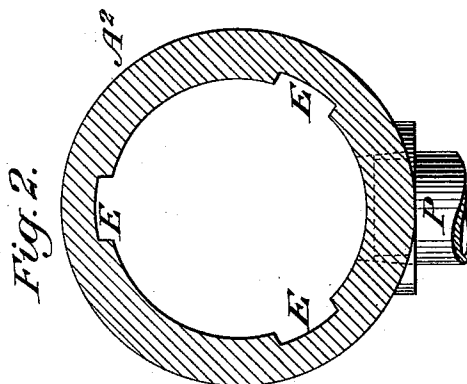
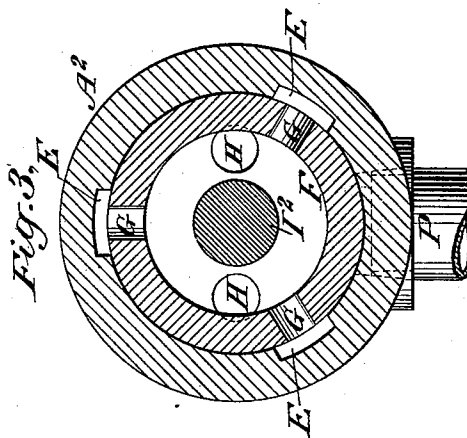
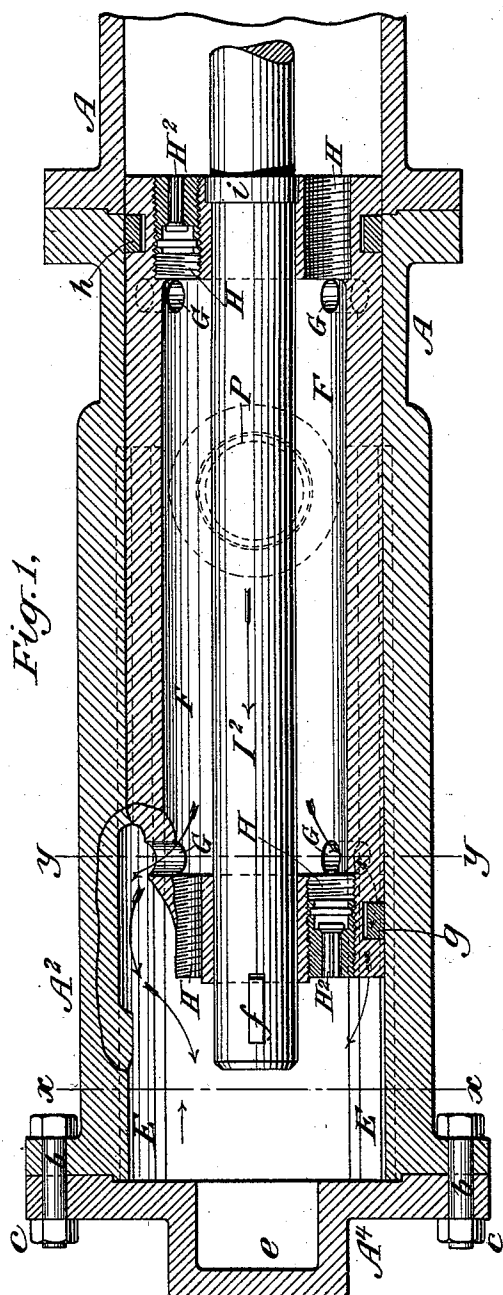


(No Model.)

E. E. THOMAS.
DIRECT ACTING STEAM ENGINE.

No. 538,218.

Patented Apr. 23, 1895.



Witnesses:-
O. N. Maybrook
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UNITED STATES PATENT OFFICE.

EDWIN E. THOMAS, OF BAY CITY, MICHIGAN, ASSIGNOR TO MICHAEL GARLAND, OF SAME PLACE.

DIRECT-ACTING STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 538,218, dated April 23, 1895.

Application filed November 27, 1894. Serial No. 530,101. (No model.)

To all whom it may concern:

Be it known that I, EDWIN E. THOMAS, of Bay City, in the county of Bay and State of Michigan, have invented a new and useful
5 Improved Direct-Acting Steam-Engine; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification.

