

No. 743,694.

PATENTED NOV. 10, 1903.

S. C. DAVIDSON.

APPARATUS FOR ENHANCING DRAFT THROUGH FURNACE FIRES.

APPLICATION FILED APR. 29, 1903.

NO MODEL.

3 SHEETS—SHEET 1.

FIG. 2.

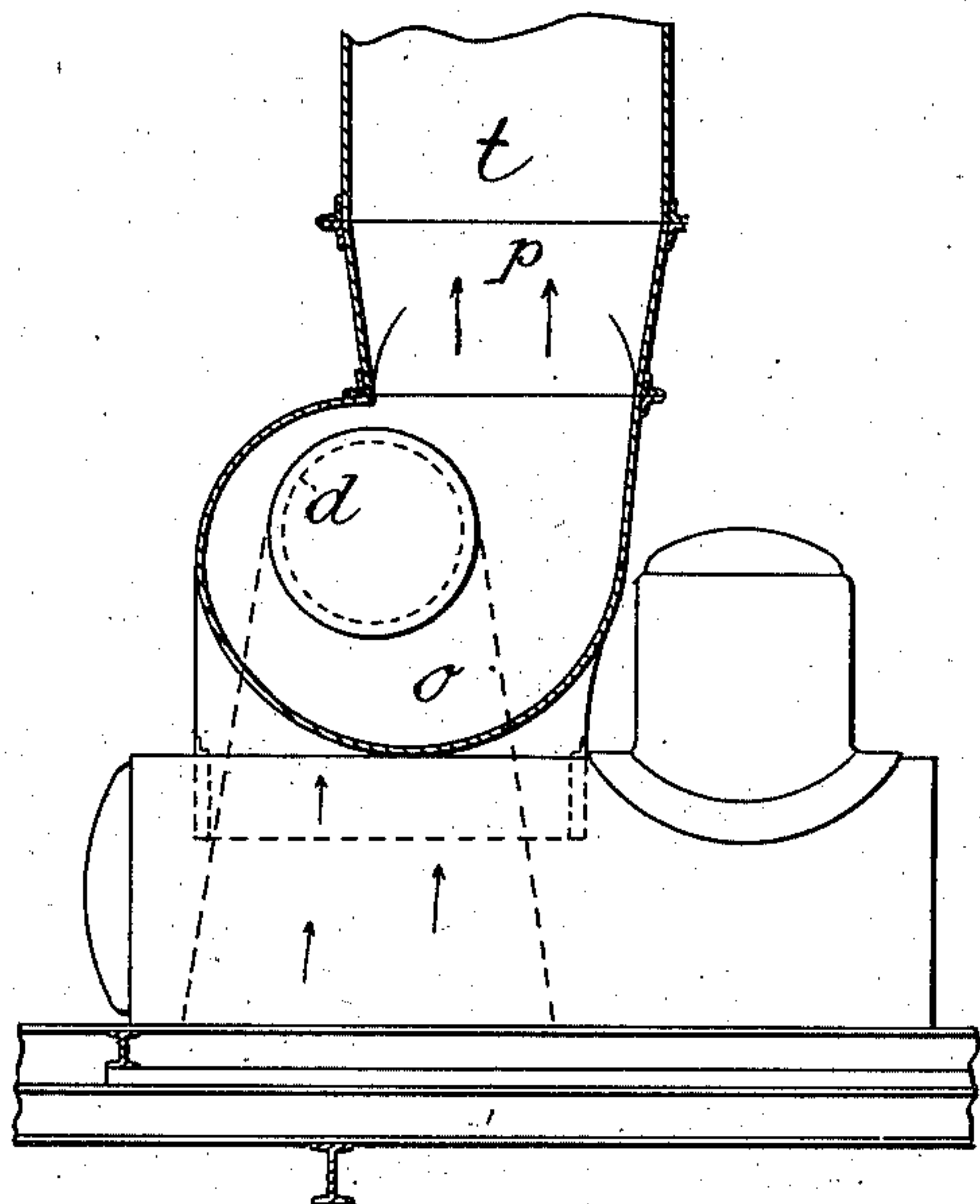
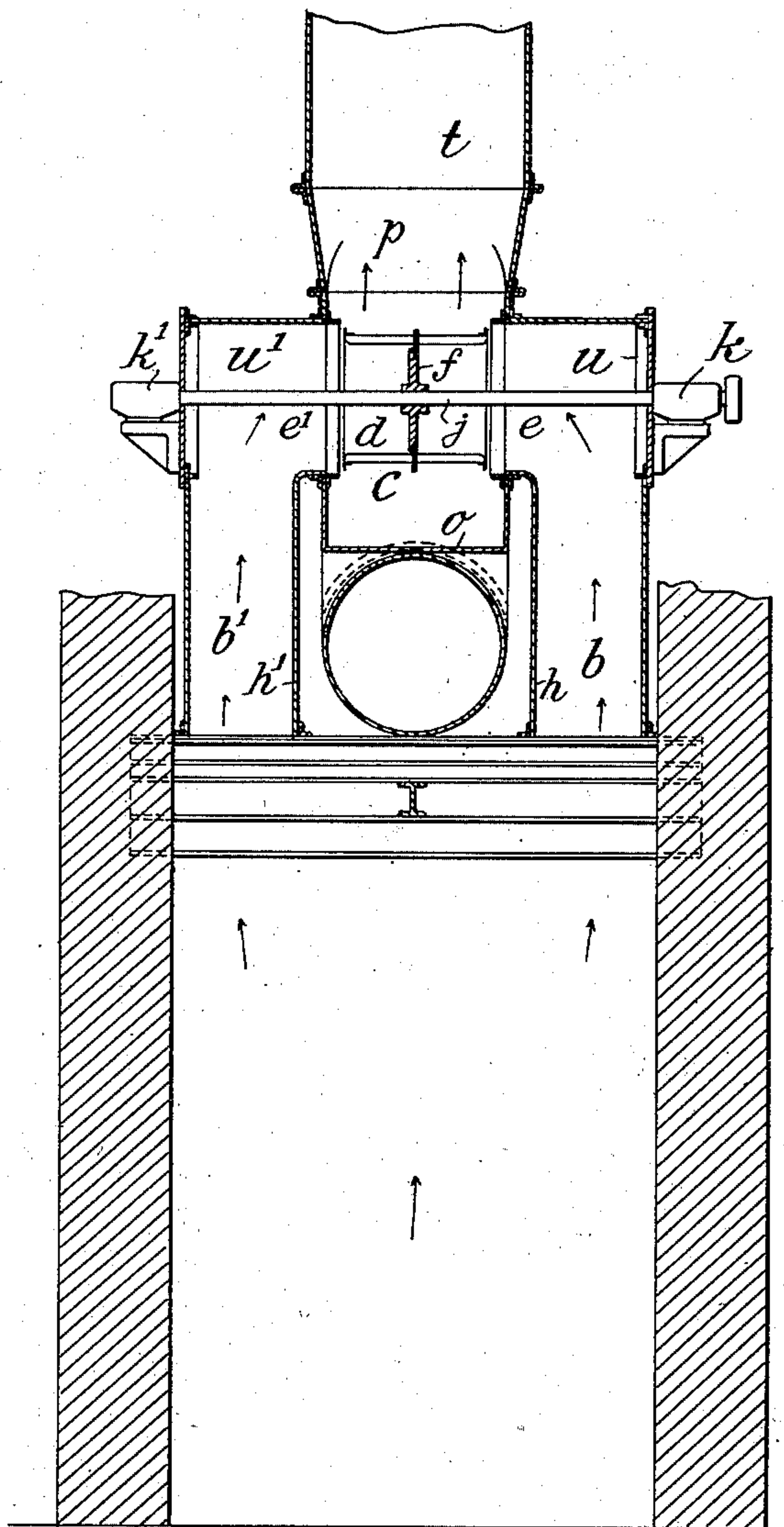


