

(No Model.)

3 Sheets—Sheet 1.

J. C. PEACHE.
STEAM ENGINE.

No. 546,900.

Patented Sept. 24, 1895.

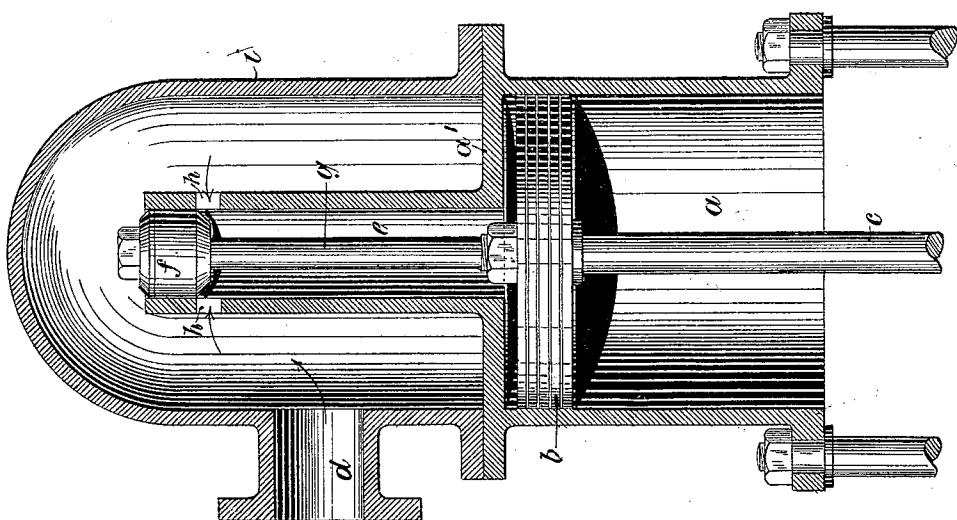


Fig. 1

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Robt. A. Blake

Inventor
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by Henry H. Leigh
Attorney

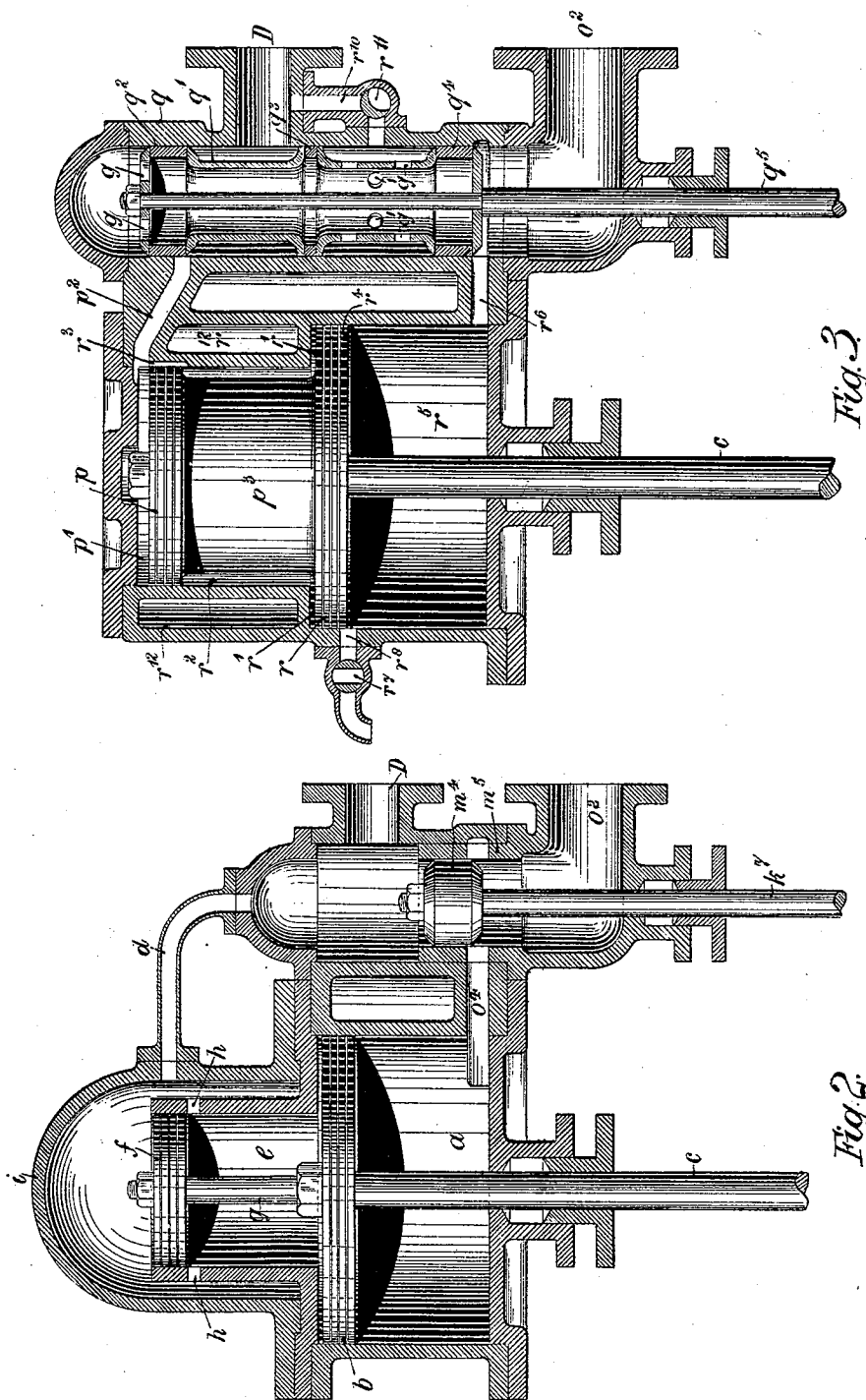
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3 Sheets—Sheet 2.

