

No. 615,311.

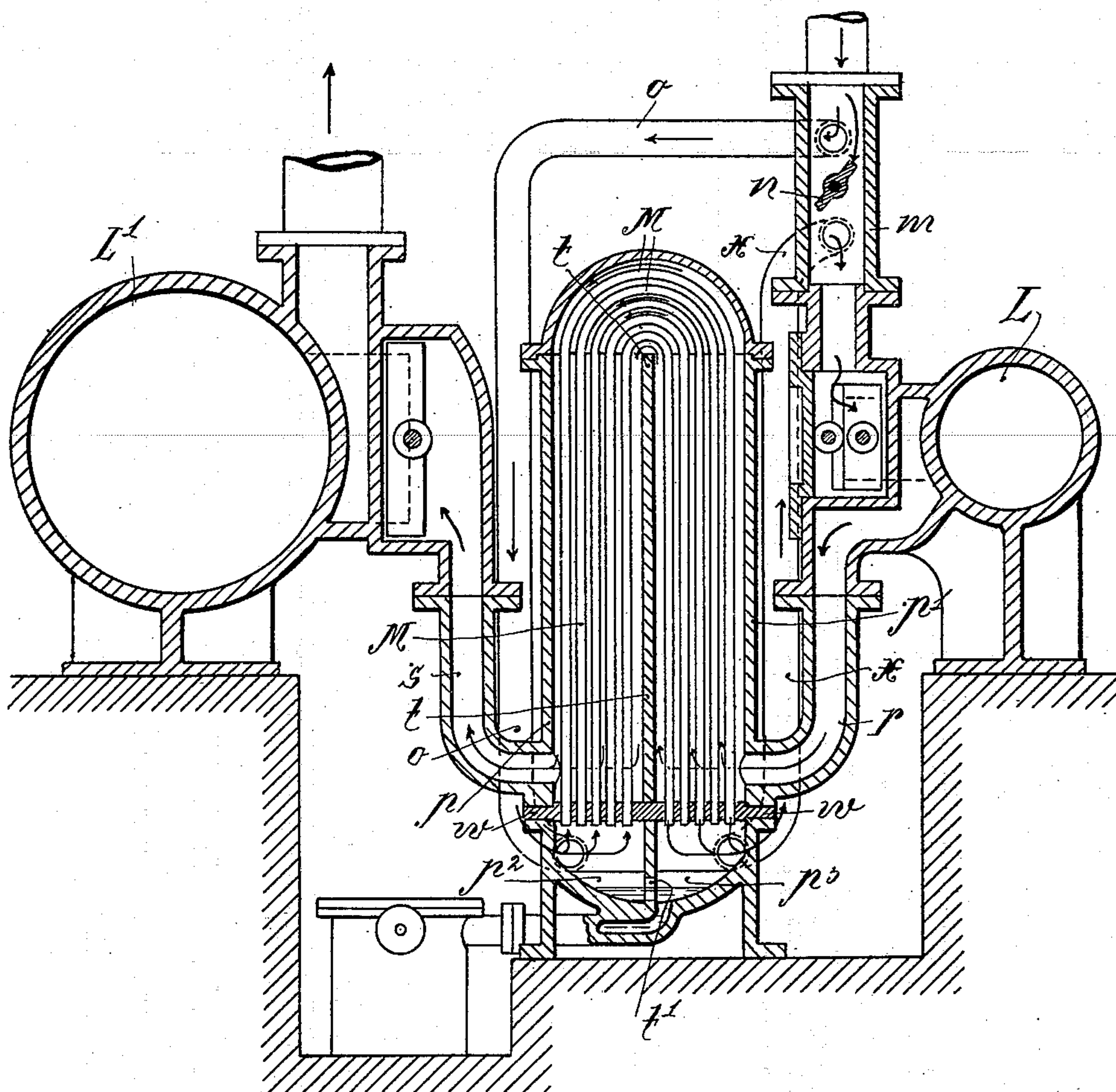
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W. SCHMIDT.

COMPOUND ENGINE WITH REGULATOR FOR SUPERHEATED STEAM.

(Application filed Mar. 30, 1897.)

(No Model.)



Witnesses:  
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# UNITED STATES PATENT OFFICE.

WILHELM SCHMIDT, OF BALLENSTÄDT, GERMANY.

COMPOUND ENGINE WITH REGULATOR FOR SUPERHEATED STEAM.

SPECIFICATION forming part of Letters Patent No. 615,311, dated December 6, 1898.

Application filed March 30, 1897. Serial No. 629,981. (No model.)

