

Cage for a clamping and/or braking device

DESCRIPTION

5 TECHNICAL FIELD

The disclosure relates to a cage for a clamping and/or braking device and a kit for a clamping and/or braking device having such a cage, and a pneumatic clamping and/or braking device.

10 BACKGROUND

In the production of tool or machine parts, machining machines, in particular work spindles or other machine tools, are used which machine material from a workpiece by means of tools fastened to a shaft, in particular in order to bring it into the desired shape. The shaft can be an
15 axis of rotation or pivot axis of such a machine. Furthermore, tables which rotate or pivot by means of a shaft are used to place tools or workpieces into the suitable machining position or to move workpieces at corresponding rotational speeds. A prerequisite for precise and efficient machining is, inter alia, a high rotational speed of the shaft. Emergency or safety systems therefore have the task of stopping the shaft in the event of a fault or failure of the systems,
20 such as, for example, a power failure or cable breakage, or of holding it in a fixed position and thus fixing it.

Common machining machines have electromagnetic, hydraulic or pneumatic clamping and/or braking devices. Such devices have a friction lining which can be frictionally connected to the
25 shaft by means of force transmission. This enables the shaft to be fixed at different speeds.

In hydraulic clamping devices, a chamber is acted upon by hydraulic oil and clamps the rotating shaft or disk firmly. Passive hydraulic clamps are also known. However, such hydraulic clamps have long reaction times or short reaction times require a very high outlay
30 there. Furthermore, the hydraulic material, in particular hydraulic valves and hydraulic pipes, is costly and requires longer assembly times. The hydraulic oil also results in an additional outlay for maintaining cleanliness in the surroundings of a hydraulic clamp.

In pneumatic clamping and/or braking devices, compressed air is usually applied to elastic
35 elements, in particular resilient plates, and can overcome some of the abovementioned disadvantages of hydraulic clamping devices.

EP 1 585 616 B1 and EP 1 651 881 B1 describe pneumatic clamping devices with two annular spring plates, which are introduced into a housing of the clamping devices and form a pressure chamber there, which can be acted upon by compressed air or aerated and vented in order to change the bending of the spring plates and as a result to change between a closed state of the clamping devices, in which an object to be clamped, such as a rotatable shaft, is clamped, and an open state of the clamping devices, in which the object is free. In practice, it has been shown that the introduction of the pressure medium into the pressure chamber between the spring plates can sometimes not be achieved reliably enough. In practice, it has also been shown that the clamping devices should be able to be acted upon by pressure medium in the axial direction from both sides, optionally alternately.

SUMMARY

Proceeding from the prior art mentioned at the outset, the disclosure is based on the object of providing means which enable the pressure medium to be introduced reliably into a pressure chamber of the clamping and/or braking device, in particular in the case of axially two-sided connections for the pressure medium.

The object is achieved with a cage having the features of independent patent claim 1, with a kit having the features of patent claims 6 and 7, and with a clamping and/or braking device having the features of patent claim 17. Some of the preferred embodiments are described in the dependent claims, in the description and in the figures.

According to the solution according to the invention, a cage for introducing a pressure medium into a pressure chamber of a pneumatic clamping and/or braking device is proposed, the cage comprising: two base surfaces; a lateral surface extending between the two base surfaces and connecting these base surfaces to one another; and an interior space which is delimited by the two base surfaces and the lateral surface together, wherein one or more of the base surfaces has an opening for a connection of the clamping and/or braking device for introducing the pressure medium into the interior space, and wherein the lateral surface has one or more openings for passing on the pressure medium from the interior space into the pressure chamber. The cage is preferably free of fastening means (e.g. a thread which is attached, for example, to a projection of one of the base surfaces) for fastening a closure element, such as a plug, a closure screw or other type of means for closing, for closing a connection opening (in a housing of the clamping and/or braking device) for the connection. Within the scope of this disclosure, wherever the term "closure screw" is used, a different type of closure element, such as, for example, a plug etc., can also be used. Accordingly, within the scope of this disclosure, wherever the term "thread" is used, a different type of fastening means for holding the closure

element, such as, for example, a hook, clamping mechanism or adhesive etc., can also be used.

Through the at least one opening in the lateral surface and the at least one base surface with an opening for the connection of the device, the cage enables the pressure medium provided at the connection to pass through the opening in the base surface into the interior space of the cage and from there to be passed on through the opening in the lateral surface into the pressure chamber when the cage is arranged between two elastic elements of the device, where the pressure chamber is also located. The cage brings about axial stabilization or fixing of the elastic elements and enables the pressure medium to be introduced reliably through the cage into the pressure chamber. As a result of the cage preferably being free of fastening means for fastening a closure screw for closing a connection opening for the connection, damage to the elastic elements, in particular the sealing layers or connection seals thereof, can be prevented when a closure screw is screwed on or off, e.g. in the course of changing the side from which pressure medium is intended to be applied to the device (e.g. when the closure screw is adhesively bonded or otherwise blocked). Preferably, no thread for screwing in the closure screw for the connection opening is attached to the cage in order to prevent co-rotating cage and damage to the elastic elements caused thereby.

Preferably, each of the base surfaces has an opening for a connection for impacting the device with a pressure medium. In this case, the cage enables alternating operation in such a way that the pressure medium can be introduced into the device in the axial direction—depending on the application—in one of two different sides without the elastic elements or the cage having to be adapted as a result. In this case, there is an opening in a base surface for introducing the pressure medium into the interior space of the cage for both connection sides, so that the pressure medium can be passed on from there through the opening in the lateral surface into the pressure chamber. By means of a measure, namely the cage, two advantages are thus realized at the same time, namely reliable introduction of the pressure medium into the pressure chamber and two-sided operation of the device in the axial direction.

Preferably, one or more of the base surfaces projects beyond the lateral surface. The projecting region of the base surfaces brings about improved axial stabilization of the elastic elements and furthermore ensures particularly reliable introduction of the pressure medium from the interior space through the opening of the lateral surface into the pressure chamber.

