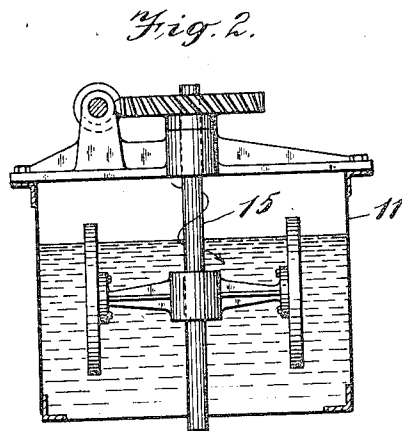
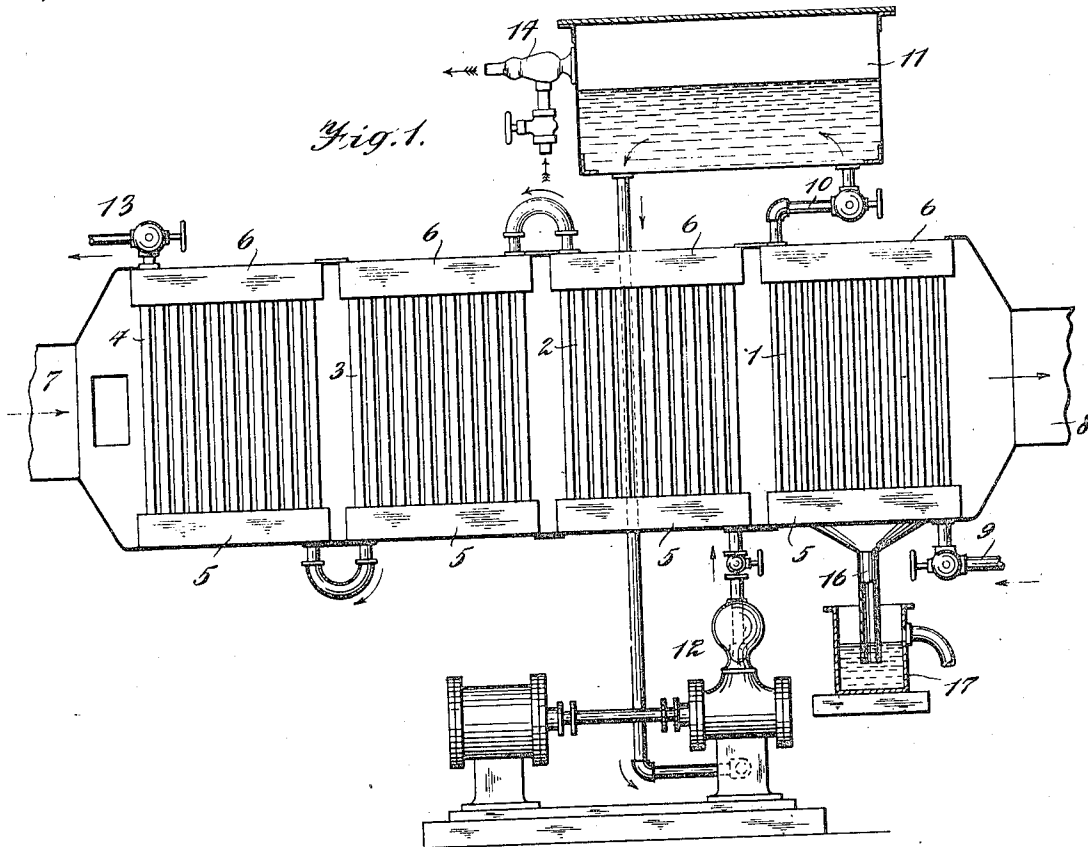


D. S. JACOBUS.
STEAM BOILER ECONOMIZER.
APPLICATION FILED AUG. 12, 1913.

Patented Mar. 13, 1917.
4 SHEETS—SHEET 1.

1,219,320.



