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(54) HAMMER TOOL ASSEMBLY, HAMMER MILL ROTOR, HAMMER MILL AND USE OF A HAMMER TOOL ASSEMBLY

(57) A hammer tool assembly (50), a hammer mill rotor (60), a hammer mill (100) and use of a hammer tool assembly (50) are provided. The hammer tool assembly (50) comprises a locking arrangement (11), a first hammer blade (1 a) and a second hammer blade (1 b). The locking arrangement (11) is arranged to be fitted into first and second through slots (5a, 5b) of the first and second hammer blades (1a, 1b) and at least a part of the first hammer blade (1a) and at least a part of the second hammer blade (1b) are arranged to be interposed between a first protuberance (15) and a second protuberance (17) of the locking arrangement (11).

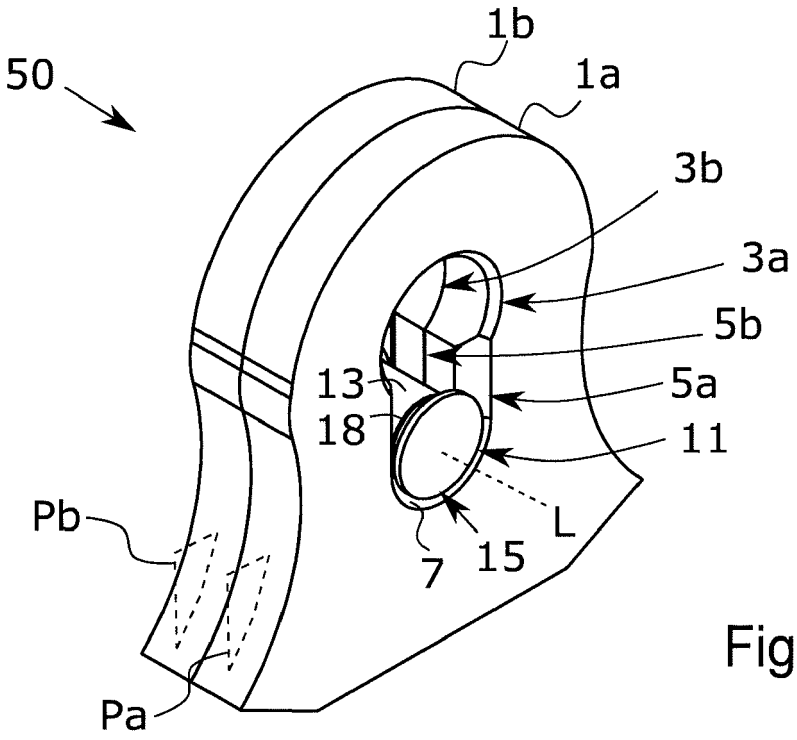

Fig.6

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Description

TECHNICAL FIELD

[0001] Embodiments herein relate to a hammer tool assembly. Embodiments herein further relate to a hammer mill rotor, a hammer mill and to use of a hammer tool assembly for crushing, separation and/or delamination of compound materials in a hammer mill.

BACKGROUND

[0002] Impact crushers or hammer mills are used in a variety of different technical fields such as, for example, separation and delamination of compound materials. Compound materials include compounds of metal, different metals, metals and plastic, different plastics or mineral compounds. Because the physical properties of the individual components of the compounds are different, such compound particles are separated in impact crushers or hammer mills in which different materials deform unequally elastically and unequally plastically and thereby separate. Typical compound materials that are processed in impact crusher or hammer mills are electronic waste and shredder waste, shredder light fractions and automotive shredder from car recycling. The hammer mill may also be used for crushing e.g. stone, limestone, minerals, concrete and various other products and/or materials.

[0003] The use of hammer mills in this area is associated with enormous wear of hammer tool assemblies therein and the hammer tool assemblies or parts thereof may therefore be replaceable. The hammer mill may comprise a rotor with a number of hammer shafts. The hammer mill assemblies may be mounted on the hammer shaft and brought to rotate / pivot by the rotor.

[0004] Some hammer mills have hammer blades which are mounted across the effective range of the rotor shaft. Often, the hammer blade is designed as a reversible hammer blade and can thus be reversed by 180 degrees after wear out of one side. With the abrasion the hammer blade not only becomes thinner but also the radial distance of the hammer blades decreases. If the hammer blade wears out at the outer edge, the gap between the hammer blade and crusher walls increases and the efficiency of the mill is reduced.

[0005] In order to maintain a satisfying efficiency of the hammer mill, the material portion of the hammer tool assemblies which is available for abrasion must be kept low. In some applications only 10 to 40% of the volume of the hammer tool assemblies is available for abrasion. Hence, the hammer tool assemblies and hammer blades have to be reversed and replaced at relatively short intervals. This in turn entails that the overall production cost increases.

[0006] Thus, there is a need for a hammer tool assembly which is improved with regards to wear properties, robustness and cost efficiency.

SUMMARY

[0007] Embodiments herein aim to provide a hammer tool assembly for hammering objects fed into a hammer mill, wherein the hammer tool assembly is arranged to be mounted on a hammer shaft of the hammer mill. The hammer tool assembly comprises;

- a locking arrangement comprising a body, a first protuberance and a second protuberance, the first and second protuberance extending out from a longitudinal direction of the body,
- a first hammer blade comprising a first main extension plane, a first through hole, arranged to receive the hammer shaft and a first through slot, arranged to receive the locking arrangement, and
- a second hammer blade comprising a second main extension plane, a second through hole, arranged to receive the hammer shaft and a second through slot, arranged to receive the locking arrangement.

[0008] The locking arrangement is arranged to be fitted into the first and second through slots, wherein the longitudinal direction of the body is arranged to intersect with the first and second main extension planes and wherein at least a part of the first hammer blade and at least a part of the second hammer are arranged to be interposed between the first protuberance and the second protuberance.

[0009] Since the locking arrangement is arranged to be fitted into the first and second through slots and at least a part of the first hammer blade and at least a part of the second hammer are arranged to be interposed between the first protuberance and the second protuberance the hammer tool assembly becomes very robust and reliable. The protuberances firmly keep the hammer blades together when the hammer tool assembly is rotated / pivoted. Hereby the hammer blades are kept in an assembled state without need for soldering, welding or similar.

