

No. 847,886.

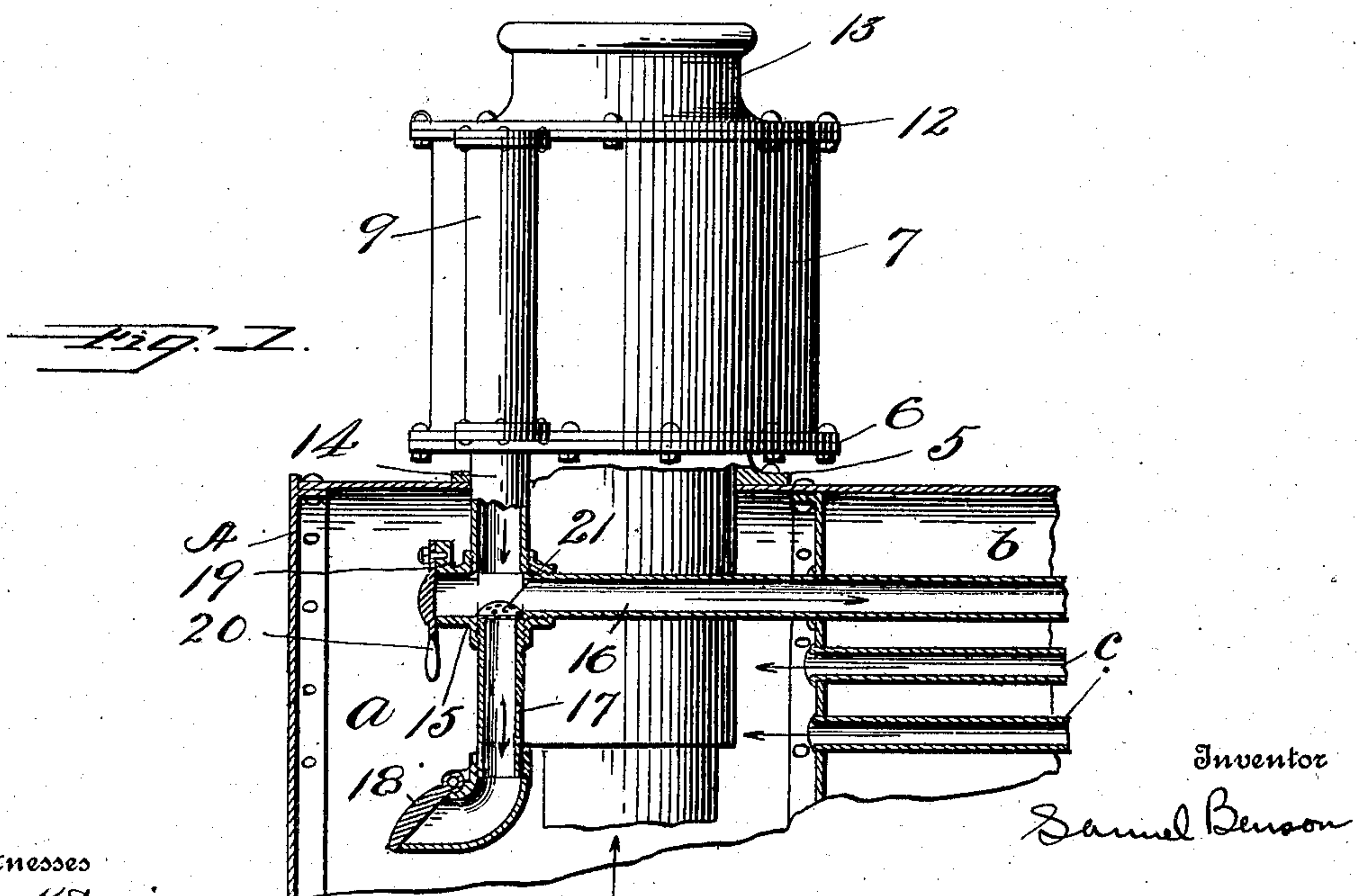