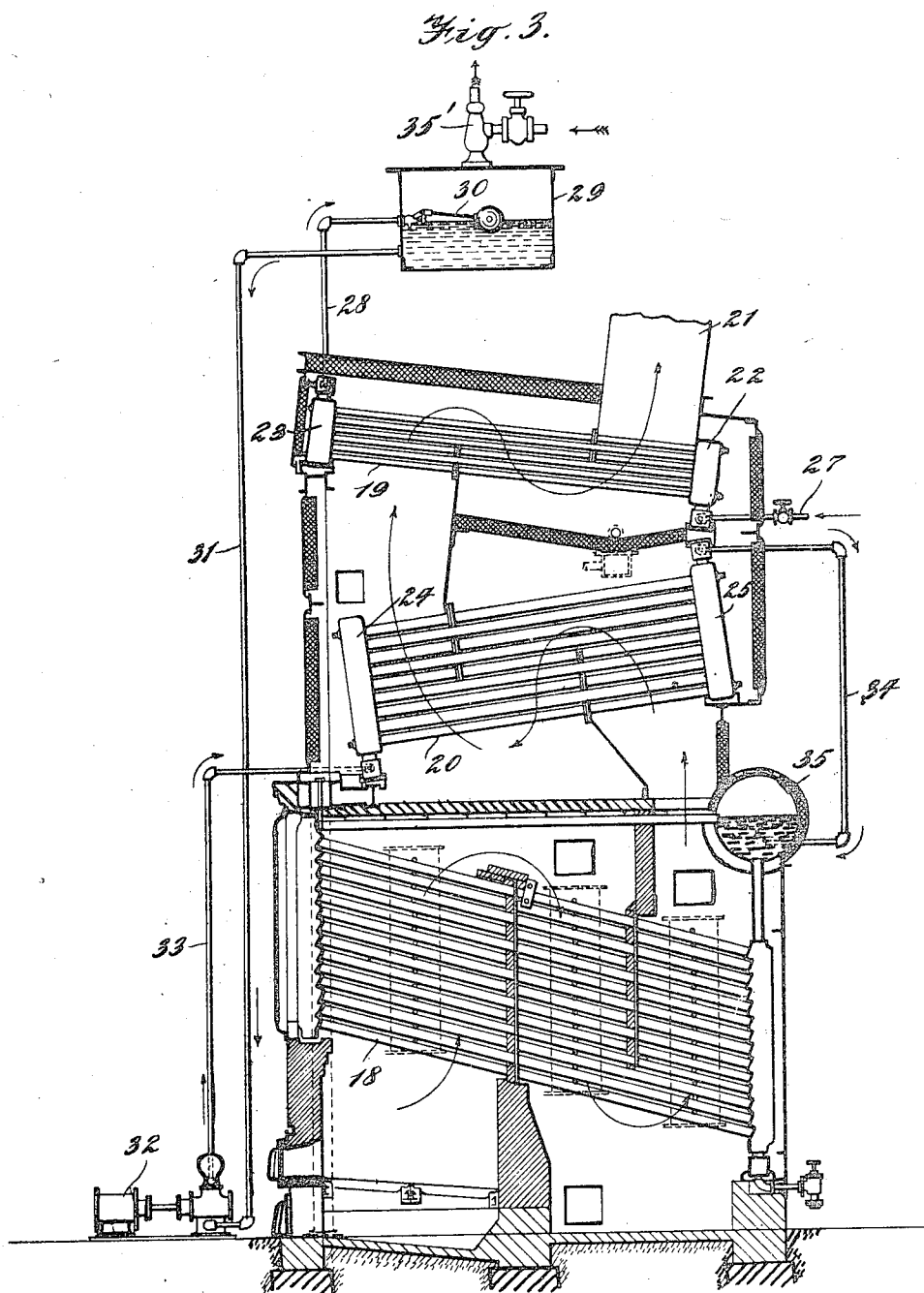
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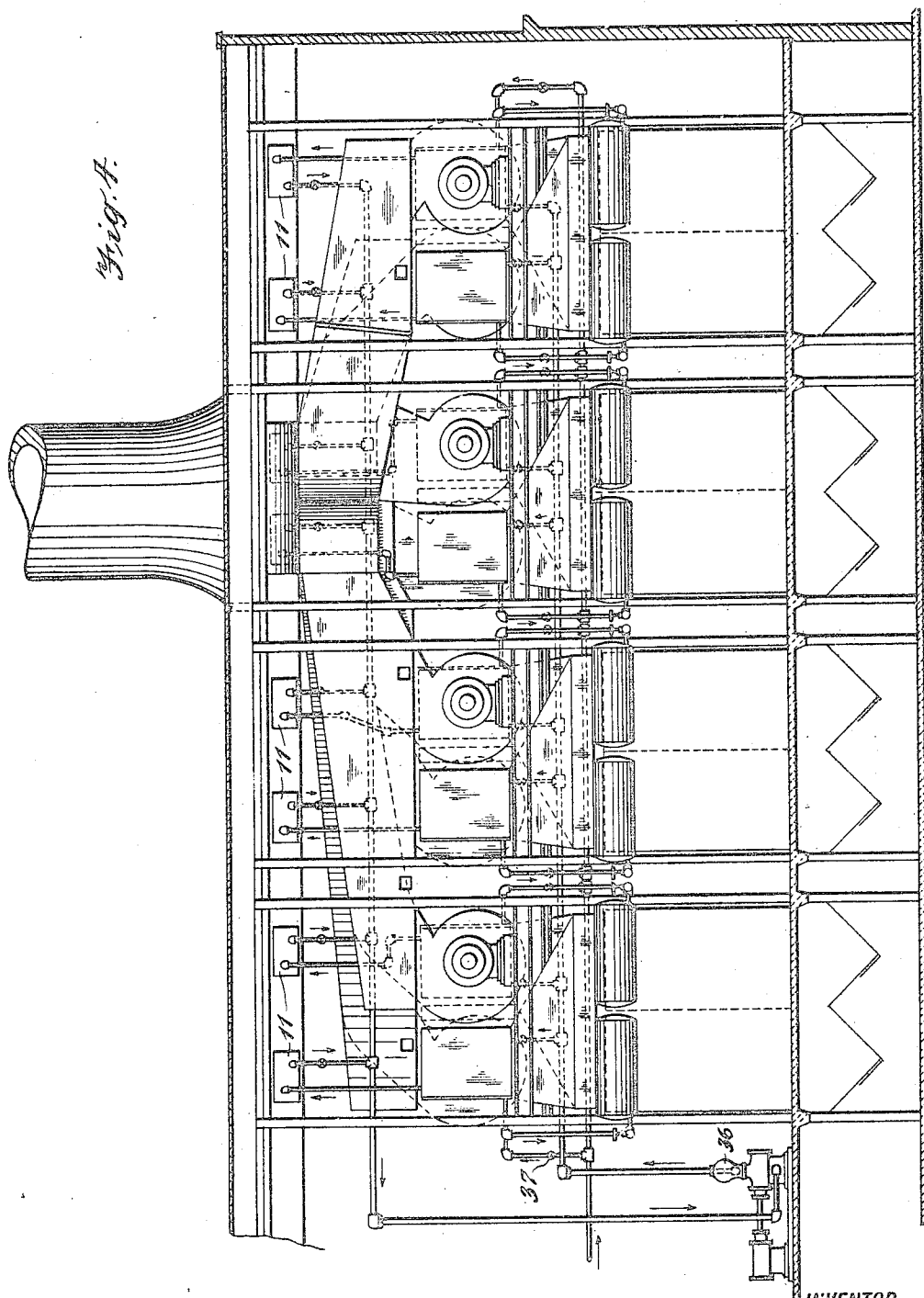
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4 SHEETS—SHEET 3.



