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(54) **CRUSHER, ITS USE AND METHOD IN CRUSHING OF SOLID MATTER**

BRECHERVORRICHTUNG, IHRE VERWENDUNG UND VERFAHREN ZUM BRECHEN VON FESTSTOFFEN

CONCASSEUR, SON UTILISATION ET PROCEDE PERMETTANT DE CONCASSER UNE MATIERE SOLIDE

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(73) Proprietor: **Raumaster OY**
26100 Rauma (FI)

(72) Inventors:
- **KULJU, Lassi**
  FI-26660 Rauma (FI)
- **LEHTONEN, Tarmo**
  FI-27100 Eurajoki (FI)
- **KOPRA, Kyösti**
  FI-27710 Köyliö (FI)

(74) Representative: **Maskula, Silla Marjatta**
Turun Patenttitoimisto Oy,
P.O. Box 99
20521 Turku (FI)

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The invention relates to a crusher, its use and method in crushing of solid matter according to the preambles of the independent claims described further below.

PRIOR ART

[0002] When feeding solid fuel, particularly so-called oil shale, in a power plant from the boiler silo to the combustion boiler itself, it may be necessary to use a crusher between the boiler silo and the boiler because of the fuel quality and properties. Thus, eventual oversized pieces among the fuel are made smaller into a size required by the process. Especially fluidised-bed and turning-bed boilers require a very uniform piece size distribution from the fuel.

[0003] It is known to use rotor crushers for crushing solid fuel, which crushers consist of a cogged rotor, an actuator for rotating the rotor as well a frame, to which is fixed a stationary comb-like cogged counter blade, with which the cogs of the rotor intermesh.

[0004] If, for example a biggesh stone or a piece of metal or a similar hard piece, which cannot be crushed by the crusher, gets among the fuel to be crushed into the crusher, there is a risk of the device to get damaged or the rotor to get stuck.

[0005] In case of a situation described above it is known to provide the crusher with a torque limiter, which can be e.g. a mechanical torque limiting clutch or an electronic monitoring system mounted in connection with the actuator, which clutch or system monitors the load of the driving motor. Such solution has been disclosed for example in the patent application FI 811079. In an overload situation the torque limiter changes the rotating direction of the rotor and/or stops the rotor. This prevents in some situations damaging of the device, but also stops the fuel feeding into the boiler until the hard piece, which has caused the overload situation, has been manually removed from the crusher.

[0006] It is also known to use a so-called breaking pin mounting in the counter blade, wherein the counter blade has been fixed to the frame of the crusher with bolts, pins or other similar fixing elements, which break in the overload situation and allow the counter blade move away from the rotor. This solution causes, when going off, even a longer break in the fuel feeding than the previous solution, because the counter blade has to be manually remounted in its place and provided with new fixing elements. At the worst, the disturbance can lead to a shutdown of the combustion boiler and to a process break.

[0007] The publications EP 0513479 A1 and US 5718389 disclose crushers according to the prior art. The French patent publication FR 7638820 discloses a crusher, in which the counter blade has been fixed to the frame of the device by articulation. The position of the counter blade can be changed by turning it about the articulation.

[0008] In the solutions according to the prior art disturbances easily cause a total stopping of a crushing process. The situation can even lead to the shutdown of the whole process, in which crushing is involved.

AIMS AND DESCRIPTION OF THE INVENTION

[0009] It is an aim of the present invention to reduce or even totally eliminate the above-mentioned problems, which appear in the prior art.

[0010] It is an aim of the present invention to accomplish a crusher for solid fuel, with which crusher downtime caused by hard pieces can be reduced in the crushing process.

[0011] An aim of the present invention is to reduce shutdowns of processes, for example of combustion boilers, caused by the stopping of the crusher for solid matter.

[0012] Another aim of the present invention is a method, with which damaging of the crusher is prevented, when hard pieces get into the crusher.

[0013] The above-mentioned disadvantages are eliminated or reduced, and the above-mentioned aims are attained with the present invention, which is characterized in what is defined in the characterising part of the independent claim presented further below.

[0014] Some preferred embodiments according to the invention are disclosed in the dependent claims presented further below.

[0015] A typical crusher according to an embodiment of the invention comprises a frame, a cogged rotor, which has been fixed to the frame and which has been arranged to rotate about its longitudinal axis, an actuator for rotating the rotor, a comb-like cogged counter blade, which has been fixed to the frame, and with the counter cogs of which the rotor cogs have been arranged to intermesh, as well as detecting means for detecting a disturbance. The counter blade has been fixed to the frame of the crusher by an articulation, about the shaft of which the counter blade has been arranged to be turned. The crusher further comprises an actuator for turning the counter blade about the articulated shaft.

[0016] The crusher according to the invention is typically used for crushing solid fuel.

[0017] In a typical method in crushing solid matter, solid matter to be crushed is fed into the crusher between the rotating cogged rotor and the comb-like cogged counter blade, when the rotor and the counter blade are in the working position, and a measured variable, which indicates the disturbance in the crusher, is measured by detecting means. When the value of the measured variable reaches a predetermined threshold value, the counter blade is turned away from the rotor to a predetermined distance from the rotor, and after that the counter blade is turned back to the working position.

[0018] In a typical embodiment of the invention the crusher comprises at least two counter blades. The coun-

ter blades can be placed parallel, so that their ends have been arranged at a distance from each other. Preferably, each counter blade has been fixed to the frame by an articulation, about the articulated shaft of which the counter blade can be turned. In case of a disturbance, all counter blades of the crusher can thus be turned to a distance from the rotating rotor.

