(No Model.) 2 Sheets—Sheet 1.

D. GROESBECK.

SPARK ARRESTER FOR LOCOMOTIVES.

No. 270,423. Patented Jan. 9, 1883.

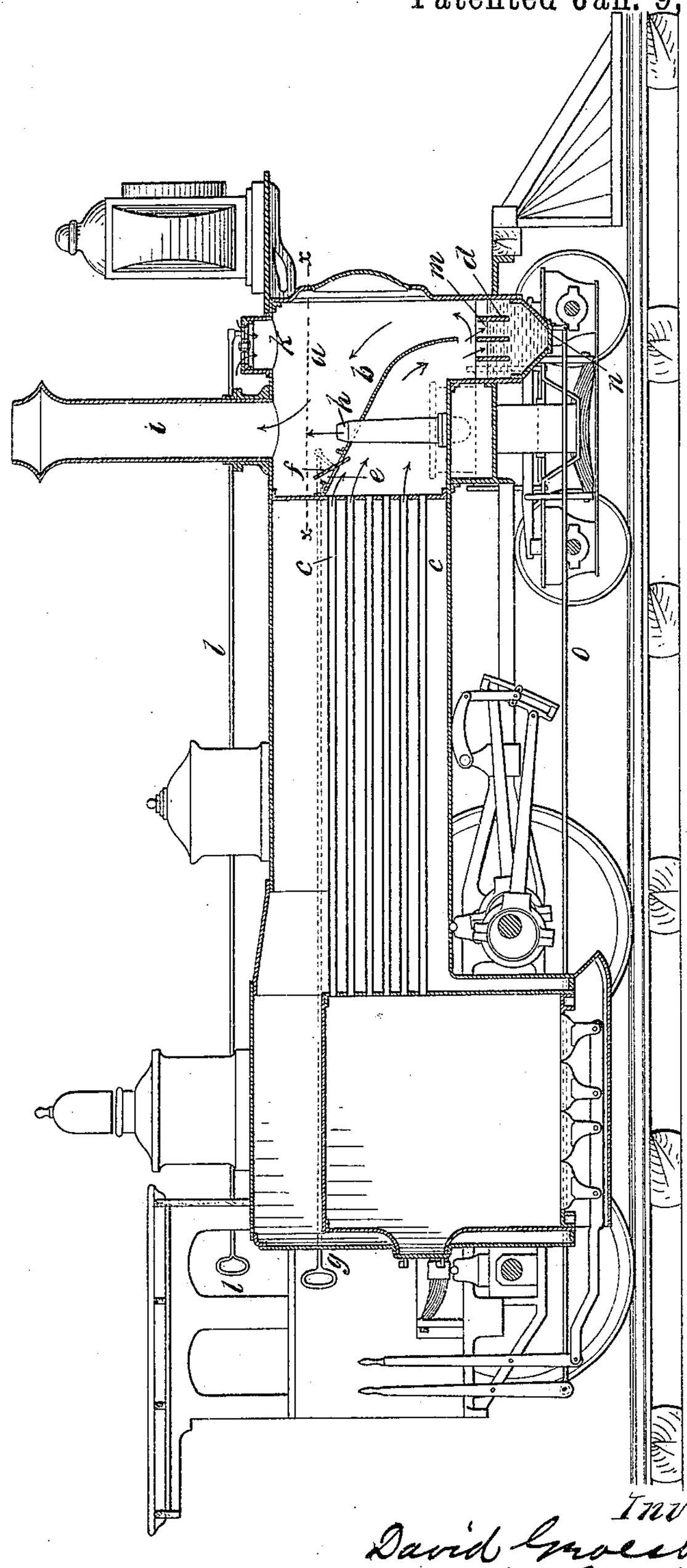