J. C. PEACHE.
STEAM ENGINE.

No. 546,900.

Patented Sept. 24, 1895.



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(No Model.)

3 Sheets—Sheet 3.

J. C. PEACHE.
STEAM ENGINE.

No. 546,900.

Patented Sept. 24, 1895.

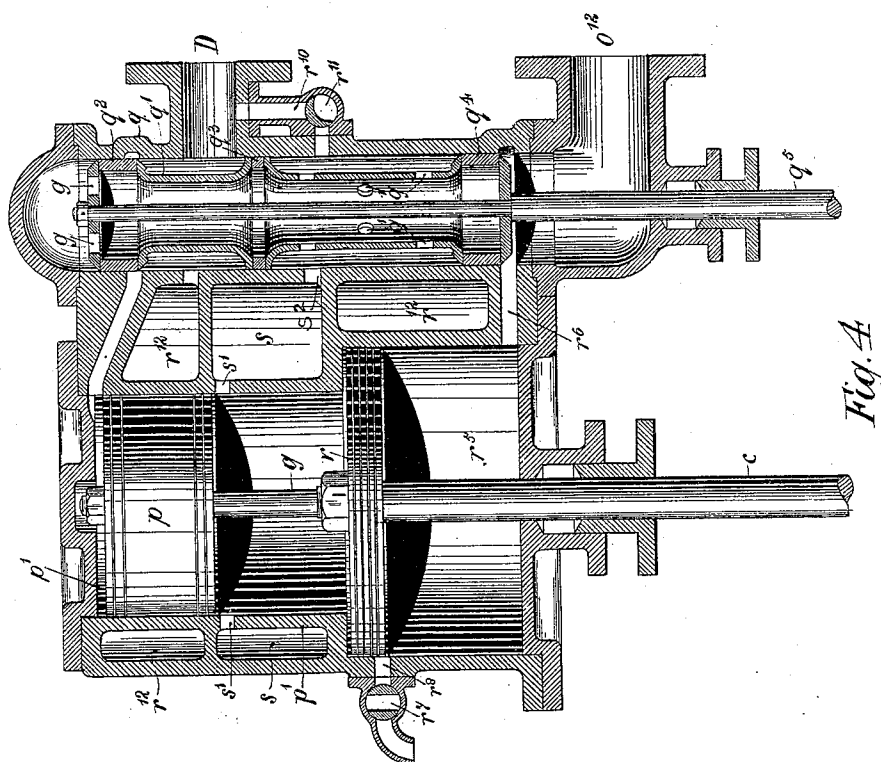


Fig. 4

Witnesses.