Preferably, the one or more openings in the lateral surface are a plurality of openings in the lateral surface which are arranged at least partially at different, preferably adjacent or opposite, portions of the lateral surface. This enables particularly effective forwarding of the pressure medium from the interior space of the cage into the pressure chamber. Furthermore, this

enables greater tolerances to be achieved in the positioning of the cage within the device. If the openings of the plurality of openings in the lateral surface are distributed rotationally symmetrically (about an axis of the cage running perpendicularly through the base surfaces) in the lateral surface, these tolerances are maximized.

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Preferably, the extent of the cage from the first base surface (including) over the lateral surface to the second base surface (including) is less than 30 mm, less than 27 mm, less than 25 mm or less than 23 mm (for example a maximum of 22 mm). In other words, the lateral surface extends about a height axis of the cage and the extent of the cage along the height axis is less than 30 mm, less than 27 mm, less than 25 mm or less than 23 mm (for example a maximum of 22 mm). The height of the cage is thus less than 30 mm, less than 27 mm, less than 25 mm or less than 23 mm (for example a maximum of 22 mm). The base surfaces can extend in one or more planes transversely to the height axis.

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By means of such a limitation of the extent of the cage, it is particularly reliably prevented that, during assembly, the axial forces on the two flat contacts of the seals (for example rubber coatings) on the elastic elements (especially in the region of the connection seals thereof) and the cutting into the seals (for example rubber coatings) are eliminated by the (projecting) edge of the cage. The cage modified in this way displaces only the necessary volume of the seals (rubber coatings) without bulging at the edges and problematic reductions of the cross sections for the supply or discharge of the pressure medium into the pressure chamber occurring.

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The cage can have a cylindrical or circular cylindrical shape. The two base surfaces can run (substantially) parallel to one another. The lateral surface can intersect the two base surfaces and/or can run (substantially) perpendicularly to the base surfaces.

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According to the solution according to the invention, a kit for a clamping and/or braking device is further proposed, the kit comprising: the cage according to the invention; a closure screw; a housing part, comprising: a connection opening; and a thread arranged on the housing part in the region of the connection opening for screwing in the closure screw for closing the connection opening.

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Preferably, the thread for the closure screw is arranged separately from the cage on the housing part (for example, the thread can be defined directly by an inner surface of the housing part or the thread is defined by means of a coupling element fastened to such an inner surface). As a result, damage to the elastic elements, in particular the sealing layers or connection seals thereof, can be prevented when a closure screw is screwed on or off, e.g. in the course of changing the side from which pressure medium is intended to be applied to the device (e.g. when the closure screw is adhesively bonded or otherwise blocked).

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According to the solution according to the invention, a clamping and/or braking device for clamping and/or braking an object to be clamped and/or braked is furthermore provided, wherein the device comprises the following: a kit according to the invention, in which the connection opening thereof is closed by screwing the closure screw into the thread and in which the elastic element thereof for sealing the housing part is arranged between the cage and the closure screw; a further housing part with a connection opening for the connection of the clamping and/or braking device for applying pressure medium to the pressure chamber; and a further elastic element for sealing the further housing part; wherein the housing parts together form a housing and are arranged with respect to one another and fastened to one another in such a way that inner surfaces of the housing parts together delimit a housing interior space within the housing; one or more clamping elements, wherein each clamping element has a clamping surface; a spring arranged in the housing interior space and comprising the elastic elements, wherein, within the housing interior space, each of the elastic elements is clamped in another of the housing parts in such a way that, in the housing interior space, the pressure chamber is formed between the clamped elastic elements, wherein the cage is arranged between the clamped elastic elements in such a way that the lateral surface of the cage extends from one of the elastic elements to the other of the elastic elements and the pressure chamber can be vented via the openings in the lateral surface, the opening of at least one of the base surfaces and the connection opening of the further housing part and can be aerated or subjected to overpressure of a pressure medium, wherein the spring is designed in such a way that, when the pressure chamber is aerated or vented or the pressure chamber is subjected to overpressure, a bending of at least one of the elastic elements is changable and as a result the device changes between an open state, in which an object to be clamped is spaced apart from the one or more clamping surfaces, and a closed state, in which at least one of the one or more clamping surfaces transmits a clamping and/or braking force to the object.

Since the cage is arranged between the clamped elastic elements in such a way that the lateral surface of the cage extends from one of the elastic elements to the other of the elastic elements and the pressure chamber can be vented via the openings in the lateral surface, the opening of at least one of the base surfaces and the connection opening of the further housing part and is aeratable or can be subjected to overpressure of a pressure medium, axial fixing of the elastic elements, reliable introduction of the pressure medium into the pressure chamber and improved sealing are achieved.

Preferably, each of the elastic elements has a sealing layer with a connection seal and the cage is arranged between the connection seals of the clamped elastic elements in such a way that the connection seals seal the, preferably projecting, regions of the base surfaces of the cage

against the housing parts. The projecting region of the base surfaces brings about improved axial stabilization of the elastic elements and furthermore ensures particularly reliable introduction of the pressure medium with reduced loss channels from the interior space through the opening of the lateral surface into the pressure chamber.

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The problem, which has not been overcome for a long time, of the introduction of the pressure medium into the pressure chamber between the elastic elements, which is susceptible to interference, could be overcome by aspects of this disclosure. By means of the means described here, individually and in combination, clamping and/or braking devices can be provided which enable reliable introduction of the pressure medium into the pressure chamber and at the same time provide a basis for the pressure medium to be applied to the device in the axial direction from different sides, to be precise both without the dynamics of the clamping and/or braking device being impaired or damaged as a result.

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BRIEF DESCRIPTION OF THE FIGURES

FIG. 1A shows a schematic cross section through an inwardly directed, passive pneumatic clamping and/or braking device according to the invention in the closed state.

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FIG. 1B shows a schematic cross section through an outwardly directed, passive pneumatic clamping and/or braking device according to the invention in the closed state.

FIG. 2A shows a schematic cross section through an inwardly directed, passive pneumatic clamping and/or braking device according to the invention in the open state.

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FIG. 2B shows a schematic cross section through an outwardly directed, passive pneumatic clamping and/or braking device according to the invention in the open state.