FIG. 1.



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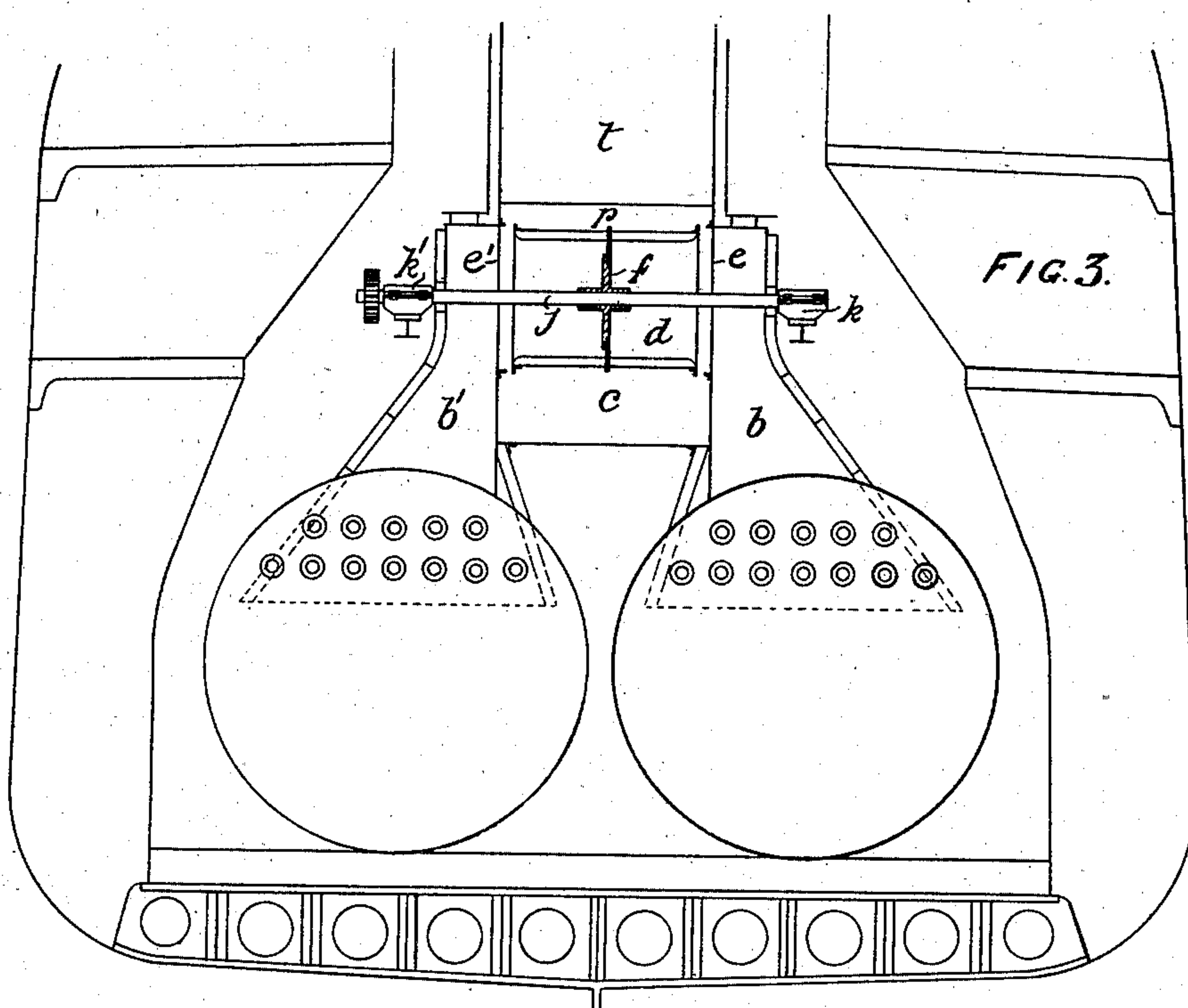
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NO MODEL.

3 SHEETS—SHEET 2.



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3 SHEETS—SHEET 3.

