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Piston compressor

The present invention relates to a piston compressor for compressing fluids. In particular, the present invention relates to a piston compressor of this type which is driven by means of a screw drive.

Piston compressors for compressing fluids such as gases for example are well known. The functioning thereof is based on a piston running in a cylinder whereby a space in the cylinder that is also referred to as a compression chamber is alternately enlarged and made smaller.

Piston compressors are employable in diverse manners, for example, for the production of compressed air (DE 44 29 097 A1 for example) or of cryogenic liquids (DE 10 2006 000 835 A1 for example).

Therein, the drive for the piston of the compressor unit is effected by a crank drive wherein the piston is connected to a crank by a piston rod.

In conventional piston compressors, the processes of sucking in the medium that is to be compressed, the compression and the expulsion thereof are controlled by suction and discharge valves. A determination therewith of the mass or the volume of the compressed medium and of the expelled amount can only be effected with difficulty and inaccurately.

In addition, it would be desirable to have a flexible system in which the working volume of the compression chamber, i.e. the volume when a compression process is not taking place, is variable.

In the known piston compressors, the compressor unit and the piston drive are independent units with corresponding space requirements.

Consequently, a piston compressor of compact construction which is space-saving would be desirable.

A further problem is that of cooling the device in order to enable the heat produced as a consequence of compressing the fluids to be removed, this thus contributing to the complexity of the device.

US patent 6,068,448 relates to a piston compressor having a ball screw drive for compressing compressible fluids, wherein the ball screw drive comprises a cylindrical ball spindle and a ball nut for the linear movement of the ball spindle. The two ends of the ball spindle are connected to a respective piston so that the pistons can be moved back and forth in an opposing compression chamber by the linear movement of the ball spindle.

US patent 6,398,514 B1 describes a piston compressor having a ball screw drive for compressing compressible fluids. The piston compressor comprises a component which consists of two cylindrical components, wherein the one cylindrical component is in the form of a ball spindle and the other cylindrical component comprises an opening at one end which is provided with a compression chamber. In the construction in accordance with US patent 6,398,514 B1, the ball spindle of the rotary part is set into a linear to-and-fro motion by the ball nut.

The Belgian patent BE 719392 describes a drive system having a crankshaft, wherein the crankshaft is surrounded by two different motors which propel the crankshaft. One of these motors is in the form of a ball screw drive, wherein the part of the crankshaft that is surrounded by this motor is in the form of a ball spindle. Here, one is concerned with a drive for a vehicle, a process of compressing fluids and in particular dosage of fluids is not envisaged.

The object of the present invention was to provide a piston compressor for the compression of fluids which will allow precise determination of the output volume of compressed medium, which comprises a compression chamber the working volume of which can be configured to be variable, and which can be cooled in a simple manner.

In accordance with a further aspect, the present invention relates to a piston compressor which has a compact, space saving construction.

In accordance with the invention, this object is achieved by a piston compressor for the compression of fluids having a compression chamber for the compression process and a compression piston, wherein, for driving the piston compressor, there is provided a screw drive having a cylindrical component which is in the form of a threaded spindle, and a threaded nut for converting a rotary movement into a linear movement, wherein an opening with a compression chamber is provided in the cylindrical component at at least one end, and a piston is arranged opposing the opening, wherein the compression chamber is slideable on the piston by the linear movement of the cylindrical component in the form of a threaded spindle.

Any fluids such as gases or liquids, such as cryogenic liquids for example, can be compressed with the piston compressor in accordance with the invention.

In accordance with the invention, at least one compression chamber is provided in the cylindrical component which is open towards one end of the component. This opening is arranged opposing a piston. In operation, the cylindrical component is moved towards the piston and, so to speak, the compression chamber is moved back and forth around the piston.

Two compression chambers can be provided in the cylindrical component, these being arranged base to base and each being open towards an end of the cylindrical component.