FIG. 3A shows a schematic cross section through an inwardly directed, active pneumatic clamping and/or braking device according to the invention in the open state.

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FIG. 3B shows a schematic cross section through an outwardly directed, active pneumatic clamping and/or braking device according to the invention in the open state.

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FIG. 4A shows a schematic cross section through an inwardly directed, active pneumatic clamping and/or braking device according to the invention in the closed state.

FIG. 4B shows a schematic cross section through an outwardly directed, active pneumatic

clamping and/or braking device according to the invention in the closed state.

FIG. 5A shows a cross section through an inwardly directed, pneumatic clamping and/or braking device according to the invention in a three-dimensional representation.

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FIGS. 5B to 5D show a variant of a housing part with an elastic element taken from FIG. 5A .

FIG. 6 shows an embodiment of a cage according to the invention.

10 FIG. 7 shows a detail of a cross section of a clamping and/or braking device according to the invention with the cage according to the invention from FIG. 6 .

Components which are represented in a plurality of figures bear the same reference symbols.

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DETAILED DESCRIPTION

The disclosure relates to an annular elastic element and a housing part for a pneumatic clamping and/or braking device and a pneumatic clamping and/or braking device having such an annular elastic element.

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When the device “clamp” or “clamping device”, the “clamping force” or the process of “clamping” is referred to in this document, the device of the “brake” or “braking device” or the “braking force” or the process of “braking” is likewise also encompassed.

25 FIGS. 1A to 5A and 8 show schematic cross sections through such a clamping device 10 according to the invention having a housing 3 which comprises two housing parts 3a, 3b, and having a spring 1 which is arranged in the housing 3 and comprises at least two annular elastic elements 1a, 1b according to the invention.

30 The clamping device 10 according to the invention comprises the following: a first elastic element 1a and a second elastic element 1b; a housing 3 comprising a first housing part 3a having an inner surface and a second housing part 3b having an inner surface (cf. 105 in FIG. 5A), wherein the housing parts are arranged with respect to one another and fastened to one another in such a way that the inner surfaces of the housing parts 3a, 3b together delimit an
35 interior space within the housing 3; one or more clamping elements 8, wherein each clamping element has a clamping surface 7; a spring 1 which is arranged in the interior space and comprises the first elastic element 1a and the second elastic element 1a, wherein the spring plate (cf. 16 in FIG. 7) of the first elastic element 1a is clamped in the interior space with its

first side surface (cf. 16a in FIG. 5A) facing the inner surface of the first housing part 3a, and wherein the spring plate of the second elastic element 1b is clamped in the interior space with its first side surface facing the inner surface of the second housing part 3b, with the result that a pressure chamber 2 between the sealing layers 17 of the elastic elements 1a, 1b is formed in the interior space, wherein the pressure chamber 2 can be vented and aerated or can be subjected to overpressure of a pressure medium which can be supplied to the housing; wherein the spring 1 is designed in such a way that, when the pressure chamber 2 is aerated or vented or the pressure chamber 2 is subjected to overpressure, a bending of at least one of the spring plates 16 of the elastic elements 1a, 1b is changable and as a result the device 10 changes between an open state, in which an object 5 to be clamped is spaced apart from the one or more clamping surfaces 7, and a closed state, in which at least one of the one or more clamping surfaces 7 transmits a clamping and/or braking force to the object 5. The device 10 according to the invention further comprises the means of the cage according to the invention mentioned at the outset. These means are explained in more detail in conjunction with FIGS. 6 to 7 .

FIGS. 1A, 1B, 4A and 4B each show such clamping devices 10 in the closed state in that the clamping surface 7 of the clamping element 8 touches the circumference of the object 5 . The clamping element 8 is also referred to as a clamping lip. The clamping element 8 can be formed integrally with the remaining parts of the housing part 3a, 3b or can be a structurally separate component of the housing part 3a, 3b from the remaining parts.

The clamping force or action of the clamping surface 7 on the object 5 to be clamped takes place in a clamping plane which is spanned by two vectors which each form a radius of the annular elastic elements 1a, 1b or annular recess 11 (cf. FIG. 5A). The axis 9 can run through the center point of the ring of the components described here as annular and can therefore be referred to as the main axis of the clamping device 10 which can run perpendicularly to the clamping plane. When “inner” and “outer” region, edge or end are referred to in this document, the inner edge, inner region or inner end are closer to the axis 9 than the corresponding outer edge, outer region or outer end. The same can, but does not have to, also apply to other components.

The clamping device 10 can be configured rotationally symmetrically about this main axis 9. The main axis 9 can run approximately or precisely centrally through an opening of the clamping device 10 (opening 14 in FIGS. 5A, 5B). In FIGS. 1A, 4A, the object 5 to be clamped, for example a rotatable shaft of a machine or a table, is placed within the opening 14 and the clamping force of the clamping device is therefore directed radially inwardly towards the main axis 9 (perpendicularly to the main axis 9) within the clamping plane. In FIGS. 1B, 4B, the object 5 to be clamped is placed outside the clamping device 10 and the clamping force of the clamping device is therefore directed radially outwardly away from the main axis 9

(perpendicularly to the main axis 9) within the clamping plane.

In FIGS. 1A, 2A, 3A, 4A, the clamping element 8 is located between spring 1 and opening 14 or main axis 9. In FIGS. 1B, 2B, 3B, 4B, on the other hand, the object 5 to be clamped at least partially surrounds the clamping device 10 so that the clamping element 8 is located there between object 5 and opening 14 or main axis 9. In FIGS. 1B, 2B, 3B, 4B, a component which at least partially fills the opening 14 and through which the main axis 9 extends can be introduced into opening 14 instead of the object 5 to be clamped.

