J. STUMPF.

STEAM ENGINE.

APPLICATION FILED SEPT. 14, 1910.

1,069,087.

Patented July 29, 1913.

4 SHEETS—SHEET 1.

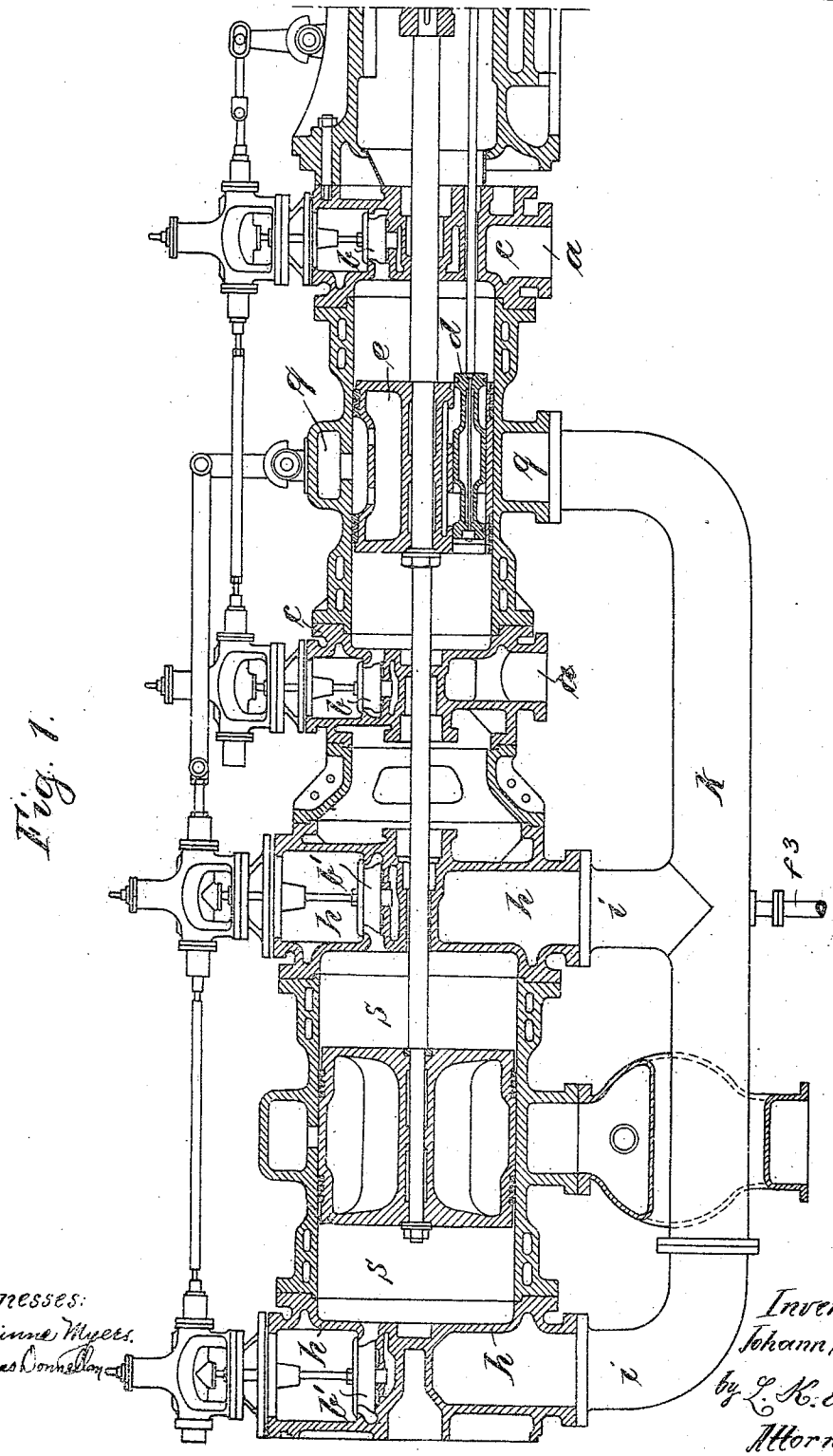

Fig. 1.

