J. STUMPF.

UNIDIRECTIONAL FLOW STEAM ENGINE.

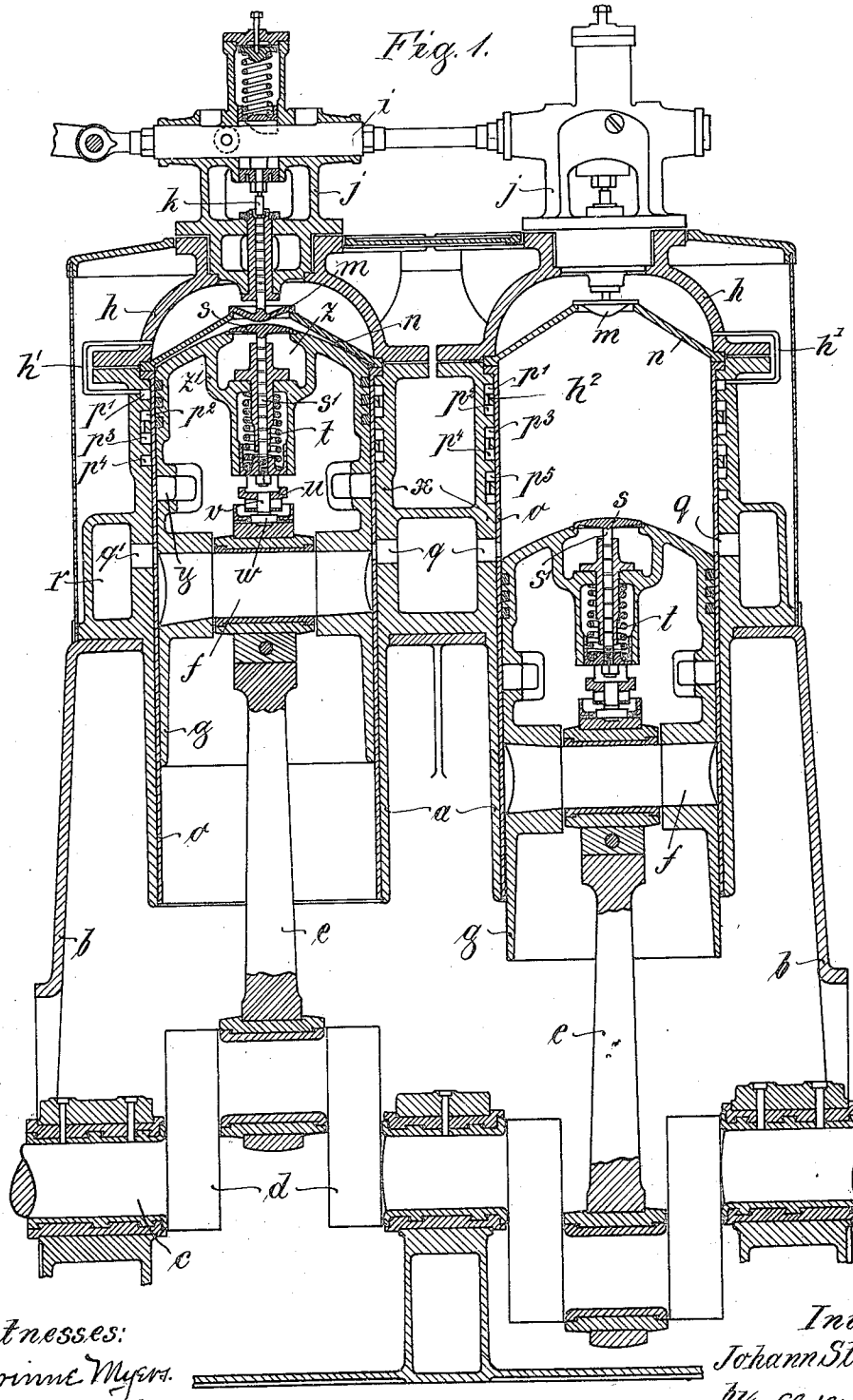
APPLICATION FILED DEC. 13, 1910.

1,045,630.

Patented Nov. 26, 1912.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
Corinne Myers.
Vera Paulsen.

Inventor.
Johann Stumpf.
by L. K. Böhm
Attorney

J. STUMPF.

UNIDIRECTIONAL FLOW STEAM ENGINE.