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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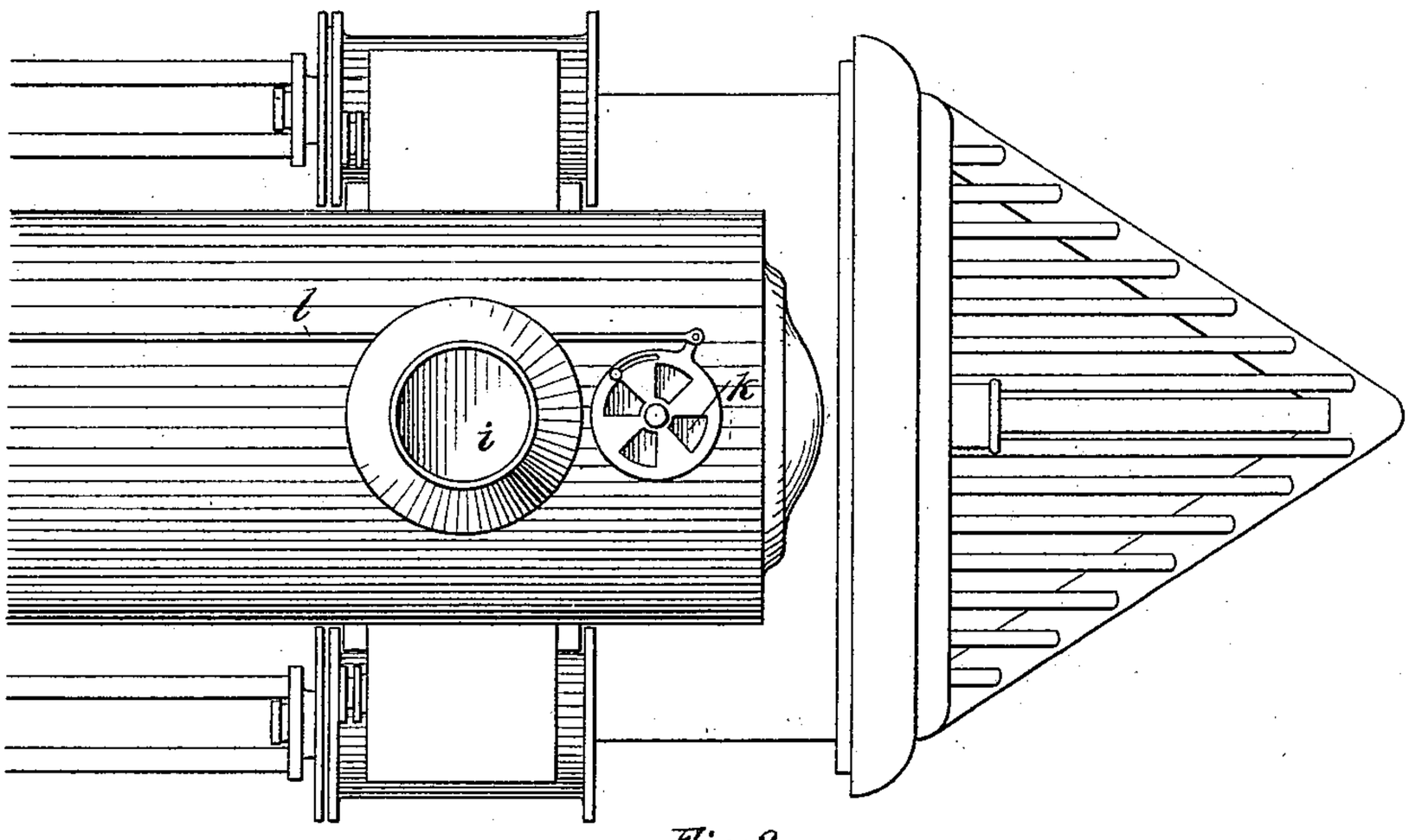