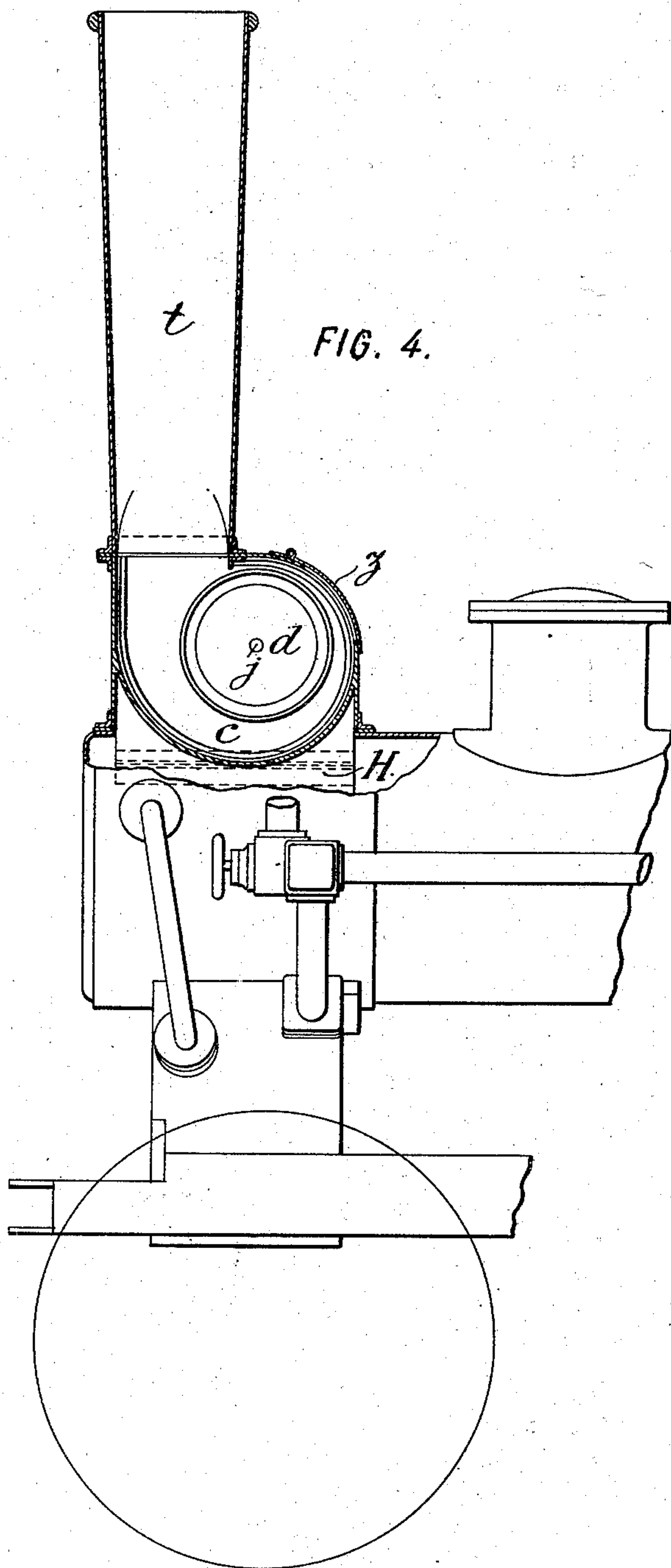


FIG. 4.