10 My invention relates to what are generally designated as "direct acting" reciprocatory engines—i. e., that species of engine in which the piston rod is connected directly to the machine to be driven—and, though more especially
15 designed for use in what are known as steam feed engines, for saw mills, may be embodied in any engine of the species mentioned.

As is well known to those skilled in the art,
20 it is important and necessary, in all cases, in the use of the kind of engine to which my improvement relates, to provide some means for cushioning the piston, at the end of each stroke, to take up the momentum of the parts,
25 and machinery propelled, first in one and then in the other direction, by the piston rod; and this is vitally important in that species of this kind of engine which is employed as the steam feed for saw mill carriages, where,
30 by reason of some carelessness, or lack of skill on the part of the sawyer, or attendant, who manipulates the valve-gear of the engine, the piston of the latter may be allowed to run dangerously close to the cylinder head, or the
35 engine be permitted to "run away"—as it is called—thus causing injurious and sometimes dangerous concussions, and often resulting in some break-down in the machinery of, or that connected with, the engine.

40 Various devices have heretofore been used to effectuate an automatic cushioning of the piston at the end of each stroke; but in all of them, that I know of, the retardation of the piston has been effected by the retention
45 within that end of the cylinder which the piston approached, of the steam which has to exhaust in advance of the piston to permit its propulsion freely by the steam operating to drive it. In many cases, or under

some circumstances, especially in steam feed
50 cylinders for saw mills, this principle of construction, or mode of cushioning the piston, is not always efficient, or reliable, and I propose to provide for use an engine, in which,
under all circumstances, and even when the
55 valve-gear, or mechanism, for reversing the motions of the engine, be carelessly, or improperly, manipulated, the piston cannot possibly be propelled too far in one direction; thus effectually preventing any injurious
60 concussive strains on any of the working parts of either the engine, or the machine being driven thereby, and affording a certain remedy for those evils and dangers, resulting from a "run-away" of the engine.

To this main end and object my invention
65 consists in the construction of the engine, as will be hereinafter explained, so that, in the event of the passage of the piston (in either direction) beyond a certain predetermined
70 point, in its stroke, the live steam which is propelling the piston, will be automatically permitted to pass into the cylinder in advance of the moving piston, and counteract the force of the steam in rear of
75 the piston; all as will be most particularly pointed out in the claims of this specification.

To enable those skilled in the art to which
my invention relates, to understand and practice
80 the same, I will now proceed to more fully describe it, referring by letters to the accompanying drawings which form part of this specification, and in which I have shown my invention as applied to the steam feed cylinder
85 of a saw mill, and carried into effect under those precise details of construction under which I have so far practiced it, though various modifications may, doubtless, be made,
without changing the principle of construction,
90 or mode of operation, involved in the novel construction shown, and, hence, without departing from the spirit of my invention.

In the drawings, I have shown only one end-
95 portion of a steam feed cylinder, the other end being, of course, a mere duplicate in construction (except that the cylinder head is, as usual, centrally perforated, and provided with a stuffing-box, for the passage through it of

the piston rod), in order to make the drawings on a sufficiently large scale, to very clearly show the novel construction essential to my invention; and I have not shown any of the steam pipe connections, nor the valve-gear mechanism of the engine, since these parts of the engine are assumed to be of the usual approved character, and form no part of my invention.

In the drawings, Figure 1 is a horizontal central section of so much of a steam feed cylinder, as is necessary to be shown, to fully illustrate the embodiment of my invention in this species of direct acting engine, and with certain parts broken away. Fig. 2, is a vertical cross-section taken in a plane indicated by the line x, x , of Fig. 1, and looking in the direction illustrated by arrow 1, in said figure. Fig. 3, is a similar section, but taken in a plane indicated by the line y, y , of Fig. 1, and showing a large portion of the cylinder broken off.

In the several figures, the same part will be found always designated by the same letter of reference.