In this case, the two ends or openings of the cylindrical component can each be arranged opposing a respective piston. The first and the second compression chambers are pushed onto the respective first and second pistons and pulled back again in alternating manner by the to-and-fro motion of the cylindrical component.

In this configuration, the piston itself or the pistons themselves are stationary and do not move relative to the cylindrical component.

In accordance with the invention, a screw drive is employed as the drive for the piston compressor. Screw drives consist of a cylindrical threaded spindle having a thread on its outer surface and a threaded nut which is screwed onto the threaded spindle and serves for converting a rotary motion into a longitudinal movement.

For this purpose in accordance with the invention, the nut is set into rotary motion which – conveyed by means of the thread - is converted into a linear movement of the counterpart.

The rotary part is supported in such a manner that it itself is prevented from effecting a linear movement. The linearly moving part of the screw drive is secured against twisting.

The linearly moved part of the screw drive is securely connected to a construction that is to be moved linearly, the cylindrical component of the piston compressor in accordance with the invention, and carries it along therewith in the linear movement.

Screw drives themselves are known. Examples of known screw drives such as can also be employed in accord with the invention are ball screw drives, roller screw drives, planetary roller screw drives as well as trapezoidal screw drives.

The process of driving the rotary part of the screw drive can be effected by means of any type of motor either directly or by gearing and belt drives.

Screw drives enable high positional accuracy between pistons and compression chamber to be achieved. Due to this high positional accuracy, the compression volume, i.e. the volume to which the fluid will be compressed, can be determined and adjusted very precisely.

It is thereby possible to make precisely adjustable output volumes of compressed fluid available in a reproducible manner. In addition, the

present invention makes it possible to provide a very precise mass controlled dosage of compressed fluid to a consuming unit such as a machine.

In accordance with the invention, ball screw drives are preferred due to the very precise positional accuracy that is possible and the lower wear-and-tear due to the reduced amount of friction.

Ball screw drives are widely known. For this purpose for example, reference is made to the article "Kugelgewindetriebe mit angetriebener Kugelumlaufmutter" in the journal "Konstruktion, 9 (2010), page 36.

A number of balls are located between a threaded spindle and a threaded nut and they are moved axially in the course of a movement along a spiral running groove in the surface of the spindle and a corresponding running groove in the inner surface of the nut. Consequently, a rotary motion of the threaded nut is converted into a linear movement of the threaded spindle and vice versa.

In accordance with the invention, the cylindrical component itself is the threaded spindle. For this purpose, an appropriate thread is formed on the outer surface of the cylindrical component and a related threaded nut is screwed onto the cylindrical component. In this case, the threaded nut is the rotary part of the screw drive and is set into rotation in any desired manner by a drive. The rotary motion of the threaded nut is transformed into a linear movement of the cylindrical component with the thread. The threaded nut itself is supported in such a manner that it is prevented from making a linear movement.

This configuration is particularly advantageous since piston compressors and screw drives form a compact, so to speak, integral constructional unit which is particularly space-saving.

In dependence on the configuration, the thread can extend over the entire length of the cylindrical component or else over only a part of it. For

example. one or both end regions of the cylindrical component may not have a thread.

The threaded nut can be driven in an arbitrary manner. The drive can be effected by electric motors, hydraulically or mechanically. The drive can be arranged around the threaded nut. The drive can be a separate component which is arranged externally of e.g. beside the screw drive. For example, the drive can be a motor that is laterally flanged thereto. The rotary motion of the nut can be conveyed in any desired manner, e.g. by means of a belt, chain, gear wheel etc.

In correspondence with a conventional piston compressor, the cylindrical component which forms the threaded spindle moves back and forth between two reversal points which correlate respectively with the starting volume and the end volume of the compression chamber. In the state of the starting volume, the compression chamber has its largest volume and in the state of the end volume its smallest volume. Accordingly, the one point of reversal is the starting point and the other point of reversal is the end point. At the starting point, the piston head typically projects somewhat into the compression chamber and thereby seals it from the surroundings.

