

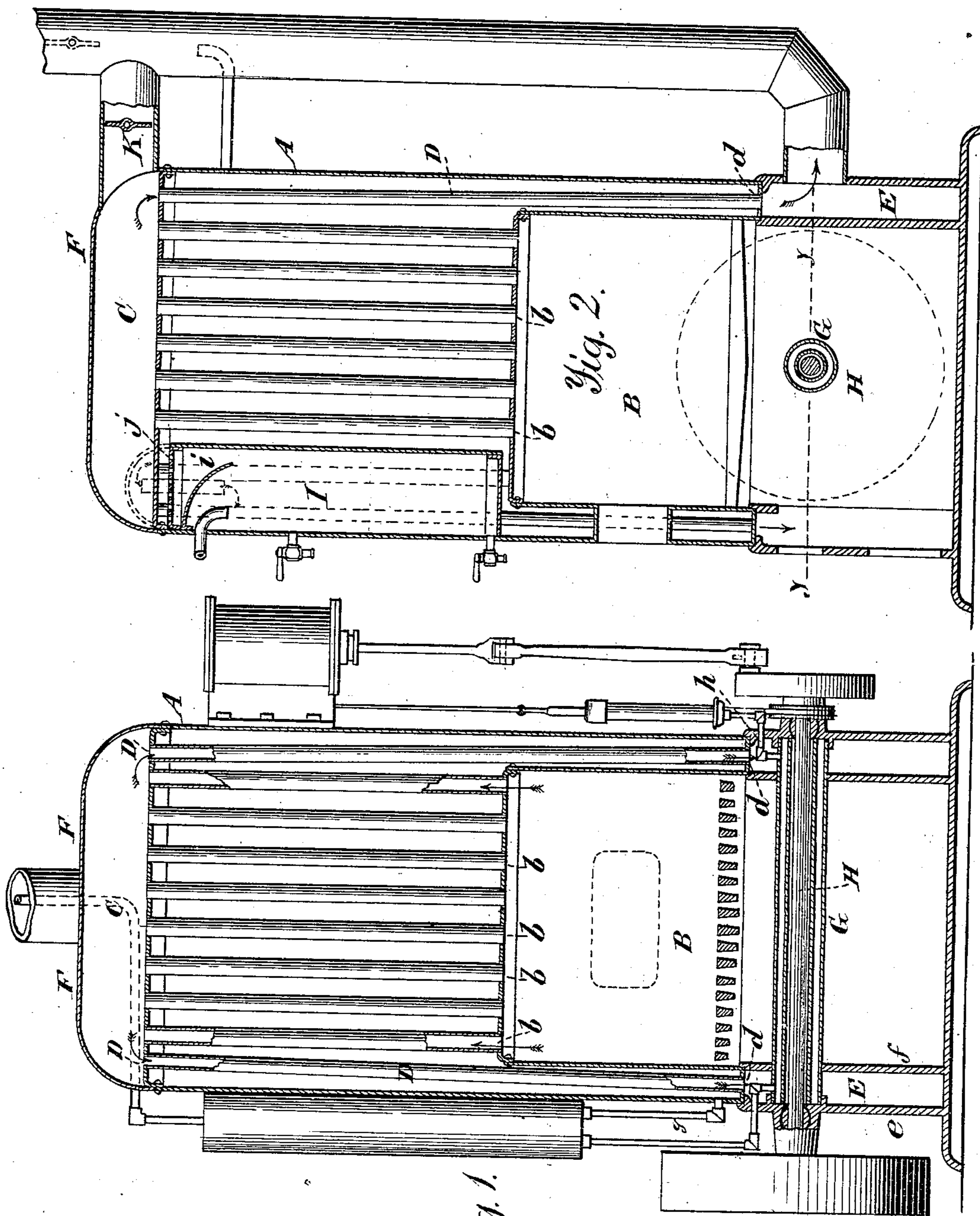
(No Model.)

2 Sheets—Sheet 1.

D. HALE.
Upright Steam-Boiler.

No. 227,105.

Patented May 4, 1880.



Witnesses.

Ralph C. Howe
A. S. Harriman

Inventor.
Daniel Hale.

