(No Model.) 3 Sheets—Sheet 1.

M. GARLAND & A. D. CATLIN.

DIRECT ACTING STEAM ENGINE.

No. 382,082. Patented May 1, 1888.

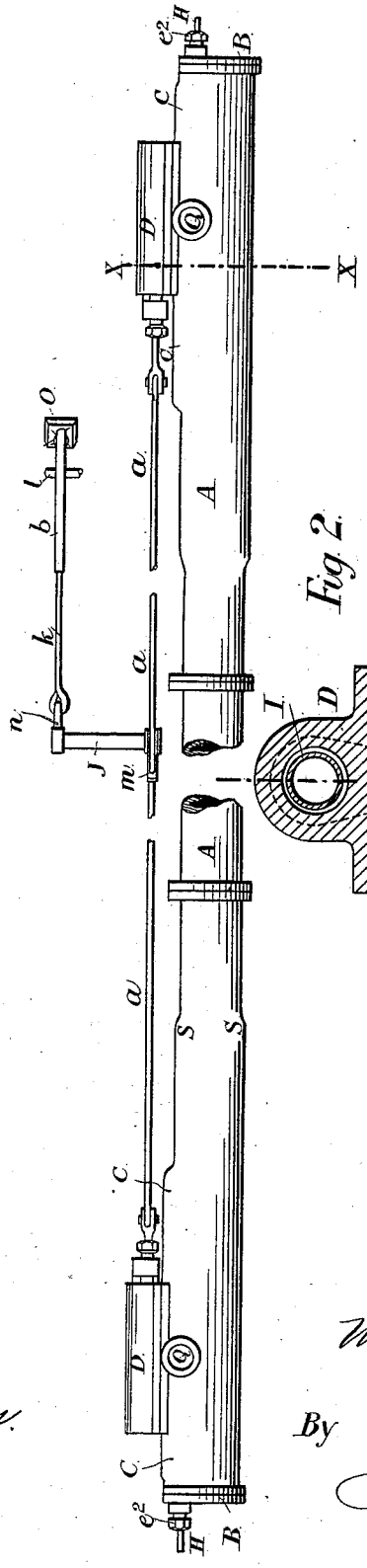

Fig. 1.

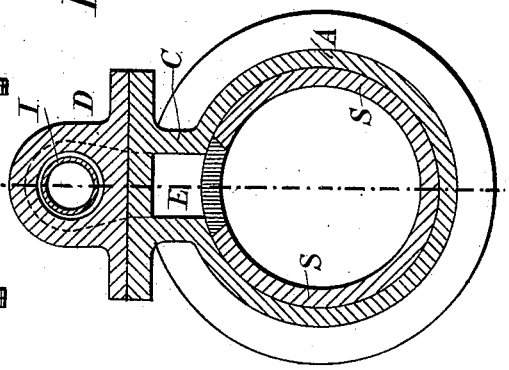

Fig. 2.