Fig: 2

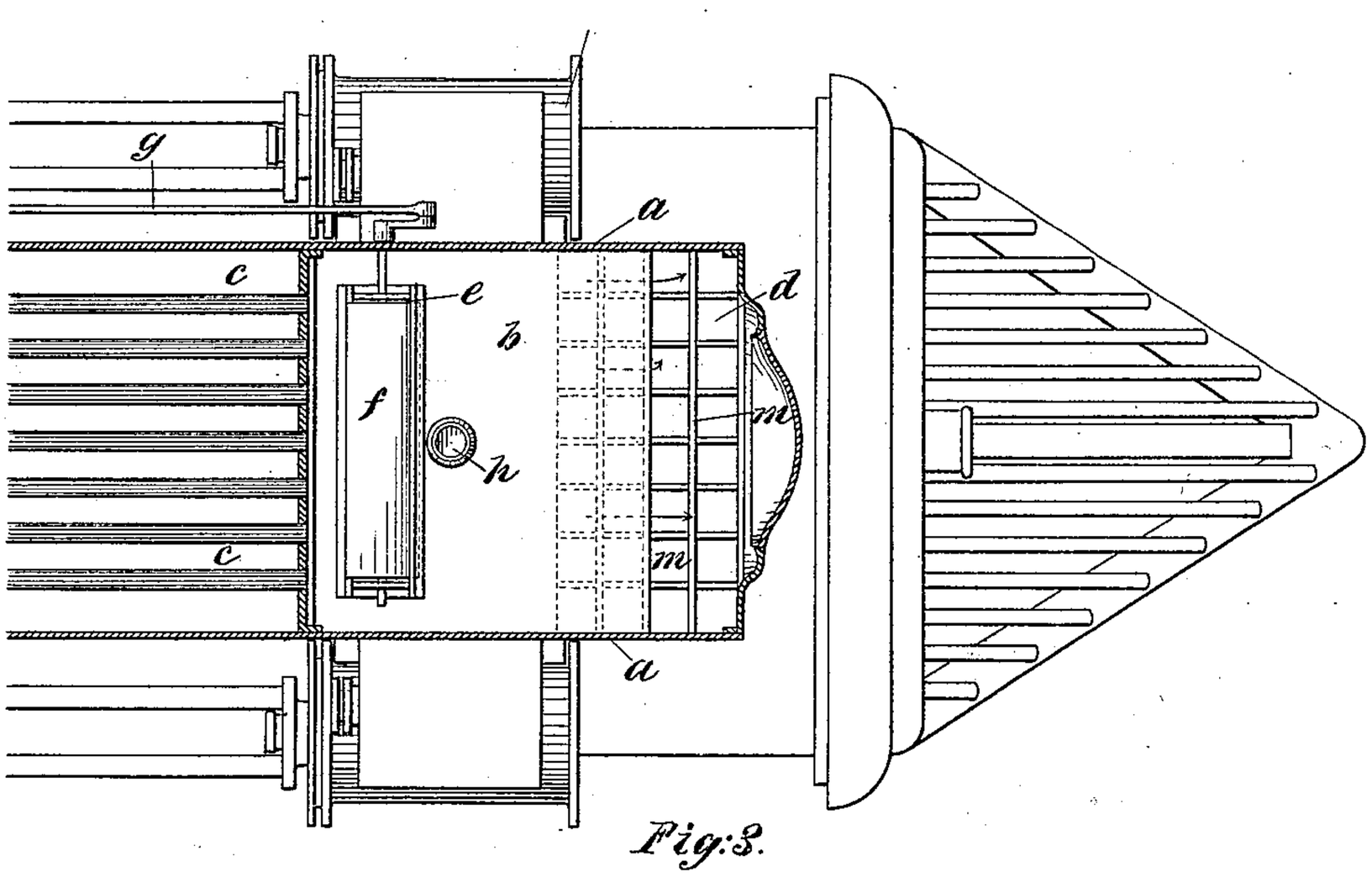

Fig: 3.

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UNITED STATES PATENT OFFICE.

DAVID GROESBECK, OF NEW YORK, N. Y., ASSIGNOR TO THE GROESBECK & WRIGHT SPARK ARRESTER COMPANY, OF SAME PLACE.

SPARK-ARRESTER FOR LOCOMOTIVES.

SPECIFICATION forming part of Letters Patent No. 270,423, dated January 9, 1883.

Application filed October 5, 1881. (No model.)

To all whom it may concern:

Be it known that I, DAVID GROESBECK, of New York city, county and State of New York, have invented certain new and useful Improvements in Spark-Arresters for Locomotives, of which the following is a specification.

My improvement relates more especially to locomotives and similar engines of that class provided with means for deflecting the sparks into a receptacle arranged below the smoke-stack; and it consists in the peculiar construction and arrangement of parts, as hereinafter more fully described, and then pointed out in the claims.

Figure 1 in the annexed drawings presents a longitudinal section of an ordinary type of locomotive provided with my improvements. Fig. 2 is a fragmentary plan of the front end, and Fig. 3 a sectional plan on line *x x* of Fig. 1.

The engine is presumed to be of the ordinary construction throughout, except at the front end or in the smoke-arch, where my improvements are embodied, as will be hereinafter described.

