Witnesses:

[Signatures]

Inventor:

[Signature]

By Fred L. Harpster
Att'y.
I. N. MOORE.
DUPLEX STEAM ENGINE.
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Witnesses:

Inventor:

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UNITED STATES PATENT OFFICE.

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ADVANCE PUMP & COMPRESSOR COMPANY, OF BATTLE CREEK,
MICHIGAN.

DUPLEx STEAM-ENGINE.


To all whom it may concern:

Be it known that I, Ila N. Moore, a citizen of the United States, residing at the city of Battle Creek, county of Calhoun, and State of Michigan, have invented certain new and useful Improvements in Duplex Steam-Engines, of which the following is a specification.

This invention relates to improvements in duplex steam-engines.

The objects of this invention are, first, to provide an improved duplex steam-engine which is adapted to maintain a comparatively even speed under varying conditions of load or work; second, to provide an improved duplex steam-engine having an even stroke or movement; third, to provide an improved duplex steam-engine which is subject to racing and one which at the same time exhausts freely, thereby avoiding back-presure.

Further objects and objects relating to structural details will definitely appear from the detailed description to follow.

I accomplish the objects of my invention by the devices and means described in the following specification.

The invention is clearly defined, and pointed out in the claims.

A structure embodying the features of my invention is fully illustrated in the accompanying drawings, forming a part of this specification, in which—

Figure 1 is a detail longitudinal sectional view taken on a line corresponding to the broken line II of Fig. 2, portions being shown in full lines. Fig. 2 is a detail transverse sectional view taken on a line corresponding to line 2 2 of Fig. 1. Fig. 3 is a detail longitudinal sectional view taken on a line corresponding to the broken line 3 3 of Fig. 2. Fig. 4 is a detail horizontal sectional view through the steam-chamber C, showing the arrangement and structure of the valve.

In the drawings the sectional views are taken looking in the direction of the little arrows at the ends of the section-lines, and similar letters of reference refer to similar parts throughout the several views.

Referring to the drawings, I provide a pair of steam-cylinders A, which are arranged side by side. Suitable pistons A' A'' are provided, and these are provided with suitable piston-rods a. The cylinders A are each provided with main admission ports or passages r, which open into the cylinders a short distance from their ends, and auxiliary or preadmission ports or passages i, which open into the cylinders at their ends beyond the passages r. These passages i and r connect the cylinder with the steam-chamber C, which is preferably common to both of the cylinders.

Valves c and c' are provided. These valves are provided, with ports n at each end, preferably several in number, as appears in Fig. 4. The combined areas, however, of the ports n at one end of the valve are less than that of one of the passages r. These valves are adapted to alternately connect the passages r to the exhaust. The steam-chamber C is connected to a suitable source of steam-supply by a pipe C'. The valves c and c' are provided with suitable stems D. The stems D are secured by links D' to the arms F and G'. These arms F and G are mounted on rock-shafts e e', respectively. (See Fig. 2.)

The rock-shafts e e' are supported on a bracket or frame E, which is arranged on the top rail B of the engine-frame. These rock-shafts e e' are connected by arms F and G to the piston-rods a, so that the rock-shafts are actuated by the piston-rods. The arms F and G are pivotally secured to blocks a', carried by the piston-rods.

The arms F and F' are arranged on the rock-shaft e in the same relation thereto that is, they project in the same general directions — so that the valve c' (which is connected to the arm F') is moved with or in the same direction as its controlling-piston A' to the piston-rod to which the arm F is connected.

The arms G and G' are arranged on the rock-shaft e in the opposite directions in relation thereto—that is, they project in opposite directions—so that the movement of the valve c, which is connected to the arm G', is opposite to that of its controlling-piston A'', to the piston-rod of which the arm G is connected.

Thus connected, the valves are actuated in succession—that is, they have a chasing or following movement in relation to each other, which of course occasions the same movement of the pistons.

I provide the inner ends of the valve-stems with bearing-sleeves d, which are arranged in the bearings e'' of the valves. The inner ends of the valve-stems are threaded, and the bearing-sleeves d are retained in position thereon by the nuts d'. (See Figs. 2,
3, and 4.) The nuts $d'$ serve as tappets for the valves. Thus connected, the valves are not actuated until their controlling-pistons have partially completed their strokes, preferably about three-fourths thereof. This connection of the valves to the stems is very simple and yet very desirable, as it enables the perfect adjustment thereof.

In the drawings the piston $A'$ is shown about the center of its instroke and the piston $A''$ at the end of its stroke. (See Figs. 1 and 3.) When the piston $A'$ is in this position, the slack in the valve-stem of the valve $e'$ is practically taken up, and as the piston moves forward the valve $e'$ is actuated and steam is admitted to the outer end of the cylinder of the piston $A''$, and its inner end is connected to the exhaust $II$. As the auxiliary or predmission ports $i$ are closed or sealed by the valve $c$, a cushion for the piston is provided. The auxiliary or predmission ports $i$ are first opened and serve to start the piston, giving them an easy start. As the ports $n$ of the valves are of lesser area than the passages they form, in connection therewith, a restricted admission-portage for the cylinders, so that this easy movement of the piston is continued throughout. The opening-ports $n$ of the valve are, as above mentioned, so arranged that the auxiliary or predmission ports or passages $i$ are sealed by the valve. The capacity of the ports $n$ is so gaged that the right quantity of steam is admitted to the cylinder within the time in which it is practical and desirable that the engine should be run.