[0010] The hammer blades or hammer blades according to embodiments herein may be relatively thin, such as having a thickness of maximum 90 mm or preferably maximum 70 mm each. In some embodiments the hammer blades are about 60-65 mm thick. They may be made of relatively hard material, such as a material manufactured and sold under the name Hardox 600®, Hardox 550® or Hardox 450®. The Hardness may e.g. be measured according to the Brinell scale. Such Hardox plates may have a hardness of about 600, 550, and 450 HBW respectively. (H from hardness, B from brinell and W from the material of the indenter, tungsten (wolfram) carbide). Other kind of hammer blades than in the above example may be used.

[0011] In some embodiments the hammer blades have a hardness of at least 450 HBW, preferably at least 500 HBW, more preferably at least 550 HBW.

[0012] Thin and hard hammer blades may be difficult

to permanently attach to each other. If welded together, weld joints or weld seam will typically be arranged at a periphery of the hammer blades. Such joints will relatively fast be worn down since the plates are first worn at its periphery. Hard hammer blades / plates may be difficult to weld together since they may need to be pre-heated before welding for avoidance of hydrogen cracks in the material. It is a cumbersome process and stainless electrodes may have to be used. In addition, welding may cause fatigue.

[0013] The hammer tool assembly according to embodiments herein provides several advantages over prior art hammer tools. For example, the hammer tool assembly according to embodiments herein may have laminar structure in that at least two relatively thin hammer blades are arranged to move in synchrony, which, for example, entails that the individual hammer blades may have different thicknesses, or can be made of different materials, or have different shapes. In addition, a hammer blade which is deformed or more worn than an adjacent hammer blade can easily be replaced. Moreover, it also entails that the hammer blades according to embodiments described herein can be made of a harder and more durable material than conventional hammer tools, which often are made of steel such as Manganese steel. Thereby, the hammer blades according to embodiments herein can be made significantly thinner than conventional hammers.

[0014] "At least a part" of the first hammer blade and "at least a part" of the second hammer means that not the entire thicknesses of the hammer blades need to be interposed between the protrusions. Outer surfaces of the first and second hammer blades may comprise one or more recesses or chamfered portions. Thus, in some embodiments an outer or distal portion of the first protrusion does not protrude out from the outer surface of the first hammer blade. An outer or distal portion of the second protrusion does not protrude out from the outer surface of the second hammer blade. Accordingly, a length of the locking arrangement in the longitudinal direction does not exceed a combined or total thickness of the hammer blades. In some embodiments, a length of the locking arrangement in the longitudinal direction is smaller than a total thickness of the hammer blades. Hereby a risk that surrounding objects will be hit by parts protruding out from the outer surfaces of the first and second hammer blades is decreased. Further, a number of hammer tool assemblies may be arranged adjacent to each other on a hammer shaft.

[0015] According to some embodiments the protuberances are arranged to exert a force on the first and second hammer blades, thereby pressing the first and second hammer blades towards each other. Herby a risk that objects get stuck between the hammer blades is decreased. This, in turn, decreases tension in the plates and decreases a risk of cracks and wash-outs.

[0016] According to some embodiments the first through slot extends from the first through hole towards a periphery of the first hammer blade and the second through slot extends from the second through hole towards a periphery of the second hammer blade. Integrated or combined through slots and through holes provides for cost-efficient production, facilitated manufacturing and easy assembling of the hammer tool assembly. In some embodiments the locking arrangement may, at least to some extent, be allowed to move slightly within the through slots along an extension of the slot. An integrated or combined through slot and through hole may be referred to as a through opening.

[0017] According to some embodiments the first hammer blade is arranged to be assembled adjacent to the second hammer blade. The first and second hammer blades may be positioned next to each other such that the first main extension plane and the second main extension plane are arranged substantially in parallel with each other in the assembled state. The first and second hammer blades may thus together form the hammer tool assembly together with the locking arrangement. In such embodiments the first and second hammer blades are the sole hammer blades in the hammer tool assembly. When only two hammer blades are present, a thickness of the first and second hammer blades may be e.g. in the range of about 50-70 mm respectively.

[0018] According to some embodiments the hammer tool assembly comprises a third hammer blade with a third main extension plane, a third through hole and a third through slot, the third hammer blade being interposed between the first hammer blade and the second hammer blade. Hereby the hammer tool assembly is formed by three blades, arranged substantially in parallel to each other. When three hammer blades are present, a thickness of the first, second and third hammer blades may be e.g. in the range of 30-50 mm respectively. The hammer blades may all have substantially same thickness or may have different thicknesses. In some embodiments a total thickness of the hammer tool assembly does not exceed 150 mm, or does not exceed 200 mm.

[0019] According to some embodiments at least one of the first through slot and the second through slot comprises at least one tapered surface. A protuberance of the locking arrangement may be arranged to press against the tapered surface, thereby pushing the hammer blades towards each other.

[0020] According to some embodiments at least one of the first protuberance and the second protuberance comprises at least one tapered portion. The tapered portion may be arranged to press against the first and/or second hammer blades, thereby pushing the hammer blades towards each other.

[0021] According to some embodiments at least one tapered portion of the at least one protuberance is arranged to be pressed towards the at least one tapered surface of at least one of the first through slot and the second through slot when the hammer tool assembly is in an assembled state. Hereby the hammer blades are pressed towards each other. When the hammer tool as-

sembly is rotated around the hammer shaft the hammer blades are pressed towards each other with even greater force due to centrifugal / centripetal forces.

[0022] According to some embodiments the locking arrangement comprises a plurality of locking parts which are arranged to be fitted into the through slots of the hammer blades. Hereby hammer blades of different sizes and / or shapes may easily be kept together by the plurality of locking parts. The number of locking parts may depend on an extension of the slot.

[0023] According to some embodiments the locking arrangement is shaped as a spool. Hereby the locking arrangement can be easily and efficiently produced. The locking arrangement may have a shape which is substantially complementary to the through slots and hammer blades.

