(No Model.)

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D. GROESBECK, C. A. BALL & J. A. STERLING.

SPARK ARRESTER.

No. 324,683. Patented Aug. 18, 1885.

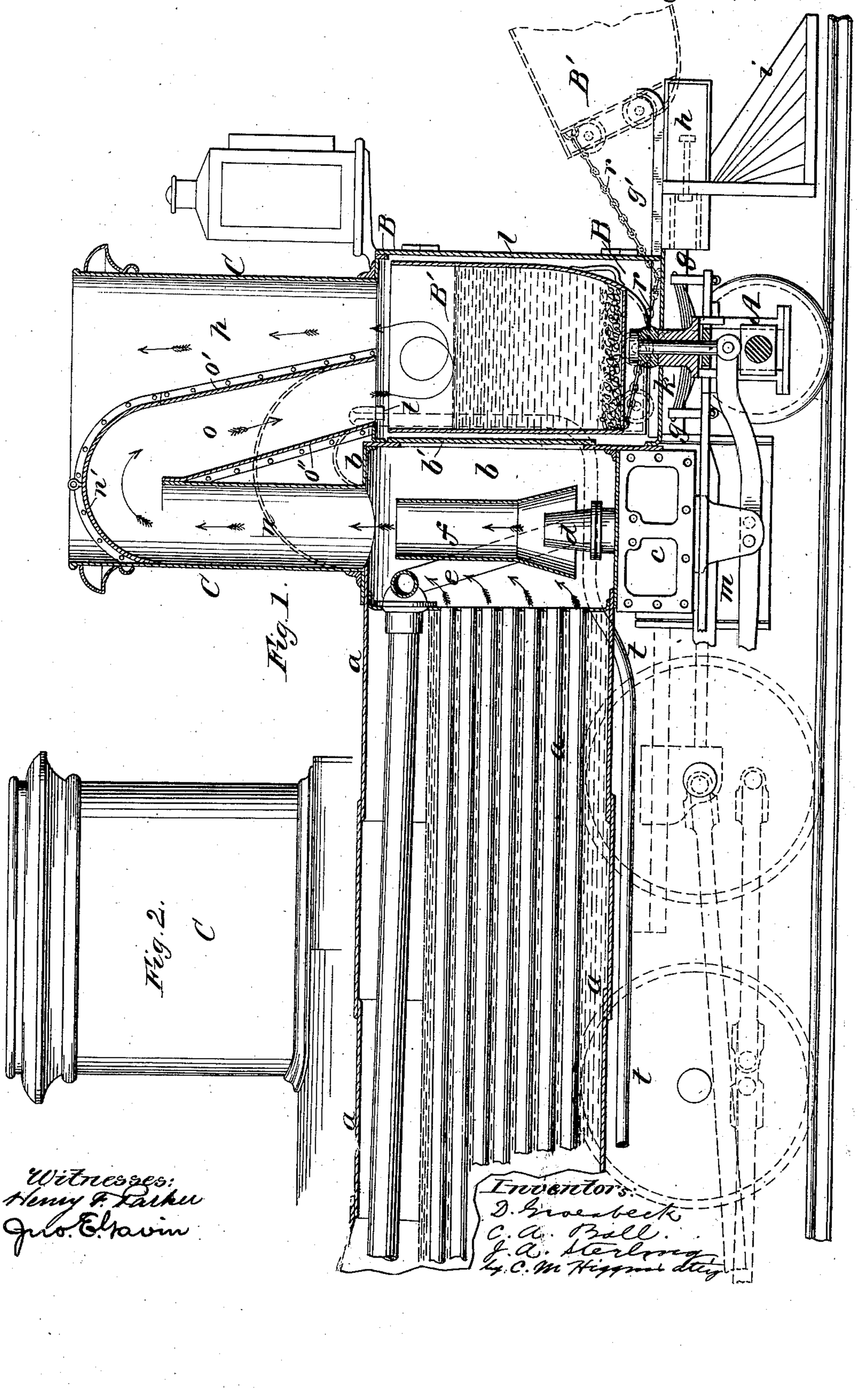

Fig. 1.

Fig. 2.

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(No Model.) 5 Sheets—Sheet 2.

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SPARK ARRESTER.

No. 324,683. Patented Aug. 18, 1885.