The starting volume is derived from the cross-sectional area of the compression chamber and the spacing between the base of the compression chamber and the end face of the piston at the starting point. The spacing between the base of the work space and the end face of the piston at the starting point is also referred to as the effective axial height of the cylinder.

The working volume of the piston compressor in accordance with the invention can thus be varied in a simple manner by altering the position of the base and thus the spacing between the base and the end face of the piston and/or by altering the diameter of the compression chamber.

Hereinafter, the principle of the piston compressor in accordance with the invention will be described in more detail on the basis of an embodiment of the piston compressor in accordance with the invention in which the cylindrical component is in the form of a threaded spindle and contains at least one compression chamber.

The compression chamber can be a sleeve which is placed into the interior of the cylindrical component. The sleeve is preferably replaceable. The outer diameter of the sleeve is matched to the internal diameter of the corresponding cavity in the cylindrical component. Since the internal diameter as well as the length of the sleeve can vary, this embodiment permits variation of the working volume of the compression chambers in a simple manner.

For cooling purposes, one or more longitudinal borings which extend in the longitudinal direction outgoing from one end of the cylindrical component can be provided in the outer casing of the cylinder. This longitudinal boring serves for accommodating a cooling pipe via which the cooling agent can be introduced. Since the diameter of the cooling pipe is selected to be smaller than the diameter of the longitudinal boring, the back and forth movement of the cylindrical component is not impeded.

The longitudinal boring can extend over the entire length of the cylindrical component, hereby, a respective cooling pipe can be provided at both ends.

The cooling pipes themselves are fixed and are connected to a respective inlet and outlet line for the cooling agent.

The length of the cooling pipes preferably corresponds substantially to the depth of the neighbouring compression chamber.

The compression chamber can be surrounded by channels which are connected to the cooling pipe so that cooling agent can be fed around the compression chamber.

If the compression chamber is in the form of an insertible sleeve, a spiral groove can be provided in the outer wall of the sleeve which, when it is inserted into the cylindrical tube, functions as a cooling agent channel.

Here, the at least one longitudinal boring is provided between the cylinder cavity and the outer surface of the cylinder. The cooling pipe or the cooling pipes are driven in and out by the back and forth movement of the cylindrical component.

If necessary, seals, which are preferably located in the region of the point of entry of the cooling pipe into the longitudinal boring, can be provided for the purposes of effecting a seal in relation to the surroundings.

A cooling hose could be also used in place of a cooling pipe.

It is thereby also possible to adequately cool even the parts of a piston compressor that are being moved.

The compression piston is arranged opposing the free end of the cylindrical component incorporating a compression chamber and is not moveable relative to the threaded spindle.

At the starting point of the device, the piston head should project at least partly into the open end of the threaded spindle and seal the compression chamber with respect to the surroundings.

Preferably, the piston is also equipped with a cooling system.

For the purposes of supplying a fluid that is to be compressed or for removing the compressed fluid, there may be provided corresponding supply and removal lines in the piston. These lines preferably open out into the compression chamber at the end face of the piston head. Valves or similar closures can be provided at the mouths in order to prevent the fluid from flowing back or to prevent premature escape of the compressed fluid.

Sensors for pressure and/or temperature measurement of the compressed fluid can be provided at the outlet points at which the compressed fluid leaves the compression chamber.

The compression unit in accordance with the invention can be surrounded by a housing or a similar device.

The housing can be totally or partially closed.

Expediently in this case, the threaded nut can be fixed to the housing wall which extends along the longitudinal axis of the cylindrical component with the thread.

The piston can be fixed to a housing wall which opposes the open end of the cylindrical component with the thread with the compression chamber. In the housing wall to which the piston is fixed, there may be provided connecting lines which connect the supply line and the removal line that run in the piston to the exterior. Preferably, the housing part to which the piston is attached is connected to the rest of the housing in releasable manner. This provides for simple replacement of the piston and matching of the piston dimensions to a possibly altered working volume of the related compression chamber.

