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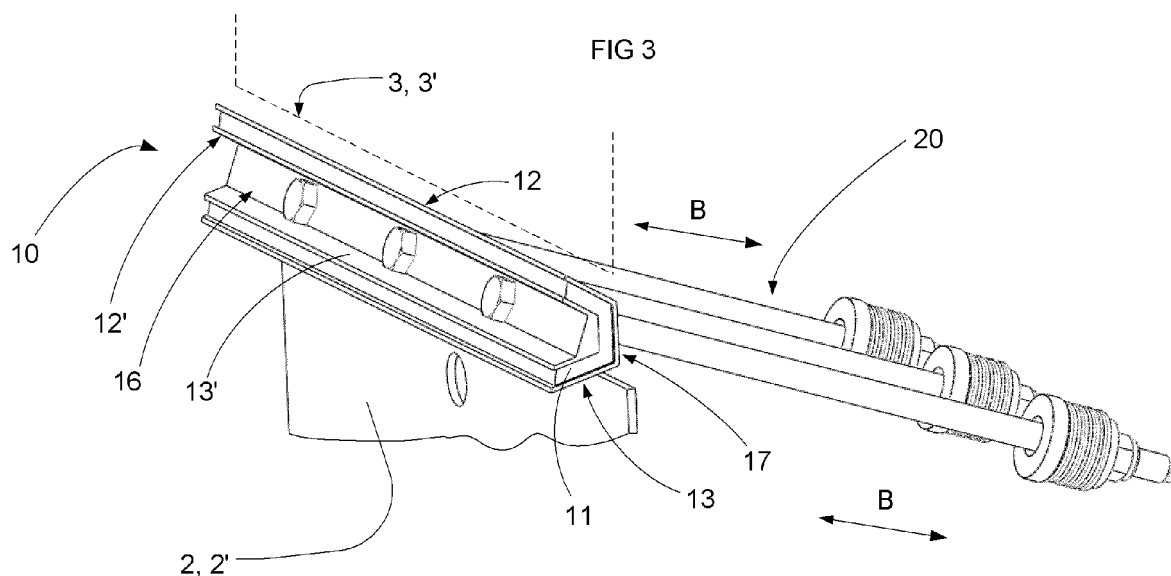
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(54) **Means for securing jaw plates in a jaw crusher**

(57) The invention concerns a jaw plate clamping bar (10) for a jaw crusher and jaw crusher comprising at least one jaw plate clamping bar (10) for securing a jaw plate (2, 2') to a jaw (3, 3') of a jaw crusher (1), the jaw plate clamping bar being adapted to work as a wedge being detachable from the jaw crusher. The jaw plate clamping

bar (10) comprises wedging portions (11, 12, 12', 13, 13', 14, 15) being adaptable to surfaces and varying distances between the jaw plate clamping bar and complementary anvil portions (4, 5) of the jaw crusher (1). The invention also concerns a method of manufacturing the jaw plate clamping bar.



Description

Technical Field of the Invention

[0001] The present invention relates to a jaw crusher used for crushing, and can be suitably used in the construction and mining industries.

Background Art

[0002] When crushing of hard material, e.g. stone blocks or ore blocks, different types of crushers may be used. One example of a type of crushers is jaw crushers of which a typical jaw crusher includes a stationary jaw and a movable jaw spaced to define a crushing chamber in between. The material to be crushed is fed into the crushing chamber and is crushed by the face of each of the jaws as the movable jaw is moved repeatedly toward and away from the stationary jaw.

[0003] The jaws of the crusher experience tremendous forces and wear, but also vibrations during crushing. Hence, the jaws are equipped with die plates for wear protection of their faces, outer die plates called jaw plates working as both wear protection and crushing surfaces in contact with the material to be crushed and intermediary die plates placed between the outer jaw plates and the jaws for protecting the jaw from wear by means of the outer jaw plates as the outer jaw plates may rub against the jaw during operation of the crusher. The outer wear protecting and crushing jaw plates of the jaws must be secured in place by known rigid solid metal wedges, which commonly are made by cast iron throughout, clamping the jaw die plate rigidly to the respective jaw by wedging against end surfaces of each jaw plate and jaw and, occasionally other adjacent anvil/support surfaces of the crusher. These prior art solid metal wedges are commonly attached to each jaw by means of threaded pull, tension or tie rods inserted through bores in each known solid metal wedge and each jaw and then having nuts threaded onto it at the other end of the jaw until a predefined prestress or moment of a force is reached for releasably securing the known solid metal wedge to the underlying jaw and crusher.

[0004] A combination of metal and rubber washers is placed between the nut and the jaw to distribute the prestress and forces in a common way for hindering unwanted slackening of the screw.

[0005] As the jaw die plates and also the known solid metal jaw plate clamping wedges are objected to wear, they have to be replaced when worn out, hence, they have to be easily mounted and dismounted from the crusher.

[0006] Moreover, as each of the jaw die plates and the known solid metal jaw plate clamping wedges are casted in one piece, the jaw plates have very rough and uneven outer surfaces as the jaw plates are only partly machined, in some case even not machined, at their end surfaces, whereby gaps are created between the parts and surfac-

es of the jaw plates and the known solid metal jaw plate clamping wedges contacting each other due to very unprecise tolerances, even though the known solid metal jaw plate clamping wedges are machined to achieve at least somewhat higher dimensional tolerances compared to the jaw plates. Furthermore, more than one clamping wedge may be required to hold a jaw plate in place in the crusher, and, in some cases, a jaw plate can be a two-part jaw plate, i.e. two jaw plate parts or be divided in more parts, each part being casted in one piece, are used for making up one and the same whole jaw plate in the crusher. The same goes for the clamping wedges.

[0007] Furthermore, the known solid metal clamping wedges may be wearied out at their fronts facing the crushing chamber deadlocking them onto the jaw, wherefore these prior art solid metal clamping wedges must be cut away by using a cutting torch.

Summary of the Invention

[0008] It is an object of the invention to provide a jaw plate clamping bar working as a wedge securely and effectively clamping a jaw plate in place in a jaw crusher, which solve, or at least lessen, the problems mentioned above and below.

[0009] It is an object of the invention to provide a jaw plate clamping bar creating an adaptability to smooth, plane, even, flat, and /or uneven/rough surfaces on cooperating wedging surfaces of the jaw plates and jaws and also adaptable to different distances between these cooperating wedging surfaces, which distances vary during the operation of the jaw crusher due to vibrations, movements of the jaw plates, lengthening and/or extension of each jaw plate due to "smearing out" of the jaw plate as the material being crushed presses on the jaw plate making it thinner partly or wholly, e.g. at the middle, but longer and wider, such that the jaw plate ends presses unevenly against the jaw plate clamping bar, and varying dimensional and surface tolerances due to the casting of the parts, and varying clamping and crushing forces.

[0010] Another object of the invention is to provide a jaw plate clamping bar with an improved clamping ability reducing the need of tightening and retightening its fastening means during standstills and/or the operation of the jaw crusher.

[0011] Yet another object of the invention is to provide a jaw plate clamping bar which maintain a secure clamping of the jaw plate by following the smooth/rough surfaces on cooperating wedging surfaces of the jaw plates and jaws and the varying distances between these cooperating wedging surfaces by means of adapting to these dynamically changing smooth/rough surfaces and gaps during both standstills when replacing clamping bars by new ones being tightened into adaptable fitment in the crusher before operation of the crusher is resumed and during the operation of the jaw crusher.

[0012] Still another object of the invention is to provide

a jaw plate clamping bar making it possible to keep the same dimensions, shapes, structure and sizes of the adjoining parts of the jaw crusher, i.e. the jaw plate and the jaw, simplifying the construction of jaw crushers but also simplifying the renovation of old crushers as worn out prior art solid metal wedges for clamping the jaw plates in place can be easily replaced by the inventive jaw plate clamping bar.

[0013] Another object of the invention is to provide a jaw plate clamping bar that reduces the number of times its fastening means has to be retightened during the operation of the jaw crusher, whereby the associated number of standstills of the crusher to be able to retighten if necessary is also reduced.