In FIGS. 1A to 5A, the spring 1 is clamped in each case between two bearing surfaces (101 and 102 in FIGS. 5C and 5D) within the housing 3 of the clamping devices 10 and extends between the two bearing surfaces. In the pressureless initial state of the device 10 in FIGS. 1A to 2B, the spring 1 can be slightly bent in order to be fixed firmly in the housing 3 in this state and the same can apply to any other state of the device 10, wherein the degree of bending of the spring 1 depends on the state in which the device 10 is located. If the device 10 is in a state in which the spring 1 is bent (e.g. bent more than in the pressureless initial state, such as in the open state), venting of an inner pressure chamber 2 of the spring 1 and ventilation of an outer pressure chamber 4 can lead to at least partial relaxation of the spring 1 while the spring 1 presses against the radial bearing surfaces, the spacing of which increases somewhat so that the housing 3 is elastically deformed in the region of the clamping element 8 or the clamping surface 7 and the clamping surface 7 thereby touches the object 5 and is pressed against the object 5 with a (predefined) clamping force in order to clamp the object 5 firmly. The object 5 is clamped firmly and the clamping device 10 is in the closed state, as shown in FIGS. 1A and 1B. In the closed state of the device 10, the spring 1 can still be slightly bent even after the partial relaxation in order to be fixed firmly in the housing 3 in this state.

The clamping element 8 can be an elastic element, such as, for example, a spring fork, which in the pressureless initial state of the device 10 is brought by the spring force of the (slightly) bent spring 1 from an initial position, in which the elastic element is relaxed, into a clamped position, for example by bending the spring fork 8, until an equilibrium between a restoring force of the elastic element 8 and the spring force of the spring 1 arises in the pressureless initial state. In this equilibrium, the clamping surface 7 can press against the object 5.

By additional application of compressed air (for example with 4 bar or 6 bar) to the outer pressure chamber 4 in the closed state, there is the optional possibility of increasing the clamping force by a predetermined value. This is indicated in FIGS. 1A, 1B by the optional additional compressed air pump (booster) 6 and the hatching (compressed air) in the outer pressure chamber 4. The outer pressure chamber 4 can be connected by means of an opening

in the housing 3 to a port I (also referred to as “close”), to which the compressed air pump 6 can be connected.

As a result, it is possible, for example, to actuate the device 10 in such a way that a change takes place between a braked movement (in the pressureless state) of the object 5 acted upon and complete clamping of the object (in the case of sufficient application of pressure).

Even if two pressure chambers 2, 4 are shown and described here by way of example, the clamping device 10 can also be operated with a single pressure chamber which can be, for example, the inner pressure chamber 2 or the outer pressure chamber 4 .

FIGS. 2A and 2B show the clamping devices 10 from FIGS. 1A and 1B in each case in the open state in which the clamping surface 7 does not touch the circumference of the object 5 or is spaced apart from the circumference of the object 5 . The inner pressure chamber 2 can be connected by means of an opening in the housing 3 to a port II (also referred to as “open”), to which a compressed air pump 6 can be connected.

By application of compressed air (for example 4 bar or 6 bar) to the inner pressure chamber 2 by the compressed air pump 6 and venting of the outer pressure chamber 4, the spring 1, compared with the closed state from FIGS. 1A, 1B, is more strongly (convexly) bent or clamped and there is a radial shortening of the spring 1 or of the distance between the two bearing surfaces. The clamping surface 7 lifts off from the object 5 in order to release the clamping. The object 5 is freely movable (for example rotatable about axis 9 or movable linearly along axis 9) and the clamping device 10 is open.

It is possible to change back and forth between the closed state and the open state of the device 10 .

Such pneumatic clamps 10 have a number of advantages over hydraulic clamps.

By using the combination of elastic component, here a spring 1 together with elastic elements 1a, 1b, and compressed air, for example very short reaction times are achieved when switching between the open and closed state and likewise reliable clamping of the object 5 is brought about. The spring 1 can preferably be of plate-shaped configuration, as shown in more detail in FIG. 5, wherein two elastic elements 1a, 1b lying one on top of the other form the spring 1 and the inner pressure chamber 2 of the spring 1 between the plates 1a, 1b. The plates 1a, 1b can likewise be annular, as shown in FIG. 5, and can optionally additionally have radial slots, so that a change in the inner diameter with particularly low forces is possible. The elastic

elements 1a, 1b can be coated with rubber, at least in the region of slots, in order to produce the tightness required for the compressed air. The elastic elements 1a, 1b are generally of such pressure-resistant and thus elastically bendable form and are arranged in the housing 3 of the clamping device 10 in such a way that the inner pressure chamber 2 is formed within the spring 1 between the elastic elements 1a, 1b and the outer pressure chamber 4 is formed between each elastic element 1a, 1b and the housing 3 or the housing parts 3a, 3b of the clamping device 10 . FIG. 5 shows a three-dimensional view of a clamping device 10 similar to FIGS. 1A and 2A.

By ventilation or application of compressed air to the outer pressure chamber 4 and venting of the inner pressure chamber 2, as shown in FIG. 1A, the spring 1 is at least partially relaxed and brings about a clamping force on the object 5 to be clamped, in particular on the circumference of a shaft 5 . As a result, in the event of an energy or pressure failure, the object 5 is clamped or the shaft 5 is brought to a standstill immediately and therefore offers a safety clamping. Such pneumatic clamps 10 can, depending on the magnitude, achieve holding torques of several 100 Nm and up to several 1000 Nm, which can be increased still further by additional application of compressed air to the outer pressure chamber 4, as indicated in FIG. 1A by a pressure pump 6 (booster). Here, a compressed air of a few bar (for example 4 bar or 6 bar) is sufficient to provide a multiple of the holding torques which are achieved without a booster. In this case, use is made of the fact that small transverse bends of the plates 1a, 1b (perpendicularly to the longitudinal axis thereof) when switching between the open and closed state of the clamp 10 generate large spring forces which can be used for clamping or for releasing prestressed clamping devices 10 . This enables secure clamping and release even of rapidly rotating machine shafts 5 .

In the case of pneumatic material, the costs and the assembly outlay are also lower in comparison with the hydraulic material, and the use of compressed air results in no additional outlay whatsoever for producing cleanliness on the installation. Such pneumatic clamps also enable a small overall size, since a small transverse bend and a small (change in the) longitudinal extent of the spring, and therefore small volumes of the pressure chambers, are sufficient to apply the required clamping forces.

In the case of pneumatic clamps, a distinction is made in principle between passive clamping devices 10, as shown in FIGS. 1A to 2B, and active clamping devices 10, as shown in FIGS. 3A to 4B .

