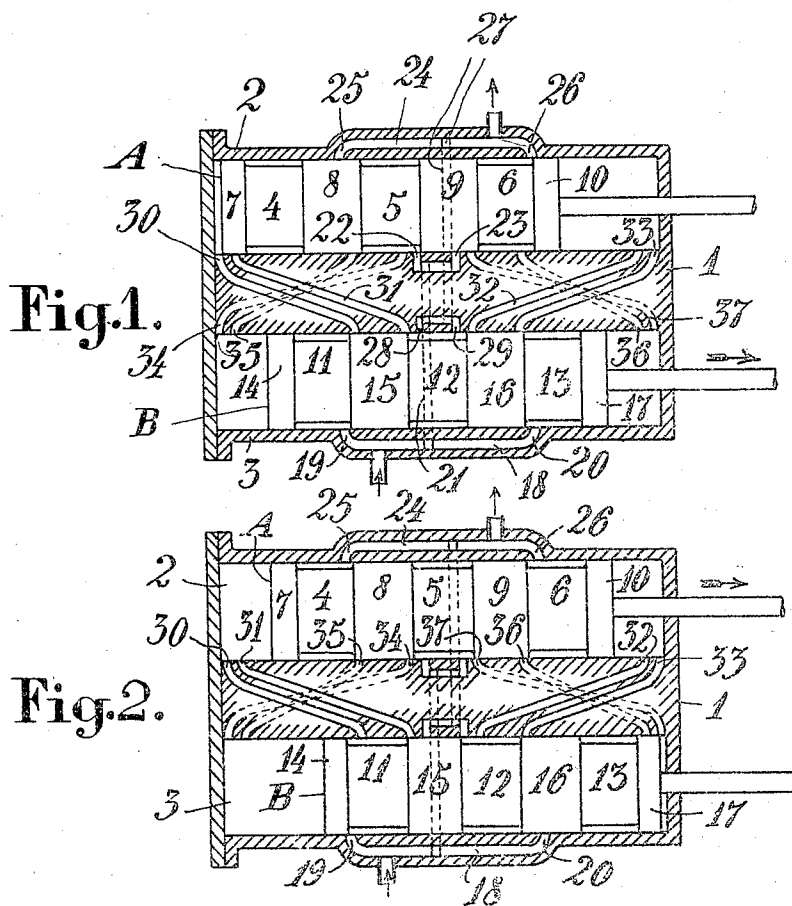


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 DUPLEX PISTON ENGINE.
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Attest:

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UNITED STATES PATENT OFFICE.

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DUPLEX-PISTON ENGINE.

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to all whom it may concern:

Be it known that I, GULLIK KRISTOFFERSEN GJERDE, a subject of the King of Norway, residing at Christiania, Norway, have
5 invented certain new and useful Improvements in Duplex-Piston Engines; and I do hereby 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
10 same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

15 My invention hereinafter described, comprises a duplex-piston engine, in which each piston operating in its own cylinder, acts as a slide valve connecting the ports of both cylinders.

20 It includes a special arrangement of steam passages, affording communication between the two cylinders; a special construction of the pistons; and inlet and exhaust steam passages in connection with the other pas-
25 sages aforesaid.

It includes also the special arrangement of these steam passages in the casting which forms or contains the said cylinders.

30 The said invention is specially, but not exclusively, designed for pumping water or compressing air, and the object thereof, in any condition of use, is to simplify the construction and to increase the efficiency of the engine.

35 It is illustrated in the accompanying drawings, in which—

40 Figures 1 and 2 represent a longitudinal section of the engine, showing the pistons in different parts of the stroke, and in diagrammatic ways, the arrangement of the steam passages between the cylinders and parts of the cylinders.

45 In these drawings the body of the engine is marked 1. It comprises two cylinders, 2 and 3, formed in the body parallel with each other, and in these reciprocate the pistons A and B, which are of considerable relative length, as indicated in the drawings. These pistons are alike, and each is provided with
50 reduced or turned down portions which, whatever be the position of the piston circumferentially, form steam passages across the cylinder when the reduced portions register with the ports. These reduced portions
55 are marked 4, 5, 6, and 11, 12, 13, respec-

tively; and these reduced portions are between four full portions or heads which are marked 7, 8, 9 and 10, and 14, 15, 16, 17, respectively. These cylinders communicate with each other by passages 30, 31, 32, 33, 34, 35, 36 and 37, which, as shown, are formed in the body or casting between the cylinder, and which, during the movement of the pistons, may be closed or may be connected with a supply or exhaust pipe respectively
60 according as the ports of the passages register with a head or with a reduced portion of a piston.

