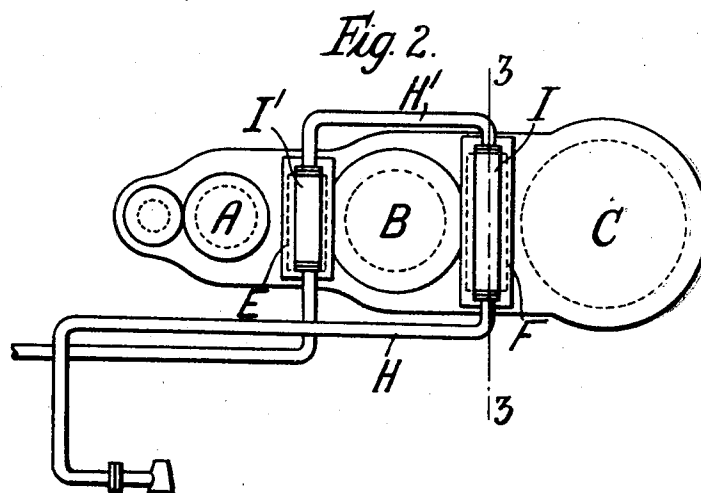
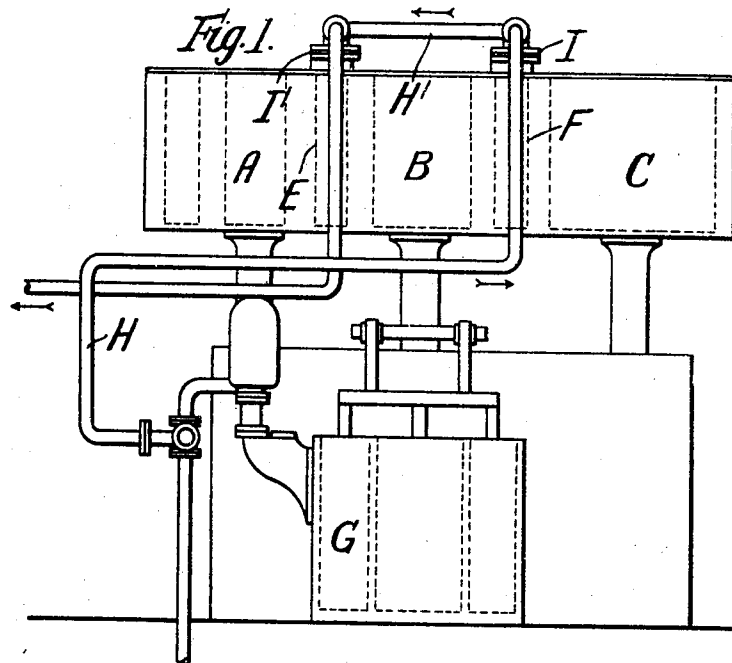


No. 782,929.

PATENTED FEB. 21, 1905.

A. STEWART.
HEATING FEED WATER.
APPLICATION FILED NOV. 7, 1904.

4 SHEETS—SHEET 1.



Witnesses.

F. Heeren
Emma D. Simon

Inventor

Andrew Stewart
by D. Singer atty

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4 SHEETS—SHEET 2.

Fig. 3.

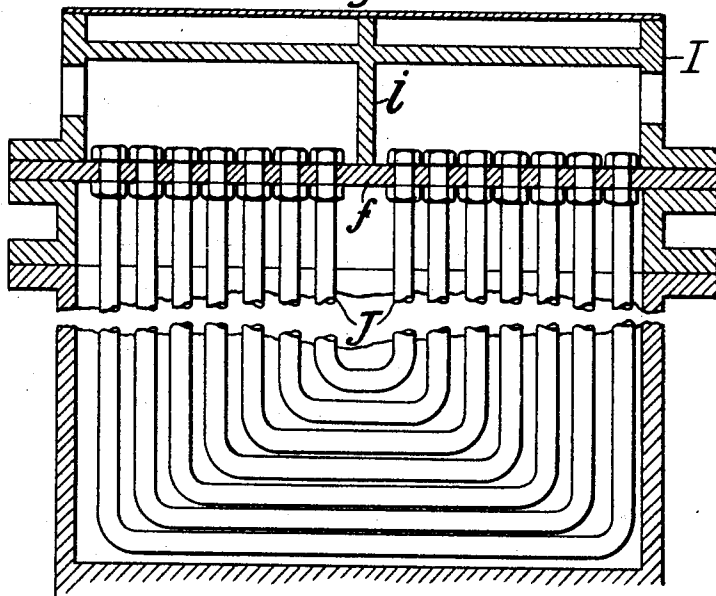
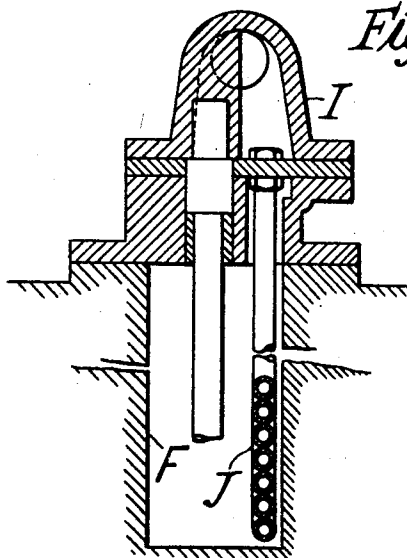


Fig. 4.