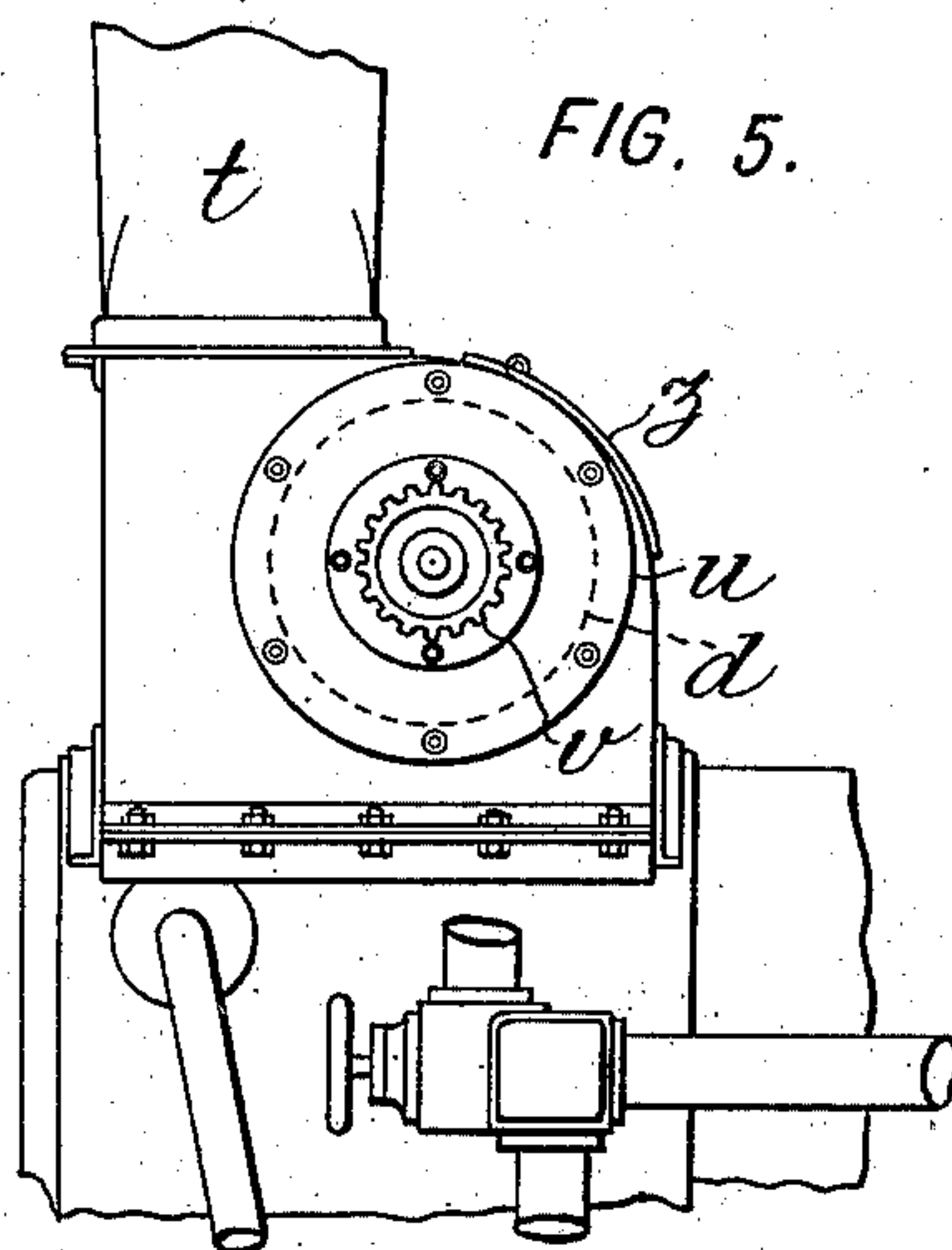


FIG. 5.

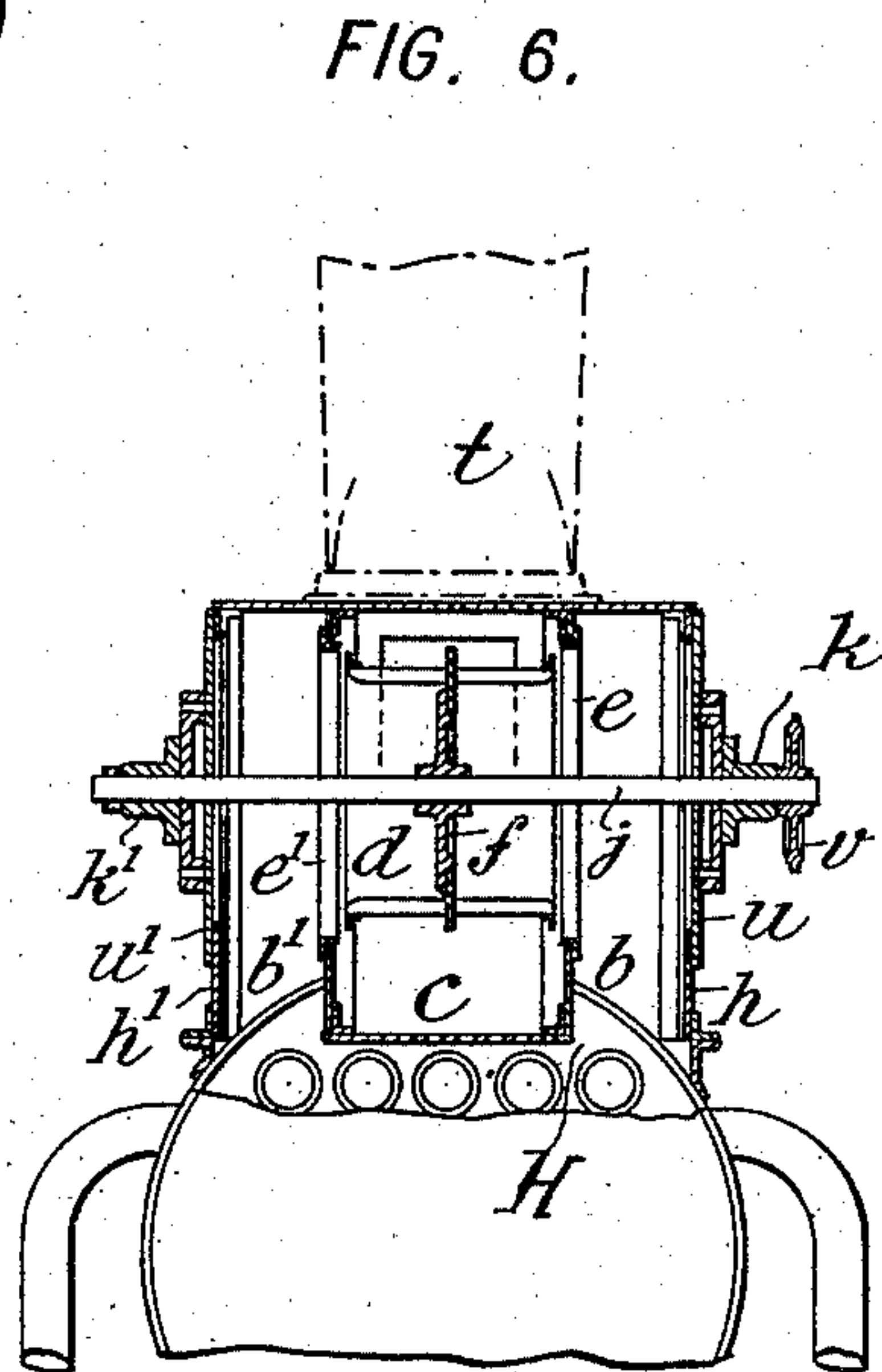


FIG. 6.