[0019] It has now been surprisingly found, that if the counter blade is arranged to the frame of the crusher by articulation, it can be turned to a distance from the rotor of the crusher, when a hard piece gets into the crusher. Thus, the hard piece falls from the gap formed between the rotor and the counter blade out of the crusher, if the diameter of the piece is smaller than the width of the gap between the rotor and the counter blade. Thus, the crushing process need not be interrupted during the removal of smallesh hard pieces, what considerably reduces the downtime of the crushing process and indirectly also the need for the shutdown of the entire process. With the aid of the invention by determining the turning distance of the counter blade also the threshold value of the diameter of hard pieces can be determined, whereby the pieces smaller than the threshold value can automatically be removed from the crusher without needing to interrupt its operation.

[0020] The counter blades arranged against one rotor can be operationally fully independent from each other. Particularly preferably, each individual counter blade is arranged to have its own actuator as described above for turning an individual counter blade to a distance away from the rotor. Thus, each counter blade can be individually turned away from the rotor without needing to change the working position of other counter blades and to interrupt their operation. In that case, from at least two counter blades mentioned in the method according to the invention exactly the counter blade or counter blades, in which the disturbance has been detected, are turned about their articulated shafts. This invention enables the fact that the crushing process very seldom needs to be entirely interrupted. Thus, also a process, in which a crusher according to the invention, for example a combustion process of a boiler of an electrical power plant, is involved, runs even less frequently than before into difficulties due to disturbances in the crushing process.

[0021] It is possible, that the crusher according to the invention has several individually controllable rotors, against each of which one or more counter blades according to the invention have been arranged. Thus, also individual rotors can be stopped in case of a disturbance without interrupting the operation of the entire crusher.

[0022] According to the invention, in case of a disturbance, the counter blade is turned about its articulated shaft by means of an actuator. The actuator of the counter blade can be e.g. a hydraulic cylinder, pneumatic cylinder or an electric motor, with which the counter blade is turned about the articulated shaft with the aid of an appropriate mechanism. Such mechanism can be for example a crank mechanism, by means of which the rotating movement of the electric motor is changed into a turning movement of the counter blade. In that case, also a reduction gear is generally needed at the rear of the motor.

[0023] According to the invention the detecting means connected to the monitoring system of the crusher are arranged to measure the position of the counter blade and/or the force directed to the counter blade. When a hard piece gets into the crusher between the rotor and the counter blade, such piece does not get crushed, but causes either a deviational movement of the counter blade or starts to turn the counter blade with a specific force.

[0024] According to an embodiment of the invention the detecting means can comprise one or more mechanical limit switches, inductive sensors, sensors for measuring the pressure of a hydraulic or pneumatic cylinder, strain-gauge transducers or a combination of these measuring devices. For example, the position of the counter blade can preferably be measured by a mechanical limit switch or an inductive sensor. The force directed to the counter blade can, for one, be determined for example from the pressure of the hydraulic or pneumatic cylinder or by measuring by strain-gauge transducers.

[0025] According to an embodiment of the invention the detecting means have been connected to a monitoring and control system. With the aid of the detecting means data is provided to the monitoring and control system for example of the position of the counter blade and/or the force directed to the counter blade during the crushing process. When the value of these variables exceeds a specific threshold value, the monitoring and control system gives to the actuator an order to turn the counter blade away from the rotor. After a certain delay the system gives to the actuator a control order to turn the counter blade back to its original working position. The monitoring and control system can be realised for example by means of a programmable logic, central automation system of a power plant or the like.

[0026] Several aforementioned different types of detecting means or several same kind of detecting means, with which the counter blade and its operation, position and/or the force directed to it are monitored during the crushing process, can be simultaneously connected to the monitoring system.

[0027] According to an embodiment of the invention, to the crusher have also been arranged position means, which have been arranged to monitor the position of the counter blade, when the counter blade is turned by means of the actuator about the articulated shaft. The position means can comprise for example an inductive sensor or a mechanical limit switch, with which the distance of the counter blade from the rotor is monitored. By using suitable position means the distance, to which the counter blade is turned from the rotor, is selected on the basis of the process requirements of the process following the crushing. Thus, the threshold value of the diameter of a hard piece can be selected, wherein the hard

pieces smaller than this threshold value can be allowed to go through the crusher and get on to the next process phase, e.g. to the fluidised-bed.

[0028] According to an embodiment of the invention the operation of the crusher is stopped, if, after turning the counter blade back, the measured variable measured by the detecting means is still bigger than the predetermined threshold value. In that case, the hard piece caught in the crusher is so big that it can't be allowed to go through the crushing phase and get on to the next process. The operation of the crusher is stopped and the piece is manually removed from the crusher.

[0029] For example, when the actuator of the counter blade according to the invention is a hydraulic or pneumatic cylinder, the detecting means can be e.g. a sensor, with which the cylinder pressure is measured. In case of a disturbance, for example, when a hard piece, such as a metal chunk, gets between the rotor and the counter blade, the counter blade moves slightly away from the rotor. Simultaneously, air or similar medium, is compressed in the cylinder, i.e. the cylinder pressure increases. If the pressure increase exceeds the predetermined threshold value, the sensor monitoring the cylinder pressure gives a control signal to the monitoring system. Thus, the pneumatic cylinder pulls the counter blade rapidly outwards from the rotor, so that the hard piece can fall through the crusher. When the counter blade has pulled away an appropriate, predetermined distance from the rotor, for example to a distance of ca. 100 mm, the monitoring system stops the movement of the counter blade. The pulling away of the counter blade from the rotor can be monitored by position means, such as an inductive sensor, with which the position data of the counter blade is transmitted to the monitoring and control system. After the counter blade has been turned to its extreme position to a distance from the rotor, it is slowly turned back to its working position. If the monitoring and control system still detects an overload situation, it gives an alarm and stops the crusher.