A, A² is the cylinder, which is supposed to be of the usual length (which varies from twenty to eighty feet); and which is made in about the ordinary way, except that its external diameter (or in other words, the thickness of its shell), is preferably increased somewhat at the vicinity of each end, as shown by the portion marked A², for a purpose to be presently explained. That end of the cylinder seen in the drawings, is closed by a head A⁴, securely fastened to the cylinder by bolts and nuts b, c , in the usual manner, and, in the case shown, is formed with a central depression, or cup-shaped portion e , merely for the accommodation of the extreme end of the piston rod I², which, as shown, projects beyond the end of the piston. In the enlarged portion A² (at each end of the cylinder) are formed a series of longitudinal depressions E. I have shown the cylinder as having three of them, which may be cored out, in casting the cylinder, and which perform the function of steam passage-ways, in a manner and for a purpose to be presently described.

F is the piston of the engine which I make, as shown, in the form of a cylinder, cast hollow, with its integral ends, or heads, centrally perforated, for the accommodation of the piston-rod I², which passes through it, and is securely fastened to it, in any suitable manner. In the case shown, the rod I² is formed with a collar at i , which fits in a slight counter-sink of the central hole in one end of piston F, and it is provided, at its protruding end, with a key f , which, as clearly seen at Fig. 1, is driven through an oblong aperture in the rod, and bears against the outer surface of the central part of the other piston end, so as to securely hold the latter in place relatively to the piston rod, both endwise and circumferentially. The piston is, as usual, provided with suitable packing-rings, such, for in-

stance, as seen at g and h , and through the shell are drilled two series of holes G, G, &c. Each series is located (see Fig. 1) close to the inner side of one of the piston heads, and the three holes of each series are arranged, or bored, about radially (see Fig. 3); and so that they match with, or come in line radially with the three depressions (or steam passage-ways) E of the cylinder hereinbefore alluded to.

Each head, or end, of the hollow piston F, has two holes, H, H, extending through it; said holes being arranged, preferably, at diametrically opposite points, and running parallel with the axis of the piston. Each of said holes communicates, at its inner end, with the interior of the hollow piston, and is provided with a check-valve, H², that is adapted to open, inwardly,—i. e., toward the interior of the piston. As the valves in the four holes H (two in each head of the piston) are duplicates, I have shown only one valve in each head, leaving out the other one, so that the drawings, at Fig. 1, will better show both the complete structure of each piston head, and the head as prepared for the reception of the valvular devices; and right here, it may be remarked, that in carrying my invention into effect, some other form and number of holes H, may be adopted, and any sort of check-valve may be employed, so long as the arrangement of devices be such, that the valves will only open inwardly, as stated, and the apertures H, in which they are located (when unclosed) form open communications between the interior of the piston and the interior of the cylinder, within which said piston works.

P is the port-pipe, which communicates with that end, or portion, of the feed cylinder shown, and which is supposed to extend, as usual, to the valve chest located beneath and about centrally (lengthwise) of the cylinder; from which steam chest another like port-pipe is, of course, supposed to extend to the other end of the cylinder, not shown in the drawings, and in the well-known manner, the steam is alternately supplied to, and exhausted from each end of the cylinder through the said port-pipe P.

At Fig. 1, the dotted circles denote the position of the port-pipe, while at Fig. 2, a portion of said pipe descending from the port hole in the lower side of the cylinder, is shown in elevation.

In the use of a steam feed cylinder, such as I have herein shown and described, it is designed, or contemplated, that the sawyer, or operator of the engine, will so manipulate the valve-gear, that the piston F will never be propelled into the position, relatively to the cylinder end, or head, in which I have shown it at Fig. 1, for the purpose of illustrating the operation of my improvement, or invention. He is supposed to manage the engine, so that the piston F will never travel far enough, in the direction indicated by the arrow on the piston-rod, to have its leading