[0014] Yet another object of the invention is to provide a jaw plate clamping bar that does not lose its clamping effect on the jaw plate even though the smooth and/or rough surfaces on cooperating wedging surfaces of the jaw plates and jaws vary and the distances between the cooperating and/or complementary wedging/anvil surfaces increases and/or decreases when the complementary wedging/anvil surfaces move towards and/or away from each other during both the replacement and tightening of the jaw clamping bars at standstills and the operation of the jaw crusher.

[0015] Another object of the invention is to provide a jaw plate clamping bar with a reduced weight, i.e. tare weight, reducing the effort for the operators handling these jaw plate clamping bar during manufacture and during the assembly and disassembly of the jaw plate clamping bars in the crusher by being able to be lifted by hand.

[0016] These objects are achieved by means of a jaw plate clamping bar, a jaw crusher comprising at least one such jaw plate clamping bar and a method of manufacturing such a jaw plate clamping bar as claimed in the associated independent claims, preferred variants thereof being defined in the associated dependent claims.

[0017] The jaw plate clamping bar according to the independent clamping bar claim makes it possible to improve the clamping ability of the jaw plate clamping bar as its wedging portions are adaptable to rough surfaces for increasing the contact area between the wedging surfaces of the jaw plate clamping bar, jaw plates and jaw crusher creating at least more contact points between those wedging surfaces.

[0018] The jaw plate clamping bar according to the independent clamping bar claim makes it possible to improve the clamping ability of the jaw plate clamping bar as its wedging portions are adaptable to varying distances between the jaw plate clamping bar and complementary anvil or wedge portions of the jaw crusher, such as jaw plates and deflector plates, by its wedging portions being able to compensate for the varying distances, both increasing and decreasing distances, during operation of the jaw crusher.

[0019] The jaw plate clamping bar according to the independent clamping bar claim makes it possible to im-

prove the clamping ability of the jaw plate clamping bar as its wedging portions are adaptable in a dynamical way to rough surfaces and varying distances between the jaw plate clamping bar and complementary anvil or wedge portions of the jaw crusher, whereby the tightening of fastening means for the jaw plate clamping bar has a less tendency of slackening reducing the need of retightening during operation of the jaw crusher.

[0020] In some embodiments/aspects, the jaw plate clamping bar, when studied in profile, comprises an upper portion and a lower portion diverging from each other towards the crushing chamber of the jaw crusher which lower and upper portions define a cavity reducing its own weight compared to conventional casted solid metal wedges reducing tare weight and load carrying ratio compared to known jaw crushers.

[0021] In some embodiments/aspects, in the jaw plate clamping bar, the cavity between the lower and upper portions extends along a substantial part of the length of the jaw plate clamping bar or along its whole length or between the fastening means detachably attaching the clamping bar to the crusher or the cavity extends both along a substantial part of the length of the jaw plate and between its fastening means, whereby its own weight is reduced compared to conventional casted solid metal wedges reducing the cumbersome and heavy lifting and handling of the jaw plate clamping bar by operators assembling and disassembling these in jaw crushers compared to known solid metal jaw plate clamping bars.

[0022] In some embodiments/aspects, the cavity of the jaw plate clamping bar is arranged to detachably house, i.e. receive at least a part of at least one flexible or resilient element. This creates the adaptability to rough surfaces on cooperating wedging surfaces of the jaw plates and jaws and also enables the adaptability to different distances between these cooperating wedging surfaces as the element achieves flexing and resiliency of the jaw plate clamping bar so that the element compensates or smoothes out the rough surfaces increasing the contact area between the contacting surfaces.

[0023] In some embodiments/aspects, the jaw plate clamping bar is at least partly made of a hard material, e.g. a hard polymer or metal, and at least one flexible and/or resilient element is sandwiched between a first and a second metallic portion of the jaw plate clamping bar. Thereby, the different materials, one being harder than the other, cooperate with a mix of properties and shapes as the intermediary element creates flexibility and/or resiliency when the harder portions are pressed towards it if the gap between the jaw plate/jaw decreases when the jaw plate or jaw moves towards each other locally, i.e. along a part or parts of the length of the clamping bar or along the whole length of the clamping bar by pressing back or when the harder portions are drawn/moved away from the intermediary element if the gap between the jaw plate/jaw increases when the jaw plate or jaw moves away from each other locally, i.e. along a part or parts of the length of the clamping bar or along

the whole length of the clamping bar, the intermediary element holds the harder portions back while at the same time letting the harder portions move back and forth and also follow varying surfaces along the length of the jaw plate clamping bar similar to a resilient material.

[0024] In some embodiments/aspects, in the jaw plate clamping bar, the at least one flexible and/or resilient element forms at least one adaptable wedging surface arranged to contact the jaw crusher or the jaw plate. Thereby, the contact surfaces are indented or impressed as the flexible, elastic or resilient material closest and in direct contact with the rough surfaces enables the tops and bottoms of the rough surfaces to be pressed into the adaptable wedging surface as the outermost layer of jaw plate clamping bar when clamping it and during operation of the crusher.

[0025] In some embodiments/aspects, the jaw plate clamping bar is at least partly covered by a wear protecting element, which wear protecting element also may be flexible and/or resilient. This improves the wear resistance and actual life of the jaw plate clamping bar before it has to be replaced due to wearing out and prolongs the accessibility of the key handles of the fastening means as those are not worn out as fast as in prior art.

[0026] In some embodiments/aspects, the wear protecting element of the jaw plate clamping bar is adapted to cover the jaw plate clamping bar where the jaw plate clamping bar faces the crusher chamber of the jaw crusher. This reduces the wear of the fastening means and the actual life of the fastening means before it has to be replaced due to wearing out and also improves the accessibility of the key handles of the fastening means when being unscrewed.

[0027] In some embodiments/aspects, the cavity of the jaw plate clamping bar is arranged to detachably house or receive at least a part of the wear protecting element. Thereby, the wear protecting means is easily replaced when worn out.

[0028] It is also an object of the invention to provide a jaw crusher comprising at least one inventive jaw plate clamping bar creating adaptability to rough surfaces on cooperating wedging surfaces of the jaw plates and jaws of the jaw crusher. The jaw plate clamping bar of the jaw crusher is thereby also adaptable to different distances between these cooperating wedging surfaces, which distances vary during the operation of the jaw crusher due to vibrations, movements of the jaw plates, and varying clamping and crushing forces.

[0029] It is also a further object of the invention to provide a method of manufacturing a jaw plate clamping bar to be used in a jaw crusher, whereby the jaw plate clamping bar creates adaptability to rough surfaces on cooperating wedging surfaces of the jaw plates and jaws of the jaw crusher and adaptability to different distances between these cooperating wedging surfaces, which distances vary during the operation of the jaw crusher due to vibrations, movements of the jaw plates, lengthening/extension of each jaw plate due to "smearing out" of the

jaw plate as the material being crushed presses on the jaw plate changing its dimension and shape making it thinner partly or wholly, e.g. at the middle, but longer and wider, e.g. such that the jaw plate ends presses unevenly against the jaw plate clamping bar, and varying dimensional and surface tolerances due to the casting of the parts, and varying clamping and crushing forces. The method of manufacturing also creates an adaptability in length to differently sized jaw crushers having differently sized jaw plates, i.e. jaw plates with differing widths, either at manufacture but also at the site of an old jaw crusher where the length of the jaw plate clamping bar is easily adjusted to the specific width of the associated jaw plate, if necessary, as the jaw plate clamping bar is made/used/sold by the metre, compared to the known cast iron wedges that were casted in one solid piece of heavy cast iron with a predetermined fixed and non-adjustable length.

[0030] The method of manufacturing a jaw plate clamping bar to be used in a jaw crusher according to the independent method claim makes it possible to improve the clamping ability of the jaw plate clamping bar reducing the need of tightening the fastening means during the operation of the jaw crusher, which reduces the number of necessary standstills for such retightening, and to optimize the length of the jaw plate clamping bar to each jaw plate.

[0031] In some embodiments/aspects, the method of manufacturing a jaw plate clamping bar, whereby the forming of the jaw plate clamping bar is done by extruding raw material creating the jaw plate clamping bar having wedging portions. Thereby, the method of manufacturing jaw plate clamping bars makes it possible to simplify the manufacturing and handling of manufactured jaw plate clamping bar and to reduce the cost of manufacture of these and to optimize the length of the jaw plate clamping bar to each jaw plate as the jaw plate clamping bar is made/used/sold by the metre.

