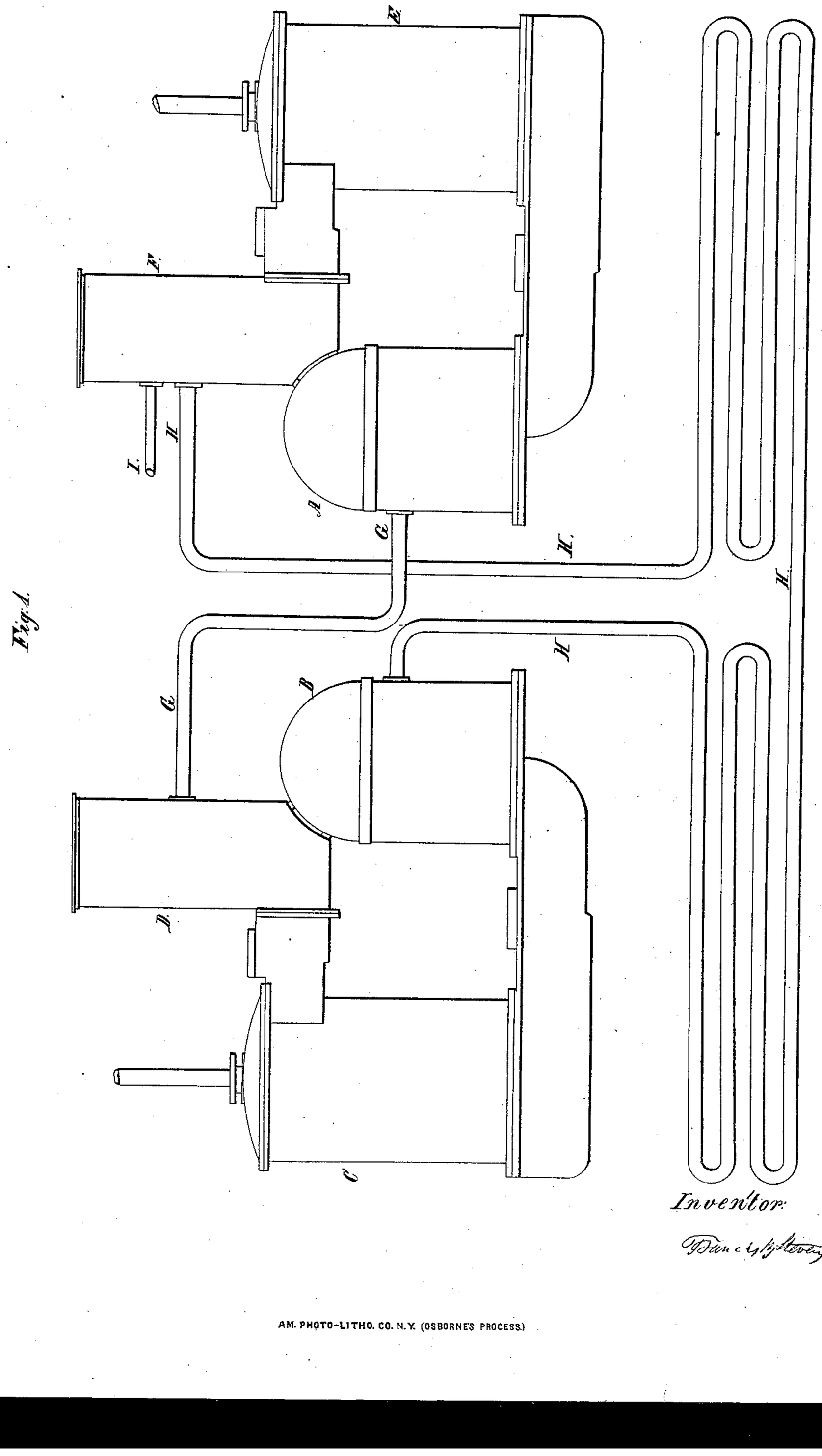
3 Sheets-Sheet 1.

