J. STUMPF.

STEAM ENGINE.

APPLICATION FILED AUG. 25, 1910.

1,043,479.

Patented Nov. 5, 1912

2 SHEETS—SHEET 1.

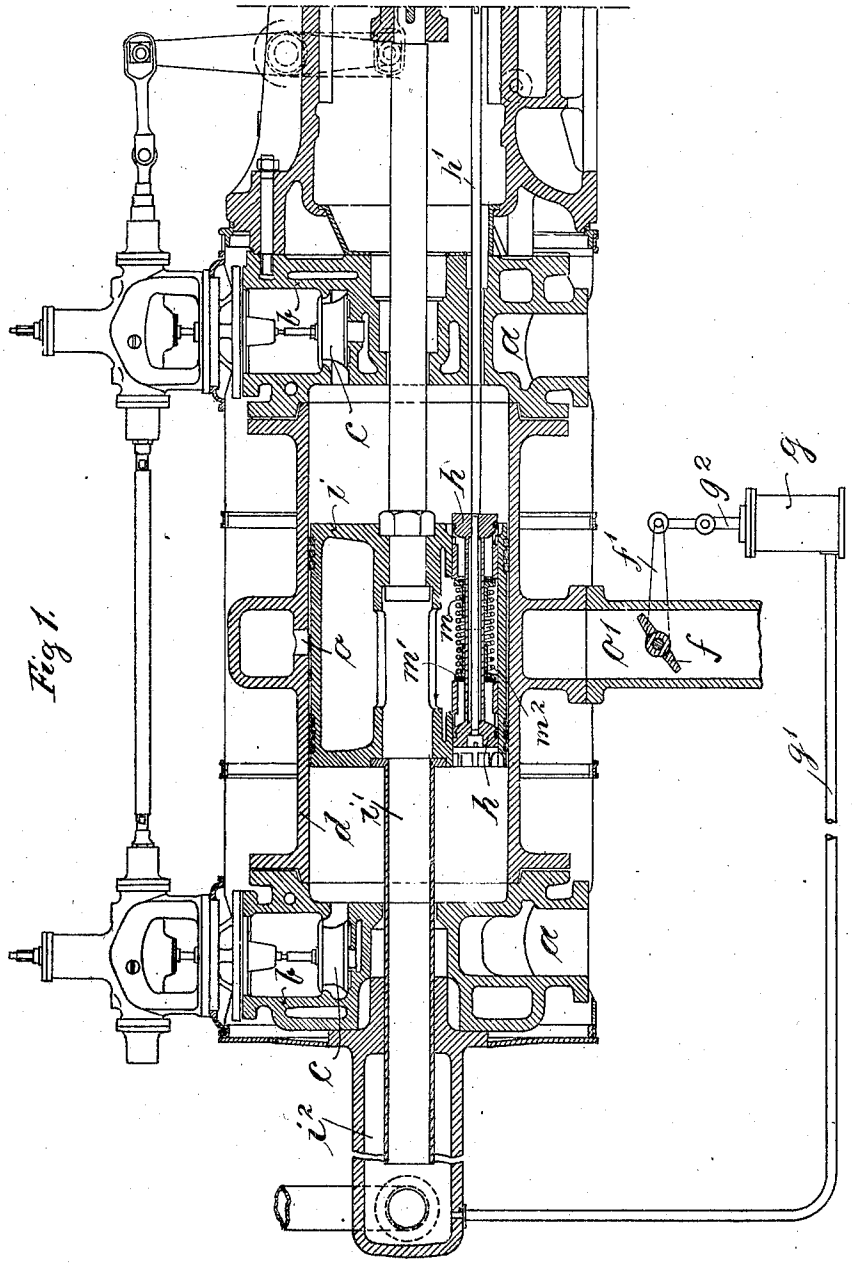

Fig 1.

