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(54) **CRUSHER DEVICE**

(57) A crusher device comprises a crusher assembly of a first jaw crusher member (10) and an opposite second jaw crusher member (20) which mutually bound a first crusher space (30).

The first jaw crusher member (10) is movably suspended and provided with a drive (1-6) which imparts thereto during operation an oscillating displacement which alternately increases and reduces the first crusher space (30). The first crusher space (30) comprises at a first outer end between the first and second jaw crusher member (10, 20) an inlet (31) and provides at an opposite outer end between the first and second jaw crusher member (10, 20) a first outlet (32) for discharge of processed material. Situated opposite the outlet (32) is a third crusher member (40) so that a second crusher space (45), in which the material processed in the first crusher space is received, is formed between the first jaw crusher member (10) and third crusher member (40). The second crusher space (45) is bounded by the first jaw crusher member (10) and third crusher member (40). The first jaw crusher member (10) and third crusher member (40) are able and configured to mutually co-act in the second crusher space (45) and further crush the material received therein.

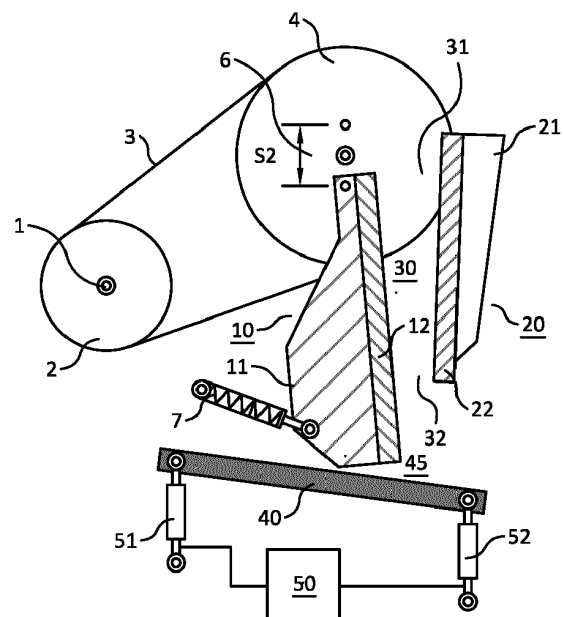


Fig.1D

Description

[0001] The present invention relates to a crusher device comprising a frame with a crusher assembly, which crusher assembly comprises a first jaw crusher member and an opposite second jaw crusher member which mutually bound a first crusher space, wherein at least the first jaw crusher member is movably suspended and is provided with a drive which imparts thereto during operation an oscillating displacement which alternately increases and reduces the first crusher space, wherein the first crusher space comprises at a first outer end between the first and second jaw crusher member an inlet for material and provides at an opposite outer end between the first and second jaw crusher member a first outlet for discharge of material which was comminuted between the first and second jaw crusher member. It is noted here that a jaw crusher member is understood to mean an optionally stationary crusher member with an operational surface and a suspension which are sufficiently strong and rigid to withstand a force of the material and to produce a counterforce sufficient for wholly or partially breaking up the material.

[0002] A crusher device of the above stated type is mainly utilized to break up and crush stone, such as natural stone, rubble and particularly concrete. The material for comminuting is here preferably rid of alien materials, such as (rebar) iron and other metal parts, carried to an inlet of the crusher device and introduced into the first crusher space between the jaw crusher members. An oscillating jaw movement is imparted to at least one of the jaw crusher members, whereby the stone succumbs under pressure and splits up into smaller parts. This smaller material exits the crusher device at an outlet which is formed on an underside by a narrow gap between the first and second jaw crusher member.

[0003] Such a device is for instance known from International patent application WO 2019/206654. The crusher device described therein comprises a fixed jaw crusher member and a jaw crusher member placed opposite thereto which is driven by an eccentric so as to perform an oscillating jaw movement. This jaw crusher member here in each case approaches the fixed jaw crusher member alternately to greater or lesser extent, whereby the size of an intermediate space therebetween changes in alternating manner. This intermediate space forms a crusher chamber into which rubble can be poured and be crushed into smaller pieces between the first and second jaw crusher member.

[0004] With a view to preserving the planet for future generations there is an increasing need to reuse already used building materials. An environmental footprint of concrete can thereby be reduced in particular. Concrete generally consists of sand, cement and gravel, of which it is particularly the production of cement which has a considerable impact in respect of the use of fossil fuels and an associated emission of greenhouse gases, such as carbon dioxide. It is therefore desirable to reclaim as

much cement from used concrete as possible so it can be reused.