*To all whom it may concern:*

Be it known that I, WILHELM SCHMIDT, a subject of the King of Prussia, German Emperor, and a resident of Ballenstädt-on-the-  
5 Harz, in the Duchy of Anhalt, in the German Empire, have invented certain new and useful Improvements in Compound Engines with Regulator for Superheated Steam, (for which patents have been obtained in Swit-  
10 zerland, No. 12,584, dated June 3, 1896; in France, No. 257,458, dated June 22, 1896; in Belgium, No. 122,307, dated July 2, 1896; in Italy, No. 324, Vol. LXXXII, dated July 6, 1896; in Hungary, No. 7,415, dated July 8,  
15 1896, and in Canada, No. 54,185, dated November 27, 1896,) of which the following is an exact specification.

This invention forms an improvement on the arrangement described in my application, Se-  
20 rial No. 599,549, filed July 17, 1896, in which a steam-power plant adapted to work with superheated steam is combined with a device for regulating the temperature, (especially the inlet temperature,) of the superheated steam,  
25 according to the degree of filling of the cylinder of the engine of that plant. Said regulating device is therefore such a one the adjustment of which may be determined after or made dependent on the degree of fill-  
30 ing of the cylinder. The object of the arrangement described in said application consists, first, in obtaining a practically perfect exhaustion of the theoretical energy of the superheated steam, and, second, in allow-  
35 ing of the use of even highly-superheated steam without any detriment to the respective cylinder and the piston of the same. The points to be considered with regard to these purposes and advantages are fully treat-  
40 ed in the prior application in question, and I therefore limit myself in the present application to dwelling upon those points only that are of special importance for the subject-matter hereinafter described. The regulation of  
45 the initial temperature of the superheated steam is also in this case (just so as in the application, Serial No. 599,549, filed July 17, 1896) to be effected in such a way that the greatest part of work that can be rendered at a stroke  
50 of the piston is rendered by dry steam, where-

as the rest of work is rendered by expanding saturated steam in such a manner that the expanding superheated steam remains dry up to about half the way of the piston. In other words, the regulation is to be such a one that  
55 on a decrease of the degree of filling of the cylinder an increase in the inlet temperature of the superheated steam is produced, and reversely, in either case with such a result that the greatest part of work which (with regard  
60 to the relative dimensions or proportions of the respective cylinder) can be admitted to be rendered by dry steam is obtained at any degree of filling of the cylinder, so that that part of the stroke on which the expanding  
65 steam remains dry may be of a uniform length in spite of changes in the degree of filling of the respective cylinder. To obtain this result, the inlet temperature of the superheated steam should thus be made dependent on or  
70 determined after the degree of filling of the cylinder, and there should be removed from the superheated steam as much heat as is in excess with regard to the degree of filling just existing.

Of course the removal of heat is effected in any case in a useful way in that the excess of heat which the too highly superheated steam is deprived of is transferred to water or steam, preferably, however, to the latter.

Now the present invention refers in general to quite a particular manner of that transfer of heat, this particular manner being intended for compound engines or multiple-expansion engines, respectively, and consisting in trans-  
80 ferring the heat removed from the superheated live steam to the expanded steam contained within or passing through the receiver of the respective engine. This steam is thus to be heated or reheated by superheated live  
90 steam. I have found it advantageous to let the superheated live steam have such a temperature that its excess of heat (with regard to the degree of filling of the high-pressure cylinder of the engine) is great enough to heat  
95 the receiver-steam up to such a degree that (with regard to the degree of filling of the low-pressure cylinder) there occurs within this cylinder a similar course in the work of the steam as is the case with the live steam 100



within the high-pressure cylinder. Therefore the receiver of the compound engine must be provided with a reheater intercalated into or connected with the live-steam conduit, so that  
 5 either all the live steam or but a part thereof passes through that reheater on its way from the generator to the high-pressure cylinder.

Letting the whole of the superheated live steam pass through the reheater of the receiver is to be preferred if the degree of filling of the cylinder of the respective engine is a constant one, whereas with engines with changing degrees of filling it is more advantageous to lead but a part of that steam  
 15 through the reheater in question, the quantity of that part being of course dependent on the degree of filling.

An arrangement adapted to work in the manner last mentioned is shown in vertical  
 20 section in the accompanying drawing.