Witnesses.

P. Heenan
Irma D. Simon

Inventor

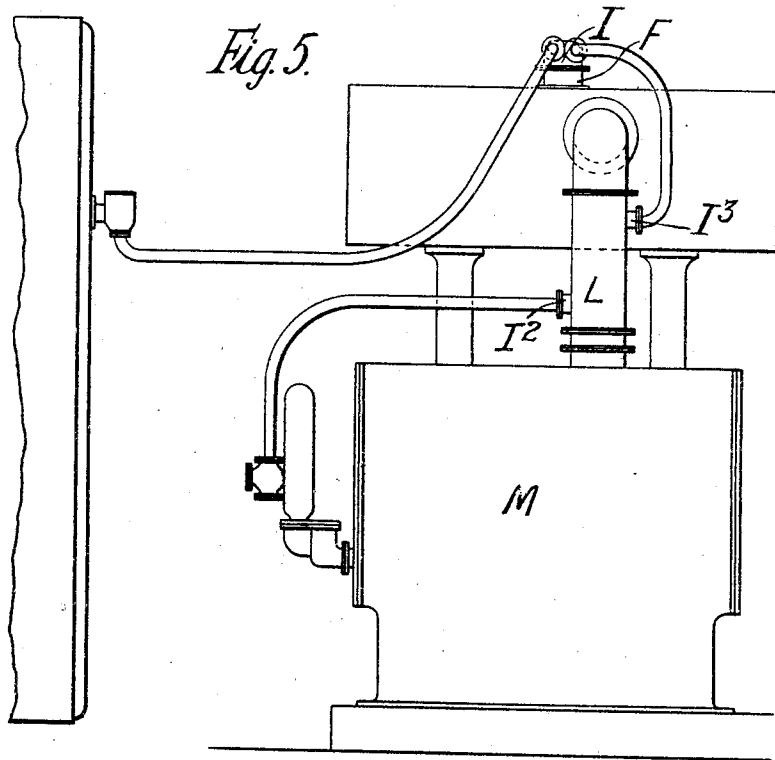
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4 SHEETS—SHEET 3.



Witnesses.

F. Heer
Irma D. Simon

Inventor

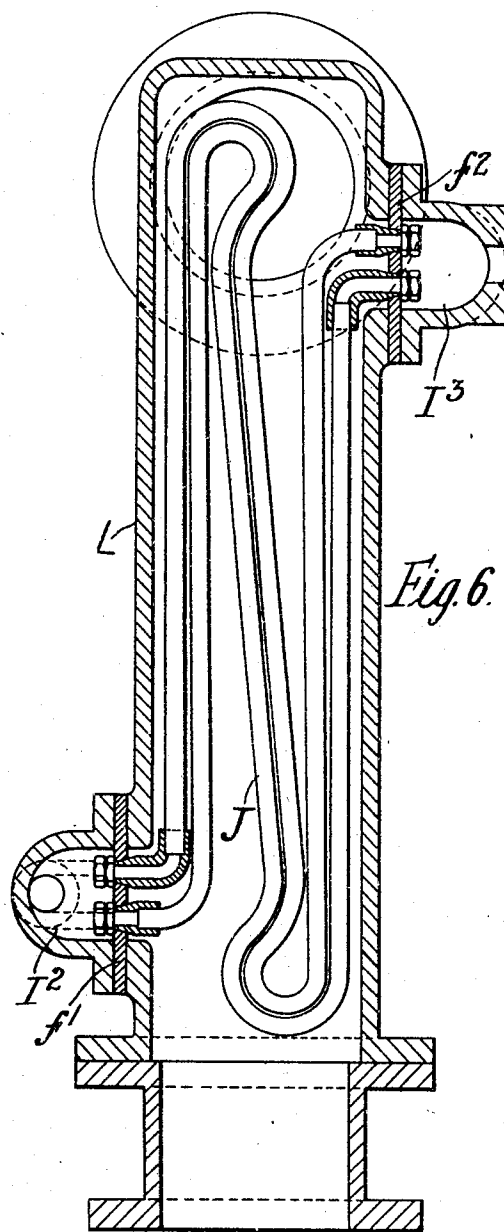
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4 SHEETS—SHEET 4.



Witnesses.

P. Green
Irma D. Simon

Inventor

Andrew Stewart
by *B. Singer* atty

UNITED STATES PATENT OFFICE.

ANDREW STEWART, OF ABERDEEN, SCOTLAND.

HEATING FEED-WATER.

SPECIFICATION forming part of Letters Patent No. 782,929, dated February 21, 1905.

Application filed November 7, 1904. Serial No. 231,741.

