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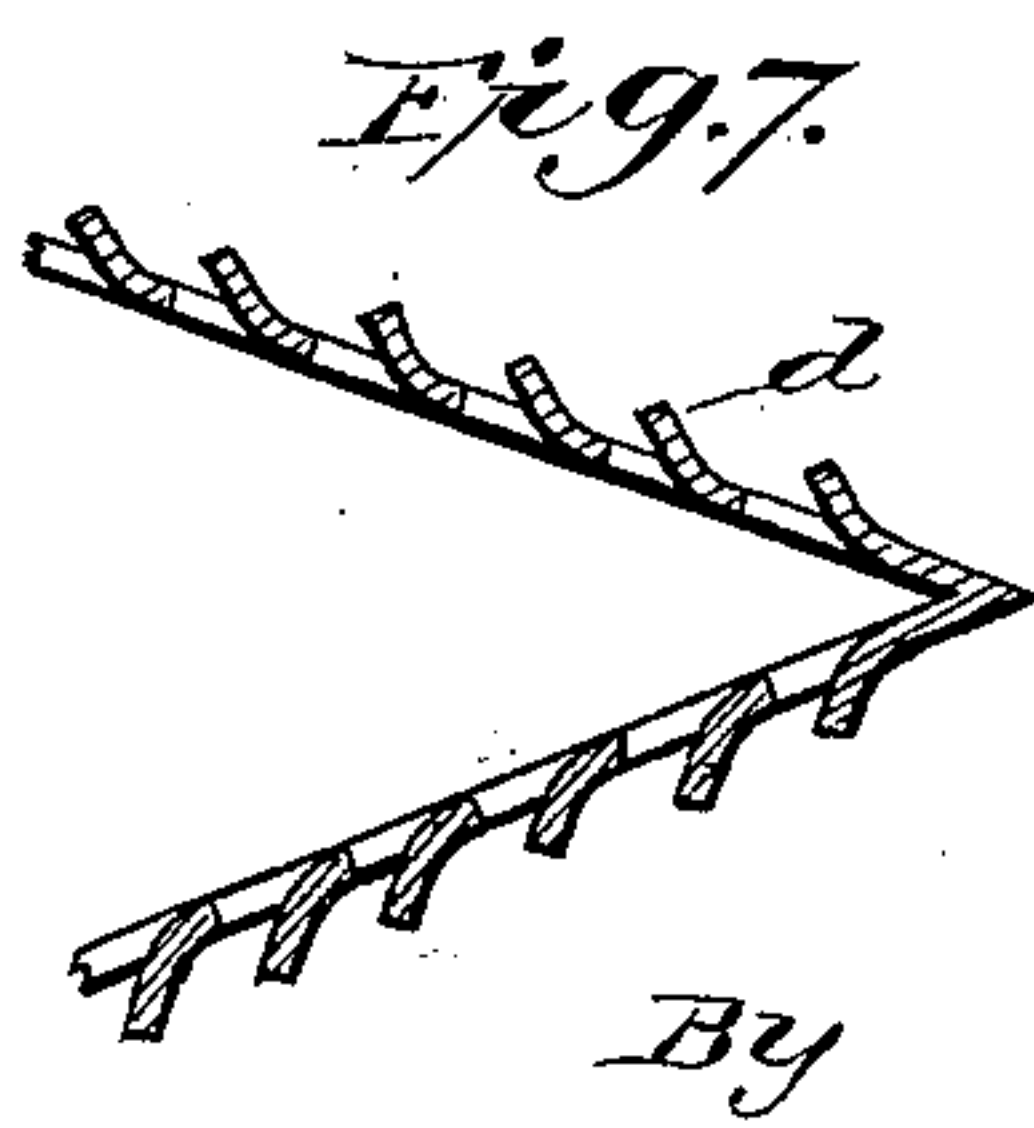