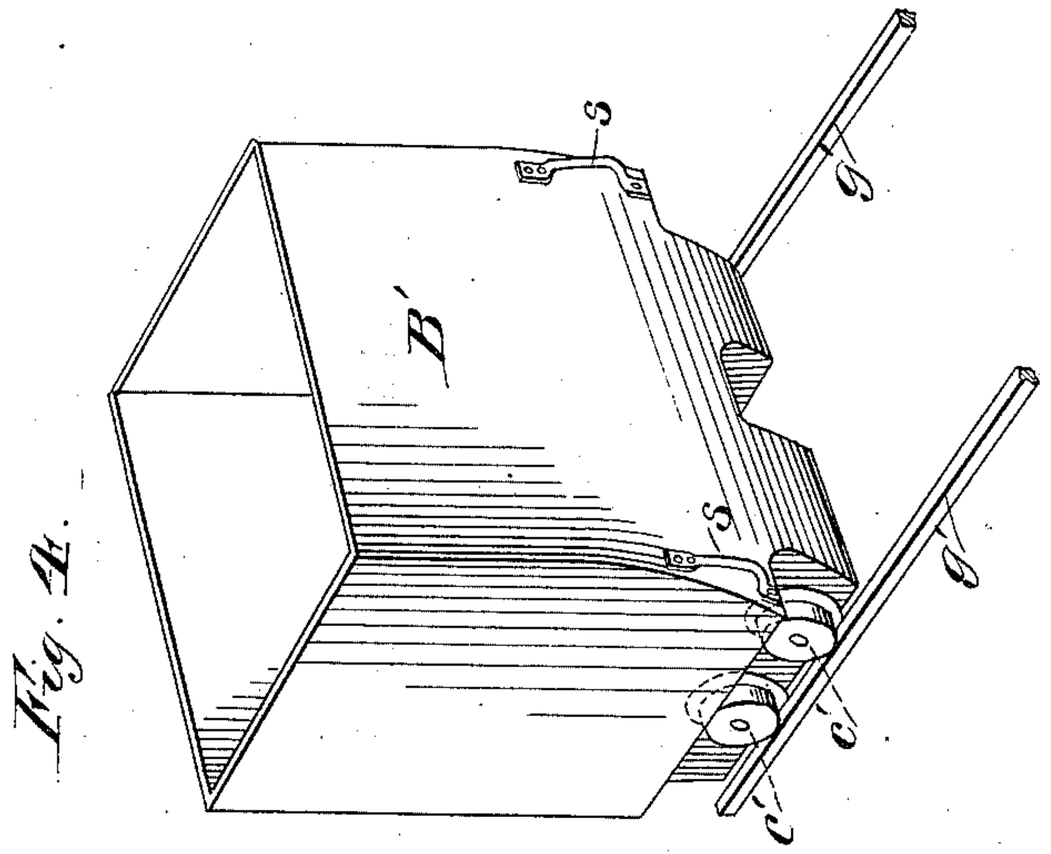

Fig. 4.

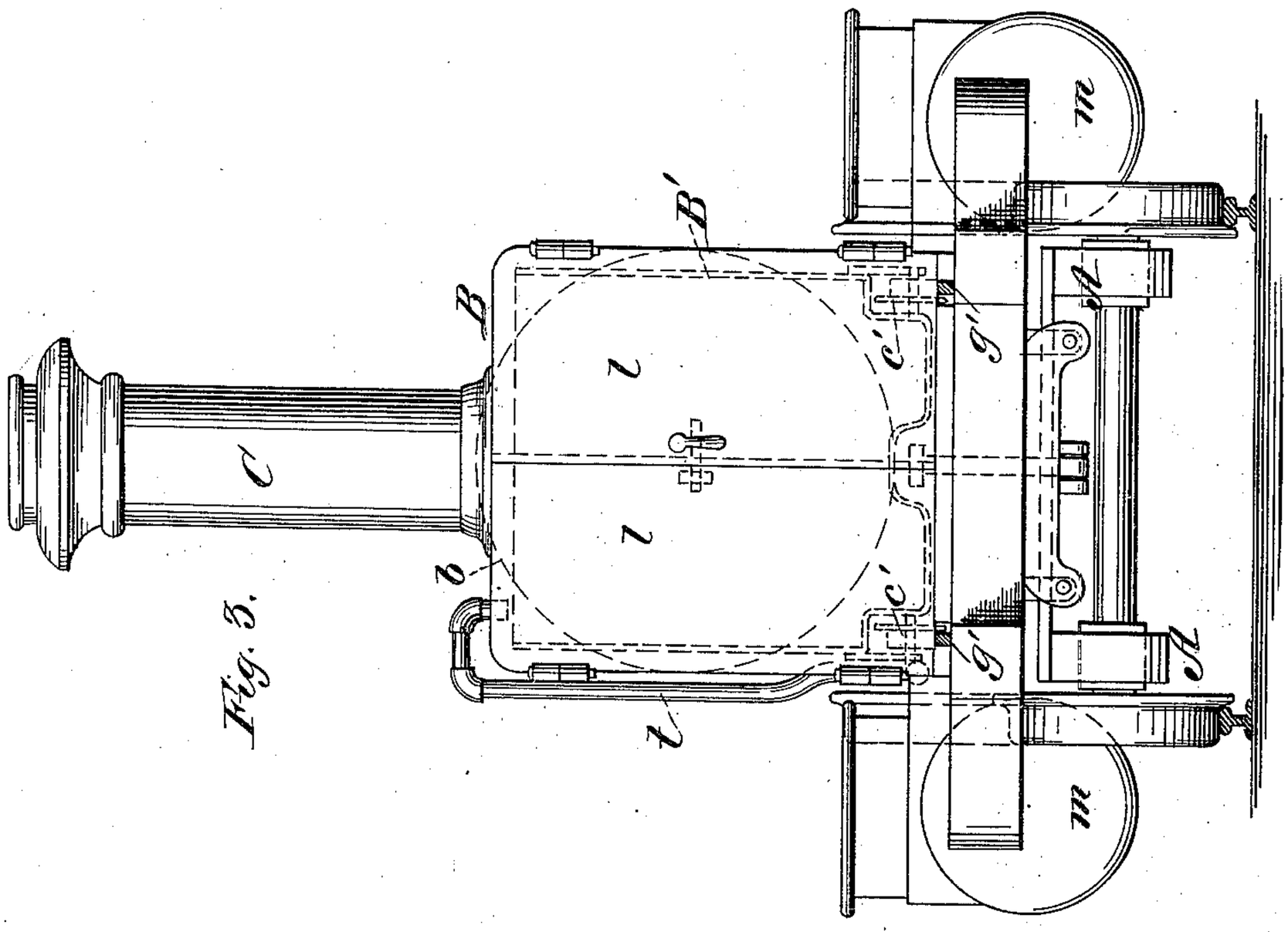

Fig. 5.

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SPARK ARRESTER.