[0024] According to some embodiments the through slot is spatially separated from the through hole in at least some of the hammer blades. This may facilitate assembling in some applications. The at least one locking arrangement can be pivotal around its longitudinal direction relatively at least some of the hammer blades when mounted in the through slots in some embodiments. The hammer tool assembly may be assembled by relative rotation of the blades and the locking arrangement. In some embodiments the locking arrangement and the hammer blades together form a bayonet coupling.

[0025] Embodiments herein also aim to provide an improved hammer mill rotor. According to an embodiment, this is provided by a hammer mill rotor comprising a rotor shaft and at least one hammer shaft. The hammer mill rotor comprises a plurality of hammer mill assemblies according to embodiments described herein, pivotally mounted on the at least one hammer shaft. Hereby a rotor which is easy assembled and/or dissembled is achieved.

[0026] Embodiments herein also aim to provide an improved hammer mill. According to an embodiment, this is provided by a hammer mill, wherein the hammer mill comprises at least one hammer mill rotor according embodiments described herein. Hereby a durable and reliable hammer mill is achieved.

[0027] Embodiments herein also aim to provide improved use of a hammer mill. According to an embodiment, this is provided by use of a hammer tool assembly according to embodiments described herein for crushing, separation and/or delamination of compound materials in a hammer mill.

[0028] Further features of, and advantages with, the embodiments herein will become apparent when studying the appended claims and the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] The various aspects of embodiments herein, including its particular features and advantages, will be readily understood from the following detailed description and the accompanying drawings, in which:

Fig. 1 illustrates a hammer blade according to some embodiments,

Fig. 2 illustrates a perspective view of the Fig. 1 hammer blade,

Fig. 3 illustrates a locking arrangement according to some embodiments,

Fig. 4 illustrates a locking arrangement according to some alternative embodiments,

Fig. 5 illustrates a hammer tool assembly according to some embodiments,

Fig. 6 illustrates a perspective view of the Fig. 5 hammer tool assembly,

Fig. 7 illustrates a hammer tool assembly according to some other embodiments,

Fig. 8 illustrates a perspective view of the Fig. 7 hammer tool assembly,

Fig. 9 illustrates a hammer tool assembly according to some alternative embodiments, and

Fig. 10 illustrates a hammer mill, a hammer mill rotor and hammer tool assemblies according to some embodiments.

DETAILED DESCRIPTION

[0030] Embodiments herein will now be described more fully with reference to the accompanying drawings, in which example embodiments are shown. Like numbers refer to like elements throughout. Well-known functions or constructions will not necessarily be described in detail for brevity and/or clarity.

[0031] In **Fig. 1** and **Fig. 2** a hammer blade **1** according to some embodiments is illustrated. The hammer blade 1 has a main extension plane **P,** i.e. the dimensions of the hammer blade 1 is much larger in the plane P than in other directions.

[0032] The hammer blade 1 comprises a through hole **3.** The through hole 3 is arranged to receive a hammer shaft of a hammer mill rotor. In other words, the hammer blade 1 can be mounted on a hammer shaft via the through hole 3.

[0033] The hammer blade 1 also comprises a through slot **5.** The through slot 5 is arranged to receive a locking arrangement. Such locking arrangement is further discussed in conjunction with e.g. Figs. 3 and 4. The trough hole 3 may have a different shape compared to the through slot 5.

[0034] The hammer blade 1 has a first extension in a

height direction, indicated by axis **H** and a second extension in a width direction, indicated by axis **W** in Fig. 1. As illustrated in Fig. 1 and 2 the through slot 5 can extend from the through hole 3 towards a periphery of the hammer blade 1. In the embodiments illustrated in Fig. 1 and Fig. 2 the through slot extends substantially in parallel with the height axis H. The hammer blade 1 has a thickness in a direction perpendicular to axis W and axis H.

[0035] In the embodiments illustrated in Figs. 1 and 2 the through slot 5 comprises at least one tapered surface **7.** Thus, the material of the hammer blade 1 which the through slot 5 is formed of comprises the at least one tapered surface 7. The through slot 5 and the tapered surface can e.g. be U-shaped. In some embodiments also the through holes may comprise one or more tapered surfaces.

[0036] The hammer blade can for example be made of a material manufactured and sold under the name Hardox 550® or Hardox 450®. Other examples of materials suitable for the hammer blades include Hardox 600®, Hardox 450® or Toolox 44®. In connection to this, it is empathized that these materials are only exemplary and the mentioned of exemplary material is non-exhaustive. The hammer blades may be made e.g. of hardened steel, quenched steel, carbon steel, martensite hardened steel or the like.

[0037] **Fig. 3** illustrates a locking arrangement **11** according to some embodiments. The locking arrangement comprises a body **13,** a first protuberance **15** and a second protuberance **17.** The first and second protuberances 15, 17 extends out from a longitudinal direction **L** of the body 13. The locking arrangement 11 may be shaped as a spool or similar. In the embodiment illustrated in Fig. 3 the locking arrangement 11 is symmetric with regards to the longitudinal direction L. Radiuses of the protuberances 15, 17 exceed a radius of the body 13. As illustrated, the locking arrangement 11 may comprise one or more tapered portions **18,** for example at the protrusions 15, 17. The longitudinal direction L represent only a spatial orientation, the locking arrangement 11 does not have to be longer in this direction than in other directions.

[0038] The locking arrangement 11 may be casted. In some embodiment the locking arrangement 11 is made of a turn out rod made of Hardox 400 ® or any other suitable material.

[0039] In **Fig. 4** an alternative locking arrangement 11 is illustrated. The locking arrangement 11 comprises a first locking part **11 a** and a second locking part **11b.** The first locking part 11a may be substantially shaped as a cuboid with protrusions 15, 17. The second locking part 11 b may e.g. be shaped as a half-spool with protrusions 15, 17. The first and/or the second locking parts may comprise one or more tapered portions 18.

[0040] In **Fig. 5** and **Fig. 6** a hammer tool assembly **50** according to some embodiments is illustrated. The hammer tool assembly 50 is arranged to be mounted on a hammer shaft of the hammer mill. The hammer tool assembly 50 comprises the locking arrangement 11 with its body 13, a first protuberance 15 and a second protuberance (not shown). The first and second protuberances extends out from the longitudinal direction L of the body 13.