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Fig. 3

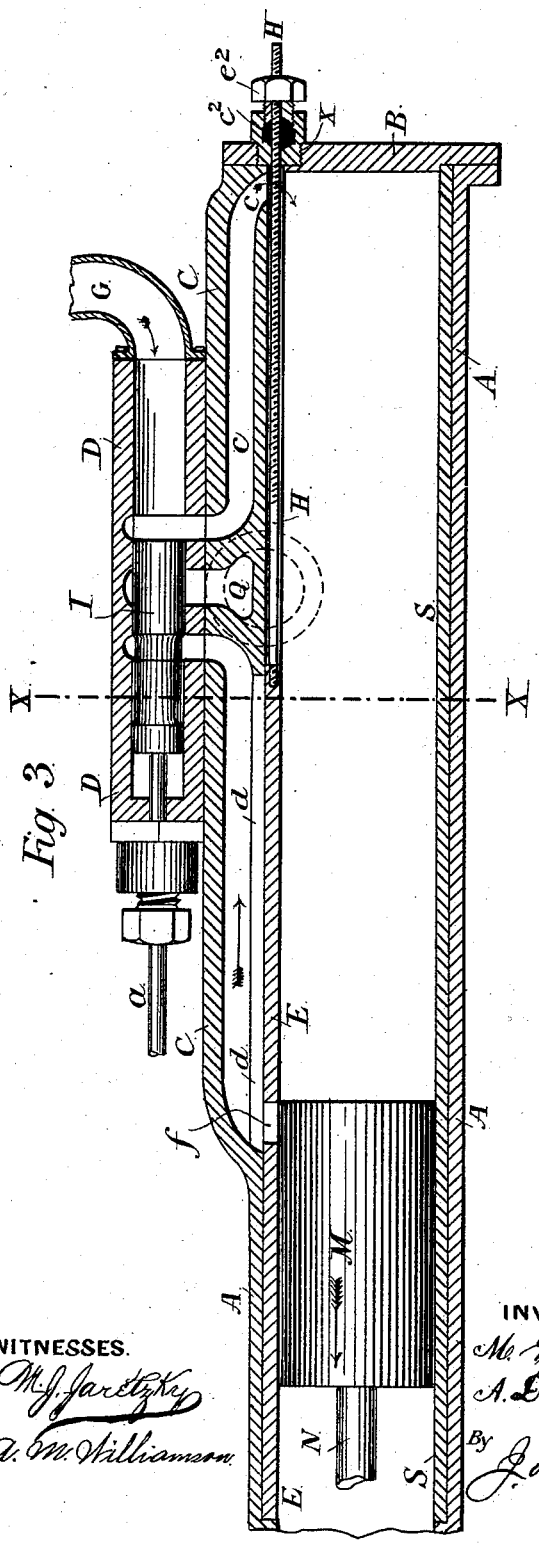
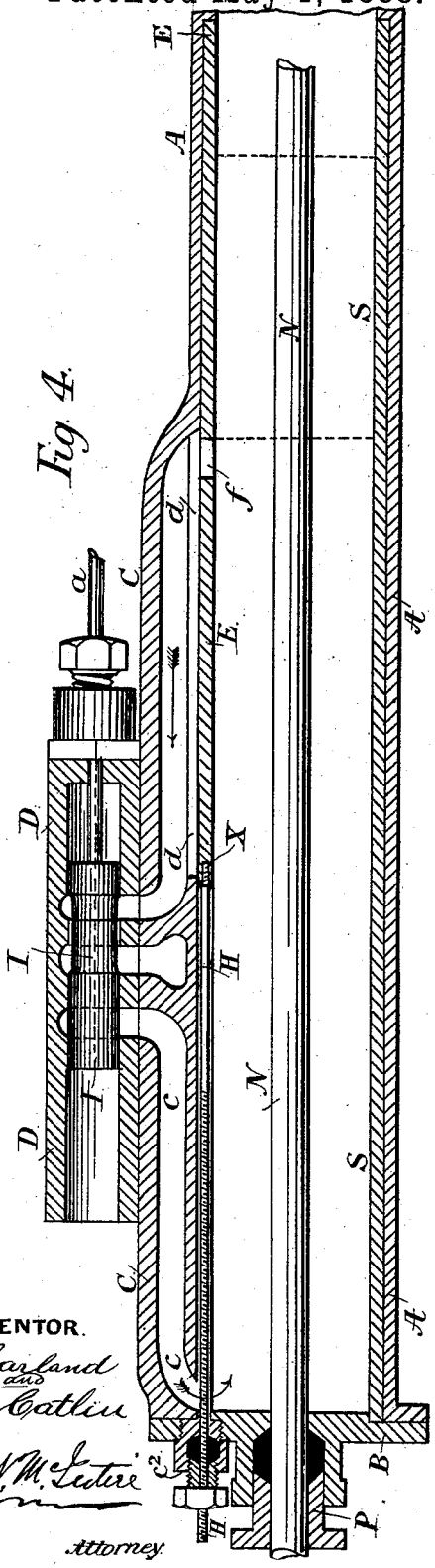


Fig. 4.



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(No Model.) 3 Sheets—Sheet 3.