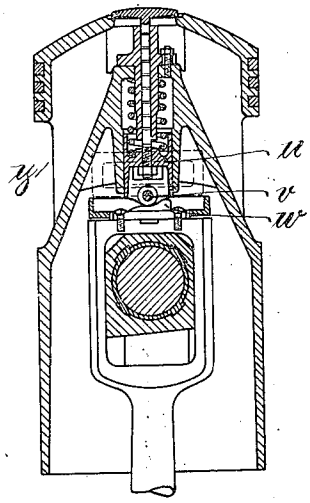
APPLICATION FILED DEC. 13, 1910.

1,045,630.

Patented Nov. 26, 1912.

2 SHEETS—SHEET 2.

Fig. 2.



Witnesses:
Corinne Myers.
Vera Paulsen.

Inventor:
Johann Stumpf.
by L. K. Böhm
Attorney.

UNITED STATES PATENT OFFICE.

JOHANN STUMPF, OF BERLIN, GERMANY.

UNIDIRECTIONAL-FLOW STEAM-ENGINE.

1,045,630. Specification of Letters Patent. Patented Nov. 26, 1912.

Application filed December 13, 1910. Serial No. 597,129.

To all whom it may concern:

Be it known that I, JOHANN STUMPF, a subject of the King of Prussia, German Emperor, and resident of 33 Kurfürstendamm, in the city of Berlin, German Empire, have invented certain new and useful Improvements in Unidirectional-Flow Steam-Engines, of which the following is a specification.

This invention relates to vertical uni-directional flow engines especially those with single acting cylinders.

In uni-directional flow steam engines during normal running the cut off is early and the ratio of expansion in each cylinder is considerable so that at the end of the expansion the dryness fraction of the steam is fairly low. This wet steam, however, in the case of a jacketed inlet, and on the cylinder, is confined practically to the layers of steam near the wide exhaust ports. When therefore these ports are uncovered by the piston the dry steam nearer the inlet end sweeps out the cylinder and produces a kind of scavenging action to clear out the fine water particles held in suspension in the steam nearer the exhaust ports and also those which may be clinging to the walls.

The object of the present invention is to provide an arrangement of cylinder and construction of piston, which will assist this "scavenging" action and facilitate the lamination of the steam in the cylinder.

According to the present invention in the first place the inlet valve in a vertical single acting unidirectional flow steam engine is arranged centrally on the cylinder end, which gives improved lamination of the steam. By "lamination" is meant the separation of the dry from the wet steam referred to above. In the second place the piston end is of convex shape on its upper surface so that the sweeping or scavenging takes place over surfaces sloping downwardly to the wide exhaust ports. In the third place the piston may be provided with a supplementary exhaust valve, as described in my co-pending application Serial No. 575921 filed August 6, 1910, but in the present case this valve is arranged centrally in the piston, which also has the effect of preserving the laminations of the steam practically undisturbed during supplementary exhaust.

The novel features of this invention will be readily understood from the following description of the form of this invention shown in the accompanying drawing, in which:

Figure 1 is a vertical section of a twin cylinder unidirectional flow steam engine according to this invention, Fig. 2 is a section of the piston at right angles to the section shown in Fig. 1.

According to the form of this invention illustrated in the accompanying drawing the cylinders a of a vertical uni-directional flow steam engine with twin cylinders are supported on a frame b in the bed of which there is supported the crank shaft c. To the cranks d there are connected rods e which have their ends fitted to the pins f on the pistons g. The pistons g are of considerable length and are arranged somewhat similarly to the pistons of an internal combustion engine. The cylinders a are provided with covers h on which the brackets j are mounted. In the brackets j there are arranged the sliding rods i which are provided with rollers co-acting with cams mounted on the valve spindles k. The valve spindles k pass centrally through the covers h and carry in the present instance flat single beat lift valves m. In the form shown the valves m are adapted to close on a valve seat formed on a conical lining n. Owing to its high resistive strength the conical lining n may be made of comparatively thin metal. Steam is supplied to the space between the cover h and the conical lining n so that there is formed a heating jacket at the end of the cylinder from which working steam is admitted to the cylinder past the centrally arranged valve m.

Within the cylinder there is fitted a liner o conveniently of comparatively thin steel or the like which considerably facilitates the rapid conduction of heat. Near the upper end of the cylinder a a number of grooves p', p^2, p^3, p^4, p^5 are arranged. These grooves are fairly close together and are supplied with steam by a pipe h', leading from the steam space between the cover h, and the conical end piece n. If this connection is made at the righthand side in the drawing the wall between the grooves p' and p^2 at a diametrically opposite point, of the right hand cylinder as shown is provided with an opening h^2. The wall between the grooves p^2 and p^3 is then provided with an opening diametrically opposite to the opening in the wall between the grooves p^1 and p^2 and so on. In this way it will be seen that steam

will pass in series through all the annular chambers p' p^2 p^3 and so on. The reason why the chambers p' p^2 etc. are arranged so closely together as shown in the drawing is to prevent the liner o becoming pressed in between the ribs forming the sides of the grooves or channels p', p^2, etc. The liner o is also provided with port openings q which are arranged opposite the exhaust port openings q' and in the cylinder a. The ports q' open into an exhaust belt r arranged around the cylinder and this exhaust belt may be directly connected to a condenser or it may itself form part of a condensing chamber.