[0041] The hammer tool assembly 50 comprises a first hammer blade **1a** comprising a first main extension plane **Pa,** a first through hole **3a,** arranged to receive the hammer shaft and a first through slot **5a,** arranged to receive the locking arrangement 11. The hammer tool assembly 50 also comprises a second hammer blade **1b** with a second main extension plane **Pb,** a second through hole **3b,** arranged to receive the hammer shaft and a second through slot **5b,** arranged to receive the locking arrangement 11.

[0042] The locking arrangement 11 is arranged to be fitted into the first and second through slots 5a, 5b. As illustrated in Fig. 5 the longitudinal direction L of the body 13 is arranged to intersect with the first and second main extension planes Pa, Pb. The longitudinal direction L of the body 13 may be substantially perpendicular to the first and second main extension planes Pa, Pb. The first and second main extension planes Pa, Pb may be parallel to each other.

[0043] As illustrated in Fig. 6 at least a part of the first hammer blade 1 a and at least a part of the second hammer blade 1 b are arranged to be interposed between the first protuberance 15 and the second protuberance. The protuberances are arranged to exert a force on the first and second hammer blades 1 a, 1 b in order to press them towards each other.

[0044] In the embodiment illustrated in Fig. 6 at least one tapered portion 18 of the at least one protuberance 15 is arranged to be pressed towards the at least one tapered surface 7 of the first through slot 5a when the hammer tool assembly 50 is in an assembled state. The locking arrangement 11 thus interconnects the hammer blades 1 a, 1 b and releasable locks the hammer blades 1 a, 1 b in relation to each other when interconnected.

[0045] In some embodiments the hammer tool assembly 11 comprises one or more intermediate hammer blades interposed between the first hammer blade and the second hammer blade. For example, 1-4 hammer blades may be interposed between the first hammer blade and the second hammer blade. When the hammer blade 1 in Fig. 2 is interposed between two outer hammer blades it may be referred to as a third hammer blade **1c** with a third main extension plane **Pc,** a third through hole **3c** and a third through slot **5c.** The hammer blades 1 a, 1 b, 1 c of the hammer tool assembly 50 is prevented from pivoting or rotating individually when mounted on the hammer shaft since they are locked to each other by means of the locking arrangement and, thus, the hammer blades 1 a and 1 b function in operation as one unit.

[0046] During a milling process relative positions of hammer tool assemblies 11 or blades thereof may be altered. Relatively worn hammer mill assemblies can be placed at a position on a hammer shaft where less wear and forces are expected. Hammer tool assemblies 11

according to embodiments herein allows for quick and easy position changes. Further, since the hammer blades are not permanently attached to each other, a single hammer blade of a pair of hammer blades may be replaced or removed.

[0047] In **Fig. 7** and **Fig. 8** a hammer tool assembly 50 according to some embodiments is illustrated. The hammer tool assembly 50 generally resembles the embodiments depicted in Figs. 5-6, but comprises a plurality of locking parts 11 a, 11 b, **11c**. The locking parts 11 a, 11 b, 11c are arranged to be fitted into the through slots of the hammer blades. In Figs 5-6. also the first hammer blade 1a, the second hammer blade 1b, the first trough slot 5a, the first and second through holes 3a, 3b are illustrated.

[0048] The hammer tool assembly 50 according to embodiments herein can be assembled by the following steps;

1) Arrangement of at least two hammer blades 1 a, 1 b next to each other with their through holes 3a, 3b substantially aligned,
2) Insertion of the locking arrangement 11 in the through holes 3a, 3b,
3) Fitting or sliding the locking arrangement 11 into the trough slots 5a, 5b such that the protrusions 15, 17 of the locking arrangement 11 locks the hammer blades 1 a, 1 b from being separated.
The hammer tool assembly 50 may then be mounted on a rotor of a hammer mill. Such step may comprise;
4) Arrange the through holes 3a, 3b of the hammer blades 1 a, 1 b on a hammer shaft.

[0049] When the hammer shaft is inserted into through holes the locking arrangement 11 is prevented from being removed. In Fig. 7 a schematic hammer shaft **30** is illustrated. If a plurality of locking parts 11 a, 11b and 11 c is used they may be arranged to, at least to some extent, fill up the through slots, as depicted in Fig. 7. Hereby tight and secure locking is achieved.

[0050] In **Fig. 9** an alternative embodiments is depicted. In this embodiment the through slot 5 is spatially separated from the through hole 3 in at least some of the hammer blades 1. The locking arrangement 11 is arranged to be inserted directly into the through slots 5. The locking arrangement 11 is then rotated relatively the blades 1 such that protrusions 15 of the locking arrangement 11 will press against an outer surface of the first and second hammer blade respectively. Hereby the plates are kept together in a safe and reliable manner.

[0051] **Fig. 10** schematically illustrates a hammer mill **100** with a hammer mill rotor **60.** The hammer mill rotor 60 comprises a plurality of hammer mill assemblies 50 according embodiments described herein. Each hammer mill assembly 50 is pivotally mounted on a hammer shaft 30. Each hammer tool assembly 50 is arranged to be mounted on a hammer shaft 30 of the hammer mill rotor 60. The hammer shaft 30 extends in a direction being substantially parallel to a rotor shaft **40** of said rotor 60. Each hammer tool assembly 50 is pivotally arranged around the respective hammer shaft 30 when mounted.

[0052] The rotor 60 may include the rotor shaft 40, a plurality of hammer shafts 30 for receiving replaceable hammer tool assemblies 50 and a plurality of replaceable hammer tool assemblies 50 mountably attached to the hammer shafts 30. Each hammer tool assembly 50 is, when mounted at a hammer shaft 30, pivotable around the hammer shaft 30. The hammer tool assembly 50 comprises at least two hammer blades each including a hammer shaft through hole for mounting on the hammer shaft 30. At least two hammer blades are arranged to be placed adjacent to each other when mounted on the hammer shaft 30. The hammer tool assembly 50 and the rotor 60 according to embodiments herein can be used in a hammer mill or impact crusher, for example, a conventional hammer mill or conventional impact crusher.