65 I have shown the body as cast in one piece, open at one end and containing cylinders and the passages, this end being closed by a plate, the piston rods passing through holes in the opposite end.

70 As the steam enters from the inlet, shown by the arrow, through the passage 18, it passes alternately the ports 19 and 20, through the passages formed by the reduced portions 11 and 13 and also alternately enters cylinder 2 through channels 30 and 33, thus giving impetus to the piston. In the same
80 manner, steam entering cylinder 2 by the passage 21, is distributed to cylinder 3 by way of the passages 34 and 37, according to the position of the piston. The steam is exhausted in a like manner by a system of parallel passages for exhausts, these passages, as shown in the drawing being substantially parallel with the inlet passages for the live steam, and they are so arranged, as the drawings show, that the exhaust is auto-
85 matically closed by the piston when near the end of its stroke, thus producing the cushioning effect.

90 Assuming the construction and arrangement of the parts above specified, to be as shown in the drawings and the position of parts to be as represented in Fig. 1, the operation of the engine on the admission of steam to the inlet port will be as follows: In the position shown in Fig. 1 the steam
95 passes through the passages 18 and 21 and through the port 22 to the reduced portion 5, then through the passage 35 into the cylinder 3 on the left hand end of its piston B which accordingly is forced to the right.
100 At the same time the steam that has been used, is allowed to escape through the passage 37, the reduced portion 6, and the port 26 of the passage 24. By the movement of the piston B to the right, the passage 30, 110

which, in the position illustrated in Fig. 1, is covered by the head 15, is caused to communicate with the reduced portion 11 while at the same time the passage 32, which is covered in Fig. 1 by the head 16, is caused to communicate with the reduced portion 12 of the same piston. Thereby fresh steam passes from the passage 18 through the recess 11 and the passage 30 to the left hand side of the piston A which is thus caused to commence its movement to the right as the piston B passes its middle position and accordingly it has its greatest speed. The exhaust on the right hand side of the piston A escapes through the passage 32, the recess 12, the port 20 and the passages 27 and 24. Both pistons consequently now move to the right the piston A being half a stroke behind the piston B. Just before reaching its extreme position on the right, the piston B itself closes the port of the exhaust passage 36 by its full portion 17 the remaining steam being compressed and acting as an elastic cushion between the piston and the end of the cylinder. Immediately after the passage 36 has been closed by head 17 of the piston B, the inlet passage 34 to the cylinder 3 is closed by the full portion 8 of the piston A, which at the same time closes the opening of the exhaust passage 38, into the cylinder 2 with its head 9. The piston A is now in its middle position in moving to the right and the piston B is in its extreme right hand side position (see Fig. 2). By the continued movement of the piston A the passages 37 and 35 are uncovered by the heads 9 and 8 respectively and the motion of the piston B is reversed, the right hand side of the cylinder 3 now communicating with the steam inlet pipe and the left hand side with the exhaust pipe. As the piston B reaches its middle position, on performing its return stroke, it will reverse in a similar manner the motion of the other piston which is then in its extreme right hand side position, and so on. In this manner the motion of the pistons goes on, one piston being constantly half a stroke behind the other so that each piston is reversed in its motion by the other piston as the latter passes its middle position.

It will be observed from the above description that there are several sets of passages within the body or casting, which contains the cylinders, a duplicate set for induction and exhaust connecting portions of the middle, or about the middle of one cylinder with portions near the end of the other, these registering at the proper time, in the motion of the piston, with the reduced portions which form passages or continuation of passages. They also register with the end portions of the cylinders and act as exhaust or supply on the heads proper or ends of the pistons. Further are the in-

let and exhaust passages 18 and 24 having duplicate ports into the cylinders, and in addition to these are the intermediate central passages marked 22 and 23, 28 and 29 respectively, which being at the center communicate with the two end portions of the cylinder; and further are the transverse passages as 21 and 27 which communicate with the intermediate central passages and the outer exhaust and supply. These latter take the live steam across one cylinder into the other, and in the same way take the exhaust from one cylinder across the other to the exhaust port.