[0030] According to an embodiment of the invention the crusher according to the invention is used for crushing of solid fuel, preferably oil shale, in power plants. Oil shale contains plenty of solids possibly causing disturbances.

BRIEF DESCRIPTION OF THE FIGURES

[0031] In the following, the invention will be described in more detail with reference to the appended schematic drawings, in which

Fig. 1 shows a crusher according to an embodiment of the invention, which crusher has two parallel counter blades,

Fig. 2 shows a side view of a crusher according to an embodiment of the invention, when the counter blade is in the normal working position,

Fig. 3 shows a side view of a crusher according to an embodiment of the invention, when the counter blade has been pulled outwards to a distance from the rotor.

DESCRIPTION OF THE EXEMPLARY EMBODIMENTS OF THE DRAWING

[0032] Fig. 1 discloses a crusher 1, which comprises a cogged rotor 3, 3' divided in two parts rotating on the same axis, an electric motor 10 and a gear assembly for rotating the rotor. Two parallel, comb-like cogged counter blades, which are shown in Figs. 2 and 3, have been fixed from their upper edge to the frame 2 of the crusher 1. The counter blades have been provided with pneumatic cylinders 4, 4', which turn the counter blades about their articulated shafts by means of an articulated mechanism 5, 5'. The pneumatic cylinder 4' of the counter blade facing the rotor 3' has been pushed to its full size, wherein the counter blade has been pulled outwards from the rotor, i.e. the counter blade has been turned to the non-working position. The counter blade facing the rotor 3 is in the working position, wherein the rotor cogs intermesh with the counter cogs of the comb-like counter blade. The material to be crushed, such as oil shale, is brought to the device 1 from the top and the crushed material goes out from the bottom of the device 1. Pneumatic cylinders 4, 4' are individually operable. Thus, it is possible, when necessary, to move both counter blades individually irrespective of each other.

[0033] Fig. 2 shows a side view of a crusher according to an embodiment of the invention, when the counter blade is in the normal working position. The counter cogs 26 of the counter blade 23 arranged in the crusher 21 intermesh with the cogs 29 of the rotor 27. Arrow A shows the rotating direction of the rotor 27. The counter blade 23 has been fixed to the frame 22 of the crusher 21 by an articulation 28, about the articulated shaft 28' of which the counter blade 23 can be turned. The counter blade 23 is in contact with the actuator, such as a pneumatic cylinder 4, through the articulated mechanism 25. The actuator is not shown in Fig. 2. During normal operation, when the counter blade 23 is in the working position, the pneumatic cylinder pushes the counter blade 23 against the mechanical end stop (not shown) for example with a pressure of 2 bars.

[0034] Fig. 3 shows a side view of a crusher according to an embodiment of the invention, when the counter blade has been pulled outwards at a distance from the rotor. The counter blade 33 of the crusher 31 has thus been turned about the articulated shaft 38' of the articulation 38, which fixes the crusher 31 to the frame 32, at a distance X from the rotor 37 and its cogs 39. The turning of the counter blade 33 has been performed by using an actuator, such as a pneumatic cylinder, which is in contact with the counter blade 33 by means of an articulated mechanism 35. The actuator is not shown in the figure. Arrow A illustrates the rotating direction of the rotor. Arrow

B illustrates the movement of the counter blade 33 and its counter cogs 36 away from the rotor 37, when the counter blade is turned about the articulation 38. Arrow C illustrates the movement of a part of the articulation mechanism 35, which is in contact with the actuator.

[0035] When a metal piece or a similar hard piece gets between the rotor 37 and the counter blade 33 of the crusher 31, the counter blade 33 moves a small distance outwards from the rotor, when the air is compressed in the pneumatic cylinder acting as an actuator. Thus, the inductive sensor monitoring the working position of the counter blade 33 gives the monitoring system a control signal and the pneumatic cylinder pulls the counter blade 33 rapidly outwards from the rotor 37 for example with a pressure of 4 bars, so that the solid piece can fall through the crusher.

[0036] When the counter blade 33 has pulled away from the rotor to a distance of ca 100 mm, the monitoring and control system stops the movement on basis of the position data received from another inductive sensor. After this, the counter blade 33 is turned slowly back to its working position. If the monitoring and control system still detects an overload situation, it gives an alarm and stops the crusher. In this case, the size of the hard piece is over 100 mm, and it cannot be allowed to go to the next process phase, for example to the combustion boiler of a power plant, but has to be manually removed from the crusher.

[0037] Figs. 2 and 3 show, for the sake of clarity, only one rotor-counter blade pair at a time. It is, however, clear that the crusher according to the invention can also have several, for example 2, 3, 4, 5, 6, 7, 8, 9, 2 - 10 or even more rotor-counter blade pairs similar to those shown in Figs. 2 and 3, each of which act in case of a disturbance individually according to the invention.

