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PROCESS AND CONTRIVANCE FOR SUPERHEATING STEAM TAKEN FROM A GENERATOR.

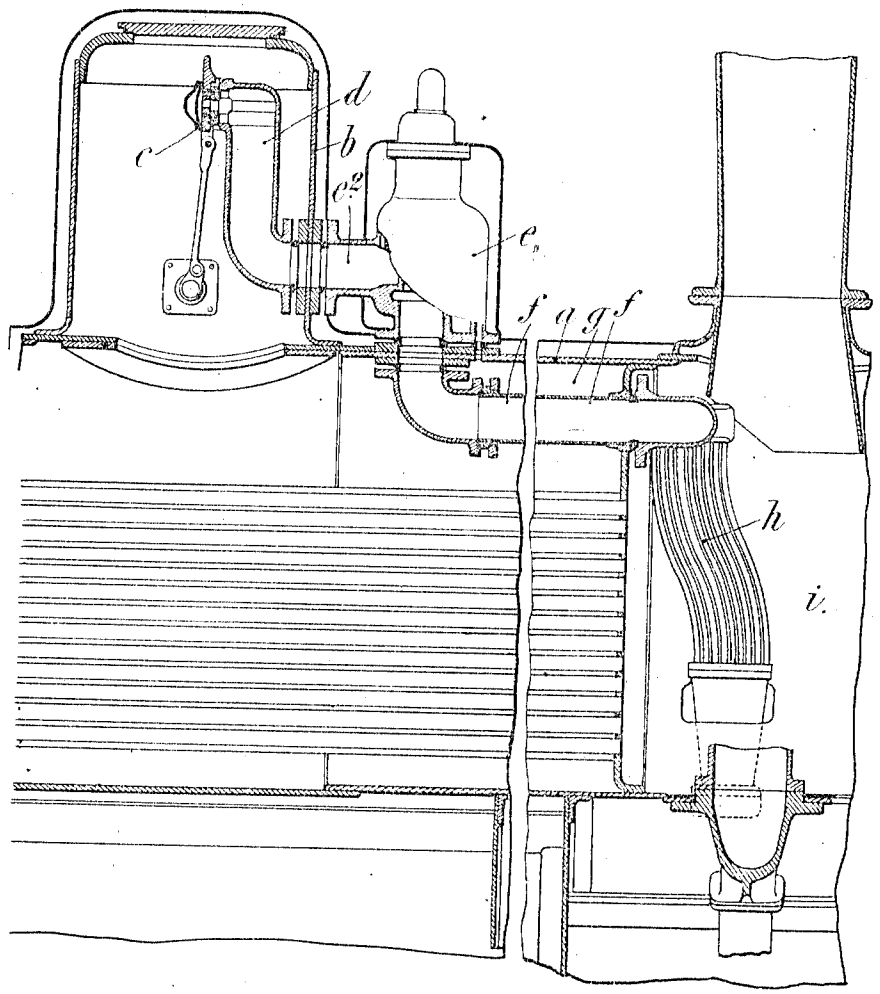
APPLICATION FILED FEB. 7, 1912.

1,063,953.

Patented June 10, 1913.

2 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:

John C. Sanders

Albert F. Heuman

INVENTOR:

Charles Caille

BY

Wm. Brucan Flint

ATTY.

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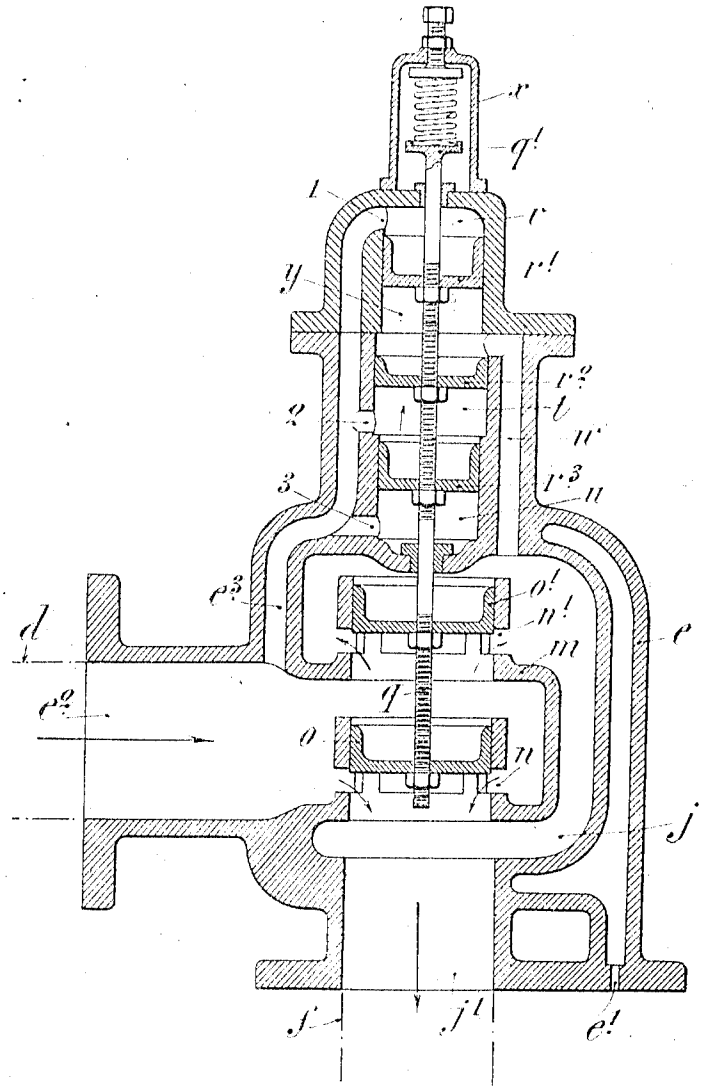
2 SHEETS—SHEET 2.