In accordance with a preferred embodiment, the piston compressor in accordance with the invention comprises a respective piston at both ends of the cylindrical component and the cylindrical component is subdivided into two compression chambers which can be separated from each other by a separating surface in the interior of the cylindrical component. If the cylindrical component is moved back and forth, then on the one hand, the compression chamber at one end will become smaller and the compression chamber at the other end will become larger or vice versa. This embodiment permits of a two-stage mode of operation of the piston compressor in that the starting volume of the one compression chamber is selected to be smaller than the starting volume of the second work space.

For the purposes of further compression, the fluid pre-compressed in the compression chamber of larger starting volume can be supplied to the

compression chamber having a smaller starting volume by way of a connection in the separating surface. Reverse flow of the compressed fluid can be prevented by a closure in the connection. Suitable closures are valves such as one-way valves and the like such as are known and likewise employed in conventional piston compressors.

In operation, the piston head should project into the opening of the compression chamber at the starting point or should adjoin it to at least an extent such that the compression chamber is sealed with respect to the surroundings. The compression chamber can be provided with respective supply and removal lines for the supply of the fluid that is to be compressed or for the removal of the compressed fluid. At the points where these lines open out into the compression chamber, there are provided valves or similar closures in order to prevent the fluid from flowing back again or for preventing premature escape of the compressed fluid.

The piston compressor in accordance with the invention makes it possible to have large variations in the size of the working volume while providing effective cooling. In particular, the end faces of the pistons as well as the bases of the compression chambers can be cooled effectively, these being the zones or regions of a piston compressor where the greatest amount of heat is developed.

One substantial advantage of the piston compressor in accordance with the invention is that the linear movement of the threaded spindle or the threaded nut and the path which these thereby traverse are readily determinable and settable with precision so that the compression volume is computable with great accuracy. For example, the linear movement of the linearly moving part can be determined by measuring the rotation of the rotary part since these are correlated. Furthermore, the linear movement of the linearly moving part can be measured directly. For example, so-called incremental displacement gauges can be utilised for the direct determination of the linear movement.

Consequently, it is possible to discharge specific volumes of compressed fluid and to set the output volumes in a reproducible manner. A determination of the output volumes of this type is not possible or is only possible with difficulty in conventional piston compressors since there, the movement of the pistons and thus the volume of the compressed fluid is not readily determinable.

In accordance with the invention, a precise mass-controlled metering of compressed fluid is also possible in that the temperature and the pressure of the compressed fluid are determined. For this purpose, appropriate temperature and pressure sensors can be provided at the outlet point, i.e. the position at which the compressed fluid leaves the compression chamber.

The piston compressor in accordance with the invention can be operated in pressure controlled manner. For this purpose for example, the pressure of the compressed fluid at the outlet point is measured and the operation of the piston compressor is controlled by the pressure in that the pressure thus determined is compared with a desired reference value.

The piston compressor in accordance with the invention can be employed for a compressor or a pump.

The piston compressor in accordance with the invention can be employed in an advantageous manner for numerous applications in which it is particularly important to meter out defined volumes or masses of fluid, for example, in machine plants, tools etc.

For example, propellant fluids for use in the field of foam technology such as injection moulding, blow moulding technology and extruding can be metered out, as can also cooling fluids and lubricating fluids.

In accordance with one embodiment, two or more piston compressor units can be operated in parallel for combined metering of different fluids, such as for example, combined metering of chemical propellant fluid and

physical propellant fluid or combined metering of cooling fluid and lubricating fluid.