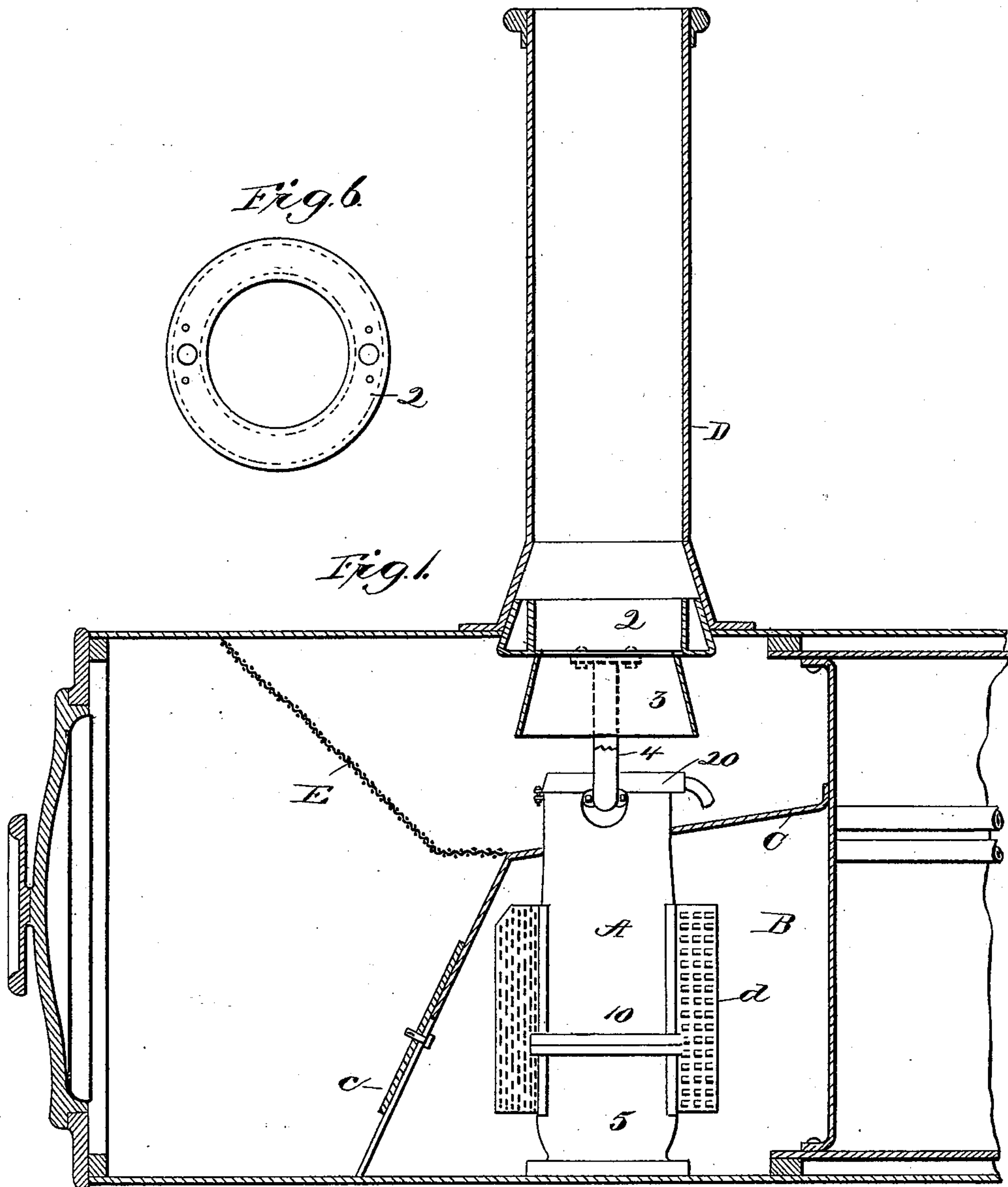
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J. Y. SMITH.

