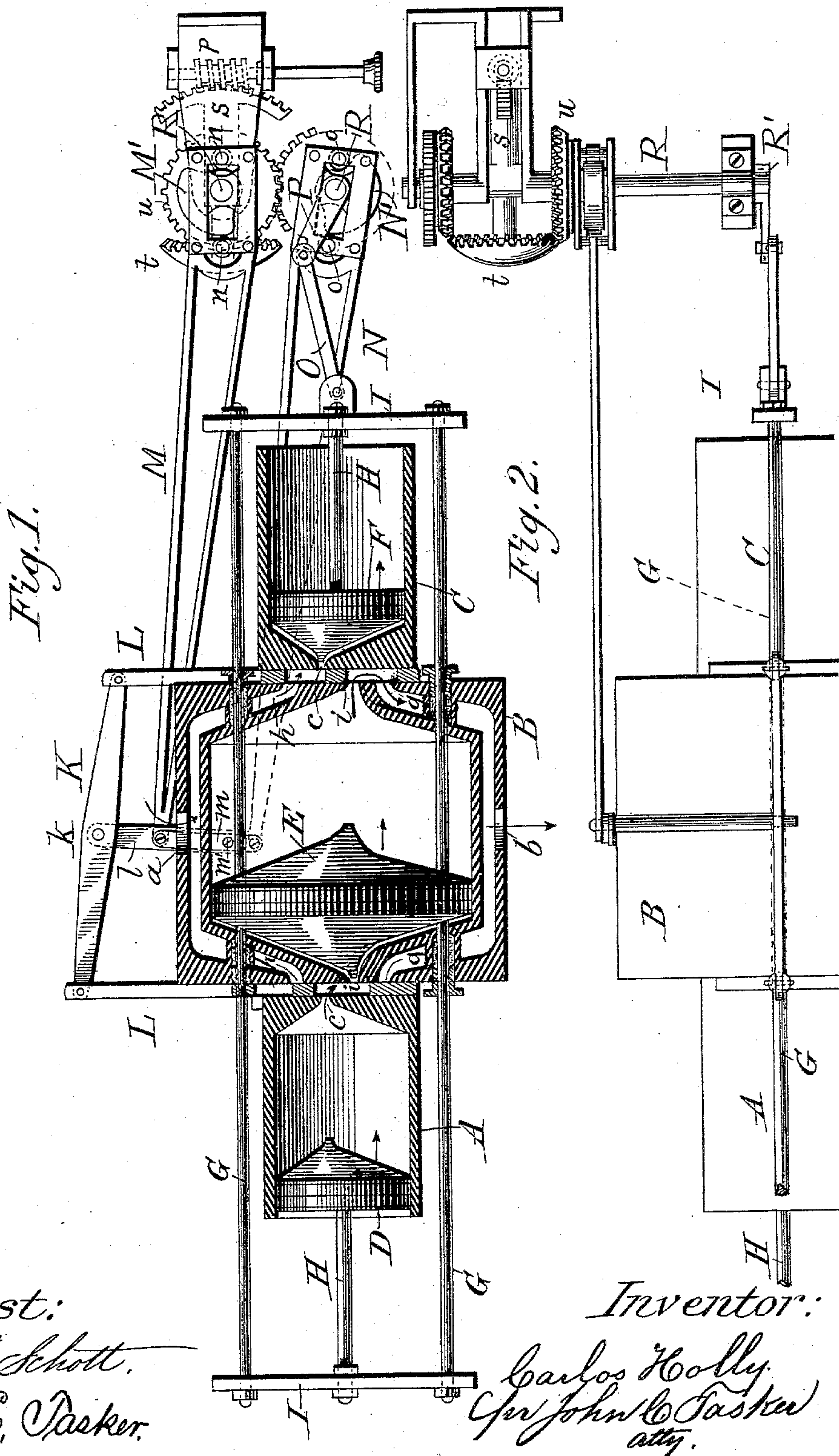


(No Model.)

C. HOLLY.  
COMPOUND STEAM ENGINE.

No. 401,167.

Patented Apr. 9, 1889.



Attest:

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# UNITED STATES PATENT OFFICE.

CARLOS HOLLY, OF LOCKPORT, NEW YORK.

## COMPOUND STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 401,167, dated April 9, 1889.

Application filed December 10, 1885. Serial No. 185,310. (No model.)

*To all whom it may concern:*

Be it known that I, CARLOS HOLLY, a citizen of the United States, residing at Lockport, in the county of Niagara and State of New York, have invented certain new and useful Improvements in Compound Steam - Engines; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

This invention relates to an improvement in compound steam-engines; and it consists in three cylinders, one double-acting and two single-acting, arranged in close relation to each other and containing pistons connected by suitable means, so as to move simultaneously in the same direction. The two single-acting cylinders in reality equal and do the work of a double-acting cylinder; but in thus dividing it into two single-acting parts I am enabled to bring the ends of the high and low pressure cylinders into close communication and shorten the ports between them, thereby overcoming the disadvantages incident to other engines which have long ports.

