing, in which—

Figure 1, Sheet 1, is a side elevation of the engine, important parts being shown in section. Fig. 2, Sheet 1, is a similar elevation, showing the cut-off valve D and the arrangement of the throttle cut-off K. Fig. 3, Sheet 1, shows the secondary valve and piston and their relations and connections. Fig. 4, Sheet 1, is a top view, showing a plan of the seats of the main and cut-off valves, and also showing the valves themselves and their relations to each other and to the seats. Figs. 5 and 6, Sheet 2, show different modes of effecting the mechanical movement of the secondary piston by the main piston. Fig. 7, Sheet 2, shows the form of arm J, in Fig. 5.

Our invention consists in an improved arrangement, herein described, of the valves and secondary piston, and the connections thereto from the main piston, of a direct-acting engine; and further consists in the construction, arrangement, and combination, with the engine, of a cut-off or other valve, in such manner that the main piston, when its movement is unduly accelerated by reason of the engine losing its load, will, by its lengthened stroke, effect such a cutting off of the supply of steam to or the exhaust from the engine as to bring it directly to rest or to a slow movement, by which means the damage often resulting to the engine from its "running away" upon the sudden loss of its load is wholly avoided; and our invention further consists in combinations and arrangements, herein described, whereby the main piston, when near and at the end of its proper stroke, is made to effect or insure such a positive cutting off, both of the steam behind and the exhaust before it, as to effectually prevent the possibility of its striking the cylinder-heads, thus wholly avoiding the disagreeable noise and often damaging effects resulting from such striking when the engine is moving at a high speed.

To enable others skilled in the art to make

and use our improvements we will now describe the construction and operation of our improved engine.

Referring to Fig. 1, A is the main piston of the engine; B, its cylinder; and C, the main valve. E is the secondary piston, carrying the main valve; F, the secondary cylinder; G, the secondary valve, shown more fully in Fig. 3; and H, a cut-off valve, hereinafter described. I is the piston-rod, and J the tappet-arm. *a a'* are the ports of the main cylinder. *c c'* are steam-ports, connected, by passages below the seat, with ports *d d'*, controlled by the cut-off valve H. *e* and *f* are the ports of the secondary valve. *g* and *h* are rods whereby valve G is removed. *i i'* are tappet-collars on rod *h*. *j* is a rod by which the cut-off valve H is moved when the engine loses its work. Referring to Fig. 3, it will be seen that the secondary valve G is arranged in two parts, one on each side of its piston E. A separate rod, *g*, is connected with each of these parts, and is carried from the chest through a stuffing-box, when the two rods *g g'* are connected by a yoke, *z*, to which the rod *h* is attached. The two parts of the valve and the ports leading therefrom to cylinder F are exactly alike, as shown, but may be arranged so that one part will operate the piston E in one direction and the other part operate it in the opposite direction. The two rods *g g'* may be firmly connected, as shown, at their inner ends by a cross-piece or mover, *x*, passing freely through an opening in piston E, said opening being so adjusted in respect to the movement of valve G that the mover *x* will come in contact with and move the piston E mechanically if and whenever it fails to be moved with sufficient promptness by the operation of its valve. This arrangement makes the movement of the main valve (attached to piston E) practically positive, and is a very substantial and effective mode of applying the invention patented to Charles P. Deane April 26, 1870. The cut-off valve H is arranged for the purpose of a stop-motion. Its construction and arrangement will be obvious from the drawing, Fig. 1, where it will be seen that the main valve C is supplied with steam through ports *d d'*, which ports are controlled by the cut-off valve H, so that when these ports are closed the engine will be brought to rest, since no steam can

then pass to the main cylinder. That part of the cut-off which is seen at the left of valve C can, if preferred, be dispensed with, though the arrangement is better and more effective as shown. The rod *j* connects the two parts H H of the cut-off, and works freely through an opening in the stem of valve C. The two parts of the cut-off may also be connected by a frame surrounding the valve C if desired. The rod *j*, outside its stuffing-box, is jointed in such manner that a portion of it may be turned down against the rest *k*, the spring *b* holding it in that position, and also holding it in the working position shown. In starting the engine, or when for any reason the stop-motion is not required, the rod is turned down, the ports *d d'* left entirely open, and the cut-off securely held in that position; and when the rod is turned up it will not be reached by the tappet-arm J so long as the engine is moving at the desired working speed; but if, by reason of the loss of its work, or from any cause, the speed is greatly accelerated, the stroke will be lengthened, and the arm J will strike the rod and move the cut-off so as to close the ports *d d'* and bring the engine to rest. If desired a small channel may be made in the seat, so that even when the ports *d d'* are covered by the cut-off H there will still be a small inlet of steam whereby the engine will be kept in motion, but at a slow speed.

