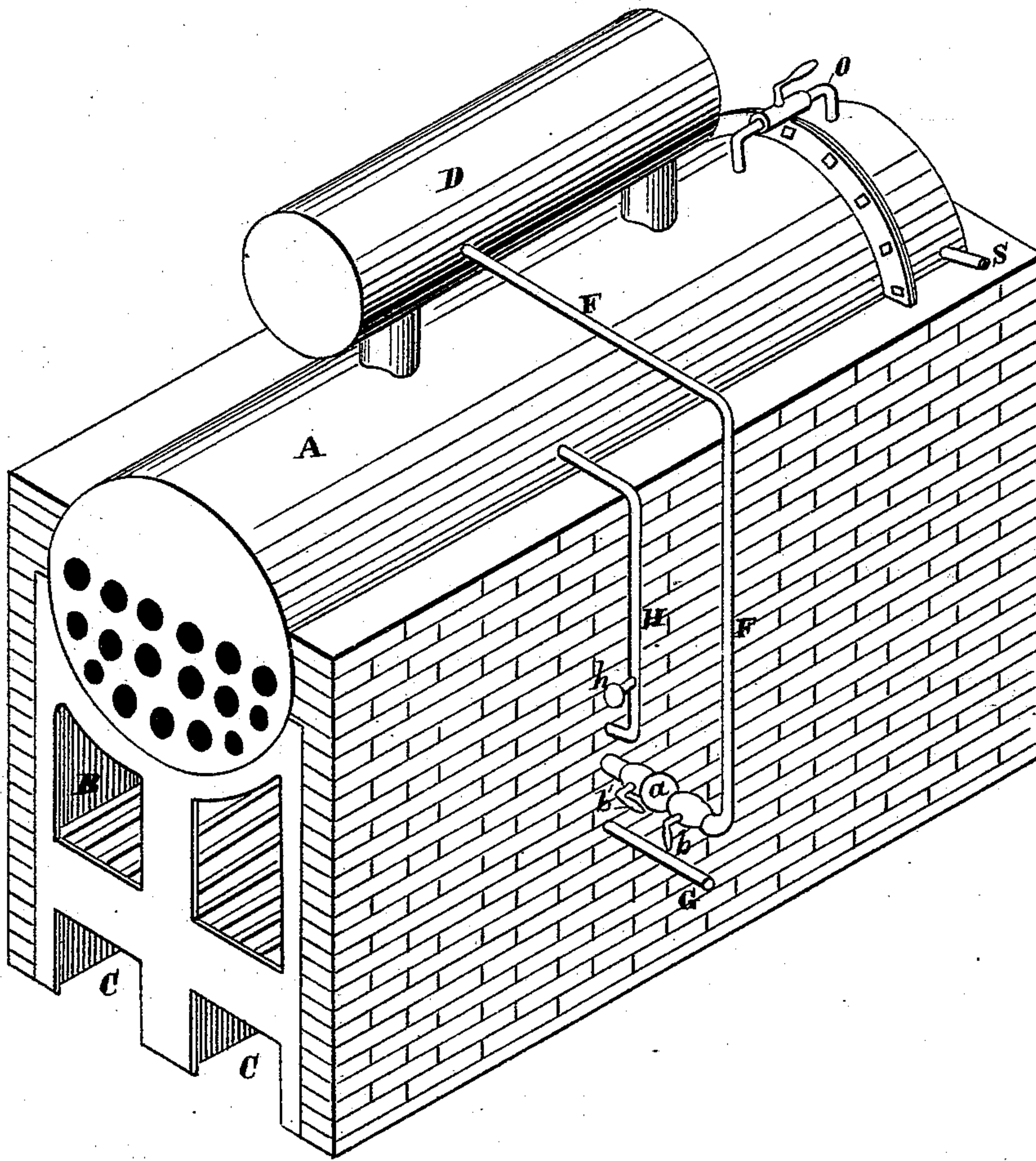


J. B. WARD.
Steam-Generator and Superheater.

No. 223,825.