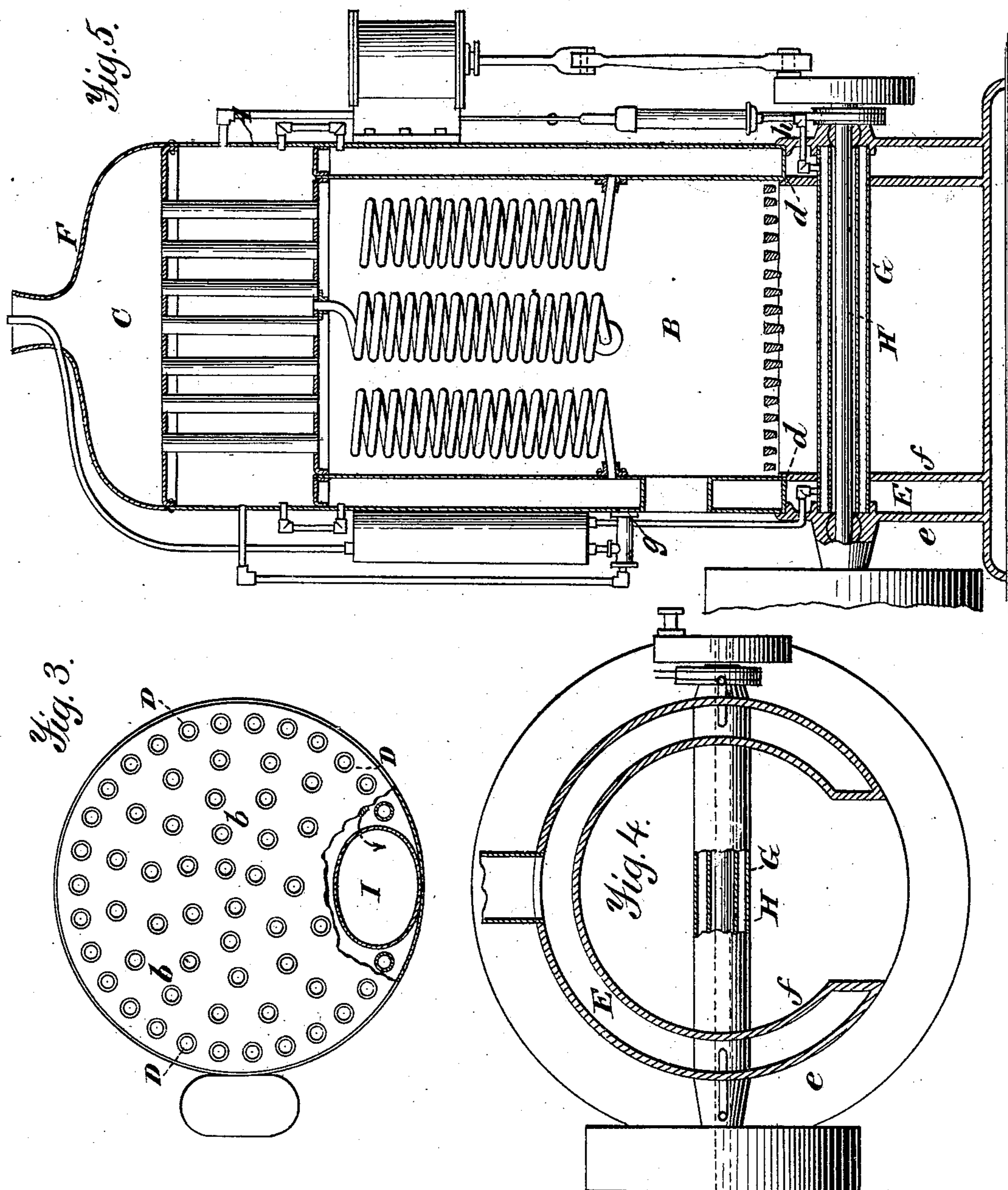
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2 Sheets—Sheet 2

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UNITED STATES PATENT OFFICE.

DANIEL HALE, OF GEORGETOWN, MASSACHUSETTS.

UPRIGHT STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 227,105, dated May 4, 1880.

Application filed March 24, 1880. (No model.)

To all whom it may concern:

Be it known that I, DANIEL HALE, of Georgetown, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Upright Steam-Boilers and attachments thereto; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it ap-
10 pertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

Like letters of reference indicate like parts
15 in all the figures.

Before describing my invention I will briefly remark that it is well known to engine-builders, engineers, and others that portable engines as now constructed are unwieldy, cumbersome,
20 and heavy, owing to the large amount or quantity of metal used in their construction, and also very costly, on account of such metal and the labor required to fit up and finish them.

In the ordinary construction the engine is
25 secured to the boiler at such points that a great shocking, shivering, and an unsteady motion is imparted to the whole machine by the thud of the engine while passing dead-centers, particularly so when the engine is running at
30 any extraordinary speed, thus loosening the boiler-seams and other joints, causing them to leak, as well as causing the uneven wearing of the bearing-surfaces.

The object of my invention, is therefore, to
35 remedy the above-named defects and others obvious to practical men.

