

Sept. 1, 1959

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TWIN-PISTON MACHINE WORKING ACCORDING TO
A TWO-STROKE CYCLE FOR PRODUCING
COMPRESSED FLUIDS

2,902,207

Filed April 8, 1957

2 Sheets-Sheet 1

Fig.1.

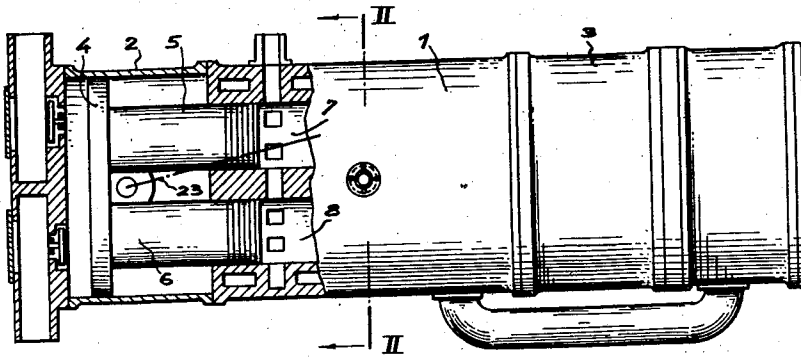
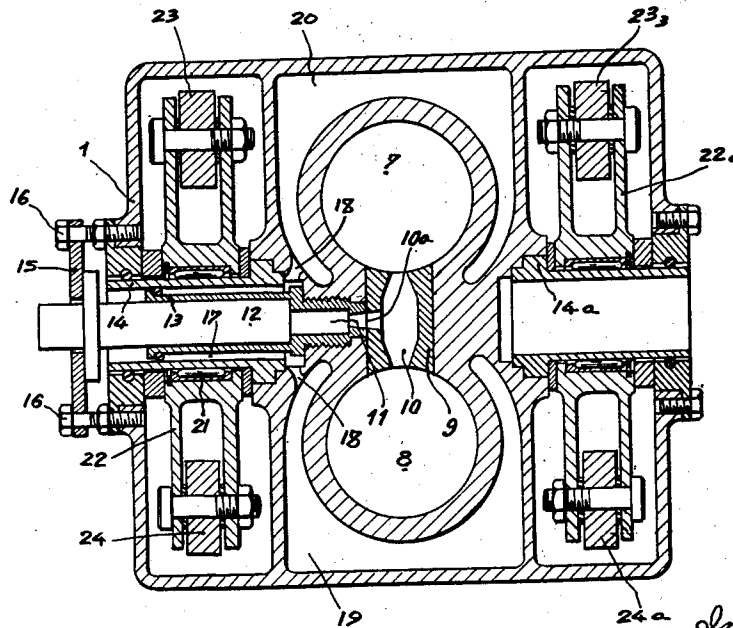


Fig.2.



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FIG. 3.

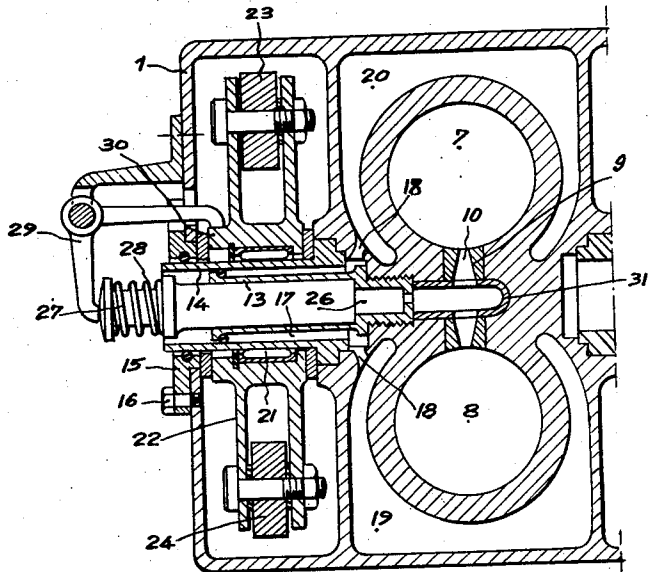
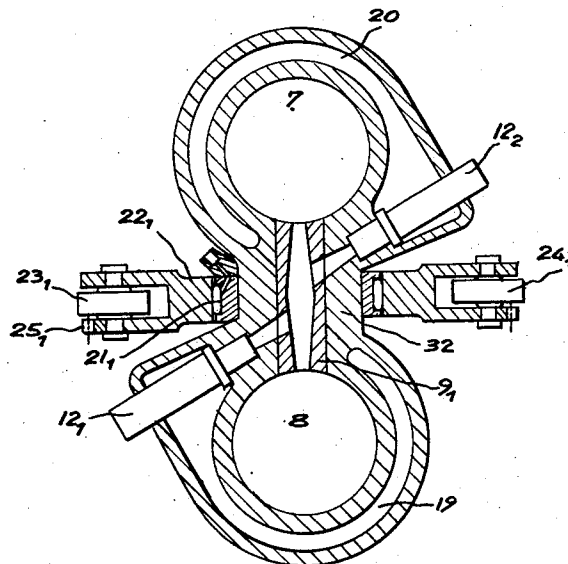


