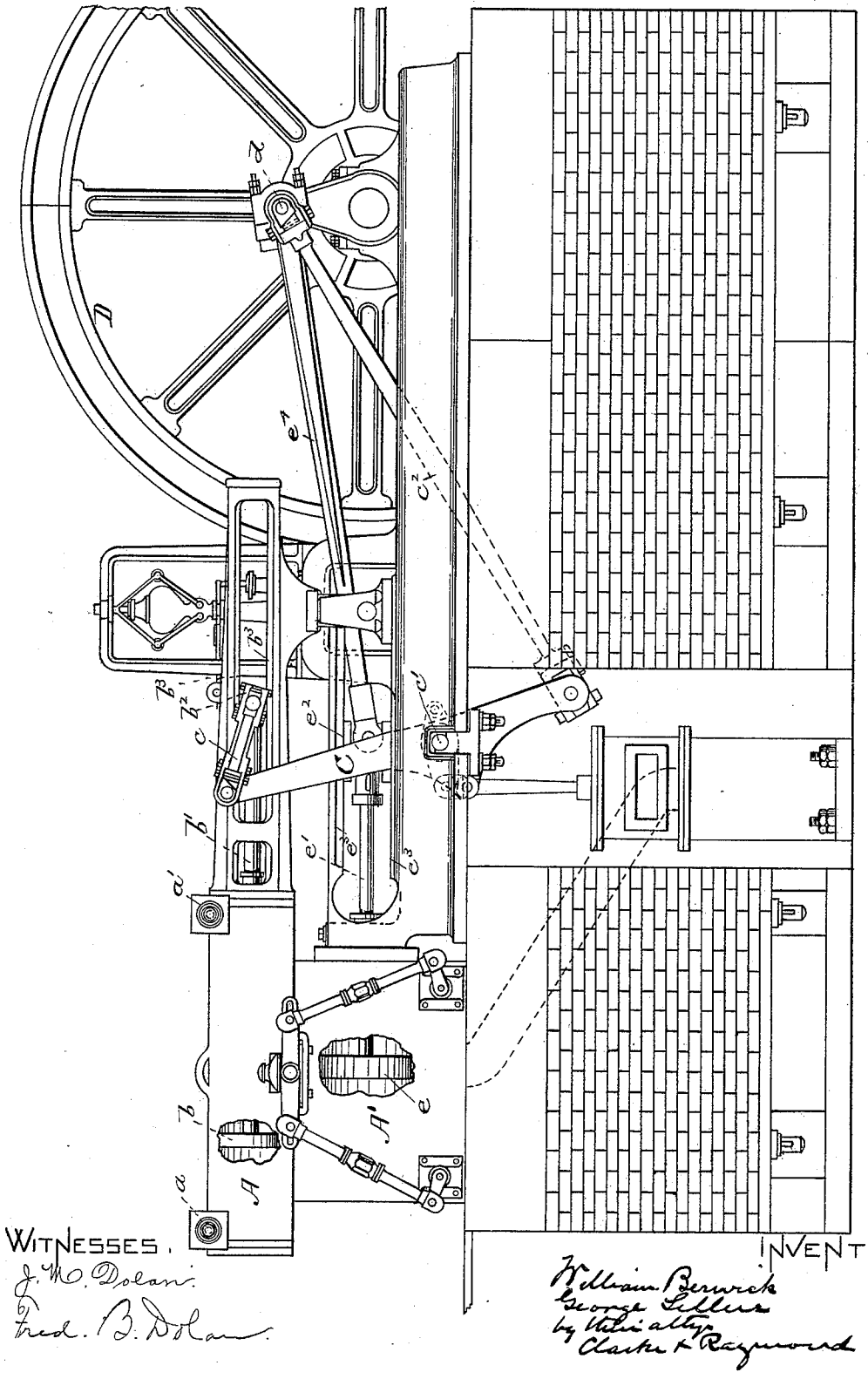
(No Model.)

W. BERWICK & G. SELLERS.

COMPOUND ENGINE.

No. 390,434. Patented Oct. 2, 1888.



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UNITED STATES PATENT OFFICE.

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COMPOUND ENGINE.

SPECIFICATION forming part of Letters Patent No. 390,434, dated October 2, 1888.

Application filed December 29, 1886. Serial No 222,861. (No model.) Patented in England October 14, 1885, No. 12,262.

To all whom it may concern:

Be it known that we, WILLIAM BERWICK, of Fall River, in the county of Bristol and State of Massachusetts, in the United States of America, and GEORGE SELLERS, of Batley, in the county of York, England, a subject of Victoria, Queen of Great Britain and Ireland, have invented a new and useful Improvement in Compound Engines, (which was patented in Great Britain October 14, 1885, No. 12,262,) of which the following is a full, clear, and exact description, reference being had to the accompanying drawing, forming a part of this specification, in explaining its nature.

The invention relates to a compound engine having two or more cylinders, one at least of which is longer than the other or others, and to the connections between the piston-rods of the said cylinders and a fly-wheel, crank, or other rotating part of the engine, whereby there is caused to be exerted thereon a continuous rotating force or effect.

It also relates to the use, in a compound engine, of two or more cylinders, one of which is longer than the other, and two pistons traveling therein, one of which has a longer stroke than the others, and which is connected with the fly-wheel, crank, or other moving part of the engine by a lever and connecting-rod, the lever being so pivoted as to increase the power communicated to its end by the piston.

The accompanying drawing is a view in elevation representing a compound engine of two cylinders, having a portion of the cylinders broken out to show the pistons.

