No. 833,581. PATENTED OCT. 16, 1906.

E. D. COUSIN.

BOILER FURNACE.

APPLICATION FILED NOV. 11, 1905.

2 SHEETS—SHEET 1.

FIG. 2.

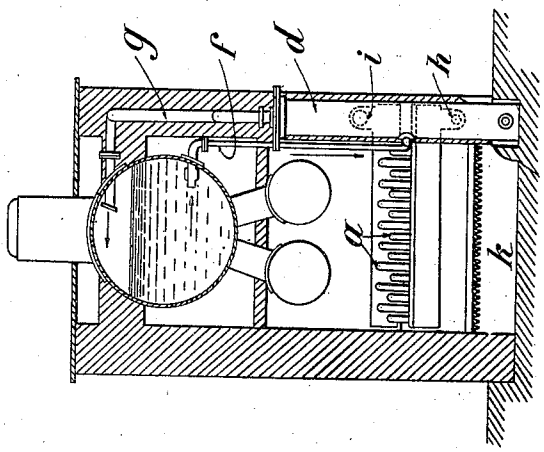
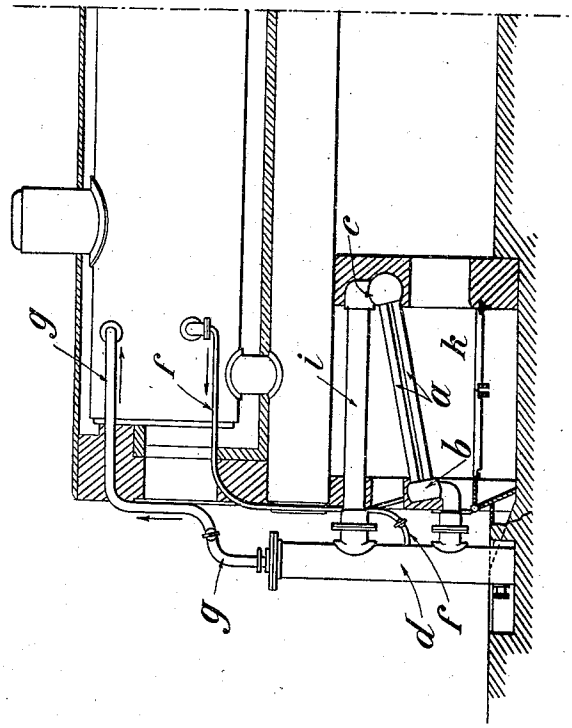



FIG. 1.




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2 SHEETS—SHEET 2.

FIG. 3.

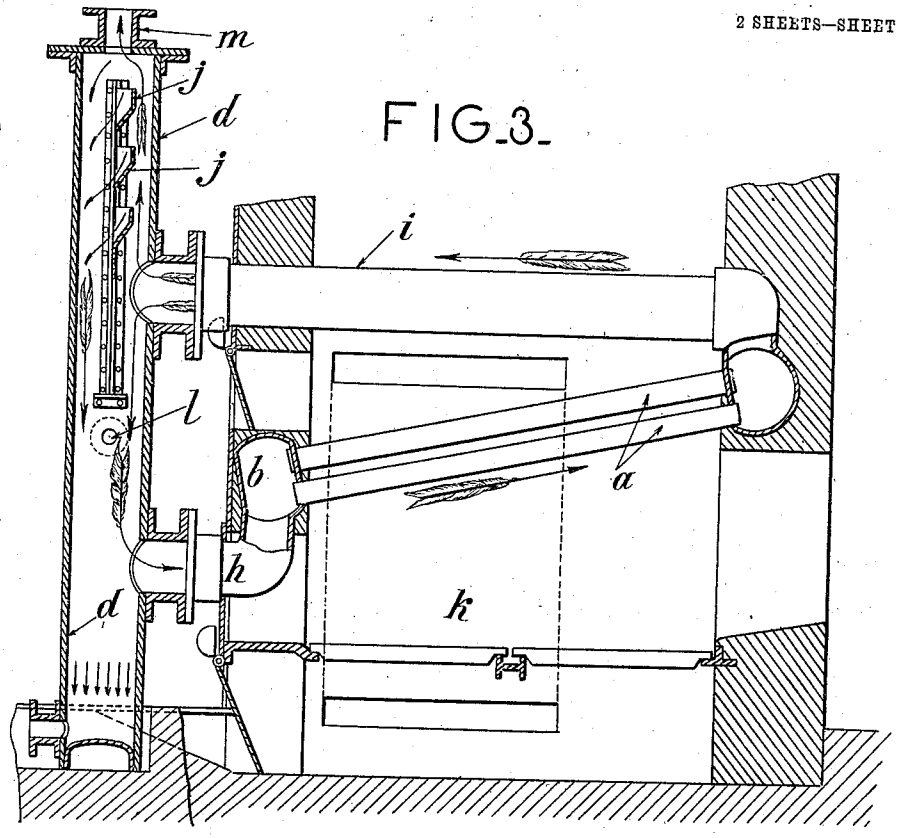



FIG. 4.