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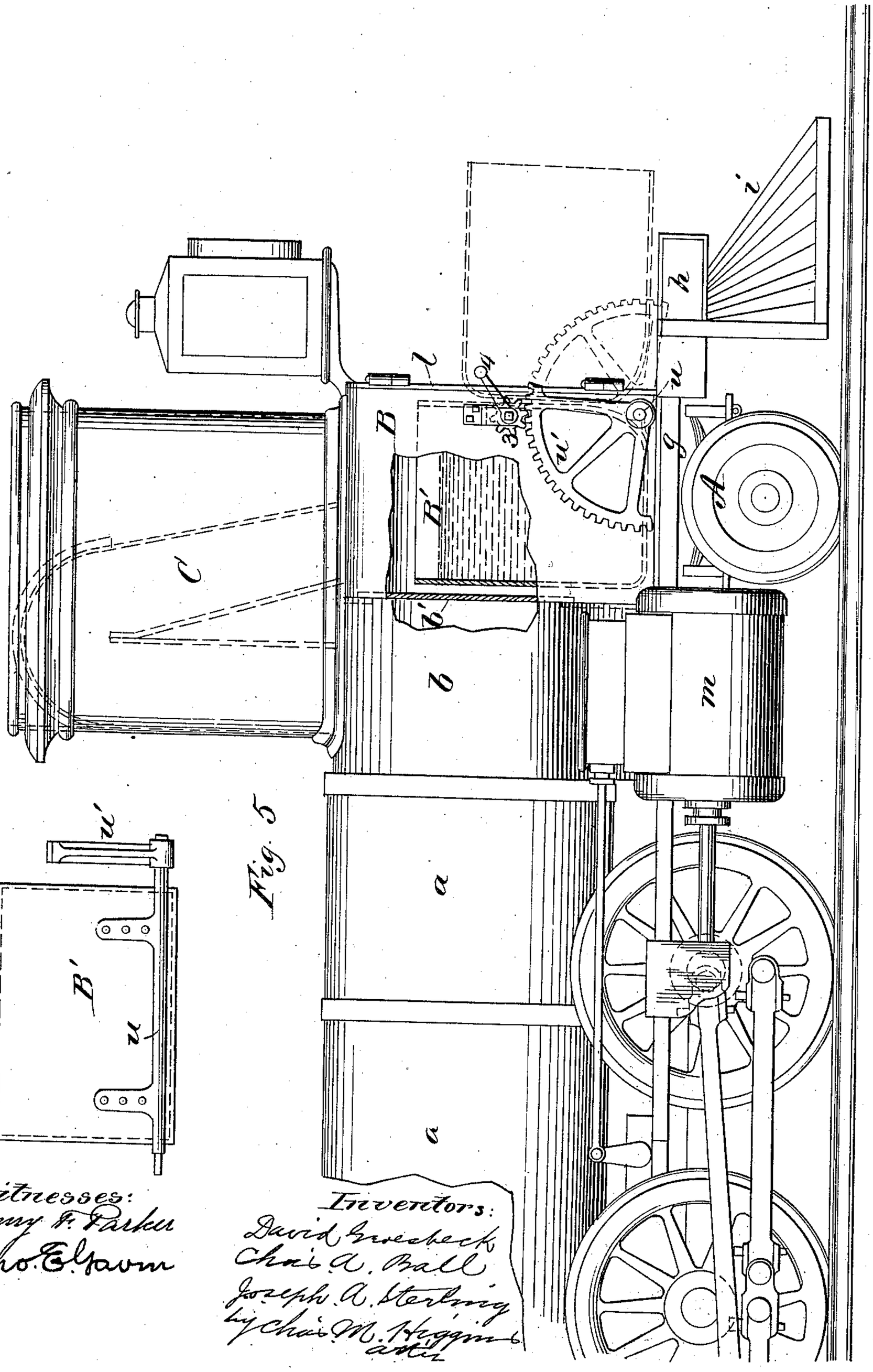

Fig. 5

Fig. 6.

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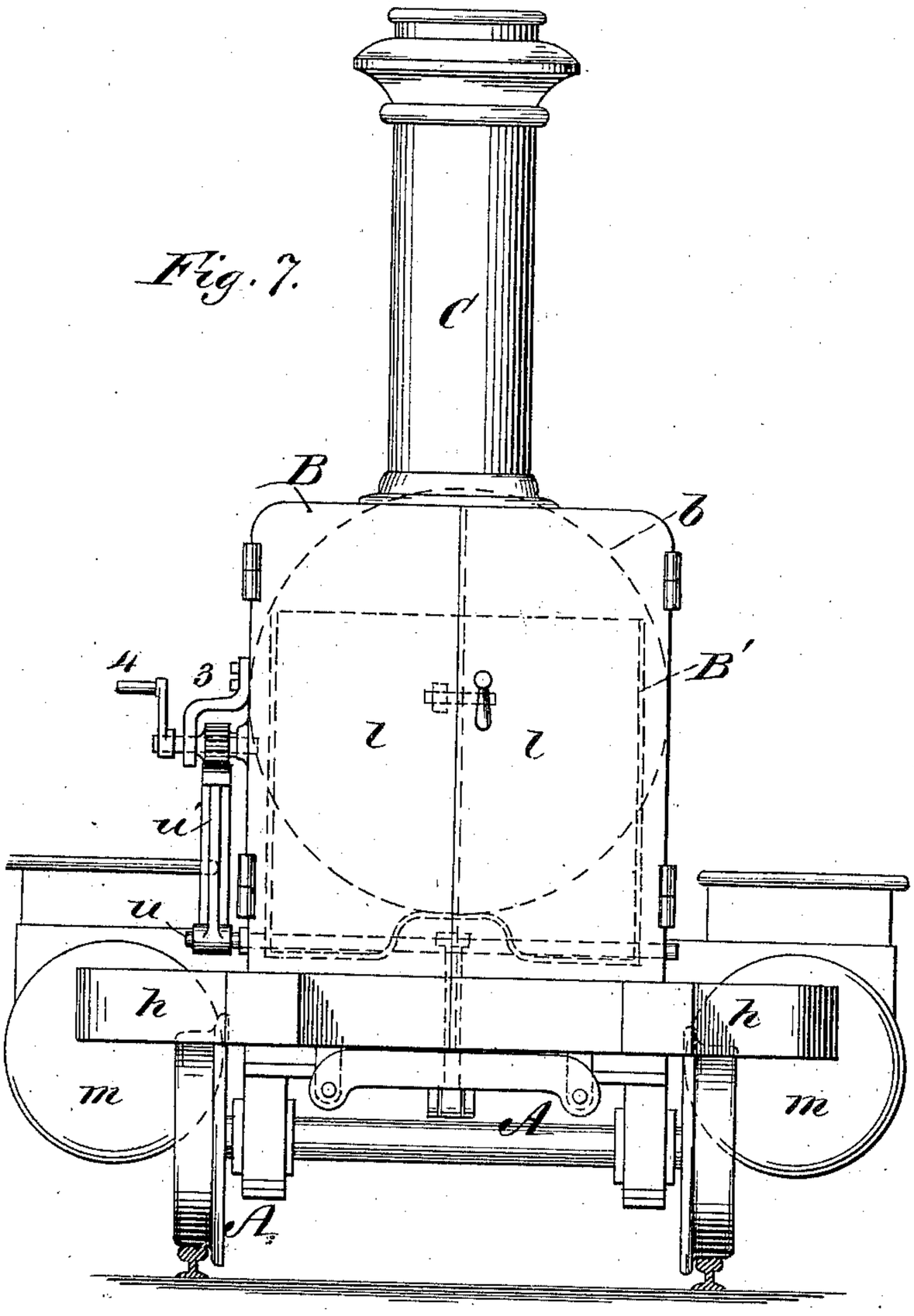
SPARK ARRESTER.