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UNITED STATES PATENT OFFICE.

SAMUEL CLELAND DAVIDSON, OF BELFAST, IRELAND.

APPARATUS FOR ENHANCING DRAFT THROUGH FURNACE-FIRES.

SPECIFICATION forming part of Letters Patent No. 743,694, dated November 10, 1903.

Application filed April 29, 1903. Serial No. 154,771. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL CLELAND DAVIDSON, merchant, of Sirocco Engineering Works, Belfast, Ireland, have invented certain new and useful Improvements in Apparatus for Enhancing Draft Through Furnace-Fires, of which the following is a specification.

My improvements relate more particularly to apparatus for enhancing draft through the furnace-fires of land and marine boilers and of railway or road locomotives or traction-engines, (hereinafter referred to as "locomotives;") and the objects of my invention are to provide improved apparatus for producing by mechanical means a strong and effective draft through said furnace-fires with a minimum absorption of power for the operation of same, while also providing for the alternative employment when required of what is termed the "natural draft" of the chimney or funnel connected thereto without involving the employment of damper-valves when changing over from natural to mechanical draft, or vice versa.

Chimneys of moderate height—say up to eighty feet, or thereabout, above the fire-grate—do not develop sufficient strength of draft to produce in said fires a combustion of the requisite intensity to effectively consume common and low-priced qualities of coal, which if burned with a strong draft give off more heat and develop more steam relatively to cost than high-priced qualities. Consequently a strong draft on the fires is a very important factor toward economy in cost for fuel.

According to my invention, the novel features of which are specially defined in the claims at the end of this specification, the fan is placed bodily within the flue and practically forms a constituent part thereof, and I divide the flue into passages or chambers, one or more of which are adapted to contain a fan or fans, while the others form conducting passages or chambers to the fan and through same to the flue beyond, said passages being practically so arranged and of such dimensions as to practically provide a through-passage of cross-sectional area equal to that of the flue or of at least one-sixth of the surface area of the fire-grate being operated upon by said fan.

I will further describe my invention with reference to the accompanying drawings, which illustrate its application to several different forms of furnaces and flues.

Figures 1 and 2 are respectively a front sectional elevation and a side elevation showing the application of my invention on the top of a land-boiler of the water-tube type, only the steam-drum and the upper part of the boiler being shown in full. Fig. 3 shows in sectional elevation an arrangement of my invention applied to the flues of steamship-boilers. Figs. 4, 5, and 6 show an arrangement of my invention applied to the smoke-box of a locomotive or traction-engine. Fig. 4 is a sectional side elevation; and Fig. 5, a side elevation of Fig. 6, which is a sectional elevation showing the front of the boiler.

In Figs. 1 and 2, where the invention is shown applied to the top of a land-boiler of the water-tube type, the uptake from the boiler-flues is here elongated to form side flues *b b'* on each side of the steam-drum and having walls *h h'* between them and the steam-drum, although the sides of the steam-drum may in some cases form part of the inner walls. The said flues *b b'* communicate with the inlets *e e'* to a fan-chamber *c*, which is located on the top of the steam-drum. The products of combustion pass through said side flues into the fan through the openings *e e'* and are discharged therefrom from the fan-chamber upwardly into the base of a chimney or funnel *t*. The fan-shaft is extended through the outer walls of the flues *b b'* and mounted in bearings fixed on suitable pedestals or brackets, such as *k k'*. Surrounding the shaft there may be openings in the outer walls of the flues of sufficient size to allow of the removal of the fan therethrough, said openings being normally closed by suitable detached plates or covers *u u'*. Apart from the above special features, the general operation of this arrangement is similar to that described in respect of Figs. 1 and 2, and the same letters of reference indicate corresponding parts.

It will be obvious that as the walls of the side flues join the continuation of the main flue, and thereby terminate said side flues, the products of combustion passing through the same from the main flue must necessarily

pass through the fan-inlets into the fan-casing and fan before reaching the continuation of said main flue, and the suction action of the chimney will cause them to do so even when the fan is not rotating, while when the fan is set in motion an immediate enhancement in the velocity of travel of said gases will take place, as hereinafter more particularly described.