[0053] The rotor 60 is via the rotor shaft 40 connected to a drive motor (not shown) for driving the rotor shaft 40. The hammer mill 100 may also comprise walls for guiding objects towards the hammer mill rotor 60 and a grating or similar below the rotor 60.

[0054] The hammer blades 1 can be designed as a reversible hammer blade and can thus be reversed by 180 degrees after a wear-out of one side. With the abrasion the blade not only becomes thinner but also a radial distance of the hammer blades 1 decreases. If the hammer blade 1 wears out at the outer edge, the gap between the hammer blade and a crusher walls increases and the efficiency of the hammer mill 100 may be reduced.

[0055] As used herein, the term "comprising" or "comprises" is open-ended, and includes one or more stated features, elements, steps, components or functions but does not preclude the presence or addition of one or more other features, elements, steps, components, functions or groups thereof.

Claims

1. A hammer tool assembly (50) for hammering objects fed into a hammer mill (100), wherein the hammer tool assembly (50) is arranged to be mounted on a hammer shaft (30) of the hammer mill (100), **characterized in that** the hammer tool assembly (50) comprises;

- a locking arrangement (11) comprising a body (13), a first protuberance (15) and a second protuberance (17), the first and second protuberances (15, 17) extending out from a longitudinal direction (L) of the body (13),
- a first hammer blade (1a) comprising a first main extension plane (Pa), a first through hole (3a), arranged to receive the hammer shaft (30) and a first through slot (5a), arranged to receive the locking arrangement (11),

- a second hammer blade (1b) comprising a second main extension plane (Pb), a second through hole (3b), arranged to receive the hammer shaft (30) and a second through slot (5b), arranged to receive the locking arrangement (11),

the locking arrangement (11) being arranged to be fitted into the first and second through slots (5a, 5b), wherein the longitudinal direction (L) of the body (13) is arranged to intersect with the first and second main extension planes (Pa, Pb) and wherein at least a part of the first hammer blade (1a) and at least a part of the second hammer blade (1b) are arranged to be interposed between the first protuberance (15) and the second protuberance (17).

2. The hammer tool assembly (50) according to claim 1 **wherein** the protuberances (15a, 15b) are arranged to exert a force on the first and second hammer blades (1a, 1b), thereby pressing the first and second hammer blades (1a, 1b) towards each other.

3. The hammer tool assembly (50) according to claim 1 or 2, **wherein** the first through slot (5a) extends from the first through hole (3a) towards a periphery of the first hammer blade (1a) and the second through slot (5b) extends from the second through hole (3b) towards a periphery of the second hammer blade (1 b).

4. The hammer tool assembly (50) according to any one of the preceding claims, **wherein** the first hammer blade (1a) is arranged to be assembled adjacent to the second hammer blade (1 b).

5. The hammer tool assembly (50) according to any one of claims 1-3, **wherein** the hammer tool assembly (50) comprises a third hammer blade (1c) with a third main extension plane (Pc), a third through hole (3c) and a third through slot (5c), the third hammer blade (1c) being interposed between the first hammer blade (1a) and the second hammer blade (1b).

6. The hammer tool assembly (50) according to any one of the preceding claims, **wherein** at least one of the first through slot (3a) and the second through slot (3b) comprises at least one tapered surface (7).

7. The hammer tool assembly (50) according to any one of the preceding claims, **wherein** at least one of the first protuberance (15) and the second protuberance (17) comprises at least one tapered portion (18).

8. The hammer tool assembly (50) according to claim 6 and 7, **wherein** the at least one tapered portion (18) of the at least one protuberance (15, 17) is arranged to be pressed towards the at least one tapered surface (18) of at least one of the first through slot (5a) and the second through slot (5b) when the hammer tool assembly (50) is in an assembled state.

9. The hammer tool assembly (50) according to any one of the preceding claims **wherein** the locking arrangement (11) comprises a plurality of locking parts (11a, 11 b, 11c) which are arranged to be fitted into the through slots (5a, 5b, 5c) of the hammer blades (1 a, 1 b, 1 c).

10. The hammer tool assembly (50) according to any one of the preceding claims, **wherein** the locking arrangement (11) is shaped as a spool.

11. The hammer tool assembly (50) according to claim 1, **wherein** the through slot (5) is spatially separated from the through hole (3) in at least some of the hammer blades (1 a, 1 b, 1 c).

12. The hammer tool assembly (50) according to any one of the preceding claims, wherein the at least one locking arrangement (11) is pivotal around its longitudinal direction (L) relatively at least some of the hammer blades (1 a, 1 b, 1c) when mounted in the through slots (5a, 5b, 5c).

13. A hammer mill rotor (60) comprising a rotor shaft (40) and at least one hammer shaft (30), **wherein** the hammer mill rotor (60) comprises a plurality of hammer mill assemblies (50) according to any one of the preceding claims, pivotally mounted on the at least one hammer shaft (30).

14. A hammer mill (100), **wherein** the hammer mill (100) comprises at least one hammer mill rotor (60) according to claim 13.

15. Use of a hammer tool assembly (50) according to any one of claims 1-12 for crushing, separation and/or delamination of compound materials in a hammer mill (100).

