A. O. DENIO.

Exhaust-Mechanisms for Locomotives.

No. 157,160. Patented Nov. 24, 1874.

FIG. 1.

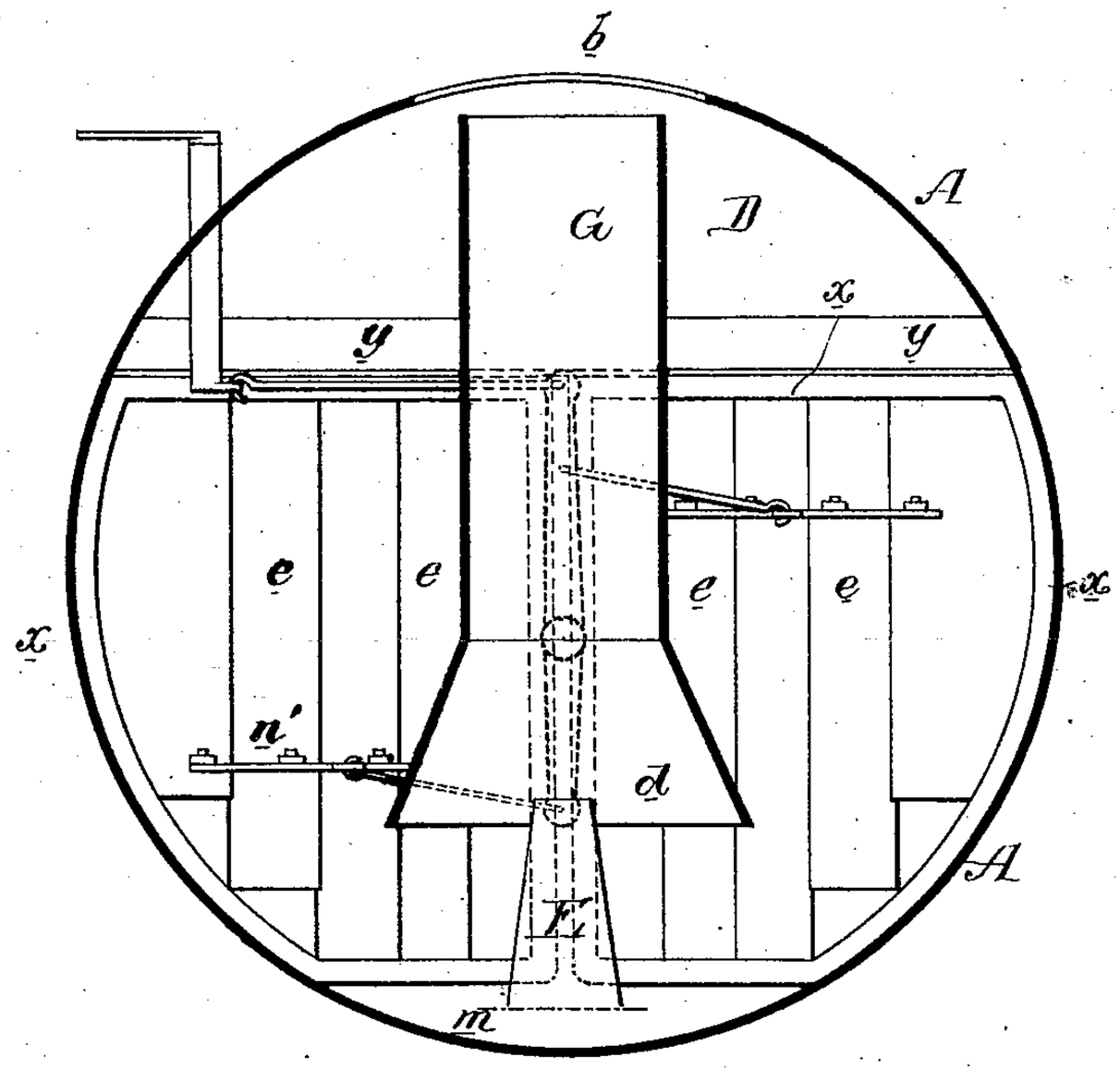
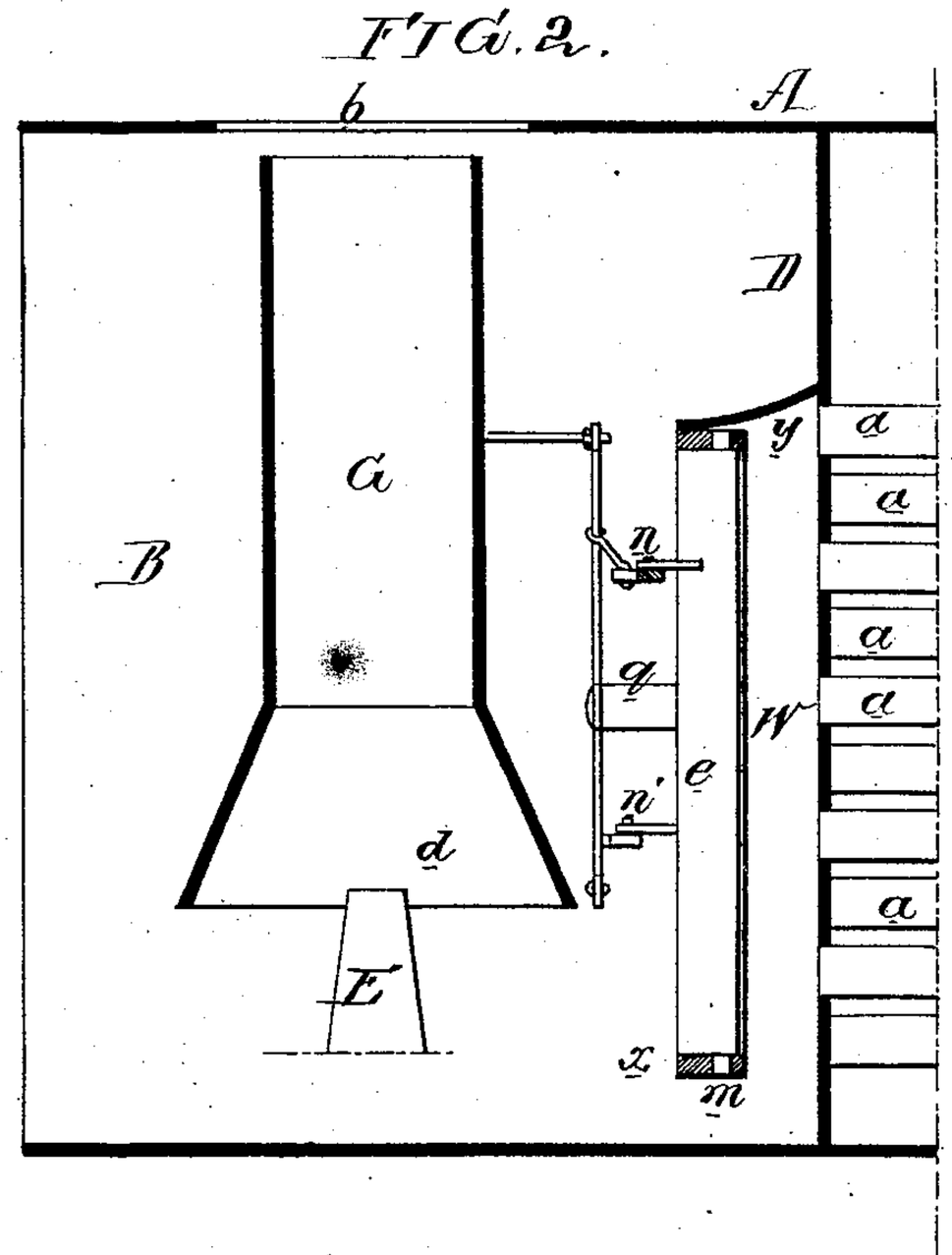


FIG. 2.