In the pressureless initial state, the spring 1 can be bent to different extents (transversely) and therefore be shortened radially to different extents. The inner side of the housing 3 can be adapted to the bend of the elastic elements 1a, 1b or can define said bend. A corresponding stop

surface for the elastic elements 1a, 1b can be formed, for example, by a housing inner wall. The housing inner wall can be of complementary (for example concave) form to a (for example convex) bend of the elastic elements 1a, 1b.

5 In the case of passive clamping devices 10, in the pressureless initial state, the spring 1 is generally slightly elastically (for example convexly) bent or is prestressed and the clamping devices 10 can be closed (FIGS. 1A, 1B). The clamping device 10 is opened only by application of force from the inside via application of compressed air to the inner pressure chamber 2 (FIGS. 2A, 2B). In most cases, the spring 1 is bent somewhat in the pressureless initial state,
10 so that in the case of clamping or in the case of a pressure drop, the spring force given by the energy stored in the spring 1 is transmitted to the object 5 to be clamped as a clamping force in order to clamp the object 5 .

In the case of active clamping devices 10, in the pressureless initial state (FIGS. 3A, 3B), the
15 spring 1 is curved transversely outwards more strongly, in particular more strongly convexly, than in the case of passive clamping devices, so that the distance between the two radial bearing surfaces is shortened and the clamping device 10 is opened. No clamping force is brought about via clamping surface 7 on the object 5 . The object is free since the clamping surface 7 does not touch the object 5 or is spaced apart from the object 5 .

20 By plastic deformation of the elastic elements 1a, 1b, in the case of the same housing 3, the spring 1 can be curved transversely outwards more strongly in the pressureless initial state and therefore be shortened radially more strongly than in the case of passive clamping devices. This smaller radial extent of the elastic elements 1a, 1b in the pressureless initial state can lead to
25 an open state of the clamping device 10 in the pressureless initial state. Even in the case of plastic deformation, the elastic elements 1a, 1b are elastically bent and press against the bearing surfaces so that the spring is fixed in the housing. The interior space of the housing or the recesses can accommodate the curvature brought about more strongly by plastic deformation in the initial state.

30 The clamping force now has to be induced actively from outside, as shown in FIGS. 4A and 4B, in order to transfer the clamp into the closed state. Here, compressed air is introduced into the outer pressure chamber 4 by a compressed air pump 6 and therefore compressed air is applied to the spring 1 from outside in such a way that the spring 1 is actively relaxed, the curvature of
35 the spring 1 is reduced, the distance between the two bearing surfaces is increased and the housing 3 is elastically deformed in the region of the clamping element 8 or the clamping surface 7 so that the clamping surface 7 touches the object 5 and brings about a clamping force on the object 5 and the object 5 is clamped firmly as a result. The active clamping device 10 is

then in the closed state.

Depending on the field of application and prescribed safety regulations, an active or passive clamping system 10 is therefore used. If a safety clamping is primarily desired, a passive clamping device is generally used. With such pneumatic passive clamping systems, it is possible, even in the pressureless state, during corresponding assembly of the device in an overall device, to generate a predetermined clamping force with which the object 5 to be clamped is acted upon. As a result of the application of overpressure or negative pressure, the forces transmitted to this object can be increased, reduced or completely cancelled, which opens up a wide variety of applications. If, on the other hand, a deliberate operation, such as a tool change, is to be carried out primarily with the clamping device, an active clamping device is generally used.

As represented in FIG. 5A, the housing 3 of the clamping devices 10 according to the invention comprises two housing parts 3a, 3b which are fastened to one another by fastening means, such as for instance screws, and are mounted in such a way that, in the mounted state, the two housing parts 3a, 3b define the interior space 13 between the housing parts 3a, 3b within the housing 3 in which the spring 1 together with its annular elastic elements 1a, 1b according to the invention are arranged. The housing parts 3a, 3b each define a recess 11 which is likewise annular and which serve to receive the annular elastic elements 1a, 1b, as represented in FIGS. 5A to 5D. At least part of the first bearing surface 101 of the housing part can run (substantially) perpendicularly to the radial direction R of the annular recess 11 and/or part of the second bearing surface 102 of the housing part can run (substantially perpendicularly) to the radial direction R of the annular recess 11.

An opening 14 (FIGS. 5A, 5B) extends through the center of the housing 3, into which opening the object 5 to be clamped, such as for instance a shaft, can be introduced. The housing can extend up to 360° around this opening and at least partially encloses the object 5 in at least one plane which is referred to as the clamping plane. The central main axis 9 of the clamping devices runs centrally through the opening 14 and perpendicularly to the clamping plane. In clamping devices according to FIGS. 1A, 2A, 3A, 4A, 5A, 8, the main axis 9 runs centrally through the shaft along the longitudinal axis thereof.

Located along the circumference of the housing 3 or the opening 14 is one or more of the clamping surfaces 7 which, in the event of elastic deformation of the housing 3 in the region of the clamping element 8 or the clamping surface 7, brings about the clamping force on the outer circumference of the object 5 and can thereby clamp the object 5. For effective opening and closing of the clamping device 10 with respect to the object 5 to be clamped, without risk of

damage to the object 5, a symmetrical distribution of the clamping force along the clamping surface 7 or along the circumference of the object 5 is desirable. A non-symmetrical distribution of the clamping force can lead to damage to the object 5. Preferably, one or both bearing surfaces 101, 102 are of circular configuration within the clamping plane. Preferably, the clamping surface 7 is of circular configuration within the clamping plane. The clamping element 8 can be of annular configuration. All annular or circular components described here can each have, individually or in combination, as the center point, the point of intersection of the main axis 9 with the clamping plane (for example center point of the opening 14).

FIG. 5B shows an embodiment of the component 40, 50 according to the invention (here with the upper housing part 3a from FIG. 5A), wherein the relevant housing part 3a of the component has an annular recess 11 for clamping the annular elastic element 1a, and wherein the housing part 3a has an inner surface defined by the recess 11 (cf. 105 in FIG. 6). The annular recess 11 preferably defines an annular opening 12 in the housing part, wherein the annular opening is formed between a first annular edge 12a of the housing part and a second annular edge 12b of the housing part. The elastic element 1a can be clamped between the first annular edge 12a and the second annular edge 12b.

