



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
23.07.2008 Bulletin 2008/30

(51) Int Cl.:
B02C 4/28 (2006.01) B02C 4/02 (2006.01)
B02C 4/42 (2006.01)

(21) Application number: **08150367.4**

(22) Date of filing: **17.01.2008**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA MK RS

(71) Applicant: **SASIL S.p.A.**
13862 Brusnengo (Biella) (IT)

(72) Inventor: **Ramon, Lodovico**
13862 Brusnengo (Biella) (IT)

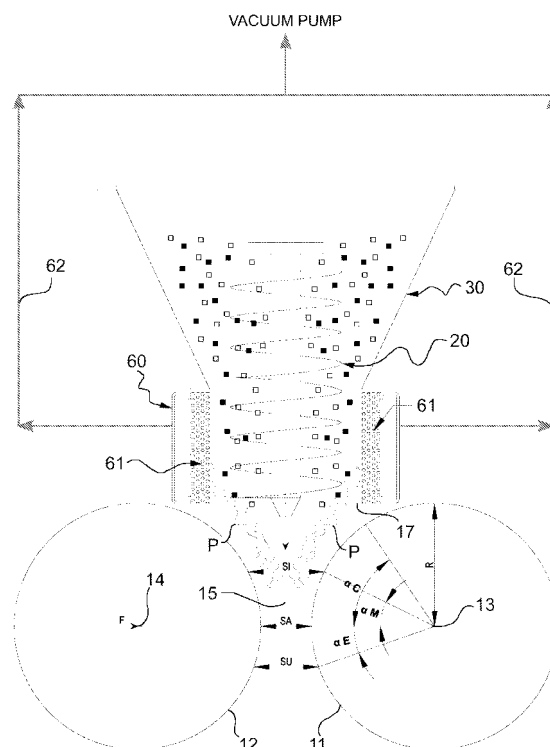
(74) Representative: **Vanzini, Christian et al**
Jacobacci & Partners S.p.A.
Corso Emilia, 8
10152 Torino (IT)

(30) Priority: **18.01.2007 IT TO20070029**

(54) **High compression crushing roll set for the grinding, to very high fineness levels, of natural minerals and solid inorganic products**

(57) An installation for grinding minerals and other solid inorganic materials includes a crushing roll set (10), comprising a pair of grinding rolls (11, 12) having respective rotation axes (13, 14) parallel to each other and arranged flanked so to define an entrance space (15) between them. The entrance space has a minimum section (SA) at the plane containing the rotation axes. The installation also comprises a feed mouth (17) adapted to feed, by gravity, a feed material to be ground in the entrance space. The installation moreover comprises a precompression screw (20) arranged at the feed mouth. The screw is adapted to compress the feed material against the grinding rolls and is arranged to allow the discharge of the air which exits from the material to be ground due to the precompression.

FIG.4



Description

[0001] The present invention generally refers to grinding systems.

[0002] Very high level grinding of natural minerals and solid inorganic products, characterised by high hardness levels among other features, has become increasingly important over the last few years.

[0003] On this matter, it should however be said that technology has not adequately supported this need, such that both the less updated processes and those more recent have yet to resolve the most important problems which affect the operating costs (energy consumptions, wear of materials, pollution of the finished products, etc.).

[0004] As is known, a grinding plant, in addition to the mill, also provides a separator device which must extract the ground fraction from the mass leaving the mill which complies with the desired specifications, and then sends the separated material which has not attained the desired fineness level back to the mill.

[0005] One problem encountered is the drop of grinding performance which occurs in the case of a high-rate grinding, due to the high quantities of air incorporated in the recycle material, which is on average 3 times the unprocessed material.

[0006] The Applicant has set up a research program aimed to confront and resolve the problems which determine the low efficiency level of the grinding processes for the obtainment of products with high and very high fineness levels (< 30 microns), not yet remedied by the available solutions.

[0007] In order to optimise the efficiency level of the grinding process, it was necessary to thoroughly study the causes that, over the course of the research, did not permit reaching high fineness levels (< 30 microns) with results which could be compared with those, quite satisfying, obtained by operating with lower fineness levels (< 50 microns). In particular, a lot of attention was given to the effects of air incorporated in the material to be ground. In fact, on one hand, such air exerted a dampening effect between the grains which obstructs the grinding, and on the other it leads to the generation of vibrations due to the deflagration of the air sacks compressed between the grains themselves.

[0008] Hence, the object of the invention is an installation for grinding minerals and other solid inorganic materials, having the characteristics defined in claim 1.

[0009] The invention utilises, with surprising results, the principle of the roller mill or crushing roll set which, unlike the preceding solutions, permits generating high compression levels on the grains and between the grains of the material subjected to grinding.

[0010] As will be appreciated below, the installation according to the invention allows not only ensuring a much greater efficiency with respect to the conventional installations but, on one hand, permits considerably reducing the specific energy consumption (kWh/t of finished product) and, on the other hand, allows minimising the wear problems, to the great advantage of the production cost and purity level of the finished product.

[0011] The preferred but not limiting embodiments of the invention will now be described, making reference to the attached drawings, wherein:

- Figure 1 is a scheme which illustrates the principle underlying the present invention;
- Figure 2 is a diagram of the pressures as a function of the grinding angle, associated with the scheme of fig. 1;
- Figure 3 is a scheme which illustrates a grinding circuit according to the present invention;
- Figure 4 is a schematic side view which illustrates a component of the circuit of fig. 3, according to a particularly preferred embodiment of the invention;
- Figure 5 is a schematic side view which illustrates an accessory device for the component of fig. 4, according to another particularly preferred embodiment of the invention; and
- Figure 6 is a schematic front view of the accessory device of fig. 5.