[0005] The present invention therefore has for its object to provide a crusher device which enables a separation of concrete into said individual components.

[0006] In order to achieve the intended object a crusher device of the type described in the preamble has the feature according to the invention that the crusher assembly comprises downstream of the outlet at least a third crusher member, that the first jaw crusher member and the third crusher member mutually bound a second crusher space which alternately increases and decreases during the oscillating displacement of the first jaw crusher member, wherein the second crusher space comprises at a first outer end between the first jaw crusher member and the third crusher member an inlet for the material which was comminuted between the first jaw crusher member and the second jaw crusher member and provides at an opposite outer end between the first and second jaw crusher member a second outlet for discharge of material which was comminuted further between the first jaw crusher member and the third crusher member. The first jaw crusher member and the third crusher member are thus able and configured to mutually co-act in the second crusher space and further comminute the material received therein.

[0007] The invention is here based on the insight that the driven first jaw crusher member can bring about not only a primary crushing of the stone but also an additional crushing of the material once it has been comminuted. For this purpose the crusher device according to the invention provides a second crusher space downstream of the first outlet, with a further jaw crusher member therein. According to the invention, the first jaw crusher member is driven and suspended such that it not only enters into co-action during operation with the second jaw crusher member in order to crush material therebetween, but it moreover simultaneously co-acts with the further jaw crusher member in the second crusher space in order to additionally crush and thereby further comminute therein the material once it has been crushed partially or incompletely. Just as the two other stated crusher members, i. e. the first and second jaw crusher member, the third crusher member provides an operational surface and a suspension which are sufficiently strong and rigid to withstand a force of the material and to produce a counterforce which is sufficient to break up the material wholly or partially.

[0008] Concrete is a composite material of cement with sand and gravel as additives. The weak component of concrete is the cement which has reacted with water and allowed the concrete to cure. The additives sand and gravel are twenty to thirty times harder than this cement. The load of the moving jaw crusher member on the previously broken material in the subsequent crusher space will therefore cause mainly the cement to succumb. It is suspected that this difference in hardness between relatively hard gravel and sand on one hand and relatively

soft cement on the other contributes to a particularly effective mutual detachment of these materials. A mutual friction and mobility of gravel pebbles in the second crusher space has furthermore also been found to be particularly effective for releasing any still attached sand/cement from the gravel. It has been found that a substantially complete mutual separation of sand, cement and gravel from concrete can be achieved with this additional crushing. These components can then separately be reused again for new concrete. All in all, the invention thereby meets a need for renewing to at least significant extent concrete which has been used before but has been reclaimed from demolition.

[0009] The third crusher member opposite the outlet between the first and second jaw crusher member serves primarily to supply counterpressure to the jaw movement of the first jaw crusher member and the intermediate mass of material. With a view thereto, a preferred embodiment of the crusher device has the feature according to the invention that the third crusher member comprises a rigid wall, particularly of steel. In contrast to a more flexible or resilient wall, such a rigid wall does not yield, or hardly so, and the impulse of the first jaw crusher member will be absorbed almost completely by the stone. A steel wall has here also been found to be a suitable choice from a viewpoint of wear and lifespan.

[0010] Although the third crusher member can per se be embodied as a stationary, rigid wall, a preferred embodiment of the crusher device has the feature according to the invention that the third crusher member is adjustable. It has been found that an adjustment of the third crusher member relative to the first outlet and the first jaw crusher member has an effect on the degree to which the material is comminuted further once it has been processed in the first crusher space.

[0011] In a first further preferred embodiment the crusher device has the feature here according to the invention that a distance of the third crusher member relative to the first jaw crusher member is adjustable. A smaller distance of the third crusher member to the outlet results here in a more compact second crusher space and thereby in a relatively greater and more powerful action by the first jaw crusher member. By increasing the distance the degree to which the first jaw crusher member acts on the material can however be reduced. The device can thus be adapted to a nature of the material to be crushed and a desired degree of further crushing.

[0012] The degree of further crushing of the stone in the second crusher space has also been found to be associated with the residence time of the stone therein. By providing the third crusher member with more or less of an incline relative to the outlet, this residence time can be tuned. For this purpose a further embodiment of the crusher device according to the invention has the feature that an incline of the third crusher member relative to the first jaw crusher member is adjustable.