When necessary, the three chambers combined may be of somewhat greater width than the main flue, so as to provide in said bifurcated suction-flues a united cross-sectional area of passage-way equivalent to preferably not less than one-sixth of the area of the fire-grate being dealt with, and the inlet-openings to the fan and also the discharge-outlet therefrom into the continuation of the main flue to the chimney or funnel should preferably, also, have at least the same area for passage-way of the gases in order that when the fan is not being rotated and merely the natural draft of the chimney or funnel is operative the gases will have a sufficiently free passage to the chimney or funnel to enable said natural draft to maintain approximately the ordinary effective rate of combustion which the chimney or funnel can of itself develop in the furnace-fires, so that on the fan being rotated an acceleration of this draft will take place, the strength of which on the fires will then be commensurate with the speed of the fan's rotation.

In Fig. 3, which shows the application of my invention to marine boilers, the same general principle of construction is employed as above described for land-boilers, with modifications merely to suit the conditions necessarily pertaining to boilers in steamships. The uptake or smoke-duct from marine boilers to the funnel may be taken as substantially the equivalent of the main flue of land-boilers, and between the upper end of same and the base of the funnel I construct my hereinbefore-described fan-chamber and side chambers, forming the three divisional compartments therein, as already set forth. In this modification the fan-chamber *c* practically forms a basement-chamber underneath the chimney or funnel *t*, the suction or side flues *b b'* being substantially a continuation or elongation of the "uptake," and the discharge-opening *p* from the fan and fan-casing *c* is directed upwardly into the base of the funnel *t*. The fan casing or chamber is of suitable size to allow of the center of the fan-wheel being approximately in line with one side of said funnel or a small distance inwardly therefrom in order to provide for the tangential discharge of the gases from the fan being as nearly as practicable parallel or coincident with the axis of the funnel. The fan-spindle is carried in bearings supported on the outer sides of the fan-chamber, and the general operation of the arrangement as above described is similar to that already de-

scribed, and similar letters of reference indicate corresponding parts.

In applying my invention to locomotives, as shown in Figs. 4, 5, and 6, the ordinarily-employed smoke-collecting chamber at the funnel end of the boiler (which is usually known and hereinafter referred to as the "smoke-box") may likewise be regarded as equivalent to the main flue in land-boilers. *H* is the smoke-box, the sides *h h'* of which are elongated upwardly to form the fan-chamber, comprising the central chamber *c* and side flues *b b'*, communicating with the inlets *e e'* of the centrally-located centrifugal fan *d* in the chamber *c*, the discharge from which is directed upwardly into the base of the funnel *t*, which practically constitutes an elongation of the fan-discharge nozzle. The inlets *e e'* in the fan-casing *c* are of sufficient diameter to admit of the insertion or withdrawal of the fan *d* through same, and corresponding orifices are provided in the walls of the flues *b b'*, which orifices when the fan is in position are closed by disks *u u*, containing a central orifice through which the fan-shaft *j* passes, said shaft being carried in bearings *k k'*, attached to the outer sides of said disks. The fan-casing where it extends out of vertical line with the funnel is fitted with a cleaning and inspection door *z*. A spur-wheel *v* is shown fitted to the shaft for driving the fan by chain gear; but any other suitable arrangement of drive may be employed.

I do not limit myself to the particular arrangements or application of the fans shown in these drawings in respect of either the flues of land-boilers or the uptake from marine boilers or smoke-box of locomotives or traction-engines, the essential features of my invention being as hereinafter claimed. The accompanying drawings merely serve to illustrate convenient forms of application which would be subject to modification to suit the particular circumstances or practical requirements of each individual installation.

In my above-described apparatus, whether same be employed in connection with land or marine or locomotive boilers, the fans may be driven by any suitable form of motor either direct coupled therewith or driving same by a belt or chain, and I may employ fans of either centrifugal or propeller types. When the centrifugal type is employed, I preferably employ fans of the type described in the specification of previous Letters Patent granted to me and dated November 27, 1900, and numbered 662,395, as these fans have important advantages in this combination; in that they occupy a very small space relatively to the volume of gases they can deal with and impart to the gases a very high velocity relatively to their speed of rotation, and I preferably use said fans of the type known as the "double-inlet" construction, in which the vanes or blades are mounted on each side of a central disk, which keeps the

currents of gases entering the fans through its oppositely-located inlets from impinging into one another; but when I employ the propeller type of fan I mount one in each inlet-opening to the fan-casing.