One example of a concrete application is that of using CO₂ for cooling cutting tools and the machining functions in machining treatments such as drilling, milling, turning etc. for example. With the device in accordance with the invention, it is possible to provide precise and uniform metering of CO₂ serving as a cooling agent so that heating of cutting tools and machining tools is prevented. An increase in the feed rate of the cutting tool and an increase in the amount of material removed is thereby possible. Due to the reduced wear-and-tear on the cutting tool, its service life can be extended. An improvement in the quality of the surface of the workpiece is obtained since impairment of the surface of the workpiece due to excessive heating during the machining process cannot occur. This is of advantage particularly in the case of plastics materials since these become soft when heated up. It has also been observed that surface tension in the workpiece is drastically reduced.

Metering of a cooling agent such as CO₂ together with a lubricant, such as oils, emulsions for example is particularly advantageous.

In accordance with a further configuration, metering of fluid can be effected in power controlled manner. For example, a higher power which a machine tool has to apply generally also requires an increase in the need for cooling and an increase in the supply of cooling agent. Since the power is correlated with the current consumption of the motor of the machine tool, the need for cooling agent is determined and accordingly regulated by the measurement of the current consumption.

A further possible application is that of filling airbag cartridges with gas. Until now, the filling level had to be determined by weighing in order to be able to establish whether the cartridge was fully filled.

With the device in accordance with the invention, it is possible to meter the gas volumes necessary for the filling process in a defined manner by appropriate setting of the piston compressor.

In accordance with a further configuration, two or more cylindrical components can be connected to one drive. It is thereby possible to meter out and administer fluid volumes simultaneously or else in time delayed manner depending upon the requirements. For example, 100 or more cylindrical components can be operated simultaneously in order to effect the administration of one or more fluids over a larger surface for example.

In accordance with a further type of application, two or more different fluids can be dispensed simultaneously. For this purpose for example, two or the corresponding number of equipments in accordance with the invention can be switched in synchronism so that an appropriate fluid mixture can be metered out to an application.

As is readily apparent from the above description, the device in accordance with the invention is capable of numerous variants.

The present invention is explained in more detail hereinafter with the aid of the accompanying Figures. Therein,

Figure 1 shows an example for a configuration of the piston compressor in accordance with the invention in which the cylindrical component functions as a threaded spindle and contains the compression chamber, and

Figure 2 a further configuration of a piston compressor in accordance with the invention having a laterally arranged drive.

Figure 1 shows an example of an embodiment of the piston compressor in accordance with the invention incorporating a cylindrical component 1 and a first compression chamber 2 and a second compression chamber 3 which are provided in the interior of the cylindrical component 1, with openings at the ends of the cylindrical component.

The configuration shown in Figure 1 is illustrated with a ball screw drive wherein the cylindrical component 1 is simultaneously in the form of a ball spindle.

A first piston 4 and a second piston 5 corresponding to the first and second compression chamber 2, 3 are arranged opposing the ends of the cylindrical component 1.

The compression chambers 2, 3 are separated from each other by a separation region 6 which extends over the cross-sectional area of the cylindrical component 1, whereby the compression chambers 2, 3 are delineated and differentiated from one another.

In the upper part of the piston compressor shown in Figure 1, the piston 4 is in its end position with the smallest volume of the compression chamber 2. In the lower part of the piston compressor shown in Figure 1, the piston 5 is in its starting position with the largest working volume of the compression chamber 3.

In the starting position, the piston 5 projects at least partly into the compression chamber 3 and thereby seals the compression chamber 3 in relation to the surroundings. The compression chamber 3 has its maximum effective axial cylinder height in this position.

For purposes of a better sealing effect, peripheral slots incorporating seals can be provided in the peripheral surface of the piston heads.

In the exemplary embodiment in accordance with Figure 1, the piston compressor is surrounded by a housing 7.

At one end thereof, the pistons 4, 5 are affixed to the respective terminating surfaces 8, 9 of the housing 7 located opposing the open ends of the cylindrical component 1. At their other ends, they extend up to the open end of the cylindrical component 1 opposing the respective terminating surface 8, 9.

The pistons 4, 5 are preferably of a length which is selected in a manner such that they can effect the sealing of the related compression chamber in their starting position.