The solution according to the present invention utilises the principle of the roller mill, commonly called also crushing roll set. Hence, crushing roll set 10 is schematically illustrated in figure 1, comprising in a conventional manner a pair of grinding rolls 11, 12 having respective rotation axes 13, 14 parallel to each other and arranged flanking so to define an entrance space 15 between them. The space 15 has a variable section in the vertical direction, having a minimum section SA at the plane containing the rotation axes 13 and 14. The crushing roll set 10 has a feed mouth 17 adapted to feed, by gravity, a material to be ground into such space 15, as indicated by the arrow A. At the feed mouth 17, the entrance space 15 has greatest section.

[0012] In figure 1, for the sake of clarity the rolls 11 and 12 are depicted at a considerable distance from each other, so that the minimum section SA is depicted with size comparable to that of the radius R of the rolls 11 and 12. In reality, the width of the entrance space 15 at such section SA is much less than the radius R.

[0013] At the feed mouth 17, a feed screw 20 is arranged that, in addition to facilitating the entrance of the material to be ground into the entrance space 15, carries out the function of compressing the material against the grinding rolls 11, 12. In figure 1, the compaction angle α_C is illustrated, which is the angle of the circular sector of the roll comprised between the radius defined by the intersection of the level of the supply mouth 17 with the circumference of the roll and the radius lying in the minimum section SA plane of the entrance space 15.

[0014] In figure 1, the start-compression section SI is also identified, at which the material to be ground begins to be compressed and thus ground by the rolls 11, 12, and the grinding angle αM is also indicated, which is the angle of the circular sector of the roll comprised between the radius defined by the intersection of the level of the start-compression section SI with the circumference of the roll and the radius lying in the minimum section plane SA of the entrance space 15.

[0015] In figure 1, the outlet section after elastic expansion SU is also identified, at which the ground material is no longer subjected to compression by the rolls 11, 12, and the elastic expansion angle αE is also indicated, which is the angle of the circular sector of the roll comprised between the radius defined by the intersection of the level of the outlet section SU with the circumference of the roll and the radius lying in the minimum section plane SA of the entrance space 15.

[0016] In figure 2, a diagram example is represented which expresses the progression over time of the compression level in the crushing roll set of fig. 1. The conditions which permit imparting a crushing force between the grains moving in the crushing roll set are favoured by the precompression generated by the screw 20 which pushes the material towards the entrance 15 of the crushing roll set 10. As will be seen below, such conditions are further favoured if one equips the crushing roll set 10 with a device for bringing the rolls 11, 12 closer together, as indicated by the arrow F in fig. 1.

[0017] The precompression obtained by means of the feed screw 20 has a very important second function, which consists of ensuring that part of the air present in the feed material which opposes its sliding towards the entrance 15 can escape before the material enters into the grinding zone of the entrance space 15, thus preventing the air from exerting a fluidifying effect. The discharge of the air is indicated by the wavy arrows P in fig. 1.

[0018] This expedient significantly contributes to limit the damping effect of the air present between the grains and therefore permits reaching very high fineness levels (< 30 microns) in conditions of minimal consumption of electrical power and minimum wear of the plant.

[0019] In figure 3, the scheme is illustrated of a closed-circuit grinding plant according to the invention. Such plant comprises a high compression roller mill 10 based on the above illustrated principle, to which a feed screw 20 is associated. The screw 20 is rotatably mounted around its own axis inside a feed hopper 30 arranged at the feed mouth 17 of the crushing roll set 10. Such crushing roll set 10 produces a mass which is naturally characterised by an average size considerably less than that of the feeding material. In such mass, however, a fraction remains, for obvious reasons, whose minimum granulometric size is greater than the maximum acceptable in the finished product, for example $75 \mu m$. This, naturally, leads to the need to interlock the crushing roll set 10 to a separator device 40 which continuously receives all of the mass leaving from the mill. Preferably, such separator device 40 is a wind separator.

[0020] The separator 40 is adjusted in a manner such to remove, in a sufficiently effective manner, the entire fraction having a size lower than the maximum level tolerated in the finished product.

[0021] The coarser material, characterised in any case by a very fine granulometric size, is collected and continuously mixed with an aliquot of raw material corresponding to the amount with correct granulometric size separated from the wind separator 40, in order to be recycled at the mill 10.

[0022] The grinding effect is obtained by compressing the material grains together at very high pressure levels (500 - 5000 kg/cm²). The aforesaid pressure is generated between the two counter-rotating rolls 11, 12. Preferably, one 11 of the rolls is fixed while the other 12 is movable due to a translation device 50 connected thereto, so to be able to vary the width of the minimum section SA. Preferably, the device 50 allows adjusting the passage of the material in an opening in the range of 0.2 to 5% of the diameter of the rolls, still more preferably 1 to 3%, and allows adjusting a crushing compression in the range of 500 to 5000 bars, and preferably 2000 to 3000 bars.

[0023] The device 50 is for example configured as an oil-pressure piston actuated by a pressurised oil circuit in turn equipped with a double damper with nitrogen bubbles. This permits regulating and therefore optimising the grinding effect, and in particular the ratio between the average granulometry of the material being fed with respect to the average granulometry of the exiting material, operating on the compression force which is exerted by means of the device 50. The damper in turn has the function of damping both the variations caused by the micro-explosions of the air pockets present between the grains of material to be ground and the wider variations of the average granulometry of the entering material.

[0024] As mentioned above, the material is fed to the entrance space 15 of the two rolls by means of the screw 20 which, in addition to favouring the outflow of the material, has the essential function of precompressing it before it reaches the grinding zone of the entrance space 15 of the crushing roll set 10.

[0025] On one hand, this facilitates the attainment of the crushing pressure of the material between the two rolls, and on the other hand favours the gradual expulsion of most of the air present.

[0026] This outflow occurs in the entrance zone 15 between the rolls along a reverse course with respect to the material flow. The positive effect of this important and essential expedient occurs since the partial removal of the air incorporated in the entering material reduces the damping effect during the compression step, and consequently accentuates the grinding effect. The size of this phenomenon is, for obvious reasons, more intense the greater the fineness level which one intends to attain and the greater the aliquot of the recycling material coming from the wind separator.

