United States Patent

[11] 3,604,204

[72] Inventors **Hans-Joachim Conrad;**
Peter Muller, both of Essen, Germany

[21] Appl. No. **20,738**
[22] Filed **Mar. 18, 1970**
[45] Patented **Sept. 14, 1971**

[73] Assignee **Fried Krupp Gesellschaft mit beschrankter Haftung**
Essen, Germany

[32] Priority **Mar. 22, 1969**
[33] **Germany**
[31] **P 19 14 717.2**

[54] **COUNTERPISTON MACHINE, ESPECIALLY COUNTERPISTON MOTOR**
4 Claims, 1 Drawing Fig.

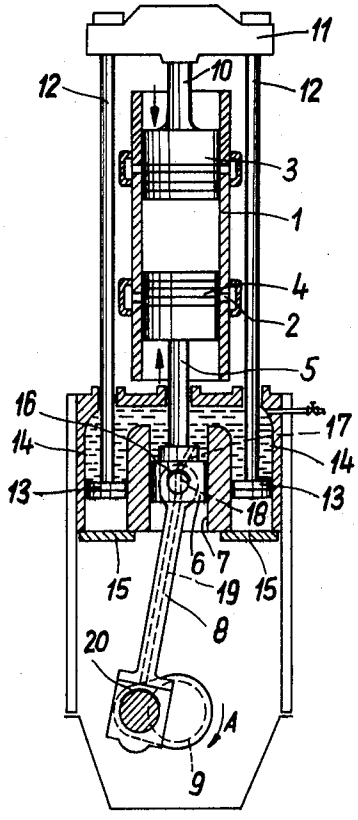
[52] **U.S. Cl.** ..... **60/19,** 60/54.5 R, 19/147
[51] **Int. Cl.** **F02b 41/00**
[50] **Field of Search** ..... 60/19, 24, 54.5 R; 92/146, 147

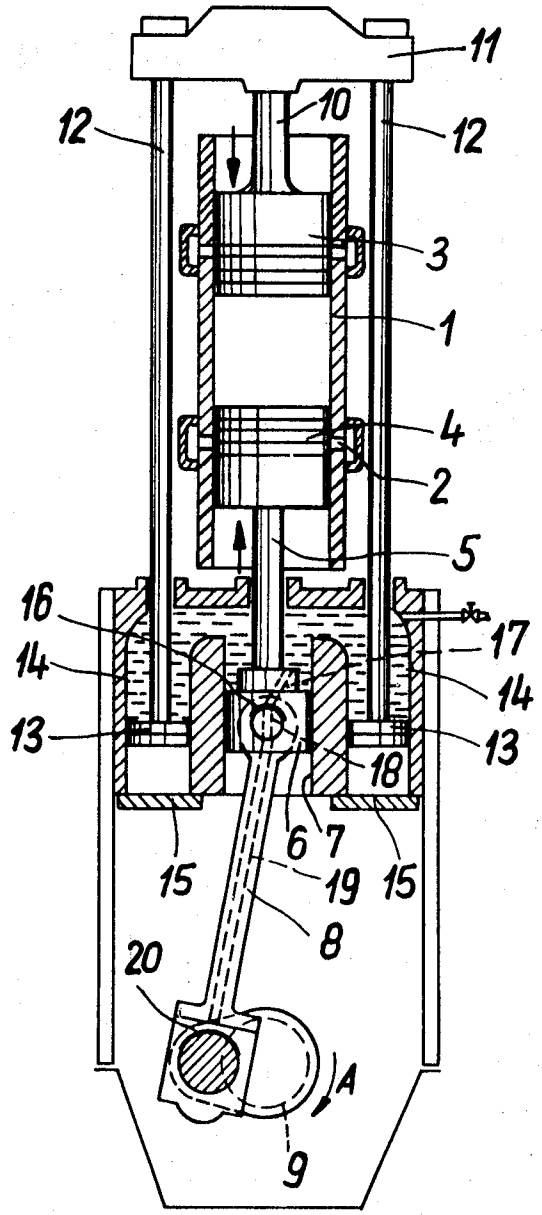
[56] **References Cited**
UNITED STATES PATENTS

2,230,760	2/1941	Pescara	60/19 X
3,066,476	12/1962	Conrad	60/19
3,135,094	6/1964	Kress	60/19 X

Primary Examiner—Edgar W. Geoghegan
Attorney—Walter Becker

ABSTRACT: A counterpiston machine, preferably counterpiston motor, in which at least two displacement pistons are, by pull rods and a transverse yoke, connected with a counterpiston, and in which the liquid columns acted upon by said counterpistons communicate with a chamber in which these columns act upon the annular surface of a piston connected to a piston rod with another counterpiston which latter is formed by a crosshead or is connected thereto.