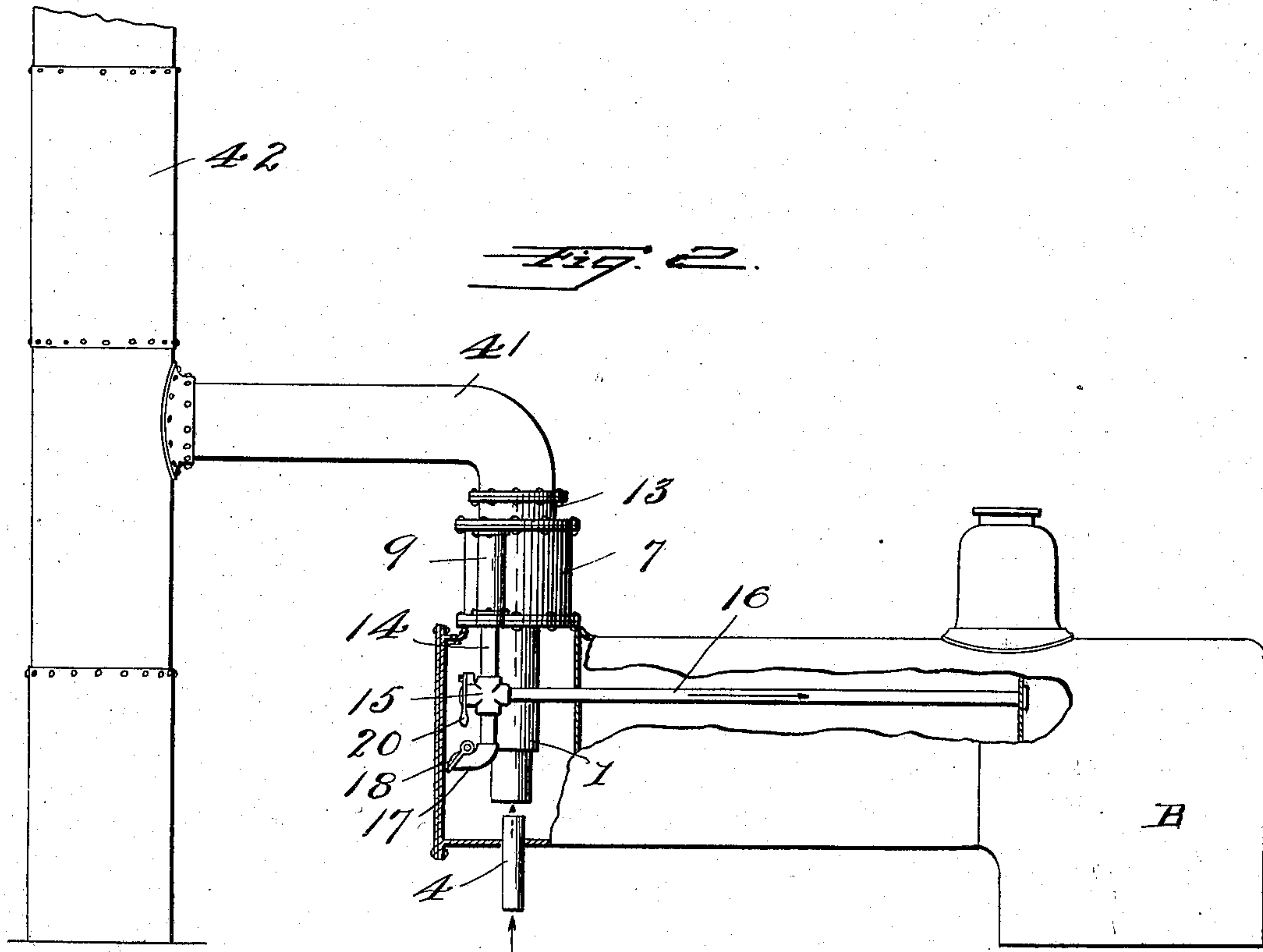
PATENTED MAR. 19, 1907.

