No 849,496. PATENTED APR. 9, 1907.

G. L. PRENTISS.

LOCOMOTIVE DIAPHRAGM.

APPLICATION FILED APR. 28, 1906.

Fig. 1.

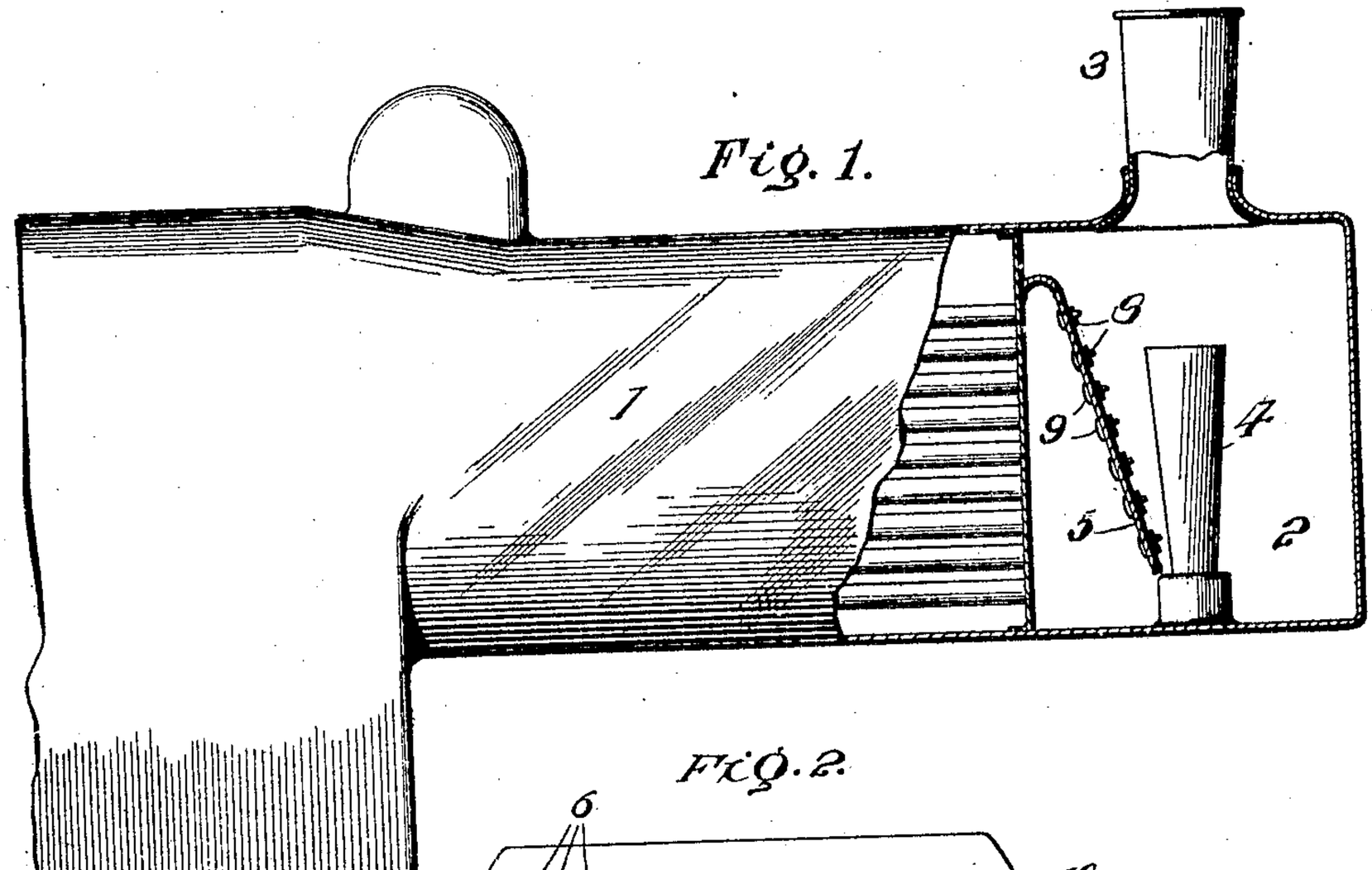


FIG. 2.