WITNESSES:

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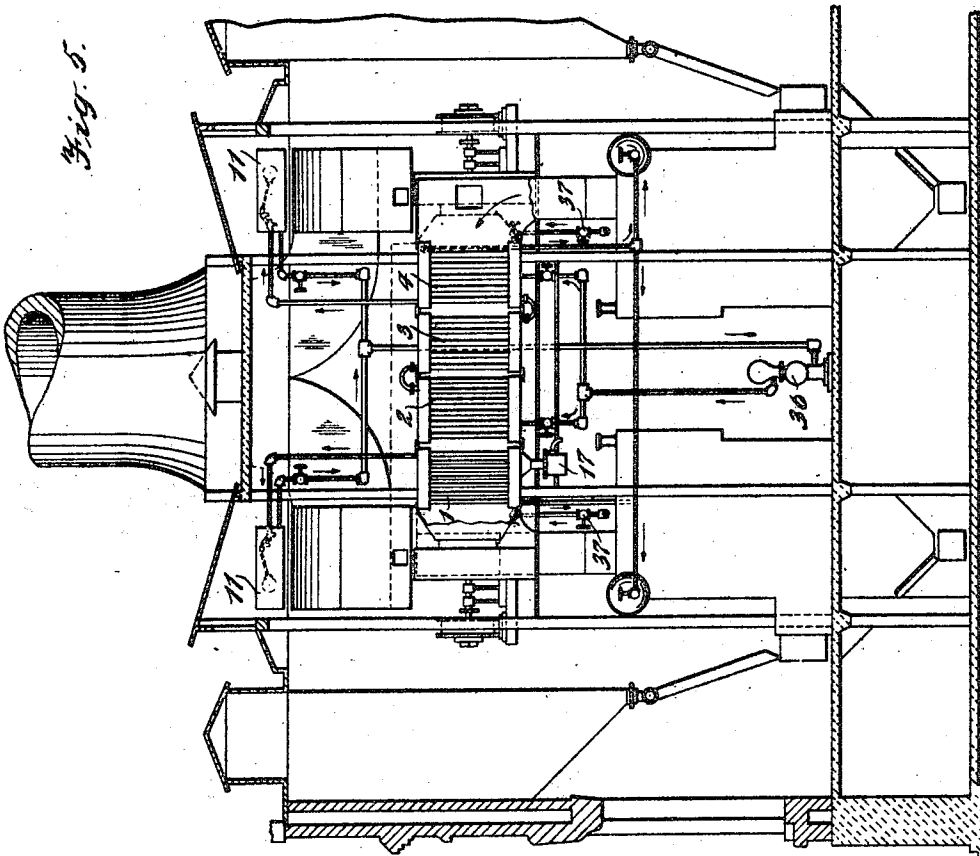
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4 SHEETS—SHEET 4.