S. BENSON.

MEANS FOR SEPARATING AND ELIMINATING SMOKE SUSPENDED MATTER.

APPLICATION FILED FEB. 23, 1906.

2 SHEETS—SHEET 1.



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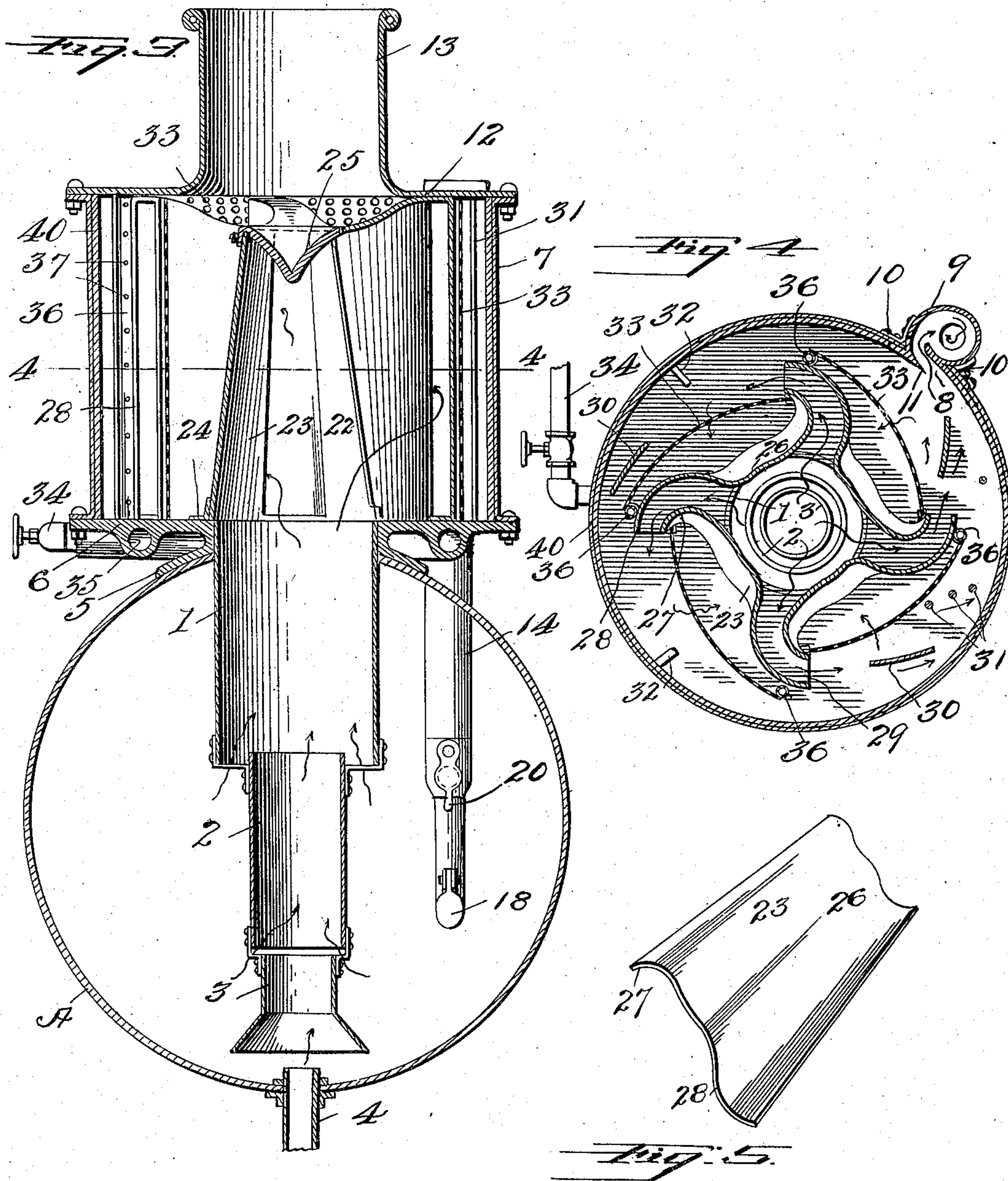
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2 SHEETS—SHEET 2.



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MEANS FOR SEPARATING AND ELIMINATING SMOKE-SUSPENDED MATTER.

No. 847,886.

Specification of Letters Patent.

Patented March 19, 1907.

Application filed February 23, 1906. Serial No. 302,616.

To all whom it may concern:

Be it known that I, SAMUEL BENSON, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Means for Separating and Eliminating Smoke-Suspended Matter, of which the following is a specification.