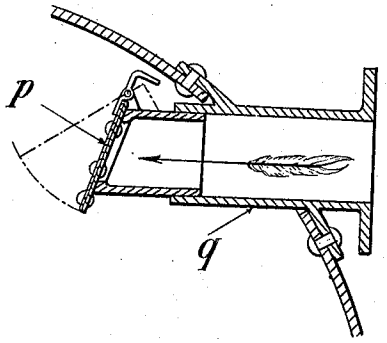
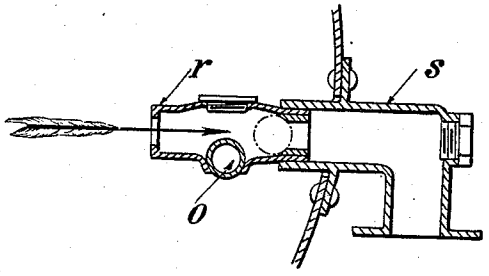



FIG. 5.




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# UNITED STATES PATENT OFFICE.

ERNEST DESIRÉ COUSIN, OF PARIS, FRANCE.

## BOILER-FURNACE.

No. 833,581. Specification of Letters Patent. Patented Oct. 16, 1906.

Application filed November 11, 1905. Serial No. 286,894.

*To all whom it may concern:*

Be it known that I, ERNEST DESIRÉ COUSIN, a citizen of France, residing at Paris, France, have invented new and useful Improvements in Smoke-Consuming Boiler-Furnaces, of which the following is a specification.

This invention relates to improvements in smoke-consuming boiler-furnaces.

In the boiler-furnaces hitherto used in which water circulates through tubes forming the hearth or grate of the furnace the said tubes are in most cases connected with separate chambers, the latter being in turn connected with the drum or boiler. This arrangement has the disadvantage of retarding the circulation of the water in the said tubes and of rendering the construction of the boiler complicated and cumbrous.

According to the present invention these disadvantages are obviated by directly connecting the boiler or drum with a system of water-tubes situated in the furnace and forming the grate on which the live fuel is placed, the arrangement being such that independent circulation takes place in the said tubes. This arrangement allows of using conduits of very small diameter for connecting the grate-tubes with the boiler, so that simple and reliable automatic cut-off devices can be arranged in said conduits for the purpose of interrupting communication between the boiler and the tubes in case one of the latter bursts or springs a leak.

One form of the invention is illustrated, by way of example, in the annexed drawings, in which—

Figure 1 is a partial longitudinal section, and Fig. 2 a cross-section, illustrating the arrangement of the improved furnace in connection with the boiler. Fig. 3 is a longitudinal section, on a larger scale, illustrating the arrangement of the grate-tubes with their accessories. Fig. 4 is a section of the device by means of which steam is allowed to enter the boiler from the grate-tubes, and Fig. 5 is a section of the device by means of which water is allowed to flow from the boiler to the pipe leading to said tubes.

The grate or hearth on which the fuel is placed for feeding the boiler-furnace is formed by two rows of staggered water-tubes *a*, the ends of which are connected with headers *b* and *c*. A vertical separator *d* communicates, by means of a pipe *f*, with the water-space of the boiler, and by means of a pipe *g* with the steam-space of the latter. The separator *d* is connected with the header *b* by means of a union *h* and with the header *c* by means of a horizontal conduit *i* of large diameter arranged above the tubes *a* at one side of the furnace. The separator *d* serves for separating the water from the steam, which flows from the tubes *a* in the manner which will be hereinafter described, plates or baffles *j* being provided for this purpose within the separator.

The live fuel which passes through the interstices of the upper grate formed by the tubes *a* falls onto the lower fire-bars *k*, on which the combustion of the said fuel is completed, the fresh fuel being placed on the water-tubes. The draft through the upper grate is downwardly directed, whereas the draft through the lower grate passes upward, so that two currents of gas impinge against each other and produce an intermingling of flames by which the smoke generated is completely consumed.

The water flowing from the boiler through the pipe *f* enters the separator *d* at *l* and passes thence through the union *h* and the header *b* to the tubes *a*. In the latter a portion of the said water is evaporated, and the mixture of steam and water passes through the header *c* and the wide conduit *i* back to the separator *d*, in which the water contained in said mixture descends and mingles with the fresh water flowing from the boiler in order to again circulate through the water-tubes. The steam, on the other hand, ascends and passes out of the separator through the nozzle *m*, with which the pipe *g*, leading to the upper part of the boiler, is connected. During its ascent in the separator the said steam impinges against the baffles *j* and is thus freed from the particles of water which it carries with it, said particles descending in the manner indicated in the drawings by downwardly-directed tailless arrows. The separator extends downward below the level of the union *h*, through which water flows to the water-tubes, so that all the impurities contained in the water are deposited at the bottom of the separator, from which they can be removed at suitable intervals with the aid of a mud-cock or the like. There is, there-

fore, no danger of incrustation in the water-tubes. Moreover, the water flowing from the boiler to the separator and serving to feed the water-tubes is already practically pure through having deposited in the boiler the greater part of its impurities.