[0013] Although an adjustment of the wall can per se be performed manually, for instance by means of a man-

ually operated screw spindle with adjusting wheel, a preferred embodiment of the crusher device according to the invention has the feature that an electronic control unit is provided, that the third crusher member is coupled to at least one mechanically driven actuator whereby at least one of a distance to the outlet and an incline relative to the outlet of the third crusher member is adjustable, and that the at least one actuator is controllable by the control unit. The control unit is for instance coupled to an intuitive user interface and can additionally be coupled to one or more electronic sensors in order to control the process in the second crusher space at least largely autonomously on the basis of parameters entered beforehand by the user.

[0014] With a view to a lateral enclosure of the material in a second crusher space a particularly practical embodiment of the crusher device according to the invention is characterized in that the third crusher member is formed by a chute with upright flanks which laterally bound the second crusher space, wherein the third crusher member is formed by a bottom of the chute. The bottom and the flanks here together form one whole, wherein a height of the flanks can be tuned to an intended distance of the third crusher member to the outlet.

[0015] Although a reciprocating, i.e. oscillating, stroke can per se be imparted to the first jaw crusher member in diverse ways, good results have been obtained with a particular embodiment of the crusher device according to the invention which is characterized in that the drive of the first jaw crusher member comprises an eccentric transmission. A great advantage of such an eccentric transmission is that both a lateral and a vertical stroke is transmitted thereby to the first jaw crusher member coupled thereto. This vertical stroke is advantageously utilized for the action of the first jaw crusher member in the second crusher space and its co-action therein with the third crusher member.

[0016] The invention will be further elucidated hereinbelow with reference to an exemplary embodiment and an accompanying drawing. In the drawing:

figures 1A-1D show an exemplary embodiment of a crusher device according to the invention in successive stages of operation; and
figure 2 shows a cross-section through a second crusher space of the device of figures 1A-1D.

[0017] It is noted here that the figures are purely schematic and not drawn to scale. Some dimensions in particular may be exaggerated to greater or lesser extent for the sake of clarity. Corresponding parts are designated as far as possible in the figures with the same reference numeral.

[0018] The device shown in the figures is arranged in a frame (not further shown) and comprises a drive in the form of a sufficiently powerful electric motor or combus-

tion engine. An output motor shaft 1 of the drive carries a drive wheel 2 which is coupled via a belt transmission 3 to a driven wheel 4. The driven wheel 4 is driven rotatably by a rotation shaft 5 which is bearing-mounted in the frame and carries at an opposite outer end, outside the plane of the drawing, a flywheel to keep the device running during operation.

[0019] A first jaw crusher member 10 is coupled to driven wheel 4 eccentrically about an eccentric shaft 6. This eccentric transmission thus imparts to the jaw crusher member 10 in question both a lateral stroke s1 and a vertical stroke s2 which are shown in figures 1B and 1C for the purpose of illustration. The jaw crusher member 10 is connected via a spring damper 7 to the frame in order to accommodate reactive forces in reliable manner during operation. Jaw crusher member 10 comprises a solid steel body 11 on which a hard steel lining 12 is arranged. Located opposite thereto is a similar second jaw crusher member 20. The second jaw crusher member 20 also comprises a solid steel base part 21 with a hard steel lining 22 thereon. In contrast to the first jaw crusher member 10, the second jaw crusher member 20 is mounted in the frame fixedly, i.e. in stationary manner.

[0020] Situated between the first and second jaw crusher member 10, 20 is a first crusher space 30 which is accessible from above via an inlet 31 provided there. The stone to be processed, particularly concrete rubble, can be let in via inlet 31 after optionally first being crushed to a standard size and/or sorted and rid of alien materials such as (rebar) iron in particular. As illustrated in figures 1A and 1B, the lateral stroke s1 provides for a lateral displacement of the first jaw crusher member 10 in the first crusher space 30, whereby the volume thereof is alternately decreased and increased. First and second jaw crusher member 10, 20 are placed at a mutual, and optionally adjustable, angle relative to each other so that the first crusher space 30 narrows toward an outlet 32 thereof. This provides for a progressive effect of the first and second jaw crusher member 10, 20 on stone poured therebetween, which is thereby put increasingly under pressure and is moved in comminuted state to the outlet 32.

[0021] The thus processed stone leaves the first crusher space 30 at first outlet 32. The processed material is here received in a second crusher space 45 which is bounded by a third crusher member 40. In this example the third crusher member 40 comprises a bottom, about 15-30 millimetres thick, of a steel chute, see also figure 2, with flanks 41, 42 standing upright on either side and likewise laterally bounding the second crusher space 45. Lying opposite thereto is the driven first jaw crusher member 10 which, when performing its vertical stroke, enters into the second crusher space to greater or lesser extent so as to once again act on the material received therein together with the third crusher member 40. This is illustrated further in figures 1C and 1D. This additional crushing has been found in practice to result in a substantially complete separation of sand, cement and gravel of con-

crete, whereby these components are then suitable for reuse, after optionally having been sorted further.