The above-described arrangement of the cut-off we regard as convenient and effective; but it is obvious that it may be arranged in many different ways to effect the purpose substantially as described. For example: If preferred it may be applied outside the chest at the main inlet of steam to the engine, as seen in Fig. 2, and the rod *j* be moved directly by a lateral projection from the arm J; or it may be moved by a lever, *v*, as shown in Figs. 2 and 4. So, too, instead of cutting off, directly or indirectly, the supply of steam to the cylinder, the exhaust from it may in like manner be cut off to effect the same purpose. And, further, it will be obvious that the cut-off may in like manner, as described, be applied to the steam or exhaust ports of the secondary cylinder F and the engine be thereby brought to rest, since it clearly cannot operate if there be no movement of piston E; and an ordinary cock with lever-handle, when used as the throttle of the engine, may be adapted and arranged with the main piston, substantially as described, so that the latter, by its lengthened stroke, when moving at more than a working speed, will close the valve.

To prevent the noise and damaging effects, in a direct-acting engine, of the main piston striking its cylinder-heads when moving at a high working speed, we so arrange the engine that the piston itself, in its movement, shall always effect or insure such a positive cutting off, both of the steam behind and the exhaust before it, as will effectually prevent its reaching the cylinder-heads at whatever speed the engine may be moving. If the movement of

the main valve be made positive, as hereinbefore described, by the mover *x* passing through the opening in piston E, as shown in Fig. 3, then in such case, since the main piston cannot reach the cylinder-heads until the main valve has been moved past its center, either by steam acting upon piston E, or, mechanically, by the main piston moving piston E by rods *h* and *g* and mover *x*, it is evident that the main piston, in its movement, will always insure the necessary cutting off of the steam behind it, because it insures the movement of the main valve before itself can reach the cylinder-heads. It will also, of course, insure the admission of steam before itself, so that, if the engine be thus made positive, the liability of the piston to strike its cylinder-heads is very much lessened; yet we find in practice that the momentum of the piston, when it is moving very fast, will, nevertheless, often carry it over so as to strike the heads. To prevent this wholly, then, where the engine is positive, as described, we arrange the ports *a* and *a'*, Fig. 1, in such manner, in respect to the stroke of the piston, that the latter, before it can reach the cylinder-heads, must pass over and close the greater part of the opening of the ports into the cylinder, so that the steam before the rapidly-advancing piston, having but a small outlet, will be so compressed as to afford sufficient resistance to counteract the momentum, and thus the possibility of any striking of the piston is prevented. The ports *a* and *a'* may, for this purpose, be constructed as plainly shown in Fig. 1; but it is obvious that the form, proportions, and relative arrangement of the ports may be more or less varied to suit the special conditions under which the engine is to be used, and it will be equally obvious that the particular manner in which the operation of the valves is made positive, as stated, is immaterial to the purpose here contemplated. This positive operation may be effected as already described, or in any other practicable way—as, for example, as shown in Figs. 5 and 6, where the piston E, (in cylinder F,) carrying the main valve C, is moved mechanically by the main piston by means of the rod *m*, when it fails to be moved with sufficient promptness by the operation of the secondary valve placed at the side of the chest, and moved by means of rod *g* and a projection, *n*, from arm J; or it may be effected as shown in Fig. 7, where a secondary tappet-arm is firmly attached to valve-rod *g*, and, by means of rod *m* and tappet-collars *p p'*, moves piston E contingently, as stated; the arrangement in both these cases of the tappet-arm or arms, in respect to the collars on rods *j* and *m*, being such that the secondary piston in cylinder F is moved mechanically, only after the secondary valve has been moved past its center.

If the engine be constructed as engines of this class more generally are, so that the movement of the main valve is not positive, as described, or, to refer to Fig. 3, if the mover *x* be left out of the engine, then we have not