Patented Jan. 27, 1880.

FIG. 1.



WITNESSES

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INVENTOR

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FIG. 2.

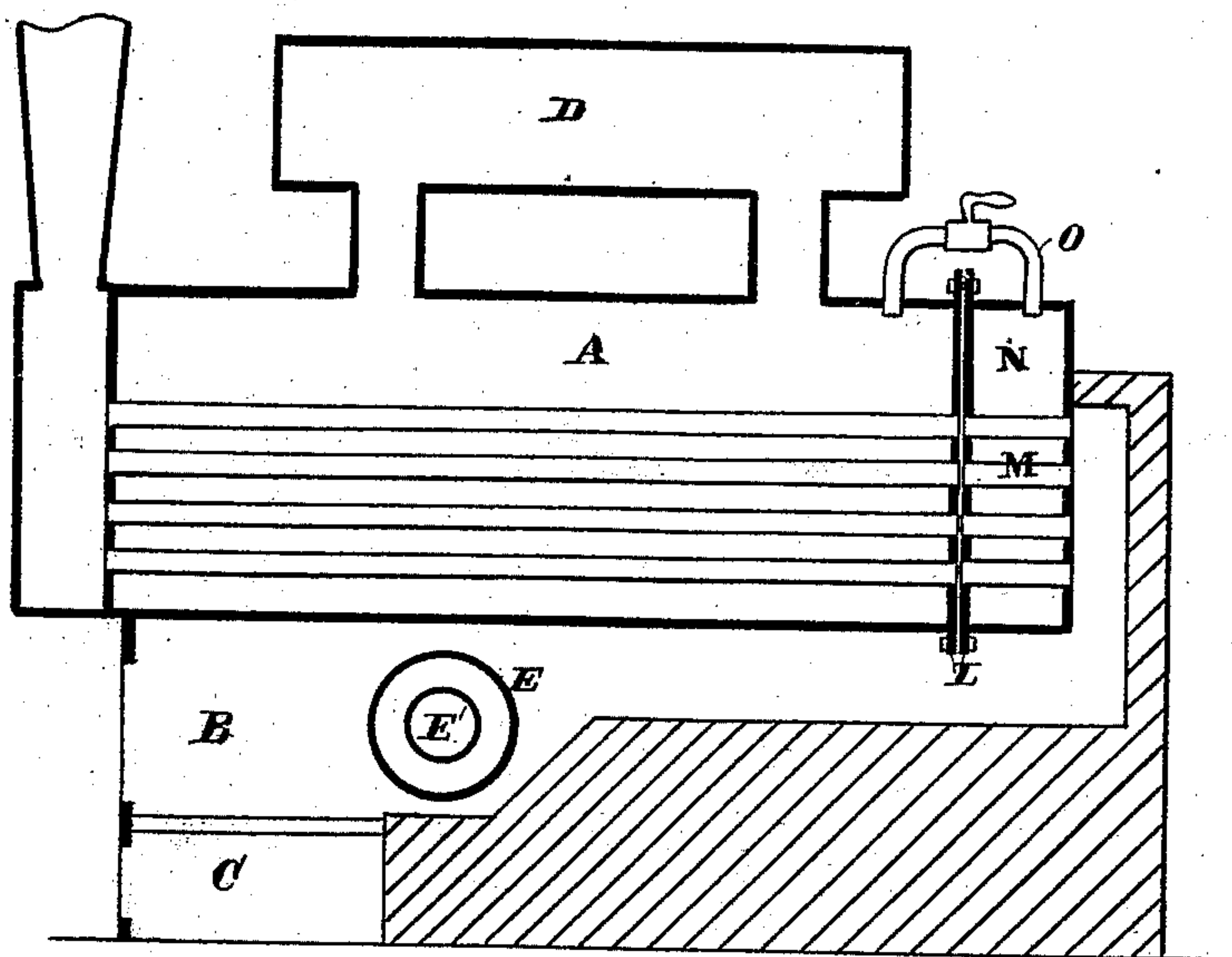
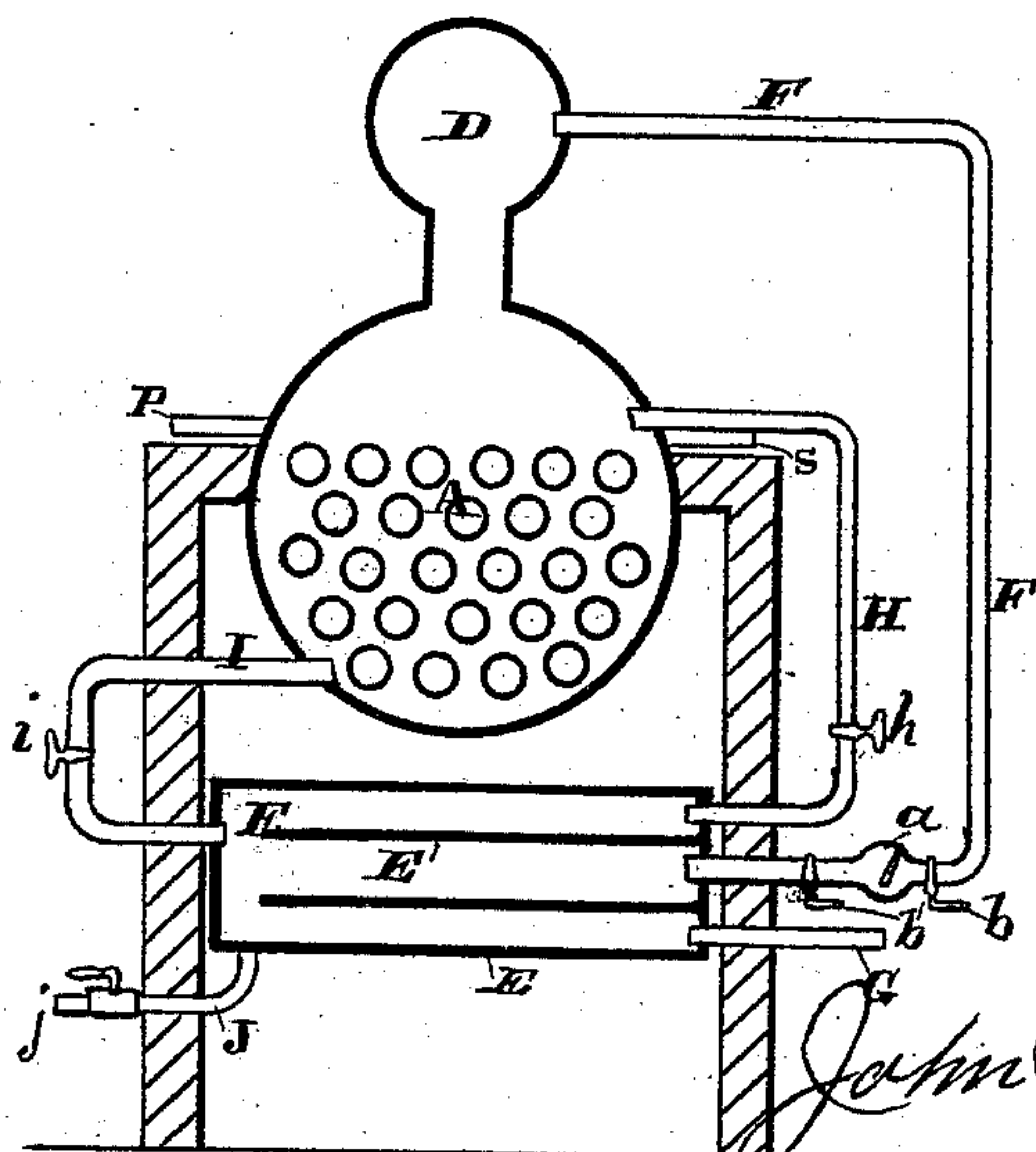


FIG. 3.