FIG. 4.



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TWIN-PISTON MACHINE WORKING ACCORDING TO A TWO-STROKE CYCLE FOR PRODUCING COMPRESSED FLUIDS

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Application April 8, 1957, Serial No. 651,210

6 Claims. (Cl. 230—56)

The present invention relates to free piston machines of the twin type as described in U.S. Patent 2,807,408 in which two equal flow scavenging motive cylinders of the same bore are arranged so that their axes are parallel. The invention relates more precisely to those of the machines which comprise two motor pistons integral with at least one compressor piston.

The main object of the invention is to ensure to the motive pistons of two movable assemblies comprised by the machine, work that is strictly equal by making it possible to equalise at every moment the pressures prevailing in the two motive cylinders. This particular embodiment has the effect of completely doing away with the risks of distortion or jamming that might arise, if combustion, more particularly, took place in an uneven manner in one or other of the motive cylinders.

One particular advantage of the machine according to the invention lies in the fact that it becomes possible very considerably to lighten the synchronisation members of the moving parts, and, furthermore, the machine made according to the invention will have a very compact structure.

Another object of the invention is to provide a machine whose working cycle is high in comparison to that of known machines, so that it affords a very considerable increase in the power-to-weight ratio.

According to the invention, the machine comprises two movable assemblies each comprising two motor pistons arranged in parallel and at least one compressor piston integral with said motor piston, these movable assemblies being displaced in opposition so that the motor pistons are placed in two parallel motor cylinders, and the cylinders are in communication at their middle part through a common chamber constituting a pre-combustion chamber into which fuel injectors are placed so that the fuel injection takes place in said common chamber.

Other characteristics of the invention will moreover be revealed by the detailed description and claims which follow.

Forms of embodiment of the purpose of the invention are shown by way of non-restrictive examples, in the attached drawings.

Figure 1 is a partially cut-away elevation of a twin piston machine for producing gas under pressure.

Figure 2 is a cross-section, on a larger scale, taken substantially along the line II—II of Fig. 1, showing a particular embodiment of the machine according to the invention.

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Figure 3 is a partial cross-section similar to Fig. 2, showing a modification.

Figure 4 is a cross-section similar to Figs. 2 and 3, showing an alternative.

Figure 1 illustrates a particular form of embodiment of a free pistons machine which comprises a motor casing 1, compressor cylinders 2, 3 being mounted on either side of it.

In the form of embodiment shown, the compressor piston 4 contained by each cylinder 2, 3 is arranged so as to work, for example, by single action, as is the case with certain motor-compressors. The pistons 4 can however be made, as well as the cylinders 2, 3, so as to carry out double-action work, more particularly when the machine is made like a self-generator, i.e. a machine provided to produce compressed gas at high temperature intended to be used in a turbine.

As can be seen on the left part of Fig. 1, the compressor pistons 4 are rigidly attached to the motive pistons 5, 6 arranged parallel to each other.