My design is also to provide a more durable, simple, compact, and economic engine and boiler, both in first cost and in repairs, as well
40 as economy in the evaporation of steam and in the consumption of fuel.

To this end, therefore, my invention consists, essentially, in providing the lower section of the boiler, below the grate, with a water-heater
45 communicating with the water-supply pump and the exhaust-steam heater; secondly, in the peculiar construction of the boiler by which a steam-space is provided within the water-space of the boiler, said steam-space being provided
50 with certain steam and water separating devices, as will hereinafter appear; also, in the construction and arrangement of the tubes,

flues, circulating devices, and other features, which will be fully described, and pointed out in the claims; also, in the location of the main
55 driving-shaft, by which the shaking and jarring motion of the engine is greatly lessened, if not entirely avoided. Universal bearing-joints may be made for the journals.

Referring to the accompanying sheets of 60 drawings, and to the letters of reference marked thereon, Figure 1 represents a vertical section of the boiler, plainly showing the water-heater or jacket with the main or crank shaft running through it, also the heater and
65 engine and their connections in elevation; Fig. 2, a vertical central section taken at right angles to Fig. 1, and showing the smoke-stack or uptake in elevation and partly in section. Fig. 3 is a plan view of the top of the boiler,
70 part of the top tube-sheet being broken away to show the position of the steam chamber or pocket. Fig. 4 is a transverse section taken on the line *y y*, Fig. 2, showing the water-jacket and heater with the main shaft running
75 through it, and also showing the hollow or chambered casting which forms the foundation of the boiler and bearings for the main shaft. Fig. 5 shows another style of boiler with my improvements attached, and also circulating
80 coil-tubes and an independent steam-chamber, which also acts as a superheater, and which is readily detachable.

Referring to the drawings more in detail, A
85 is the boiler, provided with fire-tubes *b* directly over the furnace B, and communicating with smoke-chamber C, and fastened, in the usual manner, into the upper and lower tube-sheets.

D shows another set of smoke-tubes; but
90 these are return-tubes, the upper ends of which are fastened in the upper tube-sheet, the same as the direct tubes *b*. They continue down below the direct tubes and through the water-space surrounding the furnace, and are fast-
95 ened into an annular plate, *d*, which surrounds the furnace and forms a partition between the water-space in the boiler and the lower smoke-chamber, E.

It will be seen that I thus have a return-flue
100 boiler, utilizing as far as possible the entire heat of the products of combustion by presenting a large heating-surface.

The top or cap F is detachable for the pur-

pose of ready access for cleaning or repairs, so that should a tube become leaky it can be readily removed and replaced, the difficulty heretofore being that when a tube became loose a great portion of the boiler had to be torn away to get to it.

The whole structure forming the boiler is made up of three sections firmly fastened together—*i. e.*, the lower section, forming the ash-pit; the middle section, forming the generating-chamber and steam-space; and the last and upper section, forming the smoke-chamber. The lower one of these sections, E, is cast in one piece and forms the ash-pit. Around this ash-pit is formed an annular chamber between the inner and outer walls, *e. f.* This annular chamber serves the purpose of a smoke-box, communicating with the lower end of a go-by uptake, whose function will be more fully described.

Centrally and across the ash-pit E, and between its bottom and the grate-bars, I locate a water-cylinder, G, having running through it a smaller cylinder, by which I form an annular water-space, and which I term a "heater," and through which the feed-water passes, there being pipe-connections *h* to the pump or injector, and at its other end another set of pipe-connections, *g*, to the exhaust-steam heater, and thence to the boiler. Through this cylinder G, located as described, I run my main crank-shaft H, the bearings of which are cast in the sides of the ash-pit; and, as usual, I place my fly or balance wheel on one end, and on the other I attach my crank or disk.

It will be readily seen that the cold water from the pump or injector maintains the shaft in its cool normal condition, and at the same time the water is more or less heated on its way to the heater proper, the hot water never entering the water-cylinder G unless, indeed, it should be used for a heating and circulating device independent of its character in this case; but the gist of this device G is to form a solid foundation for the crank-shaft near the floor or ground and centrally and transversely through the boiler-foundation. In this way the power exerted by the engine is transferred to the most solid portion of the structure, and by this means the jar, shaking, and shivering caused by the thud of the engine while passing the dead-centers, or from other causes, is avoided or transferred to where it is least felt.

I thus produce a smoother running and a more solid and compact engine, either for stationary or portable purposes, and by transferring the jar or shaking below the water and steam joints I preserve them from strain, and consequently from leaking. I also balance the engine and boiler by locating on one side of the boiler an exhaust-steam heater, nearly corresponding in weight to the cylinder and its attachments, thus equalizing as far as possible the weight of the apparatus on all sides, which is found to be generally desirable, as well as producing an esthetic effect.