No. 324,683. Patented Aug. 18, 1885.

Fig. 7.



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5 Sheets—Sheet 5.

D. GROESBECK, C. A. BALL & J. A. STERLING.

SPARK ARRESTER.

No. 324,683. Patented Aug. 18, 1885.

Fig. 8.

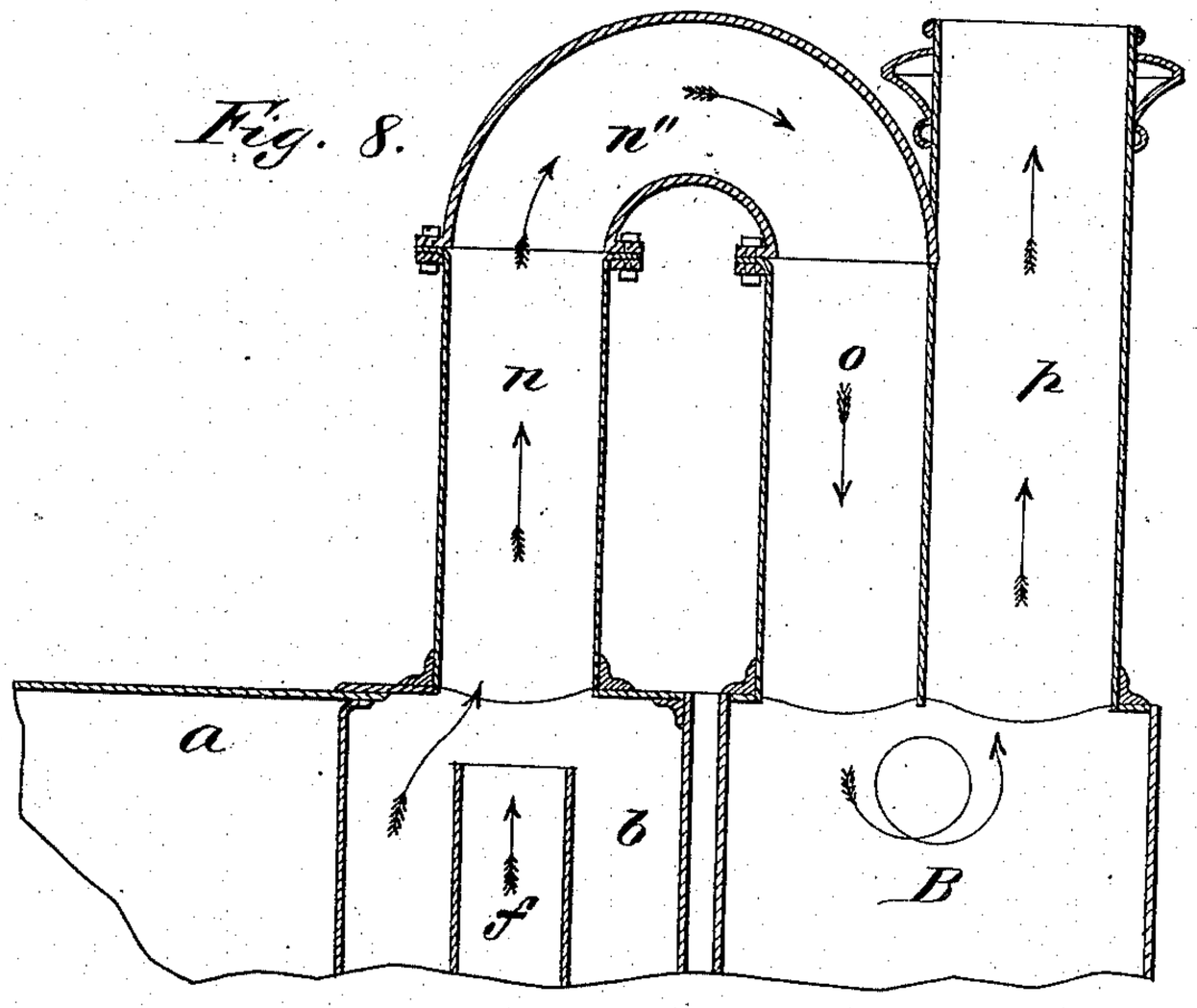
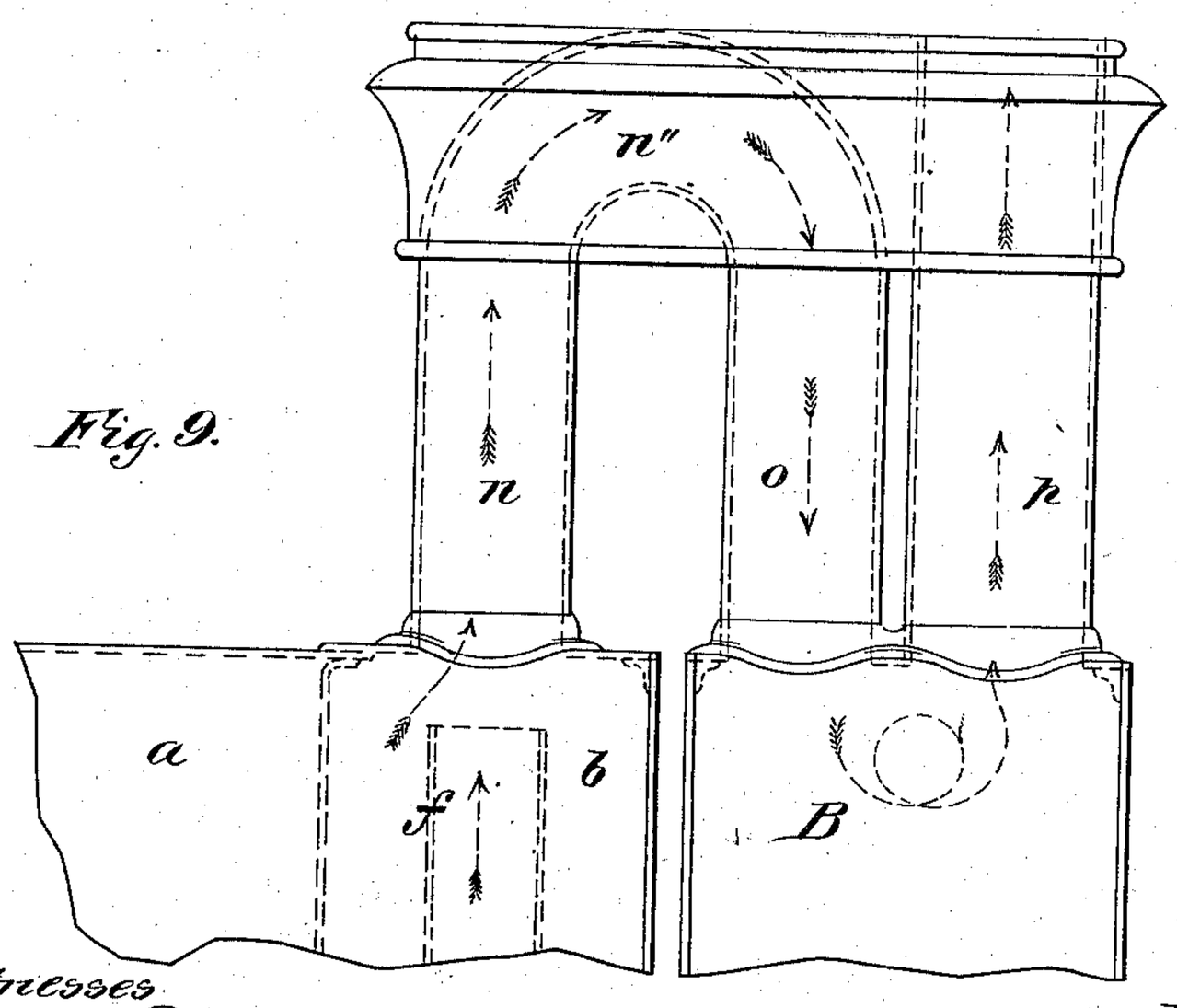


