A compressor comprising a liquid acting as piston that is displaceable in the piston compartment is described.

According to the invention, a piston dummy (5) that can be displaced with the liquid (3) is arranged in the liquid.

This piston dummy (5) is preferentially designed in such a manner that upon reaching the top dead centre it brings about an acceleration of the liquid (3) in the ring gap defined by said piston dummy and the piston chamber wall.
The invention relates to a compressor, comprising a liquid or liquid column acting as piston which is displaceable in the piston chamber.

Generic compressors, which serve for the compression of gaseous media, such as for example hydrogen and natural gas up to pressures of 1.600 bar, are also called pistonless compressors, since within the piston chamber or cylinder, no conventional piston, but a liquid or liquid column is displaceably arranged. Such a piston is known for example from the German Patent Application 102004046316.

The liquid used in such compressors is preferably an ionic liquid which on the one hand does not dissolve in the medium to be compressed and on the other hand can be separated from the medium to be compressed without any residue. In principle, however, other liquids can also be employed for example high-boiling hydraulic oils, vacuum oils or other high-boiling liquids with low medium solution.

Currently, generic compressors are cooled by the hydraulic liquid itself. If no adequate cooling effect can be achieved with said hydraulic liquid, an additional exterior cooling, for example in the form of a cooling jacket, is realized as a rule.

In order to be able to guarantee an unintentional discharge of the liquid with the compressed medium via the delivery valve and/or a preferably favorable dead space optimization, attempts have been made up to now to keep the surface of the liquid as smooth as possible. However, the heat transfer and thus the cooling effect upon the surface contact are reduced. This results in that the hottest part of the compressor—that is the region of the piston chamber in which the top dead centre is located—is cooled the least. However, this has the disadvantage that in particular the heat development in the top dead centre of the compressor reduces the thermal efficiency of the compression process.

The object of the present invention is to state a generic compressor, with which the cooling output or effect particularly in the region of the top dead centre can be improved and because of this the efficiency of the compressor increased. For solving this object, a generic compressor comprising a liquid displaceable in the piston chamber and acting as piston is proposed, which is characterized in that in the liquid a piston dummy that can be displaced with the liquid is arranged.

Further advantageous configurations of the compressor according to the invention, which constitute subjects of the dependent claims are characterized in that

- the piston dummy is designed in such a manner that upon reaching the top dead centre it brings about an acceleration of the liquid in the ring gap defined by the dummy and the piston chamber wall,
- the bottom of the piston dummy is designed in such a manner that the liquid is held or accelerated in the region of the piston dummy bottom,
- the piston dummy is designed in one or multiple pieces and
- the liquid is at least partially an ionic liquid.

The compressor according to the invention and further advantageous configurations of the compressor are explained in more detail in the following by means of the exemplary embodiment represented in the FIGS. 1 to 3.

The FIGS. 1 to 3 show a lateral sectional representation through a possible embodiment of the compressor according to the invention which is not to be scaled, wherein the FIG. 1 shows the situation at the start of a compression stroke, FIG. 2 the situation at the end of a compression stroke and FIG. 3 the situation during the intake stroke.

The compressor according to the invention comprises a piston 1 defining a piston chamber 2. Within the piston chamber 2 a liquid 3 forming a liquid column, which preferentially is an ion liquid, is arranged. By means of suitable measures—in the FIGS. 1 to 3 represented by a hydraulic piston 4—the liquid column 3 is moved up and down within the piston chamber 2. On the cylinder head, at least one suction valve 6 and at least one delivery valve 7 are provided.

According to the invention a piston dummy 5 designed in one or multiple pieces is now arranged within the liquid 3. The liquid 3 circulates about this piston dummy 5 so that any seals of the hydraulic piston 4 to be provided if applicable are in contact with the liquid 3 at all times. Advantageously, the piston dummy 5 has at least approximately the shape of the cylinder or piston chamber 2. The piston chamber 2 preferentially has an inner contour that is optimized with respect to flow and/or cooling. The aforementioned suction valves 6 and delivery valves 7 are advantageously arranged in such a manner that they support the cooling process. In addition, the bottom of the piston dummy 5 is preferably designed in such a manner that the liquid 3 is held or accelerated in the region of the piston dummy bottom.

During a compression stroke, as is represented in the FIGS. 1 and 2, the liquid 3 is moved up jointly with the piston dummy 5. Since the contour of the piston dummy 5 is matched to the head region of the piston interior an acceleration of the liquid 3 in the ring gap 8 defined by the piston dummy 5 and the piston chamber wall is achieved when the piston dummy 5 approaches the top dead centre. This acceleration of the liquid 3 results in that the liquid 3 comes into contact with the cylinder head to be cooled than with the compressor designs that count among the prior art. Because of the acceleration of the liquid 3 in the ring gap 8 a turbulent flow in the liquid 3 is additionally formed which has an additional cooling effect as a consequence.

As a rule, on reaching the top dead centre, a part of the liquid 3 is jointly with the compressed medium delivered out of the piston chamber 2 via the delivery valve 7. This concerns the uppermost and thus hottest layer of the liquid column.

Following the closing of the delivery valve 7 and at the start of the downward movement of the liquid column 3 and of the piston dummy 5 the rest of the accelerated liquid remaining in the upper region of the piston chamber 2 again shoots past the upper part of the cylinder head, resulting in an additional increase of the desired cooling effect.

In the case of a favorable configuration of the piston dummy 5 to be provided according to the invention the uppermost layer of the liquid 3 remains on the piston dummy 5. This effect occurs particularly with ionic liquids, since the accelerated fluid quantity can no longer dip into the liquid surface. However, this behavior is desired since during the following compression stroke exactly this (hot) liquid quantity is discharged from the piston 1 or piston chamber 2 via the delivery valve 7.

It is obvious, that the shape of the piston dummy 5 is substantially defined by the shape of the piston interior 2 in its
By means of the compressor concept according to the invention, a better cooling of the piston head or cylinder head, particularly in the region of the top dead centre, is achieved. This results in a reduction of the compression temperature and thus of the required compression energy. Consequently the efficiency of the compressor according to the invention increases compared with an otherwise identical compressor with which the piston dummy to be provided according to the invention is omitted.

1. A compressor, comprising a liquid displaceable in a the piston chamber acting as piston, characterized in that in the liquid a piston dummy that can be displaced with said liquid is arranged.

2. The compressor as claimed in claim 1, characterized in that the piston dummy is designed in such a manner that upon reaching top dead centre it causes an acceleration of the liquid in a ring gap defined by said piston dummy and a the piston chamber wall.

3. The compressor as claimed in claim 1, characterized in that a bottom of the piston dummy is designed in such a manner that the liquid is held or accelerated in the region of the piston dummy bottom.

4. The compressor according to claim 1, characterized in that the piston dummy comprises one or multiple pieces.

5. The compressor according to claim 1, characterized in that the liquid at least partially is an ionic liquid.