[0027] On this matter, it should be said that the aliquot of material which has not yet reached the desired fineness level and which must therefore be recycled to the crushing roll set increases with the decrease of minimum size of the

finished product.

[0028] In these cases, if it wasn't for the device capable of causing the outflow of part of the incorporated air, particularly in the recycle material, the grinding would proceed very slowly, since most of the energy supplied would be dissipated by the damping effect, as mentioned above.

[0029] In certain cases, the air present on the surface of the grains generates a sliding effect which renders useless nearly all of the energy expended for compressing the material.

[0030] In the very high-rate grinding conditions, in fact, the average granulometric size of the material sent to the mill tends to decrease and consequently the air incorporated tends to increase.

[0031] For the sake of clarity, it should be said that, when the finished product must not contain particles of size greater than 30 - 35 microns, the precompression obtainable by means of the feed screw is not sufficient for limiting the specific energy consumption, and thus the grinding cost, to optimal levels, since the residual air which is interposed between the grains, already reduced to very small dimensions, generates the above-described problems.

[0032] This negative phenomenon is further accentuated, finished product fineness level being equal, the higher the hardness of the material to be ground.

[0033] The Applicant has also confronted this problem by supporting the precompression obtained by means of the feed screw with a device capable of continuously removing most of the air.

[0034] Fig. 4 illustrates a particularly preferred embodiment of the invention. In such figure, the crushing roll set 10 is illustrated with the grinding rolls 11 and 12, and the screw 20 rotatably mounted inside the hopper 30. According to the preferred embodiment of fig. 4, the hopper 30 is associated with a suction chamber 60, arranged at the feed mouth 17 of the crushing roll set 10. The suction chamber 60 is arranged such to surround the lower section of the screw 20, and it has an inner cavity separated from the entrance chamber of the material through porous separators 61, preferably made of ceramic material. The inner cavity of the suction chamber 60 is in fluid communication with a vacuum pump by means of tubing 62. The vacuum pump, appropriate sized, maintains the entrance chamber of the material in reduced pressure through the porous separators 61 which on one hand prevent fine material losses, and on the other hand protect the pump from the abrasive action of the materials. The air removal therefore occurs by channelling such air upward, compelling it to cross through the overlying material.

[0035] In fig. 4, the air suctioned by the pump is indicated by the wavy arrows P, while the small squares indicate the granular material being fed. In particular, the empty small squares indicate the fresh material and the solid small squares indicate the recycle material coming from the separator 40.

[0036] Providing a suction system produces a net improvement of the working conditions of the crushing roll set (less vibrations caused by the deflagration of the air pockets present between the material grains), of the minimum attainable granulometric size, and as the following examples demonstrate, of the specific energy consumption and running cost of the plant (less wear of the rolls of the crushing roll set).

[0037] As said above, the channelling of the air is obtained by utilising the pressure difference between the environment inside the hopper and the entrance zone of the crushing roll set, under positive pressure caused by the compression of the material, and the environment outside the suction chamber, in which the vacuum is generated.

[0038] The calculation of the air quantity to be evacuated, which is extremely variable as a function of the parameters in play, is rather difficult, and hence leads to quite variable and approximate values.

[0039] Nevertheless, based on experience, when the crushing roll load consists of 25% raw material and 75% recycle material (1/3 weight ratio), it can be deemed that every ton of fed material brings with it 1 m³ of air.

[0040] In reality, numerous practical experiences have permitted verifying that, in order to ensure good working conditions of the system, the flow rate of air to be removed must be much greater (20 times), and that in order to obtain a sufficiently effective evacuation, it is preferably to obtain, with the vacuum pump, a residual pressure in the range of 0.1 to 0.6 bars, more preferably 0.20 to 0.25 bars.

[0041] Preferably, the crushing roll set is equipped with a lateral seal system of the rolls, schematically illustrated in figures 5 and 6.

[0042] Such compensated pressure lateral seal system comprises a lateral containment device 70 of the material to be ground, laterally arranged at the entrance zone 15 of the rolls, where the pressure exerted by the precompression screw 20 tends to make the material exit from the sides. Such phenomenon is greater the finer the granulometry being fed, and of course the higher the precompression exerted by the screw.

[0043] The device 70 comprises a stationary plate 71, for example integral with the frame of the crushing roll set (not shown), and a pressure plate 72, which supports a wear plate 73 adhering to the rolls. The pressure plate 72 is movable along the centring guides 74 which are extended parallel to the rotation axes of the rolls, so to be able to be selectively moved away from or brought closer to the entrance zone 15. The movement of the pressure plate 72 is controlled by a pneumatic control 75, which operates on a pneumatic bearing 76 connecting the pressure plate 72 to the stationary plate 71. In the device 70, the pressure exerted by the containment wall 72 against the flank of the rolls, produced by the pneumatic control 75, is automatically adjusted on the force exerted by the precompression screw. In fig. 5, adjustable thrust points 77 of the pneumatic bearing 76 are also visible, whose position with respect to the entrance zone 15 of the

rolls is adjustable by means of a pre-established rotation of a movable part of the pneumatic bearing 76 (as shown in fig. 5).

[0044] The pressure of the pressure plate 72 can also be previously calibrated with regard to the average size of the entering material.

[0045] The containment device 70 therefore leads to two big advantages:

- the pressure exerted by the wall on the roll flank is that absolutely necessary for the seal, therefore avoiding excessive consumptions both for the seal and rolls;
- possible variations in the speed of the precompression screw due to feed discontinuities are automatically compensated in real time, with a variation of the pressure on the seals consistent with the precompression increase caused by the screw.

[0046] The grinding installation is also equipped with a control system (not shown), set to monitor and control the course of the grinding, the energy efficiency of the installation, and the wear of the crushing roll set and particularly of the parts exposed to abrasive action.