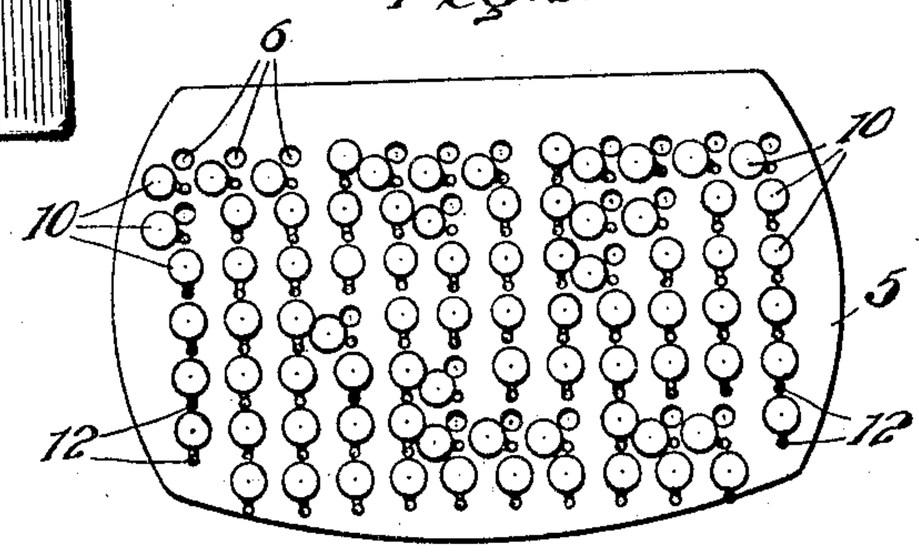


FIG. 3.

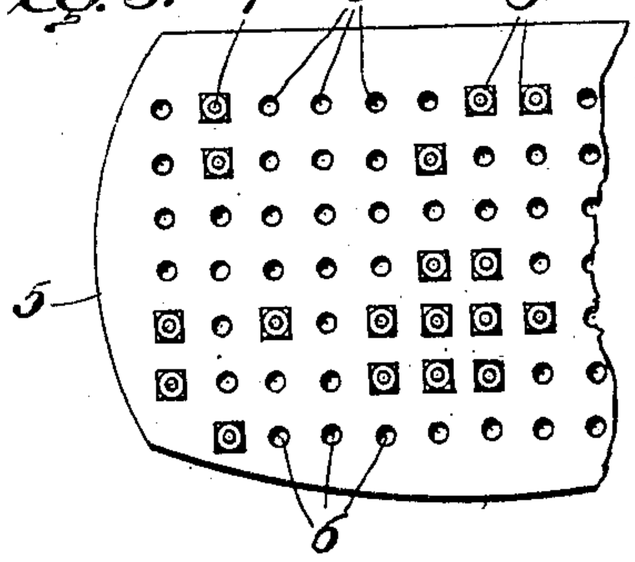


FIG. 4.

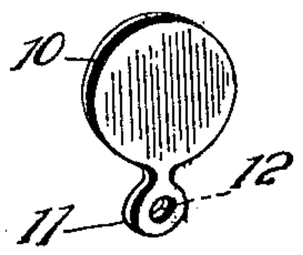
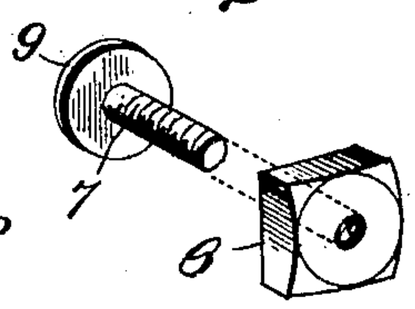


FIG. 5.



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LOCOMOTIVE-DIAPHRAGM.

No. 849,496. Specification of Letters Patent. Patented April 9, 1907.

Application filed April 28, 1906. Serial No. 314,216.

To all whom it may concern:

Be it known that I, GEORGE LOVELAND PRENTISS, a citizen of the United States of America, and a resident of Montclair, county of Essex, and State of New Jersey, have invented certain new and useful Improvements in Locomotive-Diaphragms, of which the following is a specification.

My invention relates to certain new and useful improvements in diaphragms such as are employed in locomotive engines for the purpose of interposing a resistance to the flow of furnace-gases between the fire-tubes and the exhaust of the locomotive. Such diaphragms are located in the smoke-box, which forms an extension of the boiler-shell.

My invention has particular reference to the construction of a diaphragm for the purposes indicated which within itself contains means by which its capacity to restrict, divide, or otherwise deal with the furnace-gases which impinge against it shall be adjustable throughout its entire area. I accomplish these results by interposing a diaphragm made of wrought or cast iron or any other suitable metal perforated with suitable apertures throughout its entire area, said apertures being provided with means for mechanically opening or closing the same individually.