The type of propeller-fan which I preferably employ is that described and shown in the specification of previous Letters Patent granted to me and dated July 22, 1902, and numbered 705,046, as they likewise have the important advantages of occupying a very small space relatively to the volume of gases dealt with and impart to the gases a higher velocity relatively to their speed of rotation than is the case with propeller-fans of other makes, and the construction and special curvature of the blades enable them to stand very high temperatures without warping or twisting.

In all the above modifications the strength of the draft for varying requirements is completely under control, and a much stronger draft-power can be obtained by means of my herein-described improved apparatus than would be practicable within the limits of height which necessarily apply to the funnels of locomotives or steamships and in many cases to land-boilers. The introduction of the fan-casing bodily, as it were, into the main flue, as hereinbefore described, permits of the gases entering same with a minimum of deviation from the direction of their flow through the main flue and facilitates the maintenance of large passage-ways for the gases into and through the fan, so that the velocity of flow through same is approximately the same as through the main flue itself, so that not only can the gases pass through the fan freely under natural draft when the fan is not rotated, but when the fan is rotated receive therefrom an accelerated velocity with a minimum expenditure of power, there being no unduly greater velocity of flow through the fan than is simultaneously set up in the main flue, whereby a very important economy of power is effected, because when the gases have to be forced through passages of any considerably-contracted area relatively to that of the main flue through which they are drawn and discharged the power required to produce this acceleration on a given volume rises as the square of the enhanced velocity applied thereto, and as my hereinbefore-described invention obviates necessity for the use of contracted passages the required duties are consequently obtained with a minimum of power for the effective draft created on the furnace-fires.

By the use of my invention I avoid in the case of locomotives the ungainly lopsided appearance which characterizes the external attachment of a fan to the funnel as well as the difficulty of operating valves or dampers, while in the case of steamships the space occupied by my apparatus is usually available between the base of the funnel and the top of the boilers. Hence the application of my

invention to steamships can be effected in what is usually an unoccupied space above the boilers without interfering with other appliances in the very confined space around and over the boilers—a matter of much practical importance as regards apparatus which has to be located in stoke-holds.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In an apparatus for enhancing draft through furnace-fires, the combination of a bifurcated flue, a fan-chamber, a fan mounted in said chamber so as to discharge into the chimney or funnel, oppositely-located inlets into said fan-chamber from the bifurcations of said flue and forming a continuation of the bifurcated flue through the fan-chamber to the chimney or funnel beyond, and a central partition which keeps the currents of gases entering the fan through its oppositely-located inlets from impinging upon one another.

2. In an apparatus for enhancing draft through furnace-fires as applied to an upwardly-directed flue as in marine and locomotive boilers or the top of land-boilers, the combination of a central fan-chamber formed at or near the base of the chimney or funnel and closed at its base, a fan mounted in said chamber so as to discharge into said funnel, a bifurcated uptake forming flues at the side of said chamber, inlets at the side of the central chamber and forming a continuation of the bifurcated uptake through the fan-chamber to the flue beyond, said fan being of the centrifugal type with a central disk which keeps the currents of gases entering the fan through its oppositely-located inlets from impinging upon one another, and means for driving said fan.

3. In an apparatus for enhancing draft through furnace-fires as applied to an upwardly-directed flue as in marine and locomotive boilers or the top of land-boilers, the combination of a central fan-chamber formed at the base of the funnel and closed at its base, a fan mounted in said chamber so as to discharge into said funnel, a bifurcated uptake forming flues at the side of said central chamber, inlets in the side of said central chamber and forming a continuation of the bifurcated uptake through the central chamber to the flue beyond, the outer wall of the uptake having an aperture in line with the fan-axis and of sufficient diameter to admit the insertion or withdrawal of the fan through the same, a detachable plate for closing said aperture, means for driving said fan, and a central partition which keeps the currents of gases entering the fan through its oppositely-located inlets from impinging upon one another.

4. In apparatus for enhancing draft through furnace-fires as applied to an upwardly-directed flue as in marine and locomotive boilers or the top of land-boilers, the combination of a central fan-chamber formed at the

base of the funnel and closed at its base, a fan mounted in said chamber so as to discharge into said funnel, a bifurcated uptake forming flues at the side of said chamber, in-
5 lets in the side of said central chamber and forming a continuation of the bifurcated uptake through the central chamber to the flue beyond, a portion of the fan-casing extending out of line with the funnel, a door admitting inspection of said chamber, and a
10 central partition which keeps the currents of

gases entering the fan through its oppositely-located inlets from impinging upon one another.

In witness whereof I have hereunto signed 15
my name in the presence of two subscribing witnesses.

SAMUEL CLELAND DAVIDSON.

Witnesses:

GEORGE F. WARD,
WM. FREW.