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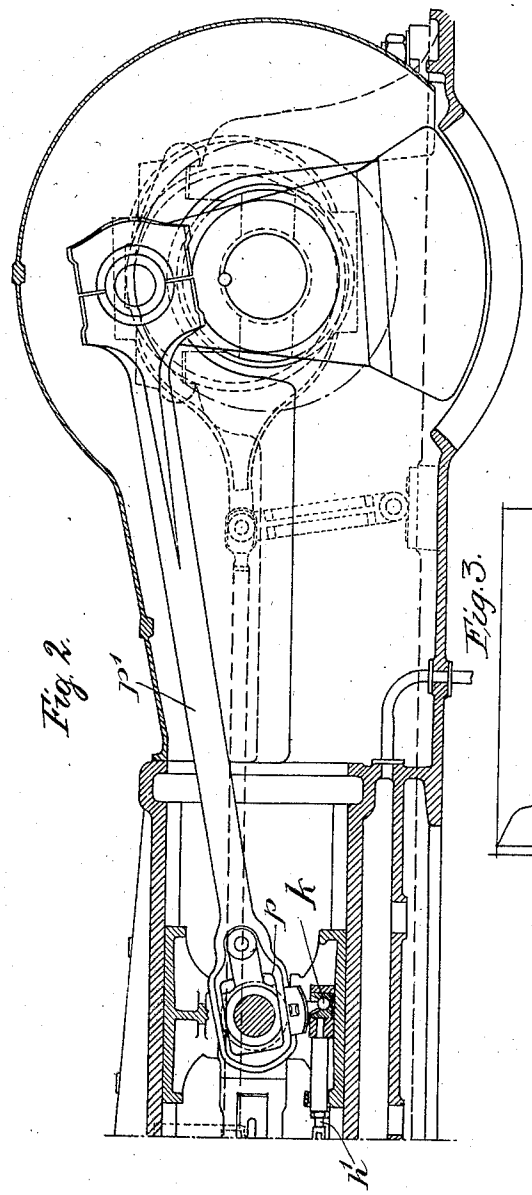

Fig. 2.

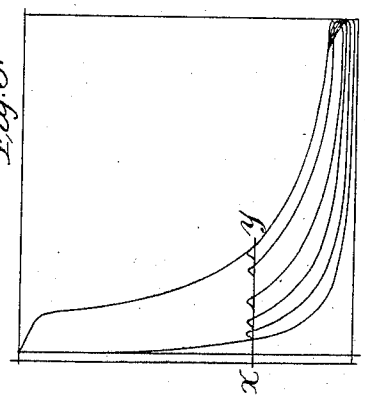

Fig. 3.

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UNITED STATES PATENT OFFICE.

JOHANN STUMPF, OF BERLIN, GERMANY.

STEAM-ENGINE.

1,043,479. Specification of Letters Patent. Patented Nov. 5, 1912.

Application filed August 25, 1910. Serial No. 578,831.

To all whom it may concern:

Be it known that I, JOHANN STUMPF, a subject of the King of Prussia, residing at Kurfürstendamm 33, Berlin, Germany, have invented certain new and useful Improvements in Steam-Engines, of which the following is a specification.

This invention relates to steam engines and especially to steam engines of the type which has become known as the uni-directional flow steam engine, that is an engine in which the steam is admitted to the end of the cylinder past an inlet valve and exhausts through ports controlled by the piston at and near the end of its stroke.

The object of the present invention is to provide means for withdrawing compressed steam from such engines and into a separate receiver. It is to be noted that the steam is not interfered with during the working stroke, which proceeds in the ordinary way and according to this invention the steam trapped in the cylinder after the exhaust ports are closed by the piston is compressed for part of the return stroke and then withdrawn and supplied to the receiver for compressed steam. For this purpose a connection is preferably provided leading through the piston, which is closed and hollow and communicates with the receiver, and in this connection and carried by the piston there is a valve, the motion of which is interdependent upon the piston in such a way that the said valve closes said connection during the working stroke of the piston and the first part of the return or compression stroke and is then operated to establish communication, through said connection, between the interior of the cylinder and the receiver for compressed steam.