On reference to the drawings, more particularly Fig. 1, it will be noted that I construct the smoke-arch *a* with an inclined partition or hood, *b*, arranged about diagonally therein and extending completely across the chamber, as seen in Figs. 2 and 3, its upper end or edge being joined with the tube-sheet just above the upper line of tubes, *c*, while its lower end curves downwardly near the front or lower corner of the smoke-chamber and extends into a depressed trough or water-tank, *d*, which depends from the front end of the smoke-chamber down between the cylinders and truck-wheels, as shown in Fig. 1, and contains a charge of water up to about the level indicated. The partition *b* does not dip into the water of the tank, but terminates above the water-level, as shown in Fig. 1, at such a distance as to leave a free space between the two equal to the combined area of the flues. It will hence be observed that this partition compels the draft or gases from the flues to take an indirect passage toward the stack—that is, diagonally downward from under the partition—thence down toward or into the water-tank, and thence up and out through the stack, as indicated by the arrows. Consequently any sparks or live coals or cinders discharging with the draft from the flues will be effectually arrested by this partition, and thence deflected forcibly down into the water of the tank, thus extinguishing and retaining the same and preventing their discharge from the stack, thereby accomplishing a most important result heretofore much sought for.

By the peculiar form of division-plate employed there is a free passage for the gases out of the tubes, and the diagonal position of the upper part of the plate gradually turns the draft and sparks downward until near the bottom, when the sparks are deflected downward into the water by the nearly-vertical part of the plate, whereas with the division-plate vertical the draft would not be so gradually deflected, and there would be a greater hinderance to the passage of the gases from the flues.

In order to allow a direct draft from the flues to the stack when the fire is first started, the partition *b* is formed with an opening, *e*, at its upper end, near where it joins the tube-sheet, in which opening is pivoted a nicely-fitting damper, *f*, from the cranked axis of which a suitable operating-bar, *g*, extends to the cab, so that it may be opened when the fire is first started and closed when it is under sufficient head way, or when the exhaust is discharging. It will be noted that the damper is so arranged that when fully shut it has an inclination similar to the partition *b*, or downward and forward, so that even when opened or partially opened it will always present such an angle to the draft as will tend to deflect the sparks downward in the same manner as the partition *b*.

Now, *h* indicates the exhaust-nozzle, which rises from the steam-chests of the cylinders through the base of the smoke-arch in the usual way, and extends up through the partition *b*, terminating just above the same, as seen best in Fig. 1, and at a point under the center of the stack *i*. Hence, when the exhaust-jets are thus discharged above the partition *b* and into the stack, the air is forcibly ejected from the stack and from the upper half of the smoke-arch on the well-known inducting action of steam-jets, thus producing a suction or partial vacuum therein, which is supplied by the air and gases which are drawn from the furnace through