I have observed in the operation of locomotive-engines under varying conditions of fuel, fire, and load that the diaphragm performs an important function in the operation of the engine and in the producing therefrom the best results both as regards the steaming qualities of the boiler and also the control of the furnace. I have also observed that the best results are obtained under certain circumstances from one form of diaphragm, whereas under another set of conditions another form of diaphragm will be more efficient. In fact, my experience leads me to believe that proper diaphragm conditions are only determinable by experiment, and the result of such experiment depends upon the peculiar characteristics of the particular engine or the particular fuel conditions or load conditions under which the engine is being employed. For this reason it is essential in the operation of such locomotive that the diaphragm should be capable of adjustment throughout its entire area and that this adjustment should be easily under the control of the engineer and should be so flexible in its adjustment as to be capable of a range of resistance or retardation from a minimum to a maximum resistance. Furthermore, I have observed that the resistance required to be interposed by a diaphragm is not necessarily of a uniform location—*i. e.*, I have observed the following phenomena, that whereas in one locomotive the draft will be directed almost entirely to one side of the diaphragm, in another locomotive of exactly the same type it will be directed on the opposite side of the diaphragm, or it may be directed above or below or to the center, as the case may be. It becomes important, therefore, that the diaphragm should be capable of such adjustment as to enable the engineer to meet these conditions—that is to say, where he finds that the draft is altogether on one side of the diaphragm he can interpose a resistance at that point by closing the dampers in the diaphragm at that point and opening them on the other side of the diaphragm, thus causing a greater resistance to the passage of the gases, and thus throwing the heat more uniformly throughout the fire-tubes. These phenomena are observable by reason of the fact that the diaphragms commonly employed in locomotives will burn out, we may say, on one side only, while, again, the same diaphragm may be taken out and put into another locomotive, which may be of exactly the same type, but which has the quality of burning out on the other side, and it will serve the purpose of the second locomotive until it is burned out on the other side. These phenomena are, however, capable of observation prior to the complete deterioration of the metal, for I have observed that where the gases of combustion are directed against a diaphragm for any considerable time in excessive volume a discoloration or stain will be indicated on the diaphragm at that point, and to one skilled in observing such phenomena it will be an easy matter to adjust the diaphragm to meet these conditions by closing the ports in the diaphragm at the point where the flame is directed against them and opening the apertures or ports on the other side of the diaphragm, or above or below, as the case may be.

The fundamental object and purpose that

I have in view is to interpose a resistance to the passage of the gases, which resistance shall vary according to the requirements of the case—that is to say, the greater resistance where there is a greater pressure of furnace-gases and a less resistance where there is a less pressure—the object being to create a back pressure on the gases in the fire-tubes which will cause the gases of combustion to flow uniformly through the fire-tubes and by so doing to create a uniform distribution of heat in the boiler.

I am aware that diaphragms of various forms and structures have been made, some of of which are capable of adjustment vertically or horizontally, as the case may be; but so far as I know all such adjustments have been along the line of contracting or expanding the whole area of the diaphragm—that is to say, making the surface area as a whole larger or smaller, as the case may be—*i. e.*, increasing or diminishing the resistance to the passage of the gases of combustion as a whole; but so far as I am informed no one has attempted to provide an adjustable diaphragm or a diaphragm capable of adjustment to meet the varying conditions incident to the flow of furnace-gases in such a way as to meet the requirements incident to variation of fuel or furnace conditions or the undefinable characteristics of locomotive operation such as I have described—that is to say, the providing of a diaphragm which has the characteristics of being entirely flexible in the matter of the interposition of the resistance or stricture which it interposes to the passage of furnace-gases, and thereby bringing about a back pressure in the fire-tubes where the pressure is excessive, thus causing a uniform distribution of heat throughout the boiler.

The diaphragm which I have here provided is capable of a wide range of adjustment, which, I believe, in the hands of an intelligent operator will meet all of the phenomena incident to gas distribution which is liable to occur in the operation of a locomotive. The adjustments are capable of being made simply and quickly and without taking the locomotive out of commission. These characteristics become especially important when changes in fuel are to be considered, for the change in the character or grade of the fuel notoriously makes necessary extensive regulation of diaphragm. Many engines are now in use under unfavorable conditions, for the reason that their diaphragms were adjusted to conditions of fuel and load other than those under which they are now being employed, and hence the adjustment is nugatory and valueless, and the engine is operating inefficiently as a result.

With these general objects in view my purpose has been to provide a diaphragm which is capable of being fitted into any type of locomotive-boiler and which is provided with the maximum number of openings which could ever be required so as to give relief to the gases whenever necessary and also to provide means for closing any or all of these openings, so as to bring about the conditions of equilibrium above referred to, and thus so far as the diaphragm is capable of contributing to bring about a condition of an equal distribution of the furnace-gases within the fire-tubes it will be capable of adjustment for accomplishing this purpose. The importance of such an adjustable diaphragm can only be appreciated when it is understood that the fire and draft conditions may and do vary according to the character of the coal, the nature of the fire, and the requirements of the engine under conditions of heavy load or tension as opposed to minimum conditions of strain. All of these may bring about a situation which may require the readjustment of the diaphragm formation, and these conditions can only be met in practice by the providing of such an adjustable diaphragm in the hands of one who will intelligently observe the conditions of the operation of the engine.