end pass over and cover the port-pipe P, (as I have shown it to have done;) but so that by a proper management of the valve gear of the engine, the piston will be properly stopped and reversed, without the aid of the means which constitute the subject matter of my invention; but in case of failure to thus properly work the operating valve, and the consequent propulsion of the piston F, too far, in the direction indicated, then the means herein shown and described, operates as follows, viz:—When the leading end of the piston reaches a point at which the periphery of the piston covers the port-pipe P, the further exhaust of the steam in front of the advancing piston is, as usual, prevented, but, instead of relying upon the expansive force of this confined steam to resist the further advance of the piston, to an injurious, or dangerous, extent, at the next moment, or instant, after the covering of the port-pipe, P (and the stoppage thus of any further escape of the steam confined in front of the moving piston), the three radial holes G, near the leading end of the piston, come into open communication with the inner ends of the three longitudinal depressions, or channels, E, of the cylinder shell A², and the live steam, which is propelling the piston (and which fills or pervades the interior, or annular, space, see Fig. 1, of the piston) rushes through the said holes, or ports, G, and, thence, through the longitudinal passage-ways, E, into the space within the cylinder, A, in advance of the moving piston (which space was just previously occupied only by the remnant of dead steam, which was prevented from exhausting by the closure of port-pipe P), and eventually filling this space, exerts its head, or pressure, against the leading end of the piston, in opposition to the tendency of the piston to keep moving, and until the stroke of the piston is forcibly and positively ended at, for instance, the point to which it is shown as having moved, at Fig. 1. By this means, it will be seen the live steam, that propels the piston, is automatically inducted to the cylinder, in advance of the piston, the moment the latter may have been permitted to pass far enough to cover the pipe-port P, and whenever it might otherwise, travel, or be propelled (by the steam in its rear) too far. The supply thus of the live steam to the cylinder, in advance of the moving piston, must, it will be seen, enforce a positive (though not too sudden) stoppage of the piston, even though the supply of steam from the valve-chest should never be cut off from that end of the cylinder from which the piston last started.

It will be understood, of course, that as all the check valves of the piston open inwardly, the two at the tail end of the piston, when it commenced the stroke just described, were then opened, so that the live steam filled the interior of the piston, and was prevented from escaping at the leading end, by the check-valves at that end; and it will be seen that

in the event of like conditions arising, when the piston may be traveling in the other direction, the operation which I have above explained, by which the piston is prevented from traveling too far, will be repeated, at the other end of the cylinder.

The hollow piston, it will be seen, is always full of the live steam, fed into, first, one, and then the other end of the cylinder, which steam, however, never escapes therefrom into the cylinder space in advance of the moving piston, except in the manner and under the conditions hereinabove explained.

The shell of the cylinder, as I have said, is preferably enlarged during that portion of its length where the depressions, or passage ways, E are formed in its bore, in order to have it equally strong at this locality, and the said depressions E are, preferably, made considerably wider than the diameter of the holes G, so that although comparatively shallow in depth, their cross-sectional area will be nearly, or quite, equal to that of the said holes, thus rendering their capacity, as conduits, about equal to that of the supply ports G. These details of construction may, however, all be varied more, or less, without changing the novel principle of construction and mode of operation of my improved engine, and, hence, without departing from my invention, the pith of which rests in providing means by which, when the piston shall have passed a given point, in making a stroke (in either direction) the live steam, which is propelling it, will be automatically ushered into the cylinder, in advance of the moving piston, with the exhaust from said portion of the cylinder closed; so that, the further advance of the piston must be positively stopped, at the proper point, even though the steam supply be never cut off. I, therefore, wish it to be understood, that, so far as this generic structural feature of my improved engine is concerned, I do not propose to be limited to the precise means shown for effectuating the transmission of the steam in rear of, and propelling the piston to the leading end, or face, of the piston, to there counteract the propulsion of the piston, as other means than that I have shown may easily be devised, involving the same mode of operation, and producing the same result.

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

1. In a direct acting engine, the combination, with the cylinder, provided with steam passages, or longitudinal depressions in its bore; and a piston adapted to receive steam within it, of ports, or apertures, in said piston, operating to form open communications between the interior of the latter and the said steam passages of the cylinder; and check-valves in either end of the piston, adapted to open inwardly; the whole constructed to operate together in substantially the manner and for the purposes hereinbefore set forth.

2. The combination of a cylinder formed,

or provided, at its end-portion with internal
depressions E; a hollow piston having ports,
or apertures, G, and holes H in its heads; and
suitable check-valves arranged in the aper-
5 tures H; the whole constructed and arranged
to operate in substantially the manner de-
scribed, for the purposes set forth.

In witness whereof I have hereunto set my
hand this 21st day of December, 1893.

EDWIN E. THOMAS.

In presence of--

A. B. LENNOX,

R. A. MCKAY.