the flues, and thence from under the partition *b*, and finally discharged from the stack, thereby producing a strong draft on the fire in the well-known manner, as before described. Now, according to the main feature of my invention, in order to prevent all of this induced draft from being drawn through the furnace and flues, as heretofore, and in order to enable the draft on the fire to be regulated as may be required, I provide the smoke-box with an independent air-inlet at some convenient point, preferably in the top and near the front, as shown best at *k* in Fig. 1, through which more or less air may be admitted when desired, thus partly or wholly supplying the suction created by the exhaust-jets, and thereby enabling the draft on the fire to be reduced or increased, and the fire kept steadily at a high or low state of activity for any length of time, according to the amount of steam required, without the objectionable necessity of opening the furnace-door, and thereby wasting fuel and subjecting the boiler to injurious and fitful changes, as heretofore. The air-inlet is preferably formed on the top of a low dome rising from the smoke-box, as illustrated in Figs. 1 and 2, which top is preferably perforated with a radial series of segmental openings, similar to an ordinary register, as best seen in Fig. 2, and is covered by a similarly-perforated register-plate, which is pivoted at the center to the perforated top of the inlet-dome, and connected by a tangential operating-rod, *l*, with the cab, so that by moving this rod back or forth the register may be opened more or less to admit more or less air to supply the suction of the exhaust, and thus correspondingly reduce the draft through the furnace. It may therefore be understood that when the fire is low, or when the engine is ascending a grade, where the greatest fire and steam power is required, the inlet *k* may be entirely closed, thus bringing all the draft to bear upon the fire, and thereby raising it to its highest activity. When, however, less fire and steaming-power is required, the inlet is partly or entirely opened, which will soon reduce the fire to the desired point without opening the furnace-door or subjecting the walls of the furnace and the tubes to any sudden change of temperature, or wasting the heat of the furnace. When the fire is thus brought to the desired state—suitable, say, for regular running on ordinary grades—it may be kept uniformly in this condition for a length of time by closing the inlets to the proper extent, as will be understood, for by this regulation of the draft the gases will rise from the fire in sufficient volume, and will be retained sufficiently long in the fire-box and flues, and will meet with the right proportion of air to produce perfect combustion before the gases reach the stack, thus producing practically a gas-burning furnace, which has been a desideratum heretofore much sought for in locomotive-engines. Hence it is readily apparent that by this simple means the fire may be kept steady at any rate of activity desired, and that efficient combustion at any rate may be obtained, while it is equally obvious that by the former system the regulation was merely fitful, and great waste of unconsumed gases produced. Furthermore, the fire may be nearly as quickly reduced when required as would be the case by opening the furnace-door, but without the serious objections which apply to that action. Thus when the furnace-door is opened, where all the draft is drawn through the furnace, as heretofore, it will be observed that the highly-heated fire-box and flues are suddenly subjected to a comparatively cold stream of air, which subjects the metal of the boiler to sudden changes of temperature, which is very injurious thereto, tending to impair its strength and to start leaks; besides, all the gases, which are now rising rapidly from the fire, are heavily diluted by and carried off with the onrushing stream of air, as well as the smaller unconsumed coals from the top of the fire, thus wasting a large quantity of fuel, and tending to increase the discharge of sparks. In contradistinction from this, by my improvement the fire when reduced is reduced, as it were, by gradually turning down the heat instead of suddenly turning on the cold, by reducing the draft or flow of air and the generation of gas in the furnace, instead of increasing the flow of air and carrying off the gases in an unconsumed and diluted state. Hence the fire-box and flues and other metal parts of the boiler are kept in a more equable condition, and are not subjected to the injurious strains, as heretofore, and the fire is regulated in an even economical manner. Furthermore, by this same action the foul-smelling gases which are now discharged in great volume from the stacks of locomotives, to the great annoyance of passengers, are prevented almost entirely, for the reason that by the simple improvement described the generation of gas in the furnace and the amount of air admitted are regulated as circumstances require, and these gases are retained sufficiently long in the furnace and flues to burn perfectly before they reach the stack, and hence issue therefrom in an almost odorless condition, instead of foul-smelling and unconsumed, as heretofore, which in itself forms a most valuable improvement in the working of locomotive-engines. Another advantage which this air-inlet has, and especially when in the location shown in the drawings, is that should it be found that under certain circumstances and with peculiar fuel the draft may be so strong that some of the lighter sparks are drawn up over the water instead of being driven into it, the engineer, by opening said inlet, may so lessen the draft that none of the sparks will be drawn over the water, but will all be driven into the reservoir, and thus the air-inlet and its regulator becomes an essential part of the spark-arresting apparatus.

The air-inlet might be arranged on the front of the smoke-arch, so as to open in the direction in which the engine advances; but this would not be so desirable, for the rapid move-

ment of the engine through the air would of itself tend to forcibly induct the air to the smoke-arch, which would in some cases tend to produce a back-draft in the furnace, which would be particularly objectionable at the time of opening the furnace-door for the purpose of firing.

I divide up the water-tank *d* into a number of small cells by cross-partitions *m m*, as shown in Figs. 1 and 2, which device effectively prevents the swashing of the water and its escape out of the tank into the smoke-box, yet offers no obstruction to the draft, and, if anything, tends to better catch and retain the sparks. These partitions *m m* have their lower edges under water, and yet out of contact with the bottom of the tank, by which arrangement the sparks striking the said partitions are deflected, and, by force of gravity, will be discharged from a single opening at the bottom of the tank. The water in the tank *d* is of course kept at a uniform level, or nearly so, by the action of a float-valve governing the supply from the water-tank of the tender or other source in the well-known manner, which needs no further description here. The base of the tank *d* is also provided with a tight-fitting valve, which may be opened by operating a rod, *o*, from the cab, thus discharging the water and accumulated cinders or coals when necessary, which valve may be again tightly closed, as will be understood, when the tank will again quickly fill with water to the desired level by the action of its float-valve.