## EXHAUST APPARATUS FOR LOCOMOTIVES.

No. 549,029.

Patented Oct. 29, 1895.



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A. M. Kelly

*Inventor:*  
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(No Model.)

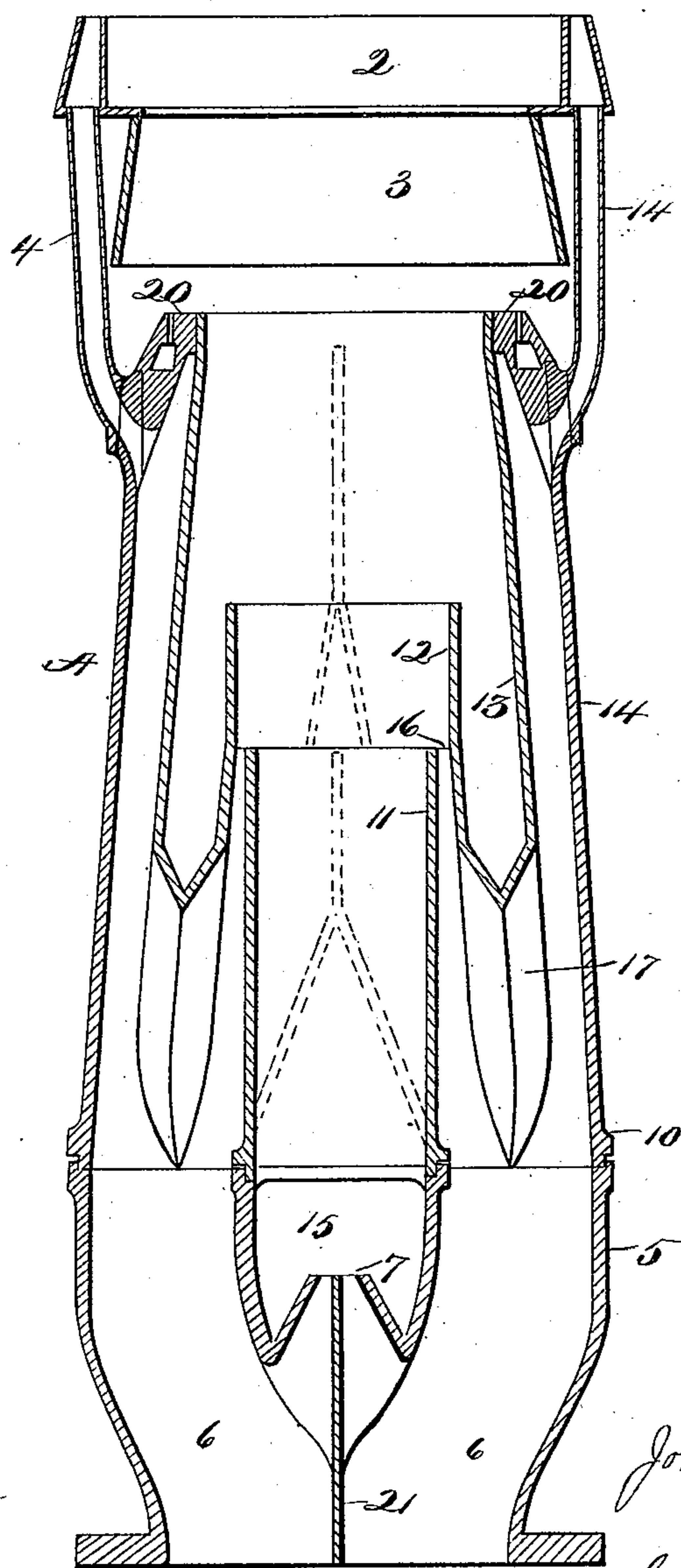
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*Fig. 2.*



