

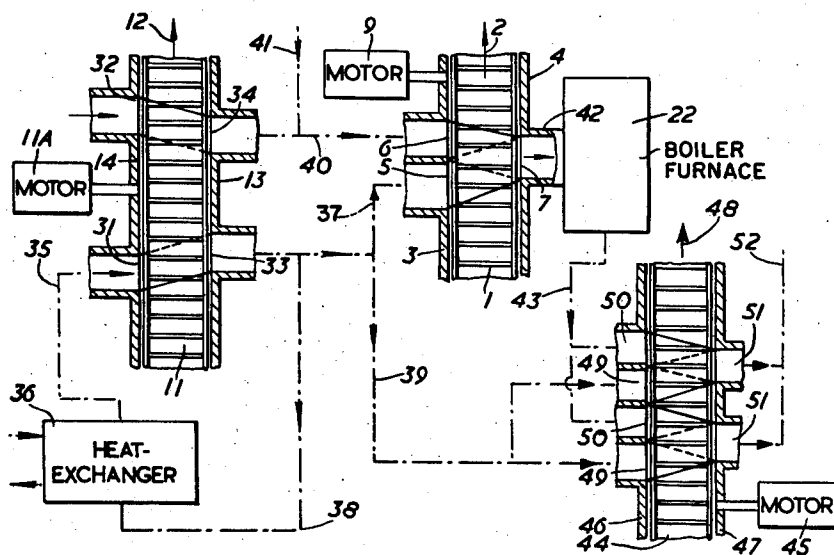
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D. B. SPALDING

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PRESSURE EXCHANGERS

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Inventor
DUDLEY BRIAN SPALDING

By
Laney and Taylor

Attorney

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PRESSURE EXCHANGERS

Dudley Brian Spalding, 2 Vineyard Hill Road,
London SW. 19, England

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1 Claim. (Cl. 110—56)

This invention relates to boiler plant and more particularly to such plant incorporating at least one pressure exchanger.

A pressure exchanger is defined herein as a machine comprising cells in which one gas expands in such a manner as to compress another gas with which it is in direct contact, ducting to lead gas streams substantially steadily to and from the cells and means to effect cyclic relative motion between the cells and the ducting.

It is customary to include in a boiler plant, a means for supplying combustion air at a pressure above atmospheric pressure. The quantity of air required is large, but the pressure is low, thus necessitating high capacity low-pressure fans. The size of such fans may therefore be considerable.

The object of the present invention is to provide a boiler plant having auxiliaries of modest size which are at the same time capable of providing an adequate mass flow at appropriate pressures for a boiler plant.

An embodiment of the invention will now be described by way of example, with reference to the accompanying diagrammatic drawing, in which the sole FIGURE illustrates an arrangement including three pressure exchangers in developed views and a boiler furnace.

Referring to the sole figure, a first pressure exchanger has a cell wheel 1, arranged to rotate in a direction indicated by an arrow 2, and end-plates 3 and 4. A first or higher pressure inlet port 5 and a second or lower pressure inlet port 6 are provided in the end-plate 3 and an intermediate pressure outlet port 7, is provided in the end-plate 4. The cell wheel 1 is driven by an electric motor 9.

A second pressure exchanger has a cell wheel 11 driven by an electric motor 11A. The cell wheel is arranged to rotate in a direction indicated by an arrow 12, and has end-plates 13 and 14.

The second pressure exchanger, which acts as a gas generator, has high and low pressure scavenging stages at which flow takes place in the same direction through the cells. The end-plate 14 has a first inlet port 31 and a second inlet port 32 and the end-plate 13 has a first outlet port 33 and a second outlet port 34. The first inlet port 31 is connected to a duct 35 which is in turn in communication with the cold pass of a heat-exchanger 36. The first outlet port 33 forms a termination of a duct 37 which has two branches 38 and 39, the branch 38 leading to the input of the cold pass of the heat-exchanger 36 and the branch 39 leading to a third pressure exchanger. The duct 37 leads to the higher pressure or first inlet port 5 of the first pressure exchanger. The lower pressure or second outlet port 34 forms a termination of a duct 40 which leads to the lower pressure or second inlet port 6 of the first pressure exchanger. The duct 40 has an inlet branch 41.

The first pressure exchanger is connected by a single duct 42 with the inlet of a boiler furnace 22. The furnace exhaust is connected by a duct 43 with the third pressure exchanger. The third pressure exchanger includes a cell wheel 44 driven by an electric motor 45, and end-plates 46, 47. The cell wheel 44 is arranged to rotate in the direction indicated by an arrow 48. The branch 39 leading from the higher pressure outlet 33 of the second pressure exchanger, itself branches to supply two higher pressure inlet ports 49 of the third pressure exchanger. The duct 43 also branches and supplies two

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lower pressure inlet ports 50. Two outlet ports 51 are connected to an exhaust duct 52 itself connected to a chimney (not shown).