F. B. Sterens,

Steam-Boiler Condenser.

No. 39,429. Patented Aug. 4, 1863.



Inventor:

F. B. Sterens

3 Sheets-Sheet 2.

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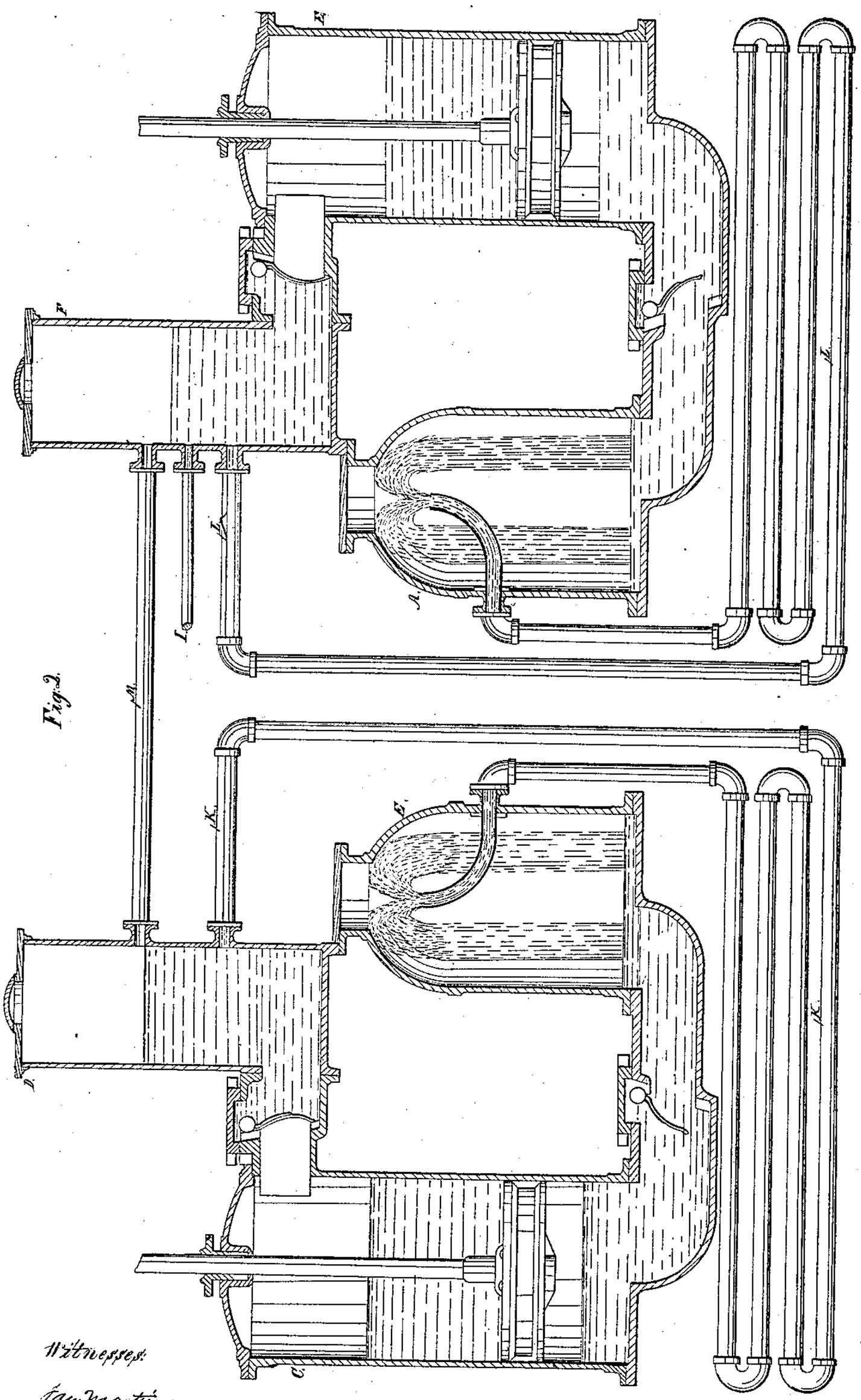

Fig. 2.