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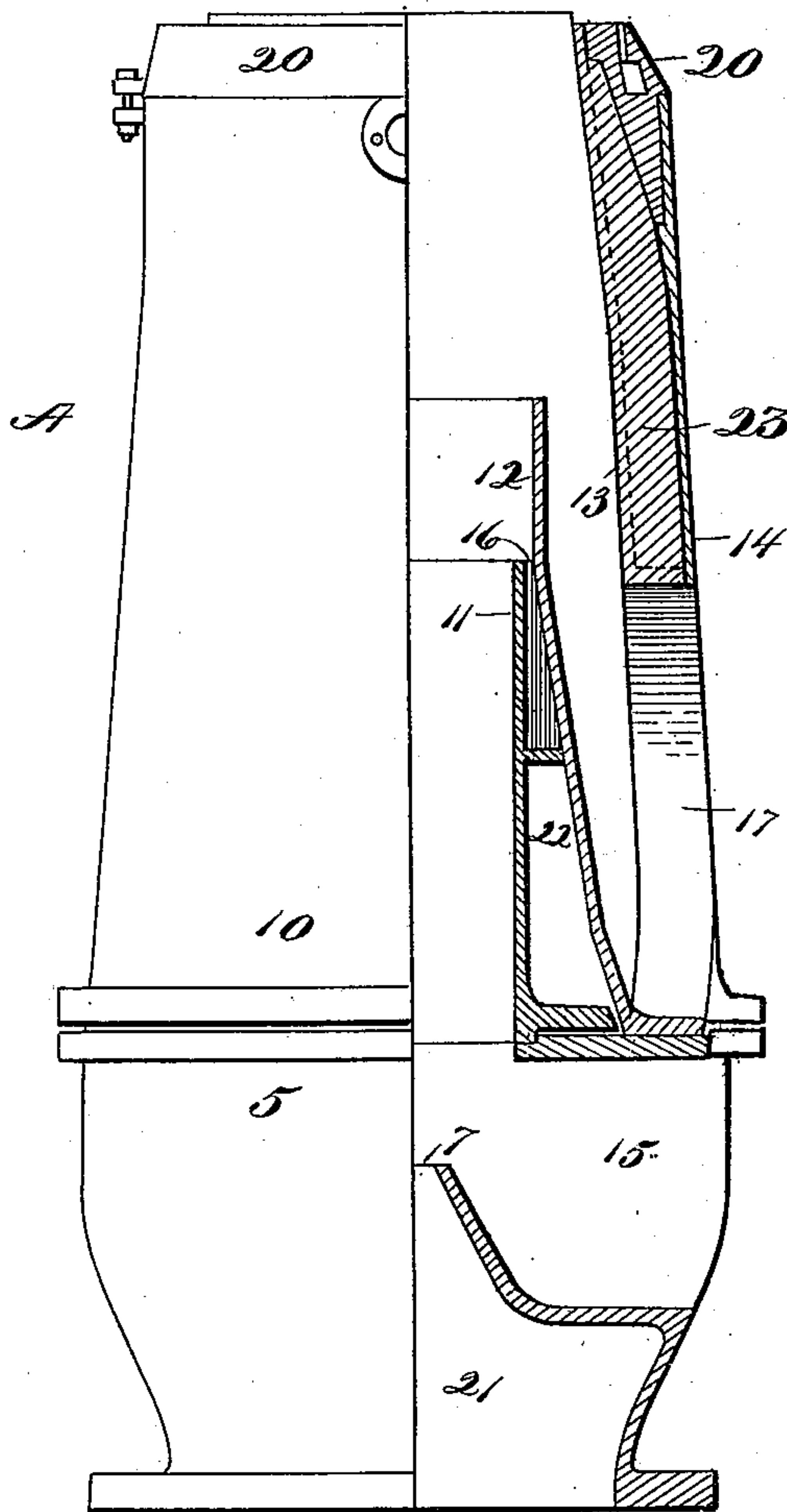
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*Fig. 3.*



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(No Model.)