11
10
12
12
3
1
4
2
5
16
17
14
14
13
13
18
6
7
15
19
15
8
20
A
9

COUNTERPISTON MACHINE, ESPECIALLY COUNTERPISTON MOTOR

The present invention relates to a counterpiston machine, especially counterpiston motor. In U.S. Pat. No. 3,066,476 there is described a counterpiston machine in which a counterpiston by means of a piston rod and a transverse yoke is connected to two pull rods the ends of which are provided with displacement pistons. These pistons are guided by cylinders located parallel to the motor cylinders. The liquid columns in the annular chambers of these displacement piston cylinder systems extend into a common chamber in which they act upon the annular surface of a piston which latter is, by an additional piston rod, connected to another counterpiston. In conformity with this arrangement, the last-mentioned piston together with a cylinder relative to which said last-mentioned piston is movable forms a stroke displacing device by means of which a hydraulic linkage system is connected to a rotary displacer. The pressure fluid delivered by said displacer is divided in at least two branch flows.

It is an object of the present invention to provide a counterpiston machine, especially counterpiston motor, which is provided with a connecting rod-crank driving system and will make use of the above-mentioned system therefor.

The invention is based on a counterpiston machine, preferably a counterpiston motor, in which at least two displacement pistons are by pull rods and a transverse yoke connected to one of the counterpistons, and in which the liquid columns acted upon by the said pistons lead to a chamber in which said liquid columns act upon the annular surface of a piston which is connected to the other counterpiston by a piston rod. The invention is seen primarily in that this piston is formed by a crosshead of a connecting rod-crank driving mechanism or connected thereto.

This design brings a considerable advantage over heretofore known counterpiston machines, especially counterpiston motors. It will be appreciated that with this design, only one connecting rod and only one crank throw is necessary for both counterpistons, whereas heretofore each of the two pull rods required a separate crank throw or a special eccentric while with large outputs, additionally a special connecting rod and a special crosshead were required.

The invention is illustrated by way of example in the accompanying drawing diagrammatically showing partially in section a counterpiston machine according to the invention.

More specifically, the motor cylinder **1** provided with upper and lower inlet and outlet openings **2** has reciprocably mounted therein two counterpistons, namely, the upper piston **3** and the lower piston **4**. The piston rod **5** having one end connected to the lower piston **4** has its other end connected to a crosshead **6** which in conformity with the present invention forms a piston and is reciprocable in a vertical cylinder **7**. The connecting rod **8** pivotally connected to the crosshead **6** is linked to a crank throw of the crankshaft **9**. The piston rod **10** which has one end connected to the upper piston **3** and extends upwardly out of the motor cylinder **1** has its other end connected to a transverse yoke **11**. From said yoke, two pull rods **12** extend downwardly parallel to the motor cylinder **1**. The lower ends of said rods **12** have connected thereto displacement pistons **13** which are reciprocable in vertical cylinders **14**. Those chambers of the cylinders **14** which are located above the pistons **13** communicate with the chamber located above the crosshead **6** and pertaining to the cylinder **7**. The total thus formed chamber is filled completely with a liquid, for instance, oil which is approximately noncompressible. The diameter of the cylinders **7** and **14** are so selected with regard to each other that the volume displaced by the crosshead **6** when the latter moves, for instance, upwardly to a certain extent equals the sum of the volumina by which the chamber above the pistons **13** increases when these pistons move downwardly to the same extent.

The cylinders **14** are at the bottom thereof closed by a cover **15**, and in the thus formed chambers below the pistons **13** there is enclosed a gas which preferably is under an overpressure.