This particular embodiment enables an efficient guiding to be given to the motive pistons and the compressor pistons, seeing that the synchronisation members, with a connecting-rod-crank or rack and pinion system, for example, are no longer subjected to twisting stresses, thus making it possible to carry them out in lighter material.

In its particular method of embodiment according to the invention, it is advisable that the scavenging and exhaust ports drilled in each of the two motive cylinders 7, 8 in which the motive pistons 5, 6 slide of the two moving sets, should be respectively placed at the same level. Moreover, it is often advantageous that the scavenging and exhaust ports of the two motor cylinders 7, 8 should respectively be connected together.

In Fig. 2, the cylinders 7, 8 in which the two sets of motor pistons slide which must be driven in opposition, are connected at their middle part by means of a nozzle 9. This nozzle 9 internally delimits a compartment 10 whose capacity and shape of the walls are determined so that this compartment 10 forms a pre-combustion chamber common to both cylinders.

11 designates a jet which emerges through the duct 10a into the pre-combustion chamber 10 at its middle part.

The injector 12 of the jet 11 is engaged in a bushing 13 arranged in the bore of a socket 14 supported inside and on the lateral side of the motor case 1. The injector 12 is held in contact by a retaining and centering cheek 15 attached to the case 1, for example, by means of screws 16.

As will be seen from the drawing, the bushing 13 delimits, with the internal wall of the socket 14, an annular chamber 17 advantageously communicating by means of ducts 18 with water jackets 19, 20 surrounding the two motor cylinders 7, 8. The particular arrangement of the water jackets 19, 20 and the annular chamber 17 enables a particularly efficient cooling to be imparted to the various parts of the machine, this cooling being especially more intense than in a machine comprising a single motor cylinder seeing that the exchange surfaces are appreciably greater for one and the same motive cylindric capacity.

The external wall of the socket 14 which forms a hub, acts as a support for a bearing 21 on which a crank 22 can be oscillated to whose ends the little ends of connecting rods 23, 24 are articulated, whose heads are articulated on each of the two movable equipments of the machine.

As shown on the right-hand side of Fig. 2, a second crank 22a is mounted in a symmetrical manner to the crank 22 on a socket 14a similar to the socket 14. This second crank 22a is connected in the same way as the crank 22 to the connecting rods 23a, 24a, also articulated to each of the moving sets of the machine.

The mounting of the two cranks 22 and 22a being strictly symmetrical, it is possible in certain cases to provide the machine with two injectors 12 placed in opposition and both delivering into the pre-combustion chamber 10.

Fig. 3 shows a slight modification according to which the machine comprises a single injector 26 with incorporated pump. The pump of this injector is driven by means of a push-rod 27 subjected to the action of a spring 28. The push-rod 27 is controlled in relation to time with the displacement of the moving sets by means of a rocker 29 bearing on the profile of a cam 30 formed or extended on the side of the crank 22.

This particular arrangement enables the construction of the machine to be considerably simplified, and is especially advantageous for constructing a low-power machine.

In this latter embodiment the pre-combustion chamber 10 is advantageously delimited both by the nozzle 9, which forms the injection nozzle, and by the socket 31 provided in the extension of the pump-injector 26 and communicating with the nozzle 9.

Fig. 4 shows an alternative embodiment according to which the two cylinders 7, 8 are separated from each other by a relatively narrow space, but sufficient to permit of the passage of the synchronisation connecting rods 23₁, 24₁ which, in this way, are partly arranged between the two cylinders so that the heads of these connecting rods can be connected to the middle part of the compressor pistons 4, this being contingently by means of rigid rods carried by these pistons and traversing a partition (not shown) separating the compressor cylinders 2, 3 from the middle part 1 of the machine.