Witnesses

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UNITED STATES PATENT OFFICE.

JOHN B. WARD, OF SAN FRANCISCO, CALIFORNIA.

STEAM GENERATOR AND SUPERHEATER.

SPECIFICATION forming part of Letters Patent No. 223,825, dated January 27, 1880.

Application filed July 17, 1879.

To all whom it may concern:

Be it known that I, JOHN B. WARD, of the city and county of San Francisco, and State of California, have invented an Improved Steam
5 Generator and Superheater; and I hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to an improved steam generator and superheater; and my improvements consist in mounting in the fire-place of
10 the boiler a superheating or generating cylinder or chamber so constructed as to answer either the purpose of generating or superheating steam, as desired. This chamber is so connected with the interior of the boiler by pipes
15 that at each stroke of the piston of the engine a supply of steam is admitted to the superheating-chamber, in which it spreads in a thin annular sheet in such a manner as to admit of
20 all the watery particles being immediately converted into dry elastic steam; but before being so highly heated as to injure the valves by burning out the lubricants it is discharged into the engine-cylinder. The chamber is of
25 a proper size to hold about as much steam as the engine-cylinder will take for each stroke, and at each stroke of the piston a fresh supply of wet steam fills the space in the chamber vacated by the dry steam which has entered
30 the cylinder. This arrangement also prevents priming.

It further consists in an arrangement of pipes by which a circulation may be established between the boiler and superheater when the
35 engine is not running, and by which the superheating-chamber may be utilized as a generating-chamber when the superheated steam is not desired.

It also consists in a chamber arranged in
40 rear of and forming a continuation of the main boiler, and heated by the same flues extending into said chamber, in combination with a communicating pipe provided with a valve, and supply and discharge pipes, whereby steam is
45 admitted into said chamber, and also into which exhaust-steam from a high-pressure cylinder may be discharged, so as to be utilized in a low-pressure cylinder. By being led into this supplemental chamber it is subjected to
50 additional heat, but remains dry and is en-

livened or made more elastic, so as to be more useful in the low-pressure cylinder.

In the accompanying drawings, Figure 1 is a perspective view. Fig. 2 is a longitudinal section. Fig. 3 is a transverse section. 55

Let A represent an ordinary steam-boiler having a fire-box, B, and ash-box C, made in the usual way, the boiler being provided with a common steam-drum, D, as shown. Inside the fire-box of the boiler, and above the grates, 60 in any desired position, I mount a superheating-chamber consisting of a closed cylinder, E, having inside it a smaller cylinder or pipe, E', one end of which is open into the main cylinder, as shown, a space being left between 65 these cylinders for the steam, as hereinafter described.

A pipe, F, leads from the steam-drum into the inner cylinder or pipe, E', and is provided with a check-valve, *a*, and cocks *b b'* on each
70 side of said check-valve, so it may be removed when desired. On the same side of the superheater, connecting with the outer cylinder or jacket, E, is a pipe, G, which leads to the cylinder of the engine, supplying said cylinder 75 with steam. Another pipe, H, with a valve, *h*, leads from the top of the boiler to the space between the pipes or cylinders E E', to establish a circulation when the engine is not running, as hereinafter described. 80

A pipe, I, provided with a valve, *i*, leads from the lower side of the boiler into the superheating-chamber, so that water may be let into the superheater while steam is being raised. Another pipe, J, provided with a cock, *j*, is for
85 drawing off the water when sufficient pressure of steam is raised.

The operation of my device is as follows: When the boiler is filled with water the cock *i* in the pipe I is opened, and water allowed to
90 flow into the superheating-chamber, so that it will not be injured by the heat. As soon as the desired pressure is raised this cock *i* is closed, and the water drawn off from the superheater through the pipe J. The cocks *b b'* in 95 the pipe F may be kept open at all times, and when the engine is ready to run the steam from the steam-drum over the boiler can then pass through the said pipe into the superheater through the check-valve, which opens inward. 100

By having the cocks *b b'* on each side of the check-valve, it may be removed at any time, even when steam is up, by closing said cocks.