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UNITED STATES PATENT OFFICE.

JAMES COURTHOPE PEACHE, OF LONDON, ENGLAND.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 546,900, dated September 24, 1895.

Application filed April 16, 1892. Serial No. 429,406. (No model.) Patented in England August 27, 1891, No. 14,526.

To all whom it may concern:

Be it known that I, JAMES COURTHOPE PEACHE, associate member Institute Civil Engineers, engineer, a subject of the Queen of Great Britain and Ireland, residing at Park Cottage, Thames Ditton, London, in the county of Surrey, England, have invented Improvements in Compressed Air and Steam Engines, (for which I have received Letters Patent in Great Britain, No. 14,526, dated August 27, 1891,) of which the following is a specification, which will enable others skilled in the art to which it appertains to make and use the same, reference being made to the accompanying drawings.

My invention relates to improvements in engines driven by compressed air or steam; and its object is to effect the absorption of the momentum which the reciprocating parts of the engine—viz., the pistons, valves, their rods and connections—acquire during their motion away from the crank-shaft. As a consequence a balance of pressure is always maintained in the direction of the said shaft and all knocking in the joints of the said parts as well as in their several junctions prevented.

In carrying my invention into effect I make use of a piston and cylinder hereinafter referred to as the "controlling-piston" and "controlling-cylinder." This combination is equally applicable to all types of engines irrespective of the relative positions of the cylinder and the crank-shaft.

The expression "steam" wherever herein-after used is to be taken as including compressed air.

The controlling-piston is rigidly connected to the parts which it is intended to control and works with a reciprocating stroke in the controlling-cylinder. When it is at or near the beginning of its stroke, steam under pressure is admitted by suitable gear and cut off shortly after the piston has commenced its stroke. The steam then expands during the remainder of the stroke, and on the return stroke it is compressed above the piston until at or near the end of the return stroke communication is again opened to the steam-supply. It is the pressure above the returning piston that is the operative agent of this invention, and provision for its adjustment

to the requirements of the case is made by varying either the area of the piston or the initial pressure of the steam or the capacity of the clearance-space in the cylinder at the top of the stroke or, within certain limits, by the point at which the steam is admitted to or cut off from the cylinder, or by a combination of two or more of the above methods.

To absorb the momentum of the main reciprocating parts on the return stroke in a single-acting steam-engine the controlling apparatus or arrangement above described is used to assist the back-pressure and compression obtained by the usual distribution of steam in the working cylinders of the engine on the return stroke of the pistons.

To regulate the admission of steam at the commencement of the stroke in the apparatus described above, I usually employ a piston-valve connected to the controlling-piston by a rod and working in a valve-cylinder that opens directly into the controlling-cylinder. In a suitable position in the side of the valve-cylinder ports are formed, having a connection with the steam-supply. At the commencement of the stroke of the controlling-piston these ports are uncovered by the piston-valve and steam is admitted above the controlling-piston. As the controlling-piston commences its stroke it carries the piston-valve with it, which latter covers the ports and thus cuts off the supply of steam to the controlling-cylinder. The steam expands in the controlling-cylinder during the remainder of the stroke of the piston and is compressed on the return stroke of the controlling-piston until the piston-valve again uncovers the ports in the valve-cylinder, when the controlling-cylinder is again placed in communication with the supply of steam. In a simple—i. e., single-expansion single-acting—engine I use the lower side of the controlling-piston as a working piston and place the upper side of the piston-valve in direct communication with the steam-chest or source of steam-supply. In a tandem compound—i. e., double-expansion single-acting—engine I place the first expansion-cylinder immediately over the second expansion-cylinder without any diaphragm or cover between them and use the upper side of the second expansion-piston as a controlling-piston and the first expansion-

piston as a piston-valve for regulating the admission of steam above the second expansion or controlling piston.