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UNITED STATES PATENT OFFICE.

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STEAM-BOILER ECONOMIZER.

1,219,320.

Specification of Letters Patent.

Patented Mar. 13, 1917.

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To all whom it may concern:

Be it known that I, DAVID S. JACOBUS, a citizen of the United States, residing at Jersey City, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Steam-Boiler Economizers, of which the following is a specification.

My invention relates to steam boiler economizers and is designed to provide an improved apparatus wherein the feed water is heated, is then taken away from the heating apparatus, air or other gases allowed to escape therefrom, and the water then fed, preferably by a pump, into the economizer or a part thereof which is under boiler pressure.

In the preferred form the feed water is first heated in one portion or stage of the economizer which is exposed to the waste gases from the boiler and is preferably a low pressure stage or section, the water then being withdrawn and air or gases allowed to escape therefrom. The water is then forced from the point where air or gases are allowed to escape, into the high pressure section of the economizer which is under boiler pressure.

By this system corrosion of the economizer or a part thereof is greatly reduced and the economizer, or the high pressure section thereof, may be made of material, such as wrought iron or steel, well adapted to withstand pressures, since air or vapors are largely eliminated before the water enters the economizer; or, at least the high pressure stage thereof.

In the accompanying drawings I show a preferred form of my invention in which the pitting and corrosion of wrought iron or steel tubes is largely eliminated and owing to the preliminary heating of the water being carried out in a low pressure stage of the economizer before the air and gases are taken off, the low pressure stage may be made of material, or coated with material, well adapted to withstand external corrosion through condensation of moisture and acid fumes from the flue gases. In these drawings Figure 1 is a side elevation of one form of economizer by which my invention may be practised, the arrangement shown being more or less diagrammatic for the pur-

pose of explaining the invention; Fig. 2 a section through the water tank of Fig. 1 showing an apparatus for agitating the water in the tank; Fig. 3 a vertical longitudinal section through a boiler showing another form of economizer arrangement; Fig. 4 a side elevation of a boiler setting showing another application of the invention; and Fig. 5 a front view of Fig. 4. Similar reference numerals indicate similar parts in the several views.

Although my invention is susceptible of application in various ways, the principle thereof will be readily understood by reference to Fig. 1. In this figure the numerals 1, 2, 3 and 4 designate sections of an economizer arranged in series, the tubes of each section being expanded into lower and upper boxes 5 and 6, respectively. The flue gases enter at 7 and, after flowing over the economizer tubes, leave through flue 8. The cold feed water enters through pipe 9, connected to the lower box of the economizer section 1, and upon leaving the same flows through pipe 10 to a tank 11. From the latter the water is forced, by pump 12, through sections 2, 3 and 4 of the economizer, and finally leaves the economizer through pipe 13. In this arrangement the hot gases first pass over the section of the economizer containing the hottest water, and the cold water enters the section exposed to the coldest gases.

The tank 11 may be open so that the water therein is under atmospheric pressure, or the tank may be closed and the space above the water connected to any suitable device or apparatus, as an ejector 14, for maintaining the pressure below that of the atmosphere. The tank may also contain an agitator 15, shown in Fig. 2.