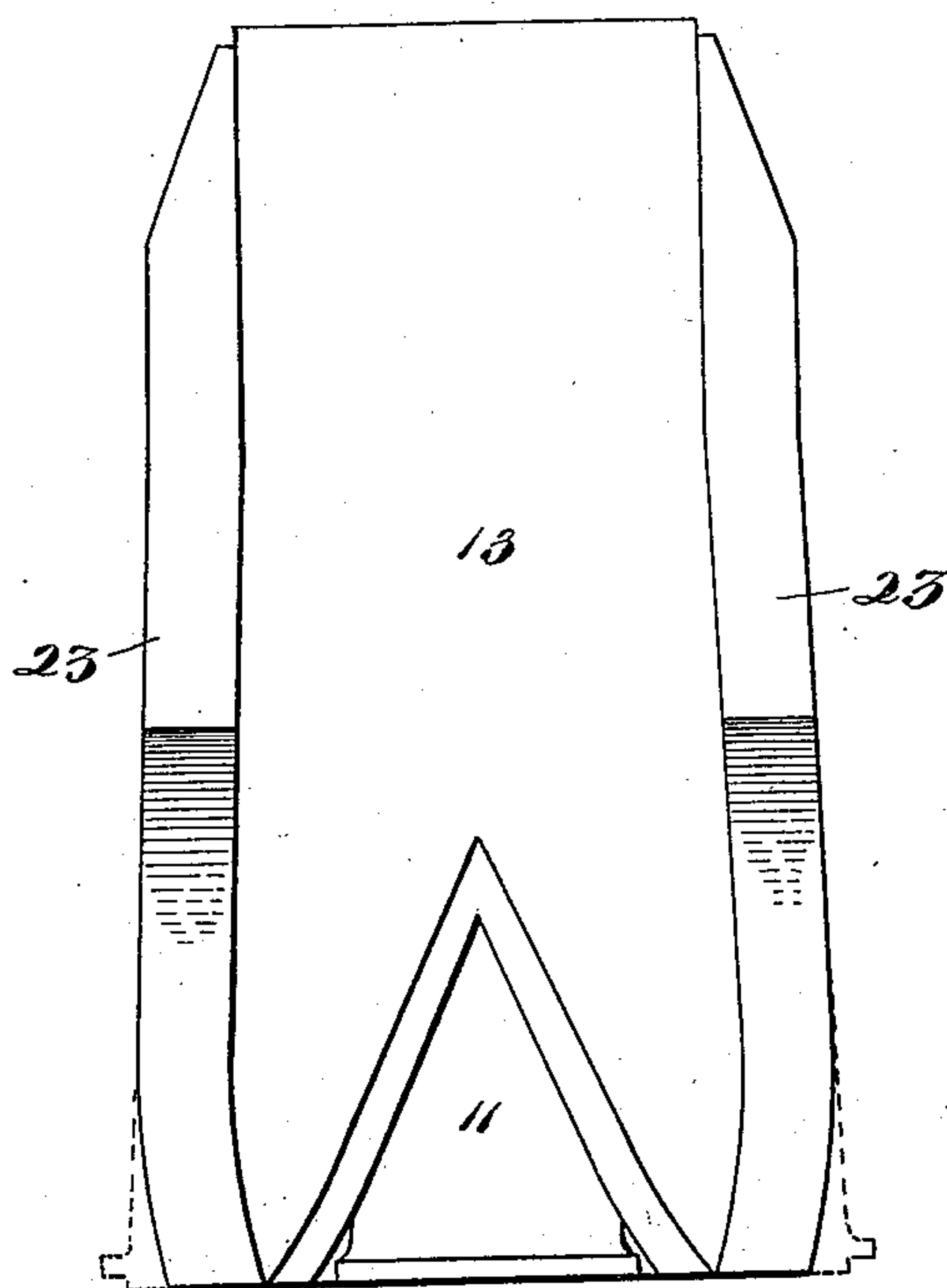
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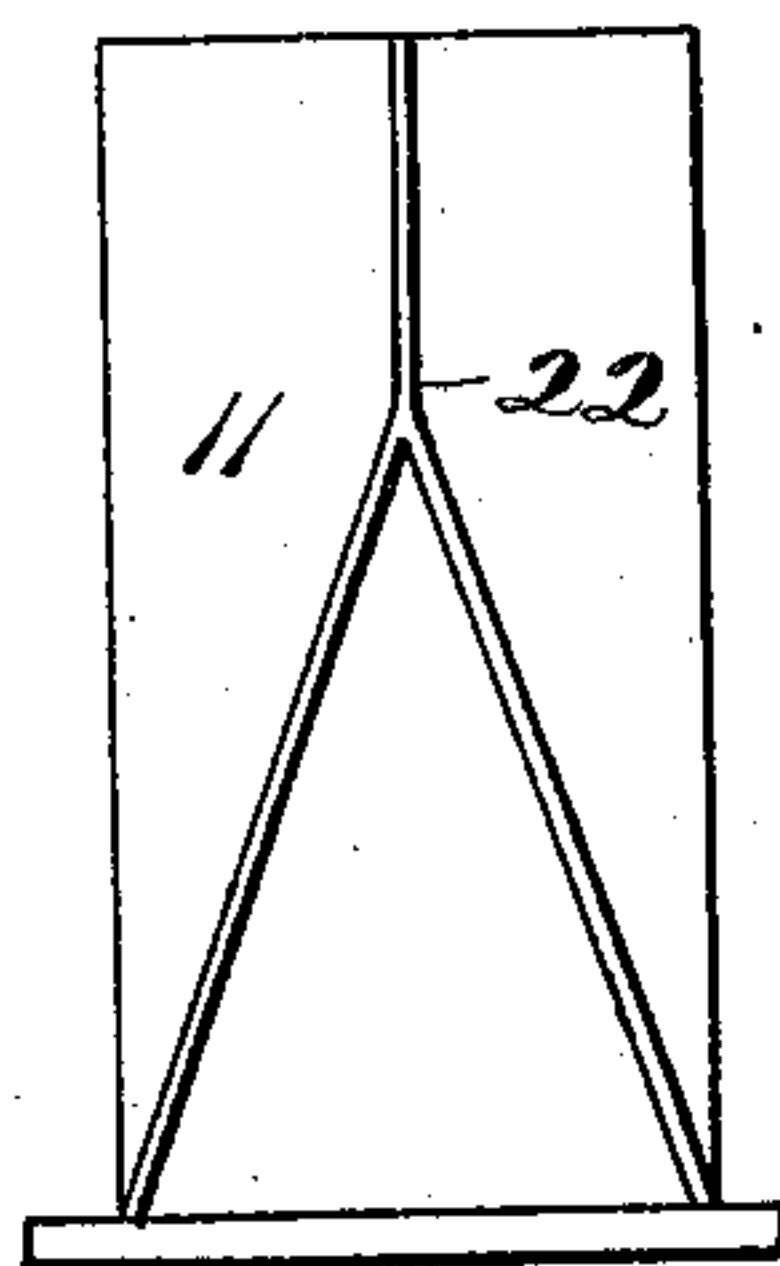
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*Fig. 4.*