Witnesses:

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Julius King

Inventor:

Francis B. Stevens

3 Sheets-Sheet 3.

F. B. Stevens,

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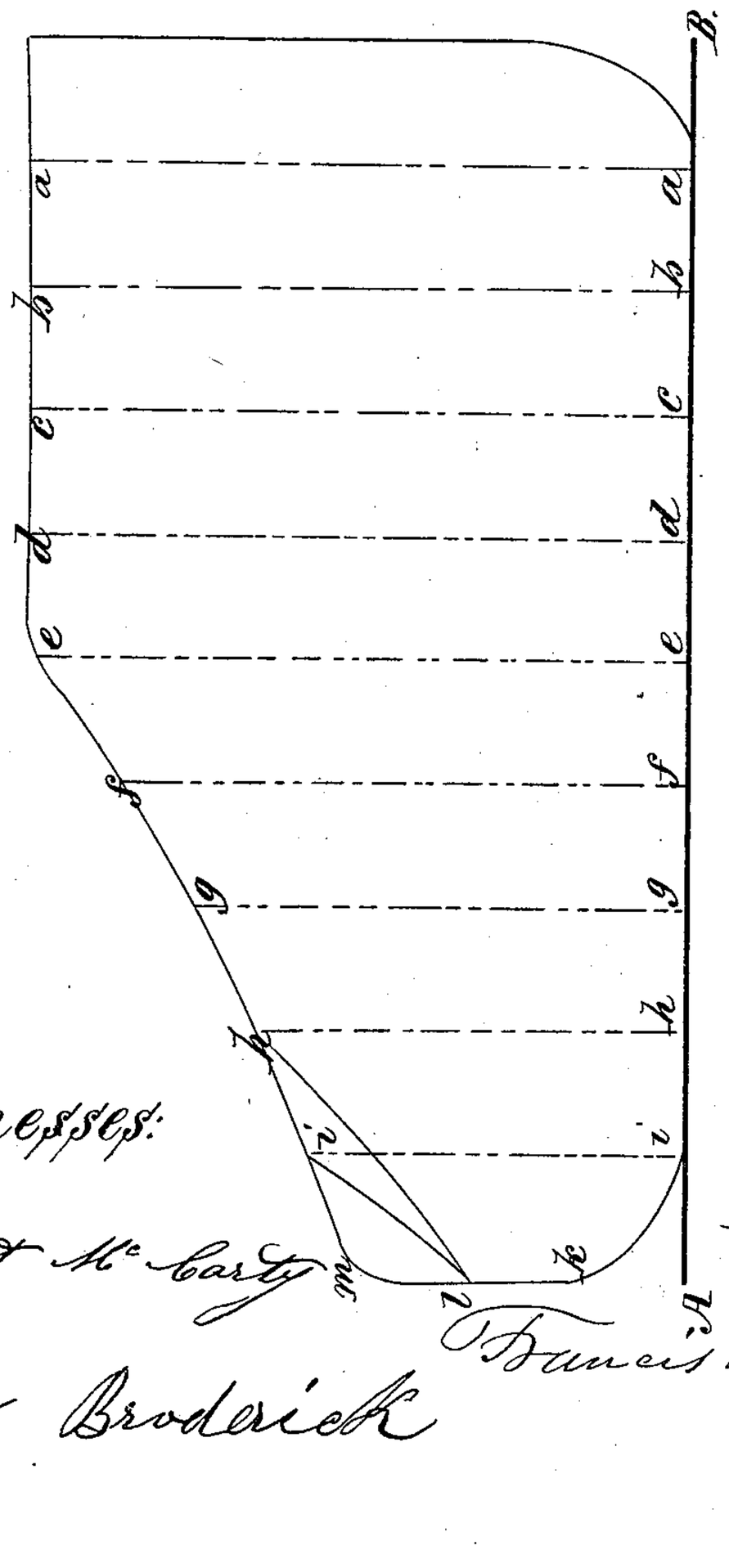
Fig. 3.