[0047] In order to limit the high-compression crushing roll wear to minimum values, it is necessary to reduce the related sliding between the flow of material being fed and the surface of the rolls as much as possible.

[0048] This optimisation is obtained by adjusting the following operative parameters:

- peripheral speed of the rolls;
- rotation speed of the feed screw;
- hydraulic pressure exerted by the piston 50 of the movable roll.

[0049] An entirely empirical expedient which nevertheless permits obtaining good functionality levels of the crushing roll set consists of adjusting the precompression value of the material in the start-compression section SI, obtained with the screw, such that the ratio between the apparent density of the exiting material with respect to that at the entrance of the rolls is approximately equal to the ratio between the distance between rolls in the outlet section SU with respect to that of start-compression SI.

[0050] The adjustment of the pressure exerted by the piston 50 of the movable roll also permits compensating the possible variations of the average granulometry of the entering material, which depend on the inconstancy of the ratio between the raw material and the recycle material.

[0051] In an advantageous embodiment of the invention, the control system is essentially programmed in order to maintain constant the granulometric composition of the material being fed, as well as maximise the power used by the crushing roll set.

[0052] In order to maintain constant the granulometric composition of the material being fed, the system comprises a PIA (Proportional Integral Adaptive) governor prearranged for receiving a signal from a sensor positioned in the hopper, in particular a continuous level sensor whose rising or descending gradient is obtained by the PIA governor, and programmed to process the feedbacks on an inverter for adjusting the fresh material flow rate as a function of the qualitative and quantitative discontinuity of the recycle material.

[0053] In order to maximise the power used by the crushing roll set, the system is based on input signals which are a function of the vibrational response following twisting deformations on the Cardan joint of the shaft of the movable roll, which depend on the qualitative and quantitative feeding discontinuities. The processed signal, which is the average of a high number of samplings per second, for example 500 samplings per second, serves for defining several critical frequencies, generally three, which are considered critical on the basis of experience acquired over hundreds of functioning hours and for their consequent influence on the grinding behaviour.

[0054] To each of these critical frequencies, an adjustment parameter is associated which intervenes in case the attention threshold is exceeded. The priorities in the adjustment of the various parameters are previously established based on a "recipe" which mainly takes into account the granulometry D50 being fed and the granulometry D50 of the finished product.

[0055] The feedbacks essentially regard the above-indicated three adjustments, i.e.:

- a - hydraulic pressure of the pistons
- b - speed of the crushing roll set
- c - speed of the precompression screw.

Examples

[0056] A comparison will now be illustrated between the grinding performances of crushing roll set made according to the invention (Example A) and those of a traditional tubular mill with spherical grinding bodies load (Example B). Such

comparison was carried out based on identical crystalline material being fed for the two plant types.

Example A

5 **[0057]** This is a plant made according to the invention, comprising a crushing roll set as described above with reference to figs. 4 - 6, and a high efficiency wind separator, produced by Hosokawa Micron Ltd., Japan with the name Alpine® Ventoplex.

[0058] The basic data of such plant were the following:

- 10 - Energy used for grinding: 68 kWh
- Roll consumption: 9000€/8800 t = 1€/t
- Alpine® type V21 separator Ø 2.10 m
- Energy used by the separator: 11 kWh
- Circulating load = 11 t/h equal to 2.5 times the finished product
- 15 - Temperature difference between inlet and outlet: 10° ÷ 15°C

Example B

20 **[0059]** This is a traditional plant, comprising a tubular mill with a load of spherical grinding bodies produced by Ziegler & Co. GmbH, Germany with the name Alubit®, and a high efficiency wind separator, produced by Hosokawa Micron Ltd., Japan with the name Alpine® Ventoplex.

[0060] The basic data of such plant were the following:

- Tubular mill Ø 2.00 m, L = 5m
- 25 - Quartz block covering
- Alubit sphere grinding load Ø 40 mm
- Rotation speed: 21.5 rev/minute
- Energy used: 105 kWh
- Alubit sphere consumption: 1.5 kg/t at 2€/kg = 3€/t
- 30 - Casing consumption: 35,000€/64,000t = 0.55€/t
- Alpine type V21 separator Ø 2.10 m
- Energy used by the separator: 16 kWh
- Circulating load = 11.2 t equal to 3.5 times the finished product
- Temperature difference between inlet and outlet: 35° ÷ 45°C
- 35

[0061] The comparison results are shown in the following tables 1 - 3.

Table 1

Basic data	MEASUREMENT UNIT	PLANT TYPE	
		A	B
MILL SIZE	m	Ø0.50xL=0.3	Ø2.00xL=5.00
ENERGY USED	kWh	68	105
45 HOURLY PRODUCTION	T/hour	4.4	3.2
SPECIFIC GRINDING ENERGY	kWh/t	15.6	33
SPECIFIC SEPARATION ENERGY	kWh/t	2.5	5
50 INLET GRANULOMETRY (D 50)	μ (micron)	500 μ	500 μ
OUTLET GRANULOMETRY (D 98)	μ (micron)	75 μ	75 μ

Table 2

Consumption data	MEASUREMENT UNIT	PLANT TYPE	
		A	B
ALUBIT SPHERE CONSUMPTION 2€/KG	kg/t		1.5
PRODUCTION OF A COMPLETE CASING	t	8800	64,000
COMPLETE CASING COST	€	9000	35,000
LIFETIME OF THE CASING	Hours	2000	20,000

Table 3

Specific production costs	MEASUREMENT UNITS	PLANT TYPE	
		A	B
LABOUR (1 Person), 20€/HOUR	€/t	4.54	6.25
ELECTRICAL ENERGY PER GRINDING, 0.10€/kWh	€/t	1.56	3.30
ELECTRICAL ENERGY PER SEPARATION	€/t	0.25	0.50
CASING WEAR CONSUMPTION	€/t	1.00	0.55
GRINDING BODY CONSUMPTION	€/t		3.00
TOTAL	€/t	7.35	13.60
TOTAL COST FOR 20,000 TONS OF PRODUCT	€	147,000	272,000
N.B. Excluded from table 3 are the internal transportation and transfer costs which can be considered analogous for the two plant types. The maintenance and repair costs can also be considered analogous for the two plant types.			