*Fig. 5.*



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*By*



# UNITED STATES PATENT OFFICE.

JOHN Y. SMITH, OF DOYLESTOWN, PENNSYLVANIA, ASSIGNOR TO THE  
SMITH EXHAUST PIPE COMPANY, OF SAME PLACE.

## EXHAUST APPARATUS FOR LOCOMOTIVES.

SPECIFICATION forming part of Letters Patent No. 549,029, dated October 29, 1895.

Application filed December 28, 1894. Serial No. 533,208. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN Y. SMITH, of Doylestown, in the county of Bucks, State of Pennsylvania, have invented certain new and useful Improvements in Exhaust Apparatus for Locomotives; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the letters and numerals of reference marked thereon.

This invention relates to the exhaust apparatus of locomotives and similar boilers wherein the steam exhausted from the cylinder or cylinders is utilized as the draft-inducing medium; and it consists in certain novel constructions and arrangements of the parts hereinafter described, whereby the action of the exhaust-steam is utilized not alone to produce and maintain the draft, but also to prevent the clogging of the apparatus and to extinguish sparks or live coals, which would otherwise escape with the products of combustion through the smoke-stack.

In the drawings, Figure 1 is a longitudinal vertical section of the fore end or smoke-box of a locomotive with the blast or exhaust apparatus arranged therein. Fig. 2 is a longitudinal vertical section of the exhaust-pipe. Fig. 3 is a side elevation, with a quarter-section removed to disclose the interior arrangement, in a plane at right angles to Fig. 2, the upper or supplemental nozzle being omitted. Fig. 4 is a side elevation of the pipe with the outer wall or casing omitted to uncover the vertical partitions and one of the air-passages leading to the interior. Fig. 5 is a side elevation of the inner tube or pipe detached, showing the partitions or wings on its exterior surface. Fig. 6 is a bottom view of the upper section or supplemental nozzle. Fig. 7 is a detail view of the netting or perforated plate for protecting the air-passage of the exhaust-pipe.

Similar letters and numerals of reference in the several figures indicate the same parts.

Many attempts have been made to improve the exhaust apparatus of locomotive and similar boilers, having mainly in view the production and maintenance of a sufficient draft in the fire-box, and experience has demonstrated

that there are other elements entering into the problem besides the production of a powerful draft which operate materially to diminish their utility—for example, a too sharp or instantaneous draft of short duration tears the fire to pieces and carries large quantities of ashes and cinders through the flues. Hence it is desirable that the action of the exhaust shall be prolonged or regulated, but without producing back-pressure, and this is accomplished by the use of the triple-expansive exhaust-pipe heretofore patented by me.

Another element to be taken into consideration is the disposition of the cinders and ashes which necessarily accompany the products of combustion through the flues and the prevention of the escape of sparks or live coals. If means are employed for intercepting these fine particles, not only is the escape of the gaseous products retarded, but the accumulation soon clogs the apparatus and seriously interferes with its action.

My present invention is designed to prevent the accumulation of ashes, &c., at the base of the exhaust-pipe and extinguish the sparks, while preserving the advantageous features of the graduated or triple expansion exhaust-pipe.

The exhaust-pipe A is located within the fore end or smoke-box B in front of the flue-sheet, as usual, its base being secured above the exhaust pipes or passages leading from the valve-chests.