The purpose of the above described arrangement is to preheat the water and largely remove air or gases therefrom, preferably in a section or part of the economizer itself, so that the remaining part of the economizer will be largely freed from the possibility of pitting or corrosion. As the pressure in section 1 of the economizer is comparatively low, said section may be made up of tubes of material well adapted to resist external corrosion and not necessarily adapted to withstand high pressures, and,

by using tubes of the right diameter and properly spacing them, the heat transferred from the gases to the tubes may be made a maximum with a minimum draft loss. As the cold water flows through the tubes of section 1 it will be heated by the gases to a sufficient temperature to expel the air therefrom, the air escaping when the water is delivered to tank 11. The latter, as above stated, may be open to the atmosphere, or any suitable device may be used to maintain the pressure below atmospheric. The expulsion of the air in this manner removes the trouble through pitting and corrosion of the wrought-iron or steel tubes of sections 2, 3 and 4 of the economizer.

It has been the practice heretofore in the operation of economizers to heat the feed water before it enters the economizer to a point where there will be no condensation of vapor from the hot gases, or, in other words, in ordinary economizer practice with tubes of wrought-iron or steel the gases are not reduced to a low enough temperature to deposit moisture or acid fumes, this being done to prevent corrosion on the outside of the tubes. At the same time it is necessary for the efficient operation of an economizer that the entering temperature of the water to the last section thereof be maintained at a given amount. In European practice it is at least 100° F. In United States practice the temperature must be about 120° F., the reason for the higher temperature being that our coals contain more sulfur. The ordinary practice, therefore, limits the temperature to which the gases can be reduced by the economizer and, therefore, limits the efficiency of the economizer. To remove this limitation with a corresponding gain in efficiency I propose, as a feature of the present invention, to make the tubes of section 1 of the economizer of a relatively acid-resisting material, or to cover the tubes, if of wrought-iron or steel, with a relatively acid-resisting material. By so doing the temperature of the gases may be reduced to a point which will cause condensation on the outside of the tubes of the vapors and fumes carried by the gases and, therefore, permit of a greater decrease in the temperature of the final gases with a corresponding increase in the temperature of the feed water in section 1 of the economizer. It is a well-known fact that when a vapor passes into a state of liquid it gives out a definite amount of heat. I am, therefore, enabled to usefully apply the latent heat which is liberated on condensing the vapor to assist in heating the water to expel the air from the same and, therefore, directly affect the economy of the system as a whole. By utilizing the latent heat of condensation, and reducing the gases to a lower temperature than is possible under ordinary economizer practice,

in which the feed water must enter at a temperature above that which will cause the vapor and fumes in the gases to condense, there will be a considerable gain in efficiency. The vapor condensed on the outer surface of the tubes in section 1 of the economizer will flow by gravity through pipe 16 into a suitable receptacle 17.

The economizer shown in Fig. 1 may be used in connection with a steam boiler, the flue 7 being connected to the outlet flue of the boiler. For the purpose, however, of illustrating one use of my invention, I have shown in Fig. 3 a plant comprising a standard Babcock and Wilcox boiler having a bank of inclined tubes 18 expanded into uptake and downtake headers. Above the generating surface is placed an economizer comprising a special section 19, and a section 20, both sections being suitably inclosed so as to be heated by the waste gases on their way to the outlet flue 21. The section 19, which corresponds in function to section 1 of Fig. 1, is made up of tubes expanded into headers or boxes 22 and 23, said tubes being preferably of material to resist the action of acid fumes in the gases which condense on the outer surface of the tubes. The section 20, which corresponds in function to sections 2, 3 and 4 of the economizer of Fig. 1, is made up of wrought-iron or steel tubes expanded into headers or boxes 24 and 25. The cold feed water enters through pipe 27 into the box or header 22 and is heated as it flows through the tubes of section 19, the water then going by pipe 28 to a tank 29 where the absorbed air and gases are permitted to escape from the water. A float valve 30 may be employed to control the supply of water in said tank. From tank 29 the water passes by pipe 31 to pump 32, and then by pipe 33 to the box or headers 24 to section 20 of the economizer.

From the latter the water flows through pipe 34 to the steam and water drum 35 of the boiler. Suitable baffles are provided to direct the gases as indicated by the arrows. The tank 29 may be equalized to the atmosphere or there may be a connection to maintain any desired degree of vacuum over the surface of the water.