[0032] The effect of the invention is that the clamping or wedging ability of the jaw plate clamping bar is improved by being adaptable to both smooth/even and rough, askew, warped and/or crooked surfaces on the cooperating wedging surfaces of the jaw plates and jaws and also adaptable to different distances between these cooperating wedging surfaces, which distances vary during both standstills when a new jaw plate clamping bar replaces an old one by being tightened and fitted into place and during the operation of the jaw crusher due to vibrations, movements of the jaw plates, lengthening and/or extension of each jaw plate due to "smearing out" of the jaw plate as the material being crushed presses on the jaw plate changing its dimension and shape making it thinner partly or wholly, e.g. at the middle, but longer and wider, e.g. such that the jaw plate ends presses unevenly against the jaw plate clamping bar, and varying dimensional and surface tolerances due to the casting of the parts, and varying clamping and crushing forces, whereby the adaptable clamping ability of the jaw plate

clamping bar makes it possible to improve the holding of the jaw plates in a more dynamically secure way in place in the jaw crusher as the rough, askew, warped and/or crooked surfaces of the jaw plate and jaw moves towards and away from each other creating varying distances between the wedging parts in a dynamical way during operation of the jaw crusher. Hence, an almost "intelligent" adaptability in view of its clamping ability is created by the inventive jaw plate clamping bar compared to the known stiff/rigid non-adaptable solid cast iron wedges.

Brief Description of the Drawings

[0033] The invention will be described in more detail with reference to the appended drawings, which show examples of presently preferred embodiments of the invention.

Figs. 1 and 2 shows a jaw crusher in two different enlargements with jaws comprising at least one jaw plate clamping bar according to the invention,

Fig. 3 is a perspective view of the jaw plate clamping bar according to the invention and one way of detachably attaching it to the jaw,

Fig. 4 is a view in cross-section showing only the jaw plate clamping bar according to the invention and how it is adaptable by means of its shape,

Fig. 5 is a view in cross-section also showing only the jaw plate clamping bar according to the invention and how it is adaptable by means of its inherent properties, e.g. by means of the material forming it,

Fig. 6 is a view in cross-section also showing only the jaw plate clamping bar according to Fig. 5 and how it adapts to surrounding wedging/anvil surfaces,

Fig. 7 is a view in cross-section also showing only the jaw plate clamping bar according to Fig. 3 being adaptable by means of a combination of its shape and its inherent properties/characteristics, i.e. a combination of its shape and material,

Fig. 8 is a view in cross-section also showing only the jaw plate clamping bar in another version similar to Figs. 3, 4 and 7,

Fig. 9 is a view in cross-section also showing only the jaw plate clamping bar in another version similar to Fig. 5,

Fig. 10 is a view in cross-section also showing the jaw plate clamping bar in another version similar to Figs. 3, 4, 7 and 8,

Fig. 11 is a view in cross-section also showing only the jaw plate clamping bar in another version similar to Figs. 5 and 9,

Fig. 12 is a view in cross-section also showing only the jaw plate clamping bar in another version similar to Figs. 3, 4, 7, 8, and 10, and

Fig. 13 is a view in cross-section showing only the jaw plate clamping bar in a version similar to Figs. 8 and 10 being adaptable by means of its shape.

Detailed Description of the Invention

[0034] A jaw crusher 1 is shown in Figs. 1 to 2. The jaw crusher comprises jaw plates 2, 2' and a moving jaw 3 and a stationary jaw 3', each jaw being provided with at least one jaw plate 2, 2'. The jaw plates are securely retained against each jaw 3, 3' by means of clamping bars 10. Each jaw plate comprises an upper surface 4 being slanted for defining a wedge surface against which the clamping bar wedges for securely clamping the jaw plate in place in the crusher (see Figs. 7 and 10). Each jaw 3, 3' comprises a lower surface 5 being slanted for defining an anvil surface against which the clamping bar wedges for securely clamping the jaw plate 2, 2' in place in the crusher 1 (see Figs. 4 to 8, 10 and 12).

[0035] Each jaw plate clamping bar 10 is detachably attached to the associated jaw 3, 3' by fastening means 20, e.g. in the form of threaded tension rods (shown as long screws working as tension rods) passing through the jaw' with nuts threaded onto their other ends as shown in Fig. 3 and/or screws/bolts threaded directly onto threaded holes (not shown) in Figs. 10 and 11. The crusher 1 has its stationary 3' and movable jaw 3 spaced to define a crushing chamber/gap 30 in between the jaws.

[0036] The jaw crusher 1 of Figs. 1 and 2 has a frame 40, which comprises a frame portion with rotary drive means for repeatedly moving the movable jaw 3 (shown to the right in Figs. 1 and 2) toward and away from the stationary jaw 3' (shown to the left in Figs. 1 and 2) and a frame portion comprising means for securing the jaws. These parts of a jaw crusher 1 and their function are readily known by a skilled person and will not be explained in more detail. Each jaw 3, 3' comprises a wedging surface 4 adapted to cooperate with the inventive jaw plate clamping bar 10. Each jaw plate 2, 2' comprises a wedging surface 5 also being adapted to cooperate with the inventive jaw plate clamping bar for securing the plate in place.

[0037] The inventive jaw plate clamping bar 10 as shown in Figs. 1 to 13 has an outer shape or contour corresponding to a wedge and is shown during assembly/disassembly to/from its placement between a jaw plate 2, 2' and a jaw 3, 3', i.e. between and above an upper portion of a jaw plate, i.e. wedging surface 4, and a lower portion 5 of a jaw, i.e. wedging surface 5. The jaw plate clamping bar 10 is adaptable. The jaw plate clamping bar 10 is adaptable by comprising a shape and/or inherent properties/characteristics. This means that the jaw plate clamping bar is adaptable due its shape or due to inherent properties in form of a material that makes it adaptable or the jaw plate clamping bar may be adaptable due to a mix of the above, i.e. shape and material. The jaw plate clamping bar 10 may be adaptable by flexing/flexibility and/or resiliency.

[0038] This is due to, if a jaw plate 2, 2' moves due to vibrations and/or movements, the casting tolerances, and dimensional "smearing out" of the jaw plates 2, 2' in an undesired way during the crushing operation, this af-

fects the adjoining/wedging between the jaw plate 2, 2' and the clamping bar 10 in a negative way. This occurs by a varying distance (increasing gap between the jaw plate 2, jaw anvil on the jaw 3, 3' or crusher and clamping bar 10) and subsequent varying clamping forces between the clamping bar and the jaw plate 2, 2', and/or jaw anvil 4, 5 along the longitudinal axis of the clamping bar and/or along a centre axis C (see Figs. 7 to 13) of the clamping bar. The inventive clamping bar adapts to these varying parameters by for example flexing out where the jaw plate moves from the clamping bar so that the clamping "follows" the jaw plate moving away keeping the clamping force substantially the same while flexing in where the jaw plate moves towards or closer to the clamping bar so that the clamping "follows" the jaw plate moving closer both during standstills and during operation of the crusher 1. The flexing in and out of the clamping bar 10 is schematically shown in Figs. 4 to 6 with wavy and/or bent shapes along parts of the length of the clamping bar 10 or discontinuously along its length or along its whole length shown in Fig. 4 and/or compressed bulging shapes, e.g. convex and/or concave, shown in Fig. 5 and/or indented shapes by more or less sharp and blunt protrusions on the associated rough surfaces. The proportions of the shown varying shapes and dimensions in Figs. 4 to 6 are more or less exaggerated or reduced to enlighten the principle of the inventive adaptability of the jaw plate clamping bar 10.

[0039] Hence, the inventive clamping bar 10 is adaptable by having a clamping ability being adaptable to varying parameters and conditions affecting the firm and secure retaining of the jaw plate 2, 2' in place during standstills and/or operation of the jaw crusher 1. These parameters may be varying forces, i.e. clamping and wedging forces, various movements and vibrations, varying shapes and surfaces of and for the jaw crusher 1, the jaw plate 2, 2' and the jaw plate clamping bar when the jaw crusher, the jaw plate and the jaw plate clamping bar cooperate during operation of the jaw crusher and when an old jaw plate clamping bar is replaced by a new clamping bar being adaptably fitted into place in the crusher 1 during a standstill.