Witnesses:

Margaret McCarty

K de Broderick

Inventor:

Francis B Stevens.

UNITED STATES PATENT OFFICE.

FRANCIS B. STEVENS, OF NEW YORK, N. Y.

IMPROVEMENT IN CONDENSERS OF STEAM-ENGINES.

Specification forming part of Letters Patent No. **39,429**, dated August 4, 1863.

To all whom it may concern:

Be it known that I, FRANCIS B. STEVENS, of the city, county, and State of New York, have invented a new and useful Improvement in Steam-Engines; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

It has heretofore been proposed to withdraw the steam from the cylinder of a steam-engine by two successive discharges, by means of two sets of eduction valves, the first set opening and closing before the last set commence to open, the eduction-valves opening after the induction-valves have closed. I will in this specification refer to this action as a "double eduction," and I will call the first of the two successive discharges the "first eduction," and I will call the other discharge the "second eduction."

An apparatus has been attached to condensing steam-engines that cools the water delivered from the hot-well, so that this cooled water can be again injected into the condenser. I designate this apparatus by the term "cooler," and I refer to the patent granted in England to William Symington, A. D. 1835, and numbered 6,925, and to the patent granted to Thomas Howard in England, A. D. 1846, and numbered 11,141, and to the patent granted to Francis B. Stevens in the United States on the 3d of December, 1861, and numbered 33,857, as examples of different forms of coolers.

My improvement consists in diminishing the amount of surface required in a surface condenser or cooler without impairing the vacuum in the ordinary or common condenser of the engine; and this I do by combining a surface condenser or cooler with a double eduction. I make this combination by condensing in an additional condenser—either by surface condensation or by a cooler—the steam discharged from the cylinder by the first eduction, and by maintaining in this additional condenser a temperature higher than that maintained in the ordinary or common condenser, and by delivering into the ordinary or common condenser the steam discharged from the cylinder by the second eduction. I thus increase the difference between the average temperature of the steam to be condensed, or of the water to be cooled, and that of the cooling water, and thereby diminish the amount of cooling-surface required without impairing the vacuum in the common condenser.

Figure 1 is a vertical drawing of an application of my improvement, the two condensers, with their channel-ways, air-pumps, and hot-wells, being shown in section. A is the additional condenser, into which the steam is discharged from the cylinder of the engine by the first eduction. B is the common condenser, into which the steam is discharged from the cylinder of the engine by the second eduction. C is the air-pump of B. D is the hot-well of B. E is the air-pump of A. F is the hot well of A. G is a pipe leading from the hot-well of condenser B and terminating in the jet of condenser A. H is a pipe forming a cooler, the greater portion of this pipe being supposed to be immersed in water colder than the water contained within it. I is the feed-pipe, attached to the hot well of condenser A in order that the feed-water may be drawn off from the hot-well, in which the temperature of the water is the highest. This pipe is shown attached to the hot-well above the level at which the water is delivered into the pipe H.

In this application of my improvement the operation is as follows: The water from the hot-well of condenser B is led by the pipe G to the condenser A, and constitutes the injection-water of this condenser, and, being drawn from this condenser by the air-pump E, is delivered into the hot-well F and into the cooler H at a temperature higher than that maintained in the common condenser B, and after being cooled in the cooler H the water is led to condenser B, and constitutes the injection-water of this condenser, the same water thus acting successively as the cooling water for both condensers. The pipe I being attached to the hot well F above the level at which the pipe H is attached, the water in the hot-well F can thereby be prevented from falling below the level of the pipe H.