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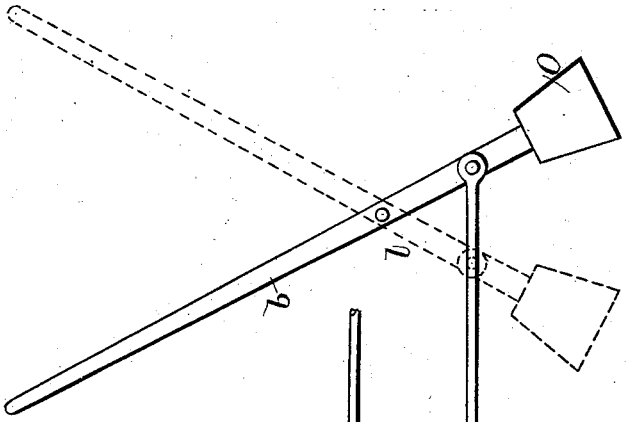
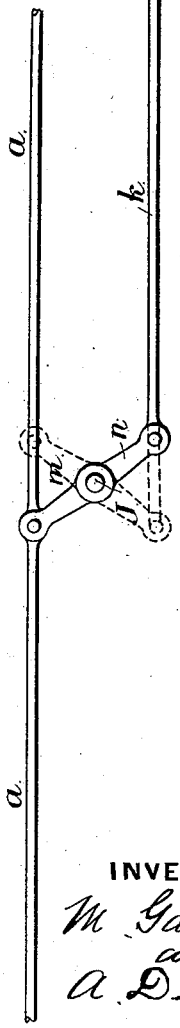


Fig 5.



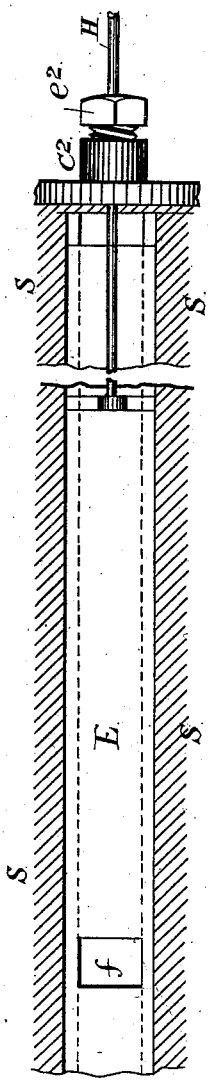


Fig 6.

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UNITED STATES PATENT OFFICE.

MICHAEL GARLAND AND ABEL D. CATLIN, OF BAY CITY, MICHIGAN; SAID CATLIN ASSIGNOR TO SAID GARLAND.

DIRECT-ACTING STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 382,082, dated May 1, 1888.

Application filed September 16, 1887. Serial No. 249,843. (No model.)

To all whom it may concern:

Be it known that we, MICHAEL GARLAND and ABEL D. CATLIN, of Bay City, in the county of Bay and State of Michigan, have invented a new and useful Improvement in Direct-Acting Steam-Engines for Driving Saw-Mill and other Carriages; and we do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, making part of this application.

Our invention relates to that kind of steam-engines (or steam-cylinders) that is employed to feed or drive the feed-carriages of circular-saw mills and for other analogous work, in which it is important to provide some means for cushioning or "taking up" the momentum of the carriage or other device at the end of its stroke (and that of the driving steam-piston) and after the carriage (thus driven by the engine) shall have been substantially relieved of the resistance it in turn offered to the motive power. Heretofore, in the use of steam-engines for directly driving such reciprocatory carriages, it has been customary to employ some sort of bumper or cushioning device, against which the carriage has spent its inertia at the end of its stroke, and after having been relieved of the resistance to its movement offered by the sawing or other operation going on during its said stroke, and, of course, in different cases it has been necessary to use cushioning devices of varying capacities or possessing different degrees of "take-up" ability, according to the speed of the reciprocatory carriage to be cushioned, the force with which it may have been driven, and other surrounding circumstances; but in all such contrivances there has been more or less imperfection of operation and effect with reference to taking up the momentum of the carriage and its driver.