In some cases I arrange an auxiliary exhaust valve s centrally on the end of the the pistons g. In the form illustrated the valve s is seated centrally on the piston g and is normally pressed to its seat by means of a spring t. The valve spindle s' as shown in the drawing is fixed to a sliding part u carrying a roller v which is adapted to engage on a cam piece w fixed to the piston end of the oscillating rod e. In this way as the engine works and the rod e oscillates the valve s is periodically opened at the required time to enable supplementary exhaust of the steam.

The operation of this engine is as follows:—When steam enters past the valve m, it passes centrally into the cylinder and, assisted by the conical formation of the inner plate n, this steam spreads in an even layer over the whole area of the cylinder. When cut off takes place therefore the hotter steam is arranged near the hot conical walls n and these walls being comparatively thin, efficiently assist the conduction of heat from the heating jacket formed between the conical end n and the cover h. As the piston continues its stroke the steam expands and falls in temperature. Owing to the transmission of heat through the cover n the steam layers near or adjacent to the conical plate n are maintained hot while the layers of steam are of gradually decreasing temperature toward the exhaust openings q q'. This maintains what has been called the "lamination" of the steam into definite temperature layers and this "lamination" is still further assisted by the heating action of the annular chambers p' p^2 etc. to p^5 which heating action is in turn accentuated by the thin walls of the liner o.

In the form of the invention illustrated the series of annular chambers stop short of the exhaust belt r so that there is an unjacketed part x on the cylinder walls. When the end of the piston uncovers the exhaust ports q the steam rapidly passes through these ports and this steam being the wettest, has an effective cooling action in the neighborhood of the exhaust belt r. When the wettest steam passes out by the ports q the drier steam layers situated immediately behind, effect a sweeping or scavenging action over the convex upper surface of the piston so that all water of condensation is effectively swept out by the ports q and q'. In this way when compression begins the steam compressed is dry steam and in consequence the temperature reached on compression is exceedingly high and in practice may approximate very closely to the temperature of the admission steam. It will be readily understood that if the lamination of the steam were disturbed, so that the wettest steam was not efficiently swept out of the cylinder the temperature of compression would be lower and the engine would in consequence have a lower thermal efficiency.

In connection with the annular heating chambers p' p^2 etc. it should be stated that the number of these chambers employed is conveniently determined by the degree of superheat of the steam used and in the extreme when saturated steam is used the annular chambers p' p^2 etc. may be continued up to the exhaust belt r.

When it is considered that the steam layer near the inlet end that is near the conical plate n is practically quiescent, it will be seen that the heat transmitted to the steam through the wall n is all retained within the cylinder. That is to say that the heating jacket on the end of the cylinder works with no loss. When however the heating jacket is continued around the cylindrical walls the thermal efficiency of this heating jacket decreases as the jacketing is continued owing of course to the fact that the steam layers heated by the jackets carry heat out at the exhaust. In the form illustrated where there is an unjacketed part x this forms a neutral zone between the heating jackets p' and p^2 etc. and the cooling jacket r. In this way the cylinder walls near the part where the piston velocity is greatest are kept comparatively cool even when highly superheated steam is used and lubrication is facilitated. As explained in my co-pending application Serial No. 575921 I sometimes arrange a mechanically operated valve in the piston to reduce the compression in the cylinder while still maintaining the uni-directional flow principle. In the construction herein described such a valve is shown arranged in a specially convenient manner to perform its function of reducing compression without disturbing the graduation of the steam in layers of wet steam at the exhaust end and dry steam at the inlet end of the cylinder steam space.

The valve s in the present case admits steam to the center of the hollow piston and this steam may escape through elongated openings y in the side walls of the piston, these openings being adapted to register with the ports q'. It will be seen that in

this way as described in my co-pending application mentioned above the compression is relative without departing from the uni-directional flow principle. In the form of this invention illustrated I arrange the valve *s* centrally in the piston, so that the withdrawal of steam past the valve *s* will not disturb the lamination of the steam. It will be understood that both in the case of the inlet valve *m* and the compression relieving valve *s* that if these valves were arranged at one side, the steam would be withdrawn more intensely locally around the valve and the even lamination of the steam into definite temperature zones would be disturbed. It is further to be noted that the steam passing the valve *s* enters the closed off chambers *z* formed on the end of the piston by the walls *z'*.