In an engine arranged in accordance with the preceding paragraph steam is admitted above the first expansion-piston by suitable valves and valve-gear, and toward the lower end of its stroke the first expansion-piston uncovers a row of holes around the wall of the first expansion-cylinder. These holes communicate with the receiver and allow some of the steam to escape from the first expansion-cylinder into the receiver; a further portion of the steam contained in the first expansion-cylinder at the end of its stroke being exhausted into the receiver on the return stroke of the first expansion-piston by valves in the usual manner. The first expansion-piston is made of a depth somewhat less than the stroke of the engine, so that at the top of its stroke the row of holes referred to above is uncovered by the lower edge of the first expansion-piston, and thus steam is allowed to pass from the receiver into the space between the first expansion and second expansion pistons. On the next downstroke the first expansion-piston again covers these holes, thus cutting off the supply of steam above the second expansion or controlling piston. Steam is admitted from the receiver to the under side of the second expansion-piston and exhausted by means of valves in the usual manner.

In the accompanying drawings, which are to be taken as part of this specification and read therewith, Figure 1 is a sectional elevation illustrating my invention in its simplest form. Fig. 2 is a sectional elevation of a single-expansion single-acting engine constructed according to my invention. Fig. 3 is a sectional elevation of a double-expansion single-acting engine constructed according to my invention. Fig. 4 is a sectional elevation of a modified form of double-expansion single-acting engine constructed according to my invention.

In Figs. 1, 2, 3, and 4 the fly-wheel, crank-shaft, eccentric, and eccentric-rod or their equivalents, with their connections, are omitted, but may be of any suitable or well-known type.

Referring to Fig. 1, *a* is the controlling-cylinder, and *b* the controlling-piston. *c* is part of the rod by which the controlling-piston is rigidly connected to the working piston or other reciprocating part of the engine which it is intended to control. *d* is the steam-supply. *e* is the valve-cylinder. It is an axial extension of the controlling-cylinder *a*, with which it communicates. *f* is a piston-valve working in the cylinder *e*. *g* is the rod by which the valve is connected to the controlling-piston *b*. *h h* are steam-ports in the valve-cylinder. *i* is a closed chamber constructed upon the annular cover *a'* of the controlling-cylinder and standing over the valve-cylinder. The steam-supply *d* opens into it.

The action of the controlling combination

above described is as follows: The controlling-piston and its valve are represented as standing at the top of their stroke. When the engine is started, steam flows into the space above the piston *b* through ports *h h* until the piston-valve *f*, as it travels downward, passes over these ports and cuts off the supply of steam. The steam inclosed above piston *b* then expands in the controlling-cylinder during the remainder of the downstroke and is compressed again on the return stroke until at or near the top of the stroke the piston-valve *f* again uncovers the ports *h h* and again places the upper side of piston *b* in communication with the source of steam-supply. The momentum of the reciprocating parts to be controlled is absorbed by the pressure of steam above the piston *b* on the return stroke.

In a single-acting engine there should always be sufficient pressure against the bearings of the reciprocating parts on the upward stroke to keep them always pressed in a downward direction, but not more pressure than is sufficient for the purpose. The correct amount of pressure can be provided for by properly proportioning the parts described.

The above remarks about single acting engines are applicable to the other forms of engines described in this specification.