[0062] As can be observed from the tables, the plant of example A made according to the invention, granulometry of inlet material and outlet product being equal, had a clearly lower specific energy consumption and a greater hourly production with respect to the traditional plant of example B. Overall, the innovative plant of example A was shown to be significantly more economical than the traditional plant of example B.

[0063] In addition, the plant of example A has a comparatively high flexibility level. In other words, such plant lends itself:

- to stopping and restarting in very short time periods, on the order of several minutes;
- to changing the fineness level of the finished product in both directions, fed raw product being equal, without interrupting the continuous running of the plant;
- to stopping the plant in order to change the feed type, to clean it and to restart it in very short time periods, on the order of several minutes.

Moreover, since costly grinding bodies, which can be worn down, are not used, and since it ensures very low wear of the high hardness steel coats of the rolls, the plant of example A causes entirely marginal pollution and has very low maintenance costs.

[0064] Naturally, the principle of the invention remaining the same, the achievement details and the embodiments can vary widely with respect to that described and illustrated, without departing from the scope of the invention.

Claims

1. Installation for the grinding of minerals and other solid inorganic materials, comprising a crushing roll set (10), comprising a pair of grinding rolls (11, 12) having respective rotation axes (13, 14) parallel to each other and arranged flanked so to define an entrance space (15) between them, said space having a minimum section (SA) at the plane containing said rotation axes, and a feed mouth (17) adapted to feed, by gravity, a feed material to be ground in said space,
characterised in that it also comprises precompression means (20) arranged at said feed mouth, said precom-

pression means being adapted to compress said feed material against said grinding rolls and being arranged to permit the discharge of the air which exits from said material to be ground due to said precompression.

2. Installation according to claim 1, wherein said precompression means comprise a feed screw device.
3. Installation according to claim 2, wherein said feed screw device is rotatably mounted inside a feed hopper (30).
4. Installation according to one of the preceding claims, moreover comprising translation means (50) adapted to move one (12) of said rolls with respect to the other (11) so to adjust the section of said entrance space.
5. Installation according to claim 4, wherein said translation means permit adjusting the section of the entrance space such that, at the minimum section (SA) of the entrance space, the width of the section is adjustable in the range of 0.2 to 5% of the diameter of the rolls, preferably in the range of 1 to 3%.
6. Installation according to one of the preceding claims, moreover comprising suction means (60) adapted to generate reduced pressure, so to favour air discharge by utilising a pressure difference between the pressure produced by said precompression means and said reduced pressure.
7. Installation according to claim 6, wherein said reduced pressure is in the range of 0.1 to 0.6 bars, and preferably in the range of 0.20 to 0.25 bars.
8. Installation according to one of the preceding claims, moreover comprising lateral containment means (70) arranged on the sides of said entrance space of the rolls, adapted to laterally contain the material in said entrance space, said containment means being prearranged to carry out an adjustable seal as a function of the pressure exerted by said precompression means.
9. Installation according to claims 1, 2 and 4 in combination, moreover comprising sensor means adapted to detect the twisting torque of the movable roll and to provide a corresponding twisting torque signal, and control means adapted to process said control signal and adjust at least one of the following parameters in a programmed manner:
 - pressure exerted by the translation means,
 - rotation speed of the rolls, and
 - rotation speed of the feed screw device,as a function of said twisting torque signal.
10. Installation according to one of the preceding claims, moreover comprising separator means (40) associated with said crushing roll set, adapted to receive material ground by said crushing roll set and to separate a fraction with granulometry lower than a pre-established threshold from a fraction with granulometry higher than said pre-established threshold, said higher-than-threshold granulometry fraction being destined to be newly fed into said crushing roll set as recycle fraction of the feed material.
11. Installation according to claim 10, moreover comprising sensor means adapted to monitor the feed material entering into said crushing roll set and to provide a corresponding monitoring signal, and control means adapted to process said monitoring signal and to adjust the feed of said crushing roll set so to maintain constant the ratio between recycle fraction and fresh fraction of the feed material.

