United States Patent

Firey

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[54] ENGINE EXHAUST GAS SEPARATING DEVICES

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[58] **Field of Search** ..... 60/29 F, 311, 324; 123/75 C, 123/119 A

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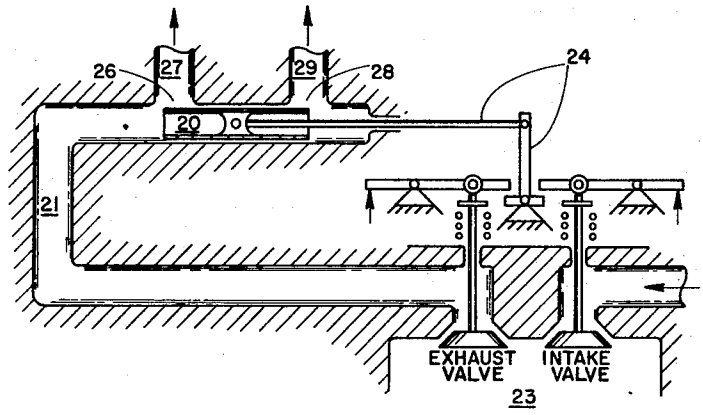
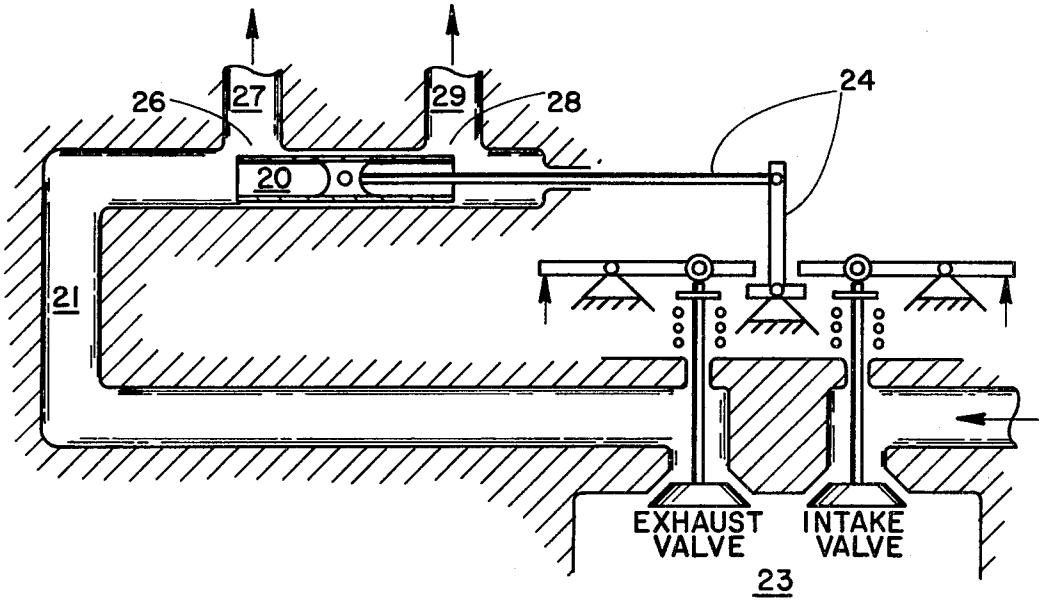
Primary Examiner—Douglas Hart

[57] **ABSTRACT**

This invention provides means for separating the exhaust gas of an internal combustion engine into two streams, one a higher temperature stream relatively richer in oxides of nitrogen, the other a lower temperature stream relatively richer in unburned fuel components. This separation is made by mechanically actuated valves.

2 Claims, 1 Drawing Figure





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ENGINE EXHAUST GAS SEPARATING DEVICES

SUMMARY OF THE INVENTION

It is an object of this invention to provide means of separating the exhaust gas of an internal combustion engine into two streams, one relatively richer in oxides of nitrogen, the other relatively richer in incompletely burned fuel components, so that means of removing or reducing these undesirable portions of the engine exhaust gas can be rendered more efficient or more effective. It is a further object of this invention to provide means of separating the exhaust gas of an internal combustion engine into two streams, one stream relatively higher in temperature and moving at a higher velocity than the other stream, so that exhaust gas heat recovery systems or exhaust gas energy recovery systems can be rendered more efficient or more effective. These and other objects of this invention may be accomplished by flow separating valves mechanically driven via the engine camshaft.

DETAILED DESCRIPTION OF THE INVENTION

The several forms of this invention are intended to be used on an internal combustion engine, hereinafter referred to as "the engine," of one or more cylinders. The engine may be of the four-stroke type comprising cylinders, pistons, connecting rods, crankshaft, camshaft, separate exhaust and intake valves and manifolds, necessary mechanical linkage (e.g., cam followers, push rods, rocker arms, etc.) to permit the exhaust valve and intake valve to be separately actuated, as desired, by the exhaust cam and intake cam of the camshaft respectively, hereinafter referred to as "the exhaust valve linkage" and "the intake valve linkage" respectively, together with an enclosing and aligning engine frame and necessary engine auxiliaries (e.g., carburetor, ignition system, fuel injection system, flywheel, etc). Usually the exhaust manifold of an engine is a single pipe or a single pipe for each cylinder, hereinafter referred to as "the exhaust pipe" or "the exhaust manifold." The object of this invention being to divide the exhaust gas into two streams, one relatively hotter and richer in oxides of nitrogen, the other relatively colder and richer in incompletely burned fuel components, the usual single exhaust pipe is divided into two separate pipes, the "hotter gas manifold" for the former stream, and the "cooler gas manifold" for the latter stream.