Fig. 2.



WITNESSES:

John C. Sanders

Albert F. Heuman

INVENTOR;

BY Charles Caille,

Wm. J. McCauley

ATTY

UNITED STATES PATENT OFFICE.

CHARLES CAILLE, OF LEPERREUX, FRANCE.

PROCESS AND CONTRIVANCE FOR SUPERHEATING STEAM TAKEN FROM A GENERATOR.

1,063,953. Specification of Letters Patent. Patented June 10, 1913.

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To all whom it may concern:

Be it known that I, CHARLES CAILLE, a citizen of the Republic of France, residing at 24 Rue de la Gaite, Leperreux, Seine, France, have invented new and useful Improvements in Processes and Contrivances for Superheating Steam Taken from a Generator, of which the following is a specification.

Hitherto, when for supplying engines with steam, it is desired to obtain the steam as dry as possible, the steam, during its passage from the steam generator to the cylinders or other consumption devices, is caused to traverse a group of tubes (a superheater) exposed to hot gases. By these previous methods and contrivances, steam which is always in the condition of saturated steam can only be dispossessed of its moisture by an increase of temperature, so that superheaters as at present constructed must be of considerable size, and in addition it is necessary to locate them at a portion of the passage which conducts the hot gases not far from the furnace. Moreover, when a superheater of this kind is insufficiently supplied with fluid to be superheated on account of a diminution or cessation more or less prolonged in the employment of steam, there is a risk of the group of tubes being burned unless complicated contrivances to prevent this are provided. The process and contrivance for superheating steam taken from a generator, which process and contrivance form the subject of the present invention, eliminate all these disadvantages.

The new process consists, in principle, in producing by means of an expansion device, located in the passage traversed by the steam in passing from the outlet valve to the superheater, an expansion which preferably is constant, that is, which produces a reduction in pressure which is practically constant, the space into which the fluid expands being maintained at the temperature of the steam before its expansion, this being effected for example by causing the expansion to take place in a suitable receiver located in the steam space of the generator. An isothermic expansion is thus obtained, and dry steam is provided by means of a superheater of relatively small dimensions, besides which this superheater can be located at some distance from the furnace, in the smoke box for example. A form of construction of a contrivance for applying this principle to a locomotive is illustrated as a representative example in the annexed drawing, in which:

Figure 1 is a part longitudinal section of a locomotive boiler to which the invention is assumed to be applied. Fig. 2 is a sectional elevation of the detail of a special expansion device which permits of a constant degree of expansion of the steam in its passage from the outlet valve to the superheater.

In Fig. 1, *a* represents the shell of a locomotive boiler provided with a steam dome *b* in which is located the usual steam outlet valve *c*. The steam from the boiler is led to a pipe *d* which opens into an expansion chamber *e*. On leaving the said chamber *e*, the steam is maintained at the same temperature as that previous to its expansion and for this purpose flows through a collector *f* which may be a single tube of suitable dimensions or a group of tubes located in the steam space *g* of the shell *a* of the generator. From the collector *f* the steam passes to the superheater *h*, which may be smaller than usual and be located in the smoke box *i* of the locomotive. The effect caused by the expansion of the steam during its passage from the pipe *d* to the superheater *h* with maintenance of its initial temperature is easily understood. Owing to the expansion at constant temperature, the water in suspension in the steam taken from the steam dome is vaporized; the collector *f* thus forms a chamber of total vaporization, so that the steam reaches the superheater *h* in the condition of gas. In the superheater *h* it undergoes an increase in temperature, which is accompanied by an increase of pressure which is maintained until the steam is admitted to the cylinders of the engine. At each admission of steam to the engine cylinders a reduction of pressure takes place in the collector *f*. The expansion device *e* then allows fresh steam to pass into the collector, and this steam expands until it reaches the reduced pressure chosen, and the water carried by the steam is vaporized; the cycle of operations described above is then repeated. The expansion device *e*, should, in accordance with this invention, be constructed in such a manner as to insure, not a reduction in the variable pressure P in the steam space *g* to a predetermined value