The superheating-chamber is made of a size in proportion to that of the cylinder of the engine so that the expanded or superheated steam in said superheater will fill the cylinder at each stroke, and the superheater will be about emptied at each stroke of the piston.

The steam entering the superheating-chamber through the pipe *F* enters the smaller interior cylinder or pipe, *E'*, passes clear across the width of the fire-box, and then out of the end of said pipe into the main outside pipe or cylinder, *E*, in which it spreads in a thin annular sheet. As this superheating-cylinder is in the flame of the fire in the fire-box, the steam entering it is immediately and suddenly expanded, and at the same time all the particles of water carried in the steam are converted into steam. As it forms a thin annular sheet around the interior of this pipe or cylinder, every atom is subject to the direct heat of the fire, and all the watery particles are converted into steam. The steam is thus dried by the additional heat; but before it can become so much superheated as to be injurious to the valves it is drawn out of the cylinder *E* at the opposite end from which it is delivered and taken into the cylinder of the engine. As the steam in the superheater is expanded by the access of heat, and the conversion of the watery particles into steam is accomplished, an accession of pressure is gained which forces back the check-valves in the pipe *F*, shutting off the supply of wet steam from the boiler.

As soon as the superheater is emptied by the stroke of the piston this pressure is relieved, and steam is again admitted from the boiler to the superheater, furnishing a supply of superheated steam for the next stroke. The boiler may therefore be reduced to a minimum size, since each charge of steam for the engine is brought to the required state of perfection in the superheater, and it is not necessary to maintain so large a supply of steam or water.

A difficulty in the use of superheated steam has been that it is so highly heated usually as to burn up or destroy any lubricants with which it comes in contact, and the valves and seats are then rapidly worn out.

By superheating the steam in a thin annular sheet suddenly, and then withdrawing it quickly from the superheater at the moment it becomes thoroughly vaporized, but before too great an accession of heat is gained, I procure dry steam which is not of too high a temperature.

A steam-drum is not an essential feature in a boiler provided with this superheater, as the pipe *F* may lead into the crown of the boiler and draw its supply from there, since it will be thoroughly dried and all the watery particles turned into vapor in the superheater.

The supply of steam for the engine while being drawn from the boiler passes through the superheater at each stroke of the piston

and comes into the engine-cylinder in a highly-elastic condition.

When the engine is not running a circulation may be established between the superheating-chamber and boiler by means of the pipe *H*. By opening the valve *h* in said pipe *H* when the throttle is closed the steam expanded in the superheater goes from it back up said pipe *H* into the boiler. The steam therefore circulates between the superheater and boiler through the pipes *H* and *F*.

When it is desired to use the steam in a low-pressure cylinder after having used it superheated in a high-pressure one, I provide an attachment or supplemental heating-chamber to my boiler, into which the exhaust-steam from the high-pressure cylinder may be discharged. In order to do this I form a diaphragm, *L*, near the rear end of the boiler, which divides off the water-space around the tubes from the main boiler; but the tubes or flues *M* connect with the flues of the main boiler. The heat, flame, and products of combustion may then pass through the rear chamber, *N*; but the water in the boiler is separated from said chamber. Steam may be admitted to the supplemental chamber *N* through the pipe *O* on getting up steam, so as to keep it from injury. When the engine is put to work the valve in the pipe *O* is closed and the steam in the chamber drawn off into the large cylinder.

By means of the supplemental chamber a locomotive may be operated with high-pressure steam in one cylinder and low pressure in the other, the exhaust from a small cylinder being led through the chamber and then into a larger one. The exhaust-pipe *S* then admits the exhaust-steam from the high-pressure cylinder to the chamber *N*, formed by the diaphragm *L*. Here this exhaust-steam receives an accession of heat, all of which is waste-heat from the boiler, and is stored to be admitted, through the pipe *P*, into the low-pressure cylinder.