Instead of admitting the air directly to the smoke-arch, it might be admitted in the funnel, provided the exhaust-jet were discharged directly in the funnel; but in practice the air should always be admitted as near as possible to the initial point at which the exhaust-jet is emitted.

It may be also noted that by the construction shown the water-tank depends from the base of the smoke-arch at the front end and hangs down between the cylinders and truck-wheels of the engine, so that the tank does not obstruct the smoke-box or reduce its internal capacity at all, and its position is quite convenient and admits of using a tank of large capacity without occupying valuable space or interfering with any of the other parts of the engine, which is quite an important practical point.

It will be also seen that the water-level in the tank is placed well below the base of the smoke-box and below the discharging end of the deflector. This not only prevents the water from being easily splashed up into the smoke-arch, but it allows the discharging end of the deflector to make a considerable downward turn over the surface of the water, which causes the sparks to be projected straight down into the water, and thereby arrested and extinguished with certainty. At the same time the draft is hardly obstructed at all, owing to the large free space between the mouth of the deflector and the surface of the water and between the deflector and the front end of the smoke-box, so that the area of the draft-passage is nowhere less than the combined area of the flues, and this passage is entirely free or open without any screens whatever. By the same means there is little or no chance of carrying out any sparks with the draft over the surface of the water, for the reason that the sparks are deflected straight down in the water with the full velocity of the draft, while the draft, as soon as it strikes the water, suddenly decreases in speed relatively to the sparks, owing to the large free space between the deflector and the water into which it spreads, and has thus little or no tendency to carry out sparks, even though small. I therefore find that the spark-extinguishing function of this construction is very effective without interfering with the draft and steaming power of the engine, which, if anything, is appreciably increased by reason of the removal of the usual obstructing-screens from the smoke-arch and funnel.

It may be also remarked that by the construction shown the exhaust-jet is discharged entirely above the deflecting-partition *b* and at a point remote from where the sparks and cinders are arrested and accumulated, and hence there is no liability of cinders being drawn into the steam-chests through the exhaust-nozzles, as occurs in present engines, with great injury to the valve-surfaces.

I make no claim here for the air-inlet, as a separate application for this feature will be hereafter filed.

What I claim is—

1. The combination, with a smoke-box, of an inclined downwardly-turned spark conductor or deflector projecting out from the flue-sheet, including the flues, in combination with a water-box depending from the base of the smoke-box below the discharging end of said deflector, with a free or open space between the deflector and the water-level, and between the deflector and the front of the smoke-arch, equal to the area of the flues, or thereabout, substantially as and for the purpose set forth.

2. In a locomotive-boiler, the combination, with a smoke-box extended forwardly beyond the stack, of a water-tank arranged in the base and front end of the smoke-box, and a spark-deflector extending out from the tube-sheet over the flues and discharging downwardly into said tank over the middle thereof, or nearly so, and remote from the stack, with an exhaust or steam jet discharging above the said deflector directly under the stack and remote from the discharging end of the deflector, substantially as and for the purpose set forth.

3. The combination, with the smoke-box of a locomotive-engine provided with a downwardly-turned spark-deflector, of a water-tank affixed to its front end below said deflector and depending from the base of the smoke-arch down between the cylinders and truck-wheels of the engine, substantially as herein set forth.

4. The combination, with the smoke-box of

a locomotive-boiler, of a water-tank affixed to the front end thereof and depending from the base of the same, with its water-level arranged below the base of the smoke-arch, in combination with a spark-deflecting partition in said smoke-box extending forward and downwardly from the tube-sheet and discharging above the water-level in said tank, substantially as herein shown and described.

5. The combination of an inclined deflecting or spark-arresting partition arranged diagonally in the box and terminating at right angles, or nearly so, to the water in a tank below it, and forming an indirect passage for the draft through the same, with a steam or exhaust jet or nozzle rising through said partition and discharging above the same into the stack, substantially as herein shown and described.

6. The combination, with a smoke-arch, of a spark collecting and extinguishing tank provided with a series of partitions having their lower edges out of contact with the bottom of the tank, whereby the sparks will readily be discharged, by gravity, from a single opening, substantially as described.

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