The advantages of the construction in respect of simplicity are obvious, but it will also be apparent that there are no dead centers, and it does not matter in what positions the pistons may have been left, one or the other will always be in position to receive live steam either directly or by a transverse passage. The pistons put on or cut off steam for each other, the length of the stroke depending on the size of the engine, but it is determined beforehand by the construction. The pistons are alike and need not be connected to each other, the steam acting upon them alternately and at either end in accordance with their respective positions. Incidentally, the cushioning is secured after each stroke and this is automatic, the exhaust passages always being closed just before the end of the stroke and the remainder of the exhaust will be sufficient for an effective cushion. At the time it will be observed that when it reaches the point of greatest compression fresh steam will be coming in for the return stroke.

The construction and arrangement of the passages are such that the body of the engine may be made, and is made of a single casting which simplifies the construction and leaves nothing to get out of order, and I have found the engine to be very economical in the use of steam. The engine may be used equally well for pumping or compressing air.

I claim:—

1. In a duplex cylinder engine having two pistons with interior reduced portions, a system of steam passages leading from both ends of each cylinder to the interior ports of the other, a corresponding system of exhaust passages leading from both ends of each cylinder to the interior portions of the other, both sets of passages arranged to co-act with the reduced portions of each piston and steam supply and exhaust passages co-acting with the steam and exhaust passages first mentioned, substantially as described.

2. An engine comprising a pair of parallel cylinders and reciprocating pistons therein, said pistons having full portions or heads 4, and intermediate or reduced

portions 3, a duplicate set of steam passages between said cylinders, one set of live steam passages leading from the central ports of each cylinder to the end ports of the other, a similar set of passages for the exhaust steam, transverse passages between these duplicate inlet and exhaust passages, all these passages being arranged in relation to the full and reduced portions of the piston, substantially as described.

3. An engine comprising a pair of parallel cylinders and reciprocating pistons therein, said pistons having full portions or heads 4, and intermediate or reduced portions 3, both pistons being circumferentially similar and interchangeable and moving freely on their axis, a duplicate set of steam passages between said cylinders, one set of live steam passages leading from the central ports of each cylinder to the end ports of the other, a similar set of passages for the exhaust steam, transverse passages between these duplicate inlet and exhaust passages, all these passages being arranged in relation to the full and reduced portions of the piston, substantially as described.

4. An engine comprising a pair of parallel cylinders and reciprocating pistons therein, said pistons having full portions or heads and intermediate or reduced portions, both pistons being circumferentially similar and interchangeable and moving freely on their axis, and both the pistons moving independently of each other but governed automatically by their relative positions to each other and to the steam and exhaust ports, a duplicate set of steam passages between said cylinders, one set of live steam passages leading from the central ports of each cylinder to the end ports of the other, a similar set of passages for the exhaust steam, transverse passages between these duplicate inlet and exhaust passages, all these passages being arranged in relation to the full and reduced portions of the piston, substantially as described.

5. An engine comprising a pair of parallel cylinders and reciprocating pistons therein, said pistons having full portions

or heads and intermediate or reduced portions, both pistons being circumferentially similar and interchangeable and moving freely on their axis and both the pistons being independent of each other but governed automatically by their relative positions to each other and to the steam and exhaust ports, a duplicate set of steam passages leading from the central ports of each cylinder to the end ports of the other, a similar set of passages for the exhaust steam, transverse passages between these duplicate inlet and exhaust passages, all these passages being arranged in relation to the full and reduced portions of the piston so as to enable the engine to start in whatever position the pistons may have relative to each other, the one piston being constantly one-half stroke behind the other, the exhaust passages being arranged to be put out of operation alternatively by the piston covering them, whereby is formed an effective steam cushion, substantially as described.

6. A duplex engine comprising two parallel cylinders, and pistons, said pistons having full and reduced portions, an inlet on one side and exhaust on the other, and steam passages arranged to carry the live steam first to one piston and then to the other, and passages 22, 23, and 28, 29, formed in the walls of the cylinders, substantially as described.

7. In an engine having two full pistons with interior reduced portions, a system of duplicate steam passages leading from both ends of each cylinder, to the interior ports of the other cylinder, and arranged to coact with the reduced portions of each piston, and steam supply and exhaust passages coacting with the steam passages first mentioned, substantially as described.

In testimony that I claim the foregoing as my invention, I have signed my name in presence of two subscribing witnesses.

GULLIK KRISTOFFERSEN GJERDE.

Witnesses:

MARTIN GUTTORMSEN,
NANA SCHIANDER.