The superheating-chamber answers also for the purpose of generating steam rapidly, a small body of water at a time being subjected to the greatest heat of the fire when desired. To do this, all that is necessary is to open the valve *h* in the pipe *H* and open the valve *i* in the pipe *I*. Some of the water in the boiler will then flow through the pipe *I* into the superheating-cylinder *E*, and the steam generated will rise through the pipe *H* into the boiler. In this way the superheater may be utilized as a steam-generator in getting up steam.

The arrangement of the chamber composed of the pipes *E E'* between the boiler and the throttle of the engine is a preventive of priming. The priming is the result of water being carried over from the boiler with the steam into the engine-cylinder. The theory of the cause of this is that the rapid action of the piston in the cylinder causes a partial vacuum at that point in the boiler from which the cylinder supply-pipe draws the steam, causes a

sudden rush of steam and water to that point to fill the space, part of this water coming into the cylinder with the steam. This I obviate by the intervention between the cylinder and boiler of the superheating-chamber, with its pipe F, carrying the check-valve. The piston action, no matter how rapid, can form no vacuum in any part of the boiler. The cylinder is supplied with steam from the superheating-chamber. A small amount of superheated elastic steam is left in the superheating-chamber, and as soon as the pressure is less in the superheater than in the boiler, from the dry steam escaping into the engine-cylinder, wet steam will flow into the superheater, not in a sudden jump, but, coming in against the already elastic steam in the superheater, will flow in more gradually, so to speak. Thus no partial vacuum will be formed in the boiler, and steam only will rush to the exit of the pipe F, the action not being sudden enough to draw water there also. Still, should any watery particles come through the pipe F, they are vaporized in the superheater, and do not go into the engine-cylinder.

The effect produced by the use of this superheating-chamber in the fire-place, arranged as described, is to utilize all the heat of the fuel in generating and superheating the steam, resulting in a great saving of fuel. The steam is superheated by the same fire that generates it, so that the steam is thoroughly dried without the need of additional fuel.

This superheating apparatus can be applied to any form of boiler, and it may be used in connection with or separate from the supplemental chamber N, as desired.

The number of pipe-connections with boiler and superheater may be reduced by connecting with the other pipes by means of T's. I do not, therefore, confine myself strictly to the position of the pipes as shown in the drawings, as these positions may be altered or changed in several ways, and the same result produced.

Having thus described my invention, I do not claim, broadly, the employment of a super-

heater extending through, across, or behind the furnace; but

What I do claim as new, and desire to secure by Letters Patent, is—

1. The interior cylinder, E', connected with the ingress-pipe F, with its check-valve *a* and cocks *b b'*, said cylinder having its opposite end open, so as to discharge into a surrounding cylinder, E, through which the steam is returned around the inner cylinder, in combination with the furnace B of the boiler A and the supply-pipe G of the engine-cylinder, substantially as and for the purpose herein described.

2. The double cylinder E E', extending across the furnace and constructed as shown, in combination with the boiler A and pipes I, J, and H, with their cocks *i j*, whereby water may be admitted from the boiler to said cylinders for their protection while steam is being raised, and discharged when desired, substantially as and for the purpose herein described.

3. The concentric cylinders E E', extending across the furnace B, and constructed as shown, in combination with the boiler A and pipes F H, with their check-valve *a*, cocks *b b'*, and valve *h*, whereby a circulation of steam may be maintained between the boiler and superheater independent of the motion of the engine, substantially as herein described.

4. The chamber N, so placed as to form a continuation of the boiler A, and heated by the flues M, in combination with the pipe O, provided with a valve for admitting steam from boiler A into said chamber, and supply and discharge pipes S P, whereby steam from a high-pressure cylinder may be discharged into the chamber and reheated for use in a low-pressure cylinder, substantially as herein described.

In witness whereof I have hereunto set my hand.

JOHN B. WARD.

Witnesses:

FRANK A. BROOKS,
S. H. NOURSE.