We design by our invention to provide a means by which not only may the carriages or other contrivances driven directly by the reciprocatory pistons of steam-engines have their momentum perfectly absorbed without loss of the generative power medium, but by which also the steam employed to drive the engine will be more economically used than in steam-engines heretofore employed for the purposes for which our improved engine is designed; and to this main end and object our invention may be said to consist, essentially, in an engine in which the piston is cushioned at the end of its stroke by steam confined between it and that head of the cylinder which it approaches, and, secondarily, in one in which the cushioning capacity may be varied by adjustment of the devices to suit the requirements of the carriage or other device being driven, whereby the engine itself is made to always properly take up the momentum of the driven device, all as will be hereinafter more fully described, and as will be more particularly defined in the claims of this specification.

To enable those skilled in the art to which our invention relates to make and use the latter, we will now proceed to more fully describe it, referring by letters to the accompanying drawings, which form part of this specification, and in which we have shown our invention carried into effect in that form of engine in which we have so far successfully embodied it, and which is more especially adapted to the purposes of driving the reciprocatory carriage of a circular saw mill.

In the drawings, Figure 1 is a side elevation of one of our improved engines, but with the middle portion broken out and the ends moved together for the purpose merely of condensing the drawings within the requisite limits without making it on too smale a scale for clearness. Fig. 2 is a cross-sectional view, on an enlarged scale, taken at a plane indicated by the line *x x* of Fig. 1. Fig. 3 is a longitudinal vertical section through the center of the cylinder on nearly as large a scale as Fig. 2, but showing only one end portion of the engine. Fig. 4 is a view similar to Fig. 3, but of the other end portion of the engine. Fig. 5 is a skeleton view showing, in side elevation, a portion of the valve-rod and the hand-lever connections for working the valves of the engine. Fig. 6 is a partial top view of the cylinder-lining and the variable or adjustable port-slide for regulating the cushioning action of the engine.

In the several figures the same part will be

found designated by the same letter of reference.

A is the usual cast-iron cylinder of the engine, which is made, preferably, in sections securely connected in line, the outer ends of the said cylinder being closed steam-tight by the cylinder-heads B B. Each end section of the cylinder is formed, as shown, with an upward extension, C, of considerable length, within which are located the steam supply and exhaust passages *c* and *d*, which communicate, through the medium of suitable ports, with the interior of the cylinder and with the exhaust-pipe of the engine, all in a manner to be presently more fully explained. On top of each of these cylinder-extensions C, or steamways, is secured a steam and valve chest, D, within which are formed the necessary steam-passages that communicate with the supply and exhaust passages of the cylinder, and to which the live steam for running the engine is supplied by a steam-pipe, G.

Within each of the chests D is a slide valve, I, which in the case shown is made in the form of a hollow cylinder, and these two valves are connected with a single valve-rod, *a*, which passes through suitable stuffing-boxes in the adjacent ends of the two valve-chests, and which is flexibly connected, preferably at or near its middle, lengthwise, with the arm *m* of a rock-shaft, J, which has another projecting arm, *n*, the outer end of which is flexibly connected with one end of a connecting-rod, *k*, which at its other end is coupled to the hand-lever *b*, (see Figs. 1 and 5,) by means of which the operative manipulates, through the media of the rod *a* and its connections, (just referred to,) the valves I of the engine. This hand-lever *b* is fulcrumed on a fixed pivot at *l*, and is provided with a weight, O, at its lower end, which operates to bring the lever to a vertical position whenever released from the grasp of the operative, all in a manner and for purposes to be presently explained.

M is the steam-piston, and N the piston-rod, which latter, as clearly shown, passes through a suitable stuffing-box at P and projects sufficiently from the cylinder-head, through which it passes, to permit it to be connected, in any desired and proper manner, with the carriage of a saw-mill, (or with any other device or contrivance to which it may be desired to directly impart the reciprocatory motion of the engine.)

Q Q are the exhaust-pipes, through which the steam is exhausted alternately from the interior end portions of the cylinder A, and which communicate, respectively, with the exhaust ports and passages of the steam-chest D, as clearly shown.