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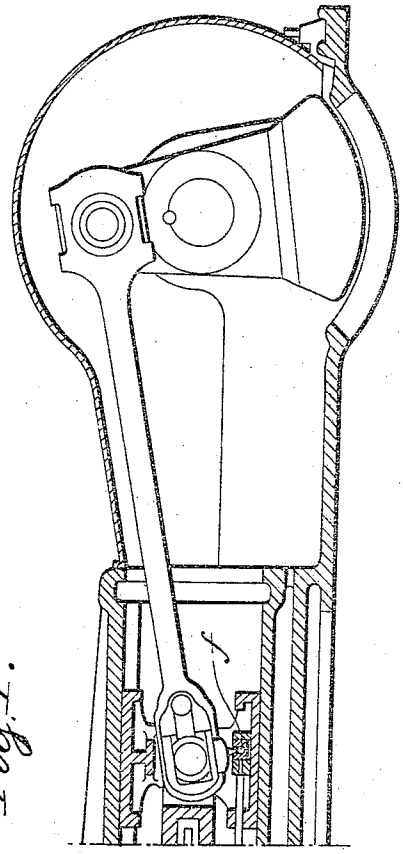

Fig. 1a.

Fig. 2.

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4 SHEETS—SHEET 3.

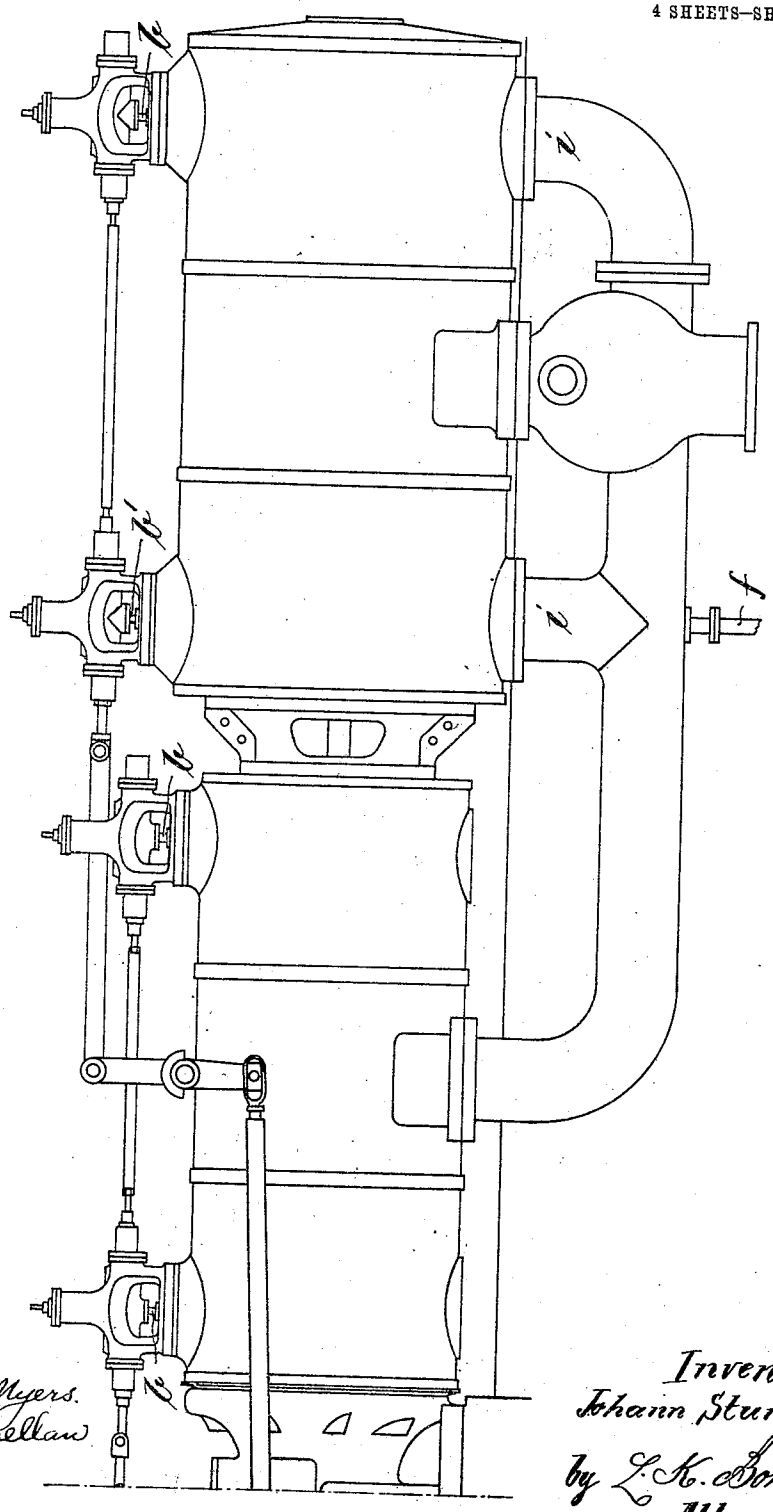

Fig. 3.

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4 SHEETS—SHEET 4.