I have illustrated my invention in connection with a pump, a portion only of the pump-cylinders $W$ being shown. The piston-rods $E$ are connected to any suitable pump-plunger, the same not being here illustrated. With the valves and gear thus arranged, should the suction become broken or the labor be taken off the water end of the pump, the engine will not pound, as the speed of the piston is limited by the time required for the steam to pass through the ports $n$ of the valves. With this restricted admission-portage, the ports or passages $n$ may be of comparatively large size, so that the cylinder is readily exhausted, thus avoiding back pressure in operation. Another advantage of this arrangement of ports is that it is possible to carry a higher pressure of steam in the steam-chest than in the cylinder, thus insuring a prompt action of the pistons, for as soon as the second valve opens, the steam-pressure in the steam-chest being higher than that in the cylinder, the second piston is at once started, this occurring in actual operation before the first piston comes to rest or reaches the limit of its stroke. This insures an even and steady stroke of both pistons.

As before explained, in the arrangement of ports and passages described, the pistons are cushioned so that their movement is even, and the liability of racing or pounding and injury to the engine by the change in the load or work is overcome.

I have illustrated and described my improved engine in the form preferred by me on account of its simplicity and economy in use. I am aware, however, that it is capable of considerable variation in structural details without departing from my invention.

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

1. The combination of a pair of cylinders; pistons therefore; piston-rods; a steam-chamber common to both of said cylinders; main inlet-passages opening into said cylinders toward the ends thereof; auxiliary or predmission passages opening into said cylinders at the ends thereof, beyond said main passages; valves having a plurality of ports or openings therein adapted to be brought into register with said main inlet-passages, the combined area of said openings being less than that of said main passages, said valves being adapted to alternately connect said inlet-passages with the exhaust; valve-stems screw-threaded on their inner ends; bearing-sleeves on said stems; nuts on said stems for adjustably securing said bearing-sleeves in position and to serve as tappets; bearings on said valves adapted to receive said bearing-sleeves; rock-shafts $e$ and $e'$; arms $F$, $G$ on said rock-shafts connected to said valve-stems; and arms $F$ and $G$ secured to said rock-shafts $e$ and $e'$ respectively, and pivottally secured to said piston-rods, all cooperating for the purpose specified.

2. The combination of a pair of cylinders; pistons therefor; piston-rods; a steam-chamber common to both of said cylinders; main inlet-passages opening into said cylinders toward the ends thereof; auxiliary or predmission passages opening into said cylinders at the ends thereof, beyond said main passages; valves having a plurality of ports or openings therein adapted to be brought into register with said main inlet-passages, the combined area of said openings being less than that of said main passages, said valves being adapted to alternately connect said inlet-passages with the exhaust; valve-stems screw-threaded on their inner ends; bearing-sleeves on said stems; nuts on said stems for adjustably securing said bearing-sleeves in position and to serve as tappets; bearings on said valves, adapted to receive said bearing-sleeves; a pair of rock-shafts, one having a pair of correspondingly-projecting arms and the other having a pair of oppositely-projecting arms; and suitable connections for said arms to said piston rods and valves, all cooperating for the purpose specified.

3. The combination of a pair of cylinders; pistons therefor; piston-rods; a steam-
chamber common to both of said cylinders; main inlet-passages opening into said cylinders toward the ends thereof; auxiliary or preadmission passages opening into said cylinders at the ends thereof, beyond said main passages, said auxiliary passages being controlled by a projecting part of the main valve when the valve approaches the end of its stroke; valves having a plurality of ports or openings therein adapted to be brought into register with said main inlet-passages, the combined area of said openings being less than that of said main passages, said valves being adapted to alternately connect said inlet-passages with said exhaust; suitable valve-stems; a pair of rock-shafts on said rock-shafts connected to said valve-stems; and arms F G on said rock-shafts secured to said valve-stems; and arms F and G secured to said rock-shafts e and e' respectively, and pivotally secured to said piston-rods, all coacting for the purpose specified.

4. The combination of a pair of parallel-arranged cylinders, pistons therefor; piston-rods for said pistons; a steam-chamber common to both of said cylinders; main inlet passages opening into said cylinders toward the ends thereof; auxiliary or preadmission passages opening into said cylinders at the ends thereof, beyond said main passages, said auxiliary passages being controlled by a projecting part of the main valve when the valve approaches the end of its stroke; valves having ports or openings therein adapted to be brought into register with said main inlet-passages, the combined area of said openings being less than that of said main passages, said valves being adapted to alternately connect said inlet-passages with the exhaust; suitable valve-stems; a pair of rock-shafts, one having a pair of correspondingly-projecting arms and the other a pair of oppositely-projecting arms, and suitable connections for said arms to said piston-rods and valve-stems, all coacting for the purpose specified.