In operation, the cylindrical component 1 is moved linearly back and forth in the axial direction by the ball nut 10. For this purpose, the cylindrical component 1 has a running groove 11 for the balls in its outermost surface. In the embodiment shown in the Figure, the running groove 11 extends over the entire length of the cylindrical component 1.

Here, the ball nut 10 that surrounds the cylindrical component 1 is fixed in position to the side walls of the housing 7.

A drive 18 surrounds the ball nut and sets it into rotation. The drive is illustrated schematically as an electric motor. Advantageously, the drive 18 is integrated into the housing.

As a consequence of the rotation of the ball nut 10, the cylindrical component 1 is set into a linear to-and-fro movement.

In the Figure, the cylindrical component 1 is shown in its highest position.

For the purposes of supplying a fluid and removing the compressed fluid, lines (12, 13) which open out into the end faces of the pistons (4, 5) are provided in the pistons (4, 5).

Depending on whether the line serves for supplying (12) the fluid or for the removal (13) of the compressed fluid, appropriate valves, such as an inlet valve or an outlet valve, are provided at the mouth ends of the lines.

For example, a non-return valve or the like can be employed as an outlet valve.

The inlet valve can, for example, be a ball check valve, a cup spring valve, a cone poppet valve or a lamella valve.

In principle, inlet and outlet valves such as those known and utilised for commercially available piston compressors can be used.

For cooling purposes, there are provided two longitudinal borings 14, 15 which each extend over the entire length of the cylindrical component 1. A cooling pipe is located at both ends of a longitudinal boring 14, 15. Here, the length dimension of the cooling pipes is preferably such that, at the time point at which the piston protrudes maximally into the neighbouring compression chamber, they are in a position which corresponds approximately to the protrusion depth of the piston. The cooling pipes are indicated in the Figure by hatched lines which are intended to indicate the end of the corresponding cooling pipe that extends into the longitudinal boring 14, 15. Hoses could also be used in place of the cooling pipes.

Running around the compression chambers 2, 3, there may be channels which are connected to the cooling pipes in order to enable the cooling agent to circulate around the compression chambers.

The compression chamber or the compression chambers 2, 3 can be an integral constituent of the cylindrical component 1 and be worked into its corpus.

In accordance with one configuration, the compression chambers 2, 3 can be sleeves which are insertible in the form of inner pipes into corresponding cavities in the cylindrical component 1 and are preferably replaceable. The cylindrical component 1 can be a hollow cylinder into which the sleeves can be inserted.

Hereby, the working volume of the compression chambers 2, 3 in the sleeves can be varied in a simple manner by variation of the internal diameter of the sleeves and/or the length.

Accordingly, the pistons can be exchanged as necessary and pistons having a different diameter and/or length can be employed.

Advantageously, the terminating surfaces 8, 9 with pistons 4, 5 and connecting lines located therein are replaceable.

In this configuration, the available working volume of the piston compressor in accordance with the invention can be varied in one and the same piston compressor in a simple manner by exchanging the inner sleeves and/or the terminating surfaces without having to replace the complete piston compressor.

For a two-stage mode of operation, the compression chambers 2, 3 may have working volumes of differing sizes and be connected by one or more connecting lines which are equipped with inlet or outlet valves for example.

A fluid that is pre-compressed in the compression chamber having the larger working volume is then fed over the connecting line into the compression chamber of smaller volume for further compression.

The position of the ball nut relative to the cylindrical component 1 as well as the stroke of the cylindrical component 1 in the form of a ball spindle depend on the particular requirements of the concrete device.

In Figure 2, there is shown a piston compressor in accordance with the invention having a construction which corresponds substantially to the configuration of Figure 1. Here however, the drive 18 is arranged outside the housing 7 with the ball screw drive and is flanged thereto. The rotary motion of the ball nut 10 is conveyed by a belt 19.

The piston compressor in accordance with the invention permits of numerous variations. The one piston side can be implemented as a low pressure system and the other piston side as a high-pressure system. Different media can be compressed simultaneously in the compression chambers.