A metal plate C is attached to the flue-sheet and extends forward and downward to a point in advance of the exhaust-pipe A, leaving a space or passage between the lower edge of said plate C and the bottom of the smoke-box. This plate constitutes a partition dividing the interior of the smoke-box into two compartments, the one containing the base of the exhaust-pipe A, (the latter projecting through an opening in the plate,) communicating directly with the flues, and the other containing the upper or discharge end of the exhaust-pipe and communicating with the smoke-stack D. Said two chambers or compartments are also in open communication under the front edge of the plate C, at which point an adjustable damper c is arranged for regulating the size of the passage.



The intakes or air-passages at the base of the exhaust-pipe, through which the gases are drawn by the action of the exhaust-steam, are covered with netting or perforated plates, as usual; but the plate or netting *d* on the side facing the flues is provided with a deflector opposite each opening therein, preferably formed by punching a section of the metal and bending it outward, as indicated in Fig. 7. The purpose of these plates is to serve as deflectors for solid particles drawn through the flues and prevent their entrance within the exhaust-pipe, and the netting is preferably so arranged that it will present an angle or curved surface toward the flues, in order that the particles may be deflected sidewise in their flight rather than arrested and deposited at the base of the exhaust-pipe, where they would accumulate and eventually choke the inlet.

In order to prevent an accumulation of these solid particles at the base of the exhaust-pipe and to insure their being carried and deposited, if necessary, in the front end of the smoke-box, the exhaust apparatus is so adjusted and regulated that there will exist a slight preponderance of draft through the compartment beyond that in which the intake for the exhaust-pipe opens—that is to say, the volume of gas expelled or drawn from above partition C shall slightly exceed that drawn through the intake of the exhaust-pipe within the lower compartment—in order that at each exhaust a current may be established through the passage beneath the front end of plate C. The object sought to be accomplished is to prolong the flight of the solid particles and cause them to be carried through the passage, and thus be deposited, if at all, in the front of the smoke-box.

A netting E may be arranged to intercept larger particles. For the twofold purpose of producing and maintaining the requisite preponderance of draft in the compartment above plate C, extinguishing sparks and live coals, I locate at the base of the smoke-stack an annular nozzle 2 and arrange the exhaust-pipe centrally below said nozzle, leaving an air-space between.

The exhaust-pipe A discharges into a petticoat-pipe 3, attached beneath nozzle 2, and the latter is supplied with exhaust-steam through pipes 4.

It will be observed that the gaseous products drawn into the exhaust-pipe from the lower compartment are caused to commingle with the steam in the interior thereof, and that the steam and gases issuing from the exhaust-pipe are discharged through the petticoat-pipe into the smoke-stack, and that the steam issuing from the nozzle 2 and assisting materially in producing the draft entirely surrounds and envelops all the products, whether passing through the exhaust-pipe proper or drawn from the compartment above the partition C. The result is that the ignited solid particles or sparks are so closely en-

veloped in an atmosphere of steam as to become extinguished while passing through the smoke-stack.

The exhaust-pipe which I prefer to employ in carrying my invention into practice is a modification of and an improvement in certain particulars upon that represented in Patent No. 503,501 and is capable of like uses. It comprises the base 5 and upper section 10, to which is added the nozzle 2. The base contains the steam-chamber 6 and central nozzle 7, while the upper section embraces the three tubes or flues 11, 12, and 13 and the casing 14. Tube 11 communicates with the exterior of the base through a transverse passage 15 and forms with nozzle 7 the first or lower ejector. Between the exterior of tube 11 and the interior of tube 12 is formed an annular nozzle 16, which latter, in conjunction with the prolongation of tube 12, constitutes the second or middle ejector.

Steam and air drawn through pipe 11 and nozzles 7 and 16 is ejected from the mouth of tube 12 and expanding in tube 13 draws an additional supply of air through the intakes opening into the space between tubes 12 and 13.

Between tube 13 and the casing 14 is formed a steam space or chamber opening at the bottom into the interior of the base-section 5 and closed at the top by an annular blower 20, the latter being in controllable communication with the live-steam supply.

The nozzle 2, which is arranged to co-operate with the smoke-stack in forming the third or upper ejector, receiving within it the discharge from the lower ejectors, is supported upon two pipes 17, whose lower ends are detachably secured to the casing and communicate through openings therein with the steam-space between the casing and pipe or tube 13.

