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PRESSURE EXCHANGERS

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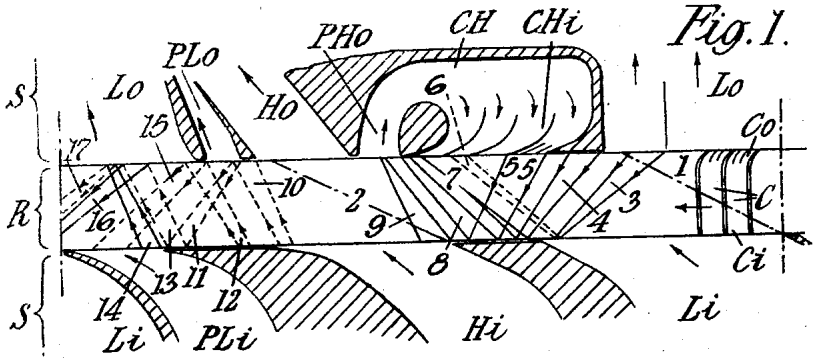


Fig. 1.

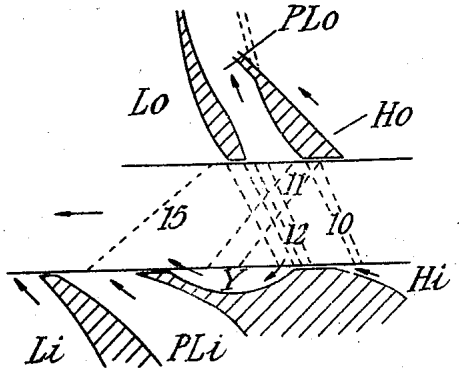


Fig. 2.

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# PRESSURE EXCHANGERS

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7 Claims. (Cl. 230—69)

This invention relates to machines, hereinafter referred to as pressure exchangers, in which each of a plurality of cells serves cyclically and successively to receive gas from a source of lower pressure and discharge it to a pressure-increasing means, and to receive gas from said pressure-increasing means and discharge it to a region of lower pressure. The cells are arranged around the periphery of a rotor mounted to pass over appropriate permanently-open ports in a stator. (Of course, the terms rotor and stator are used relatively, the one to the other, so that it might be that the "rotor" is stationary in space and the "stator" rotates about the rotor.) The admission and discharge of the gas to and from the cell in the lower and in the higher pressure stages is hereinafter referred to as "scavenging"; being defined as a condition in which both ports of the cell being open together for a sufficient duration of time, there occurs a displacement of a substantial part of the former contents from the cell, and their replacement by fresh gas.

The pressure-increasing means is conveniently a combustion chamber wherein the received gas is made to burn with a fuel to increase both its volume and temperature.

Conveniently, too, but not necessarily, the motion of the gas into and out of the cell in both of the scavenging stages is unidirectional, so that it is possible to speak of an inlet to and an outlet from the cell, the inlet being on one flank of the rotor and the outlet on the other flank.

When the machine is arranged as an engine, it serves to convert some of the pressure energy from said pressure increasing means into kinetic energy.

It is desirable that immediately before a cell reaches a scavenging stage, the gas in the cell should be accelerated towards that port, usually the cell outlet, from which the gas is to be discharged in said stage. Hereinafter this acceleration is referred to as "pre-scavenging," and its main function is to prevent the formation of unwanted compression or rarefaction pulses which would adversely affect the functioning of the subsequent scavenging stage.

A somewhat fuller exposition of the working of such machines may be found in the complete specifications accompanying my copending patent applications Numbers 594,461 and 594,462, both filed June 28, 1956.

It is an object of the present invention to provide a pressure exchanger which is improved in respect of certain wave occurrences within the cells, especially over a wide speed range.

The following description relates to the accompanying drawing wherein is shown, by way of example only, one embodiment of the invention. In the drawing,

Figure 1 is a developed view of a pressure exchanger as more fully described and claimed in the above-mentioned copending patent applications Numbers 594,461 and 594,462 both filed June 28, 1956; and

Figure 2 is a developed view of part of such a pressure exchanger modified in accordance with the present invention.



In Figure 1 a rotor R comprises a plurality of cells moving from right to left as indicated by the arrow between the two flanking parts of a stator S. The general flow of gas through the cells is in the upward direction, so that the cell ports may be identified as inlet *Ci* and outlet *Co*. In their motion the cell ports sweep over the mouths or orifices of certain ducts in the walls of the stator. Thus the cell inlet *Ci* passes over the low pressure scavenging delivery duct L*i*, the high pressure scavenging delivery duct H*i*, and the low pressure prescavenging delivery duct PL*i*. Similarly the cell outlet *Co* passes over the low pressure scavenging discharge duct L*o*, the compression delivery duct CH*i*, the high-pressure pre-scavenging discharge duct PH*o*, the high-pressure scavenging discharge duct H*o*, and the low-pressure pre-scavenging discharge duct PL*o*. Various compression and rarefaction waves are generated and reflected, some being desirable, to be utilised, and others being undesirable, to be suppressed if possible. Further details of such a pressure exchanger are to be found in the specifications accompanying the above-mentioned copending patent applications Serial Numbers 594,461 and 594,462, both filed June 28, 1956.