merely the momentum of the piston to counteract, as described, but we have also the whole force of the steam behind it, since when moving very fast it will reach the cylinder-head before the secondary piston E by the operation of its valve alone, will be moved from its state of rest to effect a reversion of valve C. In such case, then, we apply our invention for preventing the striking of the piston by arranging for the purpose a cut-off valve, D, Fig. 2, by moving which the piston effects a positive cutting off both of the steam behind and the exhaust before it. All the other parts of the engine, Fig. 2, are supposed to be exactly in the positions shown in Fig. 1; the secondary valve G having been moved to the left, and piston E thereby also moved to the left, carrying with it valve C, which is now in position to move piston A to the right. The cut-off valve D also has, by its rod *y*, been moved to the left. This cut-off will be understood by reference to Fig. 4, where it is shown with its seat in connection with the main valve and seat. The cut-off valve is shown in two parts connected at the ends; but these parts are exactly alike, and operate simultaneously and to the same effect; and the valve may be in one piece, if preferred, and may also, if desired, be made in a cylindrical form. In the seat of the main valve C, *a a'* are the ports leading directly to the main cylinder. *b b'* are ports for exhaust, connected by passages below the seats with ports *q q'* in the seat of the cut-off valve. *c c'* are ports for steam, connected by passages below the seats with ports *s s'* in the seat of the cut-off. *r* in the seat of the cut-off is the exhaust-port, leading directly to the exhaust-pipe. *t t'* are openings through valves D for the admission of steam; and *u u'* are chambers in same to connect, alternately, ports *q* and *q'* with exhaust-port *r*. In the positions shown the cut-off has been moved to the left, as stated; and it will be seen that steam is passing from the chest through the opening *t* in valve D into port *s*, and through a passage below the seat to port *c*, and thence through a chamber in valve C to and through port *a* to the main cylinder, while the opposite end of the cylinder is exhausting through port *a'* and a chamber in valve C, and through port *b'* and a passage below the seats to port *q*, and thence through chamber *u'* in valve D to and through port *r* to the exhaust-pipe. It will be observed that the steam-port *s'* is closed by cut-off D, and port *q* disconnected from exhaust-port *r*, and this was partially accomplished before valve C could have moved to the left; and it will readily be seen that if for any reason valve C had failed to be moved with sufficient promptness by piston E under the operation of valve G, the main piston would have been arrested, before it could reach the cylinder-heads, by the cutting-off of ports *s'* and *q*, which effects the cutting off of the steam behind and the exhaust before the piston when it gets in advance of the movement of its valve, as it will do when moving

very fast. The positions of the valves and ports as shown will continue until the main piston has moved to near the opposite end of its stroke, when valve D will be moved to the right, *s'* will be uncovered, *q* will be connected with exhaust *r*, *q'* disconnected, and *s* covered, so as, in like manner as described, to arrest the piston there. If the movement of this cut-off valve D be so adjusted, in respect to the movement of valve G, that the former shall very nearly close the ports it is cutting off before the valve G passes its center, the movement of the piston, when near the end of its stroke, will be so retarded as to very much lessen the concussion or shock incident to a pumping-engine when very quickly reversed, if operating at a moderate speed and raising water to a considerable height through a pipe.

It will now be seen that the operation of the improved engine is as follows: Referring to Fig. 1, the piston A in its movement to the left has, by means of arm J, tappet *i*, and rods *h* and *g*, moved valve G, so that piston E has thereby been moved to the left, carrying valve C into the position shown, to move piston A to the right, steam for this purpose passing through port *d*, and the chamber in the valve, and through port *a* into the cylinder, and exhausting through port *a'*, the chamber in the valve, and exhaust-port *b*. When the piston A has moved to the right to near the end of its stroke it will, in like manner as described, move valve G to the right; and if from any cause piston E should fail to be thereby moved with sufficient promptness, it will be moved mechanically by the mover *x*, as shown in Fig. 3, and the momentum of piston A will be counteracted by the peculiar arrangement of the ports *a* and *a'*, as described; and in the event of the engine losing its load, it will be seen that the piston, when moving to the left, will, by reason of its lengthened stroke, move the cut-off H by means of rod *j*, and thus bring the engine to rest or to a slow movement; and where the operation of the main valve is not made positive, as described, and the cut-off valve D is therefore used to prevent the striking of the piston upon the cylinder-heads, the operation of the same will be made sufficiently plain by the drawing, Figs. 2 and 4, and the explanations thereof already given.

Having thus fully described our invention, what we claim, and desire to secure by Letters Patent, is—

1. The combination of valve G in two parts with rods *g* and *g'*, yoke *z*, and rod *h*, moved by the main piston, substantially as described.
2. The combination of the secondary piston E, carrying main valve C, with the mover *x* and a connection thereto from the main piston, substantially as described.
3. The combination of the secondary valve G and secondary piston E, carrying main valve C, with rods *g* and *g'*, mover *x*, yoke *z*, and a connection thereto from the main piston, substantially as described.
4. In combination with a direct-acting en-

gine, a cut-off valve, H, therefor, applied to the engine, and arranged with the main piston, in manner substantially as herein described, so that the piston, when its movement is unduly accelerated will, by virtue of its lengthened stroke, effect the operation of the cut-off, substantially as and for the purpose described.

5. The combination of the cut-off valve H with rod *j*, and tappet-arm J moved by the main piston, substantially as and for the purpose described.

6. The combination of a throttle, K, with a rod or rods, *j*, and lever *v* moved by the main piston, substantially as and for the purpose described.

7. The combination, for the purpose set forth, of the main cylinder ports *a* and *a'*, arranged in respect to the stroke of the piston, substantially as described, with a main piston and valve, and secondary piston and valve, operating positively, substantially as described.

8. The cut-off valve D, constructed and arranged with its ports and passages and with the main valve C and its ports and passages, and operated by the main piston, substantially as and for the purpose described.

Springfield, July 17, 1871.

GEO. H. DEANE.

Witnesses: CHARLES P. DEANE.

R. F. HYDE,
A. L. SOULE.