Fig. 9.



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UNITED STATES PATENT OFFICE.

DAVID GROESBECK, CHARLES A. BALL, AND JOSEPH A. STERLING, OF NEW YORK, N. Y.

SPARK-ARRESTER.

SPECIFICATION forming part of Letters Patent No. 324,683, dated August 18, 1885.

Application filed August 23, 1883. (No model.)

To all whom it may concern:

Be it known that we, DAVID GROESBECK, CHARLES A. BALL, and JOSEPH A. STERLING, all of New York city, have jointly invented certain new and useful Improvements in Spark-Arresters, of which the following is a specification.

Our invention relates to that class of spark-arresters more particularly adapted for locomotives which employ a tank of water beneath the stack into which the draft from the flues is deflected so as to catch and extinguish the sparks, and which tank is provided with means for dumping its contents and recharging the same with water as occasion requires. Spark-arresters of this class are shown in the patent to Groesbeck, No. 270,423, of January 9, 1883, and the patent to Groesbeck, Sterling, Ball, and Wright, No. 270,424, of January 9, 1883, and our present invention is a further improvement and a variation on the spark-arresters therein shown.

The particular structure of our former apparatus was more especially adapted for hard-coal-burning engines and for locomotives of the "standard" type having a four-wheeled truck under the front end of the boiler. In this form of engine opportunity was afforded to extend the extinguishing-tank down from the base of the smoke-arch between the cylinders and truck-wheels of the engine, with a dumping-door at its base, whereby the contents of the extinguishing-tank might be dumped at frequent intervals directly on the track during the trip. The particular structure of our present apparatus is, however, designed more especially for soft-coal-burning engines and for very large locomotives of the "consolidated" type, in which a swinging two-wheeled truck is swiveled under the extreme front of the engine in advance of the smoke-arch. In these engines it is not practical to have the extinguishing-tank extended down below the frame on account of the position of the said truck, and hence, according to our present invention, we arrange the extinguishing-chamber and water-tank above the frame over the truck, and we raise the water-level therein high above the base of the smoke-arch, and thus provide an extinguishing-chamber of very large capacity, which obviates the necessity of dumping during a trip, and is capable of receiving all the sparks during a long run, and requires dumping only at the end of the trip, which becomes a most desirable and important improvement for the class of engines described. This arrangement also necessitates a material modification of the stack relatively to the smoke-arch and extinguishing-chamber, the stack in this case being compound or triple, and consisting of a primary ascending flue which rises, as usual, from the top of the smoke-arch over the exhaust-nozzles, but bends at the top into an intermediate descending flue, which discharges down into the water in the extinguishing-tank, in which the sparks are forcibly projected and extinguished, while the clear draft passes over the surface of the water and rises freely through a terminal or secondary ascending flue, which discharges in the air.

In our former apparatuses the smoke-arch was extended or enlarged so that the smoke-arch proper and extinguishing-chamber were involved in one, with a downwardly-inclined spark-deflector extending out from the flue-sheet and arching down over the water in the extinguishing-tank, forming an indirect passage for the draft to the stack, whereas in our present apparatus a close wall of separation rises between the smoke-arch proper and the extinguishing-chamber, which extinguishing-chamber forms a secondary smoke-arch, from which the secondary ascending stack arises, while the inclined deflector within the smoke-arch proper is entirely dispensed with and the deflector arranged within the stack itself in the form of the intermediate descending flue before referred to.