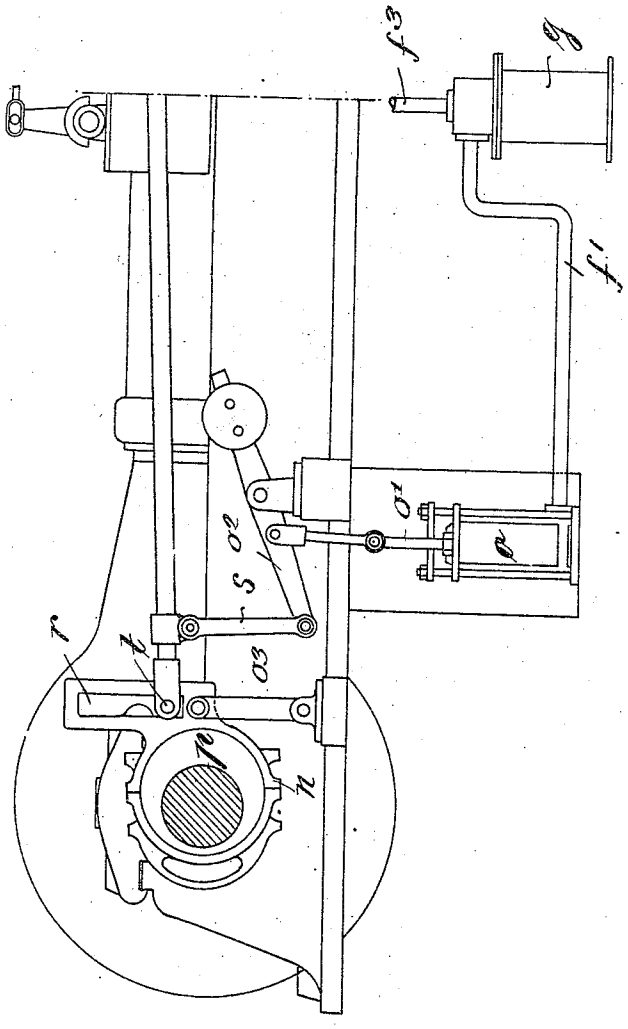

Fig. 2a

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UNITED STATES PATENT OFFICE.

JOHANN STUMPF, OF BERLIN, GERMANY.

STEAM-ENGINE.

1,069,087. Specification of Letters Patent. Patented July 29, 1913.

Application filed September 14, 1910. Serial No. 581,949.

To all whom it may concern:

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

This invention relates to an improved system of utilizing exhaust steam in power generating plants.

It relates more specifically to those systems in which auxiliary apparatus receives steam from an intermediate receiver located between the first and second expansion cylinder of a multiple expansion steam engine.

The object of the present invention is to apply uni-directional flow steam engines in such a system. "Uni-directional" steam flow engines are those in which the steam is admitted at one end and exhausts past the piston at the other end, so that once the steam enters the cylinder it does not return on its paths. In such engines the compression commences as soon as the piston, on its return stroke, covers the exhaust ports. In order that the compression be not excessive it is necessary to diminish the initial back pressure as much as possible. The back pressure existing in the high pressure cylinder of a compound steam engine of the ordinary type is consequently inadmissible in the usual forms of uni-directional flow steam engines.

According to the present invention the piston of the high pressure cylinder of the uni-directional steam flow engine is provided with means for exhausting steam on the return stroke after the piston has covered the exhaust ports, so that the conditions of exhaust encountered in ordinary steam engines are assimilated while the uni-directional flow principle and its attendant advantages are retained. The low pressure cylinder on the other hand is of the ordinary uni-directional flow type.

In accordance with this invention means are also provided by which the amount of steam admitted to the engine is regulated in accordance with the amount required in the auxiliary apparatus.

The means located in the piston for continuing the exhaust are preferably in the form of a valve operated from a moving part of the engine—such as the crosshead crank or connecting rod. This enables the auxiliary exhaust to be adjusted to give the necessary relief to the back pressure on the piston while retaining adequate cushioning.

Referring now to the drawings which illustrate this invention in one convenient form, Figures 1 and 1ª are vertical sectional views of the cylinder and crank ends respectively of a steam engine according to this invention, Fig. 2 is a hypothetical pressure volume diagram when one half of the steam passing from the high pressure cylinder is utilized in the auxiliary apparatus and the other half in the second expansion cylinder. Figs. 3 and 3ª are side elevations respectively of the cylinder and crank ends of the plant shown in Figs. 1 and 1ª. The views in Figs. 1 and 1ª and 3 and 3ª have been halved in order to bring them within the dimensions of the sheet.