[0038] It is apparent to the person skilled in the art that the invention is not limited exclusively to the examples described above, but the invention can vary within the scope of the claims presented below.

Claims

1. Crusher (1) comprising

- a frame (2),
- at least one rotor (37) provided with cogs (39), which rotor has been fixed to the frame and has been arranged to rotate about its longitudinal axis,
- an actuator (10) for rotating the rotor,
- a comb-like counter blade (33) provided with counter cogs (36),
  - which counter blade has been fixed to the frame by an articulation (38), about the shaft (38') of which the counter blade (33) has been arranged to be turned, and
  - the counter cogs of the counter blade arranged to intermesh with the cogs of the rotor.
- detecting means for detecting a disturbance,
- an actuator (4) for turning the counter blade about the articulated shaft, when a disturbance has been detected,

characterized in that the crusher comprises

- at least two counter blades (33),
- actuators (4, 4') for turning separately about the articulated shaft (38') from said at least two counter blades the individual counter blade, in which the disturbance has been detected.

2. The crusher according to claim 1, **characterized in that** the detecting means have been arranged to measure the position of the counter blade and/or the force directed to the counter blade.

3. The crusher according to claim 2, **characterized in that** the detecting means comprise one or more inductive sensors, mechanical limit switches, sensors for measuring the pressure of a hydraulic or pneumatic cylinder, strain-gauge transducers or a combination of these devices.

4. The crusher according to claim 1, **characterized in that** the actuator of the counter blade is a hydraulic cylinder, pneumatic cylinder or an electric motor.

5. The crusher according to claim 1, **characterized in that** the position means have been arranged to monitor the position of the counter blade, when it is turned about the articulated shaft.

6. The crusher according to claim 5, **characterized in that** the position means comprise an inductive sensor or a mechanical limit switch.

7. The crusher according to claim 1, **characterized in that** it comprises detecting means for detecting separately the disturbance of said at least two counter blades.

8. The crusher according to claim 1, **characterized in that** each counter blade has been fixed to the frame by an articulation, about the shaft of which the counter blade can be turned, and that each individual counter blade has been arranged to have its own actuator (4, 4') for turning an individual counter blade.

9. The use of a crusher according to claim 1 for crushing solid fuel.

10. The use according to claim 9, **characterized in that** the solid fuel is oil shale.

11. A method in crushing solid material, in which method

- solid material to be crushed is fed to the crusher (1), between its rotating rotor (37) provided with cogs (39) and its comb-like counter blade (33) provided with cogs (36), when said rotor and counter blade are in the working position,
- a measured variable indicating a disturbance in the crusher is measured by detecting means,

wherein,

- there are at least two comb-like counter blades (33) provided with cogs (36),
- a measured variable indicating a disturbance in the crusher is measured by detecting means,
- when the value of the measured variable reaches a predetermined threshold value, said counter blade is individually turned away from the rotor to a predetermined distance (X) from the rotor, and after which
- said counter blade is turned back to its working position.

12. The method according to claim 11, **characterized in that** the position of the counter blade and/or the force directed to the counter blade are measured by the detecting means.

13. The method according to claim 11, **characterized in that** the operation of the crusher is monitored by a monitoring system.

14. The method according to claim 11, **characterized in that** the distance of the counter blade from the rotor is monitored by a position means during its turning.

15. The method according to claim 11, **characterized in that** the distance, to which the counter blade is turned from the rotor, is selected on the basis of process requirements of the process following the crushing.

16. The method according to claim 11, **characterized in that** the counter blade is turned to a distance of ca 100 mm from the rotor.

17. The method according to claim 11, **characterized in that** the operation of the crusher is stopped, if, after turning the counter blade back, the measured variable measured by the detecting means still reaches the predetermined threshold value.

18. The method according to claim 11, **characterized in that** by the detecting means, a measured variable, which indicates a disturbance in the crusher, is measured separately to said at least two counter blades.

Patentansprüche

1. Zerkleinerungsmaschine (1), die umfasst:

- einen Rahmen (2)
- zumindest einen Rotor (37), der mit Zähnen (39) ausgestattet ist, wobei der Rotor am Rahmen befestigt ist und so angeordnet ist, dass er um seine Längsachse rotiert,
- einen Antrieb (10) zum Drehen des Rotors
- ein kammartiges Gegenmesser (33), ausgestattet mit Gegenzähnen (36),
  - wobei das Gegenmesser an den Rahmen mit einer Schwenkverbindung (38) befestigt ist, um dessen Achse (38') das Gegenmesser (33) angeordnet ist, damit es gedreht wird, und
  - die Gegenzähne des Gegenmessers so angeordnet sind, dass sie und die Zähne des Rotors ineinander greifen.
- Erkennungsmittel zum Erkennen einer Störung,
- einen Antrieb (4) zum Drehen des Gegenmessers um die Schwenkachse, wenn eine Störung erkannt wird,

dadurch gekennzeichnet, dass die Zerkleinerungsmaschine umfasst:

- zumindest zwei Gegenmesser (33),
- Antriebe (4,4') zum getrennten Drehen desjenigen der besagten zumindest zwei Gegenmesser, bei dem die Störung erkannt wurde, um die Schwenkachse (38').

2. Zerkleinerungsmaschine nach Anspruch 1, **dadurch gekennzeichnet, dass** das Erkennungsmittel so angeordnet ist, dass es die Position des Gegenmessers und/oder die auf das Gegenmesser gerichtete Kraft misst.