The main features of our present invention therefore lie in the points above outlined, and a further important feature consists in making the water-tank in the form of a movable box and the extinguishing-chamber in the form of a fixed inclosing-casing with doors, the water-tank being movable into and out of the extinguishing-chamber, whereby the tank is easily dumped at the end of a trip.

Our invention also embodies several details connected with the aforesaid main features, as hereinafter fully set forth.

In the drawings annexed, Figure 1 presents a longitudinal sectional elevation of a consolidated locomotive provided with our improved spark-arresting apparatus. Fig. 2 is a side elevation of the stack thereof. Fig. 3 is a front end elevation of the locomotive, and Fig. 4 is a perspective view of the movable extinguishing-tank detached. Fig. 5 is a side elevation, partly in section, of a locomotive, similar to Fig. 1, with a modified arrangement of movable dumping-tank. Fig. 6 is an inverted plan view of said movable dumping-tank. Fig. 7 is a front end elevation of the locomotive shown in Fig. 5. Figs. 8 and 9 are elevations showing different modifications of the compound stack.

Referring to Figs. 1, 3, 5, and 7, *a a* indicate the boiler of a consolidated locomotive-engine, the front end of which, forming the smoke-arch *b*, rests upon the saddles *c*, from each end of which the cylinders *m m* depend, as in the usual constructions.

e indicates the branches of the steam-pipe, which extend down within each side of the smoke-arch to each cylinder, and *d* indicates the exhaust-nozzle rising from the center of the base of the smoke-arch and discharging under the petticoat-pipe *f*, which is fixed within the smoke-arch directly beneath the stack in the ordinary manner, as shown.

Now, *g* indicates the frame of the engine, which extends out far beyond the smoke-arch and cylinders, as shown, the bumper-beam *h* and pilot *i* being of course affixed on the front extremity of the frame, as usual, while under the frame, between the smoke-arch and pilot, is arranged the two-wheeled truck A which supports the front end of the engine. This truck is of the usual construction and arrangement employed in engines of the class described, as well understood by locomotive engineers; and is sufficiently illustrated in the drawings, and therefore needs no special description here. It will be readily noted, however, that the position of the truck in front of the smoke-arch prevents the possibility of using a water-tank below the frame of the engine at this point, and prevents the use of any dumping device extending down below the smoke-arch, as in our former patents. According to our present invention, therefore, we erect above the frame of the engine over the truck A, and in front of the smoke-arch, a close compartment or extinguishing-chamber, B, which is made of boiler-iron similar to the smoke-arch, and is of about the same width and height as the smoke-arch, but having its top preferably flat and its upper corners square, while the smoke-arch is round, as shown in Figs. 3 and 7. The frame of the engine is floored over with a plate, *k*, of boiler-iron, as seen in Fig. 1, to form a floor or bottom to the extinguishing-chamber, in which, however, there is an opening to allow the swivel-head of the truck A to project up and move therein as may be required. The front of the smoke-arch, with its usual removable door, *b'*, forms the back wall of the extinguishing-chamber, and this wall forms, as will be understood, a tight partition between the smoke-arch proper and the extinguishing-chamber, while the latter forms a secondary smoke-arch. The front wall of the extinguishing-chamber is preferably made movable in the form of two hinged or swinging doors, *l l*, which may be opened wide to give access to the extinguishing-chamber to remove its contents or to give access to the smoke-arch through the usual door or head, *b'*, as will be understood, and may be again closed and locked tight by an ordinary latch or fastening. (Shown in Figs. 3 and 7.) Now, the water-box or extinguishing-tank is indicated at B', which tank, instead of being fixed within the extinguishing-chamber, as heretofore, is preferably made in the form of a separate movable tank or car capable of being moved into or out of the chamber, as occasion requires, for dumping, &c.

The water-tank, as shown in Figs. 1, 3, and 4, is preferably made in the form of a wheeled-hopper car, constructed of boiler-iron, so as to be strong and water-tight, with its bottom recessed at the sides to make room for the attachment of the wheels or rollers *c' c'*, and recessed at the middle to allow the swivel of the truck to work underneath the same when the tank is in place in the extinguishing-chamber, as shown in Figs. 1 and 3. This wheeled tank rests on rails *g' g'*, which extend along the frame of the engine from the smoke-arch out-over the bumper-beam, where the ends of the rails are curved or bent up, forming stops which will prevent the tank from rolling off the same, and which will determine and assist the dumping movement of the tank, as indicated in Fig. 1, and hereinafter more fully described.

It will be seen from Figs. 1, 3, and 4 that the movable water-tank is of about the same dimensions as the extinguishing-chamber, but sufficiently smaller to readily pass in and out of the same, as shown, and it is therefore of large capacity—say, three feet deep, four wide, and four high—and is adapted to be nearly filled with water when in action, with its normal level high above the floor of the smoke-arch, as shown in Figs. 1 and 7, containing about two hundred and fifty gallons. This amount of water is therefore sufficient to extinguish all the sparks produced during one long trip, and the capacity of the tank is sufficient to receive the accumulations of one trip, so that it becomes necessary to dump the tank only at the end of the trip.

The stack C is considerably modified from what has been heretofore employed, as will be observed from Figs. 1, 2, and 5. This stack is of about the usual height and transverse width; but in longitudinal side view it is greatly elongated, of flat oblong form, with rounded ends, and extends from the usual position of the stack on the center of the smoke-arch to the front end of the extinguishing-chamber, as fully illustrated in the drawings.

This elongated stack is divided by internal partitions, as shown, into a compound zigzag flue or passage of three members. The first member, *n*, corresponding to the usual stack, rises straight up from the smoke-arch over the petticoat-pipe *f*, as usual, but curves at the top into an intermediate descending flue, *o*, which preferably inclines forward slightly, and which discharges into the top of the extinguishing-chamber at the middle thereof, and directly over and into the water-tank when placed thereunder, as seen in Figs. 1 and 7. The third flue, *p*, is a final ascending or discharge flue, which rises from the top of the extinguishing-chamber just in front of the descending flue and opens freely in the air at the top of the stack.