S S are tubular linings to the enlarged end portions of the steam-cylinder, which linings are of the proper thickness to reduce the bores of these enlarged end portions to precisely the same diameter as that of the middle and smaller portion or section of the cylinder. These linings or inner shells, S, to the end portions of the steam-cylinder are used, however, for the purpose of affording a means for producing an adjustable valvular exhaust-port, *f*, to each end of the steam-cylinder in the following manner: A portion of each cylindrical shell S is removed at its uppermost part for a length about thrice the length of the oblong opening or communication between the steam passage-way *d* and the interior of the cylinder A, and in width a little more than the width of said oblong communication, (between *d* and A,) and the space caused by the removal of this long narrow strip of shell S is filled by a sliding strip of metal, E, (see Figs. 2 and 3,) which is perforated to form the port-opening *f*, and with which is connected a screw-rod, H, which extends from one end of said strip E toward and through a perforation in the head B of the steam-cylinder and through a stuffing-box, c^2, all as clearly shown.

Each of the screw-rods H is provided with a nut, e^2, by means of which said rod may be moved endwise (in either direction) for the purpose of sliding or adjusting longitudinally the metallic strip E, and by this adjustment of said strip E the port *f* (or the point of communication between the interior of the cylinder A and the exhaust-steam passage *d* of the said cylinder) may be set at different points, as may be required.

In the operation of a machine made as shown and as thus far herein described steam from the supply-pipes G is admitted alternately through the two valve-chests D and their steam-passages *c* to the interior end portions of the cylinder A, (by the proper manipulation of the slide-valves I under the management of the operative who handles the lever *b* of the valve-gear,) and causes a reciprocatory motion of the piston M, (which, through the medium of the protruding piston-rod N, drives the saw-carriage or other contrivance,) the steam being exhausted from the ends of the cylinder, of course, alternately; but, contrary to or unlike the usual mode of operation of a (direct-acting) steam engine, the mode of operation of our improved machine is such that at each stroke of the piston M the latter operates in completing its stroke to compress a certain quantity of steam that cannot make its escape (or cannot exhaust) from that end of the cylinder toward which the piston is moving, this compressive action resulting in cushioning the piston and any moving machinery or device driven by the piston-rod N, that (together with the piston M) would otherwise require to have its momentum taken up by some cushioning device arranged and operating independently of the engine. Supposing the working parts to be in the conditions illustrated, steam will be entering the cylinder at the right-hand end through the steam-passage and port *c*, as per arrows at Fig. 3, and will be operating to drive the piston M in the direction indicated by the arrow marked thereon at Fig. 3. As the piston progresses in its stroke and passes on a little beyond the

position in which it is seen at Fig. 3, the exhaust-port hole *f* in the adjustable strip or slide E will be exposed, so that the live steam will enter the passage-way *d*; but it cannot escape thence into the exhaust-port proper, (of this end of the cylinder,) because the position of the slide-valve I is now such, it will be seen, as to cut off all communication between the passage-way *d* and the exhaust-opening Q. The piston therefore proceeds on its way in the ordinary manner, the steam contents of the cylinder in advance or in front of the piston escaping freely through the port-opening *f*, steam-passage *d*, and exhaust-pipe Q at the other end of the cylinder, the valve I there being in such position as to permit this action.

A reference now to Fig. 4 will show that at the end of the cylinder there shown the valve I is placed so as to create a free communication through passage *d* between the interior of this end of the cylinder and the exhaust-port, (to permit the escape of the steam in advance of the moving piston, as just explained and as indicated by the arrows,) while it closes all communication between the interior of this portion of the cylinder and the live-steam (or ingress) port and passage-way *c*. Just as soon, however, as the leading end of the piston M shall have passed sufficiently beyond the position in which it is shown in dotted lines at Fig. 4 to close the exhaust-steam port *f*, then all further escape of the steam is prevented, (the communication between *c* and the steam-supply pipe G being cut off by the valve I,) and whatever steam may be remaining in this end of the cylinder is compressed by the piston as the latter completes its stroke, and forms a cushion or elastic take-up for the finish of the piston's stroke and the gradual absorption of any momentum of the saw-carriage or other device being driven by the engine.