FIG.1

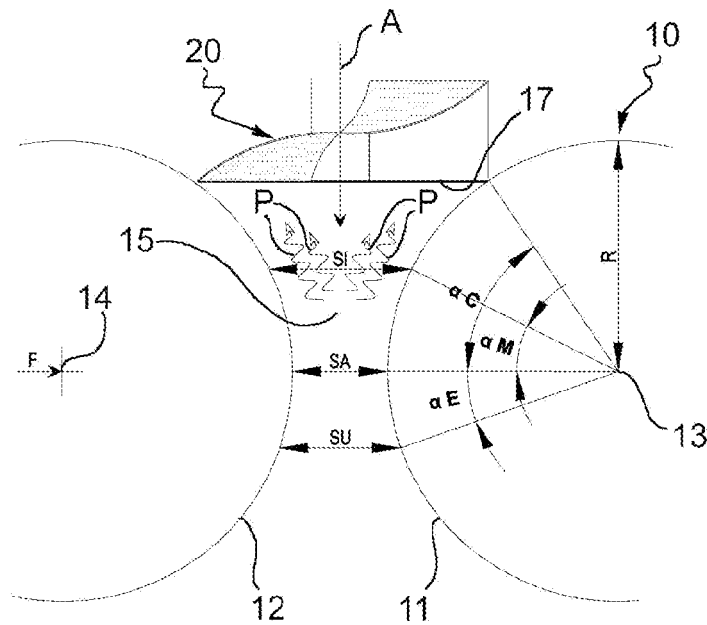


FIG.2

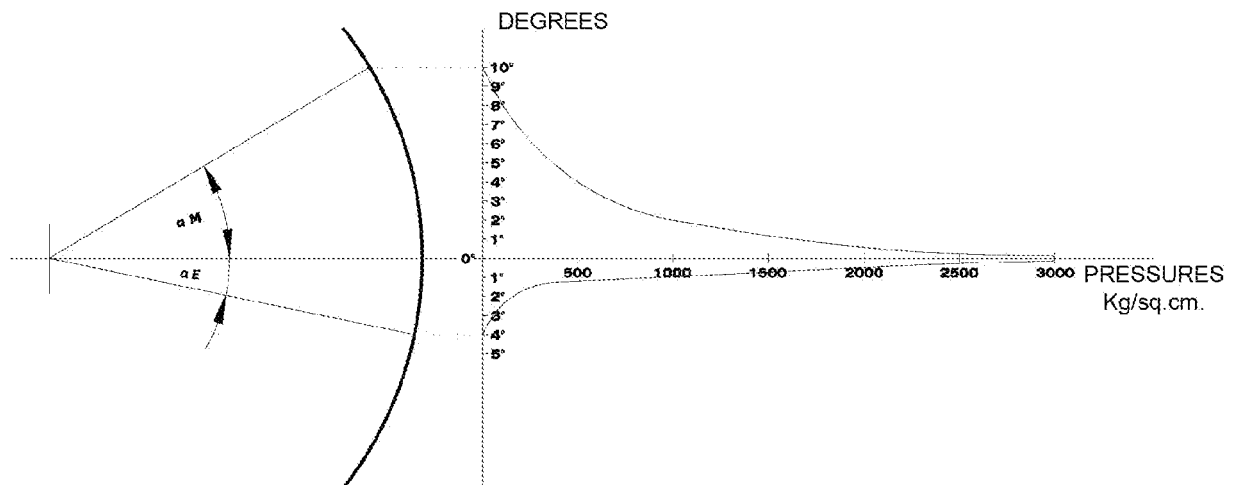