Referring to the drawings, wherein the same parts designated by the same reference-numeral wherever it occurs, Figure 1 is a side elevation of a locomotive-boiler, the smoke-box and the forward end of the boiler being shown in longitudinal section, and showing one form of my invention in position in the smoke-box. Fig. 2 is a front elevation of a diaphragm provided with a means for independently closing the openings therein. Fig. 3 is a similar view showing a different form of means for closing the openings. Fig. 4 is a detail view of the form of closing means for the openings shown in Fig. 2. Fig. 5 is a detail view of the nut-and-bolt construction by which the openings are closed, as shown in Figs. 1 and 3.

1 designates a locomotive-boiler of ordinary construction. 2 is the smoke-box, 3 the stack, and 4 the exhaust-nozzle. These parts are shown as being of the ordinary well-known construction.

5 designates a diaphragm, which is shown as being formed in one of the ordinary well-known ways—that is, being bent over at its upper edge to form a support by which it is secured to the front of the boiler. The sides of the diaphragm, as is usual, are secured to the sides of the smoke-box. The lower edge of the diaphragm is somewhat distant away from the bottom of the smoke-box, as is usual. This diaphragm may be of wrought or cast iron or of any other suitable material.

I provide the diaphragm with a plurality of openings 6, which are shown as being arranged in rows across the same, and I also provide a means by which these openings may be closed independently of each other. In the form shown in Figs. 1, 3, and 5 this means consists of bolts 7, having nuts 8, the

bolts being adapted to pass through the openings 6 and are held in place by the nut 8 being screwed down to grip the diaphragm between the nut and the head 9 of the bolt.

In Figs. 2 and 4 I have shown the means for independently closing the openings as consisting of a series of dampers 10, from which extend the lugs 11, the lugs being provided with openings 12, through which the pivots for the dampers extend and by which they are pivoted to the diaphragm. These dampers are so located that they can be swung so as to cover one of the openings or swung back, so as to leave the opening clear.

It is evident that other forms of devices may be used to independently close the openings in the dampers, and the forms here shown and described are merely for the purpose of illustration. It is also to be noted that the form or size of the openings is entirely immaterial and any other form or size of opening may be used, if found desirable, and any ratio of openings to total area of diaphragm may also be made use of.

In the operation of my invention the openings are closed and opened and experimented with until the proper combination is obtained. If afterward through a change of conditions in the locomotive it is found that more openings should be closed, or vice versa, this can be readily done by merely opening the front of the smoke-box and making the desired change.

The diaphragm above described and the openings therein provided are contemplated to be used either with or without parallel or juxtaposed diaphragm of netting or expanded metal, as the circumstances of the case determine, the object being to afford clearance of gases, create partial vacuum and rarefaction of gases whenever and wherever necessrasy and in whatever locality in the smoke-box, considered with reference to the diaphragm, such clearance, rarefaction, or vacuum may be found expedient.

While I have described one form of my invention, I desire to have it understood that I am not to be limited in the form herein shown and described, as many changes may be made in the form, materials, construction, and arrangements of parts without departing from the spirit of my invention.

What I claim is—

1. In a locomotive, a diaphragm interposed between the boiler and the exhaust-flue, said diaphragm being provided with openings which are located through substantially the entire area of the diaphragm and means which are independent of each other for permanently opening or closing one or more of said openings, whereby the draft can be caused to pass through the diaphragm at any portion of its area.

2. In a locomotive, a diaphragm interposed between the boiler and the exhaust-flue, said diaphragm being provided with openings which are located through substantially the entire area of the diaphragm, a damper for permanently opening or closing each of the openings, said dampers being independent of each other whereby the draft can be caused to pass through the diaphragm at any portion of its area by the manipulation of the dampers.

3. In a locomotive, a diaphragm interposed between the boiler and the exhaust-flue, said diaphragm being provided with openings which are located through substantially the entire area of the diaphragm and a series of independent dampers one for each opening pivoted to the diaphragm, each damper being adapted to permanently open or close one of the openings whereby the draft can be caused to pass through the diaphragm at any portion of its area.

4. A locomotive-diaphragm provided with openings located through substantially the entire area of the diaphragm and a series of means one for each opening, said means being independent of each other and each of said means adapted to be manually adjustable to permanently open or close an opening.

Signed by me at the city, county, and State of New York this 21st day of April, 1906.

GEORGE LOVELAND PRENTISS.

Witnesses:
EARL N. FINDLEY,
J. F. POTTS.