In Fig. 2 is shown the application of my controlling apparatus to a single-expansion single-acting engine. *b* is the controlling-piston, and *a* is the controlling-cylinder. The under side of the piston *b* and the lower end of the cylinder *a* are used as the working piston and cylinder, respectively. *c* is the ordinary piston-rod, through which the controlling and working piston is connected to the crank-shaft. *g* is an extension of the piston-rod, to which the piston-valve *f* is connected. This piston-valve works in a cylinder *e*, that is placed axially over the main cylinder *a*. *h h* are ports in the side of cylinder *e* for admitting steam above the controlling-piston. *D* is the main steam-supply, and *d* the branch supply to the closed chamber *i*. *m*¹ is the slide-valve, (shown as of the piston-valve type,) and *h*² is the valve-rod. *m*⁵ is the valve-cylinder, *o*⁴ the steam-port to the cylinder *a*, and *o*² the main exhaust. The action of the steam above the controlling-piston *b* is the same as that described in connection with Fig. 1, and for that reason the same reference-letters are used. Steam is admitted to the under or working side of piston *b* by valve *m*⁴ and port *o*⁴ during the upstroke and exhausted on the downstroke in the usual manner.

Referring to Fig. 3, *p* is the first expansion-piston working in cylinder *p'*. *r* is the second expansion-piston working in cylinder *r'*. These two pistons are connected together by the trunk *p*³. *c* is the usual piston-rod. *p*³ is the steam-port to the first expansion-cylinder, and *r*⁶ is the steam-port to the second expansion-cylinder. *D* is the main steam-supply, and *o*² the main exhaust. The slide-valve *q*⁷ works in a cylinder or steam-chest *q*. It is

shown as of the hollow treble-piston-valve type. $q^2 q^3 q^4$ are valve-rings. q^5 is the valve-rod. $g g$ and $g' g'$ are holes for the passage of steam. The upper side r' of the low-pressure piston r acts as the controlling-piston and the upper part of the cylinder r^5 as the controlling-cylinder. The first expansion-piston p acts as a piston-valve for regulating the admission of steam to the upper or controlling side of the piston r . r^3 is a port formed in the side of the cylinder p' .

The action of the engine and controlling combination is as follows: In the position shown steam is being admitted by valve q' and port p^2 to the upper side of the first expansion-piston p , and steam at the full pressure of that above this piston passes by port r^3 to the annular space r^2 and upper side of piston r . Shortly after the commencement of the downstroke the piston p passes over the end of port r^3 , thus cutting off the supply of steam above the piston r . Steam expands above this piston for the remainder of the stroke and is compressed again on the return stroke in the manner already described in connection with other applications of my controlling apparatus. On the return or upstroke of the piston p steam exhausts through port p^2 and holes $g g$ into the interior of the hollow piston-valve q' , and thence by holes $g' g'$ and port r^6 into the second expansion or low-pressure cylinder r^5 . The exhaust from this cylinder on the downstroke is by port r^6 , past the end of the valve q' to the main exhaust o^2 .

To facilitate the starting of an engine such as shown in Fig. 3 I place a valve r^7 , as shown, near the top of the low-pressure cylinder r^5 , but sufficiently low down, so that the first expansion-piston p shall cover the port r^3 before the low-pressure piston r uncovers the aperture r^8 , leading to the valve r^7 . This is to provide that there shall not be a blow through of steam from the first expansion-cylinder on opening the valve r^7 . I also place a valve r^{11} between the main steam-supply D and the lower or intermediate receiver part of valve-cylinder q . In the position shown the two valves are closed, and the engine then works as a single-acting engine, as already described. If, however, the valve r^{11} is turned so as to open a communication between the main steam-supply D and the intermediate receiver, the engine will work as a double-acting engine, for there will be no pressure in the space r^2 between the first and second expansion-pistons except just at the top of their stroke. The pressure in the high-pressure steam-chest and in the intermediate receiver is the same, because the valve r^{11} forms a free communication between them. On the downstroke the steam-pressure acts on the upper side of the first expansion-piston p , forcing it down, (the under side of the low-pressure piston being then in communication with the exhaust o^2), and on the upstroke the pressures per square inch on the under side r^4 of the low-

pressure piston and on the upper side of the high-pressure piston p being the same, (for both are then in communication with the receiver and steam-supply D), the total pressure on the under side of the low-pressure piston, owing to its greater area, exceeds that on the upper side of the first expansion-piston and forces the pistons up. The engine thus works as a double-acting engine until the valve r^{11} is closed.

r^{12} is a steam-jacket provided for preventing condensation of steam in the first expansion and controlling cylinders.