FIG.3

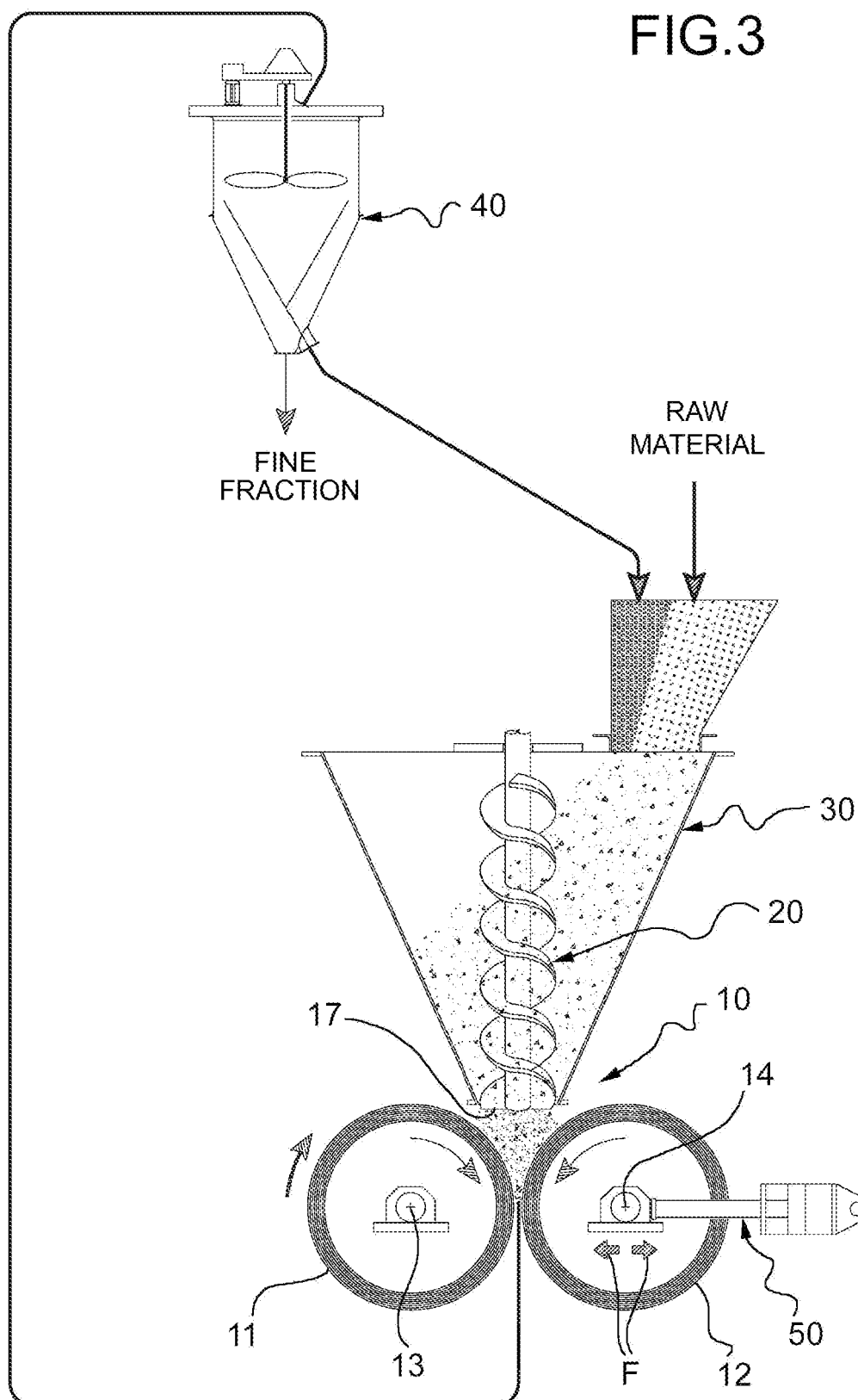
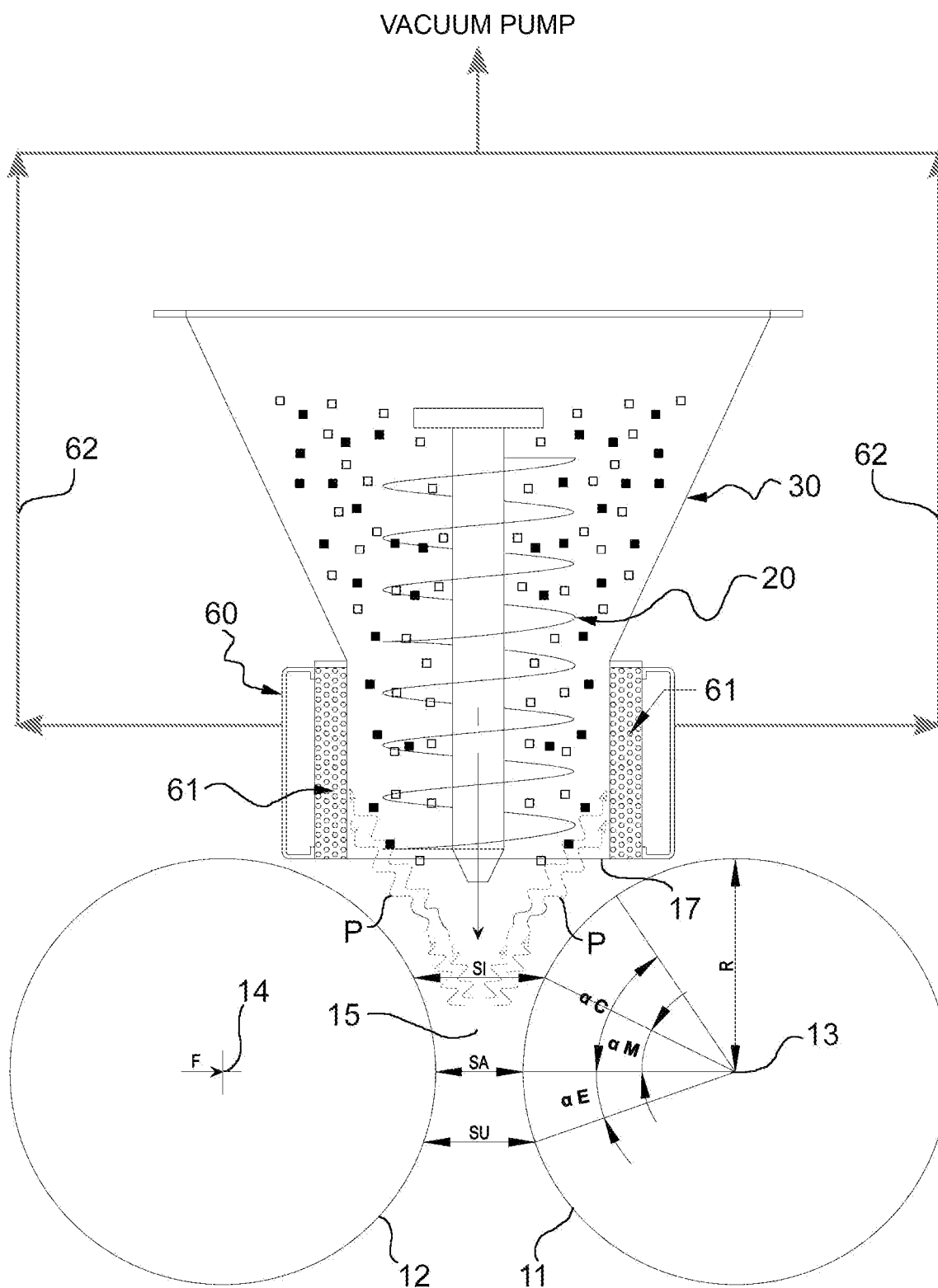