When the elastic element 1a is introduced with the first side surface (cf. 16a in FIGS. 5B, 7) facing the inner surface through the opening 12 into the recess 11 and is clamped in the recess 11, the first pressure chamber 4 is formed between the inner surface and the elastic element 1a. The elastic element according to the invention here has the means mentioned at the outset which enable reliable and effective sealing at the connection II. These means are explained in more detail in conjunction with FIGS. 7 to 8.

As shown in FIGS. 5C and 5D, the illustrated elastic element 1a of the spring 1 extends from a first bearing surface 101 within the housing part 3a to a second bearing surface 102 within the housing part 3a and can touch the latter. The first bearing surface 101 here is arranged radially further outward than the second bearing surface 102, as seen from the center point of the opening 14.

FIG. 5C shows the portion of the housing part 3a illustrated in FIG. 5B in which the upper plate 1a of the spring 1 meets the first bearing surface 101 and is preferably in contact with the latter. FIG. 5D shows the portion of the housing part 3a illustrated in FIG. 5B in which the upper plate 1a of the spring 1 meets the second bearing surface 102 and is preferably in contact with the latter. However, it is also possible for one or more further components, via which the elastic element 1a exerts its spring force on the bearing surfaces 101, 102, to be located in each case radially between the elastic element 1a and one or more of the bearing surfaces 101, 102.

As can be seen in FIGS. 5B, 5D, the elastic element 1a is clamped in the recess 11 between inner sides of the housing part 3a . Each of the plates of the spring 1 is introduced in the direction of the main axis 9 of the clamping devices 10 through the opening 12 into the recess 11 of the respectively associated housing part during assembly along inner surfaces of the housing part 3a until the respective plate butts against a stop 112, 122 at the end of each of the two bearing surfaces 101, 102 and therefore cannot be introduced further into the recess 11 . Since the extent of the elastic element 1a in the clamping plane or in the radial direction of the annular recess can be greater than the extent of the inner space defined by the housing part, the plate 1a can be bent or prestressed in the pressureless initial state.

FIG. 6 shows an embodiment of a cage according to the invention.

If, as shown in FIGS. 1 to 5, the two housing parts 3a, 3b are fastened to one another in such a way that the elastic elements 1a, 1b clamped therein lie on one another in order to form the pressure chamber 2 therebetween, it is advantageous with regard to the axial fixing of the elastic elements and the introduction of the pressure medium into the pressure chamber if the cage 20 according to the invention which is represented here is arranged between the elastic elements in the region of the connection II. How such an arrangement can appear by way of example is shown in FIG. 7 .

FIG. 6 shows a preferred configuration of the cage 20 for introducing a pressure medium into a pressure chamber 2 of a pneumatic clamping and/or braking device 10, the cage 20 comprising: two base surfaces 23a, 23b; a lateral surface 24 extending between the two base surfaces 23a, 23b and connecting these base surfaces 23a, 23b to one another; and an interior space 25 which is delimited by the two base surfaces 23a, 23b and the lateral surface 24 together, wherein both base surfaces each have an opening 21a, 21b for a connection II of the clamping and/or braking device 10 for introducing the pressure medium into the interior space 25, and wherein the lateral surface 24 has a plurality of openings 22a - 22f for passing on the pressure medium from the interior space 25 into the pressure chamber 2 . The cage is preferably free of fastening means (e.g. a thread which could be attached, for example, to a projection of one of the base surfaces) for fastening a closure screw for closing a connection opening (in a housing of the clamping and/or braking device) for the connection.

The cage has a cylindrical or circular cylindrical shape. Both base surfaces 23a, 23b project beyond the lateral surface 24.

The two base surfaces 23a, 23b can run (substantially) parallel to one another. The lateral

surface 24 intersects the two base surfaces 23a, 23b and can run (substantially) perpendicularly to the base surfaces 23a, 23b.

FIG. 7 shows a detail of a cross section of a clamping and/or braking device 10 according to the invention with the cage 20 according to the invention from FIG. 6 . FIG. 7 also shows an installed variant of the next kit 30 .

The kit 30 comprises: the cage 20 according to the invention from FIG. 6; a closure screw 32; a housing part 3a, comprising: a connection opening 33; and a thread 3 arranged on the housing part 3a in the region of the connection opening 33 for screwing in the closure screw 32 for closing the connection opening 33. The thread 31 for the closure screw 32 is separate from the cage 20, so that screwing in the closure screw 32 into the thread 31 cannot damage the cage and the sealing layer 17 on the spring plate 16 in the housing part 3a (for example by means of rotation). The sealing layer 17 has a connection seal 18 which is configured to seal one of the base surfaces 23a of the cage 20 against the housing part 3a and/or the closure screw 32.

The device 10 comprises a further housing part 3b with a connection opening 33 for the connection II for applying the pressure medium to the pressure chamber 2; and a further elastic element 1b together with spring plate 16 and sealing layer 17 for sealing the further housing part 3b. The housing parts 3a, 3b together form a housing 3 and are arranged with respect to one another and fastened to one another in such a way that inner surfaces 150 of the housing parts 3a, 3b together delimit a housing interior space within the housing 3.

A spring arranged in the housing interior space and comprising the elastic elements is provided, wherein, within the housing interior space, each of the elastic elements is clamped in another of the housing parts 3a, 3b in such a way that the pressure chamber 2 is formed in the housing interior space between the clamped elastic elements, wherein the cage 20 is arranged between the clamped elastic elements in such a way that the lateral surface 24 of the cage 20 extends from one of the elastic elements to the other of the elastic elements and the pressure chamber 2 can be vented via the openings 22a-f in the lateral surface 24, the opening 21a-b of at least one of the base surfaces 23a-b and the connection opening 33 of the further housing part 3b and is aeratable or can be subjected to overpressure of a pressure medium.