[0040] The adaptability/adaptable clamping ability of the inventive jaw plate clamping bar 10 means that the retaining of the jaw plate is improved and simplified as less follow-up draft of the fastening screws and nuts is required, wherefore also the trouble with narrow spaces behind the jaws 3, 3' in the crusher making the accessibility of the nuts to be very low is reduced as less subsequent tightening of the screws is needed during operation of the jaw crusher 1.

[0041] Moreover, as the jaw plates 2 and the anvil parts 4, 5 of the jaws 3, in between which the inventive clamping bar 10 is wedged, are made by casting, the surfaces and shapes of the portions of the jaw plates and the jaw anvil parts to be wedged against by the adjoining clamping bar are rough with uneven surfaces and low surface tolerances due to low quality demands on these toleranced

dimensions for the jaw plate and jaw anvil. This is due to the fact that a machining of these casted surfaces to dimensions with higher tolerances is too expensive. This means that the rigid and very stiff prior art solid metal clamping bars that are also casted with very rough and uneven surfaces easily lose their clamping ability due to too few contacts points and too small contact surfaces with the jaw plate and the jaw anvil when the jaw plate moves/vibrates/changes shape by being "smeared out" during crusher operation and the rigid and very stiff cast prior art solid metal clamping bars are unforgiving and therefore easily come loose and start for example moving laterally into engagement with cheek plates of the jaw crusher increasing the unwanted wear on these and also let the jaw plate come loose due to the decreased clamping force from the loose and too stiff prior art clamping bars due to their lost wedging effect.

[0042] The jaw plate clamping bar 10 is in Figs. 8 and 12 removably attached above and engages the upper edge 4 of the jaw plate 2, 2'. The wedging/clamping jaw plate clamping bar 10 is flexible creating a retaining of the jaw plate against the jaw crusher being forgiving against wear, low dimensional tolerances and misalignment reducing any undesired loosening of the wedging/clamping bar 10 if the jaw plate 2, 2' tilts in the same direction as its plane, i.e. if one part of its end surface 5 close to one cheek plate of the crusher 1 moves towards the jaw plate clamping bar 10 while the other or opposite part of the end surface 5 close to the other cheek plate of the crusher moves away from the jaw plate clamping bar, the jaw plate clamping bar flex out where the distance between it and the jaw plate increases and flex in or is compressed or indented where the distance between it and the jaw plate decreases.

[0043] The number of jaw plate clamping bars 10 depends on the size of the crusher 1 and its jaw plates 2, 2', i.e. the width of the jaw crusher and its plates and may be between one, two, three and more, but is preferably between one jaw plate clamping bar and two jaw plate clamping bars for each jaw plate 2 and 2'. In one example, one jaw plate 2 is arranged on the moving jaw 3 and one jaw plate 2' is arranged on the stationary jaw 3', each jaw plate comprising one jaw plate clamping bar 10. In another example, each jaw plate comprises two or more jaw plate clamping bars 10.

[0044] The inventive jaw plate clamping bar 10 has a wedge-shaped outer contour in profile and in cross-section, as shown in Figs. 4 and 5, and is an elongated item, but may of course have a length close to or equal to its width in cross-section or profile seen in Figs. 4 and 5. The jaw plate clamping bar 10 may also have a length being shorter, i.e. smaller, than its width, however, a length being larger than its width is the most preferred dimensional proportion. The jaw plate clamping bar wedging portions 11, 12, 12', 13, 13' have a shape creating the adaptability.

[0045] The inventive jaw plate clamping bar 10 comprises a first portion 11 that may be made of a solid non-

metallic material making up the whole jaw plate clamping bar 10 as shown in Figs 5, 9 and 11. The first portion 11 of the jaw plate clamping bar 10 may also be an integrated part of the jaw plate clamping bar 10 as shown in Figs 3, 7, 8, 10, and 12.

[0046] Each of the jaw die plates 2, 2' and the known solid metal jaw plate clamping wedges have hitherto been casted in one piece, whereby they always have very rough and uneven outer surfaces, at least partly, as not their whole surfaces have been machined, creating gaps between these parts contacting each other due to very unprecise tolerances. The jaw plates 2, 2' may be divided into at least two parts, whereby at least one joint is created between these two jaw plate parts, which joint then would have to be secured in the similar way as the ends of the jaw plates, e.g. by further jaw plate clamping bars. In this case, the description is focused on the clamping of the jaw plates at their "free" ends and not their ends at the joint between their parts, even though, the same structure and jaw plate clamping bars of course can be used at a joint of a two-part jaw plate. The stiff and rigid known solid metal jaw plate clamping wedges easily come loose for example at one end, i.e. they loose contact with the jaw plate/crusher at one end while the other end of the known solid metal jaw plate clamping wedges is still clamped by still being in contact with the jaw plate/crusher surface to surface.

[0047] The jaw plate clamping bar 10 may be made of a metallic material having a shape with an upper 12, 12' and a lower 13, 13' portion diverging from each other, whereby the portions define a cavity/space 16 between each other (see Figs. 3 to 9 and 11 to 13). This cavity 16 creates an adaptability of the wedging portions of the jaw plate clamping bar as the upper and lower portions forms in principle, seen in profile or cross-section, two diverging legs of a V- or U-shape, whereby these legs due to the cavity 16 between them may flex towards and away from the cavity when the jaw plate clamping bar is subjected to the rough and varying surfaces and different distances between the jaw plate clamping bar and complementary anvil or seat portions 4, 5 of the jaw crusher 1 during operation of the jaw crusher. In this cavity or space, at least one flexible/resilient element 11 may be detachably or fixedly arranged. The upper portion 12, 12' and a lower portion 13, 13', when studied in profile, diverge from each other towards the crushing chamber of the jaw crusher. The cavity 16 between the lower and upper portions 12, 12', 13, 13' opens on to the crushing chamber 30 of the jaw crusher 1.

[0048] The jaw plate clamping bar 10 may also comprise both non-metallic and metallic material. The jaw plate clamping bar 10 may also comprise at least one flexible or resilient element 11 made of a non-metallic material as shown in Figs 3, 7, 8, 9, 12 and 13.

[0049] The whole jaw plate clamping bar 10 may be made of one flexible or resilient material or element 11, whereby the material of this element body 11 has the ability to adapt, e.g. by flexing, when the jaw plate clamp-

ing bar is subjected to the rough and varying surfaces and different distances between the jaw plate clamping bar and the complementary anvil or seat portions 4, 5 of the jaw crusher 1 during operation of the jaw crusher (see Figs. 5, 9 and 11). Fig. 9 is a view in cross-section showing only the jaw plate clamping bar in another version similar to Fig. 5 being adaptable by means of its inherent properties and/or characteristics and/or material. The jaw plate clamping bar comprises at least one flexible and/or resilient element 11 making the wedging portions 12, 12', 13, 13' of the jaw plate clamping bar adaptable. The at least one flexible and/or resilient element 11 is mainly made of a polymeric material or another flexible material.

[0050] The upper jaw plate clamping bar portion 12 of the jaw plate clamping bar 10 comprises an upper contact surface 15 and the lower jaw plate clamping bar portion 13 comprises a lower contact surface 14 with an angle α between these surfaces 14, 15.

[0051] The jaw plate clamping bar 10 comprises, when studied in profile, a first portion 12 and a second portion 13 with an angle α between these portions 12, 13. The portions 12 and 13 together with contact surfaces 14 and 15 form wedge/wedging portions by means of which the jaw plate 2, 2' is clamped to the jaw. The jaw plate clamping bar 10 is releasably attached to the underlying jaw 3, 3' by means of detachable fastening means 20 being introduced through an intermediary portion or back portion 17 of the jaw plate clamping bar forming an adjoining corner area between the end areas of the upper and lower portions 12 and 13 as shown in Figs 9 to 13. The wedge shape of the jaw plate clamping bar 10 means that the jaw plate clamping bar can be moved in and out, i.e. in both directions of the arrows B shown adjacent the fastening means 20 in Fig 3 towards the jaw 3, 3' and away from the jaw depending on how far it is pulled in by the fastening means and how far and in which direction it moves during the operation of the jaw crusher 1. In Fig. 7, arrow A shows the same direction as arrow B if the centre axis C extend straight through the clamping bar as in Figs. 4 to 10, and 12 to 13, while in Fig. 11, the direction of arrow A indicating the movement of the clamping bar 10 may differ from the direction of arrow B being in parallel with the centre axis of the fastening means 20 extending somewhat obliquely in relation to the centre axis C. However, the direction of arrow A may also differ from the direction of the centre axis C or be in parallel with the centre axis C as shown in Fig. 7. The back portion 17 is not supposed to be in contact or to abut against the jaw or jaw crusher as it then may be a risk of non-tensioning, i.e. slacking of the fastening means 20 and lost clamping ability, i.e. the distance between the back portion 17 of the jaw plate clamping bar 10 and the associated surface of the jaw crusher 1 as shown in Fig 7 is required to maintain and create a tension in the fastening means 20 enabling the clamping.