In carrying the invention into effect according to the form illustrated, steam enters the engine by the pipes *a* and passes to the hollow covers *c* which act as heating jackets at the inlet ends of the high pressure cylinder. This steam is admitted past the valves *b* into the high pressure cylinder. In this cylinder it expands and propels a piston *e* forward. The steam expands until the piston uncovers the exhaust ports in the cylinder walls which communicate with the exhaust receiver *q*. In the form illustrated as soon as the piston *e* in its return stroke again covers the exhaust ports the valve *d* which is operated from an arm *f* set eccentrically on the connecting rod, establishes communication between the compression space of the cylinder and the interior of the hollow piston *e*. The residual steam in the compression space then passes through the hollow piston to the receiver *q* as will be readily seen from Fig. 1. It will be understood that the valve *d* may open before the piston *e* covers the exhaust ports.

The steam passes from the receiver *q* through the pipe *k* and by the branch *i* into the hollow covers *h* of the second expansion stage *s*. The valves *b'* control the admission of steam to this expansion stage. The second expansion stage *s* is illustrated as an ordinary unidirectional flow steam engine cylinder and need not be further described. Connected with the intermediate receiver *q* and *k* there is a pipe *f* leading to any auxiliary or like apparatus *g* which is shown diagrammatically in Fig. 3. From the auxiliary apparatus *g* there leads a pipe *f'* to a pressure motor *o*, which responds to varia-

tions in pressure, so as to operate a rod o', which shifts a sliding block t, in the slot r, through the medium of lever o^2, and link o^3. The slot r is arranged in the eccentric sheave n on the eccentric p which operates the valves for the low pressure cylinder.

The particular form of valve gear illustrated constitutes no part of the present invention and is in itself known. The action of the pressure motor o is to make the cut off in the low pressure cylinder s, later, when the pressure in the pipe f' rises and vice versa *mutatis mutandis*.

It will be seen that the pressure in the pipe f' will rise when a sufficient excess of steam is passing to the auxiliary apparatus g. If an insufficient quantity of steam is passing to the auxiliary apparatus g the pressure in the pipe f' will fall and the cut off in the low pressure cylinder will be earlier so that a greater proportion of the steam in the receiver q will pass to the auxiliary apparatus. This process may be carried on until the entire amount of steam exhausted from the high pressure cylinder passes to the auxiliary apparatus. The low pressure cylinder is present not so much for the purpose of obtaining the compound action as for the purpose of utilizing that excess of steam exhausted from the high pressure cylinder which is not required in the auxiliary apparatus.

Referring to the diagram in Fig. 2 it will be seen that in this case about 50% of the steam exhausted from the high pressure cylinder represented by the line y is withdrawn to the auxiliary apparatus while the steam represented by the line x is utilized for expansion in the low pressure cylinder. With this construction the clearance space in both the cylinders may be maintained very small. In the high pressure cylinder the clearance is shown in Fig. 2 as about 2% of the volume of the cylinder space while in the low pressure cylinder it is shown as amounting to 6%. In the form illustrated it is intended that the high pressure cylinder be controlled by any usual construction of governor so that the pressure motor o does not in any way interfere with the ordinary governing of the engine. The engine governor is preferably arranged to control the cut off through a shifting eccentric.

It will be understood that the engine cylinders may be arranged in any other convenient way and many other constructional alterations may be made without departing from this invention.

I claim:—

1. In a compound engine in combination with a receiver forming a source of back pressure, a high pressure cylinder having a steam inlet at one end and intermediate exhaust ports, a working piston controlling said exhaust ports at and near the end of its travel, a connection leading from said exhaust ports to said receiver, means in said piston for exhausting steam to said receiver after said exhaust ports have been covered by the piston, a second expansion cylinder communicating with said receiver, substantially as set forth.

2. In combination with the moving parts of a compound engine, a receiver forming a source of back pressure, a high pressure cylinder having a steam inlet at one end and intermediate exhaust ports, a working piston controlling said exhaust ports at and near the end of its travel, a connection leading from said exhaust ports to said receiver, a valve in said piston adapted to establish communication between the cylinder and the exhaust ports, means for operating said valve to establish said communication after the exhaust ports have been covered by the piston, said means being driven from a moving part of the engine and a second expansion cylinder communicating with said receiver, substantially as set forth.

3. In a compound engine in combination with a receiver forming a source of back pressure, a high pressure cylinder, having an inlet valve at one end and intermediate exhaust ports, mechanism for operating said inlet valve, a working piston controlling said exhaust ports at and near the end of its travel, mechanism to control said inlet valve, a pressure motor communicating with said receiver and operable on said mechanism, a connection leading from said exhaust ports to said receiver, means in said piston for exhausting steam to said receiver after said exhaust ports have been covered by the piston, a second expansion cylinder communicating with said receiver, substantially as set forth.

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

JOHANN STUMPF.

Witnesses:
JOHANNES HEYNEMANN,
FRANZ MÜLLER.