It may be assumed that the crankshaft **9** rotates in the direction of the arrow A so that the crosshead **6** and the lower piston **4** move upwardly. During this movement, the crosshead **6** displaces oil from cylinder **7** into the cylinders **14**. As a result thereof, the pistons **13** and thus the upper piston **3** move downwardly by the same distance by which the crosshead **6** and the lower piston **4** move upwardly.

Between the pistons **3** and **4** moving toward each other, the fuel mixture therebetween is compressed. After the ignition has been effected, the lower piston **4** moves downwardly and the upper piston **3** moves upwardly. Consequently, the lower piston **4** through piston rod **5** acts upon the crosshead **6**. On the other hand, the liquid pressure brought about by the upwardly moving pistons **13** acts upon the crosshead **6**. Consequently, the power component of the upper piston **3** is hydraulically conveyed to the crosshead **6**. Therefore, no separate mechanical driving system associated with the upper piston is required, but a connecting rod-crank driving mechanism **6, 8, 9** will suffice.

The gas in cylinders **14** below the displacement pistons **13** will act as buffer and will thus assure that when starting the motor, the pistons **13** will engage the liquid columns in the cylinders **14**.

The quantity of liquid in the total chamber above the pistons **6** and **13** may by tapping be reduced or may be increased by introducing an additional quantity of fluid. To this end, it is possible in a simple manner, even during the operation of the motor, to change the dead center position of the upper piston **3** whereby the compression ratio can be varied.

The design according to the invention furthermore makes it possible to hydraulically relieve the loaded sliding surfaces of the connecting rod-crank driving mechanism. To this end, the pressure field **16** at the upper portion of the crosshead journal is, through a bore **17** in the crosshead, in communication with the chamber above said crosshead in which the liquid has the respective pressure required for power transmission. This pressure thus relieves the sliding surface of the pressure field **16**.

From the pressure field **16**, bores **18, 19** lead into the crosshead journal or in the connecting rod **8** lead to the pressure field **20** which prevails on the crank journal; consequently, in view of the fluid pressure thus acting upon the pressure field **20**, the loaded sliding surfaces on the crank journal are relieved.

It is, of course, to be understood that the present invention is, by no means, limited to the particular construction shown in the drawing, but also comprises any modifications within the scope of the appended claims.

Thus, while the gas below the displacement pistons **13** may be of any suitable type, air has proved very satisfactory in this connection.

What we claim is:

1. A counterpiston machine, especially counterpiston motor, which includes: first cylinder means having inlet means for a fuel gas mixture and also having outlet means for the exhaust gases, counter running first and second piston means reciprocable in said first cylinder means and operable to compress a fuel gas mixture therebetween prior to the ignition thereof and to exhaust the combustion gases from therebetween after effected ignition, hydraulic chamber means adapted to be filled with hydraulic fluid and comprising second cylinder means and third cylinder means, crosshead piston means reciprocably guided by said second cylinder means and reciprocably connected to said first counter piston means, one side of said crosshead piston means forming a movable wall portion of said hydraulic chamber means, at least two displacement pistons reciprocable in said third cylinder means and forming movable wall portions of said hydraulic chamber means, the total displacement of said

movable wall portions formed by said displacement pistons substantially equaling the displacement of said movable wall portion formed by said crosshead piston means, yoke means connected to said second piston means, and pull rod means operatively connected to said yoke means and said displacement piston means and operable in response to a movement of said counter running first and second piston means toward each other to cause said displacement pistons to convey fluid from said third cylinder means to said crosshead piston means in a quantity substantially equaling the simultaneous displacement of said one side of said crosshead piston means which forms a movable wall portion of said hydraulic chamber means, said crosshead piston means being operable in response to said counter running pistons moving away from each other to convey fluid from said second cylinder piston means to said displacement pistons in a quantity substantially equaling the total simultaneously effective displacement of

said movable wall portions formed by said displacement pistons.

2. A machine according to claim 1, in which said third cylinder means comprise elastic buffer means located at that side of said displacement pistons which face away from said hydraulic chamber means.

3. A machine according to claim 1, which includes means for varying the filling of said hydraulic chamber means to thereby vary the dead center position of said first counter running piston means.

4. A machine according to claim 1, which includes crank drive means comprising connecting rod means pivotally connected to said crosshead piston means, said crank drive means including conduit means establishing communication between load receiving areas of said crank drive means and the interior of said hydraulic chamber means.