5. The combination of a pair of cylinders; pistons therefor; piston-rods; main inlet-passages opening into said cylinders toward the ends thereof; auxiliary or preadmission passages opening into said cylinders at the ends thereof, beyond said main passages, said auxiliary passages being controlled by a projecting part of the main valve when the valve approaches the end of its stroke; valves having ports or openings therein adapted to be brought into register with said main inlet-passages, the combined area of said openings being less than that of said main passages, said valves being adapted to alternately connect said passages to the exhaust; valve-stems; a pair of rock-shafts, one having a pair of correspondingly-projecting arms and the other having a pair of oppositely-projecting arms, and suitable connections for said arms to said piston-rods and valve-stems, for the purpose specified.

6. The combination of a pair of cylinders; pistons therefor; piston-rods; main inlet-passages opening into said cylinders toward the ends thereof; auxiliary or preadmission passages opening into said cylinders at the ends thereof, beyond said main passages, said auxiliary passages being controlled by a projecting part of the main valve when the valve approaches the end of its stroke; valves having ports or openings therein adapted to be brought into register with said main inlet-passages, the combined area of said openings being less than that of said main passages, valve-stems; suitable tappets therefor; a pair of rock-shafts, one having a pair of correspondingly-projecting arms and the other having a pair of oppositely-projecting arms, and suitable connections for said arms to said piston-rods and valve-stems, for the purpose specified.

7. The combination of a pair of cylinders; pistons therefor; piston-rods; main inlet-passages opening into said cylinders toward the ends thereof; auxiliary or preadmission passages opening into said cylinders at the ends thereof, beyond said main passages, said auxiliary passages being controlled by a projecting part of the main valve when the valve approaches the end of its stroke; valves having ports or openings therein adapted to be brought into register with said main inlet-passages, the combined area of said openings being less than that of said main passages, valve-stems; a pair of rock-shafts, one having a pair of correspondingly-projecting arms and the other having a pair of oppositely-projecting arms, and suitable connections for said arms to said piston-rods and valve-stems, for the purpose specified.

8. The combination of a pair of cylinders; pistons therefor; piston-rods; main inlet-passages opening into said cylinders toward the ends thereof; auxiliary or preadmission passages opening into said cylinders at the ends thereof, beyond said main passages, said auxiliary passages being controlled by a projecting part of the main valve when the valve approaches the end of its stroke; valves having ports or openings therein adapted to be brought into register with said main inlet-passages, the combined area of said openings being less than that of said main passages, valve-stems; a pair of rock-shafts, one having a pair of correspondingly-projecting arms and the other having a pair of oppositely-projecting arms, and suitable connections for said arms to said piston-rods and valve-stems, for the purpose specified.

9. The combination of a pair of cylinders; pistons therefor; piston-rods; main inlet-passages opening into said cylinders toward
the ends thereof; auxiliary or preadmission passages opening into said cylinders at the ends thereof beyond said main passages, said auxiliary passages being controlled by a projecting part of the main valve when the valve approaches the end of its stroke; valves having ports or openings therein adapted to be brought into register with said main inlets; auxiliary or preadmission passages connecting said cylinders to the exhaust; valve-stems; suitable tappets therefor; and connections for said piston-rods and valve-stems whereby one of said valves is given a movement to correspond to that of its controlling-piston, and the other is given a movement opposite to that of its controlling-piston, for the purpose specified.

14. The combination of a pair of cylinders; pistons therefor; piston-rods; main inlets; passages opening into said cylinders toward the ends thereof; auxiliary or preadmission passages connecting said cylinders to the exhaust; valve-stems; suitable tappets therefor; and connections for said piston-rods and valve-stems whereby one of said valves is given a movement to correspond to that of its controlling-piston, and the other is given a movement opposite to that of its controlling-piston, for the purpose specified.
ends thereof; auxiliary or preadmission passages opening into said cylinders at the ends thereof beyond said main passages, said auxiliary passages being controlled by a projecting part of the main valve when the valve approaches the end of its stroke; valve-stems; and connections for said piston-rods and valve-stems whereby one of said valves is given a movement to correspond to that of its controlling-piston and the other is given a movement opposite to that of its controlling-piston, for the purpose specified.

17. The combination of a pair of cylinders; piston-rod therefor; piston-rods; main inlet-passage opening into said cylinders toward the ends thereof; auxiliary or preadmission passages opening into said cylinders at the ends thereof beyond said main passages, said auxiliary passages being controlled by a projecting part of the main valve when the valve approaches the end of its stroke; valves having ports or openings therein adapted to be brought into register with said main inlet-passage, the combined area of said openings being less than that of said main passages, said valves being adapted to alternately connect said passages to the exhaust; valve-stems; and suitable connections for said piston-rods and valve-stems, for the purpose specified.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

ILA N. MOORE.

Witnesses:

Edward Reeves,
Claude A. Finn.