By "working" stroke and "compression" stroke is of course meant the "working" and "compression" strokes with respect to any given side of the piston; thus during any single travel of the engine the "working" stroke on one side is being carried out simultaneously with the "compression" stroke on the other side of the piston.

The improved engine will be more readily understood from the following description of one form illustrated by way of example in the accompanying drawings, in which:—

Figure 1 is a sectional elevation through the rear half of a horizontal uni-directional flow steam engine according to this invention. Fig. 2 is a similar section through the cross head and crank case of the engine. Fig. 3 is a hypothetical pressure-volume diagram, illustrating the operation of the engine.

According to the form of the invention shown, the working steam enters the hollow cover b, by the inlet pipes a, from which it passes, past the valves c, into the cylinder d. When that edge of the piston i, which acts as the controlling means for the exhaust ports, uncovers the exhaust ports o, the expanded steam exhausts through the ports o, in the cylinder walls and passes off by the exhaust pipe o', to the atmosphere or a condenser or some other auxiliary apparatus for further use. The steam thus enters at one end of the cylinder steam space and exhaust at the end thereof remote from that at which it enters and this constitutes the essential of a uni-directional flow steam engine. In the exhaust passage o', there is arranged a throttling member shown as a butterfly valve f, which is adapted to be controlled by any suitable means dependent upon the pressure in the compressed steam receiver i^2. In the drawing a controlling motor g, is indicated and this motor is connected by a pipe g', to the compressed steam receiver i^2, whereby this motor will respond to fluctuations in the pressure of steam in the receiver i^2. The operating rod g^2, of the motor g, is connected to the arm f' of the butterfly valve f, so that when the rod g^2, sinks, the valve f, is caused to obstruct the exhaust pipe o', to a greater extent and thereby throttle the exhaust. This has the effect of leaving more steam to be trapped in the cylinder when the exhaust ports o, are covered by the controlling edge of the hollow piston i.

The piston i is in the form of a closed hollow body, the interior of which is connected by a hollow tail rod i', to the compressed steam receiver i^2, and the ends of the piston have circular openings or bores whereby a connection is formed through the hollow piston i, and hollow tail rod i', between the interior of the cylinder at each side of the piston and the compressed steam receiver i^2. In this connection I arrange a valve h, the motion of which is interdependent upon that of the piston i, in such a manner that the said valve breaks the communication between the interior of the cylinder on that side of the piston which is carrying out its working stroke and the compressed

steam receiver. This communication is also broken during the first part of the compression stroke, that is the compression stroke with reference to each side of the piston, as it will be understood as mentioned above that when the piston is performing work on one side (that is executing its working stroke) it will be compressing steam on its opposite side. After compression has been effected for a desired amount the valve h, is opened to establish communication between the compression side of the piston and the receiver i^2, and then the valve h, is closed shortly before the piston reaches the end of its stroke. This cycle of operations will be readily followed from the hypothetical diagram in Fig. 3.

In the form of this invention illustrated the compressed steam is withdrawn through the valve h, arranged in the hollow piston i, and passes through the hollow piston i, rearwardly through the hollow tail rod i'. The valve h, is operated by a rod h', which is connected to a slide in the crosshead of the engine which slide is operated by an arm k, on the crosshead end of the connecting rod so as to open and close the valve h, at the desired times.