The invention also embraces a construction of the cylinders whereby the ports are located in their heads and the interior walls are fashioned in a novel manner, to which the construction of the piston is made to conform; and the invention further consists in peculiarities of the construction and arrangement of parts, as will be hereinafter set forth.

In the annexed drawings, illustrating my invention, Figure 1 represents a side sectional view of my improved steam-engine cylinders. Fig. 2 is a top plan view of the same.

Similar letters of reference denote corresponding parts in all the figures.

In Fig. 1 we have represented three cylinders, A, B, and C, situated in line with each other and containing pistons D, E, and F. The middle cylinder, as B, is double-acting and larger, being of greater diameter than the end or single-acting cylinders, as A and C, and may receive the steam from the latter at a low pressure, while the steam enters the end cylinders at a high or boiler pressure. The

end or single-acting cylinders receive steam through suitable pipes or conduits provided for the purpose. In Fig. 1 these pipes are shown as formed in the cylinder-casing. *a* is the supply-opening, which admits steam coming from the boiler, and *h h* are continuations of the pipes or openings in the ends of the cylinder for admitting steam to the high-pressure cylinders when the valves are in proper position to open the ports of the latter. The exhaust-steam from the low-pressure cylinder passes out through an exhaust-pipe, which in the present instance is likewise formed in the casing of the middle cylinder, and is provided with end openings, *g g*, and an outlet, *b*, which may connect with a condenser.

In the middle cylinder each head is provided with one port, as *i*, which alternately serves as an induction and an eduction port for the steam acting on the middle piston, and the heads of the end cylinders next the middle one have each a single port, *c*, through which high-pressure steam is admitted to these cylinders, and which also serves as an exhaust-port for the steam in its passage to the central or low-pressure cylinder.

In this example of my invention the interiors of the cylinder-heads are formed with walls which are conical or V-shaped, the port in each head being located at the apex of the cone or V shape. The pistons are constructed to conform to this shape of the cylinders, the piston of the middle cylinder being a double cone or V-shaped on each side to adapt it to close tightly against each head, while it is only necessary for the pistons of the end or single-acting cylinders to have the cone or V shape on one side, since these cylinders have but one head, the other end being left open. The V-shaped portions of the pistons are formed at the apex of the V with a slightly-projecting tongue, which is adapted to fit loosely into the adjacent steam-port, leaving only space enough between it and the sides of the port to contain a very small film of steam, and by this construction I am enabled to expel practically all the steam from a cylinder when the piston reaches the end of its stroke, thereby allowing little or no waste in the passages or clearance.

The pistons D, E, and F are connected to-



gether by any suitable means, so as to have a simultaneous movement. We have here shown two longitudinal piston-rods, G G, cross-heads I I, and rods H H, which latter connect the pistons D and F with the cross-heads I I, while the middle piston is secured to the side rods, G. These rods pass through the middle cylinder by being inclosed within suitable stuffing-boxes provided for the purpose. Thus it will be seen that when one piston moves they will all move in the same direction.

The valve mechanism which is used with this arrangement of cylinders for the purpose of controlling the admission of steam consists of a slide-valve perfectly balanced by being so situated that the steam can exert no pressure upon it either to close or open it, it being automatically actuated at each end of the stroke by means of a system of levers and cams. This valve consists of two parts. It may be said there are two valves, which are located in spaces between the middle and each end cylinder, said spaces being constructed to inclose the valve, so that it may slide tightly therein, and said valves being formed for closing and unclosing the ports and openings which enter the spaces.

The mechanism which I employ for the purpose of actuating the valves is arranged as follows: Above the middle cylinder is located a beam or rod, K, which is pivoted at *k* to any convenient portion of the engine-frame, and to which at the point *k* is rigidly secured a downwardly-extending arm, *l*. To the extremities of the rod K are pivotally attached the vertically-reciprocating rods L L, which carry the valves that are located between the heads of the middle cylinder and the end cylinders. It is obvious, therefore, that if the arm *l* be oscillated by any means the valve-rods L L will be reciprocated and the valves moved so as to cover or uncover the ports. A short lever, *m*, is pivoted to the arm *l* at a point—say *m'*—near its lower end, and to the upper and lower ends of the lever *m* are connected, respectively, the horizontal rods M and N, whose other ends are fashioned to inclose the cams M' and N', respectively. Within these frame-like ends of the rods M and N are journaled suitable rollers, *n n* and *o o*, which are located on each side of the cams M' and N'. These cams are secured rigidly upon shafts R and R', which are geared to each other, and one of which, R', is the crank-shaft, and is connected with the cross-head I by means of the connecting-rod O. In this way the two cams will be actuated simultaneously during the movement of the piston, and their rotation will cause the rods M and N to be moved endwise, which will result in moving the lever *m*, thus oscillating the arm *l* and causing the valves to be moved in the manner desired for properly closing or opening the ports.