To all whom it may concern:

Be it known that I, ANDREW STEWART, of Aberdeen, Scotland, have invented a certain new and useful Improvement in Apparatus for Heating Feed-Water of Steam-Boilers; and I hereby declare that the following is a full, clear, and exact description of the same.

This invention relates to apparatus for heating the feed-water for steam-boilers on its passage thereto from the pump.

Under the invention the feed-water is led from the pump through a series of tubes extending through a receiver which takes the place of the exhaust or eduction pipe from the low-pressure cylinder of the engines and thence through a series of tubes in each receiver or valve-chest between the cylinders, through which the steam passes on its way from each cylinder to that into which it is expanded, so that the feed-water is highly heated by transference of heat from the exhaust and from the expanding steam in the valve-chests or receivers and is delivered at extremely high temperature into the boiler with resulting economy of fuel and enhanced vacuum in the condenser.

The invention is illustrated by way of example in the accompanying drawings, in which—

Figure 1 is a side elevation in diagrammatic form of a triple-expansion engine, showing the pipe connections for the feed-water from the pump through the receivers located between the cylinders. Fig. 2 is a plan thereof. Fig. 3 is a vertical section, on a larger scale, taken at the line 3 3 of Fig. 2, showing one of the receivers and the tubes through which the feed-water passes to be heated by the steam flowing through the receiver. Fig. 4 is a cross-sectional view thereof. Fig. 5 is an elevation of a compound engine in which the feed-water-heating devices are applied to the valve-chest or receiver between the two cylinders and to the eduction or exhaust pipe from the low-pressure cylinder; and Fig. 6 is a vertical section of the eduction-pipe to a larger scale, showing the feed-heating pipes therein. The feed-water-heating tubes may be located only within the receivers or valve-

chests between the cylinder of the engines, or within such receivers and also within the eduction or exhaust pipe, or only within the latter.

Referring to the drawings, and more especially to Figs. 1 to 4, A is the high-pressure cylinder, B the intermediate cylinder, and C the low-pressure cylinder of a three-cylinder triple-expansion engine. E is the receiver or valve-chest between the high-pressure and intermediate cylinders, and F is the receiver between the intermediate and low-pressure cylinders. To the feed-pump G is connected a pipe H, which leads the feed-water to a casing I, bolted onto and forming the cover for the upper end of the valve-chest or receiver between the low-pressure cylinder C and the cylinder B adjoining it. The casing I is divided into two compartments by a web *i'*, and between it and the valve-chest or receiver F is fitted a tube-plate *f'*, in which are secured the ends of U-shaped or like tubes J, one end of each tube J being open to one compartment and the other end to the other compartment of the casing I, so that water entering said casing by the pipe H must pass through the tubes J to reach the other end of the casing, whence it passes by the pipe H' either direct to the boiler or, as shown, to a similar casing I', which is or may be a duplicate of the casing I and has fitted to it a tube-plate with water-heating tubes extending into the receiver E, located between the high-pressure and intermediate cylinders A and B.

When water-heating tubes J are also fitted within the eduction or exhaust pipe L, leading from the low-pressure cylinder to the condenser M, the arrangement shown at Figs. 5 and 6 is adopted. A casing I² is fitted on the eduction-pipe L over an opening in its side covered by a tube-plate *f''*, in which latter are secured the ends of bent tubes J, whose other ends are secured in a tube-plate *f''* and are open to a casing I³ on the farther side of the eduction-pipe L, so that the water led from the feed-pump into the casing I² traverses the bent tubes and flows out through the casing I³, being heated in its course through the tubes J by the exhaust-steam in its passage through the eduction-pipe impinging on

the tubes. The heated water may either be led direct to the boiler or to the casing I over the receiver F between the engine-cylinders.

The arrangement and form of the water-heating tubes J may obviously be varied to suit the dimensions and location of the receivers through which the steam flows in its passage from cylinder to cylinder or to the condensers, and they may be fitted to all of such receivers in a compound or multiple-expansion engine or to one or more of them.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. In a compound multiple-expansion steam-engine, the combination with the cylinders of a receiver between the cylinders into which the steam passes from one cylinder to enter another cylinder of lower pressure, a feed-pump, piping connecting said pump to the boiler, and tubes within said receiver through which the feed-water passes on its way to the boiler, substantially as described.

2. In a compound multiple-expansion steam-engine, the combination with the cylinders of a receiver between the cylinders, a casing

forming the cover for said receiver, a web dividing said casing into two compartments, a tube-plate between said casing and said receiver, bent tubes connecting said compartments, a feed-pump and piping connecting said pump to the boiler and connected to said compartments, substantially as described.

3. In a compound multiple-expansion steam-engine, in combination, a plurality of cylinders, a receiver between each pair of cylinders, a condenser, an eduction-pipe leading from the low-pressure cylinder to the condenser, water-heating tubes led through said eduction-pipe, water-heating tubes led through said receivers, a feed-pump, and a connection including said tubes, joining said feed-pump to the boiler, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ANDREW STEWART.

Witnesses:

JNO. ARMSTRONG, Junr.,
W. HOWIESON.