[0052] Each of the adaptable contact surfaces 14 and 15 of the jaw plate clamping bar 10 is adapted to press towards an upper defining slanted wedge surface 4 of

the jaw plate 2, 2' or jaw 3, 3' and a lower defining slanted wedge surface 5 of the jaw plate 2, 2' to effectively secure the jaw plate 2, 2' to the jaw 3, 3' by being able to flex when the jaw plate moves, vibrates, changes shape and dimension by being "smeared out", and/or tilts, whereby the jaw plate clamping bar adapts in shape absorbing rough surfaces and distributing the transmission of forces for counterbalancing the effects of the movement, vibration, changing dimensions, and/or tilting of the jaw plate during operation of the crusher 1.

[0053] The jaw plate clamping bar 10 and its upper and lower portions 12, 13 may form two, three or four layers with the third portion or element 11, which layers are sandwiched in different ways and shapes as shown in Figs 3, 7, 8, 10, 12 and 13 for making up the inventive jaw plate clamping bar 10. The jaw plate clamping bar 10 may also be formed in only one layer/element 11, i.e. one piece, as shown in Figs. 5, 9 and 11. Moreover, element 11 may form an intermediary layer as shown in Figs. 3 and 7 or both an outer and middle layer of the jaw plate clamping member as shown in Figs. 12 and 13.

[0054] A first layer 11, 13, 14 is shown in Figs. 8 and 12 as making contact only with the jaw plate 2, 2' or shown in contact with both the upper wedge surface 4 and the lower wedge surface 5 in Figs. 7 and 10. The first layer may be the upper portion 12 and the lower portion 13 in combination as an outer layer as shown in Figs. 4, 8 and 10. The first layer may also be the third portion, i.e. the element 11 as shown in Fig. 12, both as a middle and an outer layer, and may also comprise or form the two portions 12 and 13 and the back portion 17 as shown in Figs. 3, 7, 8 and 10.

[0055] The second layer is fixed to the first layer, which second layer may be made of a flexible or elastic material, e.g. Nylon plastic (PA6) or rubber. The second layer may be the element 11 as shown in Figs 3, 7, 8, 10, and 13. This second layer 11 may be seen as arranged in the cavity 16 of the jaw plate clamping bar 10 and filling out the cavity 16 as shown in Figs. 8 and 10, where Fig. 10 also shows protrusions or knobs inside the cavity 16 for improving the attachment of element 11 by a better grip/engagement of it.

[0056] In Fig 12, there are four layers and element 11 is both the first layer forming the outer surface and the back portion 17 to the right and the intermediary third layer between the second layer being the upper portion 12 and the lower portion 13 enclosed in whole by element 11 and another outer layer being the upper portion 12' and the lower portion 13' to the left. In Figs. 3 and 7, the third layer to the left being the outer layer/upper portion 12' and lower portion 13' is fixed to the second layer being element 11.

[0057] The jaw plate clamping bar 10 as shown in Figs 8, 10, 12 and 13 is at least partly covered or fully covered over its whole outer and/or inner surface by a wear protecting layer 11. This wear protective layer may be made of a flexible or resilient material. This wear protective layer may be the element 11 in the form of a plug as in Figs.

8 and 10, which plug may be detachably or fixedly attached to the jaw clamping bar 10 forming a wholly separate part or a partly or fully integrated part of the jaw clamping bar.

[0058] In Fig. 13, the wear protective layer may be the element 11 in the form of a membrane covering the jaw plate clamping bar 10 where the jaw plate clamping bar faces the crusher chamber 30 of the jaw crusher 1. Here, the wear protective layer 11 may be arranged as a curtain being fixed at the upper portion 12, 12' of the jaw plate clamping bar in Figs. 3 and 13 and hanging downwards with its lower portion being loosely attached to the lower portion 13, 13' of the jaw plate clamping bar and covers the whole face of the jaw plate clamping bar facing the crusher chamber of the jaw crusher similar to a lid fitted over the cavity 16 of the clamping bar 10.

[0059] Fig. 11 shows a view in cross-section over only the jaw plate clamping bar 10 in another version similar to Figs. 5 and 9. Here, the jaw plate clamping bar 10 is adaptable by means of its inherent properties or characteristics or material and is configured to be detachably attached to the jaw crusher by using somewhat obliquely extending fastening means 20 in relation to the centre axis C of the clamping bar. The centre axis C extends in parallel with the plane of Fig. 11 but is perpendicular to a longitudinal axis of the clamping bar extending perpendicularly to the plane of Fig. 11.

[0060] To sum up, the jaw plate clamping bar 10 according to the invention is adapted to press towards/against the upper defining slanted wedge surface 4 and the lower defining slanted wedge surface 5 to effectively secure the jaw plate 2, 2' to the jaw 3, 3' by flexing when the jaw plate clamping bar is secured and pulled in as a wedge between these surfaces 4 and 5 of the jaw plate and the jaw, respectively, to the underlying jaw. However, in some cases, the upper wedge surface 4 and the lower wedge surface 5 may be parts of a jaw plate if the jaw plate clamping bar is arranged in a joint between two-parts of a jaw plate, and, in other cases, the upper wedge surface 4 may be the lower surface of a deflector plate having no numeral in this description as it is a part of the jaw to the right in Figs. 1 and 2 and shown as the upper most slanting surface above the jaw plate clamping bar where the drawn line from the upper numerals 3, 3' end. Hence, these wedging surfaces 4 and 5 work as complementary anvil/seat portions cooperating with the portions 11-15 and 17 and surfaces 14 and 15 of the jaw plate clamping bar. The flexing of the jaw plate clamping bar 10 occurs due to the shape or the material, i.e. the properties of the material that makes up the jaw plate clamping bar or a combination of these two parameters making the jaw plate clamping bar adaptable in shape and/or material to "absorb" rough surfaces and to "compensate" for varying distances between the cooperating wedging surfaces 4, 5, 14, 15 and to distribute the transmission of forces during operation of the jaw crusher 1 for counterbalancing between too high and too low clamping forces.

[0061] The legs of the diverging portions 12, 12' and 13, 13' of the metal jaw plate clamping bar 10 follows the rough surfaces and the decreasing and increasing distances both along its width, i.e. in the direction of the centre axis C, but also along its length, as seen in Figs 1 to 3, i.e. in the direction of the normal to the centre axis C in Figs. 7 to 13. The same goes for the jaw plate clamping bar 10 being made of a solid non-metallic body 11 shown in Figs. 5, 6, 9 and 11 and also for the mixed/sandwiched material version of the jaw plate clamping bar 10 shown in Figs. 3, 7, 8, 10, 12 and 13. Then, the contact surfaces 4, 5, 14, 15 are, more specifically, also indented/impressed, especially the versions in Figs. 9, 11 and 12, where element 11 is a non-metallic and flexible, elastic or resilient material closest and in direct contact with the tops and/or valleys of the rough surfaces being pressed into the element 11 as the outermost layer of jaw plate clamping bar 10 when clamping the jaw plate clamping bar and during operation of the crusher 1. The flexing in and out, pressing together and impression of the jaw plate clamping bar 10 and its body and surfaces are schematically shown in Figs. 4 and 5 by solid lines and dashed lines.

[0062] The invention also concerns a jaw crusher 1 comprising at least one jaw plate clamping bar 10 according to the above description for securing at least one jaw plate 2, 2' of the jaw crusher.