It will be seen that the water not evaporated during one passage through the water-tubes continues to circulate in the latter until its evaporation is complete, so that the boiler need only supply a small quantity of water to the water-tubes. The diameter of the pipe *f* need, therefore, only be small, amounting, say, to from four to six centimeters. The diameter of the steam-pipe leading from the separator to the boiler can also be small, amounting to from seven to ten centimeters approximately, since the said pipe only serves to conduct the steam generated in the water-tubes. The improved water-tube grate does not, therefore, necessitate the making of large holes in the walls of the boiler, so that the latter is not weakened. Another important advantage resulting from the small diameter of the conduits referred to lies in the fact that automatic cut-off devices can be arranged in said conduits in order to instantaneously interrupt communication between the boiler and grate-tubes in case one of the latter should burst. Fig. 4 illustrates a cut-off device adapted to be used in connection with the steam-pipe *g*, the said device comprising a shutter *p*, which is pivotally connected inside the boiler with a short length of tubing inserted into the union *q*, with which the steam-pipe *g* is connected. During the normal working of the steam-generator the said shutter is raised by the current of steam flowing from the grate-tubes. If, however, the pressure in the latter is reduced by reason of an escape of steam, the shutter is immediately closed by the pressure within the boiler and prevents the escape of steam from the latter.

The cut-off device used in connection with the water-pipe *f* is illustrated in Fig. 5 and comprises a ball-valve *o*, situated in a tubular chamber *r*, which is connected inside the boiler with the union *s*, to which the water-pipe is joined. During the normal working of the steam-generator the ball *o* occupies the position shown in the drawings, and thus allows water to flow from the boiler to the union *s* and water-pipe *f*; but if a leak or escape occurs in connection with the grate-tubes the velocity momentarily imparted to the current flowing through the chamber *r* immediately causes the ball *o* to move into the position indicated in Fig. 5 by dotted lines, so that the further flow of water from the boiler is prevented. In the case of any injury to the grate-tubes the latter are therefore immediately cut off from the boiler and the escape of steam and water is restricted to the small quantity contained in the said tubes at the time of the accident, so that serious consequences are avoided.

The improved arrangement described can be used in connection with any type of boiler, even with boilers holding a very small volume of water, such as Belleville boilers, since if a shortage of water occurs the boiler will be burned before the grate. In the case of a Belleville boiler the water-pipe feeding the grate-tubes is connected with the lowest element of the drum and the separator then serves as an accessory to the latter.

In the case of very large furnaces it is preferable to use two separators, one at each side of the boiler. The separator or separators is or are in the most cases made of sheet-iron, but can also be made of wrought-iron, cast-steel, or the like.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A smoke-consuming boiler-furnace comprising in combination an upper grate consisting of tubes *a*, a lower grate consisting of fire-bars *k*, transverse headers *b* and *c* into which lead the tubes *a* at their respective ends, a vertical separator *d*, a union *h* connecting the header *b* to the separator, a wide conduit *i* connecting the header *c* to the separator, a water-pipe *f* of very small diameter extending from the separator to a point below the water-level of the boiler, and a steam-pipe *g* of small diameter extending from the separator to the steam-space of the boiler, substantially as described and for the purpose set forth.

2. A smoke-consuming boiler-furnace comprising in combination an upper grate consisting of tubes *a*, a lower grate consisting of fire-bars *k*, transverse headers *b* and *c* into which lead the tubes *a* at their respective ends, a vertical separator *d* extending downward below the grate-bars *k*, baffle-plates *j* arranged within the separator, a union *h* connecting the header *b* to the separator, a wide conduit *i* connecting the header *c* to the separator, a water-pipe *f* of very small diameter extending from a point *l* between the union *h* and the conduit *i* of the separator to a point below the water-level of the boiler, and a steam-pipe *g* of small diameter extending from the top of the separator to the steam-space of the boiler, substantially as described and for the purpose set forth.

3. A smoke-consuming boiler-furnace comprising in combination an upper grate consisting of tubes *a*, a lower grate consisting of fire-bars *k*, transverse headers *b* and *c* into which lead the tubes *a* at their respective ends, a vertical separator *d*, a union *h* connecting the header *b* to the separator, a wide conduit *i* connecting the header *c* to the separator, a water-pipe *f* of very small diameter

extending from the separator to the boiler and provided with an automatic cut-off device, and a steam-pipe *g* of small diameter extending from the separator to the boiler and provided with an automatic cut-off device, substantially as described and for the purpose set forth.

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

ERNEST DESIRÉ COUSIN.

Witnesses:
LOUIS YOSE,
HANSON C. COXE.