[0022] A degree of additional crushing depends here, besides on the stroke s2 of the first jaw crusher member 10, on a distance d1 to the bottom 40 of the chute and an incline of bottom 40 relative to the first outlet 32 of the first and second jaw crusher member 10, 20. In this exemplary embodiment both this distance d1 and the incline of chute bottom 40 are mechanically adjustable by means of actuators 51, 52 which are provided for this purpose and which are coupled to a control unit 50 of the device. This is a set of linear actuators, such as for instance a set of energizable screw spindles or pressure cylinders, a stroke of which is controlled by the control unit. Depending on the progression of the process, these parameters can be set or adjusted by a user, for instance by means of a user interface with screen coupled to the control unit for this purpose. The process can also be monitored by means of one or more sensors or cameras which generate an output signal to control unit 50.

[0023] All in all, with the second crusher space the invention provides a particularly effective addition to a crusher device, which allows a complete separation of concrete into its constituent parts.

[0024] Although the invention has been further elucidated above on the basis of only a single exemplary embodiment, it will be apparent that the invention is by no means limited thereto. On the contrary, many variations and embodiments are still possible within the scope of the invention for a person with ordinary skill in the art.

Claims

1. Crusher device comprising a frame with a crusher assembly, which crusher assembly comprises a first jaw crusher member and an opposite second jaw crusher member which mutually bound a first crusher space, wherein at least the first jaw crusher member is movably suspended and is provided with a drive which imparts thereto during operation an oscillating displacement which alternately increases and reduces the first crusher space, wherein the first crusher space comprises at a first outer end between the first and second jaw crusher member an inlet for material and provides at an opposite outer end between the first and second jaw crusher member a first outlet for discharge of material which was comminuted between the first and second jaw crusher member, **characterized in that** the crusher assembly comprises downstream of the outlet at least a third crusher member, that the first jaw crusher member and the third crusher member mutually bound a second crusher space which alternately increases and decreases during the oscillating displacement of the first jaw crusher member, wherein the second crusher space comprises at a first outer end between the first jaw crusher member and the third crusher mem-

ber an inlet for the material which was comminuted between the first jaw crusher member and the second jaw crusher member and provides at an opposite outer end between the first and second jaw crusher member a second outlet for discharge of material which was comminuted further between the first jaw crusher member and the third crusher member. 5

2. Crusher device according to claim 1, **characterized in that** the third crusher member comprises a rigid wall, particularly of steel. 10
3. Crusher device according to claim 1 or 2, **characterized in that** the third crusher member is adjustable. 15
4. Crusher device according to claim 3, **characterized in that** a distance of the third crusher member relative to the first jaw crusher member is adjustable. 20
5. Crusher device according to claim 3 or 4, **characterized in that** an incline of the third crusher member relative to the first jaw crusher member is adjustable.
6. Crusher device according to claim 3, 4 or 5, **characterized in that** an electronic control unit is provided, that the third crusher member is coupled to at least one mechanically driven actuator whereby at least one of a distance to the outlet and an incline relative to the outlet of the third crusher member is adjustable, and that the at least one actuator is controllable by the control unit. 25
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7. Crusher device according to one or more of the preceding claims, **characterized in that** the third crusher member is formed by a chute with upright flanks which laterally bound the second crusher space, wherein the third crusher member is formed by a bottom of the chute. 35
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8. Crusher device according to one or more of the preceding claims, **characterized in that** the drive of the first jaw crusher member comprises an eccentric transmission. 45

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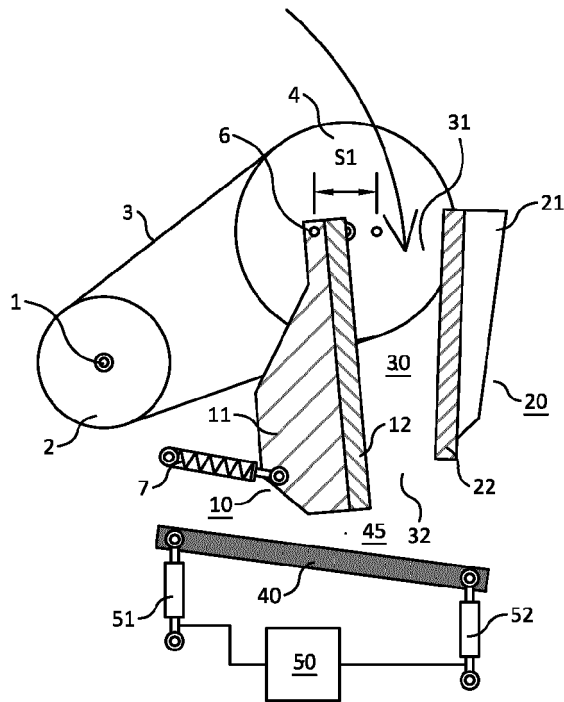