The heat-exchanger 36 would be, in practice, incorporated in the furnace 22, preferably in the form of a bank of air tubes. If desired, more than one set of ports 5, 6, 7 may be provided in the first pressure exchanger as described above with reference to the third pressure exchanger.

The manner of operation of the invention will now be described. In the first pressure exchanger, lower pressure air enters through the port 6 and higher pressure air through the port 5. Air at a pressure intermediate the higher and lower pressure leaves the cell wheel 1 through the port 7 and passes to the furnace 22 through the duct 42. The first pressure exchanger serves as a pressure equaliser.

The second pressure exchanger has a low pressure scavenging stage including the inlet port 32 and the outlet port 34 and a high pressure scavenging stage including the inlet port 31 and the outlet port 33. At the low pressure scavenging stage fresh air from atmosphere is drawn in through the port 32. The low pressure air passes along the duct 40 to the inlet port 6 of the first pressure exchanger whilst additional air from atmosphere is received through the branch duct 41. At the high pressure scavenging stage, heated air is received from the heat-exchanger 36 at the port 31 whilst compressed air leaves through the port 33, one portion recirculating to the heat-exchanger 36, another passing to the third pressure exchanger through the duct 39 and another to the high pressure or first inlet port 5 of the first pressure exchanger.

The third pressure exchanger acts as a pressure equaliser and is effective as an induced draught unit. Lower pressure exhaust gases from the furnace 22 enter the cell wheel 44 through the ports 50 and higher pressure air from the high pressure scavenging stage of the second pressure exchanger enters through the ports 49. Gases at a pressure intermediate the higher and lower pressures leave through ports 51 and pass to a chimney (not shown) through the duct 52.

At the scavenging stages of each pressure exchanger compression waves in the cells are indicated by full lines and expansion waves by broken lines.

I claim:

A boiler plant including:

a boiler furnace;

an inlet and an outlet for the furnace;

first, second and third pressure exchangers;

driving means for the pressure exchangers;

each pressure exchanger incorporating,

a plurality of open-ended cells arranged as a cell ring,

and an end-plate disposed at each end of the cell ring having ports through which working fluid can pass to and from the cells;

the said first pressure exchanger comprising,

a first inlet duct to lead a quantity of high-pressure fluid to the cells,

a second inlet duct to lead a quantity of lower-pressure fluid to the cells,

and an outlet duct to lead fluid from the cells at a pressure intermediate the said high- and lower-pressure;

the said second pressure exchanger comprising,

a first inlet duct to lead a quantity of high-pressure fluid to the cells,

a second inlet duct to lead a quantity of lower-pressure fluid to the cells,

a first outlet duct to lead a quantity of high-pressure fluid from the cells,

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a second outlet duct to lead a quantity of lower-pressure fluid from the cells, and heating means having an inlet and an outlet, the inlet communicating with the said first outlet duct and the outlet communicating with the said first inlet duct; 5

the said third pressure exchanger comprising, a first inlet duct to lead a quantity of high-pressure fluid to the cells, a second inlet duct to lead a quantity of lower-pressure fluid to the cells, 10 and an outlet duct to lead fluid from the cells at a pressure intermediate the last-said high- and lower-pressures; each of the ducts of the said first, second and third pressure exchangers communicating with the cells through corresponding ports in the said end-plates, 15

the first outlet duct of the second pressure exchanger communicating with the first inlet duct of the first pressure exchanger; 20

the second outlet duct of the second pressure exchanger communicating with the second inlet duct of the first pressure exchanger;

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the second inlet duct of the second pressure exchanger being open to atmosphere; the outlet duct of the first pressure exchanger communicating with the inlet of the boiler furnace; the first outlet duct of the second pressure exchanger also communicating with the first inlet duct of the third pressure exchanger; the outlet of the boiler furnace communicating with the second inlet of the third pressure exchanger; and the outlet of the third pressure exchanger communicating with atmosphere.

References Cited in the file of this patent

UNITED STATES PATENTS

2,404,938	Armocost et al. -----	July 30, 1946
2,623,698	Dickey -----	Dec. 30, 1952
2,738,123	Hussmann -----	Mar. 13, 1956
2,853,979	Berchtold -----	Sept. 30, 1958
2,901,163	Waleffe -----	Aug. 25, 1959