Fig. 2 is a vertical drawing of another application of my improvement. In this application the pipe L forms the cooler that cools the water taken from the hot-well F of the additional condenser A, and that is then returned, cooled, to this condenser A, and the pipe K forms the cooler that cools the water that is taken from the hot-well D of the common condenser B, and that is then returned,

cooled, to this condenser B. The feed-pipe I is attached to the hot-well F of condenser A above the level of the pipe L. The two hot-wells are connected by the pipe M, in order that the amount of water added to condenser B by the condensation of steam therein may be led to the hot-well F of condenser A, so that it may be returned to the boiler.

In Fig. 2, the pipe L can be disconnected from the hot-well F of the additional condenser, and can be connected, instead, to the pipe delivering the steam discharged from the cylinder by the first eduction. This steam will then be condensed by surface condensation while passing through the pipe L, and in like manner the pipe K may be disconnected from the hot-well D, and connected, instead, to the pipe delivering the steam discharged from tne cylinder by the second eduction. One double-acting air-pump, connected at one end with the hot-well D and at the other end with the hot-well F, can, if desired, be used instead of the two single-acting pumps C and E.

If my invention is applied to two condensing-engines connected together—such, for instance, as the double engines used in steamers—then the apparatus can be very greatly simplified by employing the condenser, channel-way, air-pump, and hot-well of one engine to condense the steam discharged by the first eduction from the cylinders of both engines, and by employing the condenser, channel-way, air-pump, and hot-well of the other engine to condense the steam discharged by the second eduction from the cylinders of both engines. Thus, if in either of the above applications A were the condenser of one engine, and B the condenser of the other engine, then the first eduction from both engines must be delivered into condenser A, and the second eduction from both engines must be delivered into condenser B. If the steam discharged from the cylinder by the first eduction is taken from the cylinder on the induction side of the piston, a certain amount of power must be lost, and therefore the utility of having two eductions must, in such case, depend upon the amount of the loss of power in comparison with the advantages to be gained by heating the feed-water or by diminishing the amount of surface required in a surface condenser or cooler. The amount of this loss of power can be approximated to by the following method:

Fig. 3 shows an ordinary indicator-card of a condensing-engine, the line of the stroke A B being divided into tenths by the lines of pressure *a a*, *b b*, *c c*, *d d*, *e e*, *f f*, *g g*, *h h*, *i i*, and *k m*. Now, if one-third of the weight of the steam is supposed to be taken from the cylinder on the induction side of the piston, then the pressure at the end of the stroke of the piston will be about two-thirds of the pressure *k m*, and will be represented by the pressure *k l;* and if the first eduction commences when the piston has completed eight-tenths of its stroke, and is at *h h*, then the power lost compared to the whole power will be as the area *h l m*, compared to the area of the whole indicator card; and, again, if the first eduction commences when the piston has completed nine-tenths of its stroke, then the ratio of the power lost will be to the whole power as the area of *i l m* is to the area of the whole indicator-card, the loss being in the first case about one per cent. of the whole power and in the second case about two per cent. of the whole power, while one-third of the weight of the steam used by the engine (and consequently about one-third of the heat contained in the steam used by the engine) is withdrawn by the first eduction.

What I claim as my invention is—

1. The general arrangement, construction, and combination for increasing the average difference between the temperature of the steam to be condensed or of the water to be cooled and that of the cooling water by the combination of a cooler or of a surface-condenser with a double eduction, in the manner herein described.

2. In connection with the combination of a cooler with a double eduction, the arrangement by which the water taken from the hot-well of the common condenser is injected into the additional condenser, in the manner herein described.

3. In connection with the combination of a cooler with a double eduction, the arrangement by which a separate cooler is used for each condenser, in the manner herein described.

4. Delivering the steam discharged by the first eduction from both the cylinders of two connected condensing-engines into one condenser, and by delivering the steam discharged by the second eduction from both these cylinders into another condenser, in the manner herein described.

New York, May 8, 1863.

FRANCIS B. STEVENS.

Witnesses:

JAMES A. STEVENS,

ALBERT S. EASUM.