One form of this invention is shown in the Figure wherein a splitter valve, **20**, is placed in the exhaust passage, **21**, of each cylinder of a four-stroke-cycle, internal combustion engine, **23**, said valve being moved back and forth by alternate action of the engine exhaust valve cam or linkwork and the engine intake valve cam or linkwork, through the splitter valve links, **24**. The splitter valve links, **24**, are arranged so that opening of the engine exhaust valve moves the splitter valve, **20**, to gradually open the exhaust gas port, **28**, into the cooler gas manifold, **29**, simultaneously closing the exhaust gas port, **26**, into the hot gas manifold, **27**, the gas port, **26**, not being fully closed nor the gas port, **28**, being fully open until the engine exhaust valve is almost fully opened by action of the engine exhaust valve cam. The splitter valve links, **24**, are further arranged so that opening of the engine intake valve moves the splitter valve, **20**, to open the gas port, **26**, into the hot gas manifold, **27**, and simultaneously close the gas port, **28**, into the cooler gas manifold, **29**, in such manner that the gas port, **26**, is fully open and the gas port, **28**, is fully closed before the engine intake valve completes its opening and closing operation. It is not intended to restrict this invention to the particular form of splitter valve and linkwork shown in the Figure. For example, the valve could also be of the poppet, or flat slider, or intermittently rotary type.

Each form of this invention separates the exhaust gas from the engine cylinder into two streams, a hotter, first flowing portion, and a cooler, later flowing portion. In the normal operation of an internal combustion engine undesirable oxides of nitrogen are formed and these survive best to exhaust in those gas portions which remain at the higher temperatures. Unburned and partially burned portions of the fuel are also formed in the normal operation of an internal combustion engine and particularly in the layer of chilled gas next to the combustion chamber and cylinder walls. When the engine exhaust valve or exhaust port is first opened, the gas pressure in the cylinder is appreciably greater than the pressure in the exhaust manifold. The cylinder gases flow rapidly into the manifold under the action of this large pressure difference, and these first flowing gases come largely from the unrestrained central portions of the cylinder volume and, hence, are largely the hotter portions of the exhaust gas, relatively richer in the undesirable oxides of nitrogen. The several forms of this invention direct this first flowing exhaust gas into the hotter gas manifold. Subsequently, the cooler exhaust gas is forced out of the cylinder, by the piston in a four-stroke-cycle engine, or by the scavenging gas in a two-stroke-cycle engine. These later flowing gases are relatively richer in the chilled gas from the layers next to the combustion chamber and cylinder wall surfaces and, hence, are cooler gases and are relatively richer in the undesirable unburned and partially burned portions of the engine fuel. The several forms of this invention direct this later flowing exhaust gas into the cooler gas manifold. This invention thus makes possible the more efficient and more complete removal of unburned and partially burned fuel from the exhaust gas by, for example, oxidizing these materials with extra added air, because the unburned and partially burned fuel is more concentrated in the cooler gas stream than in the entire engine exhaust gas stream. In a similar way, the reduction and removal of the oxides of nitrogen can be carried out more efficiently and more completely by chemical or catalytic methods within the hotter gas stream wherein these oxides are more concentrated than they would be in the entire engine exhaust gas stream.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. An exhaust gas flow separating device for a four-stroke-cycle internal combustion engine having an exhaust valve, an exhaust valve linkage and an intake valve linkage, comprising a valve element, for each cylinder of the engine, actuated by the exhaust valve linkage and the intake valve linkage in such a manner that said valve element is open, directing gas to a hotter gas manifold well before the engine exhaust valve starts to open, and that, as the engine exhaust valve starts to open, said valve element starts to close the hotter gas manifold and simultaneously to open gas flow to a cooler gas manifold, such closing and opening being completed at or before the time of widest opening of the engine exhaust valve.

2. An exhaust gas flow separating device for a four-stroke-cycle internal combustion engine having an exhaust valve, an exhaust valve linkage and an intake valve linkage, to direct the hotter, first flowing exhaust gas portions into a hotter gas manifold and the cooler, later flowing exhaust gas portions into a cooler gas manifold, comprising a valve element for each cylinder of the engine, located in the engine exhaust manifold of each cylinder, said valve element being actuated by the intake valve linkage of that cylinder to connect the exhaust manifold of that cylinder to the hotter gas manifold by the opening action of the engine intake valve, and subsequently being actuated by the exhaust valve linkage of that cylinder to connect the exhaust manifold of that cylinder to the cooler gas manifold by the final opening action of the engine exhaust valve, the ports of said valve being so proportioned that the exhaust manifold is at all times connected either to the hotter gas manifold, or the cooler gas manifold, or to both.

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