Witnesses, Harry Smith
Thomas McElvain

A. O. Denio
by his Attys.
Hudson and Dor

UNITED STATES PATENT OFFICE.

ASA O. DENIO, OF WILMINGTON, DELAWARE, ASSIGNOR TO HIMSELF, EDWARD RUSHTON, AND STILLMAN A. HODGMAN, OF SAME PLACE.

IMPROVEMENT IN EXHAUST MECHANISMS FOR LOCOMOTIVES.

Specification forming part of Letters Patent No. **157,160**, dated November 24, 1874; application filed October 15, 1874.

To all whom it may concern:

Be it known that I, ASA O. DENIO, of Wilmington, New Castle county, Delaware, have invented certain Improvements in Locomotive-Boilers, of which the following is a specification:

My invention relates to a new and improved plan of carrying into successful practical operation modes heretofore proposed, and to some extent practiced, of obstructing, or partially obstructing, the tubes of locomotive-boilers for the purpose of counteracting the detrimental effects of the violent intermittent discharge of exhaust steam, the evil results being, first, a waste of fuel, amounting to nearly fifty-five per cent., caused by the too rapid passage of the products of combustion through the tubes, and by the premature escape of unconsumed fuel in the condition of gases and ignited sparks; second, the disturbing, or, as it is technically termed, the "drawing," of the fire, and interfering with the proper and economical combustion of the fuel; and, third, the injurious cutting effect which particles of fuel in rapid motion have on the fire-box and tubes.

In order to thoroughly explain my improvements it will be necessary to refer to prior intions of this class, an early example of which is that devised by Mr. Gooch, of the Great Western Railroad, England, who applied a damper directly to the tube-sheet in the smoke-box of a locomotive-boiler, the damper opening and closing in sympathy with the pulsations of exhaust steam, and being also under the control of the engineer. (See D. K. Clarke's locomotive-engine, 1852.) Subsequently experiments were made with permanent hoods secured within the smoke-box and arranged at a short distance from the tube-sheet, the patent granted to H. N. Winans, November 8, 1864.

Neither of these devices appear to have been successful, as there is no record of their continued use.

It will be unnecessary to refer to instances of the use of permanent hoods, or to automatic obstructions, which open and close in obedience to the pulsations of exhaust steam, for a series of experiments made on the Philadelphia, Wilmington and Baltimore Railroad have determined the fact that obstructions for neutralizing the action of the exhaust steam or the fuel must, to be of any practical avail, be under the control of the engineer.

An obstructing frame or plate with adjustable vanes controllable by the engineer has been placed in the smoke-box at a short distance from the tube-sheet, with the view of dispensing with the petticoat or draft pipe, which is an indispensable element of the combination of parts comprised in my invention, the above-mentioned tests having proved satisfactorily that without the draft-pipe the controllable obstructions can be of very little avail.

In my present application this draft-pipe plays its proper part, as illustrated in the accompanying drawing, in which—

Figure 1 is a transverse section of the smoke-box end of a locomotive-boiler with my improvements, and Fig. 2 a longitudinal section of Fig. 1.

A represents part of the shell of the boiler; B, the smoke-box; D, the tube-sheet; *a*, the tubes, and *b* the opening in the shell for the chimney. E is the exhaust-nozzle, and G the draft-pipe, having a flaring lower end, *d*, and arranged concentrically with the said chimney and exhaust-nozzle. A series of vanes, *e*, are situated between the draft-pipe G and the tube-sheet D, each vane being hinged at its upper and lower ends to a frame, *x*, fitted to the inside of the smoke-box. The lower portion of the frame is at a distance from the shell of the said smoke-box, so as to leave a segmental opening, *m*, which, viewed in connection with the draft-pipe, performs an important duty, explained hereafter. The chamber W, between the vanes and the tube-sheet, is closed at the top by a plate, *y*, which may, however, have small perforations. One-half of the vanes are connected together by a transverse bar, *n*, and the other half by a transverse bar, *n'*, and these bars are connected to a lever, *q*, which, by the aid of

other appliances, can be operated by the engineer, who can thus open and close the vanes at pleasure.