The highly-superheated steam enters first a casing *m*, that contains a throttle-valve *n*. The latter may be adjusted or regulated either by hand or from the regulator or link-motion  
 25 or steam-distributor of the engine or from any movable part, the extent of motion of which depends on that of any of the parts just mentioned. A pipe *o* branches from the casing *m* above the valve *n*. Said pipe terminates in a lower chamber *p*<sup>2</sup> of the receiver  
 30 *p p'*. The right-hand side of the receiver is connected with the outlet-pipe *r* of the high-pressure cylinder *L* and the left-hand side of the receiver is connected with the low-pressure cylinder *L'* by the pipe *s*. The lower portion of the receiver is separated from the other or main portion by a horizontal wall or plate  
 35 *w*, that supports a number of upright pipes *M* of U-like shape. The legs on the left-hand side are separated from those on the right-hand side by means of the wall *t*, and the steam passing from the pipe *r* to the pipe *s* is therefore compelled to wash the pipes *M* on the whole of their length. The right-hand  
 40 lower chamber *p*<sup>3</sup> of the receiver is connected with the casing *m* by a pipe *x*, terminating in said casing below the valve *n*. The chambers *p*<sup>2</sup> and *p*<sup>3</sup> are put into intercommunication by an aperture *t'*, allowing of the water  
 50 of condensation collecting within the chamber *p*<sup>2</sup> to flow into and through the chamber *p*<sup>3</sup>. There is not constantly a formation of water of condensation, but only on the commencement of work. When the aperture *t'*  
 55 is not fully closed by the water of condensation, then of course a small quantity of steam will pass through the aperture from *p*<sup>2</sup> to *p*<sup>3</sup>. Owing, however, to the small size of that aperture the quantity of steam passing through  
 60 the same is so little that a change in the effect with regard to the object in view is not caused thereby.

The combined surfaces of the pipes *M* are so measured that the initial temperature as  
 65 required for the lowest degree of filling for

the high-pressure cylinder, as well as the low-pressure cylinder, may be attained and maintained when the throttle-valve is fully open, so that the greatest part of the superheated steam passes directly through the casing *m*  
 70 into the high-pressure cylinder *L*, while but a small part flows to said cylinder on the by-way through the pipes *o*, *M*, and *x*. When the degree of filling is increased, there takes place a corresponding reduction of the free  
 75 section of the casing *m* by a suitable turning of the valve *n*, and a greater part of the superheated steam is therefore caused to pass through the pipes *o*, *M*, and *x*. In either of  
 80 these cases the respective excess of temperature of the superheated steam is transmitted to the steam present within or flowing through the receiver *p p'*, and that heat is utilized within the low-pressure cylinder *L'* according to the idea of invention.  
 85

Having thus fully described the nature of this invention, what I desire to secure by Letters Patent of the United States is—

1. In a compound engine, the combination with the high and low pressure cylinder, the receiver and the parts between the latter and  
 90 said cylinders, of a reheater combined with said receiver, said reheater being connected on the one side to the live-steam conduit of the engine, and at the other side to the high-pressure cylinder *L*, of the same, the receiver-space proper being connected at one side with  
 95 the exhaust-steam pipe *r* of said high-pressure cylinder *L* and at the other side with the steam-inlet pipe *s* of the low-pressure cylinder *L'*, for the purpose as described.

2. In a compound engine, the combination with the high and low pressure cylinder, the receiver and the parts between the latter and  
 105 said cylinders, of a reheater combined with said receiver, said reheater being connected on the one side to the live-steam conduit of the engine, and at the other side to the high-pressure cylinder *L* of the same, the receiver-space proper being connected at one side with  
 110 the exhaust-steam pipe *r* of said high-pressure cylinder *L* and at the other side with the steam-inlet pipe *s* of the low-pressure cylinder *L'*, a direct connection between the said live-steam conduit and the high-pressure cylinder,  
 115 for the purpose as described.

3. In a compound engine, the combination with the high and low pressure cylinder, the receiver and the parts between the latter, and  
 120 said cylinders, of a reheater combined with said receiver, said reheater being connected on the one side to the live-steam conduit of the engine, and at the other side to the high-pressure cylinder of the same, the live steam being caused to a greater or less extent, according to the position of the throttle-valve  
 125 *n*, partly to pass directly through the casing *m*, and partly through *o M x* to the said high-pressure cylinder, the receiver-space proper being connected at one side with the exhaust-  
 130



steam pipe *r* of the high-pressure cylinder L,  
and at the other side with the steam-inlet  
pipe *s* of the low-pressure cylinder L', a di-  
rect connection between the said live-steam  
5 conduit and the high-pressure cylinder of the  
engine, and a regulating device in said direct  
connection, for the purpose as described.

In testimony whereof I have signed this  
specification in the presence of two subscrib-  
ing witnesses.

WILHELM SCHMIDT.

Witnesses:

R. HERPICH,  
C. BROCKHAUS.