I claim:—

1. In a uni-directional flow steam engine, a cylinder, a cover on the end of said cylinder, a truncated conical end piece of sheet metal arranged within said cover and over the end of said cylinder, said conical end piece forming with the cover a steam space, a valve arranged to seat on the narrow end of said conical end piece to control the admission of working steam to said cylinder, an exhaust belt around the cylinder and connected directly thereto by a ring of ports and a piston in said cylinder and arranged to overrun and control said ports at and near the end of its working stroke.

2. In a uni-directional flow steam engine, a cylinder having a series of closely arranged grooves, forming heating channels on its internal surface, a sheet metal ported liner therein, a piston working within said liner and arranged to cover and uncover the ports in said liner at and near the end of its outward position, a truncated conical end piece on said cylinder, a cover over said conical end piece and forming therewith a steam space with which the grooves on the cylinder wall communicate and a valve arranged to seat on the narrow end of said conical piece and to control the admission of working steam to the cylinder.

3. In a uni-directional flow steam engine a cylinder having a ring of exhaust ports, a cover on said cylinder, a truncated conical end piece of sheet metal over the end of the cylinder and within said cover, a steam supply pipe to the space between said cover and said end piece, a valve arranged co-axially with the cylinder to seat on the narrow end of said conical end piece, a spindle on said valve passing centrally outward from said cover, a bracket in which said spindle is guided and means movable in said bracket and co-acting with said spindle to operate the valve.

4. In a uni-directional flow steam engine a plurality of cylinders arranged side by side, said cylinders having exhaust ports, an exhaust chamber into which said ports all open directly, covers on said cylinders, truncated conical end pieces of sheet metal over the end of said cylinders and within said covers, steam supply pipes to the spaces formed between said covers and said conical end pieces, valves arranged to seat on the narrow ends of said conical pieces, spindles on said valves passing centrally outward through the covers and a reciprocating rod passing the ends of said cylinders at right angles thereto and co-acting with said valve spindles to operate the valves.

5. In a uni-directional flow steam engine, a vertical cylinder having a steam inlet port at its upper end and exhaust ports in its cylindrical walls, and means for preserving the steam in layers of driest steam at the inlet end and wettest steam near the exhaust and also promoting scavenging of said wettest steam through the exhaust ports comprising a working piston in said cylinder, said piston having a convex upper end with an opening therein the lower edges of which convex end uncover the exhaust ports in the cylinder walls at and near the end of the downward stroke of the piston, a ported chamber formed on the end of said piston the port in said chamber being arranged to register with the exhaust ports in the cylinder walls and a mechanically operated valve arranged centrally on said piston to control the opening on the end thereof and admit exhaust steam from the cylinder to said ported chamber.

6. In a uni-directional flow steam engine a vertical cylinder, a truncated conical end piece of sheet metal on said cylinder, a cover over said end piece and forming therewith a steam chamber and a heating jacket on the upper end of the cylinder, a valve arranged centrally to seat on the narrow end of said truncated conical piece and controlling the admission of steam in a centrally arranged stream to said cylinder, an exhaust belt around said cylinder and directly connected thereto by a ring of ports, a convex ended piston with a centrally arranged opening on the convex end thereof, said piston being arranged to uncover the ring of ports leading to the exhaust belt at and near the end of its working stroke, a ported chamber on the end of said piston, the port in said chamber being arranged to register with the ports leading to the exhaust belt and a mechanically operated valve in the piston and controlling the central opening on the convex end thereof.

7. In a uni-directional flow steam engine, a vertical cylinder, a truncated conical end piece of sheet metal on said cylinder, a cover over said end piece and forming therewith a steam chamber and a heating jacket on the upper end of the cylinder, a valve arranged

centrally to seat on the narrow end of said truncated conical piece and controlling the admission of steam in a centrally arranged stream to said cylinder, a heating jacket arranged about the cylindrical walls of the cylinder near the upper end, an exhaust belt around said cylinder and directly connected thereto by a ring of ports, a convex ended piston with a centrally arranged opening on the convex end thereof, said piston being arranged to uncover the ring of ports leading to the exhaust belt at and near the end of its working stroke, a ported chamber on the end of said piston, the port in said chamber being arranged to register with the ports leading to the exhaust belt and a mechanically operated valve in the piston and controlling the central opening in the convex end thereof.

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

JOHANN STUMPF.

Witnesses:
JOSEPH HEPPA,
WOLDEMAR HAUPT.