This invention relates to new and useful improvements in means for separating and eliminating smoke-suspended matter from gases of combustion and applies generally to locomotives and other furnaces.

The invention is an improvement upon the construction shown and described in my co-pending application for Letters Patent, filed August 17, 1904, Serial No. 221,149, and is for the most part based upon the same broad principles of construction and operation.

The primary object of the present invention is to provide a construction in which centrifugal force is utilized to separate unconsumed carbon particles from the gases of combustion and in connection with which a condensing agent for the carbon particles is employed.

A further object of the invention is to provide means for thoroughly agitating the products of combustion in order that the carbon particles may thoroughly come in contact and interblend with the condensing agent and may be educed from the apparatus by suitable means provided therefor.

Means are further provided for separating the condensing agent from the solid carbon particles and for reintroducing the latter through a suitable draft-conduit to the furnace.

The detailed construction will appear in the course of the following description, in which reference is had to the accompanying drawings, forming a part of this specification, like numerals designating like parts throughout the several views, wherein—

Figure 1 is a side elevation of an apparatus constructed in accordance with my invention and showing its application to a boiler and furnace of approved form, the boiler being illustrated in fragmentary longitudinal section. Fig. 2 is a side elevation somewhat similar to Fig. 1, but on a reduced scale, and illustrating the employment in conjunction with the apparatus of the present invention of an enlarged chimney and chimney connection of approved form. Fig. 3 is a ver-

tical transverse section of an apparatus constructed in accordance with my invention, said section being taken at a substantial right angle to Fig. 1. Fig. 4 is a horizontal section on the line 4-4 of Fig. 3, and Fig. 5 is a detailed perspective view of one of the elements of the means employed for directing the gases of combustion in an axially-whirling line of travel.

The invention is particularly designed for use in connection with locomotive and other portable boilers, and this adaptation thereof is advantageously illustrated in Fig. 1, in which the letter A designates a boiler which is provided with a furnace B, (see Fig. 2,) a front portion *a*, a water-section *b*, and tubular flues *c*, leading therethrough from the furnace. Disposed within the front portion *a* of the boiler A are the usual petticoat-pipes 1, 2, and 3, with which the exhaust or blast pipe 4 from the furnace is designed to register and communicate. Surrounding the pipe 1 is a saddle 5, which carries an annular base-plate 6, upon which the elements constituting my invention are mounted. The invention specifically comprises a cylinder 7, which forms a hood for the component parts of the apparatus and which in practical use coacts with said parts. The cylinder 7 has its ends overlying one another in spaced relation, whereby an education-passage 8 is afforded, which communicates with an auxiliary separating-cylinder 9 of volute cross-sectional shape, which is secured to cylinder 7 by clips 10 or otherwise. Adjacent the passage 8 the cylinder 7 is provided with a narrow detachable blade 11, of hard metal, having a sharp edge at the lip of the passage 8 and which serves as a means for deflecting the solid carbon particles from the cylinder 7 into the cylinder 9. The blade 11 may be in single form or of V shape to fit over the end of the casing and to be secured thereto. A cap-plate 12 constitutes a closure for the cylinders 7 and 9 and to this end is conformable to their combined cross-sectional shape. Independent plates may be employed as closures for said cylinders, if so desired, but this is but an arbitrary departure. In like manner the annulus 6 serves as a closure for the lower ends of the cylinders 7 and 9. The cap-plate 12 is formed axially of the cylinder 7 with a tubular discharge extension 13 of approved form.

The above description relates to the ele-

ments which form a housing, as it were, for the operating devices, and the connections of said elements are clearly illustrated in Figs. 1 and 2. The pipe 4 leads from the furnace to the cylinder 7, as above set forth. In the cylinder 7 the solid particles are separated from the gases, which latter are discharged through the extension 13. The former are educed from the cylinder 9 through a branch pipe 14, communicating therewith and axially thereof and having connection by a union 15 with a draft return-conduit 16, which leads to the furnace. A drainage-pipe 17, through which the condensing agent is discharged upon the completion of its work, depends from the union 13 and is provided with a gravity flap-valve 18, operating in the well-known manner. The union 15 is formed with a free end 19, which communicates axially with the pipe 16, the end 19 being provided with a gate 20, of conventional form, by which access may be had to the pipe 16 for cleansing purposes. A strainer 21 for separating the solid carbon particles from the condensing agent is interposed at the junction of the pipes 16 and 17.