The little ends of the connecting rods 23₁, 24₁, are articulated on a crank 22₁ advantageously formed by a circular plate supported by a bearing 21₁ which is itself mounted on a hollow shaft 32 connecting the two motor cylinders 7, 8 at their middle part. The hollow shaft internally carries a nozzle 9₁ similar to the nozzle 9, and like the latter, delimiting a pre-combustion chamber 10 communicating with the two cylinders 7, 8. This particular arrangement enables a single synchronisation system to be utilized, whose crank, for example, comprises teeth 25₁ for driving dependent parts and more particularly the feed pump or pumps of injectors 12₁, 12₂ arranged obliquely in relation to the axis of the socket 9₁ and delivering into the pre-combustion chamber 10. The machine carried out as shown in Fig. 4 may possess various modifications. More particularly, it is possible to replace the injectors 12₁, 12₂ by incorporated pump injectors like the injector 26. In the latter case the pump-injectors can be driven by a lever system similar to that of Fig. 3, the crank 22₁ comprising one or more suitable cams, and preferably a cam or cams integral with a pinion (not shown) activated by teeth 25₁.

It is also possible to replace the crank 22₁ by a pinion meshing with racks which, in this case, are substituted for the connecting rods 23₁, 24₁.

As will be seen from the foregoing, as well as from the drawings, the machine according to the invention enables strictly equal stresses to be applied to each of the motive pistons of the two moving sets, which completely does away with risks of distortion or jamming which might arise from uneven stresses applied during

the motive cycle to each of the pistons. This embodiment furthermore enables the synchronisation members of the two moving sets to be considerably lightened whose motor cylinders as well as the attached members are suitably cooled owing to the fact of the ease with which large sized water circulation jackets can be made, which enables a thermo-siphon effect to be obtained, eliminating the water pump and hence the rotary movement, which is always difficult to obtain in these machines, and to effect the cooling of the water radiator by air circulated by utilizing the kinetic energy of exhaust gases in an aspirator.

The invention is not restricted to the examples of embodiment shown and described in detail, for various modifications can be applied to it without going outside of its scope.

I claim:

1. A free piston machine comprising two movable elements each consisting of two parallel motor pistons and at least one compression piston rigidly connected to both motor pistons, a housing formed with two parallel motor cylinders, separated by a partition, and open at their ends for the reception of the two motor pistons of each of the two elements, two casings each rigid with said housing at the respectively opposite ends thereof, located outwardly of the motor cylinders, and formed to define compression cylinders symmetrically disposed with relation to the axes of the motor cylinders, the compression pistons of the respective elements being reciprocable in the corresponding compression cylinder, at least a two-arm crank journaled for oscillation upon an axis extending transversely to the motor cylinders through the partition, connecting rods interconnecting the respective arms of said crank and the respective elements, said partition delimiting a chamber communicating with said two motor cylinders at the middle part thereof, at least one fuel injector opening in said chamber substantially in the central portion thereof, and means operated by said crank to control the fuel rate of said injector.

2. A machine as set forth in claim 1 comprising a tubular axis for said crank pivoting around said axis in which said fuel injector is inserted to extend transversely with respect to said chamber in communication with said two motor cylinders.

3. A machine as set forth in claim 2 comprising a cam integral with said crank, a fuel pump connected to said fuel injector and a rocker bearing on said cam and driving said fuel pump.

4. A machine as set forth in claim 1, in which said housing formed with said two parallel motor cylinders is provided further with circulating channels for cooling medium, said circulating channels being formed in part around said motor cylinders and in part around said fuel injector.

5. A free piston machine comprising two movable elements each consisting of two parallel motor pistons and at least one compressor piston rigidly connected to both motor pistons, a housing formed with two parallel motor cylinders open at their ends for the reception of the two motor pistons of each of the two elements, two casings each rigid with said housing at the respectively opposite ends thereof, located outwardly of the motor cylinders and formed to define compression cylinders symmetrically disposed with relation to the axes of the motor cylinders, the compression pistons of the respective elements being reciprocable in the corresponding compression cylinder, a hub interconnecting transversely said motor cylinders at the middle portion of their length, a two arm crank pivotally mounted on said hub between said motor cylinders, connecting rods interconnecting the respective arms of said crank and the respective elements, said hub having further an inner chamber with two symmetrical openings for communication with the inside of said cylinder and said hub and said housing delimiting an inclined recess the axis of which is directed substantially to the central portion of said chamber and fuel injectors

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inserted in said recess to supply fuel into said chamber and said motor piston.

6. A free piston machine as set forth in claim 5 in which said housing is provided with at least an annular channel for circulating a cooling agent around said motor cylinder and said fuel injector.

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