Referring to Fig. 4, this engine is similar to that shown in Fig. 3, but differs from it in that steam for the controlling-cylinder is taken from the intermediate receiver instead of from the steam-supply. The port r^3 is therefore dispensed with, because it becomes unnecessary. s is the intermediate receiver. s' s^2 are the ports through which it communicates with the controlling-cylinder and the valve-chest, respectively. The first expansion-piston p is made rather shorter than the stroke of the engine. It is attached to the low-pressure piston by an extension g of the main piston-rod. At the lower end of the stroke the first expansion-piston uncovers the port s' and allows a portion of the steam contained in the high-pressure cylinder to escape into the intermediate receiver. At the top of the stroke the lower edge of the piston p uncovers the ports $s' s'$ and steam flows from the receiver into the space above the controlling-piston r .

The other parts of Fig. 4 and their working are identical with the corresponding parts of Fig. 3 and are marked with the same reference-letters, respectively.

I wish to call attention to the fact that in the double-expansion engines illustrated in Figs. 4 and 5 the construction and arrangement of the slide-valve q' provides for steam only at the pressure in the intermediate receiver being behind the valve-rings q^2, q^3 , and q^4 , and that this, while sufficient to press them out and keep them steam-tight, does not subject them to so much wear as would steam at the full pressure.

I claim—

1. The combination of controlling cylinder closed throughout its sides and one of its ends with the exception of a communication through the latter to the valve cylinder; valve cylinder of smaller sectional area than the controlling cylinder, aligned therewith and joined to the said closed end thereof; controlling piston rigidly held to the reciprocating member of the engine to be controlled and adapted to move to and fro in the controlling cylinder; valve rigidly held to the controlling piston at a distance from it not less than the length of the stroke of the latter and adapted to move to and fro in the valve cylinder aforesaid; and a port or ports in the said valve cylinder which communicate with the supply and are adapted in respect of their position in the

said valve cylinder to be opened by the valve only at the commencement of the working stroke and at the end of the return stroke.

2. The combination of controlling cylinder closed throughout its sides and one of its ends with the exception of a communication through the latter to the valve cylinder; valve cylinder of smaller sectional area than the controlling cylinder, aligned therewith and joined to the said closed end thereof; piston adapted to move to and fro in the first mentioned cylinder; port and valve adapted to regulate the supply to and exhaust from the working face of the said piston; a valve rigidly held to the said piston at a distance from it not less than the length of the stroke of the latter and adapted to move to and fro in the valve cylinder above mentioned, and a port or ports in the said valve cylinder which communicate with the supply and are adapted in respect of their position in the said valve cylinder to be opened by the valve only at the commencement of the working stroke and at the end of the return stroke.

3. The combination of high and low pressure pistons on the same piston rod and adapted to work within the high and low pressure cylinders respectively; high and low pressure cylinders aligned and communicating with each other; a port establishing a communication between the supply and the space between the two pistons aforesaid until it is closed by the outstroke of the high pressure

piston; ports from the valve cylinder or steam chest to the outer ends of the high and low pressure cylinders, respectively, and a reciprocating valve working in the said valve cylinder or steam chest to distribute the steam to the said high and low pressure cylinders successively and to control the exhausts therefrom.

4. The combination of high and low pressure pistons on the same piston rod, and adapted to work within the high and low pressure cylinders respectively; high and low pressure cylinders aligned and communicating with each other; a port establishing a communication between the supply and the space between the two pistons aforesaid until it is closed by the out-stroke of the high pressure piston; a controllable branch supply from the main supply to the intermediate receiver; ports from the valve cylinder or steam chest to the outer ends of the high and low pressure cylinders, respectively, and a reciprocating valve working in the said valve cylinder or steam chest to distribute the steam to the said high and low pressure cylinders successively and to control the exhaust therefrom.

In testimony whereof I have hereunto affixed my signature, in presence of two witnesses, this 16th day of March, 1892.

J. COURTHOPE PEACHIE.

Witnesses:

HENRY H. LEIGH,
T. F. BARNES.