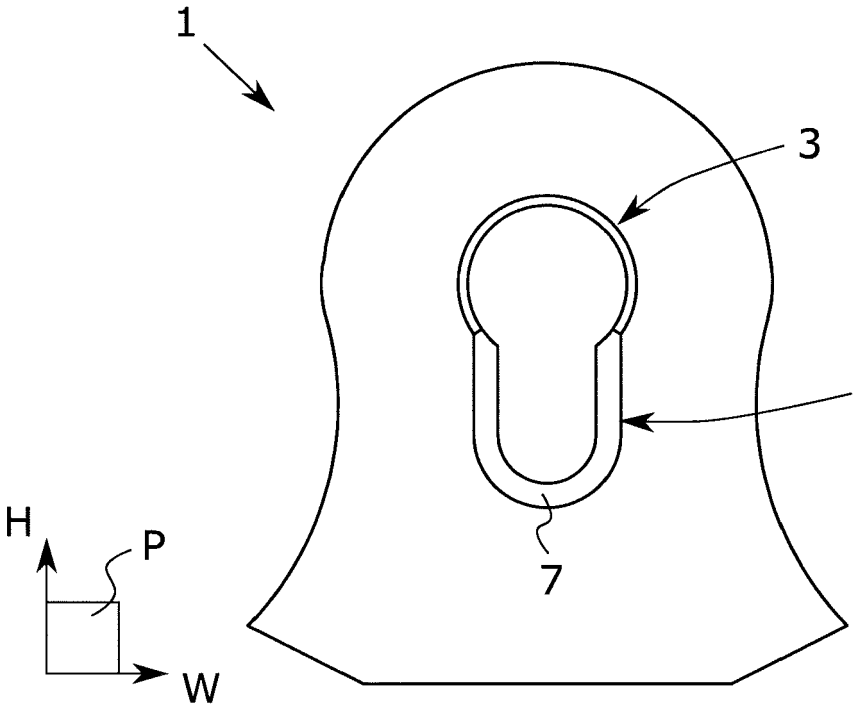

Fig.1

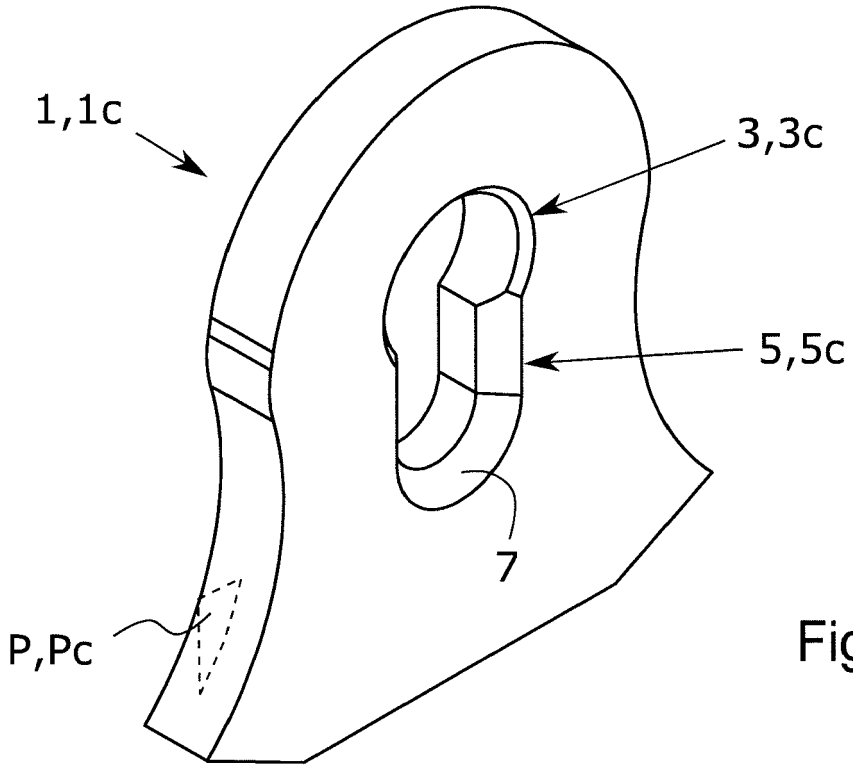

Fig.2

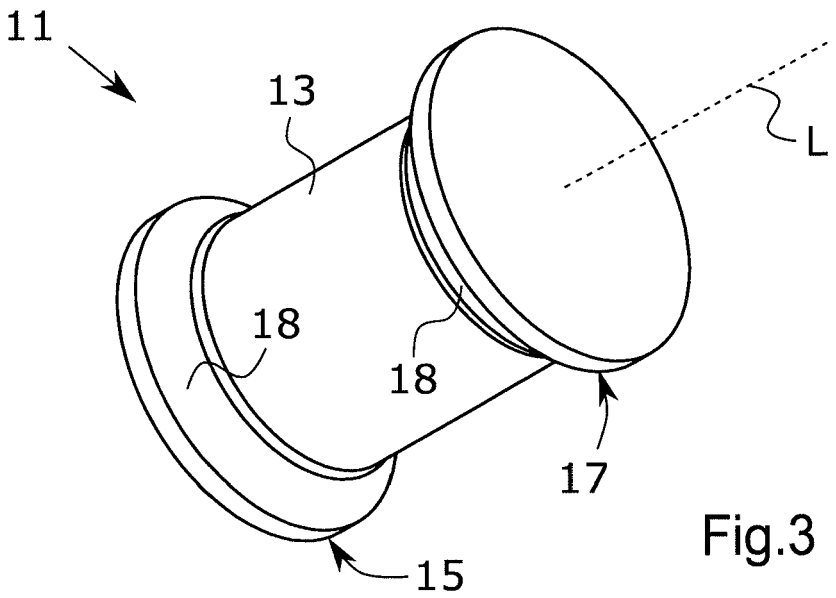

Fig.3

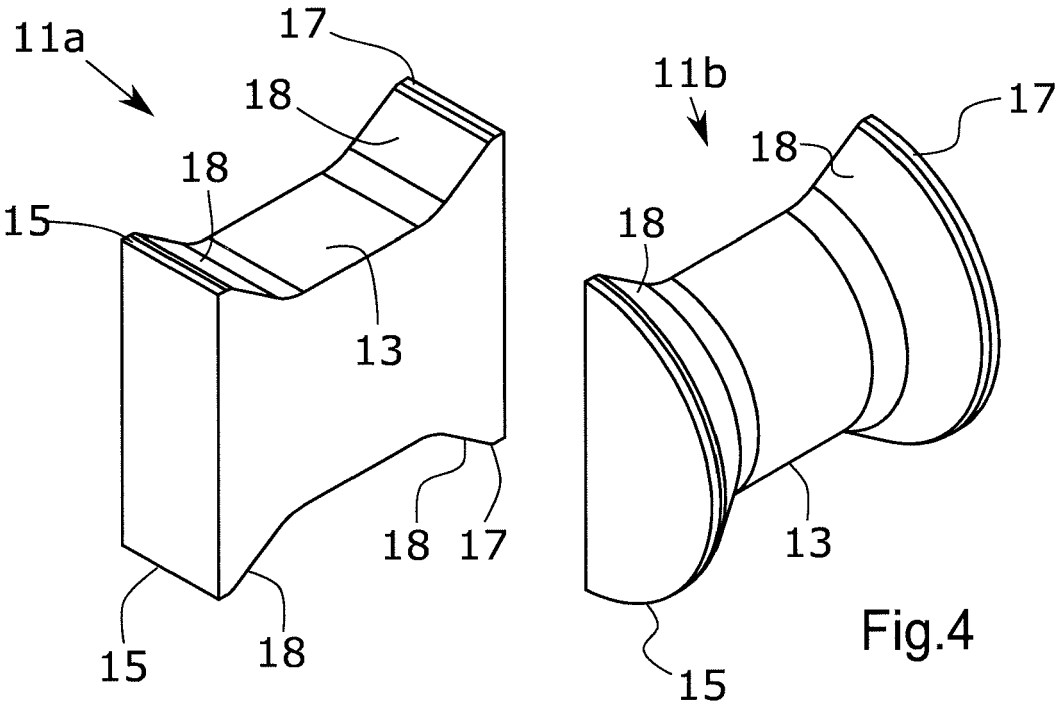

Fig.4

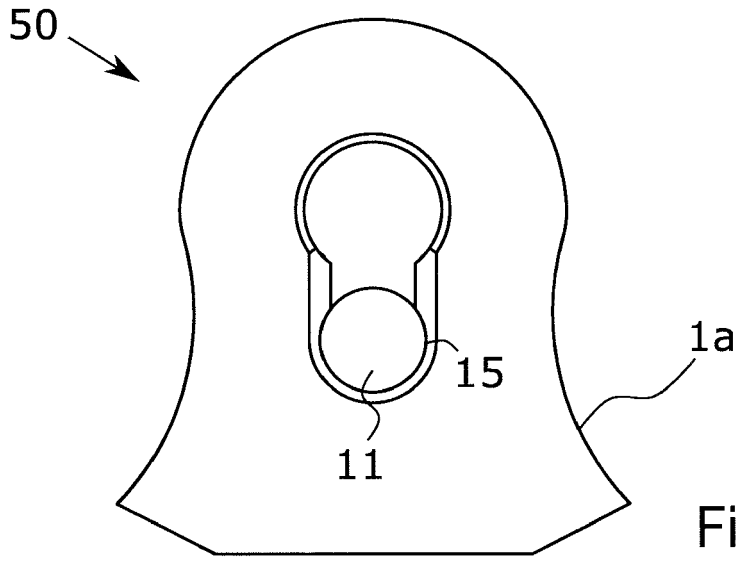

Fig.5