FIG.4



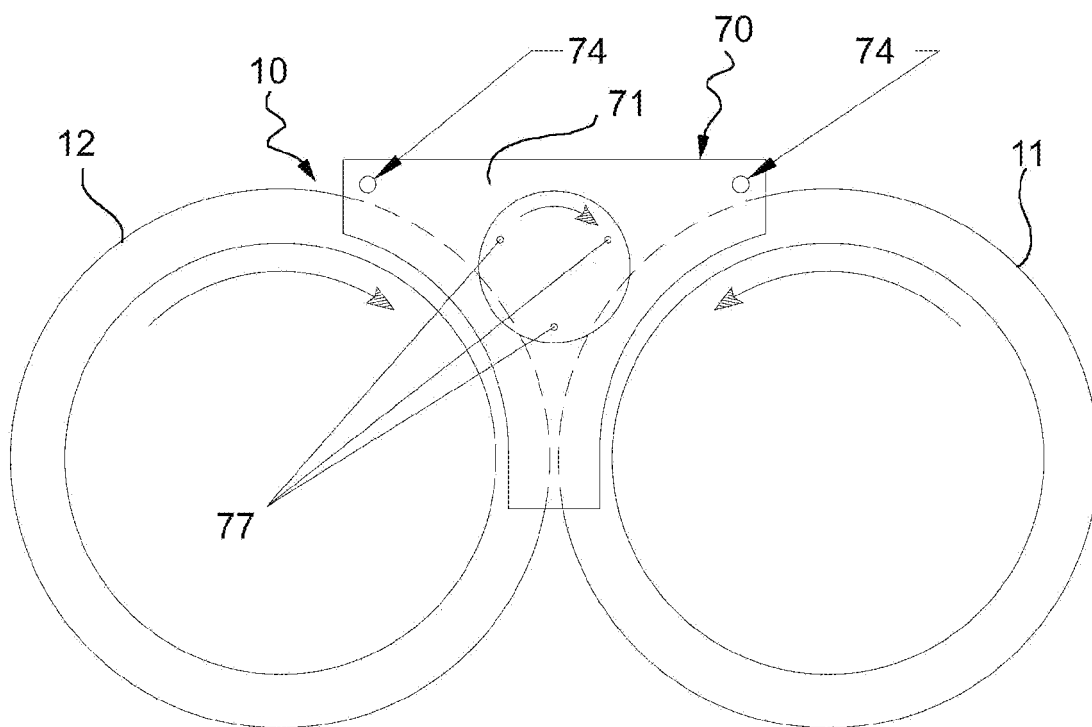


FIG. 5

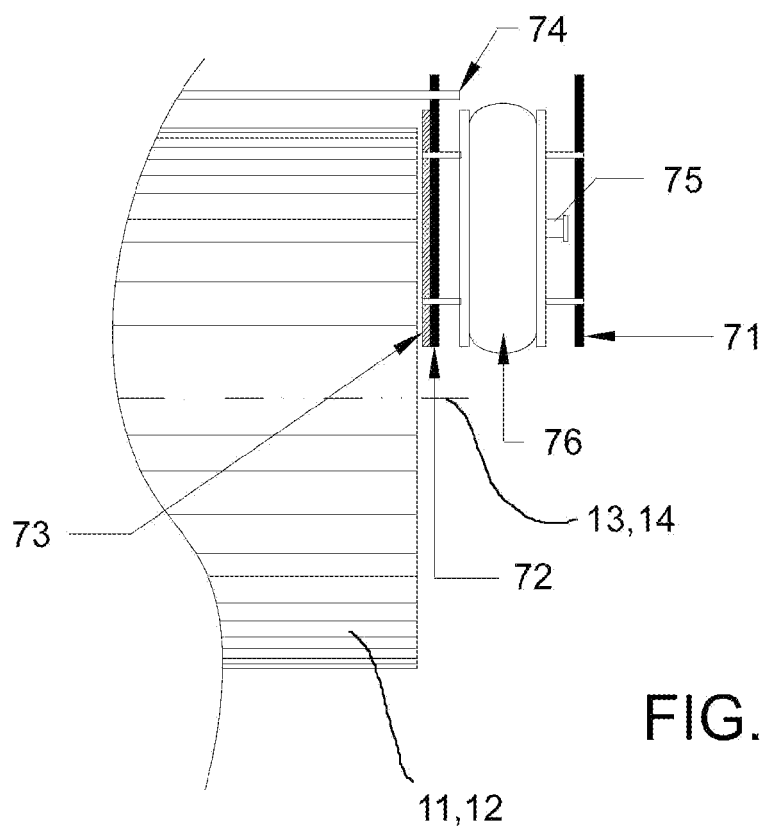


FIG. 6



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 08 15 0367

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 271 319 A (PLAGEMANN WERNER A [DE]) 21 December 1993 (1993-12-21)	1-8	INV. B02C4/28 B02C4/02 B02C4/42
Y	* column 2, line 62 - column 3, line 6; figure 1 * * column 3, line 26 - line 32 *	9-11	
Y	US 3 114 930 A (OLDHAM WILBUR N ET AL) 24 December 1963 (1963-12-24) * figure 1 *	10	
Y	WO 93/08915 A (SMIDTH & CO AS F L [DK]) 13 May 1993 (1993-05-13) * page 8, lines 24-31 *	9	
Y	EP 0 399 192 A (KLOECKNER HUMBOLDT DEUTZ AG [DE]) 28 November 1990 (1990-11-28) * column 1, lines 40-48 *	11	
Y	EP 0 413 155 A (KLOECKNER HUMBOLDT DEUTZ AG [DE]) 20 February 1991 (1991-02-20) * column 3, line 50 - column 4, line 3; figure 1 *	11	
X	US 4 111 626 A (FUNAKOSHI YOSHIRO ET AL) 5 September 1978 (1978-09-05) * the whole document *	1-8	TECHNICAL FIELDS SEARCHED (IPC) B02C
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 20 March 2008	Examiner Kopacz, Ireneusz
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

1

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 08 15 0367

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

20-03-2008

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5271319	A	21-12-1993	BR 9105991 A	10-11-1992
			DE 4003342 A1	08-08-1991
			DK 514432 T3	09-05-1994
			WO 9111320 A1	08-08-1991
			EP 0514432 A1	25-11-1992
			JP 6006240 B	26-01-1994
			JP 5503880 T	24-06-1993

US 3114930	A	24-12-1963	NONE	

WO 9308915	A	13-05-1993	BR 9206693 A	24-10-1995
			CN 1072113 A	19-05-1993
			CZ 9400980 A3	17-08-1994
			DE 69206819 D1	25-01-1996
			DE 69206819 T2	08-08-1996
			DK 180491 A	02-05-1993
			EP 0610268 A1	17-08-1994
			ES 2081632 T3	01-03-1996
			GR 3019222 T3	30-06-1996
			GR 3029991 T3	30-07-1999
			KR 100237102 B1	15-01-2000
			MX 9206203 A1	01-05-1993
			PL 172645 B1	31-10-1997
			TR 28083 A	02-01-1996
			US 5454520 A	03-10-1995
			ZA 9208060 A	28-04-1993

EP 0399192	A	28-11-1990	DE 3916641 A1	29-11-1990
			DK 399192 T3	06-12-1993

EP 0413155	A	20-02-1991	DE 3926882 A1	21-02-1991
			US 5114131 A	19-05-1992

US 4111626	A	05-09-1978	CH 605106 A5	29-09-1978
			DE 2605099 A1	02-09-1976
			FR 2302193 A1	24-09-1976
			GB 1491387 A	09-11-1977

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82