P^1, but such that the difference between the variable pressure P in the steam space and the variable pressure p in the collector f, shall be a constant, the magnitude of which can be chosen and regulated at will. In other words the contrivance should be so constructed that if P represents the variable pressure in the boiler, p the variable pressure in the collector f, $P-p=k$ at any moment, k being a constant chosen at will and regulated by the tension of the spring or the weights with which the expansion device e is loaded. In addition, the temperature of the expanded fluid is maintained at the temperature of the fluid to be expanded in such a manner that at each expansion there is a corresponding vaporization of the water in the steam, that is to say, a drying of the steam taken from the generator. The expansion device which permits this constant reduction in pressure to be obtained, and which is shown in Fig. 2, consists of: a casing e communicating on the one hand, by means of an orifice e^1, with the space g of the generator and on the other hand a branch e^2 projecting from the said casing is connected to the pipe d on which is carried the steam-outlet valve c under the control of the driver. Within the casing e is fitted the expansion contrivance itself which comprises a box-shaped chamber j which communicates by a pipe j^1 with the collector f. In this box is provided a cylindrical casing m having two series of apertures n, n^1 the opening and closing of which establishes and breaks respectively communication between d and f. This partial or total opening and closing is determined according to the position of the movable element of the expansion device. This element comprises for the two series of holes n, n^1, two pistons, o, o^1 of the same diameter connected by a rod q. A passage e^3 leading from the branch e^2 is formed in the wall of the casing e; orifices 1, 2, 3 place this passage e^3 and consequently the branch e^2 into communication respectively with the upper surface of the piston r^1, the lower surface of the piston r^2, the upper surface of the piston r^3, and also the lower surface of this last mentioned piston. In other words the branch e^2 is, by means of the passage e^3, in constant communication with the chambers v, t, u. The chamber y is on the other hand in communication by means of a passage w, formed in the wall of the casing e, with the chamber j of the expansion device. The two pistons r^1 and r^3 are of the same diameter, the piston r^2 being of greater diameter. These three pistons are carried by the rod q, which is continued through the cover of the casing e and has at its upper end a head q^1 on which rests a spring x the compression of which can be regulated. The compression of the said spring determines precisely the constant k which is equal to $P-p$ as defined above, and insures the expansion of the fluid which passes from the boiler through the steam valve c. The steam admitted at d is conveyed through e^2 and e^3 respectively to the casing m and the spaces v, t, u. But the pistons r^1 and r^3 have the same diameter, and the pressure of the fluid to be expanded is the same on each; it is the same with the two pistons o and o^1. On the other hand the piston r^2 is on its lower surface subjected to the action of the fluid to be expanded, and on its upper surface it is exposed to the pressure which exists in the chamber j. If S be the area of the piston r^2, s the area of the piston r^3, then the rod q and the pistons which it carries tend to move up under the action of a force represented by $(S-s)P$, while the same elements are subjected to a counteracting force represented by $(S-s)p$ to which is added the compression k of the spring x. The pistons o, o^1 accordingly take a position of equilibrium effecting a partial closure of the expansion device, which corresponds to the equation

$$(S-s)P-(S-s)p+k$$

which may be written:—

$$(S-s)(P-p)=k.$$

As $S-s$ is constant it is only necessary to vary the value of k in order to vary the value of $P-p$. When, during a working stroke, the value of p diminishes during an admission stroke of the piston of the engine, the value of $P-p$ will increase and the equilibrium will be destroyed, the orifices n and n^1 being thereby uncovered. As described above, the steam expanded from a pressure P to a pressure p is maintained at a temperature the minimum magnitude of which is equal to the temperature of the steam in the boiler, by placing the collector f in the steam space or at any other place of higher temperature. The drying of the steam, expanded by the means described above, thus takes place almost entirely in the collector, thus permitting the size of the superheater to be reduced to a minimum.

In connection with the special superheating device described above it should be noted that the arrangement of the piston r^2 of area S between the two pistons r^1 and r^3 of area s allows the value of the constant k to be reduced, while leaving the values of S and s sufficiently high for efficient working. In short, if the value of k be low, the expansion device will work with the necessary sensitiveness and speed without the effects of inertia interfering with its efficient operation.

Of course the collector f could in certain cases perform the dual function of collector and superheater or this dual function could be assigned to the superheater alone, the characteristic feature of the contrivance

described being always the isothermic expansion of the fluid before its admission to the collector-superheater.

I claim:

1. In combination, a boiler, a collector, and an expansion chamber adapted to receive steam from the boiler and communicating with said collector, whereby said collector will receive the expanded steam, said collector being exposed to the steam from the boiler.

2. In combination, a boiler provided with a steam space, a steam collector and means adapted to receive steam from the steam space and deliver it into said collector, said means being responsive to the difference in pressure between the steam in the steam space and the steam in the collector thereby maintaining constant the difference between the pressure in the steam space and the pressure in the collector.

3. In combination, a boiler, a collector a chamber communicating with said collector, said chamber having a port to permit steam from the boiler to enter said chamber, a valve controlling said port and means controlled by the difference in pressure between the steam in the boiler and the steam in the collector to control the movement of said valve.

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

CHARLES CAILLE.

Witnesses:
LOUIS FAUTRAT,
H. C. COXE.