Mounted with the cylinder 7 are a plurality of elements for thoroughly comingling the carbon particles with the condensing agent and for directing the gases of combustion in an axially-whirling line of travel, whereby the solid carbon particles may be thrown toward the annular wall of the cylinder 7 and may be deflected by the blade 11 into the cylinder 9. To this end a conical receiving-hood 22 is employed, which communicates at its enlarged lower end with the pipe 1. The hood 22 is composed of a plurality of elements, a preferred embodiment of which is shown in detail in Fig. 5, four of such elements being employed in the construction shown. This numerical disclosure is purely arbitrary, as any preferred number of sections may be used. The hood 22 comprises a plurality of substantially S-shaped plates 23, which may be secured at their lower ends by clips 24 to the ring 6 and which converge toward their upper ends and are closed by a deflecting-cap 25 of inverted-cone shape. The plates 23 are conformable with one another and to this end severally comprise a body portion 26, an abruptly-curved end 27, and an elongated offset end 28, curved in an opposite direction to the end 27. In the assemblage of the plates 23 the hood 22 possesses the cross-sectional shape of a swastika cross; the ends 27 of the plates 23 coacting with the ends 28 of the adjacent plates to form tangentially-curved longitudinal discharge-passages 29, which afford communication between the hood 22 and the interior of the cylinder 7. The passages 29 serve to initially direct the gases of combustion in a tangential spiral line of travel, and this action is facilitated by the provision of

vertically-disposed deflecting-plates 30, arranged at suitable intervals in the concentric space between the hood 22 and the cylinder 7 and preferably adjacent the mouth of the passages 29. For the purpose of creating auxiliary eddies and currents a plurality of vertically-arranged posts 31 and horizontally-projecting studs 32 are provided. The secondary currents thus created materially aid in effecting a thorough comingling of the unconsumed particles with the condensing agent. Disposed adjacent to each of the curved ends 27 of the plates 23 are arcuate screening-plates 33, secured to said arms 27 and having their free ends spaced a relatively short distance from the adjacent ends 28 of the plates 23. The plates 33 are of sheet metal or other desirable foraminous material.

The condensing medium employed in the preferred embodiment of the invention is water, which may be admitted by a valve-controlled pipe 34 through any suitable conductor, as 35, provided upon the base of the annulus 6 and in the construction shown as integral therewith. A plurality of vertically-disposed tubes 36 are closed at their upper ends and communicate at their lower ends with the conductor 35. The tubes 36 are disposed between the plates 33 and the ends 28 of the plates 23 and may be provided with a plurality of closely-associated apertures 37, arranged in any suitable manner and adapted to discharge the condensing agent in fine sprays within the cylinder 7.

In practical use the draft which is established between the furnace and the discharge-extension 13 will educe crude smoke from the furnace into the hood 22. The smoke thus induced into said hood egresses therefrom through the tangential passages 29, and the conformation of said passages imparts movement to the gases of combustion passing therethrough in a tangential spiral line of travel. A rapid whirling movement of the gases of combustion is thus effected, whereby the solid particles will be thrown outwardly by centrifugal force in a comparatively dense layer or sheet toward the inner periphery of the cylinder 7. When the solid particles reach the limit of their outermost rotation, they will be deflected or switched off by the blade 11 in a dense sheet tangentially into the cylinder 9 and their whirling movement will be continued in said cylinder 9, but in a direction opposite to the direction of their rotation in the cylinder 7. From the cylinder 9 the solid particles will be educed in a whirling jet and will be separated from the condensing agent and conducted through the pipe 16, aided by the suction of the draft, to the furnace B.

It is to be borne in mind that the solid carbon particles will possess an affinity for the particles of the condensing agent sprayed

into the cylinder 7, and in view of this fact it will be readily understood that the weight of said solid particles is increased, so that they will be the more effectually thrown outwardly by centrifugal force exerted in the direction of the tangential impulses imparted to said particles as they are discharged from the hood 22. The centrifugally-filtered gases of combustion will yield to the free draft and will be drawn through the screening-plates 33 in an axial whirl to their discharge by way of the chimney 13. This action will be facilitated also by the continuous inrush of crude smoke into the cylinder 7, which exerts a contributory effect in the discharge of the gases of combustion by crowding the filtered smoke through the screens 33 (when employed) and into the space between said screens and the plates 23.