Therefore the operation of my engine is as

follows: Suppose the pistons to be near one end of the stroke, as shown in Fig. 1. Steam passing along the conduit after entering the opening *a* will find its way barred in one direction by the closed port in one end of the cylinder, while at the other end, the port being open, it will enter the end cylinder, C, and act against the piston therein, driving it to the other end of its stroke. At the same time the ports between the contiguous ends of the cylinders A and B will be open, so that the steam can expand from the smaller into the larger cylinder and act against its piston, and the steam on the other side of this piston in the larger cylinder will be exhausting through its exhaust-port. As the pistons reach the other limit of their stroke the valves will be shifted, so that steam from the boiler will cease to enter the cylinder C, but will begin to enter cylinder A, while the steam already in C will expand into the larger cylinder against its piston, and the steam on the other side of the same piston will exhaust through opening *g*. This operation will progress continuously. The valve mechanism shown in the drawings will operate as follows to admit, exhaust, and cut off the steam: At each end of the piston-stroke the cam N', which is rigid on the crank-shaft R', will, when rotated, move the rod N endwise, and thus actuate the valves, so that boiler-steam will be admitted to one of the high-pressure cylinders, exhaust-steam will pass from the other high-pressure cylinder into the low-pressure cylinder on one side of its piston, while the exhaust-steam on the other side of this piston will pass out through the exhaust-port. The function of the cam M' is to move the rod M endwise, and thus actuate the valves, so as to cut off the admission of the high-pressure steam to the cylinders at any desired point in the length of the stroke. The position of the cam M' with respect to the cam N' can be varied at pleasure, so as to regulate the point in the length of the stroke at which the cut-off valve may be made to operate. Mechanism for changing the position of this cam is shown in the drawings, consisting of a worm, *p*, that meshes with a segment-gear on the arm *s*, that carries a gear, *t*, that meshes with the gear *u* on the shaft R', on which shaft the cam M is secured. It will be readily seen that a movement of the worm *p* will adjust the cam M' relatively to the cam N'.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a compound steam-engine, a double-acting cylinder, in combination with two single-acting cylinders arranged on the ends of the double-acting cylinder and provided with simultaneously-moving pistons which are connected by means of piston-rods joined at their ends by cross-pieces, said piston-rods passing through the double-acting but outside of the single-acting cylinders, the middle piston be-



ing secured to the rods and the end pistons being connected by rods with said cross-pieces, substantially as described.

2. In a compound steam-engine, the combination of a low-pressure cylinder, two high-pressure cylinders placed on the ends of the low-pressure cylinder, the adjacent heads of said cylinders having each a steam-port and ingress and exhaust passages, arranged substantially as shown, and all of said cylinders being provided with simultaneously-moving pistons which are connected by means of piston-rods joined at their ends by cross-pieces, and passing through the double-acting but outside the single-acting cylinders, the middle piston being secured to the rods and the end pistons connected with the cross-pieces, and valves situated between the heads of the cylinders, each of said valves having two openings, and arranged to operate substantially as specified and shown.

3. In a compound steam-engine, a double-acting cylinder, in combination with two single-acting cylinders arranged on the ends of the double-acting cylinder, a piston within each cylinder, and a frame for enabling the pistons to have a simultaneous movement without the use of a piston-rod common to the three pistons, said frame consisting of a cross-piece at the outer end of each single-acting cylinder and rods connecting the pistons with said cross-pieces, substantially as described.

4. In a compound steam-engine, the combination of a low-pressure cylinder, two high-pressure cylinders placed on the ends of the low-pressure, the adjacent heads of said cylinders having each a single port, and being likewise provided with ingress and exhaust passages, and valves situated between the heads of the cylinders, each of said valves having two openings, one to admit steam to the high-pressure cylinders and the other for allowing steam to pass from the high-pressure to the low-pressure cylinders, and also from the low-pressure to the exhaust, all arranged and operated substantially as described.

5. In a compound steam-engine, a central low-pressure double-acting cylinder, in combination with two contiguous single-acting high pressure cylinders, said cylinders being provided with pistons having port-closing projections, and all connected together and having a simultaneous movement in the same direction, as and for the purpose specified.

6. The combination of cylinder B, its piston E, cylinders A and C, their pistons D and F, the piston-rods G G and H H, and the cross-pieces I I, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

CARLOS HOLLY.

Witnesses:

PHILIP MAURO,  
FRED E. TASKER.