Instead of carrying the tubes 12 and 13 down to the base all around, they are cut away on opposite sides and united some distance above the base, as shown in Figs. 2, 3, and 4. This is done with a view to enlarging the passage for the exhaust-steam, allowing a wide and free passage up to a point very near the second nozzle 16, so that the steam will flow freely into the steam-space between tube 13 and the casing, while continuing to act in nozzle 16.

In order to effect a proper regulation of the action of the several nozzles, or rather of the exhaust-steam intermittingly supplied thereto, and to avoid at the same time back-pressure, the several steam-passages have been divided by partitions into two sections, each of the latter communicating directly with one of the cylinders. Thus a partition 21 is formed in the passage leading to nozzle 7, and upon the exterior of tube 11 on opposite sides thereof are formed or applied vertical partition-plates 22, the lower portions of said plates being preferably formed on diverging lines, so as to avoid dead-steam spaces and in order



to facilitate the flow of steam. In like manner vertical partitions 23 are applied to the exterior of tube 13.

By the addition of the partitions 21, 22, and 23 the nozzles 7 and 16 and the steam-passages leading thereto and to the third or upper nozzle 2 are separated into two sections, each independent of the other and receiving exhaust-steam from but one cylinder, while the air-passages and mingling-chambers are common to both sections, and by omitting said partitions the exhaust-pipe can be converted or changed from one with a separate steam-discharge for each cylinder to one having its discharge-nozzles and steam-passages common to both cylinders.

Another object had in view in thus dividing the steam-passages is to enable a larger volume of steam to be delivered into the upper nozzle 2, the latter not being divided as the lower ones are, but being designed to fill at each exhaust, so as to effect a complete envelopment of the escaping products and drown out, as it were, any sparks.

Having thus described my invention, what I claim as new is—

1. In an exhaust apparatus, such as described, the combination with the intake of the exhaust pipe, a netting or perforated plate provided with deflecting plates opposite the openings therein for diverting the solid particles drawn through the flues said netting or perforated plate with its deflecting plate being located within the smoke box in proximity to the exhaust pipe so as to direct the solid particles into the forward end of the smoke box beyond the intake of the exhaust pipe; substantially as described.

2. In an exhaust apparatus, such as described, the combination with the smoke-box and partition separating said smoke box into two sections or chambers, the one communicating directly with the flues and the other with the smoke stack, with a passage connecting said chambers, an exhaust pipe discharging into the base of the smoke-stack and having its intake in the chamber communicating directly with the flues, and an annular nozzle supplied with exhaust steam and discharging into the base of the smoke-stack with an air space or passage between said nozzle and the discharge end of the said exhaust pipe; substantially as described.

3. In an exhaust apparatus, such as de-

scribed, the combination of the partition C with the passage beneath the front end; the exhaust pipe arranged with its intake beneath said partition and covered by a deflecting perforated plate; and the annular nozzle arranged within the smoke stack above the discharge end of the exhaust pipe, as and for the purpose set forth.

4. In an exhaust pipe, such as described, the combination with the middle or second ejector formed by tubes 11 and 12, the vertical partitions separating the steam passage into two sections; substantially as described.

5. In an exhaust pipe, the combination with the base section and tubes 11, 12 and 13, and casing 14 forming air and steam passages, substantially as described, the vertical partitions interposed between the tubes 11 and 12 and tube 13 and the casing dividing said steam passages into two sections, each communicating with the exhaust from one cylinder, substantially as described.

6. In an exhaust pipe, such as described, comprising the base and upper section, the latter embracing tubes 11, 12 and 13, and casing 14, the said tubes 12 and 13 being united at a point some distance above the base to form a passage for the steam near the nozzle, substantially as described.

7. In an exhaust pipe, such as described, the combination with the tubes 11, 12, 13 and 14, forming the steam and air passages and steam nozzle, all mounted upon a base provided with a steam chamber, of the blower applied to the ends of tubes 13 and 14 to close the end of the steam space between said tubes, at the top of the exhaust pipe, and the annular nozzle supported above the discharge end of the pipe and connected thereto by one or more tubes communicating with the steam space between tubes 13 and 14, as set forth.

8. The improved exhaust apparatus herein described, the same comprising the base and upper sections containing the divided steam passages and nozzles, and air passages, and the annular nozzle supported above the discharge end of the said upper section in open communication with both sets of steam passages, as and for the purpose specified.

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