For example, a liquid can be compressed at the one side and a gas at the other side.

In particular, if compression chambers in the form of exchangeable sleeves are employed, the piston compressor in accordance with the invention makes it possible to vary the available working volume for one and the same device. A replacement of the entire device is not necessary.

List of reference symbols

1. cylindrical component (in the form of a ball spindle)
2. first (upper) compression chamber
3. second (lower) compression chamber
4. first (upper) piston
5. second (lower) piston
6. separation region
7. housing
8. (upper) terminating surface
9. (lower) terminating surface

10. ball nut
11. running groove
12. fluid supply
13. fluid removal
14. cooling agent inlet
15. cooling agent outlet

18. drive
19. belt

P A T E N T K R A V

1. Stempelkompressor til komprimering af fluider med et kompressionskammer (2, 3) til kompressionen og et kompressionsstempel (4, 5),
 hvor et gevinddrivværk til at drive stempelkompressoren er forsynet med en cylinderformet komponent, der er dannet som gevindspindel (1), og en gevindmøtrik (10) til at omsætte en drejebevægelse til en lineær bevægelse,
 k e n d e t e g n e t ved, at
 der i gevindspindlen (1) ved mindst én ende er tilvejebragt en åbning med kompressionskammer (2, 3), og et stempel (4, 5) er anbragt liggende over for åbningen,
 10 hvor kompressionskammeret (2, 3) kan forskydes på stemplet (4, 5) ved en lineær bevægelse af gevindspindlen (1).
2. Stempelkompressor ifølge krav 1,
 hvor der i begge ender af gevindspindlen (1) er anbragt et respektivt åbent kompressionskammer (2, 3), og hvor begge kompressionskamre (2, 3) ligger over for et stempel (4,
 15 5), hvor kompressionskamrene (2, 3) skiftevis kan forskydes på stemplerne (4, 5) til kompression ved en lineær bevægelse af gevindspindlen (1).
3. Stempelkompressor ifølge krav 1 eller 2,
 hvor gevindspindlen (1) er en træcylinder, som har et indvendigt rør, som omgiver det mindst ene kompressionskammer (2, 3).
- 20 4. Stempelkompressor ifølge krav 3,
 hvor det indvendige rør er et udskifteligt hylster.
5. Stempelkompressor ifølge krav 4,
 hvor et udskifteligt hylster er anbragt som kompressionskammer (2, 3) i begge ender af gevindspindlen (1).
- 25 6. Stempelkompressor ifølge et af de foregående krav,
 hvor stempelkompressoren har to kompressionskamre (2, 3), der har et forskellig størrelse arbejdsvolumen.
7. Stempelkompressor ifølge et af de foregående krav,
 hvor kompressionskammeret eller kompressionskamrene (2, 3) og/eller stemplet eller
 30 stemplerne (4, 5) har et kølesystem (14, 15).
8. Stempelkompressor ifølge et af de foregående krav,
 hvor stempelkompressoren er omgivet af et helt eller delvist lukket hus (7).
9. Stempelkompressor ifølge et af de foregående krav,
 hvor gevinddrivværket er udvalgt blandt et kuglegevinddrivværk, rullegevinddrivværk,
 35 planetrullegevinddrivværk og trapezgevinddrivværk.
10. Stempelkompressor ifølge et af krav 9,
 hvor gevinddrivværket er et kuglegevinddrev.
11. Stempelkompressor ifølge et af de foregående krav,
 hvor to eller flere gevindspindler (1) er forbundet med en drivanordning og drives

samtidigt.

12. Anvendelse af en stempelkompressor ifølge et af de foregående krav til at dosere fluider, hvor doseringen foregår volumenstyret, massestyret, belastningsstyret og/eller trykstyret.

- 5 13. Anvendelse af en stempelkompressor ifølge et af de foregående krav, hvor der samtidig skal doseres to eller flere forskellige fluider.