The spring is designed in such a way that, when the pressure chamber 2 is aerated or vented or the pressure chamber 2 is subjected to overpressure via the connection II, a bending of at least one of the elastic elements is changeable and as a result the device 10 changes between an open state, in which an object to be clamped is spaced apart from the one or more clamping surfaces,

and a closed state, in which at least one of the one or more clamping surfaces transmits a clamping and/or braking force to the object.

Each of the elastic elements has a sealing layer 17 with a connection seal 18 and the cage 20 is arranged between the connection seals 18 of the clamped elastic elements in such a way that the connection seals 18 seal the, preferably projecting, regions of the base surfaces 23a, 23b of the cage 20 against the housing parts 3a, 3b.

By means of the means described here, individually and in combination, the improved introduction of the pressure medium from connection II via the connection opening 33, the interior space 25 of the cage 20 can be introduced into the pressure chamber 2, with axial fixing or stabilization of the elastic elements. This enables reliable operation of the clamping and/or braking device 10 without adversely affecting the dynamics of the device. In addition, the cage according to the invention with two base surfaces which each have an opening in the device 10, as represented in FIG. 7, enables the pressure medium to be reliably applied to the pressure chamber 2 via the cage 20 both via the connection opening 33 of the housing part 3b and via the connection opening 33 of the housing part 3a. It is only necessary for that connection opening 33 which is not intended to be selected for the application or for connection II (opening 33 in housing part 3a in FIG. 7) to be closed by the closure screw 32, while that connection opening 33 which is intended to be used for the connection II or the application (opening 33 in housing part 3b in FIG. 7) is free of the closure screw. When screwing in or screwing out the closure screw 32, for example in order to change the connection side, the connection seal 18 is not co-rotated, since the thread 31 is arranged separately from the connection seal 18 and is also arranged separately from cage 20. As a result, damage to the connection seals 18 is prevented.

Preferred embodiments of the subject matter claimed by the appended claims are described in the description and in the figures. The optional features disclosed in the above description, the claims and the drawings can be used both individually and in any desired combination for the embodiment of the subject matter claimed here in accordance with the appended claims in its various configurations.

The various aspects and embodiments described above can be combined to create yet further embodiments. These and other changes can be made to the embodiments in the light of the above detailed description. In general, the terms used in the following claims should not be construed as limiting the claims to the specific aspects and embodiments disclosed in the description and the claims, but as encompassing all possible embodiments together with the full scope of equivalents to which such claims are entitled.

CLAIMS

1. A cage (20) for introducing a pressure medium into a pressure chamber (2) of a
5 pneumatic clamping and/or braking device (10), the cage (20) comprising:
two base surfaces (23a, 23b);
a lateral surface (24) extending between the two base surfaces (23a, 23b) and
connecting these base surfaces (23a, 23b) to one another; and
an interior space (25) which is delimited by the two base surfaces (23a, 23b) and the
10 lateral surface (24) together,
wherein one or more of the base surfaces has an opening (21a, 21b) for a connection
(II) of the clamping and/or braking device (10) for introducing the pressure medium
into the interior space (25),
wherein the lateral surface (24) has one or more openings (22a - 22f) for passing on the
15 pressure medium from the interior space (25) into the pressure chamber (2), and
wherein the cage (20) is free of fastening means (31) for fastening a closure screw (32)
for closing a connection opening (33) for the connection (II).
2. The cage of claim 1, wherein each of the base surfaces has an opening for a connection
20 (II) of the clamping and/or braking device (10) for introducing the pressure medium
into the interior space (25).
3. The cage according to any one of the preceding claims 1-2, wherein one or more of the
base surfaces (23a, 23b) projects beyond the lateral surface (24).
- 25 4. The cage according to any one of the preceding claims 1-3, wherein the one or more
openings (22a - 22f) in the lateral surface (24) are a plurality of openings (22a - 22f) in
the lateral surface (24) which are arranged at least partially at different, preferably
adjacent or opposite, portions of the lateral surface (24).
- 30 5. The cage according to any one of the preceding claims 1-4, wherein the fastening means
comprise a thread (31) for screwing in the closure screw (32).

6. A kit (30) for a clamping and/or braking device (10), the kit (30) comprising:
the cage (20) according to any one of the preceding claims;
a closure screw (32);
a housing part (3a, 3b) comprising:
5 a connection opening (33); and
 a thread (31) arranged on the housing part (3a, 3b) in the region of the
 connection opening (33) for screwing in the closure screw (32) for closing the
 connection opening (33).
- 10 7. A kit (30) for a clamping and/or braking device (10), the kit (30) comprising:
a cage (20) for introducing a pressure medium into a pressure chamber (2) of the
pneumatic clamping and/or braking device (10), the cage (20) comprising:
 two base surfaces (23a, 23b);
 a lateral surface (24) extending between the two base surfaces (23a, 23b) and
15 connecting these base surfaces (23a, 23b) to one another; and
 an interior space (25) which is delimited by the two base surfaces (23a, 23b)
 and the lateral surface (24) together,
 wherein one or more of the base surfaces has an opening (21a, 21b) for a
 connection (II) of the clamping and/or braking device (10) for introducing the
20 pressure medium into the interior space (25), and
 wherein the lateral surface (24) has one or more openings (22a - 22f) for passing
 on the pressure medium from the interior space (25) into the pressure chamber
 (2);
characterized in that the kit (30) further comprises:
25 a closure element, preferably a closure screw (32);
 a housing part (3a, 3b) comprising:
 a connection opening (33); and
 a fastening means, preferably a thread (31), arranged on the housing part (3a,
 3b) in the region of the connection opening (33) for holding, preferably
30 screwing in, the closure element (32) for closing the connection opening (33).
8. The kit according to claim 7, wherein the cage (20) is free of fastening means (31) for
fastening a closure screw (32) for closing a connection opening (33) for the connection
(II).
- 35 9. The kit according to claim 7 or 8, wherein each of the base surfaces has an opening for
a connection (II) of the clamping and/or braking device (10) for introducing the
pressure medium into the interior space (25).

10. The kit according to any one of the preceding claims 7-9, wherein one or more of the base surfaces (23a, 23b) projects beyond the lateral surface (24).