In Fig. 2 is shown the steam-chamber I, with-

in the water-space of the boiler, and extending from nearly the top tube-sheet to the bottom. I find this arrangement very convenient and valuable, as it serves every purpose of a steam-dome and occupies a position entirely out of the way. Near the top of this steam-chamber I locate a curved plate, *i*, extending across and downwardly, and I form the top of a perforated plate, J, so that should the boiler prime or have any foreign substance floating on the surface of the water it would be prevented from entering the steam-chamber, and thus prevented from being carried to the valves of the engine.

Another purpose this perforated plate serves is, the steam is compelled to enter the chamber in jets, and in this way it is made to impinge against the top of the curved plate *i*. The water in the steam being the heavier, it adheres to the surface of the plate, and is thus separated from the steam, the steam passing to the engine in a dry and clean state. I may, however, form a chamber above the tube-sheet and convey the steam to the chamber, as shown in dotted lines on Fig. 2.

The pipe which conveys the steam to the engine is shown with its mouth down; but it may be turned up, or in any approved way, or it may be stopped at the end and the body perforated.

In operating the engine the pumps may be attached in the usual way; but I prefer to have the eccentric that operates the valve also operate the pumps. I however claim nothing on the engine.

Fig. 2 also shows the smoke-stack provided with two induction-apertures from the boiler, one at the top of the boiler, communicating with the direct tubes, and one communicating with the return-tubes, at the ash-pit. When it is desirable to have direct draft, at such times as first kindling the fire, or when the temperature in the boiler is to be lowered, &c., the valve in the upper branch is opened; but when it is desired to have the products of combustion returned through the outside circle or down tubes to chamber E, then the valve K is closed, and then the smoke passes out the bottom flue to the smoke-stack. Should the down-draft be sluggish the exhaust-steam may be turned into the chimney or a jet of live steam, and thus the draft be accelerated.

Fig. 5 represents a very compact, cheap, and efficient boiler, also made in three sections—the lower, middle, and top sections—substantially the same as the other, differing only in the size of the combustion-chamber, and inserting water-circulating and steam-generating coils of pipe in the place of the fire-tube, and which are made very cheaply, and are rapid generators. Two of these coils are fastened to the sides of the boiler and the other two to the crown-sheet. The top and middle sections are also connected by outside pipes, both for steam and water circulation. This boiler is comparatively light, holding but little water and exposing a large heating-surface. The upper

portion of the boiler forms the steam-chamber, and is provided with a series of flame-tubes, which not only generate steam but also super-heat it.

5 The lower portion or ash-pit performs the same functions as regards the engine-shaft, and is constructed the same as that shown on Sheet 1, only that the annular plate around the furnace is not perforated for flue-holes.
 10 The chamber E in this case could be used entirely for a feed-water heater with good results. In this figure (5) an injector is shown attached to the heater-connections, so that should it be preferred to dispense with the pump, or if the
 15 pump should break, the injector would be available without further trouble.

It is evident that blow-off cocks to the heater, bottom of the boiler, &c., may be applied in the usual manner; also, safety-valves, gages,
 20 and other appliances, (not shown,) will readily suggest themselves.

Having now described my invention and its mode of operation, what I claim as new, and desire to secure by Letters Patent, is—

25 1. In a boiler and engine, the combination of the shaft of the engine with the water-cylinder, running transversely and centrally through the ash-pit of the boiler, and resting in bearings formed in the same, whereby the power
 30 of the engine is transferred below the bottom

of the boiler, in the manner and for the purposes herein shown and described.

2. In a portable boiler, the combination of the pump-connection *h* and water-cylinder G, located as shown, with the exhaust-steam heater 35 and their combined connections, whereby the water is first heated in the water-cylinder and then in the exhaust-steam cylinder before its induction into the boiler, all constructed and arranged to operate as shown and described. 40

3. In a steam-boiler, the combination of the steam-chamber located within the water-space between the tube-sheets, said chamber being provided with a perforated top to prevent scum from entering, and a curved plate, *i*, for separating the steam from the water, all constructed 45 and arranged to operate as herein set forth and described.

4. In an engine-boiler, the combination of the furnace, the direct fire-tubes *b*, the smoke- 50 box C, return-tubes D, the ash-pit smoke-chamber E, formed by the walls *e f* and the annular tube-sheet *d*, with the branch smoke-stack, all constructed and arranged to operate in the manner and for the purpose set forth 55 and described.

DANIEL HALE.

Witnesses:

H. S. HARRIMAN,
 H. P. NOYES.