3. Zerkleinerungsmaschine nach Anspruch 2, **dadurch gekennzeichnet, dass** das Erkennungsmittel eine oder mehrere induktive Sensoren, mechanische Begrenzungsschalter, Sensoren zum Messen des Drucks eines Hydraulik- oder Pneumatikzylinders, einen Drehmomentsensor oder eine Kombination dieser Bauteile umfasst.

4. Zerkleinerungsmaschine nach Anspruch 1, **da-**

durch gekennzeichnet, dass dieser Antrieb des Gegenmessers ein Hydraulikzylinder, ein Pneumatikzylinder oder ein Elektromotor ist.

5. Zerkleinerungsmaschine nach Anspruch 1, **dadurch gekennzeichnet, dass** das Positionsmittel vorgesehen ist, um die Position des Gegenmessers, wenn es um die Schwenkachse gedreht wird, zu überwachen.

6. Zerkleinerungsmaschine nach Anspruch 5, **dadurch gekennzeichnet, dass** das Positionsmittel einen induktiven Sensor oder einen mechanischen Begrenzungsschalter umfasst.

7. Zerkleinerungsmaschine nach Anspruch 1, **dadurch gekennzeichnet, dass** es Erkennungsmittel zum getrennten Erkennen der Störung besagter zumindest zweier Gegenmesser umfasst.

8. Zerkleinerungsmaschine nach Anspruch 1, **dadurch gekennzeichnet, dass** jedes Gegenmesser am Rahmen mit einem Gelenk befestigt ist, um dessen Achse das Gegenmesser gedreht werden kann, und jedes einzelne Gegenmesser so vorgesehen ist, dass es seinen eigenen Antrieb (4, 4') zum Drehen eines einzelnen Gegenmessers besitzt.

9. Verwendung einer Zerkleinerungsmaschine nach Anspruch 1 zum Zerkleinern festen Brennstoffs.

10. Verwendung nach Anspruch 9, **dadurch gekennzeichnet, dass** der feste Brennstoff ölhältiger Schiefer ist.

11. Ein Verfahren zum Zerkleinern von festem Material, bei dem

- festes, zu zerkleinerndes Material der Zerkleinerungsmaschine (1) zwischen deren sich drehendem Rotor (37), der mit Zähnen ausgestattet ist, und seinem kammartigen Gegenmesser (33), das mit Zähnen (36) ausgestattet ist, zugeführt wird, wenn der Rotor und das Gegenmesser in Arbeitsstellung sind,
- eine gemessene Größe, die eine Störung anzeigt, in der Zerkleinerungsmaschine mit einem Erkennungsmittel gemessen wird, wobei
- zumindest zwei kammartige, mit Zähnen (36) ausgestattete Gegenmesser (33) vorhanden sind,
- eine gemessene Größe, die eine Störung in der Zerkleinerungsmaschine anzeigt, mit einem Erkennungsmittel gemessen wird,
- wenn der Wert der gemessenen Größe einen vorbestimmten Grenzwert erreicht, das Gegenmesser einzeln vom Rotor zu einem vorbestimmten Abstand (X) vom Rotor weggedreht wird und danach
- das Gegenmesser zurück in die Arbeitsstellung gedreht wird.

12. Verfahren nach Anspruch 11, **dadurch gekennzeichnet, dass** die Stellung des Gegenmessers und/oder die Kraft, die auf das Gegenmesser gerichtet ist, mit den Erkennungsmitteln gemessen wird.

13. Verfahren nach Anspruch 11, **dadurch gekennzeichnet, dass** der Betrieb der Zerkleinerungsmaschine durch ein Überwachungssystem überwacht wird.

14. Verfahren nach Anspruch 11, **dadurch gekennzeichnet, dass** der Abstand des Gegenmessers vom Rotor durch ein Positionierungsmittel während seiner Drehung überwacht wird.

15. Verfahren nach Anspruch 11, **dadurch gekennzeichnet, dass** der Abstand, in welchen das Gegenmesser vom Rotor weggedreht wird, ausgewählt ist auf Grund der Prozesserfordernisse des Prozesses, der auf das Zerkleinern folgt.

16. Verfahren nach Anspruch 11, **dadurch gekennzeichnet, dass** das Gegenmesser in einen Abstand von etwa 100 mm vom Rotor weggedreht wird.

17. Verfahren nach Anspruch 11, **dadurch gekennzeichnet, dass** der Betrieb der Zerkleinerungsmaschine angehalten wird, wenn nach dem Zurückdrehen des Gegenmessers die gemessene Größe, die durch die Erkennungsmittel gemessen wird, nach wie vor den vorbestimmten Grenzwert erreicht.

18. Verfahren nach Anspruch 11, **dadurch gekennzeichnet, dass** eine gemessene Größe, die eine Störung in der Zerkleinerungsmaschine anzeigt, durch Erkennungsmittel unabhängig für jedes der mindest zwei Gegenmesser gemessen wird.