In this arrangement all of the water fed to the boiler passes through the special section 19 of the economizer and the main section 20. When there are a number of boilers in a plant there may be a separate feed pump for each boiler, or a single special element of the economizer corresponding to section 1 of Fig. 1, or section 19 of Fig. 3, may be placed in the outlet of any number of boilers.

In Figs. 4 and 5 I have shown two batteries of boilers with economizers arranged according to the system described in United

States Patent No. 1,048,739 dated December 31, 1912. In this arrangement the economizers may be of the vertical tube type shown in Fig. 1 with a water tank 11 above each section of the plant, and pipe connections leading to a common pump 36. The flow of the water into and through the special sections of the economizers, thence to tanks 11, pump 36, and sections 2, 3 and 4 of each economizer, is indicated by arrows. With this arrangement it will be necessary to adjust the flow of water through each of the special sections by means of throttling valves 37 in the inlet pipes, so as to make the temperatures of the water leaving the tanks 11 approximately uniform.

While in the foregoing specification I have described a complete economizer plant, it is obvious that the non-corrosive element may be made as a special attachment which may be used in connection with existing economizer plants. The preliminary heating of the water prior to removing the air and gases and forcing the water into the economizer or the high pressure section thereof, may be carried out by heating means other than the low pressure economizer section or stage shown, and by heat other than the waste heat from the boiler; although my invention is limited to an economizer, or a high pressure section or stage in the economizer, heated by the waste gases from a boiler, the water being fed into the boiler from the economizer or at least the high pressure section thereof after being heated and treated. The materials for the tubes in the two stages may be varied and other changes may be made without departing from my invention.

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

1. A steam boiler economizer having high and low pressure sections, the high pressure section being connected to a boiler, means for maintaining the water in said sections under different pressures, a receptacle to which the heated water is delivered from the low pressure section arranged to allow air or gases to escape from the water, and means for forcing the water from said receptacle through the high pressure section and thence to a boiler.

2. A steam boiler economizer having high and low pressure sections, the high pressure section being connected to a boiler, means for maintaining the water in said sections under different pressures, means for permitting the escape of air or gases from the water after it has passed through the low pressure section, and a pump between said sections for forcing the water heated in the low pressure section through the high pressure section to a boiler.

3. The combination with a steam boiler having an outlet flue for the waste gases,

of an economizer having high and low pressure sections and set in said flue so that the gases first contact with the high pressure section and then with the low pressure section, means for maintaining the water in said sections under different pressures, a receptacle to which the heated water is delivered from the low pressure section arranged to allow air or gases to escape from the water, and means for forcing the water from said receptacle through the high pressure section to a boiler.

4. The combination with a steam boiler having an outlet flue for the waste products of combustion, of an economizer having high and low pressure sections set in said outlet flue and with which the gases successively contact, means for maintaining said sections of the economizer at different pressures, means for feeding water into the cooler lower-pressure section of the economizer, means intermediate the sections arranged to allow air or gases to escape from the water heated in the cooler lower-pressure section of the economizer, and means for forcing the heated and treated water to the hotter higher-pressure section or sections of the economizer.

5. The combination with a steam boiler having an outlet flue for the waste products of combustion, of an economizer in said outlet flue and formed of a plurality of sections with which the gases successively contact, means for maintaining different sections of the economizer at different pressures, a connection for feeding water into the cooler lower-pressure section of the economizer, means intermediate the sections arranged to allow air or gases to escape from the water heated in the cooler lower-pressure section of the economizer, and means for forcing the heated and treated water to the hotter higher-pressure section or sections of the economizer, the cooler lower-pressure section of the economizer being constructed of different material from the higher-pressure section or sections and better adapted to resist corrosion than the higher-pressure section or sections thereof.

6. A steam boiler having an outlet flue for the waste products of combustion, an economizer in said flue and formed in sections having different pressures, a tank or vessel to which the water is fed from the low pressure section of the economizer, means for maintaining the pressure in said tank below that existing in the low pressure section of the economizer to aid in removing the air and gases from the water, and means for forcing the water from said tank into a higher-pressure section or sections of the economizer.

7. A steam boiler having an outlet flue for the waste products of combustion, an economizer in said flue having high and low pres-

sure sections, a tank to which the water is fed from the low pressure section of the economizer, means for maintaining a pressure in said tank adapted to aid in removing
 5 the air and gases from the water, and means for forcing the water from said tank into the high pressure section of the economizer.

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

DAVID S. JACOBUS.

Witnesses:

WM. SHELDRIK,
 CHARLES S. JONES.