[0063] Moreover, the invention also concerns a method of manufacturing the jaw plate clamping bar 10 according to the above description for securing at least one jaw plate 2, 2' to at least one jaw 3, 3' of the jaw crusher 1. The jaw plate clamping bar works as a wedge being detachable from the jaw crusher. Firstly, the jaw plate clamping bar 10 is formed by raw material creating the jaw plate clamping bar with wedging portions 11, 12, 12', 13, 13', 14, 15, and then cut into suitable lengths for the jaw plate 2, 2'. The forming of the jaw plate clamping bar 10 may be done by extruding raw material for creating the jaw plate clamping bar with wedging portions 11, 12, 12', 13, 13', 14, 15.

1	jaw crusher
2	moving jaw plate
2'	stationary jaw plate
3	moving jaw
3'	stationary jaw
4	upper (slanted) wedge defining surface of jaw crusher
5	lower (slanted) wedge defining surface of jaw crusher
10	jaw plate clamping/wedging bar
11	resilient jaw plate clamping bar means/element
12, 12'	first clamping bar portion
13, 13'	second clamping bar portion
14	lower clamping bar contact surface
15	upper clamping bar contact surface
16	cavity/space in jaw plate clamping bar

17	third jaw plate clamping bar portion
20	fastening means for jaw plate clamping bar
30	crushing chamber/gap
40	crusher frame
5 C	centre axis of clamping/wedging bar 10
A	arrow showing directions of movement of clamping/wedging bar 10
B	arrow showing direction of extension of fastening means 20

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Claims

1. A jaw plate clamping bar (10) for securing a jaw plate (2, 2') to a jaw (3, 3') of a jaw crusher (1), the jaw plate clamping bar being adapted to work as a wedge being detachable from the jaw crusher, **characterised in that** the jaw plate clamping bar (10) comprises wedging portions (11, 12, 12', 13, 13', 14, 15) being adaptable to surfaces and varying distances between the jaw plate clamping bar and complementary anvil portions (4, 5) of the jaw crusher (1).
2. The jaw plate clamping bar (10) according to claim 1, wherein the wedging portions (11, 12, 12', 13, 13', 14, 15) of the jaw plate clamping bar (10) have a shape creating the adaptability.
3. The jaw plate clamping bar (10) according to any preceding claim, comprises, when studied in profile, an upper portion (12, 12') and a lower portion (13, 13'), diverging from each other towards the crushing chamber of the jaw crusher (1), which lower and upper portions define a cavity (16).
4. The jaw plate clamping bar (10) according to claim 3, wherein the cavity (16) between the lower and upper portions (12, 12', 13, 13') extends along a substantial part of the length of the jaw plate clamping bar (10).
5. The jaw plate clamping bar (10) according to claim 3 or 4, wherein the cavity (16) between the lower and upper portions (12, 12', 13, 13') opens on to the crushing chamber (30) of the jaw crusher.
6. The jaw plate clamping bar (10) according to claim 3, wherein the jaw plate clamping bar (10) has its cavity (16) along its length between fastening means (20) for detachably attaching the jaw plate clamping bar to the crusher (1).
7. The jaw plate clamping bar (10) according to any of the claims 3 to 6, wherein the cavity (16) of the jaw plate clamping bar (10) is arranged to detachably house at least a part of at least one flexible element (11).

8. The jaw plate clamping bar (10) according to any preceding claim, wherein the jaw plate clamping bar (10) is made of at least one non-metallic material.
9. The jaw plate clamping bar (10) according to any preceding claim, wherein the jaw plate clamping bar (10) comprises at least one flexible element (11) making the wedging portions (12, 12', 13, 13', 14, 15) of the jaw plate clamping bar (10) adaptable. 5
10. The jaw plate clamping bar (10) according to claim 7 or 9, wherein the at least one flexible element (11) is mainly made of a polymeric material.
11. The jaw plate clamping bar (10) according to any of the claims 7 to 10, wherein the jaw plate clamping bar (10) is at least partly made of metal and at least one flexible element (11) is sandwiched between a first (12, 12') and a second metallic portion (13, 13') of the jaw plate clamping bar. 15 20
12. The jaw plate clamping bar (10) according to any of the claims 7 to 11, wherein the at least one flexible element (11) of the jaw plate clamping bar (10) forms at least one adaptable wedging surface (14, 15) arranged to contact the jaw crusher (1) or the jaw plate (2, 2'). 25
13. The jaw plate clamping bar (10) according to any preceding claim, wherein the jaw plate clamping bar (10) is at least partly covered by a wear protecting element (11). 30
14. The jaw plate clamping bar (10) according to claim 13, wherein the wear protecting element (11) is flexible. 35
15. The jaw plate clamping bar (10) according to claim 13 or 14, wherein the wear protecting element (11) is adapted to cover the jaw plate clamping bar (10) where the jaw plate clamping bar faces the crusher chamber (30) of the jaw crusher (1). 40
16. The jaw plate clamping bar (10) according to any of the claims 3 to 7 and claim 15, wherein the cavity (16) of the jaw plate clamping bar (10) is arranged to detachably house at least a part of the wear protecting element (11). 45 50
17. A jaw crusher (1) comprising at least one jaw plate clamping bar (10) according to any preceding claim for securing jaw plates (2, 2') of the jaw crusher (1).
18. A method of manufacturing a jaw plate clamping bar (10) according to any of the preceding claims for securing a jaw plate (2, 2') to a jaw (3, 3') of a jaw crusher (1), the jaw plate clamping bar working as a

wedge being detachable from the jaw crusher, **characterised by**

- forming raw material creating the jaw plate clamping bar (10) having wedging portions (11, 12, 12', 13, 13', 14, 15), and
- cutting the jaw plate clamping bar (10) into suitable lengths for the jaw plate (2, 2').

- 10 19. The method of manufacturing a jaw plate clamping bar (10) according to claim 18, whereby the forming of the jaw plate clamping bar (10) is done by extruding raw material creating the jaw plate clamping bar having wedging portions (11, 12, 12', 13, 13', 14, 15).