Revendications

1. Concasseur (1) comprenant

- un bâti (2),
- au moins un rotor (37) pourvu de dents (39), lequel rotor a été fixé au bâti et a été agencé afin de tourner autour de son axe longitudinal,
- un actionneur (10) servant à faire tourner le rotor,
- une contre lame de type à peigne (33) pourvue de contre dents (36),

- laquelle contre lame a été fixée au bâti par une articulation (38) autour de l'arbre (38')

de laquelle la contre lame (33) a été agencée en vue d'être tournée, et
- les contre dents de la contre lame sont disposées de façon à s'engrener avec les dents du rotor,

- des moyens de détection permettant de détecter une perturbation,
- un actionneur (4) pour faire tourner la contre lame autour de l'arbre à direction pivotante, lorsqu'une perturbation a été détectée,

caractérisé en ce que le concasseur comporte

- au moins deux contre lames (33),
- des actionneurs (4, 4') pour faire tourner de façon séparée autour de l'arbre à direction pivotante (38') à partir desdites au moins deux contre-lames la contre lame individuelle, dans laquelle la perturbation a été détectée.

2. Concasseur selon la revendication 1, **caractérisé en ce que** les moyens de détection ont été agencés afin de mesurer la position de la contre lame et/ou la force dirigée vers la contre lame.

3. Concasseur selon la revendication 2, **caractérisé en ce que** les moyens de détection comportent un ou plusieurs capteur(s) inductif(s), des interrupteurs-limiteurs mécaniques, des capteurs pour mesurer la pression d'un cylindre hydraulique ou pneumatique, des transducteurs à jauge de contrainte ou une combinaison de ces dispositifs.

4. Concasseur selon la revendication 1, **caractérisé en ce que** l'actionneur de la contre lame est un cylindre hydraulique, un cylindre pneumatique ou un moteur électrique.

5. Concasseur selon la revendication 1, **caractérisé en ce que** les moyens de positionnement ont été agencés en vue de contrôler la position de la contre lame lorsqu'elle tourne autour de l'arbre à direction pivotante.

6. Concasseur selon la revendication 5, **caractérisé en ce que** les moyens de positionnement comportent un capteur inductif ou un interrupteur-limiteur mécanique.

7. Concasseur selon la revendication 1, **caractérisé en ce qu'**il comprend des moyens de détection pour détecter séparément la perturbation desdites, au moins deux, contre lames.

8. Concasseur selon la revendication 1, **caractérisé en ce que** chaque contre lame a été fixée au bâti par une articulation, autour de l'arbre de laquelle la contre lame peut être tournée, et **en ce que** chaque contre lame individuelle a été agencée en vue d'avoir son propre actionneur (4, 4') pour faire tourner une contre lame individuelle.

9. Utilisation d'un concasseur selon la revendication 1 pour concasser un combustible solide.

10. Utilisation selon la revendication 9, **caractérisée en ce que** le combustible solide est du schiste bitumineux.

11. Procédé de concassage d'un matériau solide, procédé dans lequel

- le matériau solide à concasser est fourni au concasseur (1) entre son rotor rotatif (37) pourvu de dents (39) et sa contre lame de type à peigne (33) dotée de dents (36), lorsque ledit rotor et la contre lame se trouvent en position de fonctionnement,
- une variable mesurée indiquant une perturbation dans le concasseur est mesurée par des moyens de détection,

dans lequel,

- il existe au moins deux contre lames de type à peigne (33) pourvues de dents (36),
- une variable mesurée indiquant une perturbation dans le concasseur est mesurée par des moyens de détection,
- lorsque la valeur de la variable mesurée atteint une valeur de seuil prédéterminée, ladite contre lame est tournée individuellement à l'écart du rotor sur une distance prédéterminée (X) à partir du rotor, et après quoi
- ladite contre lame est tournée en retour vers sa position de fonctionnement.

12. Procédé selon la revendication 11, **caractérisé en ce que** la position de la contre lame et/ou la force dirigée vers la contre lame sont mesurées par les moyens de détection.

13. Procédé selon la revendication 11, **caractérisé en ce que** le fonctionnement du concasseur est contrôlé par un système de surveillance.

14. Procédé selon la revendication 11, **caractérisé en ce que** la distance entre la contre-lame et le rotor est contrôlée par des moyens de positionnement pendant la rotation de la contre lame.

15. Procédé selon la revendication 11, **caractérisé en ce que** la distance à laquelle la contre lame est tournée à partir du rotor, est sélectionnée sur la base des exigences du processus suivant le concassage.

16. Procédé selon la revendication 11, **caractérisé en ce que** la contre lame est tournée à une distance de 100 mm environ à partir du rotor.

17. Procédé selon la revendication 11, **caractérisé en ce que** le fonctionnement du concasseur est arrêté si, après une rotation en arrière de la contre lame, la variable mesurée par les moyens de détection atteint encore la valeur de seuil prédéterminée.

18. Procédé selon la revendication 11, **caractérisé en ce que** par les moyens de détection, une variable mesurée qui indique une perturbation dans le concasseur, est mesurée de façon séparée pour lesdites, au moins deux, contre lames.