A is the longer cylinder. A′ is the shorter. The longer cylinder preferably is arranged over the other, and is adapted to receive steam under high pressure through the ports *a a′* at the ends of the cylinder. *b* is the piston therein; *b′*, the piston-rod, the outer end of which is connected with a cross-head or slide-block, b^2, supported by or movable upon suitable ways or slides, b^3. This slide-block or cross-head is connected with the lever C by means of the link *c*. The lever is journaled upon or supported by the pivot or short bearing-rod *c′*, and its lower end is connected by means of the pitman or connecting-rod c^2 with the crank-pin *d* of the fly-wheel D. The second or shorter cylinder, A′, has the piston *e* attached to its piston-rod *e′*, and the cylinder is adapted to receive the exhaust-steam from the long high-pressure cylinder A, and of course acting expansively in the shorter cylinder. This cylinder is considerably larger in diameter than the longer cylinder, and preferably is arranged immediately below it. The piston-rod of this cylinder is connected directly with the crank-pin *d* of the fly-wheel through the slide-block or cross-head e^3, which is mounted upon the ways or slides e^3 and the pitman or connecting-rod e^4.

The two cylinders are connected by suitable ports controlled by valves, and the high-pressure cylinder exhausts, preferably, directly into the low-pressure cylinder, although this is not essential. The low-pressure cylinder has suitable exhaust ports and valves for controlling them. The high-pressure cylinder is made longer than the low-pressure cylinder, in order that its piston may have a sufficiently long stroke to communicate through a lever additional or multiplied power to the crank-pin *d;* and it will be seen that the lever represented in the drawing is so pivoted as to substantially double the amount of power of the long cylinder-piston upon the crank-pin. Of course this lever, when connected with a crank-pin common to the pitman or connecting-rod of the direct-acting piston, must be so pivoted and of such proportion as to communicate to its connecting-rod or pitman the same range of movement as is given the other connecting-rod or pitman. It will be seen that by this construction the actuating force is applied to the crank-pin of the fly-wheel from two directions, so that there can be substantially no dead-center so far as the two pistons and connecting-rods are concerned, as when the crank-pin is on a dead-center with one slide-block or cross-head it is not upon a dead-center with the other, and the other continues to exert force upon the crank-pin until it has passed by the dead-center of the other cross-head, when the other piston operates to throw the crank-pin by the dead-center of the first-named.

We would not be understood as confining ourselves to the especial form of construction shown in the drawing, as there are many different forms and arrangements of devices

which may be substituted or used for those herein named without, however, varying from the essential features of the invention. For instance, it is not necessary that the long cylinder be placed above the short one. It is not essential that the long cylinder exhaust directly into the low-pressure cylinder. The length of the stroke of the piston of the long cylinder may be increased or diminished from that shown, and the lever may be increased or decreased in length. The connections between the end of the piston-operated lever and between the cross-head or slide-block of the other or direct-acting piston may extend directly to a common crank-pin, or to separate crank-pins, or to any other rotary part of the engine or part to which it is desired to communicate motion.

It will be seen that the pistons of the two cylinders will travel in reverse directions.

The advantages of this invention are obvious. In lieu of the lever, of course any other mechanical equivalent for multiplying the power of the piston of the long cylinder during its transmission to a crank or other part of an engine may be employed.

We are aware of the compound engine shown and described in British Patent No. 654 of 1872, in which there are high and low pressure cylinders, the cross-head of the piston-rod of the low-pressure cylinder being connected to the crank by a pitman and the cross-head of the piston-rod of the high-pressure cylinder being connected with the former cross-head through suitable levers and links; and we do not wish to be understood as claiming, broadly, a compound engine having high and low pressure cylinders with a direct pitman-connection between the piston-rod cross-head and the crank and an indirect or lever connection between the cross head of the high-pressure-cylinder piston-rod and the low-pressure-piston cross-head, such as is shown by the said patent.

One very essential point of difference between our engine and the engine shown by the patent just referred to lies in the fact that in our engine there is practically no dead-center, the arm of the lever C, which is connected by the pitman c^2 with the crank, being so arranged that when the crank is on the dead-center with relation to the pitman e^4 and cross-head e^2 it will be off the dead-center with relation to the pitman c^2 and the connection of the said pitman c^2 with the said lever, and vice versa, as will be clear from the drawing.

Having thus fully described our invention, we claim and desire to secure by Letters Patent of the United States—

1. In a compound engine, the combination, with the crank-shaft and crank, of the high-pressure cylinder A, the low-pressure cylinder A′, pistons and piston-rods for said cylinders, slides or cross-heads for said piston-rods, a pitman connecting the low-pressure piston-rod cross-head to the said crank, a lever having long and short arms, as described, a pitman connecting the long arm of the said lever to the high-pressure piston-rod cross-head, and a pitman connecting the short arm of the said lever to the said crank, substantially as set forth.

2. In a compound engine, the combination, with the crank-shaft and crank, of the high-pressure cylinder A, the low-pressure cylinder A′, the high-pressure cylinder being of greater length than the low-pressure cylinder and the latter being of greater diameter than the high-pressure cylinder, the pistons b and e, the piston-rods b' and e', the slides or cross-heads b^2 and e^2, the lever C, pivoted off its center and thus having long and short arms, as described, the pitman c, connecting the long arm of the said lever with the said cross-head b^2, and the pitmen e^4 and c^2, connecting the said cross-head e^2 and the short arm of the said lever, respectively, to the said crank, substantially as set forth.

WILLIAM BERWICK.
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