The transverse area of the primary flue *n* is the same as that of the ordinary stack, and the transverse area of the descending flue *o* at the narrow part is equal thereto, while the area of the discharge-flue *p* at the lower end is preferably greater than the former—say of twice the area—and the distance between the top of the extinguishing-chamber and the water-level in the extinguishing-tank is about equal to the diameter of the primary flue—say fifteen inches. This distance remains uniform or nearly so during action, for we find in practice that the evaporation of the water from the effects of the sparks and hot draft about equals the displacement caused by the accumulation of extinguished sparks, so that no automatic devices are necessary to maintain a regular level, and a regular level is not in fact necessary, as the level may vary a few inches up or down from that indicated without any derangement in the action of the apparatus, thus presenting the important advantages of simplicity and efficiency.

The general construction being now made plain, the action will be readily understood by referring to Fig. 1—that is, the tank being properly charged with water and placed within the extinguishing-chamber and the doors closed and locked, as indicated, the engine may now be started, when the draft and sparks will be drawn from the smoke-arch under the impulse of the steam-jets through the exhaust-nozzle and petticoat-pipe, and will thence ascend in a powerful volume in the primary flue *n* of the stack, which ascending current will be gradually turned into the descending flue, *o*, down through which the draft and sparks will be forcibly directed into the water-tank. The sparks will be projected directly into the water, where they will be immediately extinguished, and thence sink to and accumulate in the bottom of the tank, while the clear draft will pass over the surface of the water, and thence rise finally in the ascending flue *p* and discharge in the air. By this means it will be noted that the sparks will be most effectually arrested and extinguished, yet no screens or obstructions are employed in smoke arch or stack, and hence the draft is in no way obstructed, but is actually improved, and the combustion in the furnace and the steaming power of the boiler is therefore actually assisted.

It will be noted that as the descending flue *o* extends nearly straight down for a considerable length the sparks during the passage through it receive a forcible downward momentum, which causes them to be projected with certainty into the water, and thus prevents any tendencies to take a lateral course under the influence of any slight lateral currents in the extinguishing-chamber, so that there is hence little or no liability of any sparks passing out over the surface of the water into the discharge-flue *p*. This liability of lateral currents affecting the sparks is further reduced by the fact that any lateral currents in the extinguishing-chamber will always be at a much lower speed than the speed of the sparks when projected downward from the descending flue *o*, for, as the space within the extinguishing-chamber above the water-level is of much greater area than the area of the descending flue, and as the area of the discharge-flue *p* is also much greater than the descending flue *o*, it follows that the draft, as soon as it enters the extinguishing-chamber, spreads out into this space and becomes suddenly and greatly reduced in its speed relatively to the speed of the sparks, so that while the draft necessarily takes a turn over the surface of the water and ascends the discharging-flue *p* it always does so at a greatly-reduced speed compared with the downward velocity of the sparks, and hence with little or no tendency to carry out live sparks, dust, or ashes with it, so that the action of this apparatus becomes particularly clean, simple, and satisfactory in arresting sparks and other solid matter, and at the same time maintaining a clear, unobstructed draft.

After a long run—say of one hundred miles—or at the end of the trip, when the tank is found to be overcharged with accumulated sparks, the engine is brought to a standstill at a suitable dumping-place, and the tank may then be easily dumped. This is done by opening the doors *l l* and rolling out the tank on its rails *g' g'*, which is easily done by one man seizing the handles *s s* on the front and base of the tank-car, and thus pulling it out to the end of the rails over the bumper-beam. It will now be noted that the lower and front corner of the tank is recessed or rounded off, and that the wheels are disposed under the back portion of the tank only, leaving the retreating front corner overhanging, so that the center of gravity is thus brought toward the front of the tank at or nearly over the front pair of wheels. Consequently, when the tank is rolled out on the rails so that the front wheels strike the curved upturned ends of the rails, the axle of these wheels forms a pivot on which the tank may be easily revolved or turned out over the pilot by applying a little force in that direction, as indicated by dotted lines in Fig. 1, thus upsetting the tank and

thereby dumping its contents into a suitable pit or other receptacle in advance of the engine. A short length of chain, *r*, fixed at one end in the floor of the extinguishing-chamber, and at the other end to the back corner of the tank-car, forms a safety-connection to limit the dumping movement of the car and prevent its being entirely overturned, as will be understood. After the tank is thus dumped it is again raised into position on the rails, and is rolled back into the extinguishing-chamber and is there charged with fresh water through the feed pipe *t*, which extends from the water-tanks in the tender along the side of the locomotive to the top of the extinguishing-chamber, down through which it discharges in a position over the mouth of the tank, as fully shown in Figs. 1 and 3, and after the tank is thus filled to the desired level the doors *l l* may be closed and the spark-arresting apparatus will be again ready for another long run, as will be understood.

The water may be forced through the feed-pipe *t* by a steam-jet or other motive device, as will be understood; but if desired this feed-pipe *t* may be entirely dispensed with and the tank filled before it is rolled into the extinguishing-chamber from the hose of the usual watering-station at the side of the track.

Referring to the stack in Fig. 1, the curved hood or partition *n'*, forming the arched top of the primary and intermediate flues, is preferably formed of chilled cast-iron in a semi-cylindrical shell, having flanges at each end whereby it is bolted to the stack-casing, whereby this hood is well adapted to resist the rain of incandescent sparks which will be thrown against it. The inclined partitions *o' o''* of the intermediate flue may also be formed of chilled cast-iron similarly attached to the stack-casing, as indicated; but this is hardly necessary, as wrought-iron will serve for said parts.