To get the proper action and desired effect, the operative in charge of the valve-gear should release his hold on the hand-lever *b*, (see Figs. 1 and 5,) which, during the movement of the piston just described, has been held by him in the position seen in the drawings at about the time the saw-carriage (and the driving-piston) is relieved of the main resistance offered to the driving movement of the engine, (usually about as the piston M begins to cushion on or compress the confined steam,) whereupon said lever will, by the gravitating action of its weight O, assume a vertical position. This automatic movement will cause the valves I, which are both connected to the valve-rod *a*, to be moved about a half-stroke or half-throw, in which new position the live steam port and exhaust-port at Fig. 4 still remain closed.

Of course, to repeat the action or operation just described, but by a stroke of the piston M in an opposite direction, the operative simply moves the hand-lever to the position shown in dotted lines at Fig. 5, whereby the valves I will be still further shifted, so as to admit steam through port *c* at that end of the cylinder shown at Fig. 4 and open the communication between *d* and Q at the other end. (Seen at Fig. 3.) Now, as in the use of the contrivance shown, under different circumstances, it may be necessary to materially change the extent or degree of the compressor-like or cushioning action of the engine, we have provided for this purpose the movable strip or slide E, provided with the port-opening *f*, and the screw-rod H, with its nut e^2, all as shown and as hereinbefore alluded to.

In the drawings the slide E is shown as set so as to bring the port-opening *f* in that position in which the maximum amount of steam will be retained in each end of the cylinder, and hence so that the greatest degree of cushioning action of which the engine is capable will be accomplished; but if by reason of the character of the work being done (as, for instance, if a saw-mill carriage is being driven, that from its weight and the nature of its work requires a lighter cushion to take up its momentum after the cessation of the cut) it is desired to decrease the capacity of the steam-cushion, then by turning the nuts e^2 in the proper direction the sliding pieces E are moved along endwise, so as to bring their port-holes *f* nearer to the ends of the cylinder, thus enabling the piston M to travel nearer to the end of its stroke before passing the ports *f* and cutting off the opportunity of steam-escape through said ports, and consequently leaving less steam in the cylinder to be compressed and a smaller amount of movement of the piston within which to perform the cushioning effect. If the exigencies of the case require it, these devices E may be (separately) adjusted so as to make the compressor-like action at one end of the piston's stroke different from that at the other end.

It will be understood that by the means shown not only may the engine be made to effect a perfect cushioning of the piston, and in this manner a complete but gradual absorption of any momentum of the device or machinery being driven that might otherwise be hurtful or injurious or require some other less efficient and more expensive expedient to take up the inertia, but that, furthermore, the act of compressing the steam left in each end of the cylinder, as described, operates to increase the temperature of the exhaust-steam, (used in advance of the piston,) and to thus avoid the usual loss of steam-power heretofore consequent to the successive reductions of the temperature of the metallic parts of the engine into which the live steam is alternately fed to drive the piston back and forth.

Of course many mere modifications of our invention may be made and various changes in the details of construction of the novel machine shown may be effected without changing the novel principle of construction and mode of operation shown and described, and hence

without departing from the pith of our invention.

What we claim, broadly, as new, and desire to secure by Letters Patent, is—

1. In combination with the cylinder, piston, and suitable valve-gear of an engine, an adjustable port, *f*, which operates when set at different points lengthwise of the cylinder to effect the cushioning of the piston during longer or shorter portions of the stroke of said piston, all substantially in the manner and for the purposes hereinbefore set forth.

2. In an engine adapted to be driven by steam, (or any other elastic medium,) the combination, with the cylinder, piston, and suitable valve-gear, of adjustable ports *f f*, arranged one near each end of the cylinder and separately adjustable lengthwise of the cylinder, as specified, whereby the cushioning of the piston on the cylinder may be effected differently at the opposite ends of the cylinder and the piston-stroke, all substantially as hereinbefore set forth.

In witness whereof we have hereunto set our hands this 27th day of August, 1887.

MICHAEL GARLAND.
ABEL D. CATLIN.

In presence of—
JAS. E. THOMAS,
W. H. POWER.