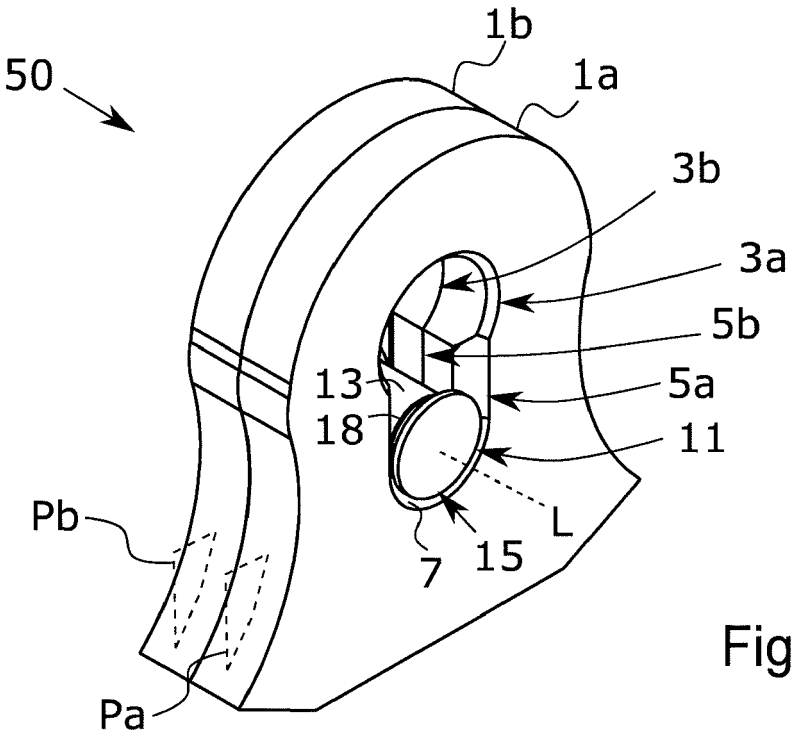

Fig.6

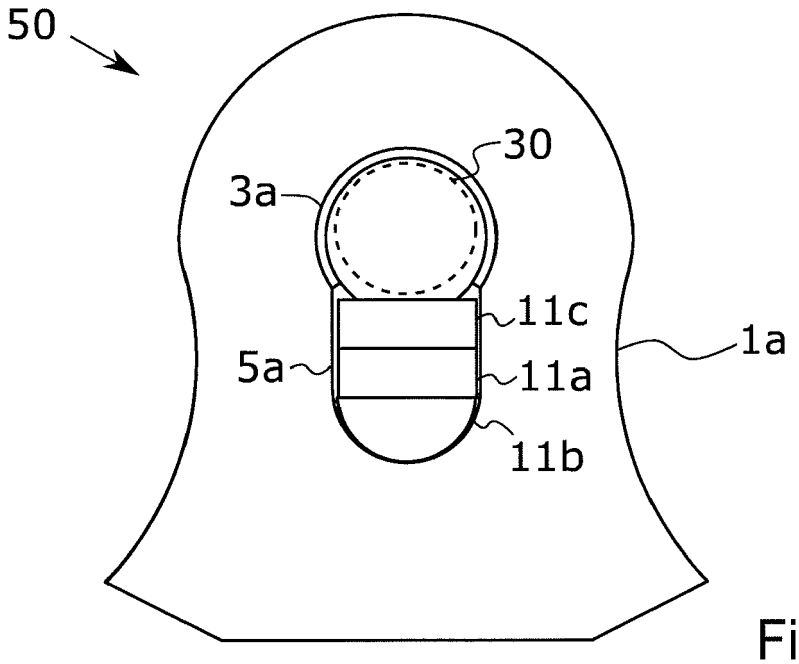

Fig.7

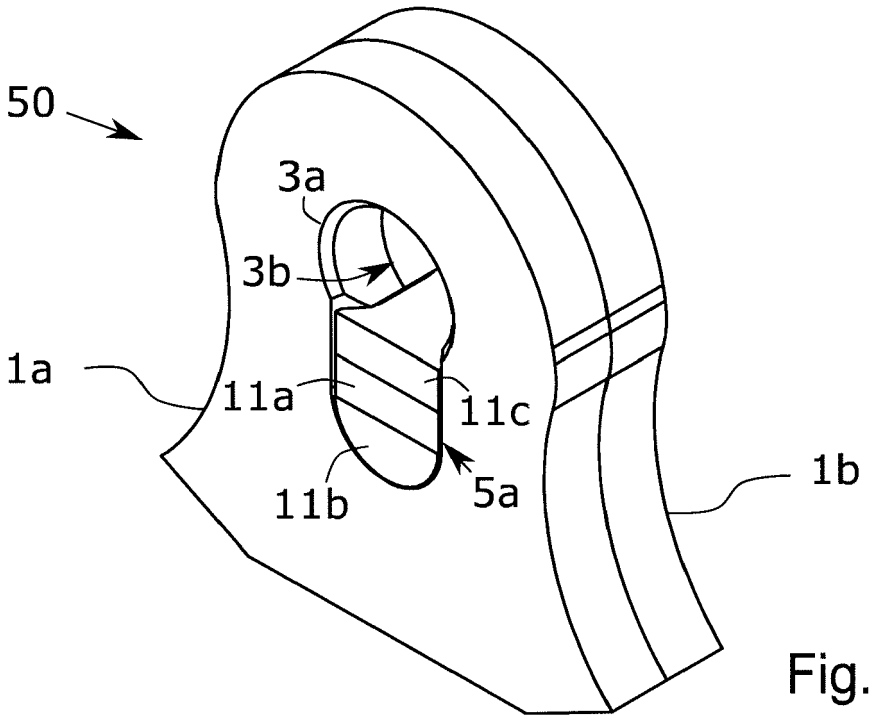

Fig.8

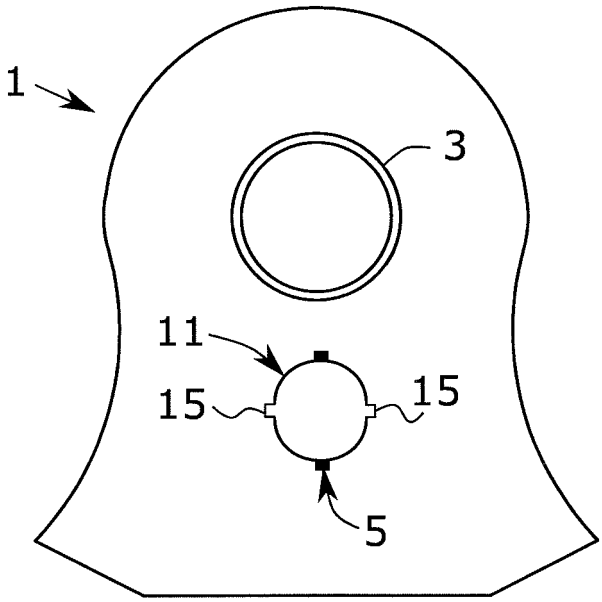

Fig.9

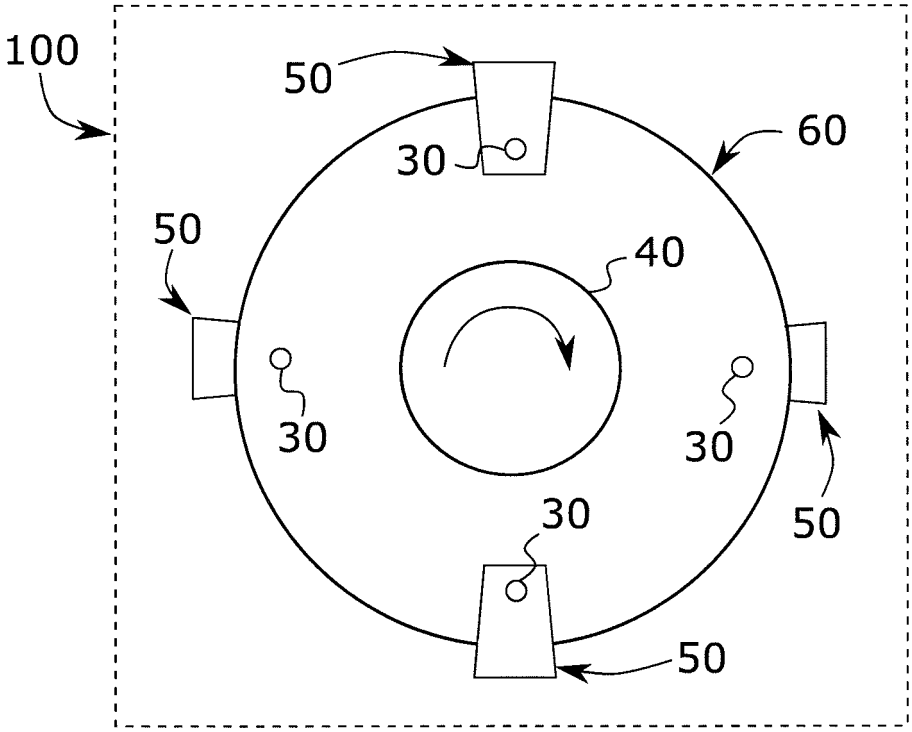

Fig.10

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Application Number
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Place of search	Date of completion of the search	Examiner
Munich	29 June 2016	Kopacz, Ireneusz

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