It is not essential that these vanes should be vertical. They may, for instance, be arranged horizontally, or some may be vertical and others horizontal. In fact, it is not necessary to adhere to vanes as adjustable obstructors of the draft; but whatever devices may be used for this purpose, it is imperative that the obstruction should take place at a distance from the tube-sheet, and that the amount of obstruction, and the time for operating the same, should be at the judgment and control of the engineer.

In carrying out my invention the aim has been to fulfill the following requirements:

First. The effects of the violent intermittent pulsation of exhaust steam should be counteracted. Two evils are attributable to this cause, namely, the disintegrating, or, as it is technically termed, the "drawing," of the ignited fuel, and the forcing of disintegrated portions through the tubes and out through the chimney, and the too rapid motion through the tubes of the products of combustion, which, consequently, do not perform their full duty, but pass at a high temperature through the tubes and out the chimney. The mode of counteracting these evils has been in a measure accomplished by the devices referred to above; but these devices were objectionable, and have fallen into disuse, owing, mainly, to the discarding of the second requirement.

Second. This is the controlling of the obstructions by the engineer—an essential requirement—for on starting the engine, or on ascending an inclined plane, where the discharges of the exhaust are very violent, or on descending an inclined plane, different adjustments are required, and the engineer should have the power of manipulating the said obstructions as circumstances may demand. Experience has demonstrated the fact that the greater the obstruction consistent with the requirements of the power of the engine, the more will be the economy of the fuel; hence the importance of enabling an expert engineer to exercise economy in the consumption of fuel by the adjustment of the obstructions.

Third. It is essential to the success of my invention that there should be a space or chamber, *m*, between the tube-sheet and the obstruction—a feature not exhibited in some of the above-described apparatus, in which the obstructions closed against the tube-sheet, and consequently maintained the sparks within the tubes, thereby entirely choking them and detracting from the efficiency of the engine. It must be borne in mind that a choked tube cannot be remedied except by artificial cleansing. By arranging the obstructions at a distance from the tube-sheet, and by closing or nearly closing the top of the chamber thus formed, the sparks are not only free to escape from the tubes, but are directed downward to a point whence they can be removed by the fourth requirement.

Fourth. This is the ready disposal of the sparks which accumulate at the bottom of the chamber and induce the choking of the lower tubes, and this requirement is fulfilled by so arranging an open space, *m*, at the under side of the vanes in respect to the flaring lower end of the draft-pipe G that the exhaust steam tends to force the sparks through the said draft-pipe and out through the chimney. The sparks being thus carried off as fast as they fall down to the bottom of the chamber *w*, the lower tubes must always be clear, which is rarely the case in locomotives.

It will thus be seen that the four requirements stated above are requisite to fully carry my invention into successful practical effect.

A permanent obstructing-shield, situated at a distance from the tube-sheet, with an opening below, may be used, providing the shield is perforated and the opening is provided with a damper under the control of the engineer; but as this device forms the subject of a separate application for a patent, further allusion to it here will be unnecessary.

I claim as my invention—

The combination, in a locomotive smoke-box, of adjustable obstructing devices, controllable by the engineer, arranged to form a chamber, *w*, in front of the tube-sheet, and extending above the tubes, an opening or openings, *m*, below the obstructing devices, and the draft-pipe, by which, in conjunction with the exhaust steam, the sparks are carried from said chamber, all substantially as set forth.

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

ASA. O. DENIO.

Witnesses:

HUBERT HOWSON,

HARRY SMITH.