The present invention is illustrated by Figure 2. There, the stator is formed with a pocket *y* in the wall facing the front end of the rotor between high pressure scavenging H*i* and low pressure prescavenging PL*i*. Gases from cells coming into communication with the pocket are discharged with a high whirl velocity in the direction of rotor movement, but owing to their return to the rotor shortly afterwards little loss is caused. The result is to extend rarefaction wave **12**, which is created by the closing of the cell inlet *Ci* to the high pressure scavenging delivery duct H*i*, and to produce a compression wave later to cancel the rarefaction wave **11** created by the opening of the cell outlet *Co* to the low pressure prescavenging discharge duct PL*o*. Furthermore, the rarefaction pulse **13—14** (Figure 1; the rarefaction wave **13** being a reflection of the wave **11**, and the compression wave **14** being created by the opening of the cell inlet *Ci* to the low pressure prescavenging delivery duct PL*i*) which pulse is particularly conspicuous at speeds below the design speed, is prevented from forming; and in consequence the gas flow in the flowing scavenging stage is made more uniform over a wide speed range.

A flow reversal pocket of this type may of course be used in other pressure exchangers than that of Figure 1. Further the prescavenging duct PL may be dispensed with and its function taken over by an enlarged pocket *y* in the simplest designs.

In order to avoid production of an undesirable rarefaction pulse when moving out of communication with the said pocket, the dividing wall between pocket and following duct is made of a width less than the spacing of the rotor cells.

What I claim is:

1. A pressure exchanger comprising a rotor having a plurality of radially extending partitions about the periphery thereof to form a plurality of cells which are open at opposite sides of the rotor, a stator having a wall adjacent each side of the rotor, each wall having ducts therein communicating with the openings in the cells, the ducts in a first wall defining delivery ducts and those in the second wall defining receiving ducts, means for supplying scavenging gas at a low pressure to a first delivery duct, means for supplying scavenging gas at a high pressure to a second delivery duct, a low pressure pre-scavenging receiving duct between high and low pressure scavenging receiving ducts in the second wall and substantially opposite a wall portion between the high and low pressure scavenging delivery ducts, said last named wall portion

having a pocket therein to extend a rarefaction wave produced by the closing of one end of the cell as it passes from open to closed condition.

2. A pressure exchanger as in claim 1 in which the wall portion partially overlaps the low pressure scavenging delivery duct, said pocket extending into the overlapping portion.

3. A pressure exchanger as in claim 2 in which the pocket has a smoothly rounded base portion whereby gases from cells coming into communication with the pocket are discharged with a high whirl velocity in the direction of rotation of the rotor.

4. A pressure exchanger comprising a rotor having in its periphery an array of open-ended cells, a stator having a wall covering at all times the openings in at least one end of said cells in said rotor but having orifices in said wall which register with said open ends of the cells at the said one end successively as the rotor rotates in a cycle determined by the peripheral location of said orifices in said wall, means for supplying high pressure gas to a first wall orifice, means for supplying low pressure gas to a second wall orifice, said wall having a pocket formed in the surface thereof and forming in effect a discharge opening located between said first and second orifices.

5. A pressure exchanger as claimed in claim 4, in which said pocket is so shaped that gas is discharged thereinto from the cells with a high whirl velocity in the direction of rotor movement, and is returned shortly afterwards with little loss.



6. A pressure exchanger as claimed in claim 4, in which said pocket is so shaped and dimensioned that the rarefaction wave produced by closing of the cell to the said first orifice is extended.

7. A pressure exchanger comprising a rotor having in its periphery an array of open-ended cells, a stator having opposing walls covering at all times the open ends of said cells in said rotor but having orifices in said walls which register with said open ends of the cells successively as the rotor rotates in a cycle determined by the peripheral location of said orifices in said walls, means for supplying high pressure gas to a first orifice in one wall, means for supplying low pressure gas to a second orifice in the one wall, said one wall having a pocket formed in the surface thereof and forming in effect a discharge opening located between said first and second orifices said pocket being so shaped and dimensioned that a compression wave is produced which at least in part neutralizes a rarefaction wave produced in the cell by the opening of the cell to an orifice in the opposite wall and receiving low pressure gas from the cells.

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