Fig.1A

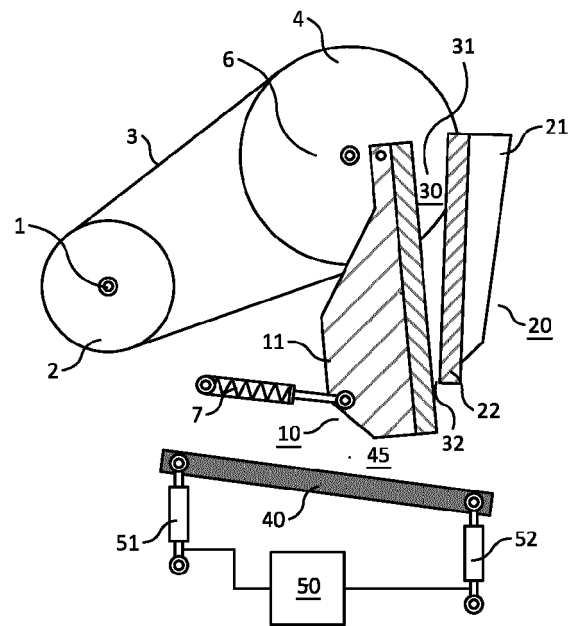


Fig.1B

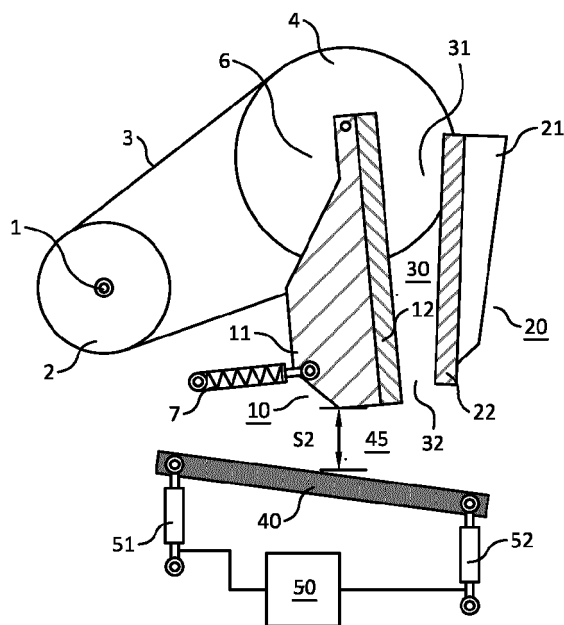
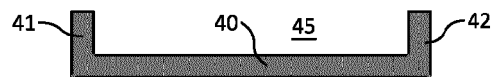


Fig.1C

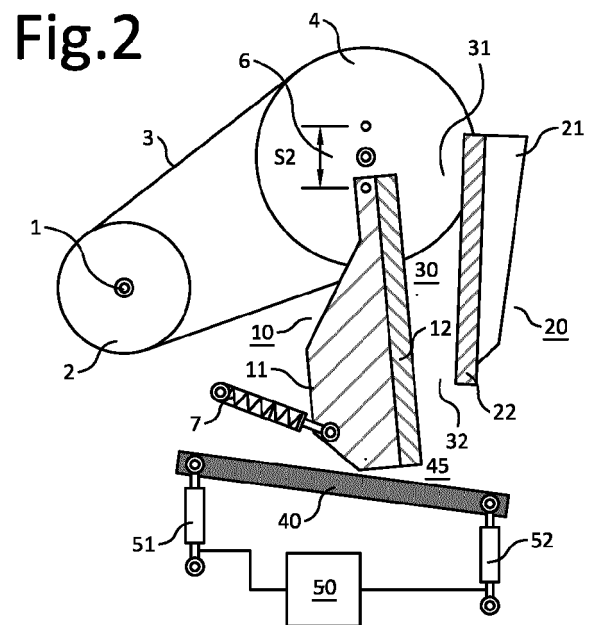


Fig.1D



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Application Number

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EPO FORM 1503 03.82 (P04C01)

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 18 January 2022	Examiner Leitner, Josef
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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