If desired the valve h, may be arranged to open before the main exhaust ports o, are covered by the piston i. Any suitable means may be provided for insuring that the compressed steam passing to the receiver is of a desired predetermined pressure. The means shown is, however, the preferable form and comprises what might be called a compound or duplex valve control. This compound valve control consists of the mechanically operated valve h and spring controlled valves m and m', located in series with the valve h, and behind said valve with respect to the interior of the cylinder—that is to say the spring controlled valves m and m' are located between the valve h and the compressed steam receiver i^2. The residual or trapped steam in the cylinder, in this case, will be compressed when the steam passage in the piston valve h is closed by the spring-controlled valves m and m', as is illustrated in Fig. 1, and said steam passage in the piston valve h will only be opened by one or other of the valves m and m' when the residual steam has been compressed up to the desired pressure, represented in the hypothetical diagram in Fig. 3, by the horizontal line x—y. When the desired pressure is reached steam continues to pass off through the valve h and the valve m or m' as the case may be, until the valve h, is closed; this conveniently takes place after about $\frac{8}{10}$ths of the compression stroke on each side of the piston so as as to give sufficient cushioning.

In the form of the invention illustrated the engine is double acting and the piston valve h, is in two co-axial ported end parts and both the valves m and m' are co-axial with the valves h, and control the ports therein being acted upon by a common spring interposed between them.

I claim:

1. In a steam engine, a cylinder having a steam inlet port at its end and separate exhaust ports at an intermediate point in its length, a working piston in said cylinder and adapted to uncover said exhaust ports at the end of its working stroke and on its return to close said exhaust ports and compress the steam trapped in the cylinder, a receiver for compressed steam, a connection from said receiver to the interior of said piston, means interdependent upon the motions of the piston and operable to close said connection during the working stroke and the first part of the compression stroke of the piston and to open said connection for a second part of the compression stroke, substantially as described.

2. In a steam engine, a cylinder having a steam inlet at its end and separate exhaust ports at an intermediate point in its length, a closed hollow working piston in said cylinder and adapted to uncover said exhaust ports at the end of its working stroke and on its return to close said exhaust ports and compress the steam trapped in the cylinder, a compressed steam receiver, a connection leading through said hollow piston from the cylinder interior to said compressed steam receiver, a valve in said connection, said valve being closed to break said connection during the working stroke of the piston and the first part of the compression stroke and being opened to establish communication between the cylinder and the compressed steam receiver after the piston has compressed the steam trapped in the cylinder.

3. In a steam engine, a cylinder having a steam inlet at its end and separate exhaust ports at an intermediate point in its length, a closed hollow working piston in said cylinder and adapted to uncover said exhaust ports at the end of the working stroke and on its return to close said exhaust ports and compress the steam trapped in the cylinder, a compressed steam receiver, a connection leading through said hollow piston from the cylinder interior to said compressed steam receiver, a mechanically operated valve in the piston and controlling said connection, and means for operating said valve interdependent upon the motions of the piston to hold said valve closed during the working stroke of the piston and the first part of the compression stroke and being opened to establish communication between the cylinder and the compressed steam receiver after the piston has compressed the steam trapped in the cylinder.

4. In combination, a steam cylinder having inlet ports and separate exhaust ports, a hollow piston in said cylinder adapted to uncover said exhaust ports at the end of its working stroke, and means for withdrawing compressed residual steam comprising a valve in said piston, means for operating said valve from a moving part of the engine to place said hollow piston in communication with the compression space of the cylinder, means for withdrawing steam from said hollow piston, a throttling member for the exhaust steam and means dependent upon the pressure of the residual steam after leaving said hollow piston for controlling said throttling member.

5. In a steam engine, a cylinder having a steam inlet at its end and separate exhaust ports at an intermediate point in its length, a closed hollow working piston in said cylinder and adapted to uncover said exhaust ports at the end of its working stroke and on its return to close said exhaust ports and compress the steam trapped in the cylinder, a compressed steam receiver, a connection leading through said hollow piston from the cylinder interior to said compressed steam receiver, a compound valve control for said connection and located in said piston, said compound valve control comprising a mechanically operated valve operated interdependently upon the motions of the piston to be closed during the working stroke and the latter part of the compression stroke and a spring controlled valve in series with said mechanically operated valve and located behind said valve in respect to the interior of the cylinder.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHANN STUMPF.

Witnesses:
JOHANNES HEYNEMANN,
FRANZ MÜLLER.