The carbon particles which are returned to the furnace through the pipe 16 for the utilization of their fuel energy are separated from the excess of the condensing agent by the screen 21 and pipe 17, through which said condensing agent gravitates until the weight thereof is sufficient to raise the flap-valve 18.

In view of the many differing conditions of service and structure, the kind of fuel used, and other local factors influencing operative results in the varied forms of fuel-consuming apparatus to which my device applies it will be understood that corresponding degrees of modification will be necessary. For instance, in most cases no special device for the elimination of the water of condensed steam or the condensation and filtration of dense smoke will be required where such water is eliminated before reaching the exhaust or blast pipe and where bituminous fuel is not used. Where any soft light fuel is used—such as wood, sawdust, shavings, straw, or the like—where sparks do not readily respond to the centrifugal impulse, screens may be required to prevent "throwing fire." Where fuel is dense and gritty and sensitive to centrifugal action, screens may be omitted, and a protective lining 40, as shown in Figs. 1 and 4, may be applied within the cylinder 7 or when desired to the cylinder 9 or all exposed surfaces. In the event of using coke or anthracite coal as fuel water-spraying, smoke-eddy, or special deflecting means may be omitted from the cylinder 7 as required.

With reference to Fig. 2 an adaptation of the invention to a stationary enlarged smoke-stack is illustrated; and, as shown, an elbow 41 has connection at one end with the extension 13 and forms a conductor between said extension and the cylinder 7 communicating therewith and the smoke-stack 42.

While the elements herein shown and described are well adapted to serve the func-

tions set forth, it is obvious that various minor changes may be made in the proportions, shape, and arrangement of the several parts without departing from the spirit and scope of the invention as defined in the appended claims.

While in the preferred embodiment of my invention I arrange my improved separating means in and above the smoke-box of the furnace, it is to be understood that said separating means comprising the casing, hood 22, separating-chamber, and associated parts may be provided with suitable end connections at the top and bottom and arranged and secured in any suitable position along the draft-conduit between the combustion-chamber and the terminal outlet of the chimney.

Having fully described my invention, I claim—

1. A device of the type set forth comprising the combination with a furnace, of a smoke-separating cylinder in communication therewith, means for imparting spiral rotation to the gases of combustion from said furnace, means for separating the solid carbon particles from the gases of combustion and for discharging said particles and said gases severally through independent outlets and means for introducing a condensing agent into said separating-chamber.

2. A device of the type set forth comprising the combination with a furnace, of a smoke-separating cylinder in communication therewith, means for imparting spiral rotation to the gases of combustion from said furnace, means for separating the solid particles from the gases of combustion and for discharging said particles and said gases severally through independent outlets and means for introducing a liquid-condensing agent in a fine spray into said separating-chamber.

3. A device of the type set forth comprising the combination with a furnace, of a smoke-separating cylinder in communication therewith, means for imparting spiral rotation to the gases of combustion from said furnace, a plurality of foraminous sheets disposed within said chamber, means for separating the solid carbon particles from the gases of combustion and for discharging said particles and said gases severally through independent outlets, said sheets forming partitions between said outlets and serving as a filtering agent for the crude smoke.

4. A device of the type set forth comprising the combination with a furnace, of a smoke-separating cylinder communicating therewith, a free draft-discharge conductor leading from said cylinder, an auxiliary cylinder parallel to said first-named cylinder and communicating therewith by a longitudinal tangential passage and a longitudinal

deflecting-blade in said first-named cylinder adjacent to said passage and overlapping the adjacent edge portion of said first-named cylinder.

- 5 5. A device of the type set forth, comprising the combination with a main separating-chamber, means in said chamber for separating the gases of combustion from the solid particles, a return draft-conduit leading to
10 the furnace and serving as a passage for the

return of said solid particles thereto, a valve-controlled branch pipe depending from said conduit, and a strainer interposed between said branch pipe and said conduit.

February 19, 1906.

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