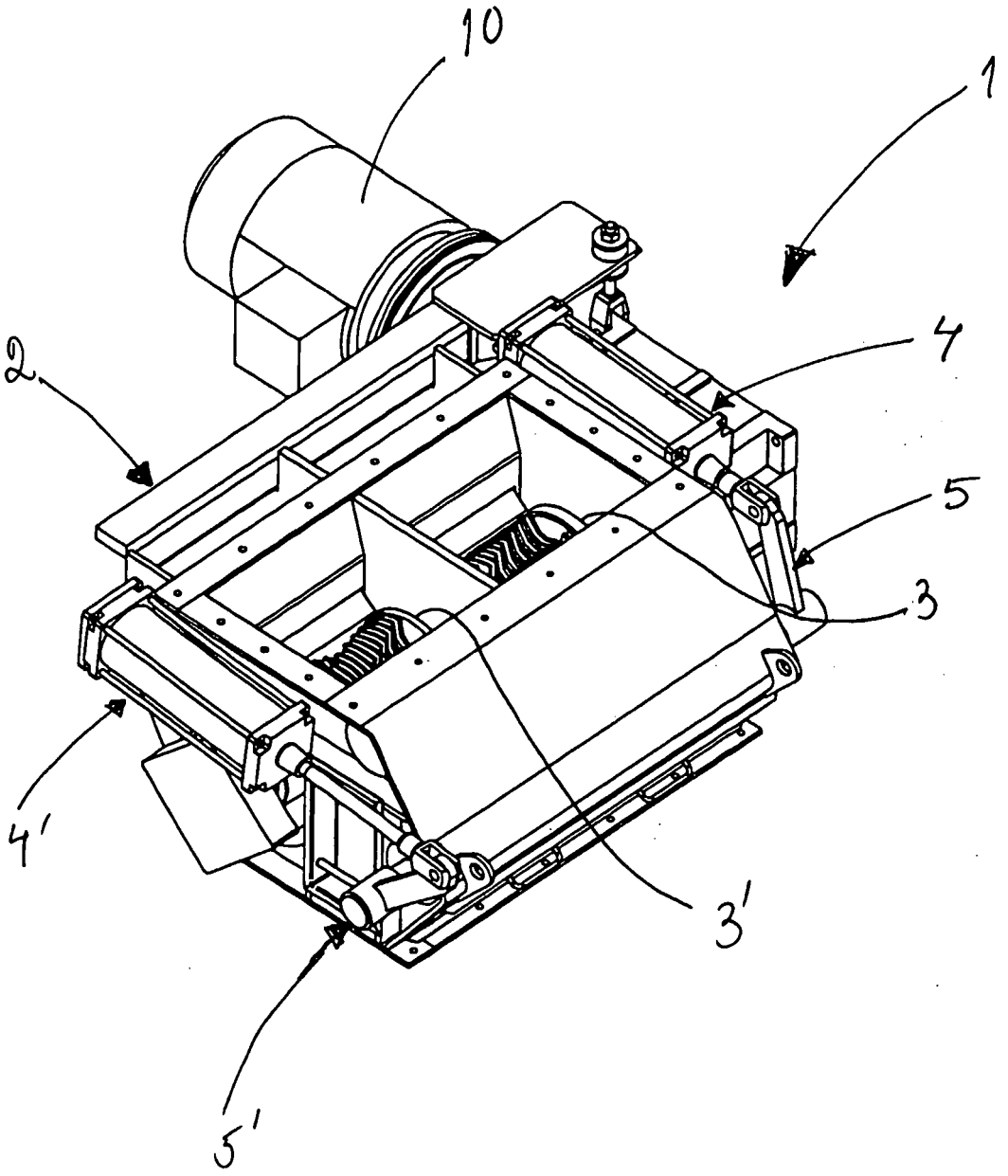


FIG. 1

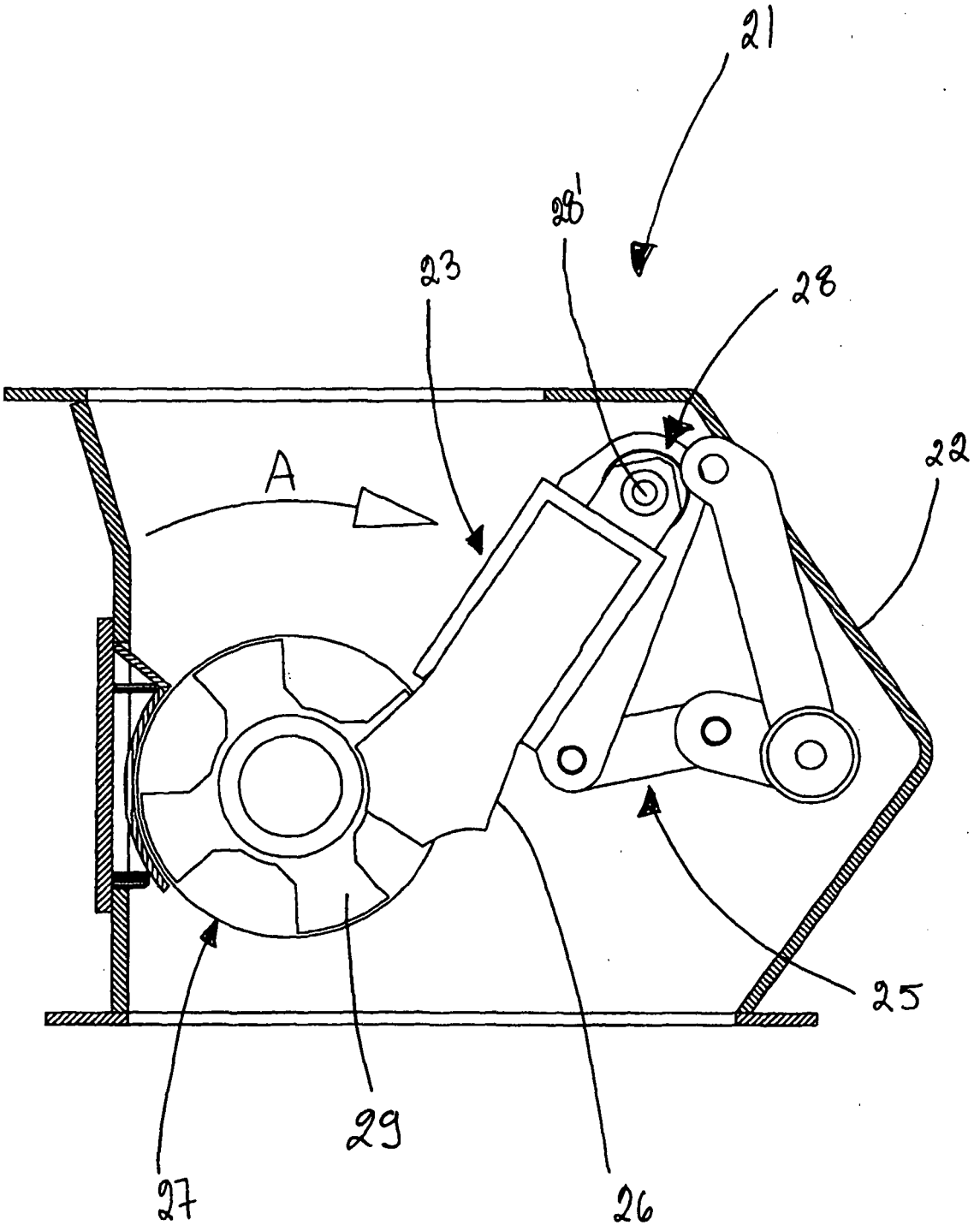


FIG 2

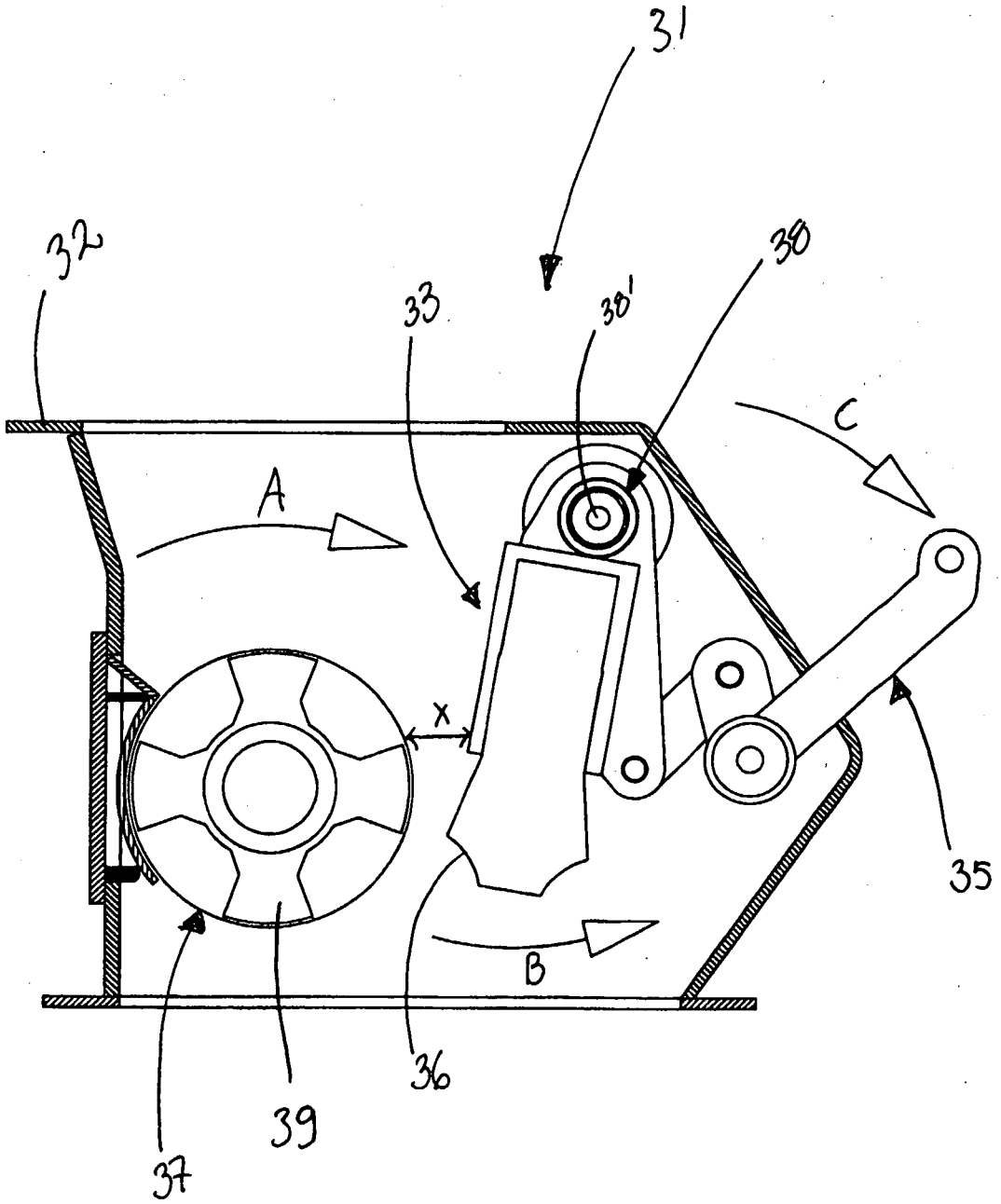


FIG 3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- EP 0513479 A1 **[0007]**
- US 5718389 A **[0007]**
- FR 7638820 **[0007]**