11. The kit according to any one of the preceding claims 7-10, wherein the one or more openings (22a - 22f) in the lateral surface (24) are a plurality of openings (22a - 22f) in the lateral surface (24) which are arranged at least partially at different, preferably adjacent or opposite, portions of the lateral surface (24).

12. The kit according to any one of the preceding claims 7-11, wherein the fastening means comprise a thread (31) for screwing in the closure screw (32).

13. The kit according to any one of the preceding claims 6-12, wherein the fastening means (31), in particular the thread, for the closure element, in particular the closure screw (32), is defined by an inner surface of the housing part (3a, 3b),

or

wherein the fastening means (31), in particular the thread (31), for the closure element, in particular the closure screw (32), is defined by a coupling element fastened to the housing part (3a, 3b), which is configured to couple the housing part (3a, 3b) to the closure element, in particular the closure screw (32).

14. The kit according to any one of the preceding claims 6-13, wherein the fastening means (31), in particular the thread (31), for the closure element, in particular the closure screw (32), and/or the coupling element is/are separate from the cage (20).

15. The kit according to any one of the preceding claims 6-14, further comprising an elastic element (1a, 1b) which is configured to be arranged between the cage (20) and the closure element, in particular the closure screw (32), received, in particular screwed, in the fastening means (31), in particular the thread (31), for sealing the housing part (3a, 3b).

16. The kit according to claim 15, wherein the elastic element (1a, 1b) comprises a spring plate (16) and a sealing layer (17) fastened on the spring plate (16), wherein the sealing layer (17) has a connection seal (18) which is configured to seal one of the base surfaces (23a, 23b) of the cage (20) against the housing part (3a, 3b) and/or the closure element, in particular the closure screw (32).

17. A clamping and/or braking device (10) for clamping and/or braking an object to be clamped and/or braked, comprising:
a kit (20) according to claim 15 or 16, in which the connection opening (33) thereof is

closed by holding the closure element by means of the fastening means (31), in particular by screwing the closure screw (32) into the thread (31), and in which the elastic element (1a, 1b) thereof is arranged between the cage (20) and the closure element, in particular the closure screw (32), for sealing the housing part (3a, 3b);

5 a further housing part (3b) with a connection opening (33) for the connection (II) of the clamping and/or braking device (10) for applying the pressure medium to the pressure chamber (2); and

a further elastic element (1b) for sealing the further housing part (3b);

wherein the housing parts (3a, 3b) together form a housing (3) and are arranged with
10 respect to one another and fastened to one another in such a way that inner surfaces (105) of the housing parts (3a, 3b) together delimit a housing interior space within the housing (3);

one or more clamping elements (8), wherein each clamping element has a clamping surface (7);

15 a spring (1) arranged in the housing interior space and comprising the elastic elements (1a, 1b), wherein, within the housing interior space, each of the elastic elements (1a, 1b) is clamped in another of the housing parts (3a, 3b) in such a way that the pressure chamber (2) is formed in the housing interior space between the clamped elastic elements (1a, 1b),

20 wherein the cage is arranged between the clamped elastic elements (1a, 1b) in such a way that the lateral surface (24) of the cage (20) extends from one of the elastic elements (1a, 1b) to the other of the elastic elements (1b) and the pressure chamber (2) can be vented via the openings (22a-f) in the lateral surface (24), the opening (21a-b) of at least one of the base surfaces (23a-b) and the connection opening (33) of the
25 further housing part and is aeratable or can be subjected to overpressure of a pressure medium,

wherein the spring (1) is designed in such a way that, when the pressure chamber (2) is aerated or vented or the pressure chamber (2) is subjected to overpressure, a bending of at least one of the elastic elements (1a, 1b) is changeable and as a result the device
30 (10) changes between an open state, in which an object (5) to be clamped is spaced apart from the one or more clamping surfaces (7), and a closed state, in which at least one of the one or more clamping surfaces (7) transmits a clamping and/or braking force to the object (5).

35 18. The device (10) according to claim 17, wherein each of the elastic elements (1a, 1b) has a sealing layer (17) with a connection seal (18) and the cage (20) is arranged between the connection seals (18) of the clamped elastic elements (1a, 1b) in such a way that the connection seals (18) seal the, preferably projecting, regions of the base surfaces (23a,

23b) of the cage (20) against the housing parts (3a, 3b).

19. The clamping and/or braking device (10) according to any one of the preceding claims, wherein the device (10) is designed in such a way that, as a result of aerating the pressure chamber (2) or subjecting the pressure chamber (2) to overpressure through the cage (20), one of the clamping elements (8) moves towards a portion of one of the inner surfaces (105) and/or the bending of at least one of the spring plates (16) of the elastic elements increases, and as a result the device (10) changes from the closed state into the open state.

20. The device (10) according to any one of the preceding claims, wherein the clamping and/or braking force is caused by the inner or outer edge of at least one of the spring plates (16) of the elastic elements (1a, 1b) being supported on one of the inner surfaces (105) of the housing parts (3a, 3b) and the outer or inner edge of the at least one spring plate (16) pressing against the clamping element.

21. The clamping and/or braking device (10) according to any one of the preceding claims, wherein the housing interior space comprises a further pressure chamber (4) between the elastic elements (1a, 1b) and the inner surfaces (105) of the housing parts (3a, 3b),

wherein a spring plate (16) of at least one of the elastic elements (1a, 1b) is designed, as a result of subjecting the further pressure chamber (4) to overpressure, to reduce its bending in order, when the inner or outer edge of the spring plate (16) is supported on the inner surface (105) of the respective housing part, to press with the outer or inner edge of the spring plate (16) against one of the clamping elements in such a way that as a result a transmission of the clamping and/or braking force from the clamping surface of the clamping element to the object (5) to be clamped and/or braked is caused and the device (10) changes from the open state into the closed state

and/or

wherein the device (10) is designed in such a way that, as a result of aerating the further pressure chamber (4) or subjecting the further pressure chamber (4) to overpressure, one of the clamping elements moves away from a portion of one of the inner surfaces (105) and/or the bending of at least one of the spring plates (16) of the elastic elements decreases, and as a result the device (10) changes from the open state into the closed state.