Instead of having the flues *n o* extending high up to the top of the stack, they may make a short turn into the extinguishing-chamber, as indicated in dotted lines in Fig. 1; but we find that the extension of the primary flue *n* straight up to the top of the stack, and thence curving it gradually into the descending flue *o*, enables the exhaust-jets and petticoat-pipe to act with greater eductive effect and imparts a much more positive impulse to the draft through the several flues of the stack and gives a better momentum and a straighter direction to the sparks, which renders the said construction much more desirable, as conducing to a better draft and a more certain arrest of the sparks. We also find that the natural draft in this stack is not impaired, but is actually increased. Instead, however, of making the stack, as shown in Figs. 1 and 5, with one oblong inclosure divided by internal partitions, the stack may be made in either of the forms shown in Figs. 8 and 9—that is, of three distinct cylindrical pipes, *n o p*, the primary and intermediate pipes being joined at the top by a semicircular wrought or cast pipe, *n''*, as illustrated. In Fig. 8 the curved connecting-pipe is left exposed, and the top of the final discharge-pipe surmounted by a molding or capital to finish the same, while in Fig. 9 the tops of the three pipes are inclosed in an encircling oblong molding or capital to impart an appearance of finished termination thereto. We consider, however, the stack shown in Figs. 1, 3, 5, and 7 as the best, in being more simple and efficient in construction and neat and symmetrical in appearance.

In lieu of having the water-tank in the form of a wheeled car, as before described, it may be constructed and arranged as shown in Figs. 5 and 6. In this case the tank is fixed at its lower and front corner to a strong rock-shaft, *u*, which is journaled at each end in the front and lower corner of the extinguishing-chamber, and on one end of this shaft is fixed a toothed sector, *u'*, which meshes with a pinion, 3, journaled in a bracket on the side of the extinguishing-chamber and provided with a hand-crank, 4. Hence by this construction it will be seen that the tank is pivoted or hinged in the extinguishing-chamber, and it may therefore be readily dumped, when the doors of the extinguishing-chamber are opened, by turning the crank 4, and thereby turning the tank on its pivot, and thus upsetting or dumping the same over the bumper-beam, as indicated by dotted lines.

Any other arrangement of movable tank may, however, be used besides those shown; but we prefer the wheeled tank shown in Figs. 1, 3, and 4, as we consider this simpler and more easily managed by hand. We do not, however, limit ourselves to having the water-tank movable and separate from the extinguishing-chamber, for one great advantage and distinguishing feature of our present invention lies in having a water-tank in front of and at the base of the smoke-arch proper, above the frame or truck of the engine, with its water-level high above the base of the smoke-arch, in connection with the zigzag deflecting-flues, as before described, as this presents a spark-arresting chamber of great capacity adapted for a long run without needing dumpings or renewals during the run, and forms an exceedingly simple, effective, and inexpensive spark-arresting apparatus admirably adapted for consolidated locomotives and for soft-coal-burning engines.

These improvements are not, of course, confined to locomotives, but may be applied to agricultural, portable, or other engines, with suitable adaptations when required.

What we herein claim as our invention is as follows:

1. In a locomotive-engine, the combination, with an extinguishing-chamber arranged in front of the smoke-box and extending from or near the base to or near the top thereof, with a charge of water in said chamber extending from or near the base of the smoke-box high above the same, and a free air-space in the top of said chamber above said water, of a flue

discharging from the smoke-box downwardly into said air-space and above the level of said water, and a secondary flue rising from said extinguishing-box above the water-level and discharging outwardly therefrom, substantially as herein set forth.

2. The combination, in a locomotive-engine of the consolidated type, of an extinguishing-chamber supported on the frame of the engine above the truck and in front of the smoke-box, with a charge of water in said chamber rising high above the base of the smoke-box to or near the top thereof, a free space in the top of said chamber above said charge of water, a primary flue discharging downwardly into said free space above said water, and a free discharging flue or outlet into the atmosphere from said space beyond said downward flue, substantially as herein shown and described.

3. In a locomotive or equivalent engine, an extinguishing-chamber arranged in front of the smoke-box, with a flue or stack discharging therein from the smoke-box, and a removable extinguishing-tank inclosed therein beneath said flue and capable of being moved into and out of said chamber, substantially as and for the purpose set forth.

4. In a locomotive-engine, a water-tank supported on the frame of the engine in front of the smoke-box and separated therefrom with a charge of water in said tank extending from or near the base of the smoke-box high above the same, with a free air-space in the top of said tank above the water level, in combination with the primary flue *n*, ascending from the smoke-box, the intermediate descending flue, *o*, discharging downwardly into the free space in the water-tank above the water-level, and the ascending flue *p*, rising from the said free space above the water into the air, substantially as herein shown and described.

5. In a locomotive-engine, the following combination and organization of elements: the smoke-arch *b* and extinguishing-chamber A in front of the same, a charge of water in said extinguishing-chamber above the base of the smoke-arch, a free air-space in the top of said chamber above the water-level, the primary flue *n*, ascending from the smoke-arch, exhaust-jet *d*, directed into said flue *n*, downward flue *o*, continuing from flue *n* and discharging into the air-space in the extinguishing chamber above the water therein, and the final discharging-flue *p*, rising from said extinguishing-chamber above the water-level, substantially as herein shown and described.

6. In a locomotive-engine, the combination, with the smoke-arch and the extinguishing-chamber in front of the same, of the compound stack consisting of an oblong inclosing casing superposed upon and connecting both the smoke-arch and the extinguishing-chamber, and provided with internal partitions forming a zigzig flue, *n o p*, the flue *n o*, rising from the smoke-arch and discharging into the extinguishing-chamber, while the flue *p* rises from the extinguishing-chamber, substantially as set forth.

7. In a spark-arresting apparatus, substantially as described, the combination, with the extinguishing-chamber, of the movable water-tank, movable into and out of the same, movable doors on the walls of said chamber to inclose said tank or allow the removal thereof, and means to remove and dump the said tank, substantially as herein set forth.

8. In a spark-arresting apparatus, substantially such as described, the combination, with the extinguishing-chamber B and supporting-rails *g' g'*, of the wheeled water-tank B', arranged and operating substantially as and for the purpose set forth.

9. In a spark-arresting apparatus, such as set forth, the combination, with the extinguishing-chamber and the movable extinguishing-tank, of the water-feed pipe *t*, discharging at the top of the chamber over and into the mouth of the tank, substantially as herein shown and described.

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