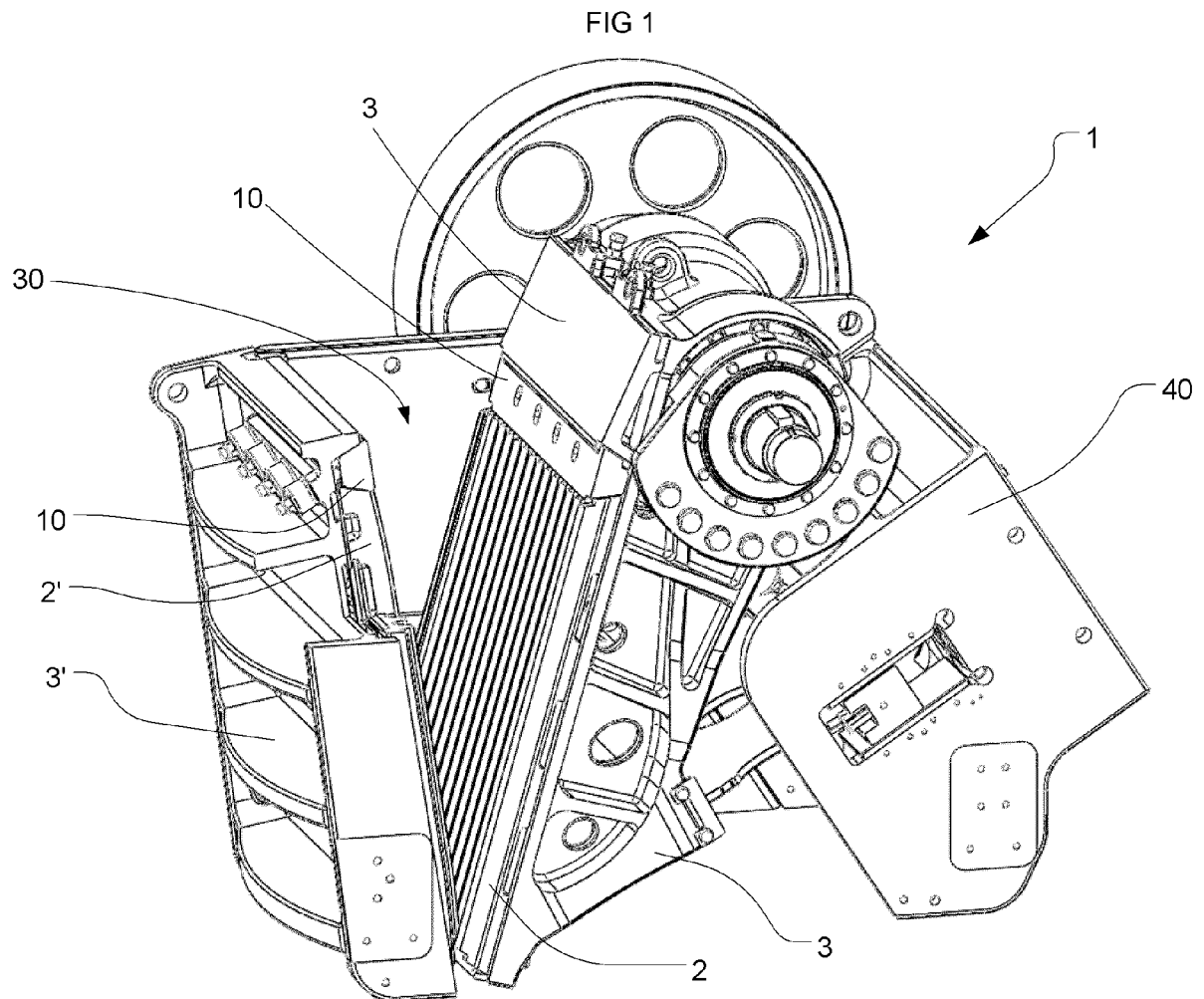
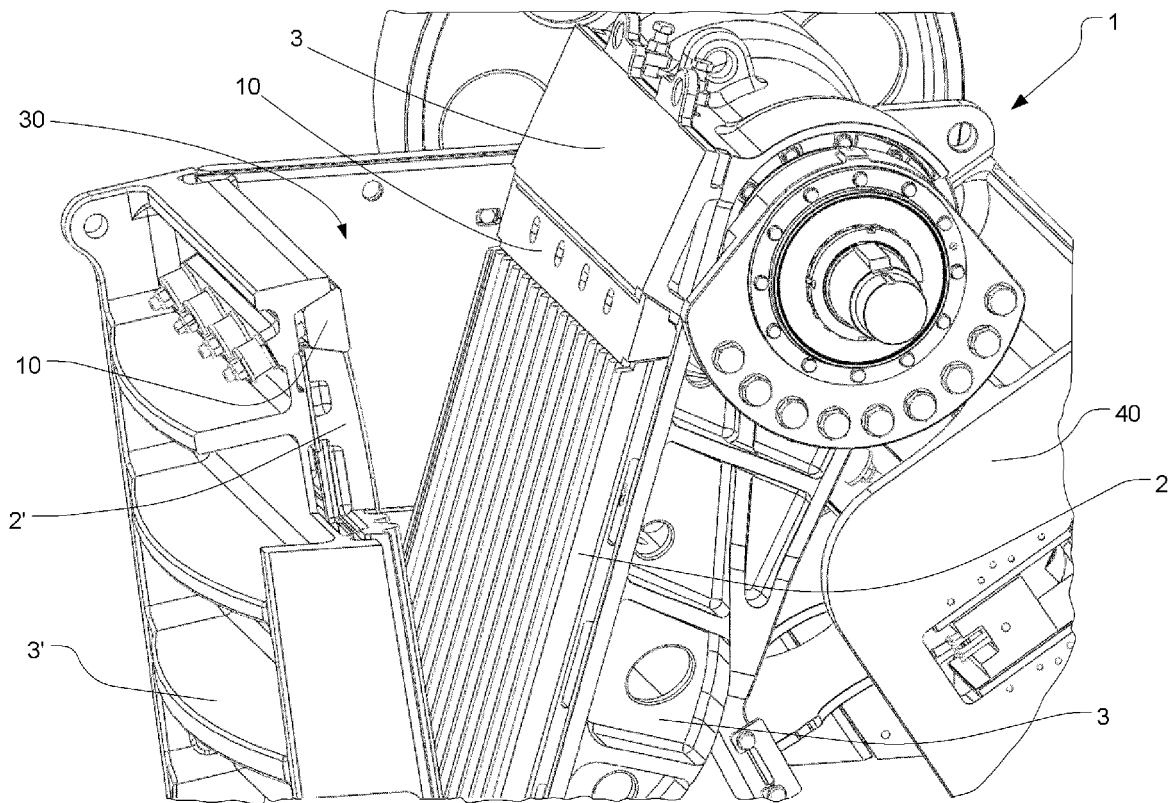
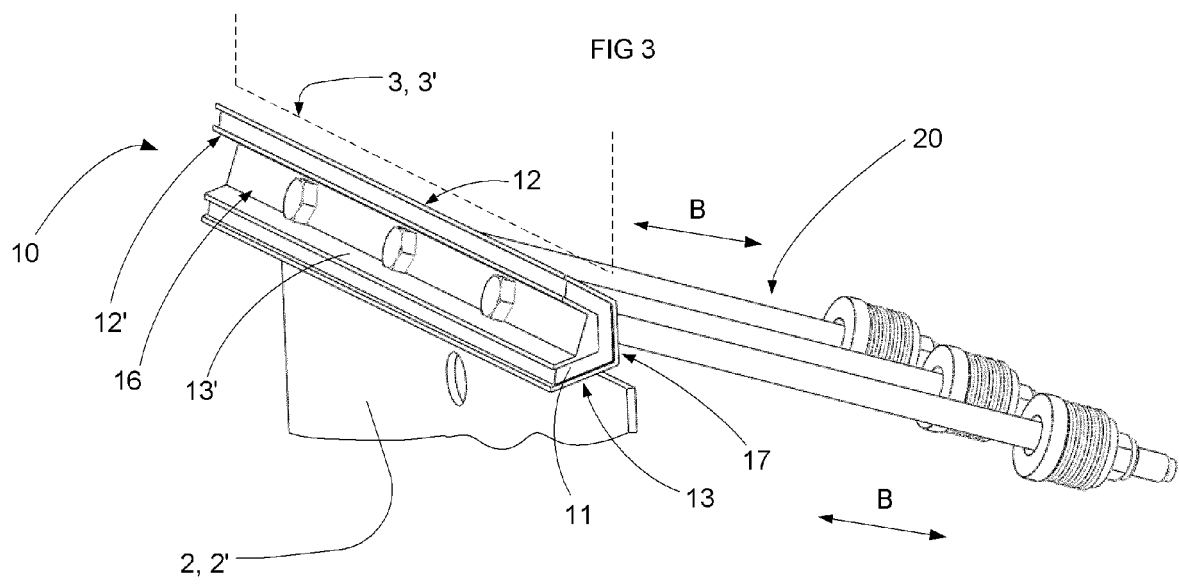
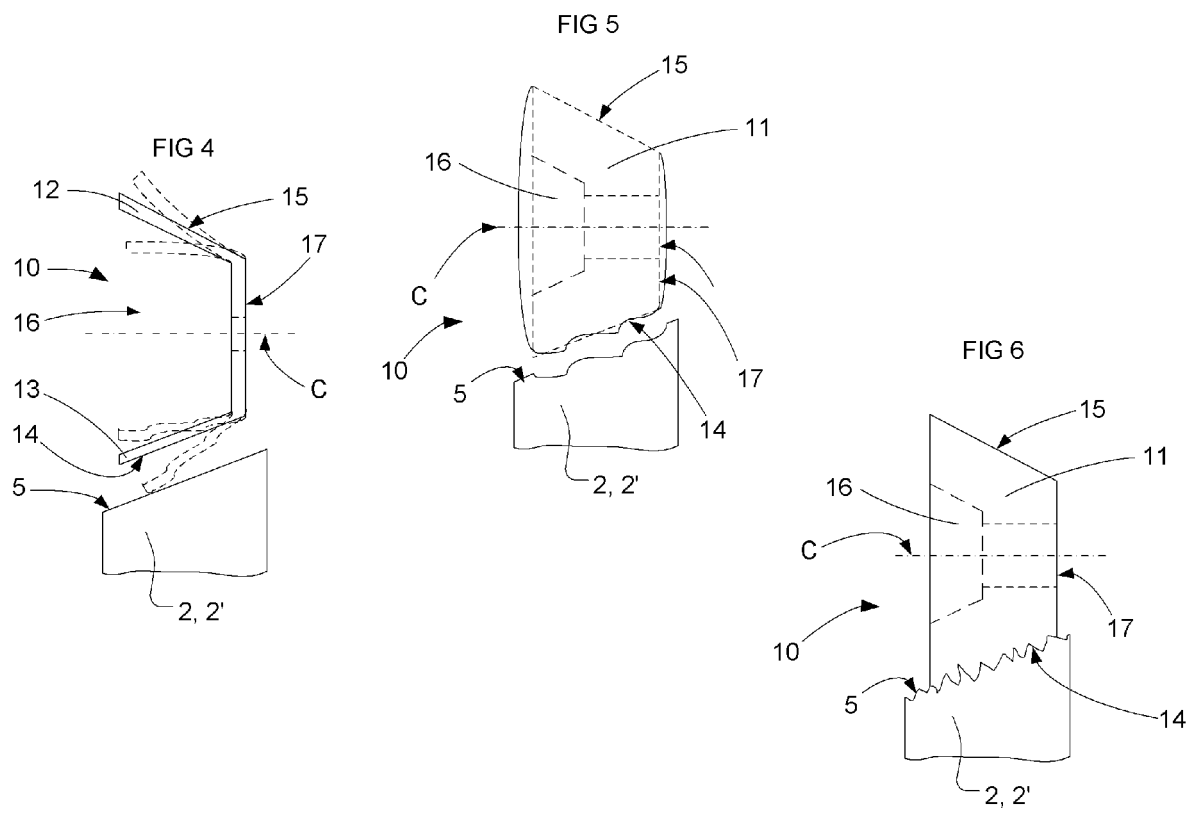
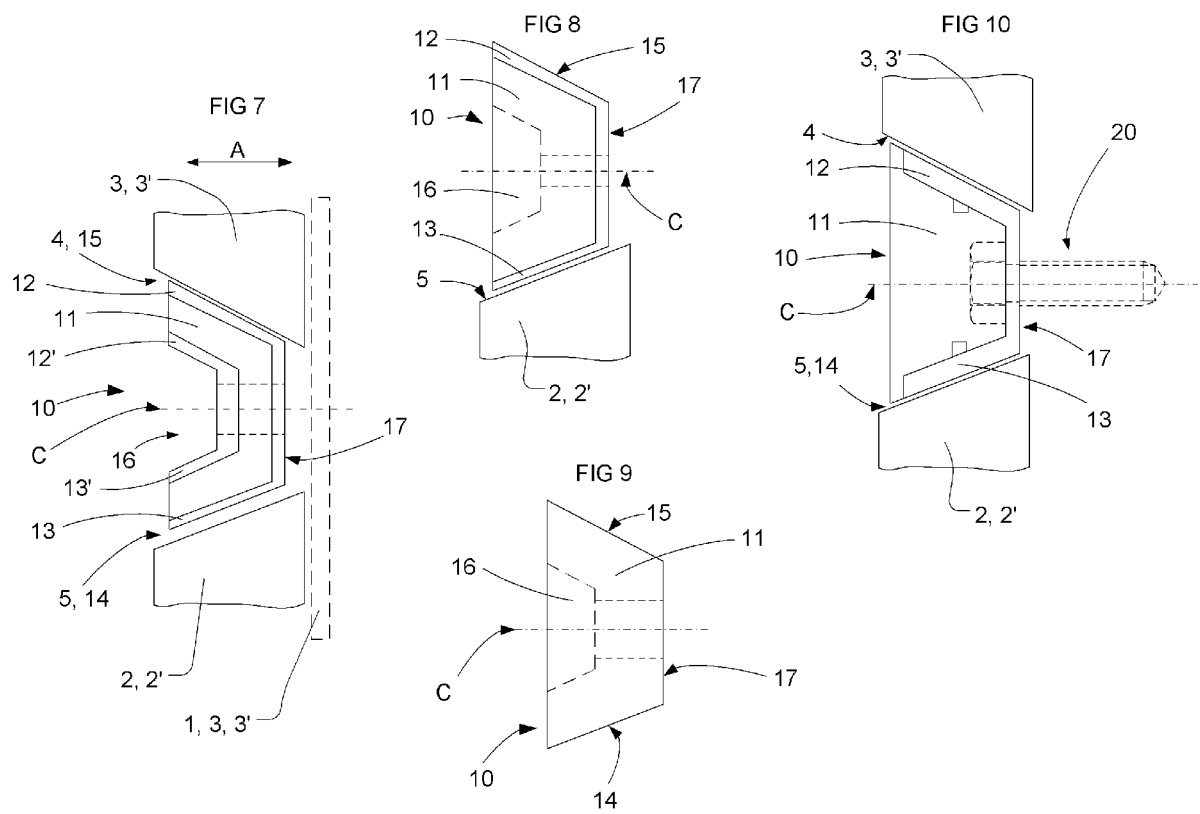


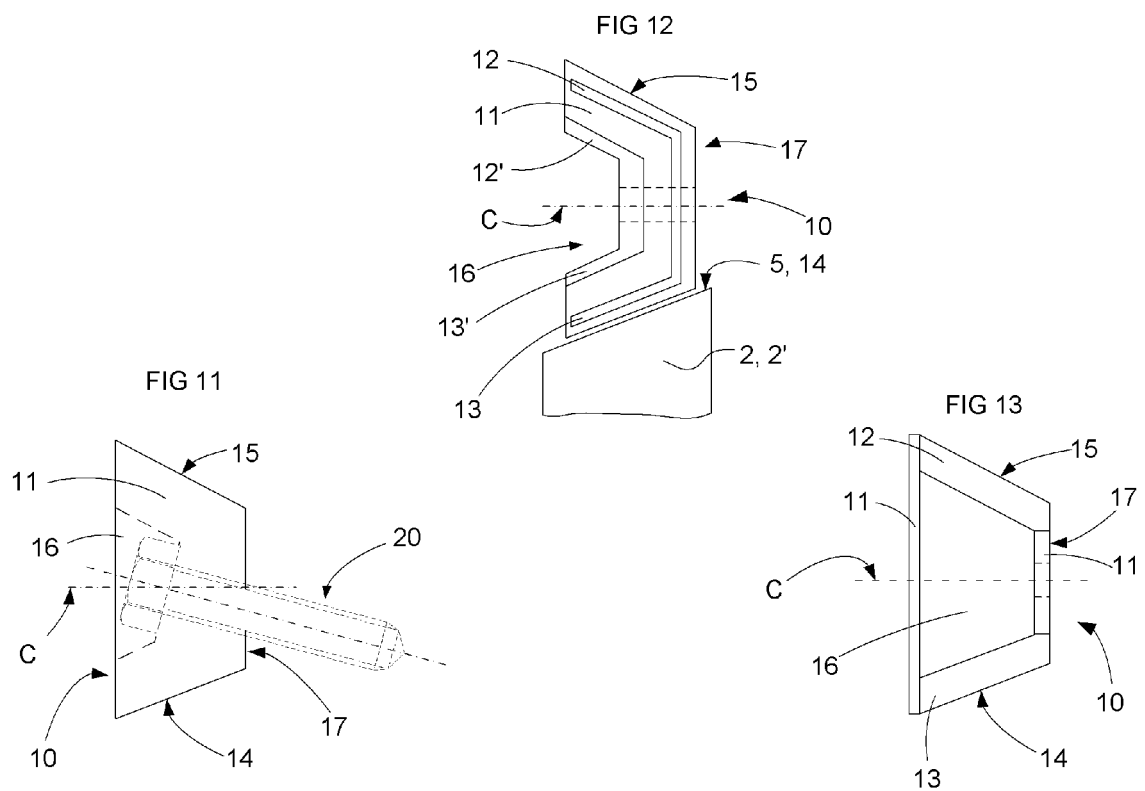
FIG 2













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 Application Number
 EP 12 17 1786

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Place of search Munich		Date of completion of the search 6 December 2012	Examiner Flodström, Benny
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